

# Promotion Application Supplemental Materials

Tina R. Hubler, Ph.D.  
Department of Biology  
University of North Alabama  
Fall 2016

## Contents

Letters of Support  
Examples of Teaching Effectiveness  
Examples of Scholarly Performance  
Examples of Service  
Appendix

# Table of Contents

## Letters of Support

For Teaching effectiveness

Sarah Tingle (student in Genetics and Senior Assessment Seminar)

Keri Lewis (graduate student in Education, who shadowed, assisted and taught with me)

For Scholarly performance

Dr. William Cale (President Emeritus and colleague, with whom I shared ideas about research opportunities for students and for whom I provided service to the local Institute for Learning in Retirement)

Dr. Patti Adams (Assistant Dean of Operations, South University, Savannah Georgia; research collaborator with whom I have published)

Caroline Thomas (previous student researcher and UNA graduate from Honor's program)

Vivian Lesende (previous student researcher and UNA graduate from Honor's program; recently earned a Master's degree from Ohio University)

## Examples of Teaching Effectiveness

BI498 Senior Assessment Seminar (SAS)

Syllabus

Benefits of Senior Assessment Seminar

Evaluation of CDs for Senior Assessment Seminar

SAS Flashcards

SAS sample certificate

SAS GRE Biology prep books

BI415 Molecular Biology

Syllabus

BI 415 Carroll's article, questions;

BI 415 HHMI video, outline, nonhomologous crossing-over practice

BI 415 exams containing mathematics calculations

BI 415 new labs

BI 415 research articles read and discussed in class

BI306 Genetics

Syllabus

BI 306 recorded lectures on Canvas

BI 306 chemical structures

BI 306 quizzes on structures of molecules

BI 306 sketches of molecules during lecture

BI 306 PowerPoints for genetics problem-solving

BI 306 genetics problem sets with answers on Canvas

- BI 306 selected HHMI videos and outlines
- BI 306 students' sketches of mutation and selection
- BI 306 essay questions on mutation and selection
- BI306 Genetics Lab
  - BI 306 Lab PowerPoints created in 2014-15
  - BI 306 Lab study guide for comprehensive lab final
  - BI 306 new labs
- BI101 Introductory Biology
  - Syllabus
  - BI 101 Five ways to succeed
  - BI 101 recorded lectures posted on Canvas
  - BI 101 practice sheets
  - BI 101 sketches on Doc Cam outline
  - BI 101 outline completed on DocCam
  - BI 101 selected diagram from ABT article
  - BI 101 PowerPoint on population change
  - BI 101 selected HHMI videos and outlines
  - BI 101 estimating percent water on earth's surface
  - BI 101 family pedigrees
  - BI 101 cilia and flagella
  - BI 101 reproductive structures of flowering plants
  - BI 101 and 306 albino eyelashes
- BI101 Introductory Biology Lab
  - Syllabus
  - BI 101 Lab Five ways to succeed
  - BI 101 Lab PowerPoints
- Teaching effectiveness, student evaluations:
  - graphs of student evaluation data
  - examples of student evaluation comments
- Teaching effectiveness, other:
  - appreciative faculty, administrators' and students' comments
  - graduate faculty appointment

### **Examples of Scholarly Performance**

- How it all started-the miniature Scammell Lab in FSB
- Publications
  - Evidence for science literacy crisis
  - ABT and NABT information
  - ABT on education resources websites
  - The American Biology Teacher Feature Article
  - The American Biology Teacher Inquiry and Investigation
  - colleagues' requests for materials used in ABT publication
- Student research enrollment 2012-16
- Student presentations
  - Profiles in excellence, Caroline Thomas
  - Profiles in Excellence, Rosmely Hernandez

Rachel Herwick  
Profiles in Excellence, Vivian Lesende  
Grants  
College of Arts and Sciences  
QEP

### **Examples of Service**

#### Academic service

Scholarship awards  
Scholarship candidate  
Chair, Laura Harrison Award committee  
Chair, Faculty Search committee  
Integrative Health Program planning group  
Chair, Interdisciplinary Studies committee  
Chair, Faculty Senate Academic Affairs subcommittee  
Letters of recommendation for students

#### Professional service

Judge, Junior Alabama Academy of Science competitions  
Manuscript reviews  
Chair, ASB Diversity committee

#### Community service

Invited speaker, Lifelong Learning in Retirement  
Kilby 3<sup>rd</sup> graders science activity  
Deibert Park children's museum activity

### **Appendix**

Performance evaluations  
Raw data student evaluations and grade distributions  
Department of Biology Guidelines for Tenure and Promotion

# Letters of Support

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## Teaching Effectiveness

**Sarah Tingle**

student in Genetics and Senior Assessment Seminar

**Keri Lewis**

graduate student in Education, who shadowed, assisted in laboratories and taught with me

## Scholarly Performance

**Dr. William Cale**

President Emeritus, with whom I shared ideas about research opportunities for students and for whom I provided service to the local Institute for Learning in Retirement (ILR)

**Dr. Patti Adams**

Assistant Dean of Operations, South University, Savannah Georgia, with whom I have collaborated

**Caroline Thomas**

previous student researcher and UNA graduate from Honor's program

**Vivian Lesende**

previous student researcher and UNA graduate from Honor's program, who recently earned a Master's degree from Ohio University

June 30, 2016

To Whom It May Concern:

Dr. Hubler is one of the most effective teachers I have ever had at the University of North Alabama. From the first day of the semester, she has been fully prepared and exceptionally caring for her students. One of the first things I was impressed with was the amount of resources she had made available to us on Canvas. From note outlines, additional websites, practice questions and answers, and complete PowerPoint slideshows, Dr. Hubler was well prepared for the entire semester. I very much appreciated the number of helpful resources she allowed us to have and encouraged us to use. Not only did she make these resources available for online use, but often times I would come to class to find multiple worksheets that were already printed out ready for us to have in class that day.

Not only did she provide ample, helpful resources, Dr. Hubler is one exceptional teacher. Many people can simply teach, but I think Dr. Hubler has a special gift of making difficult biological concepts easily understandable. Since my freshman year and BI 111, I have never fully understood genetics as a whole. It was a small part of that Principles of Biology class, but I had always felt as if my understanding of it was just out of reach. However, that is not so anymore. Dr. Hubler slowly and steadily covered every concept on our syllabus until it was all explained and taught in such a way that every student could understand it. I loved how she would draw out concepts on transparencies to go along with the PowerPoint for that class. I found that extremely helpful.

Dr. Hubler also was an exceptional teacher in laboratory. I have often felt as if lab was completely separate from lecture and none of the concepts went together or complemented each other. However, that was not the case in genetics class. Normally lab would follow the concept we were learning in lecture. Not only did we have an experiment to work on during lab, Dr. Hubler would lecture during down times (when gels were running, etc.) so that we would better understand why we were doing something and how it was being done. I appreciate how thoroughly she explained laboratory concepts and connected them to lecture.

Although most students have Dr. Hubler as their genetics teacher, I also had the privilege of having her for Senior Seminar class to prepare us for the Major Field Test. Genetics ends up being one-fourth of the Major Field Test in biology, and I must say, due to Dr. Hubler's teaching in genetics class and her preparing us in senior seminar, I was prepared more for the genetics section than any other section of the MFT.

As you hopefully can see, Dr. Hubler is one amazing teacher and an amazing person in general. She is always available to help any student and truly cares about the wellbeing of her students as well. I truly believe Dr. Hubler will be an asset to the University of North Alabama as a Professor.

Sincerely,

/s/ Sarah Tingle

Sarah Tingle

Student at the University of North Alabama; [stingle@una.edu](mailto:stingle@una.edu)

July 5, 2016

To Whom It May Concern:

I will forever be thankful for the opportunity to work with Dr. Tina Hubler during the Spring 2016 semester. I began my teacher training in the Fall 2015 semester, 12 years after receiving my bachelor's degree in Biology from the University of Texas in Dallas. The benefits of this opportunity to shadow Dr. Hubler for the semester are innumerable. I was given the opportunity to observe and be observed by a teacher that has the style of teaching I wish to emulate. She has an ease with her students that creates an atmosphere of learning, and creates conversation about the given topic. She provided information and guidance on how sometimes your teaching style must adjust to the different attributes of each class that you teach each semester. Some classes may be very astute and able to accommodate new information easily, while other classes need more attention and may need a different strategy for success. And how to make these judgements by assessing the quiz and exam grades, and the overall tone of the classroom.

Dr. Hubler is an excellent candidate for any position that she pursues, she has the ability to adjust her strategy based on her audience, her knowledge in the field is such that it is easy for her explain new material in several different ways if someone is having difficulty understanding, and she is approachable, so her students feel comfortable coming to her when there is a problem.

Sincerely,

Keri L. Lewis

256-263-0126

Klewis6@una.edu

Student - degree seeking - M. Ed. Alt-A certification in Secondary Biology

July 25, 2016

Portfolio Reviewers  
University of North Alabama  
Florence, AL 35632



Dear Professors and Administrators:

It is a pleasure to write in strong support of the application of **Dr. Tina R. Hubler** for promotion to full professor at UNA. Promotion through the academic ranks is a process of professional growth benchmarked against a set of high standards of accomplishment in scholarship, teaching, and service. Because UNA sets among its highest priorities the fostering of excellence in the learning environment for students, that aim must likewise be evident in support of the promotion application. At the full professor level the candidate should be recognized as an accomplished scholar who is committed to engaging students in discovery and thus preparing them for a life of learning. In short, scholarship not only adds to knowledge but also is the mechanism that informs and enriches the teaching experience. It is my conclusion that Dr. Hubler presents a compelling dossier consistent with the profile of a full professor. What I will focus on is the way in which Dr. Hubler has incorporated her impressive record (a record that compares favorably in every respect with others who have attained the rank of full professor) through leadership and service in support of the advancement of UNA, its students, and the broader region.

The best of universities look to the senior faculty, especially full professors, for wisdom born of experience. That experience is exemplified through mentoring students and colleagues and then becoming part of the decision process that evaluates others. Such experience is garnered only through engagement that is made available as a result of personal accomplishment. There is no other path. Within a university community individuals respect, value, and look for wisdom, from those who been there before them. We have in Tina Hubler someone who has established her academic credibility through her scholarship, and as a result been invited to serve in some of the most consequential roles at the university (Chair of her departmental tenure committee, member of her departmental promotions committee, university senator, member of the faculty credentials committee for our regional accreditation, and many others). Outside UNA her established record is recognized in many significant ways: peer manuscript reviewer, textbook reviewer, regional committee chair within the Association of Southeastern Biologists, invited presenter, and more. There comes a time when the record speaks for itself. Dr. Hubler's record is that of a full professor.

Beyond my professional knowledge of Dr. Hubler I have come to know her in settings outside UNA. Through the lectures she has presented I have witnessed someone who has the ability to take extremely complex scientific topics and present them to lay audiences in clear, understandable language. It is not a great leap to assume this clarity of thought and organization characterizes her teaching as well. She is a great credit to our university, to her profession, and to this community. Dr. Hubler is in full possession of all the credentials necessary to assume the rank of full professor. I am pleased to offer an unqualified endorsement.

Sincerely yours,

A handwritten signature in blue ink that reads "William G. Cale". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

William G. Cale

PRESIDENT EMERITUS  
UNA Box 5004, Florence, AL 35632-0001  
P: 256.765.4445 | F: 256.765.4644 | [www.una.edu](http://www.una.edu)

Equal Opportunity / Equal Access Institution

July 14, 2016

Portfolio Reviewers  
University of North Alabama  
Florence, AL 35630

To whom it may concern:

I would like to submit this letter of support for Dr. Tina Hubler as a valuable research colleague. I have known Dr. Hubler professionally for over a decade. During that time, I have developed a high level of respect for her both as an educator and as a researcher.

Our most recent research collaborations related to developing effective strategies to improve undergraduate students' understanding of molecular evolution. The first part of the project involved development of plasmids to use in a novel laboratory activity intended to illustrate how mutation contributes to the molecular evolution of species. Once the plasmids were developed, we co-authored a detailed laboratory activity for undergraduate college students or honors biology students in high school. After working on this project, we realized that we needed to generate a second manuscript to ensure that instructors had all the resources and knowledge they needed to effectively implement the activity. This second manuscript would educate teachers with a weaker background in molecular biology or evolution on the principles of molecular evolution. Ultimately, we published these in reverse order, with the instructional paper published first and the lab activity published second (in back-to-back issues of *American Biology Teacher*).

Our overall aim for this project was to improve the ability of instructors (particularly less experienced instructors or those with limited background in molecular evolution) to help students grasp on an "application level" how molecular evolution may occur. Within a few weeks of publication, we had our first request (from a high school teacher in Missouri) for samples of our plasmids. As a result, this turned out to be a rare situation of "instant gratification" in which we were able to quickly feel that our scholarly efforts were appreciated.

I always appreciate the opportunity to collaborate with Dr. Hubler on projects. While we each bring specific talent sets to the collaboration, I unfailingly learn something new whenever I work with her, and this has consistently been the case over the years. I am sure that anyone else who has "collaborated" with her walks away from the completed project with new perspectives, new knowledge, or both. Dr. Hubler is a pleasure to work with because she always carries her share of the workload, and she ensures that all parties to the project are kept on track. But perhaps the most important reason that I enjoy working with her is that she enjoys the process of pontification. I have found that we often have spent hours discussing the possibilities of data that we came across in the literature and the different ways that it may influence a project on which we are working. These conversations are where I think we have both learned the most,

and I have no doubt that Dr. Hubler has similar conversations with the students who work with her on research projects.

Sincerely,

A handwritten signature in blue ink that reads "P. Adams". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Patti Adams, M.S., Ph.D.  
Assistant Dean of Operations and  
Associate Professor of Pharmaceutical Sciences  
South University School of Pharmacy  
Savannah, GA  
Phone: 912-201-8126

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To Whom It May Concern:

Performing research with Dr. Tina Hubler at the University of North Alabama has been to my benefit in many ways. Because of this experience I am able to apply myself confidently in a research lab setting, I have gained writing and communication skills necessary for success in every field of science, and I now have a foundation of knowledge that allows me to teach others.

In performing research with Dr. Hubler, I learned several technical skills that furthered my confidence in pursuing my graduate education. I was instructed in advanced laboratory techniques, e.g., Western Blotting, Bradford Protein Assay, qPCR, that will allow me to be a valuable member of a research team. The time I spent researching articles and conversing with Dr. Hubler coalesced in the laboratory when I was able to see how a variety of techniques were correlated with pursuing a common goal. The comfort I have in a lab, which I have gleaned from this understanding, will be invaluable in the years of education and professionalism that I am pursuing.

In addition to technical skills and an understanding of the materials used in performing research, I was also challenged in my ability to communicate my ideas and findings clearly. Under the guidance of Dr. Hubler, I learned how to write and present information at a level conducive with higher academia. I now feel equipped with the skills needed to explain significant findings and respond eloquently to inquisitors and critics. This added confidence in public speaking and scholarly writing has enabled me to be more prepared to defend my scientific position on topics as a graduate student and a professional in the science fields. Finally, All that I learned from Dr. Hubler has allowed me to apply myself in teaching settings. I have had success instructing a new research

student in the lab, and taught two introductory biology lab classes as a substitute for another professor.

The opportunities I was given through this research experience have opened my eyes to the world of academic research and positioned me to see more clearly how the process unfolds to provide scientific evidence. Research requires patience, persistent dedication, discipline, and an unquenchable curiosity. I am overwhelmingly thankful for the time Dr. Hubler put into my academic career through instruction and mentoring. She has given me the tools necessary for achieving the goals that I have for my professional life and career.

Sincerely,

Caroline Thomas

Vivian Lesende  
5410 Marion-Johnson Rd #B  
Athens, OH 45701  
VL295212@ohio.edu

To whom it may concern:

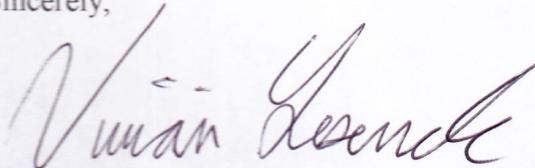
I am writing this letter to recommend Dr. Tina R. Hubler for the position of professor. Dr. Hubler is an excellent candidate for professorship, as she has always gone above and beyond her role as an instructor in terms of her mentorship of students and her research. Furthermore, her passion for her research played an instrumental role in my decision to pursue a graduate education and a career in molecular and cellular biology research.

I became a student of Dr. Hubler around spring 2012 when I enrolled in her Genetics and Molecular and Cellular Biology courses. Her lectures for these courses were always well organized and presented, making complex subject matter much easier to comprehend. In addition to granting me a great foundation in a highly complex and changing field, Dr. Hubler's courses gave me the hands on experience of performing many molecular and cellular biology techniques including PCR, gel electrophoresis, Southern blot, and more.

Dr. Hubler's knowledge and passion for her field inspired me to choose her to lead my University of North Alabama Honors Program Capstone research project. From Fall 2012 to Spring 2013, Dr. Hubler assisted me with the planning, writing, and experimentation required for my project. When the university offered a \$1000 grant for student research proposals, Dr. Hubler guided me through the arduous but rewarding process of writing and editing a professional grant proposal. Through her excellent guidance, our project was awarded the \$1000 grant. My research project was an offshoot of Dr. Hubler's own work, and involved isolating and analyzing DNA sequences from squirrel monkeys and humans. This project provided me with indispensable experience in proper cell culture technique, as well as solidified my knowledge of PCR and gel electrophoresis. The final stage of my project was the presentation of my work to an audience. Dr. Hubler led me through the process of presenting my work in a clear and concise format, which is a skill crucial to any scientist.

As a recent graduate of Ohio University's Biological Science master's program, I firmly believe that the knowledge and experience that Dr. Hubler's guidance provided me with were invaluable in my completion of graduate school. She is excellent at laying the foundation undergraduate students require to pursue a graduate education in molecular and cellular biology. Perhaps most importantly, she inspires and encourages students to set goals and work to achieve them. For these reasons, I believe Dr. Hubler is an excellent candidate for professorship.

Sincerely,

  
Vivian Lesende

# Examples of Teaching Effectiveness

# Examples of Teaching Effectiveness

BI 498  
Senior Assessment  
Seminar

**BI 498 Senior Assessment Seminar  
Spring 2016**

Dr. Tina Hubler 336 SETB  
256-765-4761 [trhubler@una.edu](mailto:trhubler@una.edu)

Office hours	M 11:30-1:30 Other times by appointment	T 11:00 - 2:00	W 11:30 - 1:30 Research lab 345
Text	<i>Biology</i> by Campbell and Reese, or other biology textbook written for biology majors. GRE Biology Subject Test review books are available for loan.		
Course Description	Preparation for the Major Field Test in Biology senior exit examination and transition into professional school or workforce. Review of the major subject areas of biology, preparation of a professional resume, participation in departmental assessment and completion of the Major Field Test in Biology.		
Attendance, Make-ups and class participation	Regular and punctual attendance is expected at all scheduled classes. Attendance will be taken at the <u>beginning</u> of class; if you are not present, you will be counted absent. If absences (excused or unexcused) exceed four (4), no credit will be earned for the course. Make-up work will only be considered for excused absences and will be offered at the discretion of the instructor. Excused absences require documentation e.g. physician note for illness; notice of required scheduled university-sponsored event; notice of death in family. Missed assignments or tests as a result of unexcused absences or tardiness result in a grade of zero ("0").		
:	Class participation (citizenship) points comprise 1% of your grade and will be forfeited for behaviors that distract from an effective learning environment (e.g. tardiness, lack of appropriate materials and electronic devices out during class). All electronic devices are to be <u>turned off</u> and kept <u>out of sight</u> in the classroom.		
Course Objectives	Use textbooks described above and other materials (including discussions with faculty members) to review each of the major subject areas of biology that are included in the Major Field Test in Biology. Complete quizzes in each of the subject areas to identify strengths and weaknesses. Utilize the university Career Planning and Development Center and the format provided by the instructor of the course to prepare a professional resume or curriculum vitae. Participate in assessing the strengths and weaknesses of the Department of Biology by completing the "Program Adequacy Questionnaire". Employ your best effort on the Major Field Test in Biology.		
Grading	Quiz on Unit I (Organismal Biology)		9 pts
	Quiz on Unit II (Population Biology, Evolution and Ecology)		9 pts
	Quiz on Unit III (Cell Biology)		9 pts
	Quiz on Unit IV (Molecular Biology and Genetics)		9 pts

Major Field Test (MFT) in Biology	60 pts
Resume (format must be followed)	2 pts
Departmental assessment	1 pts
Class participation	1 pts
Total	100 pts

No extra credit will be offered.

Calculation of grade for MFT: The national average on the MFT will be used as the benchmark to determine the points you earn for the test. The national average will be equated to a score of 80% in this course. For example, if your score is equal to the national average on the MFT, your points for the test will be  $0.80 \times 60 = 48$  points. Each point above or below the national average would earn  $\pm 1\%$  of 60 points. For example, if the national average is 153 and you score 151, you would earn 78% of 60 points ( $0.78 \times 60 = 46.8$  points). If the national average is 153 and you score 163, you would learn 90% of 60 points ( $0.9 \times 60 = 54$  points).

Grading scale: A = 90-100 B = 80-89 C = 70-79 D = 60-69 F = 59 or less  
Any incident involving plagiarism or dishonesty results in a grade of "0".

Student Activities, by week **NOTE: This is a tentative schedule and may be revised !**

Jan 25	Introduction; Books available; Assignment of Unit I (Organismal Biology)
Feb 1	Review of Unit I - <i>No class meeting</i>
Feb 8	Quiz on Unit I; Assignment of Unit II (Population Biology, Evolution and Ecology)
Feb 15	Review of Unit II - <i>No class meeting</i>
Feb 22	Quiz on Unit II; Assignment of Unit III (Cell Biology)
Feb 29	Review of Unit III - <i>No class meeting</i>
Mar 7	Quiz on Unit III; Assignment of Unit IV (Molecular Biology and Genetics)
Mar 14	Review of Unit IV - <i>No class meeting</i>
Mar 21	Quiz on Unit IV
Mar 28	Review for MFT - <i>No class meeting (spring break)</i>
Apr 4	Review for MFT
Apr 18-22	Major Field Test and Assessment of Department (student selects one of the available dates and times for test administration)
Apr 25, May 2	No class meeting; Portfolio/resume due May 2

**Academic Honesty:** Students of the university academic community are expected to adhere to commonly accepted standards of academic honesty. Allegations of academic dishonesty can reflect poorly on the scholarly reputation of the University including students, faculty and graduates. Individuals who elect to commit acts of academic dishonesty such as cheating, plagiarism, or misrepresentation will be subject to appropriate disciplinary action in accordance with university policy.

Incidents of possible student academic dishonesty will be addressed in accordance with the following guidelines:

1. The instructor is responsible for investigating and documenting any incident of alleged academic dishonesty that occurs under the instructor's purview.
2. If the instructor finds the allegation of academic dishonesty to have merit, then the instructor, after a documented conference with the student, will develop a plan for disciplinary action. If the student agrees to this plan, then both instructor and student will sign the agreement. The faculty member will forward a copy of the signed agreement to the Office of Student Conduct for record-keeping purposes.
3. If the student disagrees with the instructor's proposed plan for disciplinary action and wishes to take further action, he/she is responsible for scheduling a meeting with the chair of the department where the course is housed to appeal the proposed disciplinary plan. The department chair shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the departmental level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the dean of the college where the course is housed to appeal the proposed disciplinary plan. The college dean shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the college level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the Vice President for Academic Affairs and Provost (VPAA/P) to appeal the proposed disciplinary plan. The VPAA/P shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. After reviewing all documentation, the VPAA/P may, at his/her discretion, choose either to affirm the proposed action, to refer the case to the Office of Student Conduct for further review, or to dismiss the matter depending on the merits of the case. The final disposition of the case will be disseminated to appropriate parties, including the Office of Student Conduct.
4. If a student is allowed academic progression but demonstrates a repeated pattern of academic dishonesty, the VPAA/P may, after consultation with the Office of Student Conduct, assign additional penalties to the student, including removal from the University.

#### **Communication:**

The official method of communication at UNA is UNA portal, with emphasis placed on University email.

#### **Disability Accommodations:**

In accordance with the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973, the University offers reasonable accommodations to students with eligible documented learning, physical and/or psychological disabilities. Under Title II of the Americans with Disabilities Act (ADA) of 1990, Section 504 of the Rehabilitation Act of 1973, and the Americans with Disabilities Amendment Act of 2008, a disability is defined as a physical or mental impairment that substantially limits one or more major life activities as compared to an average person in the population. It is the responsibility of the student to contact Disability Support Services to initiate the process to develop an accommodation plan. This accommodation plan will not be applied retroactively. Appropriate, reasonable accommodations will be made to allow each student to meet course requirements, but no fundamental or substantial alteration of academic standards will be made. Students needing assistance should contact Disability Support Services (256-765-4214).

#### **Title IX:**

The University of North Alabama has an expectation of mutual respect. Students, staff, administrators, and faculty are entitled to a working environment and educational environment free of discriminatory harassment. This includes sexual violence, sexual harassment, domestic and intimate partner violence, stalking, gender-based discrimination, discrimination against pregnant and parenting students, and gender-based bullying and hazing.

**Faculty and staff are required by federal law to report any observations of harassment (including online harassment) as well as any notice given by students or colleagues of any of the behaviors noted above.** Retaliation against any person who reports discrimination or harassment is also prohibited. UNA's policies and regulations covering discrimination and harassment may be accessed at [www.una.edu/titleix](http://www.una.edu/titleix). If you have experienced or observed discrimination or harassment, confidential reporting resources can be found on the website or you may make a formal complaint by contacting the Title IX Coordinator at 256-765-4223.

# Benefits of Senior Assessment Seminar

## Positive Aspects of SAS

1. Review to take admission exams (medical, dental, graduate school)



2. Review to prepare for job interviews



3. Train to be a member of Team UNA

4. Celebrate your accomplishments



## Negative Aspects of SAS

# BI 415 Evaluation of CD for Senior Assessment Seminar

Sample CD evaluated for SAS

Login or Register

PRODUCTS ▾ search 

 0 ▾ My Account ▾

Shop Our Products Digital Catalogs Order by Number Frey Scientific CPO Science

[Home](#) > [Biology](#) > [Advanced Placement](#)

## Neo/SCI AP\* Biology Exam Preparation Software Individual License CD-ROM

By: [Neo Sci](#) Item#: 12-1041  [Write a review](#)

Share:      [Print](#)

[Features](#) [Specifications](#) [Reviews](#)

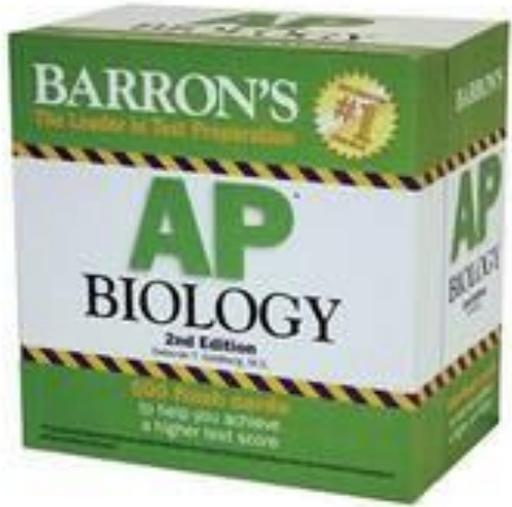
Neo/SCI AP Biology Exam Preparation Software CD-ROM with Individual License reinforces the AP curriculum content with instant feedback in practice mode. Test their AP curriculum knowledge and receive instant grades in test mode. CD-ROM includes over 400 questions that cover concepts throughout all 12 AP Biology labs. This CD-ROM needs the following requirements such as Windows 95, Mac 8.6 and 64 MB RAM. \*AP and Advanced Placement are trademarks registered and/or owned by the College Board, which was not involved in the production of, and does not endorse, this product.

Catalog Price  
**\$59.95**

QTY  [ADD TO CART](#)



# Senior Assessment Seminar flashcards





# Certificate of Achievement

this certificate is awarded to

**John Thomas**

for performance on the

**Major Field Test in Biology**

Score: 169   National Average: 153   Percentile: 87

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Assoc. Professor, Dept of Biology,

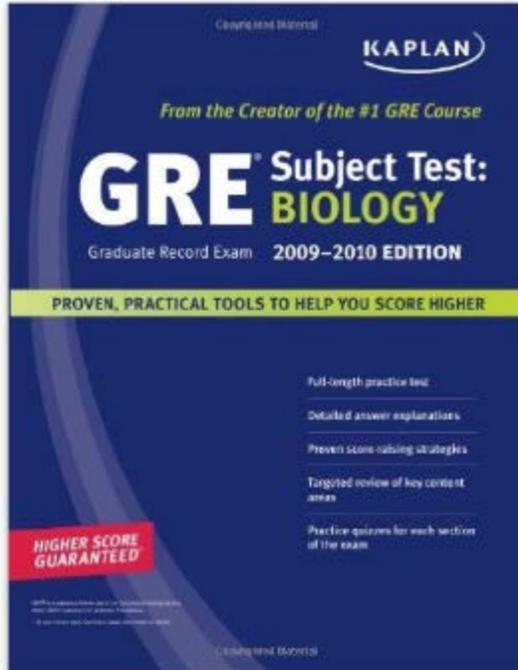
University of North Alabama

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Chair, Dept of Biology,

University of North Alabama

# Senior Assessment Seminar - books for loan to students as a resource



# Examples of Teaching Effectiveness

BI 415  
Molecular Biology

## BI 415 Molecular Biology

Fall 2014

Dr. Tina Hubler

408 Floyd Hall

765-4761

[trhubler@una.edu](mailto:trhubler@una.edu)

Office hours: M 11:00 -2:00 T 1:00 -2:00 W 11:00 -2:00  
Other times by appointment

Course Description: BI 415 4 hrs. Molecular Biology. The molecular basis for gene structure, function and regulation of gene expression. Emphasis on understanding current molecular biology methods, performing laboratory techniques and data interpretation. 2 lecture hrs; 4 lab hrs. Prerequisites: BI 306, BI 305, BI 307. Special fee: \$30.00. Summer.

Text: Scientific American Current Issues (required)  
iGenetics A Molecular Approach, 2<sup>nd</sup> edition, Peter J. Russell (optional)  
or Essentials of Genetics, 7<sup>th</sup> edition, William S. Klug (optional)

Lab Manual: Laboratory instructions will be provided.

Course Objective: This is an advanced course in molecular biology, expanding on concepts learned in Genetics BI 306. The laboratory techniques will include polymerase chain reaction (PCR), electrophoresis, DNA purification, restriction digestion and cloning, site directed mutagenesis, transfection, protein expression analysis, detection of genetically modified food, microsatellite analysis, DNA sequencing and Southern blotting. In lecture we will review concepts and methods from genetics that pertain to conducting and interpreting laboratory experiments. Because the emphasis in this course will be on laboratory methods and data interpretation, we will provide opportunities for students to learn marketable laboratory skills as well as refine their critical thinking skills.

Classroom participation: It is expected that mature students participate in class by managing themselves so that other students have the maximum opportunity to learn. Distractive behavior, such as repeated tardiness and failure to bring the materials needed for class, will result in loss of class participation points. All electronic devices (including computers) are to be turned off and kept out of sight while in the classroom and laboratory unless permission is given for use.

Attendance: Research suggests that regular class attendance improves students' course grades. Attendance will be taken at each class. Excused absences require documentation e.g. physician note for illness; notice of required scheduled university-sponsored event; notice of death in family. Missed assignments as a result of unexcused absences result in a grade of zero ("0"). Tardy students are not permitted to come into class and disrupt others for information while class is being conducted.  
**The student is responsible for all announcements, assignments, material discussed and missed work, etc. if absent or tardy.**  
Make-up quizzes or labs will not be given.

Grading:	4 exams	100 pts each
	2-4 quizzes on reading assignments	20 pts each
	Additional announced quizzes	10 pts each
	Class quizzes	5 pts each (~ 140 pts)
	Class participation	5 pts/exam (~ 20 pts)
	Lab notebook	100 pts

Exams: cover principles underlying laboratory methods, techniques, data interpretation and lecture.

Reading quizzes: cover reading assignments from Scientific American.

Announced quizzes: cover specific topics discussed in class (e.g. calculating dilutions) or homework assignments (e.g. performing BLAST analyses)

Weekly quiz: two to four oral questions at beginning of class on material covered and experimental procedure from previous lab. Tardy students receive a zero. All student are allowed to drop one zero on a weekly quiz.

Class participation: each student should be prepared to perform experiments alone or with a partner. This includes reading assigned material and being present to prepare reagents and perform experiments. Because experiments will be ongoing, points will be forfeited for unexcused absences.

Lab notebook: should include lab instructions (handouts), reagent preparation, notes taken during class, data and interpretation; should be divided into sections containing individual experiments; should be neat and thorough. A rubric will be provided and the notebook will be reviewed at the end of the semester.

Grading scale: Based on the per cent of total possible points  
 A = 90-100 B = 80-89 C = 70-79 D = 60-69 F = 59 or less  
 Any incident involving plagiarism or dishonesty results in a grade of "0".

Equal Opportunity Statement: In accordance with the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973, the University offers reasonable accommodations to students with eligible documented learning, physical and/or psychological disabilities. Under Title II of the Americans with Disabilities Act (ADA) of 1990 and Section 504 of the Rehabilitation Act of 1973, a disability is defined as a physical or mental impairment that substantially limits one or more major life activities as compared to an average person in the population. It is the responsibility of the student to contact Developmental Services prior to the beginning of the semester to initiate the accommodation process and to notify instructors within the first three class meetings to develop an accommodation plan. Appropriate, reasonable accommodations will be made to allow each student to meet course requirements, but no fundamental or substantial alteration of academic standards will be made. Students needing assistance should contact Developmental Services.

Lecture Schedule – Fall 2014

**NOTE: This is a tentative schedule for tests !  
Dates for tests to be announced in class !**

Genetics review of replication, transcription, translation, electrophoresis, PCR  
Electrophoresis of dyes (IDEA)  
PCR – amplification of the neomycin resistance or the FKBP5 gene  
Gel extraction of DNA from agarose gels  
Determination of DNA concentration  
Article: Scientific American Molecule of Life

**Test # 1**

Genetically modified foods – experimental controls  
TA cloning, selection and controls  
Edvotek experiment series  
Article: Scientific American Riboswitches

**Test # 2**

Microsatellites  
DNA sequence analysis  
Detection of lactate dehydrogenase isoenzymes  
Distinguishing owl monkey DNA from squirrel monkey DNA by PCR  
Article: Tale of the Icefish

**Test # 3**

Tissue culture  
Western blotting FKBP5 in New World and Old World primate cells  
Transfecting cells with mutant plasmids  
Enzymatic assay of transfected cells  
Article: Scientific American Intelligence or Mental Illness

**Test # 4**

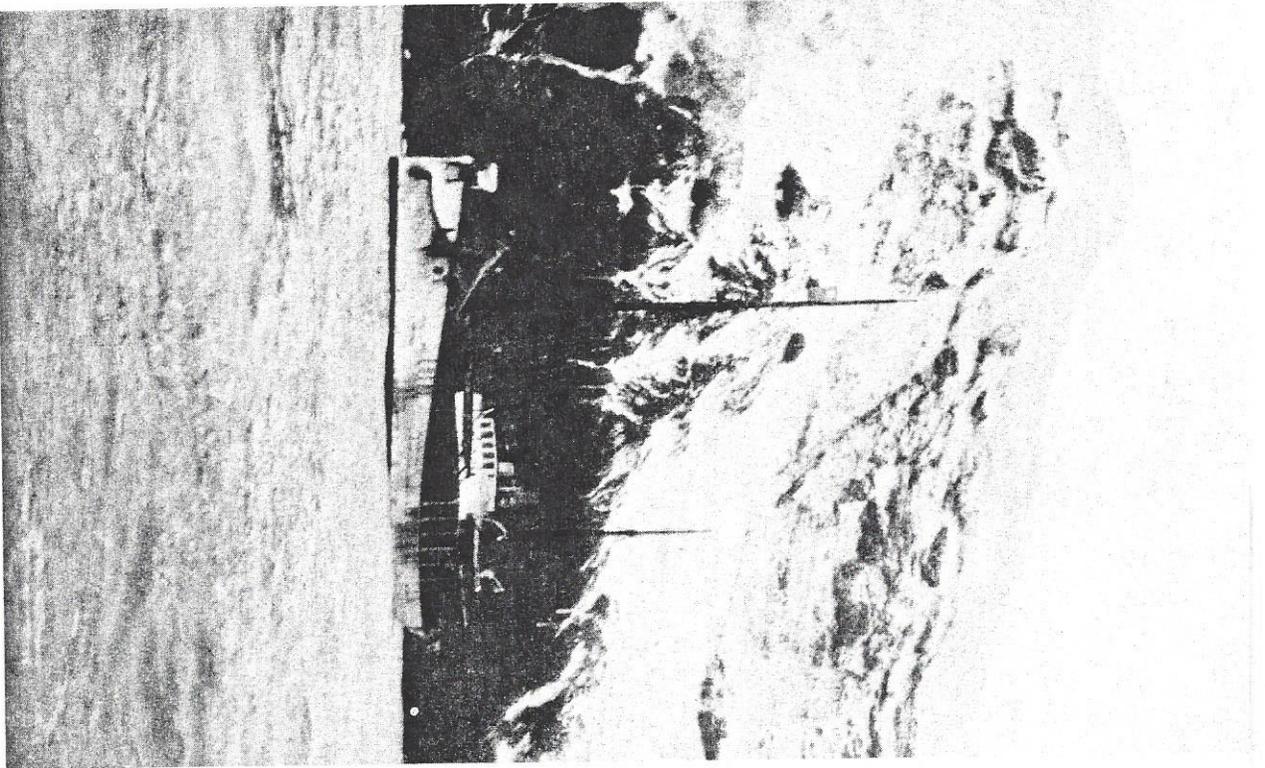


FIGURE 9.1 *The Norvegia at Bouvet Island.*  
Photo from Fangst Og Forskning I Sydishavet by Bjarne Aagaard, Volume 2,  
"Nye Tider." Published by Gyldendal Norsk Forlag, Oslo, 1930.

N I N E

## In Cold Blood: The Tale of the Icefish

In all things of nature there is something of the marvelous.

—Aristotle

It was a long way just to go fishing.

The 125-foot converted wooden sealing boat *Norvegia* put to sea out of Sandeford Harbor, Norway on September 14, 1927. Its primary destination was perhaps the most remote piece of land on the planet. Tiny Bouvet Island, a speck in the vast Southern Ocean, lay more than six thousand miles from Norway, sixteen hundred miles from the tip of Africa, and more than three thousand miles from South America.

In the mid-1920s, commercial whaling was booming. The Norwegian invention of factory ships allowed greater numbers of animals to be taken without relying on shore facilities. Finding new stocks of whales was a priority for the entrepreneurs who went to sea, and establishing claims to territory and waters was a priority for the countries involved. The Norwegian government wanted to stake a claim to this ice-covered volcanic rock with

# BI 415 Article questions

Into the Jungle Sean B. Carroll In Cold blood: the Tale of the Icefish

1. The bloodless fish was discovered accidentally during commercial whaling expeditions. One of the researchers, Rudd, noted "it was impossible because...all vertebrates share...presence of O<sub>2</sub>-binding hemoglobin in red blood cells". What does this tell you about the nature of current knowledge (dogma)?
2. When blood was centrifuged what was absent in the bloodless icefish?  
a. blood cells b. red blood cells c. oxygen d. proteins
3. How does O<sub>2</sub> capacity (% O<sub>2</sub> per volume) of icefish compare to red-blooded relatives?  
a. <1% compared to 100% b. <1% compared to 6% c. no difference
4. Arctic waters are on average -1.9°C. The freezing point of water is 0°C. Why don't organisms freeze?  
a. solutes (particles) in solutions decrease the boiling point  
b. solutes (particles) in solutions increase the freezing point  
c. solutes (particles) in solutions decrease the freezing point
5. What geologic changes may have occurred around Antarctica ~ 33-34 MYA (million years ago)?  
a. Antarctica joined South America b. Antarctica separated from S America  
c. Antarctica is a volcanic island that surfaced at that time
6. What happened to water temperatures ~ 15 MYA, about the same time that icefish fossils appear in fossil records?  
a. increased b. decreased to below freezing c. decreased to 37°C
7. What type of molecule is AFGP? What does glyco mean?  
a. protein; sugar b. sugar; lipid c. enzyme; protein d. nucleic acid; protein
8. The AFGP are composed of repeats of \_\_\_\_\_?  
a. three amino acids b. short tandem repeats of GATA c. Alu sequences
9. Draw the structure of threonine and show where you can add sugar groups to an amino acid.
10. The AFGP DNA in icefish is extraordinarily similar to the trypsinogen gene. What regions of the AFGP gene are found in the trypsinogen gene?  
a. 5' and 3' ends b. 2 introns c. the coding sequence d. a and b

# BI 415 Article questions

11. What does this degree of similarity suggest?
  - a. AFGP functions as a digestive enzyme
  - b. AFGP evolved from trypsinogen
  - c. AFGP is not needed by the cell
  - d. trypsinogen is not needed by the cell
12. Where in the trypsinogen gene is the repeat found?
  - a. in the exon/intron boundary
  - b. in the coding sequence
  - c. in the 5' end
  - d. in the 3' end
13. The relation of AFGP to trypsinogen suggests a mechanism for genetic (molecular) evolution. It is (choose a or b):
  - a) tinkering with materials (DNA sequences) already available
  - b) inventing new DNA sequences from scratch
14. Hemoglobin protein is made from a-globin and b-globin genes. What is the status of these in icefish?
  - a. a-globin is intact; b-globin is a remnant
  - b. a-globin is remnant; b-globin is intact
  - c. a-globin is remnant; b-globin is absent
15. A nonfunctional remnant of a gene is a \_\_\_\_\_ (a molecular fossil).
  - a. 5' flanking region
  - b. 3' UTR
  - c. pseudogene
  - d. homologue
16. What features of the icefish cardiovascular system allow it to survive without hemoglobin?
  - a. large gills, heart and blood volume
  - b. scale-less skin with large capillaries
  - c. large amount of myoglobin
  - d. a and b
  - e. all of the above
17. What happened to the myoglobin gene in icefish that caused it to become a molecular fossil?
  - a. overexpression
  - b. gene amplification (duplication)
  - c. mutation
18. Evolution is not necessarily progressive (i.e. developing **new** traits). Sometimes genes and functions are \_\_\_\_\_.
- 19-20. What may happen to icefish if waters warm again? Think of 2 possibilities:
  - 19.
  - 20.

# BI 415 HHMI video and outline

## HHMI video and outline



SHORT FILM

The discovery of the Antarctic icefish has provided a stunning example of adaptation in an environment both hostile and abundant, where the birth of new genes and the death of old ones have played crucial roles. Researchers Bill Detrich, Christina Cheng, and Art DeVries have pinpointed the genetic changes that enable icefish to thrive without hemoglobin and red blood cells and to avoid freezing in the icy ocean.

### **Howard Hughes Medical Institute: Tale of the Icefish Outline**

Norway claimed island as an outpost. Explore sealife.

Crocodile fish – translucent, scaleless, gills are white. Organs colorless, including heart.

Icefish - all other known vertebrates had red blood; 45% of our blood is RBCs

Blood cells increase viscosity of blood. Scaleless fish can do without hemoglobin because O<sub>2</sub> transports through skin.

Even though below freezing point, fish thrive.

Arther DeVries and wife Christina Cheng study fish at -1.8°C

# BI 415 HHMI video and outline

Antifreeze protein binds to ice crystals.

When and how was protein “invented”?

35MYA land masses separated and water cooled to  $-1.8^{\circ}\text{C}$

\*\*\*\*ancestral gene duplicated then mutated

Icefish eliminated hemoglobin.

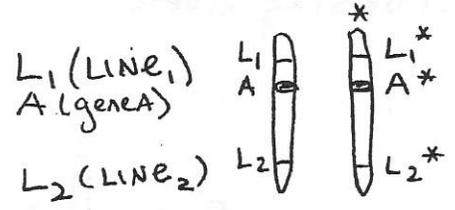
Globin genes: normal hemoglobin vs icefish mutated hemoglobin

Because hemoglobin not needed, mutation was not harmful. The gene is now a pseudogene.

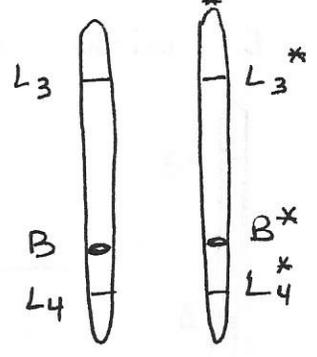
# BI 415 activity

## Non homologous Cross over Practice 😊

chromosome 1



chromosome 6

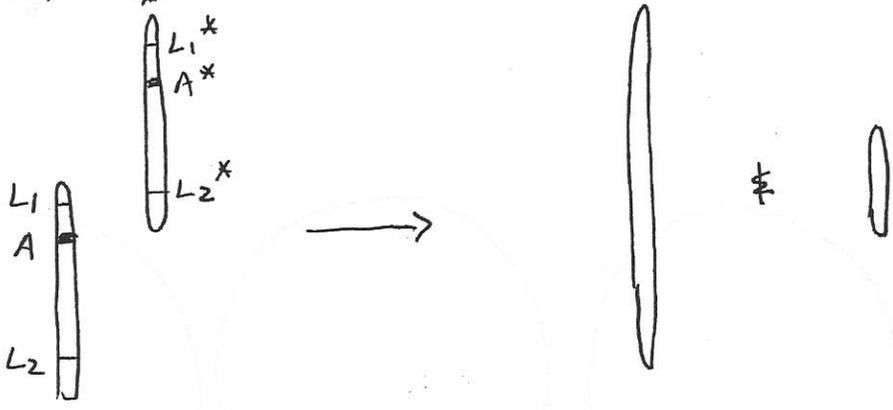


Assume LINES are similar repetitive sequences that will allow crossing over  $L_1 \sim L_2 \sim L_3 \sim L_4$

①

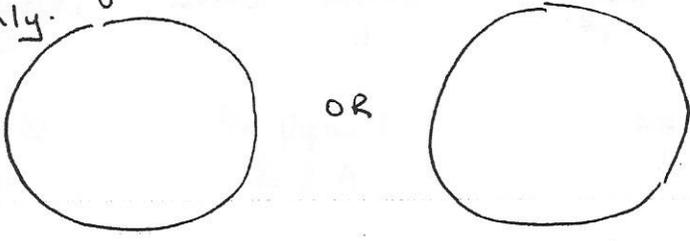
USE CHROMOSOMES 1 ONLY = Unequal crossing over on homologous chromosomes

a) Align  $L_1$  with  $L_2$  and cross over.



gene duplication on 1 chromosome;  
gene deletion on 1 chromosome

b) Predict which gametes will contain gene duplication using chrom 1 only.



c) Which gamete will probably die?

d) Which gamete has 2 copies of gene A on one chromosome?

# BI 415 Exams with mathematics

1. Determine the amount (mg) of a dye added to a package of M&M's

Standard curve of blue reference dye (stock solution is 1.0 mg/mL)

uL dye	uL solvent	concentration(ug/mL)	absorbance
5	995		0.1
10	990		0.22
20	980		0.46
40	960		0.92

calculate the concentrations

show work here for the first calculation:

graph the standard curve on paper included

label both axes, including units (e.g. ug/mL) **this is MICROGRAMS per mL**

Your sample was prepared as follow and analyzed:

1 M&M

2.0 mL extraction solution

1:10 dilution

Absorbance 0.5

**Calculate amount of blue dye in 1 M&M (either ug or mg)**

SHOW ALL STEPS IN ORDER

2. Concentration from absorbance

Account for dilution

Account for extraction volume

3. ANSWER \_\_\_\_\_ (include units)

4. Calculate the amount (mg) of blue dye added to a package containing 100 blue M&M's and 100 purple M&M's assuming purple M&M's are coated with 10% blue and 90% red dye. SHOW ALL WORK

# BI 415 Exams with mathematics

5. Calculate the amount (ug) of DNA extracted from a gel.  $A = abc$

A band was extracted and purified using silica spin column technology. Final elution volume was 10  $\mu\text{L}$ .

$a$  for DNA is  $0.02 (\text{ug/ml})^{-1}\text{cm}^{-1}$  note:  $a = 1/50$

UV absorbance at 260 nm = 0.6 UV absorbance at 280 = 0.32

6. What is the purity ratio of the DNA in #3?

7. What volume of 75  $\text{ug}/\mu\text{L}$  stock solution is required to make 20 mL of a 1.0  $\text{ug}/\text{mL}$  solution?

8. How do you prepare 100 mL of electrophoresis buffer from a 5X concentrate?

9. How do you prepare a 50  $\mu\text{L}$  PCR reaction that provides a Master mix at 2X concentration? You need GoTaq Master Mix, 2  $\mu\text{L}$  of template and 1.0  $\mu\text{L}$  each of 2 different primers in the PCR reaction. INCLUDE all components to add up to 50 $\mu\text{L}$ .

10. How do you prepare a 50  $\mu\text{M}$  primer solution from 20 nmol of solid primer? Calculate how much nuclease-free water to dissolve the primer into.

# BI 415 Exams with mathematics

- d. it replaces cytosines with adenines, thus preventing gene silencing

## Transfection

51. Which of the following is not a commonly used method of transfection  
a. electroporation      b. lipophilic dendrimer (liposomes)      c. microinjection
52. \_\_\_\_\_ cells take up introduced DNA best  
a. quiescent (dormant)      b. confluent (dish uniformly filled with cells)  
c. dying      d. actively dividing
53. Serum used in tissue culture contains  
a. antibiotics      b. growth factors      c. substrates for the enzymatic assay

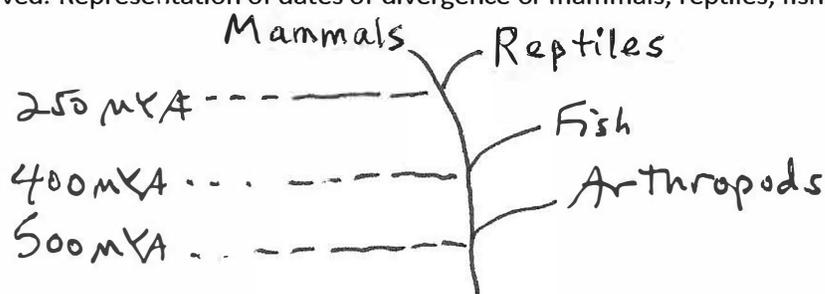
## Luciferase Assay

54. Firefly or beetle luciferase is a \_\_\_\_  
a. carbohydrate      b. lipid      c. protein      d. nucleic acid      e. phospholipid
55. We expect to transfect only 5% of the COS cells, and yet we expect to obtain a large response (signal) in our assay. Why?  
a. the assay employs an enzymatic reaction, in which the enzyme is recycled  
b. the assay employs a colorimetric reaction, in which the substrate is regenerated  
c. the untransfected cells produce a high background signal  
d. the instrument reduces (attenuates) the signal
56. The components of the assay system are lysis buffer and assay reagent. What does the assay reagent contain?  
a. substrate      b. detergent      c. enzyme      d. NaOH
57. The components of the assay system are lysis buffer and assay reagent. What does the lysis buffer reagent contain?  
a. substrate      b. detergent      c. enzyme      d. ATP
58. In our assay, a luminometer is used to measure  
a. absorption of light in the 400-800 nm range  
b. emission of light in the 350-650 nm range  
c. fluorescence at a selected peak wavelength  
d. ATP production

## Problems

### Molecular Clock

Human and lizard cytochrome C amino acid sequences were compared. 8 out of 50 substitutions were observed. Representation of dates of divergence of mammals, reptiles, fish and arthropods (MYA):



# BI 415 Exams with mathematics

59. Calculate SHOW ALL WORK

The % difference in substitutions between Human and Lizard

60. Calculate SHOW ALL WORK

The % change that occurred every ONE MILLION YEARS that lead to the difference in substitutions just calculated

61. Calculate SHOW ALL WORK

If prokaryotes and eukaryotes diverged 2.5 billion years ago (BYA), how much difference (in %) should we see in bacterial cytochrome c?

62. It has been proposed that molecular clocks can be used to estimate the time of divergence of organisms that have not left fossil records. What must we assume is occurring at a constant rate in order for these estimates to be valid. (Hint the same type of assumption is made with regard to radioactive decay when we use radioactive elements to date rocks)

## Luciferase Assay

63. Prepare a graphical representation for the following data.

DNA:	0	pGL3	pGL3mutant
RLUs:	33	365000	90
	36	330000	100
	35	340000	105

# BI 415 Exams with mathematics

64. Label the axes

65. Describe how you treated the data after it was collected to generate a number to graph on the y-axis.

66. Which sample represents background (“noise”)

67. Describe in 1 or 2 concise sentences WHY you would include background data in your figure.

68. Explain the results of the pGL3 sample

69. Explain the results of the pGL3mutant sample

## Progesterin (R5020) cell responses and FKBP51 article

70. Cellular responses to progestins can be measured as a function of dose (concentration) of R5020.

**Sketch a graph (dose response curve) that would suggest that the dose required for maximal response is**

$10^{-9}$  M. Label it **CTL**.

71. FKBP51 present in PR complexes inhibits cellular response to R5020. On the above graph, sketch a curve that reflects the response in cells with high levels of FKBP51. Label it **h51**.

72. If a mutation is made in FKBP51 that prevents it from incorporating into the PR complex, sketch a curve on the above graph that reflects the cellular response. Label it **h51m**.

# BI 415 Exams with mathematics

Microsatellite repeat: gata

TCAGGTGGACAGATGTACTCC

1 tcaggtggac agatgtactc ctcaaatoccc cactgaagtg gtatTTTTTT tottaaaata

61 atatacattg agaaatacaa aagcagcccc cattttgagt gggcccactt ctataataga

121 atattgttgc cttttctttt ctggataacc acagagtctt gatagataga tgatagatag

181 atagatgata gatagataga tagatagata gatagataga tattcagttg taaacctact

241 ttatggagac ctttctcctc atctgaactt gaaacatcca gttgcctt

AAGGCAACTGGATGTTTCAA

# BI 415 Exams with mathematics

350

325

300

255

230

204

200

175

145

120

105

100

94

75

50

(E)

(CR)

(CH)

(M)

275

285

283

277

285

280

294  
290

292

285

293

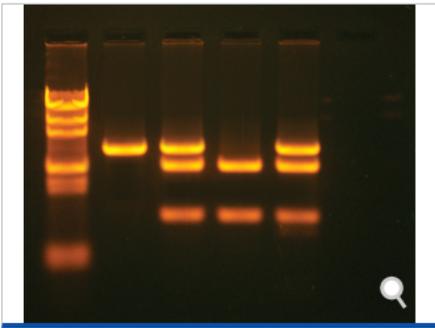
290

graphical analysis  
of data

# BI 415 New labs

BI 415 new labs

From Edvotek

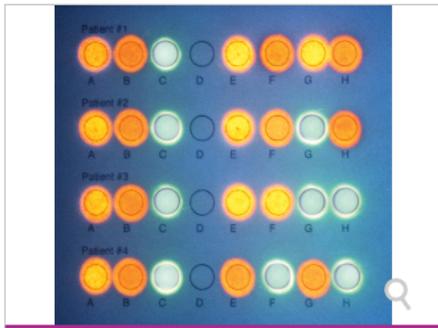


## In Search of the Cancer Gene

Cat. #314



Suppressor genes such as p53 are essential for cell functions. Mutations in the p53 gene can be correlated to predisposition for certain cancers. Mutations in genes can either be inherited or accumulated due to environmental insults. This experiment deals with a family pedigree determination of several generations relating to cancer formation due to p53 gene mutation. This experiment does not contain human DNA.



## DNA/RNA Microarrays

Cat. #235

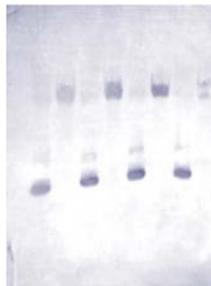
Membrane microarray technology is enabling scientists to screen large numbers of samples in one assay. This technology has led to cost savings by reducing the sample size, while saving time and yielding accurate results. Students will apply simulated DNA and RNA samples to a membrane to screen for positive and negative samples.



From Modern Biology

## 402. Application of the Southern Blot Procedure (EXP-402)

In 1975, Edward M. Southern at the University of Edinburgh, developed a powerful technique for DNA analysis which has become known as Southern blotting. Here your students use the Southern blotting procedure to identify the major control region for transcription and replication in the lambda phage genome. Following the step-by-step procedures in their manuals, students digest lambda DNA with a restriction endonuclease, electrophorese the DNA, and then transfer the separated fragments on the gel to a nylon membrane. The DNA fragment containing the control region is then identified by hybridization analysis using a biotinylated probe for the control region and the enzyme-color-producing assay. This exercise provides a wealth of practical information on one of the most powerful methods in molecular biology and illustrates an important strategy for mapping simple and complex genomes. This experiment requires about three 2-3 hour laboratory periods and typical results are shown in both the picture to the right and an attachment at the bottom of this page.

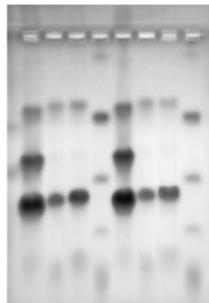


Detection of the Control Region in Lambda Phage DNA  
The separated DNA fragments on the gel were transferred to a nylon membrane and the DNA containing the control region was identified by hybridization analysis.

Electrophoresis Buffers, Agarose and Stains for this series are available

## 106. Protein Fingerprinting (Exp-106)

A comparison of specific proteins from different species provides a powerful approach for establishing evolutionary relationships and for identifying organisms. A common approach used for this purpose is protein fingerprinting where electrophoretic properties of specific proteins are analyzed in different species. In this exercise, students use the approach to compare the forms of the enzyme lactate dehydrogenase that are found in serum of different mammals. Typical results of this graphic experiment are shown below. The results illustrate that each species has a characteristic pattern of bands and that the pattern in sheep and goat is similar while the patterns from cow and especially horse are distinct.



Serum proteins from cow (lanes 1, 5), sheep (lanes 2, 6), goat (lanes 3, 7), and horse (lanes 4, 8) were separated by electrophoresis. The different forms of lactate dehydrogenase were then detected by activity staining.

[Electrophoresis package 1/8](#) provides sufficient agarose, buffers, and stains for this and 5 more experiments from this series!

**TIP:** Additional LDH is now available from Modern Biology. See below for ordering information!

## 401. Evolution of the Vertebrate Genome (EXP-401)

The history of evolution is recorded in the genomes of present-day organisms and enlightened guesses of evolutionary events can be made by comparing DNA sequences in different species. Evidence drawn from this approach has led to the construction of family trees of organisms that agree remarkably well with those obtained from more traditional procedures. In fact, on a number of occasions, comparative DNA sequence analysis has been used to clarify and expand on phylogenetic relationships that were derived from classical studies. For example, although biologists have long disagreed about the taxonomic placement of the giant panda, recent studies using DNA hybridization techniques strongly suggest that this animal is more closely related to bears than to raccoons. These important concepts are illustrated in this exercise where students use a dot-blot hybridization procedure to compare DNA sequences in salmon, turkey, chicken and cow. In the analysis, single strands of chicken or cow DNA that have been previously linked to biotin are mixed with single strands of DNA from a second species. The two types of DNA are allowed to form double-stranded hybrid molecules and the extent of hybridization is measured using a simple color-producing enzyme reaction. This exercise requires approximately two 2-3 hour laboratory periods and electrophoresis equipment is not required.



### Request Information

[Click here to request .pdf instructions for experiment.](#)

From Bio Rad

## PV92 PCR Informatics Kit



### Overview



[Purchasing Guide Table](#)



[Lab Preparation Checklist](#)



[PV92 PCR Informatics Kit Flowchart](#)

Description Specifications Ordering Refills Documents

With the PV92 PCR Informatics Kit, your students use real-world forensic techniques to extract DNA from their hair follicles or cheek cells, and then use PCR amplification and electrophoresis to fingerprint their own DNA at a specific genetic locus. Using their own results, students test the Hardy-Weinberg equilibrium theory within their classroom population, then go online to compare their classroom results to genetic data of populations worldwide.

## Rapid detection of carbapenemase genes by multiplex real-time PCR

Jussimara Monteiro<sup>1,2</sup>, Raymond H. Widen<sup>1</sup>, Antonio C. C. Pignatari<sup>2</sup>, Carly Kubasek<sup>1</sup> and Suzane Silbert<sup>1\*</sup>

<sup>1</sup>Esoteric Testing Laboratory, Pathology Department, Tampa General Hospital, Tampa, FL, USA; <sup>2</sup>Laboratório Especial de Microbiologia Clínica—LEMC, Universidade Federal de São Paulo, São Paulo, Brazil

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Received 28 October 2011; returned 24 November 2011; revised 5 December 2011; accepted 6 December 2011

**Objectives:** To develop a single multiplex real-time PCR assay to detect six different genetic types of carbapenemases already identified in Enterobacteriaceae (KPC, GES, NDM, IMP, VIM and OXA-48).

**Methods:** A total of 58 bacterial isolates were tested. Thirty were previously characterized as resistant to carbapenems and documented by PCR and sequencing analysis to carry the following genes: *bla*<sub>KPC</sub> type, *bla*<sub>GES</sub> type, *bla*<sub>IMP</sub> type, *bla*<sub>VIM</sub> type, *bla*<sub>OXA-48</sub> and *bla*<sub>NDM-1</sub>. These positive strains included 21 Enterobacteriaceae, 1 *Acinetobacter baumannii* and 8 *Pseudomonas aeruginosa* isolates. The remaining 28 isolates previously tested susceptible to carbapenems and were negative for these genes. Bacterial DNA was extracted using the easyMag extractor (bioMérieux, France). The real-time PCR was performed using the Rotor-Gene 6000 instrument (Corbett Life Science, Australia) and specific primers for each carbapenemase target were designed using the DNASTar software (Madison, WI, USA).

**Results:** Each one of the six carbapenemase genes tested presented a different melting curve after PCR amplification. The melting temperature ( $T_m$ ) analysis of the amplicons identified was as follows: *bla*<sub>IMP</sub> type ( $T_m$  80.1°C), *bla*<sub>OXA-48</sub> ( $T_m$  81.6°C), *bla*<sub>NDM-1</sub> ( $T_m$  84°C), *bla*<sub>GES</sub> type ( $T_m$  88.6°C), *bla*<sub>VIM</sub> type ( $T_m$  90.3°C) and *bla*<sub>KPC</sub> type ( $T_m$  91.6°C). No amplification was detected among the negative samples. The results showed 100% concordance with the genotypes previously identified.

**Conclusions:** The new assay was able to detect the presence of six different carbapenemase gene types in a single 3 h PCR.

**Keywords:** resistance,  $\beta$ -lactamases, Enterobacteriaceae

### Introduction

The emergence and spread of carbapenem-hydrolysing  $\beta$ -lactamases amongst Enterobacteriaceae over the past decade represents a serious issue in the hospital environment. This fact is worrying, especially because these enzymes also hydrolyse almost all antimicrobial  $\beta$ -lactams and often are also resistant to commercially available  $\beta$ -lactamase inhibitors. The genes coding for these enzymes are frequently located in mobile genetic elements, facilitating the dissemination of resistance among different bacteria.<sup>1,2</sup> Carbapenemase-producing Gram-negative bacteria have been associated with increasing mortality and with serious hospital outbreaks that present major therapeutic and infection control challenges.<sup>3</sup> For all these reasons, the inter- and intra-hospital spread of these enzymes has become a major clinical concern and rapidly identifying the organisms carrying these genes might be the best way we have to reduce or prevent this problem in healthcare centres.

New breakpoints established by the CLSI to detect carbapenem-resistant Enterobacteriaceae contributed positively

to better screening of strains expressing these important mechanisms of resistance.<sup>4</sup> Increased carbapenem MICs in Enterobacteriaceae can be a result of two different mechanisms of resistance: (i) hyperproduction of class C  $\beta$ -lactamases or extended-spectrum  $\beta$ -lactamases (ESBLs) in combination with porin alteration; and/or (ii) carbapenemase production by serine carbapenemase and/or metallo- $\beta$ -lactamases.<sup>3</sup> Thus, the new breakpoints established by the CLSI can be an excellent screening test, but they do not identify the resistance mechanism. Therefore, tests based on molecular techniques are considered the standard tests for the identification of carbapenemase genes.<sup>5</sup>

Molecular tests have been described to identify carbapenemase-producing Gram-negative bacteria. Some assays use multiplex real-time PCR to identify serine carbapenemase genes or metallo- $\beta$ -lactamase genes.<sup>6,7</sup> Assays that target more than one class of carbapenemase (A, B and D) have been developed, but all of them use conventional PCR.<sup>8,9</sup> None of them represented a single sensitive and specific assay that is designed to rapidly detect all of the main carbapenemases.

**Table 1.** Primers used in this study

Target	Primer name	Sequence (5'–3')	Amplicon size (bp)	Primer concentration (μM) <sup>a</sup>	T <sub>m</sub> <sup>b</sup>	Reference
<i>bla</i> <sub>KPC</sub> type	KPC-F	TCGCTAAACTCGAACAGG	785	0.2	91.6	10
	KPC-R	TTACTGCCCGTTGACGCCCAATCC				
<i>bla</i> <sub>NDM-1</sub>	NDM-F	TTGGCCTTGCTGTCCTTG	82	0.2	84	this study
	NDM-R	ACACCAAGTGACAATATCACCG				
<i>bla</i> <sub>GES</sub> type	GES-F	CTATTACTGGCAGGGATCG	594	0.2	88.6	this study
	GES-R	CCTCTCAATGGTGTGGGT				
<i>bla</i> <sub>OXA-48</sub>	OXA-48-F	TGTTTTTGGTGGCATCGAT	177	0.2	81.6	this study
	OXA-48-R	GTAAMRATGCTTGGTTCGC				
<i>bla</i> <sub>IMP</sub> type	IMP-F	GAGTGGCTTAATTCTCRATC	120	1.2	80.1	6
	IMP-R	AACTAYCCAATAYRTAAC				
<i>bla</i> <sub>VIM</sub> type	VIM-F	GTTTGGTCGCATATCGCAAC	382	0.2	90.3	6
	VIM-R	AATGCGCAGCACCAGGATAG				

<sup>a</sup>Final concentration in the multiplex real-time PCR.

<sup>b</sup>Melting point calculated by the Rotor-Gene 6000 using Type-it HRM.

The purpose of this study was to develop a single multiplex real-time PCR assay to identify the most common types of serine-β-lactamase (KPC, GES and OXA-48) and metallo-β-lactamase (IMP, VIM and NDM), already described in Enterobacteriaceae isolates, using high-resolution melting curves.

## Materials and methods

### Bacterial isolates

A total of 58 Gram-negative isolates with decreased susceptibility to carbapenems were tested in this study. Thirty of them, previously characterized by PCR and sequencing analysis, harbour the following carbapenemase genes: *bla*<sub>KPC</sub> type (*n*=15; all of them isolated at Tampa General Hospital, Tampa, FL, USA), *bla*<sub>GES</sub> type (*n*=3; samples kindly provided by JMI Laboratories, North Liberty, IA, USA and LEMC-ALERTA Laboratories, São Paulo, Brazil), *bla*<sub>IMP</sub> type and *bla*<sub>VIM</sub> type (*n*=5 and *n*=3; samples kindly provided by LEMC-ALERTA Laboratories), *bla*<sub>OXA-48</sub> (*n*=3; samples kindly provided by JMI Laboratories and LEMC-ALERTA Laboratories) and *bla*<sub>NDM-1</sub> (*n*=1; ATCC BAA-2146). These positive strains included 21 Enterobacteriaceae (*bla*<sub>KPC</sub> type, *bla*<sub>IMP</sub> type, *bla*<sub>OXA-48</sub>, *bla*<sub>NDM-1</sub> and *bla*<sub>GES</sub> type), 1 *Acinetobacter baumannii* (*bla*<sub>IMP</sub> type) and 8 *Pseudomonas aeruginosa* isolates (*bla*<sub>IMP</sub> type, *bla*<sub>VIM</sub> type and *bla*<sub>GES</sub> type). The other 28 Enterobacteriaceae isolates were negative for the six carbapenemases tested.

### DNA extraction

Bacterial DNA was extracted using the NucliSens easyMAG platform with NucliSens magnetic extraction reagents (bioMérieux, France), according to the manufacturer's recommendations. The extracted DNA was recovered in 60 μL of the elution buffer. The DNA extraction takes approximately 1 h.

### Design of primers

The details of the reference genes used in this assay were obtained from the following homepage: <http://www.lahey.org/studies/>. These genes were: class A carbapenemases encoding GES and KPC type, class D oxacillinases encoding OXA-48 and class B metalloenzymes encoding NDM, IMP and VIM.<sup>1,2,5</sup> The sequences of these genes were downloaded from

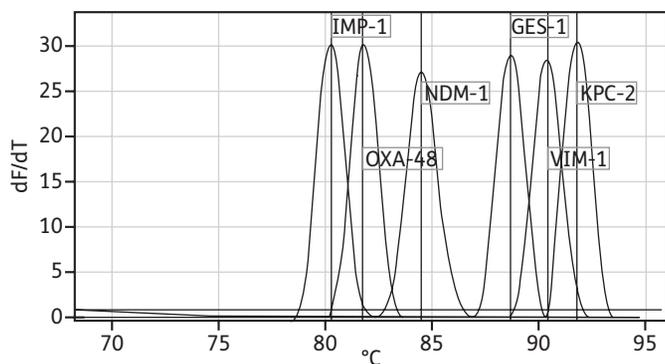
the GenBank web site (<http://www.ncbi.nlm.nih.gov/genbank/>). Based on the comprehensive analyses and alignments of each carbapenemase type, primers were specifically designed to amplify all alleles of each carbapenemase gene family described above. The melting temperature (*T<sub>m</sub>*) of the amplification product of each carbapenemase gene family was determined by the Lasergene software package (DNASTAR, Madison, WI). VIM, IMP and KPC pairs of primers were adapted from previously published sequences.<sup>6,10</sup> To confirm the specificity of the real-time PCR assays, the primers were evaluated in a single PCR format to ensure that they correctly amplified their respective loci and that the amplicons showed the expected *T<sub>m</sub>*. Subsequently, the multiplex format was optimized by assaying different primer pair concentrations. The size of each of the PCR products was verified by electrophoresis in a 2% agarose gel. All primers were synthesized by IDT (Coralville, IA, USA). Primer sequences and references are listed in Table 1.

### Multiplex real-time PCR

Amplifications were performed in 25 μL of the Master Mix reaction containing 12.5 μL of 2× high-resolution melt (HRM) PCR Master Mix (Hot-StartTaq Plus DNA polymerase, Type-it HRM PCR buffer, EvaGreen dye, Q-solution, dNTP mix of ultrapure quality and RNase-free water) (Qiagen®, Germany), a sufficient quantity of sterile water, primers and 1 μL of the DNA template. The pairs of primers were optimized to a final concentration of 0.2 μM, except for IMP-F and IMP-R, which were optimized to a final concentration of 1.2 μM. The PCR run was performed using the Rotor-Gene 6000 instrument (Corbett Life Science, Valencia, CA, USA). All the PCR runs were performed using the six positive controls and RNase-free water as a negative control. The real-time PCR conditions were as follows: 95°C for 5 min; 35 cycles of 95°C for 20 s, 55°C for 45 s and 72°C for 30 s; and a melt curve step (from 65°C gradually increasing by 0.1°C/s to 95°C, with fluorescence data acquisition every 1 s). The Rotor-Gene instrument automatically calculated the negative derivative of fluorescence measured at 533 nm and generated melting peaks by plotting with regard to temperature (–dF/dT).

### Data analysis

To analyse the results obtained in this new multiplex real-time PCR assay, each one of the six positive controls was tested in quadruplicate in the same run and in three different runs. The *T<sub>m</sub>* mean, SD and coefficient



**Figure 1.** Results from the real-time multiplex PCR melting curves of the amplicons generated by primers targeting the six carbapenemases types. The gene targets, from left to right, are as follows: *bla*<sub>IMP</sub> type ( $T_m$  80.1°C), *bla*<sub>OXA-48</sub> ( $T_m$  81.6°C), *bla*<sub>NDM-1</sub> ( $T_m$  84°C), *bla*<sub>GES</sub> type ( $T_m$  88.4°C), *bla*<sub>VIM</sub> type ( $T_m$  90.3°C) and *bla*<sub>KPC</sub> type ( $T_m$  91.6°C).

of variation (CV%) were calculated to access the inter- and intra-run reproducibility of the assay.

## Results and discussion

This study was performed using high-resolution melting curve analysis. The same  $T_m$  from each gene was detected when the positive control strains (*bla*<sub>KPC-2</sub>, *bla*<sub>GES-1</sub>, *bla*<sub>OXA-48</sub>, *bla*<sub>IMP-1</sub>, *bla*<sub>VIM-1</sub> and *bla*<sub>NDM-1</sub>) were tested by simplex real-time PCR and by multiplex real-time PCR assay. The  $T_m$  analysis of the amplicons identified was as follows: *bla*<sub>IMP</sub> type ( $T_m$  80.1°C), *bla*<sub>OXA-48</sub> ( $T_m$  81.6°C), *bla*<sub>NDM-1</sub> ( $T_m$  84°C), *bla*<sub>GES</sub> type ( $T_m$  88.6°C), *bla*<sub>VIM</sub> type ( $T_m$  90°C) and *bla*<sub>KPC</sub> type ( $T_m$  91.6°C) (Figure 1).

Among the 58 strains tested, a concordance of 100% was observed when results of multiplex real-time PCR assay were compared with genotypes previously identified by Sanger sequencing. PCR products were also visualized and determined to be of the appropriate size by agarose gel electrophoresis. Results showed sizes compatible with fragments of 82, 177, 188, 382, 594 and 785 bp for *bla*<sub>NDM-1</sub>, *bla*<sub>OXA-48</sub>, *bla*<sub>IMP</sub>-type, *bla*<sub>VIM</sub>-type, *bla*<sub>GES</sub>-type and *bla*<sub>KPC-2</sub>, respectively. No amplification was observed when the 28 non-carbapenemase-producing enterobacterial isolates were tested.

$T_m$  values of genes *bla*<sub>KPC-2</sub>, *bla*<sub>NDM-1</sub> and *bla*<sub>OXA-48</sub> were very similar among runs. However, the  $T_m$  values of *bla*<sub>GES</sub>, *bla*<sub>VIM</sub> and *bla*<sub>IMP</sub> presented minor variations among variants of the same gene, as follow: *bla*<sub>GES-1</sub> ( $T_m$  88.65°C), *bla*<sub>GES-5</sub> ( $T_m$  88.4°C) and *bla*<sub>GES-16</sub> ( $T_m$  88.4°C), *bla*<sub>VIM-1</sub> ( $T_m$  90.35°C) and *bla*<sub>VIM-2</sub> ( $T_m$  90°C), and *bla*<sub>IMP-1</sub> ( $T_m$  80.1°C), *bla*<sub>IMP-13</sub> ( $T_m$  79.0°C), *bla*<sub>IMP-16</sub> ( $T_m$  79.6°C) and *bla*<sub>IMP-18</sub> ( $T_m$  78.4°C). These differences in the  $T_m$  for allelic variants likely were linked to the GC content of the amplicons. Even though our study demonstrated these differences among  $T_m$  of the same gene type, the precision of interpretation of the results and concordance with the previous publication by Mendes et al.<sup>6</sup> were not affected.

The mean  $T_m$ , SD and CV% of the multiplex real-time PCR assay were calculated from results of quadruplicates amplified in three different runs. The  $T_m$ , SD and CV% values for each

positive control of carbapenemase in the three different runs (inter-run) were as follows: KPC-2 (91.73, 0.05 and 0.05%), GES-1 (88.65, 0.12 and 0.14%), IMP-1 (80.34, 0.10 and 0.13%), VIM-1 (90.38, 0.03 and 0.03%), NDM-1 (84.48, 0.05 and 0.06%) and OXA-48 (81.70, 0.08 and 0.09%). The  $T_m$ , SD and CV% values for quadruplicates of each positive control of carbapenemase (intra-run) were: KPC-2 (91.63, 0.12 and 0.13%), GES-1 (88.57, 0.20 and 0.23%), IMP-1 (80.15, 0.14 and 0.17%), VIM-1 (90.30, 0.17 and 0.19%), NDM-1 (84.33, 0.24 and 0.28%) and OXA-48 (81.54, 0.18 and 0.22%). These results show excellent reproducibility of this new assay.

To our knowledge, this is the first report of a multiplex real-time PCR assay, in a single reaction, for the identification of the most common types of serine carbapenemases and metallo- $\beta$ -lactamases (KPC, GES, OXA-48, IMP, VIM and NDM-1) described in Enterobacteriaceae isolates. This assay provides for the rapid, sensitive and specific detection and identification of these important genes of resistance. Considering the demonstrated potential for rapid horizontal and vertical transmission of these genes, the accurate and timely identification of these resistance genes will be an important tool to help infection control measures and guide the appropriate choice of antimicrobial therapy. The entire assay, including DNA extraction, sample preparation, multiplex PCR run and results analysis was performed in 3 h.

## Conclusions

In summary, the multiplex real-time PCR assay developed in this study is a fast (3 h) and reliable assay for rapid screening and identification of the most relevant genes identified in Enterobacteriaceae carbapenemase-positive clinical isolates.

## Acknowledgements

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## Transparency declarations

None to declare.

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## BRIEF REPORT

A PCR-Based Marker to Simply Identify *Saimiri sciureus* and *S. boliviensis boliviensis*MARTIN OSTERHOLZ<sup>1</sup>, JAN VERMEER<sup>2</sup>, LUTZ WALTER<sup>1,3</sup>, AND CHRISTIAN ROOS<sup>1,3\*</sup><sup>1</sup>Primate Genetics, German Primate Center, Goettingen, Germany<sup>2</sup>La Vallée des Singes, Romagne, France<sup>3</sup>Gene Bank of Primates, German Primate Center, Goettingen, Germany

Squirrel monkeys, mainly *Saimiri sciureus* and *S. boliviensis*, are common in zoos and widely used in biomedical research. However, an exact species identification based on morphological characteristics is difficult. Hence, several molecular methods were proposed, but all of them are expensive and require extensive laboratory work. In contrast, we describe an Alu integration, which is present in *S. boliviensis boliviensis* and absent in *S. sciureus*. Among analyzed *S. b. peruviansis* specimens various presence/absence patterns of the integration were detected indicating that this study population might have originated from a natural hybrid zone. Based on the size of the Alu element (~300 bp), the presence/absence pattern of the integration can easily be traced by PCR and followed by agarose gel electrophoresis. *Am. J. Primatol.* 70:1177–1180, 2008. © 2008 Wiley-Liss, Inc.

**Key words:** *Saimiri*; identification; DNA; PCR; Alu

## INTRODUCTION

Squirrel monkeys (genus *Saimiri*) are New World monkeys and belong to the family Cebidae. The genus is distributed, apart from some isolated populations in Costa Rica and Panama, in tropical forests of northern South America to Bolivia and central Brazil [Groves, 2001; Hershkovitz, 1984; Rowe, 1996]. The taxonomic classification of squirrel monkeys changed several times with 1 to 7 species and 7 to 16 subspecies [Costello et al., 1993; Elliot, 1913; Groves 2001; Hershkovitz, 1984; Hill, 1960; Lönnerg, 1940; Rowe, 1996; Thorington 1985; von Pusch 1942]. On the basis of morphological, acoustic, chromosomal, molecular and behavioural differences, most authors agree in distinguishing two different species groups, *S. boliviensis* including *S. vanzolinii*, and *S. sciureus* with *S. ustus* and *S. oerstedii* [Boinski & Cropp, 1998; Boinski & Newman, 1988; Groves, 2001; Hershkovitz, 1984; Moore et al., 1990; Rowe, 1996; Schreiber et al., 1998].

Squirrel monkeys, mainly *S. sciureus* and *S. boliviensis*, are common in zoos and widely used in biomedical research [Mittermeier et al., 1994; Vermeer, 1996]. Accordingly, many breeding colonies exist, and to minimize inbreeding, animals are regularly exchanged among them. However, because the exact origin of founder animals is mainly unknown, the (sub)species identity of such animals is difficult to assess with morphological characteristics [Vermeer, 1996]. As a result, several hybrids

were produced between species or subspecies in recent decades [Schreiber et al., 1998; Vermeer 1996]. Although both *S. sciureus* and *S. boliviensis* are currently classified as only “least concern” [IUCN, 2007], pure breeding is of interest for conservation issues. In biomedical research, pure breed lineages are also important, because species differ in critical biological parameters as e.g. susceptibility to diseases [Lavergne et al., 2003; VandeBerg & Williams-Blangero, 1997; VandeBerg et al., 1990]. However, as an accurate identification of species and hybrids based on external characteristics is difficult, methods not reliant on phenotype (e.g. molecular markers) should be applied. Some molecular tests based on allozyme and microsatellite polymorphisms or sequencing of marker genes have been proposed [Boinski & Cropp, 1998; Cropp & Boinski, 2000; Lavergne et al., 2003; Schreiber et al., 1998; Silva et al., 1993; VandeBerg et al., 1990], but all of them are expensive and time demanding.

Short INTerspersed Elements (SINE) represent a class of retrotransposons integrating via an RNA

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intermediate into the genome [Okada, 1991]. The integration of a SINE at a new locus is irreversible and precise excision is highly unlikely [Shedlock & Okada, 2000; van de Lagemaat et al., 2005]. Orthology can be verified and homoplasmy can be excluded by tracing direct repeats, which flank the integration [Schmitz et al., 2005]. Alu elements are primate-specific SINEs and have been widely propagated in their genomes.

In this study, we tested the presence/absence pattern of an Alu insertion in 93 squirrel monkeys.

## MATERIAL & METHODS

### Database Approach

Bacterial artificial chromosome (BAC) clones from various New World monkey species (*S. b. boliviensis*, *Callithrix jacchus*, *Aotus nancymae*, *Ateles geoffroyi* and *Callicebus moloch*) were obtained from GenBank database. Using BLAT search, orthologous BAC clones were identified and aligned with MAFFT software [Kato et al., 2005]. Subsequently, Alu integrations were identified with RepeatMasker [Jurka et al., 2005]. At least 400 bp sequence information from both sides of the integration site was selected and subjected to BLAT search to find orthologous loci in the genomes of *Homo sapiens*, *Pan troglodytes* and *Macaca mulatta*. Based on this information, conserved oligonucleotide primers were constructed, which bind in the flanking regions of the Alu insertion. In the frame of this study, one AluTa15 integration (*SscSbo*) was detected, which was present in *S. b. boliviensis*, but absent in other platyrrhines.

### Laboratory Methods

To further test the presence/absence pattern of the *SscSbo* integration, blood samples from 93 squirrel monkeys kept in European institutions were collected. The species identity of study specimens was determined by fur coloration and other external characteristics. Samples from phenotypically pure *S. sciureus* were provided by Dresden zoo ( $n = 2$ ), Gettorf zoo ( $n = 5$ ) and Schwerin zoo ( $n = 1$ ), phenotypically pure *S. b. boliviensis* from Mannheim zoo ( $n = 2$ ), Nuremberg zoo ( $n = 3$ ) and Romagne primate park ( $n = 3$ ) and *S. b. peruviansis* from Romagne primate park ( $n = 53$ ). Samples from animals, which were identified phenotypically as hybrids between *S. boliviensis* and *S. sciureus*, were obtained from the German Primate Center ( $n = 14$ ) and from Madrid zoo ( $n = 10$ ). We have adhered to the guidelines for the use of animals in research and the legal requirements of Germany.

DNA from blood samples was extracted using the Qiagen (Hilden, Germany) DNA Mini kit. PCR amplifications were performed with the locus-specific oligonucleotide primers 5'-AGTTCCTCTCTACCTT

GTACC-3' and 5'-GCCCTACTCTTGCATTAATGC-3'. The expected fragment lengths of the PCR product are ~450 and ~750 bp in the case of presence and absence of the AluTa15 integration, respectively (Fig. 1a). PCR conditions were 94°C initial denaturation for 2 min, followed by 40 cycles each with 94°C denaturation for 1 min, 58°C annealing for 1 min and 72°C extension for 1 min. The final extension step at 72°C was performed for 5 min. Results of PCR amplifications were analyzed using a 1% agarose gel. To confirm the orthology of the integration, PCR products from each one individual of *S. sciureus* and *S. b. boliviensis* were sequenced. Therefore, PCR products were excised from the gel and purified with the Wizard (Mannheim, Germany) gel purification kit (Promega). Sequencing reactions were run on an ABI 3100-Avant sequencer using the Big Dye (Foster City, CA) Terminator Cycle Sequencing Kit (Applied Biosystems) and the primers mentioned above. To confirm the orthology of the integration, sequences were edited and manually aligned in BioEdit [Hall, 1999].

## RESULTS

In an alignment including BAC clones from *S. b. boliviensis* (AC188239), *C. jacchus* (AC188222), *A. geoffroyi* (AC188259) and *C. moloch* (AC188270), an AluTa15 [Ray & Batzer 2005] insertion was detected, which is present in *S. b. boliviensis* and absent in the remaining three taxa. To further check the presence and absence of the integration, conserved primers binding in the flanking region of the insertion were constructed and tested in a panel of various New World monkeys. Interestingly, all tested species including *S. sciureus* showed an absence of the Alu insertion at that locus. Consequently, further squirrel monkey individuals were examined to test whether the integration is specific for *S. boliviensis*. Among the 93 squirrel monkeys examined, in 39 individuals the integration is present (+/+), whereas in 18 the integration is absent (-/-). In another 36 individuals, a heterozygous pattern (+/-) was detected, indicating that both alleles are present (Fig. 1a). All studied specimens that were phenotypically identified as *S. sciureus* showed a homozygous absence of the integration, whereas phenotypically *S. b. boliviensis* showed a homozygous presence of the insertion. The specimens identified as *S. b. peruviansis* showed an insertion pattern with all possible combinations ( $n = 26: +/-, n = 25: +/+, n = 2: -/-$ ). Similar results were obtained for 24 individuals, which were identified phenotypically as hybrids ( $n = 10: +/-, n = 5: +/+, n = 9: -/-$ ).

## DISCUSSION

The results of this study indicate that the analyzed Alu insertion is specific for *S. b. boliviensis*,

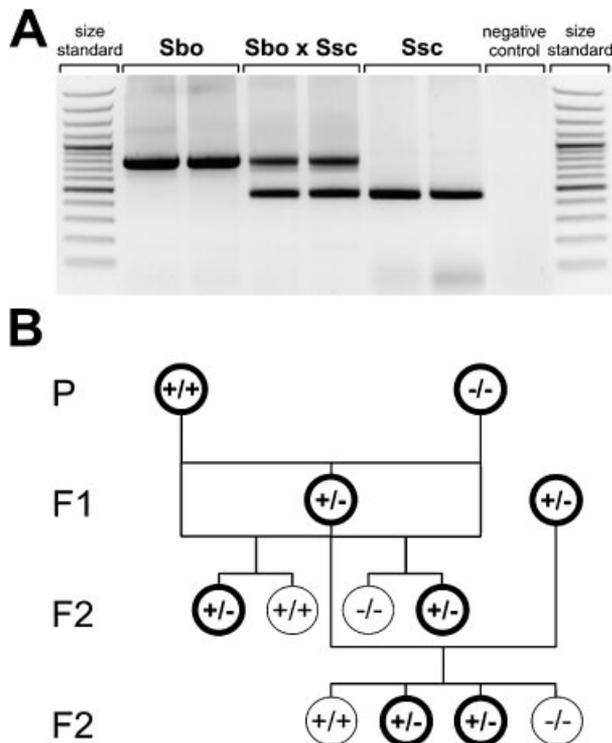


Fig. 1. (A) Presence/absence analysis of the Alu integration as revealed by agarose gel electrophoresis. Pure *S. boliviensis* (Sbo) and *S. sciureus* (Ssc) show PCR product sizes of ~750 and ~450 bp, respectively. Hybrids (Sbo × Ssc) possess both alleles. (B) Inheritance scheme of alleles with (+) and without (-) Alu integration. F1 hybrids between pure *S. sciureus* (-/-) and *S. boliviensis* (+/+) show a heterozygous (+/-) pattern, whereas in the F2 generation heterozygous (+/-) as well as homozygous (+/+; -/-) individuals are possible. Accordingly, the latter are falsely classified as pure breed animals (indicated by thin lines).

and hence, can be used to distinguish *S. b. boliviensis* from *S. sciureus*. However, contradicting results were obtained for *S. b. peruviansis*, because we found homozygous positive, homozygous negative and heterozygous insertion patterns. It is possible that our study specimens of *S. b. peruviansis* originated from a natural hybrid zone between *S. sciureus* and *S. b. peruviansis*, which has been reported from the margins of the Ucayali river in the Peruvian Amazonia [Silva et al., 1992]. Moreover it cannot be excluded that *S. b. peruviansis* is the result of ancestral hybridization at all, as indicated by the fact that they are phenotypically intermediate between *S. sciureus* and *S. b. boliviensis*, showing male head coloration as in the former and female head coloration as in the latter. However, recent molecular studies indicate a close affiliation of *S. b. peruviansis* and *S. b. boliviensis* [Boinski & Cropp 1998; Cropp & Boinski 2000]. Therefore, and owing to the partial presence of the integration it seems likely that *S. b. peruviansis* from outside the hybrid zone may be homozygous positive.

Among the 24 phenotypically identified hybrids, 10 individuals showed a heterozygous pattern

indicating indeed that these animals are hybrids between *S. b. boliviensis* and *S. sciureus*. The other 14 animals show either homozygous presence or absence of the integration. With the herein presented marker, all F1 hybrids can be clearly defined, whereas in F2 hybrids only 50%, those with heterozygous pattern, are traceable. F2 hybrids with either homozygous presence or absence patterns would be falsely classified as either pure *S. b. boliviensis* or *S. sciureus* (Fig. 1b).

Although with some drawbacks, we identified a potential molecular cladistic marker to distinguish between *S. sciureus* and *S. b. boliviensis*. The advantage of this marker is that the size of PCR products with and without integration differs by ~300 bp, so that only agarose and no acrylamide gels or sequencing analyses are necessary. Accordingly, results can easily be determined and laboratory costs are relative low. However, as no other species than *S. boliviensis* and *S. sciureus* were analyzed, it remains open which presence/absence pattern the other species will show. Another drawback of the marker is that only F1 hybrids and not those in further generations are traceable with significance. This can be overcome if more such markers will become available. Nevertheless, the presented marker provides a useful tool to easily distinguish pure breed *S. sciureus* and *S. b. boliviensis*, which may help to improve captive breeding management.

## ACKNOWLEDGMENTS

We thank the staff of the zoos in Dresden, Gettorf, Madrid, Mannheim, Nuremberg, Romagne, Schwerin and the German Primate Center for providing samples of squirrel monkeys. We have adhered to the guidelines for the use of animals in research and the legal requirements of Germany.

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# Lactate dehydrogenase genes of caiman and Chinese soft-shelled turtle, with emphasis on the molecular phylogenetics and evolution of reptiles

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## Abstract

L-Lactate dehydrogenase (LDH) cDNAs encoding for LDH-A<sub>4</sub> (muscle) and LDH-B<sub>4</sub> (heart) isozymes from caiman (*Caiman crocodilus apaporiensis*) belonging to the order Crocodylia and Chinese soft-shelled turtle (*Pelodiscus sinensis*) belonging to the order Chelonia were sequenced. The phylogenetic relationships of the newly determined cDNA and their deduced protein sequences, as well as the previously published sequences of vertebrate LDH isozymes, were analyzed by various phylogenetic tree construction methods. These results indicated that Chelonia is indeed more closely related to Crocodylia. The divergent times between caiman and alligator, turtle and soft-shelled turtle, and Chelonia and Crocodylia were estimated to be approximately 36, 100 and 177 million years, respectively. © 2001 Elsevier Science B.V. All rights reserved.

**Keywords:** Lactate dehydrogenase; Isozymes; cDNA sequence; Phylogenetic tree

## 1. Introduction

L-Lactate dehydrogenase (LDH, EC1.1.1.27) is a ‘house-keeping’ enzyme in the glycolysis. The LDH isozyme system is one of the most popular models used to elucidate the phylogenetic relationships among clades, since LDH isozymes are known to be very stable and also slow-evolving genes (Holmes, 1972; Markert et al., 1975). In higher vertebrates, there are three isozymes of LDH: the M form (LDH-A) found predominantly in muscle tissues; the H form (LDH-B) found in heart muscle and the X form (LDH-C) found only in the testes and spermatozoa of mammals and pigeons (Li, 1990). The position of turtles (order Chelonia) in the reptile phylogenetic tree has always been a controversial issue. Traditionally the turtle has been placed among Anapsida (the absence of a temporal opening) according to morphology and paleontology. On the basis of molecular systematics the turtle has recently been placed

among Diapsida (the presence of two temporal openings) and Chelonia (turtles) are surprisingly more closely related to the order Crocodylia (including the families Alligatoridae, Crocodylidae and Gavialidae). In addition, turtles had branched off after the divergence of squamates and birds (Mannen et al., 1997; Mannen and Li, 1999; Hedges, 1999). The main objective of this study is to further confirm the phylogenetic relationships among turtles, Chinese soft-shelled turtles, caimans, alligators, lizards and birds. The results provide strong evidence that turtles are the latest diverged group in reptiles, and not basal reptiles as previously thought.

## 2. Materials and methods

### 2.1. Specimen collection

Various tissues (heart, muscle, liver, kidney, lung, spleen and testis) of *Caiman crocodiles apaporiensis* (caiman) and *Pleodiscus sinensis* (Chinese soft-shelled turtle) were collected from a local supplier in Kaohsiung, Taiwan. The tissues were treated with liquid nitrogen immediately after dissection and then stored at  $-70^{\circ}\text{C}$ .

Abbreviations: LDH, lactate dehydrogenase; ME, minimum evolution; ML, maximum likelihood; MP, maximum parsimony; Myr, million years; NJ, neighbor-joining; UTR, untranslated region(s)

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<sup>1</sup> These two authors contributed equally to this study.

## 2.2. Electrophoretic analysis of LDH isozymes

The heart, muscle, liver, kidney, lung, spleen and testis from caiman and the heart, muscle, liver and testis from Chinese soft-shelled turtle were used for LDH isozyme analysis. Tissues were homogenized separately in 2 volumes of chilled Tris buffer (0.1 mM Tris-HCl (pH 7.0), with 1 mM EDTA and 0.05 mM NADP). The homogenates were centrifuged at 14,000 rev./min for 30 min at 4°C. Supernatants were collected and stored at -70°C until electrophoresis. Horizontal starch gel electrophoresis was performed at 4°C for 5–6 h in a 10% gel with a Tris-citrate II buffer system (pH 8.0) (Selander et al., 1971) at 14 V/cm. After electrophoresis, gels were sliced and stained according to Shaklee et al. (1973).

## 2.3. RNA isolation and cDNA synthesis

Total RNAs were extracted using Rezol™ C&T Reagent (Protech Technologies), and poly(A)-containing RNAs were isolated with the Straight A's™ mRNA Isolation System (Novagen). The caiman and Chinese soft-shelled turtle cDNAs from heart, muscle and liver were synthesized according to the instruction manual of the cDNA synthesis kit (Stratagene).

## 2.4. PCR amplification and cDNA subcloning

Various sets of PCR primers were synthesized based on the conserved regions of LDH-A (VGVGAVGM at residues 26–33 and EVIKLKG Y at residues 240–247) and LDH-B (EDKCLKGEM at residues 55–62 and VVDSAYEV at residues 234–240) among vertebrates. The amplification of the various fragments was achieved by using the PCR system of Promega and the following program: 2 min at 94°C, 30 cycles at 50–58°C, respectively, and 5 min at 72°C. PCR products with more than one band were separately isolated by subcloning according to pGEM-T Easy Vector systems (Promega). 5'-UTR and 3'-UTR were amplified followed the 5'-RACE and 3'-RACE system (GIBCO BRL).

## 2.5. Phylogenetic tree reconstruction

The LDH-A and LDH-B cDNAs sequences from caiman and Chinese soft-shelled turtle were determined in this investigation. The scientific names of the organisms and the GenBank Accession numbers for the published LDH cDNA sequences are as follows: human, *Homo sapiens*, A(X02152), B(Y00711); mouse, *Mus musculus*, A(U19687), B(X51905); rat, *Rattus norvegicus*, A(X01964), B(U07181); lizard, *Sceloporus woodi*, A(U28410), B(U28411); pigeon, *Columbia livia*, A(L76362), B(L79957); turtle, *Trachemys scripta elegans*, A(L79953), B(L79954); alligator, *Alligator mississippiensis*, A(L79951), B(L79952). The tandem aligned data set of LDH-A and LDH-B cDNA coding regions without the first 60 nucleotides of a highly variable region from caiman and

Chinese soft-shelled turtle, as well as the previously published LDH sequences of vertebrates, were aligned by two different computer programs, BioEdit (Hall, 1999) and DAMBE (Xia, 2000). The phylogenetic tree was constructed with neighbor-joining (NJ) (Saitou and Nei, 1987), minimum evolution (ME) (Rzhetsky and Nei, 1993), maximum parsimony (MP) (Fitch, 1977) and maximum likelihood (ML) (Kishino et al., 1990) using Kimura two-parameter distances from the Mega2 package with 1000 bootstrap replications (Kumar et al., 2000). The indels were all excluded from the analyses.

## 2.6. Estimating divergence time

The divergence times among reptiles were estimated according to the average distance method (Kumar and Hedges, 1998) by using the tandem aligned data set of LDH-A and LDH-B protein sequence without the first 20 amino acids of a highly variable region. The divergence of diapsids and synapsids provides a calibration point to anchor molecular clocks at 310 Myr ago ( $T$ ) (Benton, 1993, 1997; Kumar and Hedges, 1998). The unknown divergence times ( $t$ ) between  $A_1$  and  $A_2$  groups were estimated by  $t = d_{12}/(2r)$ , where  $d_{ij}$  is the number of substitutions per site between protein sequences  $i$  and  $j$ .  $r = (d_{1B} + d_{2B})/(4T)$  is the rate of change for lineage A (including caiman, alligator, Chinese soft-shelled turtle, turtle, pigeon, and lizard) and lineage B (including mouse, rat and human).

## 3. Results and discussion

### 3.1. Electrophoretic patterns of LDH-A and LDH-B Isozymes

Electrophoretic patterns of *Caiman crocodilus apaporicensis* LDH-A and LDH-B isozymes were analyzed from various tissues, including heart, muscle, liver, kidney, lung, spleen and testis (data not shown). The isozyme patterns appear to have four bands corresponding to  $A_4$ ,  $A_3B_1$ ,  $A_2B_2$  and  $B_4$  multiplex with  $A_1B_3$  missing. The four-isozyme pattern was previously reported in the *Crotalus viridis* (Murphy and Crabtree, 1985). The most probable reason for the four-isozyme pattern could be due to the unstable  $A_1B_3$  heterotetramer. The electrophoretic patterns of *Pleodiscus sinensis* LDH-A and LDH-B isozymes were also analyzed from four tissues including heart, muscle, liver and testis. The patterns of five isozyme bands from each tissue corresponding to  $A_4$ ,  $A_3B_1$ ,  $A_2B_2$ ,  $A_1B_3$  and  $B_4$  multiplex were observed as expected (Markert, 1963).

### 3.2. Sequence analysis of caiman LDH-A and LDH-B cDNAs

The cDNA sequences encoding for caiman LDH-A and LDH-B isozymes from heart, muscle and liver were determined. The newly determined cDNA sequences of both



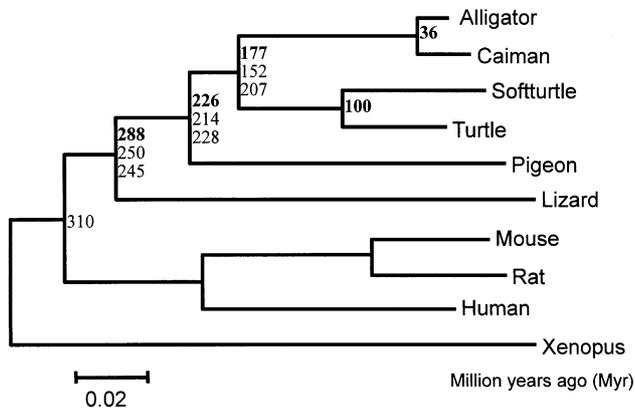


Fig. 2. The divergent time among amniotes. The earliest ancestors of mammals and birds are lizard-like and first appear in the Carboniferous period at ~310 Myr ago. A tandem sequence of LDH-A and LDH-B regions without the first 20 amino acids was used to estimate the divergent time by applying the average distance method,  $t = d_{12}/(2r)$ , where  $r = 0.00031848$  is the rate of change of lineage of rats and turtles. (Top) The estimated values in this investigation; (middle) Mannen and Li (1999); (bottom) Hedges and Poling (1999).

after divergence of squamates (lizards and snakes) and birds (Mannen et al., 1997; Mannen and Li, 1999; Hedges, 1999).

### 3.5. Divergence times among reptiles

The divergence times among reptiles were estimated by using a tandem aligned amino acid sequence set of LDH-A and LDH-B without the first 20 amino acids of a highly variable region. The total length of the tandem alignments is 627 and the number of variable sites is 159 among tetrapods. The 310 Myr calibration point between mammals (synapsids) and birds (diapsids) was used, and the estimated divergence time for the caiman–alligator split is 36 Myr ago, 100 Myr ago for the turtle–Chinese soft-shelled turtle split and 177 Myr ago for the caiman–alligator clade and turtle–Chinese soft-shelled turtle clade split (Fig. 2). The divergence time between the caiman–alligator clade and the turtle–Chinese soft-shelled turtle clade is consistent with the previous estimates of 152 Myr (Mannen and Li, 1999) and 207 Myr (Hedges and Poling, 1999).

### 3.6. Conclusions

1. The nucleotide sequences of caiman and Chinese soft-shelled turtle LDH-A and LDH-B cDNAs were determined.
2. The deduced protein sequence for caiman LDH-A (332 amino acids) and LDH-B (333 amino acids) shows 98 and 96% identities with those of *Alligator mississippiensis*, respectively.
3. The deduced protein sequence for Chinese soft-shelled turtle LDH-A (332 amino acids) and LDH-B (333 amino acids) shows 97 and 96% identities with those of the turtle, *Trachemys scripta*, respectively.

4. Chelonia (turtle and Chinese soft-shelled turtle) was shown to cluster with Crocodylia (alligator and caiman) with high robust bootstrap values (above 90%). This result strongly confirms (a) the previously reported Chelonia–Crocodylia relationships, (b) the phylogenetic position of the turtles among Diapsida (the presence of two temporal openings), and (c) that the turtle evolved after divergence of squamates and birds.
5. The divergent times between caiman and alligator, turtle and soft-shelled turtle, and Chelonia and Crocodylia are estimated to be approximately 36, 100 and 177 Myr, respectively.

### Acknowledgements

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# Examples of Teaching Effectiveness

BI 306  
Genetics

## BI 306 Genetics

Spring 2016

Dr. Tina Hubler      336 SETB  
256-765-4761      [trhubler@una.edu](mailto:trhubler@una.edu)

- Office hours:      M 11:30 -1:30      T 11:00 -2:00      W 11:30 -1:30  
Other times by appointment      Research lab 345
- Text:      Essentials of Genetics, 8<sup>th</sup> edition, William S. Klug *et al.*  
Students are responsible for reading textbook chapters corresponding to class lectures.
- Lab Manual:      None; materials will be provided in class.
- Course Objective:      This course is a study of the science of heredity. It includes molecular genetics and the mechanisms by which genetic information is expressed, transmission (or classical) genetics and the mechanisms of inheritance, and applications of genetics as a tool to study heredity, evolution, and human disease. The overall goal is to develop an understanding of the underlying role of gene activity in all life processes, from cell structure and function to reproduction. The laboratory exercises will provide reinforcement to key concepts we discuss in lecture and will introduce data interpretation as it applies to DNA technology.
- Classroom participation:      It is expected that mature students participate in class by managing themselves so that other students have the maximum opportunity to learn. Distractive behavior (e.g. repeated tardiness, private conversations during class, electronic devices out during class) will result in loss of class participation points. All electronic devices are to be turned off and kept out of sight in the classroom.
- Attendance:      Regular class attendance improves students' course grades. Attendance will be taken (beginning of class). Excused absences require documentation e.g. physician note for illness; notice of required scheduled university-sponsored event; notice of death in family. Missed assignments, quizzes or tests as a result of unexcused absences result in a grade of zero ("0").
- Tardy students will miss announcements and are not permitted to come into class and disrupt others for information during class.  
**The student is responsible for all announcements, assignments, material discussed and missed work if absent or tardy.**
- Makeup exams or labs:      Make-up exams will only be given if the student contacts me by phone or directly (not email) BEFORE the exam and the absence is EXCUSED. The make-up exam may be a different exam and will be offered at the instructor's convenience. No make-up labs, however the student is responsible for material discussed and taking the lab quiz as scheduled. For excused absences only, assignments may be submitted on the next day and make-up quizzes must be completed within 1 week.

Grading:	4 tests (100 points each)	total approx. 400pts
	Lab participation (5 pts each; first lab 10 pts)	total approx.. 75 pts
	Lab quizzes (20 pts each)	total approx. 300 pts
	Final lab exam	100 points
	Class participation (lecture)	10 pts

Lab participation: includes cleaning up and submission of a lab summary, if assigned. Lab summary will be submitted in lecture on the Monday following lab. If student has excused absence on the Monday of lab summary submission, lab summary should be delivered to my office before Tuesday at noon. No late labs accepted without excused absence.

Lab quizzes: covers handouts, techniques, and data interpretation. The lowest lab quiz grade will be dropped, EXCLUDING lab quizzes pCI-neo and pGLO, that are used for department assessment purposes.

Final lab exam: given in lecture class the week before final exams; covers all lab techniques and data interpretation

Class participation includes items listed above in syllabus.

No extra credit will be offered.

Grading scale: Based on the per cent of total possible points  
 A = 90-100 B = 80-89 C = 70-79 D = 60-69 F = 59 or less  
 Any incident involving plagiarism or dishonesty results in a grade of "0".

Lecture Schedule – Spring 2016

**NOTE: This is a tentative schedule for tests !  
Dates for tests to be announced in class !**

In detail:

- Chpt 1 Genetics: an introduction (out of class assignment)
- Chpt 9 DNA structure and analysis
- Chpt 11 Chromosome structure and DNA sequence organization
- Chpt 10 DNA replication
- Chpt 12 The genetic code and transcription

**Test # 1**

In detail:

- Chpt 13 Translation and proteins
- Selected topics in:
  - Chpt 14 Gene mutation, transposition and DNA repair

In detail:

- Chpt 15 Regulation of Gene Expression
- Chpt 16 Cancer and regulation of the cell cycle

**Test # 2**

In detail:

- Chpt 2 Mitosis and meiosis (out of class assignment)
- Chpt 3 Mendelian Genetics
- Chpt 4 Modifications of Mendelian Ratios  
Genetics problems

**Test # 3**

Selected topics in:

- Chpt 17 Recombinant DNA technology and gene cloning
- Chpt 19 Applications and ethics of genetic engineering and biotechnology
- Chpt 23 Molecular Evolution

If time allows:

- Chpt 20 Development

**Test # 4(Final Exam)**

**Academic Honesty:** Students of the university academic community are expected to adhere to commonly accepted standards of academic honesty. Allegations of academic dishonesty can reflect poorly on the scholarly reputation of the University including students, faculty and graduates. Individuals who elect to commit acts of academic dishonesty such as cheating, plagiarism, or misrepresentation will be subject to appropriate disciplinary action in accordance with university policy.

Incidents of possible student academic dishonesty will be addressed in accordance with the following guidelines:

1. The instructor is responsible for investigating and documenting any incident of alleged academic dishonesty that occurs under the instructor's purview.
2. If the instructor finds the allegation of academic dishonesty to have merit, then the instructor, after a documented conference with the student, will develop a plan for disciplinary action. If the student agrees to this plan, then both instructor and student will sign the agreement. The faculty member will forward a copy of the signed agreement to the Office of Student Conduct for record-keeping purposes.
3. If the student disagrees with the instructor's proposed plan for disciplinary action and wishes to take further action, he/she is responsible for scheduling a meeting with the chair of the department where the course is housed to appeal the proposed disciplinary plan. The department chair shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the departmental level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the dean of the college where the course is housed to appeal the proposed disciplinary plan. The college dean shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the college level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the Vice President for Academic Affairs and Provost (VPAA/P) to appeal the proposed disciplinary plan. The VPAA/P shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. After reviewing all documentation, the VPAA/P may, at his/her discretion, choose either to affirm the proposed action, to refer the case to the Office of Student Conduct for further review, or to dismiss the matter depending on the merits of the case. The final disposition of the case will be disseminated to appropriate parties, including the Office of Student Conduct.
4. If a student is allowed academic progression but demonstrates a repeated pattern of academic dishonesty, the VPAA/P may, after consultation with the Office of Student Conduct, assign additional penalties to the student, including removal from the University.

#### **Communication:**

The official method of communication at UNA is UNA portal, with emphasis placed on University email.

#### **Disability Accommodations:**

In accordance with the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973, the University offers reasonable accommodations to students with eligible documented learning, physical and/or psychological disabilities. Under Title II of the Americans with Disabilities Act (ADA) of 1990, Section 504 of the Rehabilitation Act of 1973, and the Americans with Disabilities Amendment Act of 2008, a disability is defined as a physical or mental impairment that substantially limits one or more major life activities as compared to an average person in the population. It is the responsibility of the student to contact Disability Support Services to initiate the process to develop an accommodation plan. This accommodation plan will not be applied retroactively. Appropriate, reasonable accommodations will be made to allow each student to meet course requirements, but no fundamental or substantial alteration of academic standards will be made. Students needing assistance should contact Disability Support Services (256-765-4214).

#### **Title IX:**

The University of North Alabama has an expectation of mutual respect. Students, staff, administrators, and faculty are entitled to a working environment and educational environment free of discriminatory harassment. This includes sexual violence, sexual harassment, domestic and intimate partner violence, stalking, gender-based discrimination, discrimination against pregnant and parenting students, and gender-based bullying and hazing.

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# BI 306 recorded lectures on Canvas



☰ exam2

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☰ 📎 chpt 13 translation and proteins 2015.pptx

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☰ 📎 hydrophobic bob and pipette.JPG

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☰ 📎 Genetics Chpt 13 Outline.doc

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☰ 📎 chpt 13 review questions.doc

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☰ 📎 [Chpt13 Part1 Video](#) ↗

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☰ 📎 [Chpt13 Part2 Video](#) ↗

## Structures you need to know

Nucleic Acids:

Ribose

Deoxyribose

Adenine

Thymine

Guanine

Cytosine

Uracil

Phosphodiester bond

DNA ATCG – 1 rung

Protein:

generic amino acid

peptide bond

codon

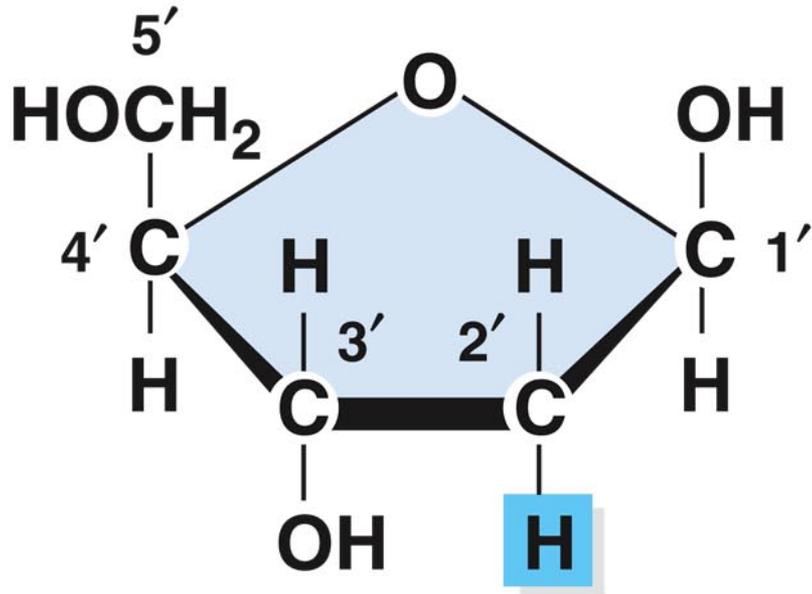
anticodon

tRNA

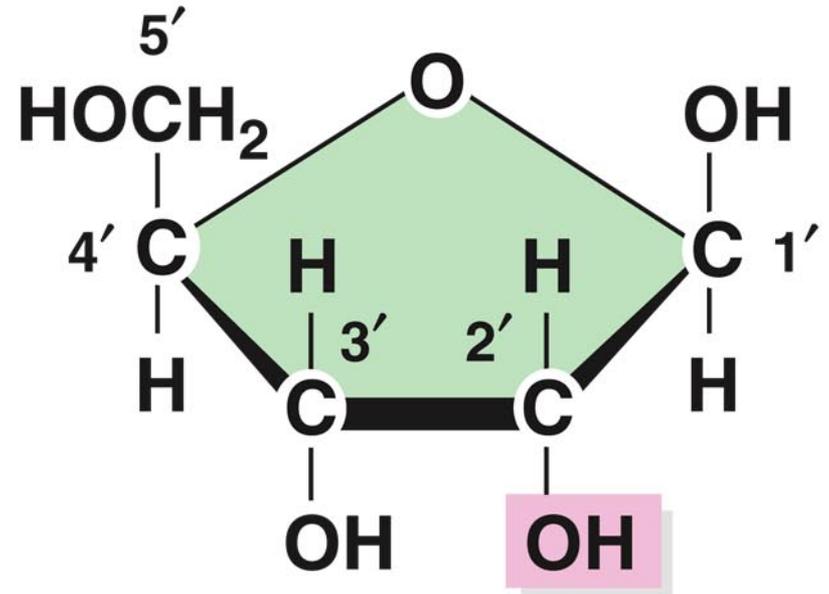
mRNA



# BI 306 Chemical Structures

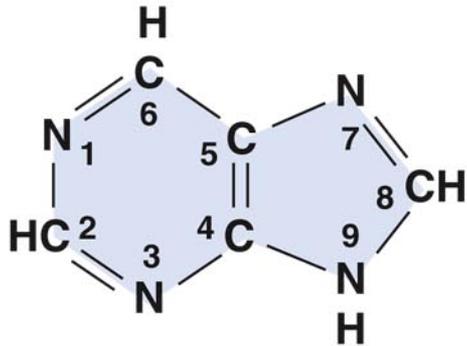


**Deoxyribose**

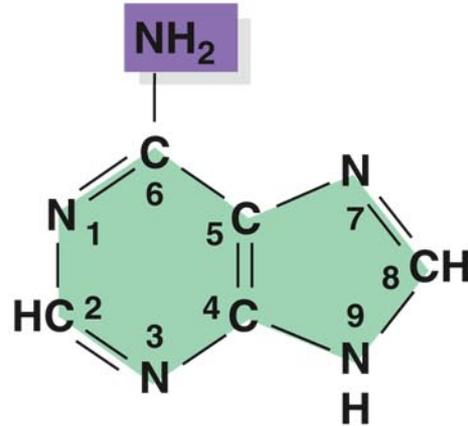


**Ribose**

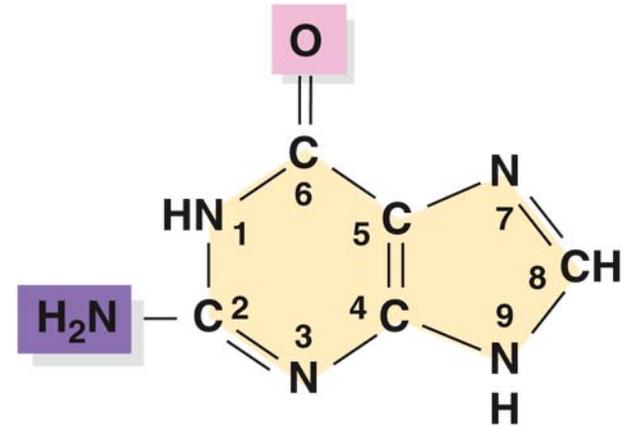
# BI 306 Chemical Structures



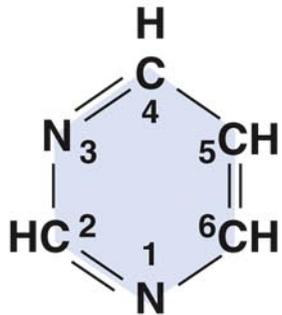
**Purine**  
(parent compound)



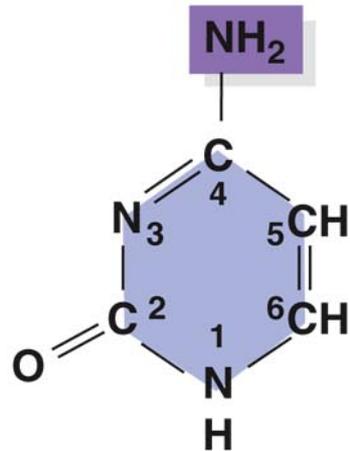
**Adenine (A)**



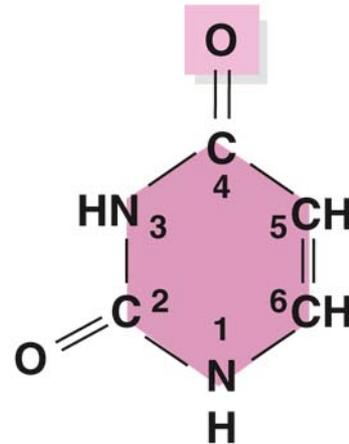
**Guanine (G)**



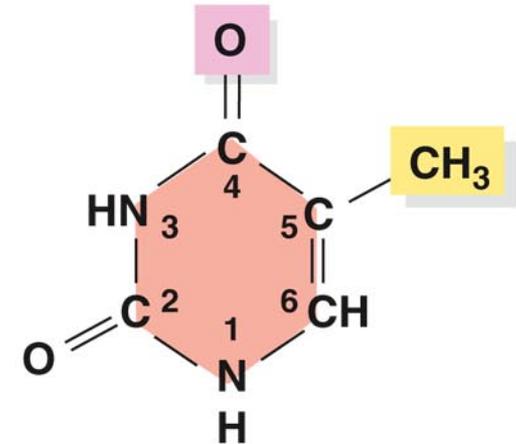
**Pyrimidine**  
(parent compound)



**Cytosine (C)**



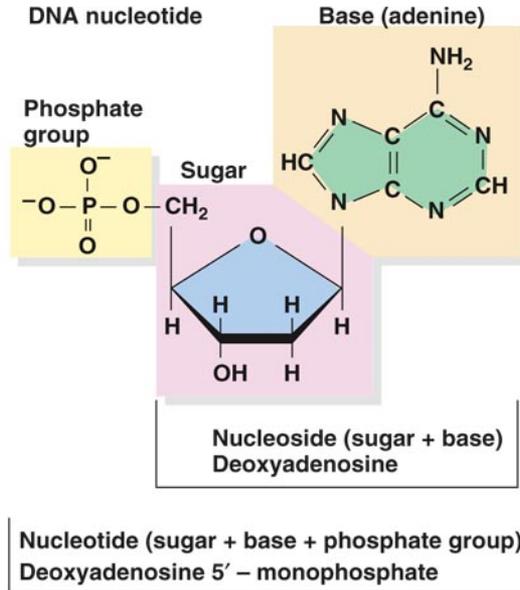
**Uracil (U)**  
(found in RNA)



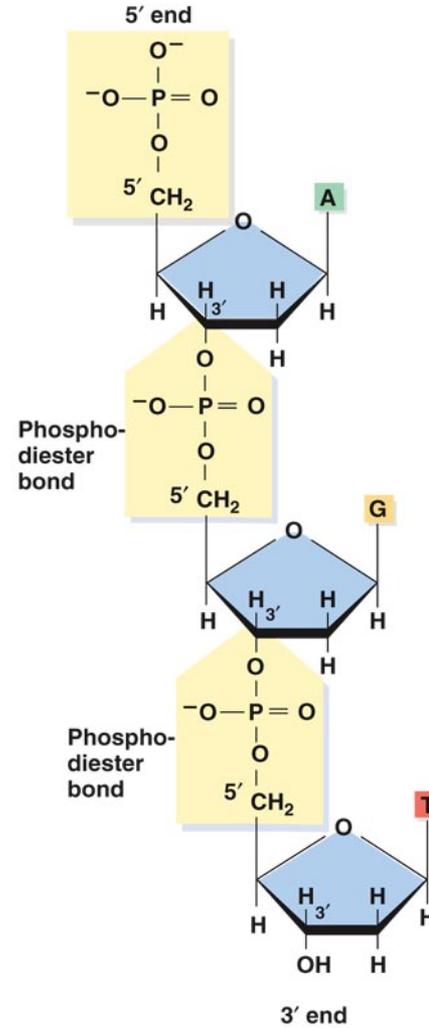
**Thymine (T)**  
(found in DNA)

# BI 306 Chemical structures

## a) DNA and RNA nucleotides

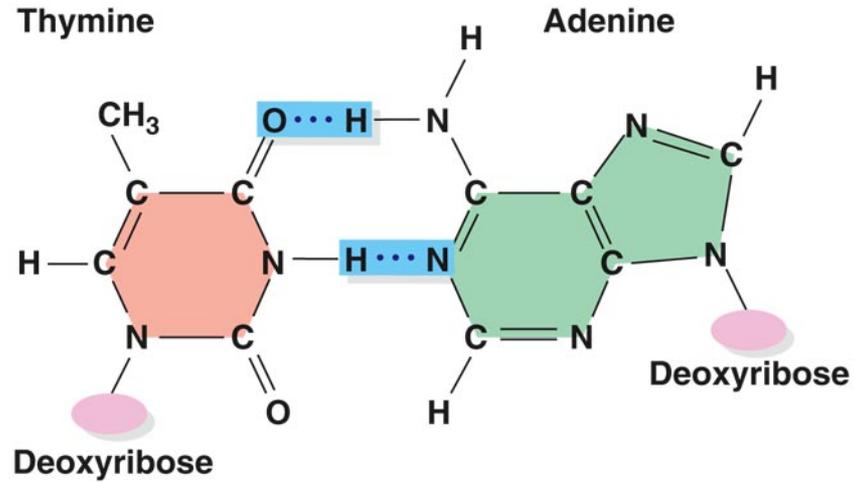


## b) DNA polynucleotide chain

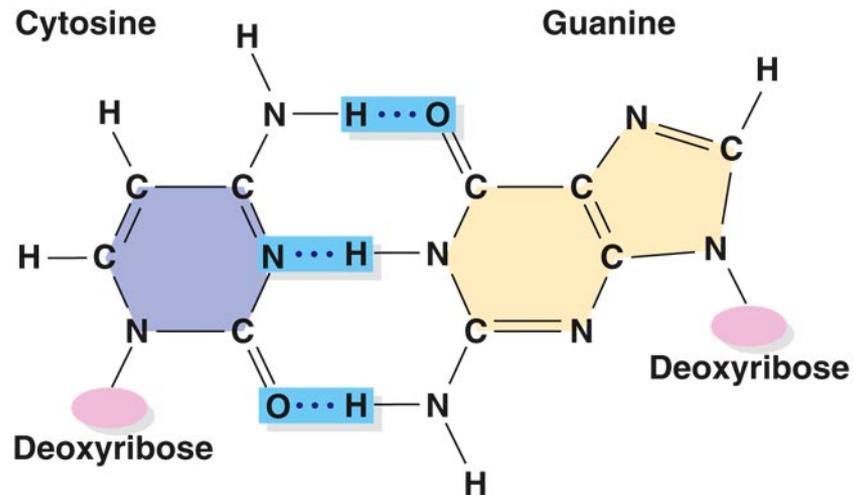


# BI 306 Chemical structures

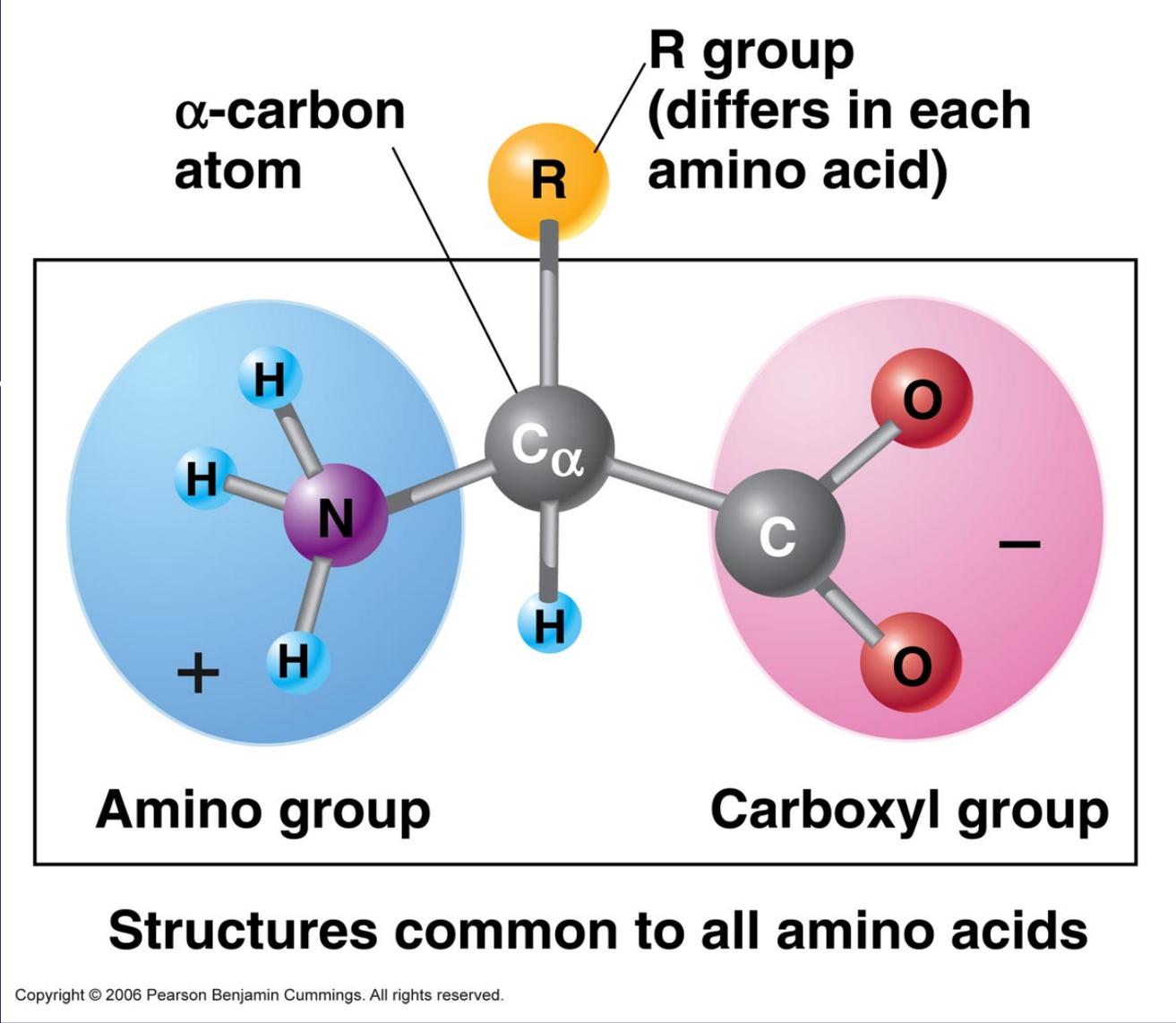
## a) Adenine–thymine base (Double hydrogen bond)



## b) Guanine–cytosine base (Triple hydrogen bond)



# Structural and functional properties of proteins

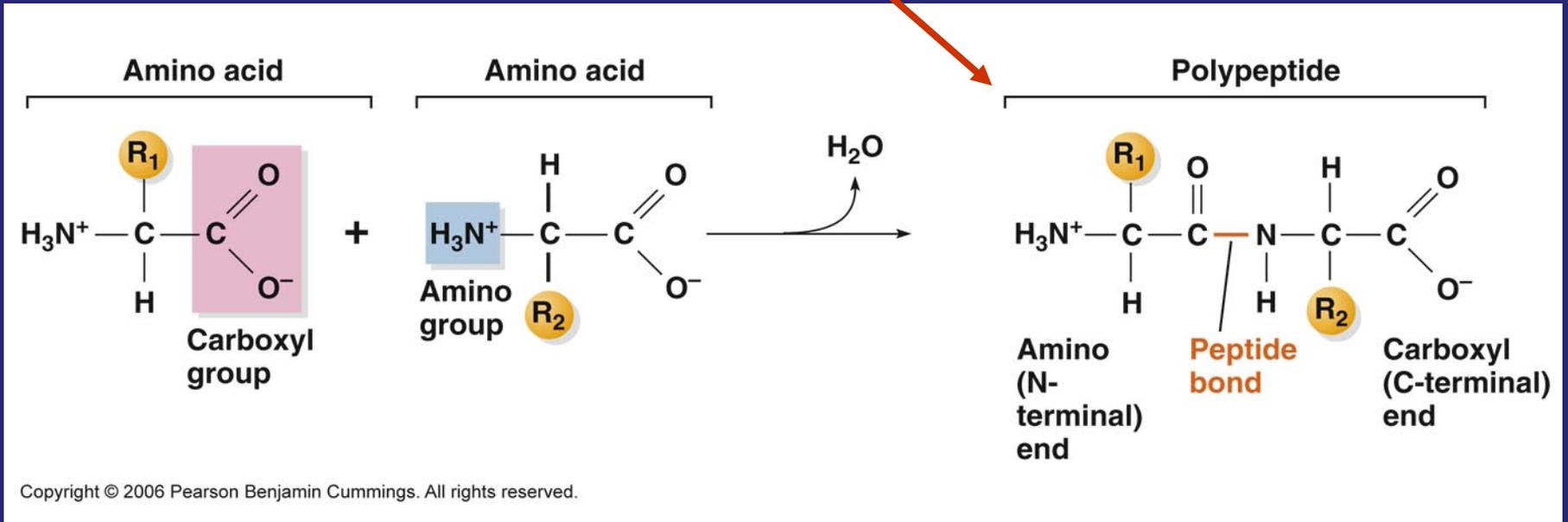


At cellular pH, is (+)  
pH 7.4

At cellular pH, is (-)

# Peptide bond formation: the dehydration (condensation) reaction

N-terminus = beginning of peptide

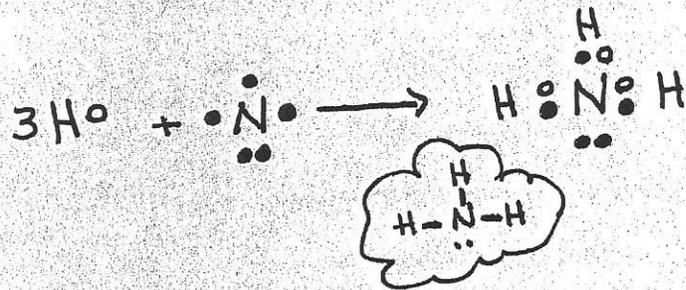
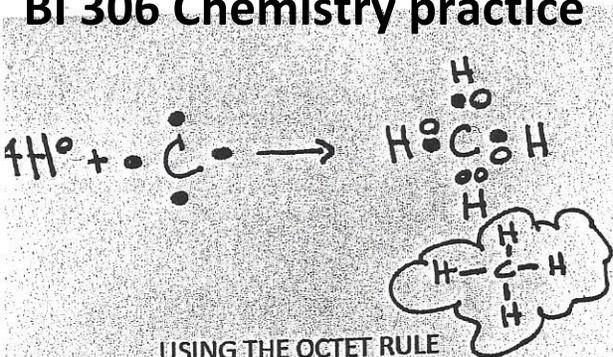


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At cellular pH 7.4 (+) (-)

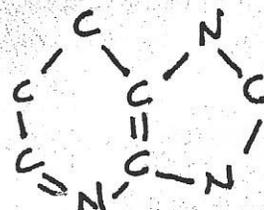
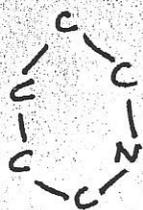
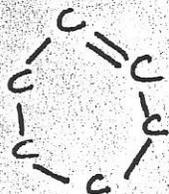
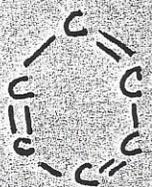
R groups determine overall charge of polypeptide

# BI 306 Chemistry practice

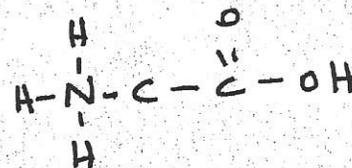
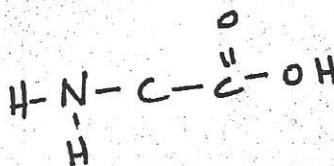
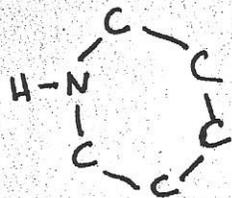
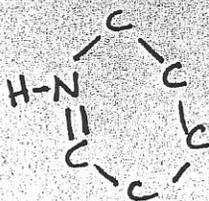


USING THE OCTET RULE

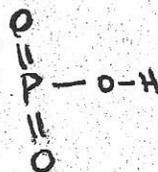
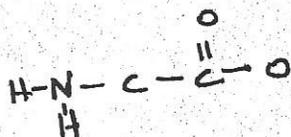
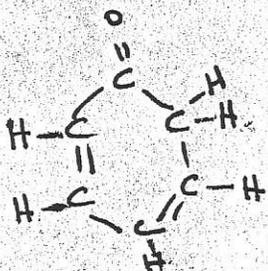
For the following molecules, add H atoms where needed to obey the octet rule.



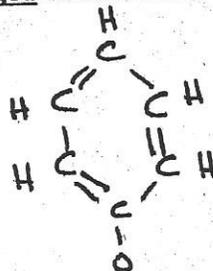
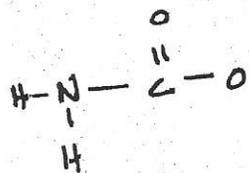
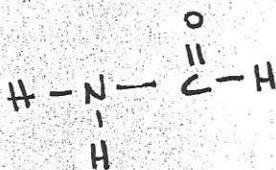
For the following molecules, determine the charge on the N atom.



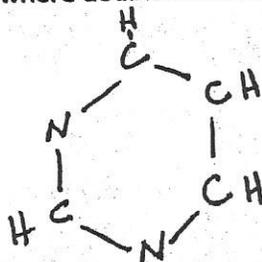
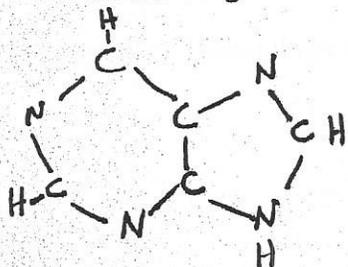
For the following molecules, determine the charge on the O atom.



For the following molecules, determine if the uncharged O atom needs a H atom.



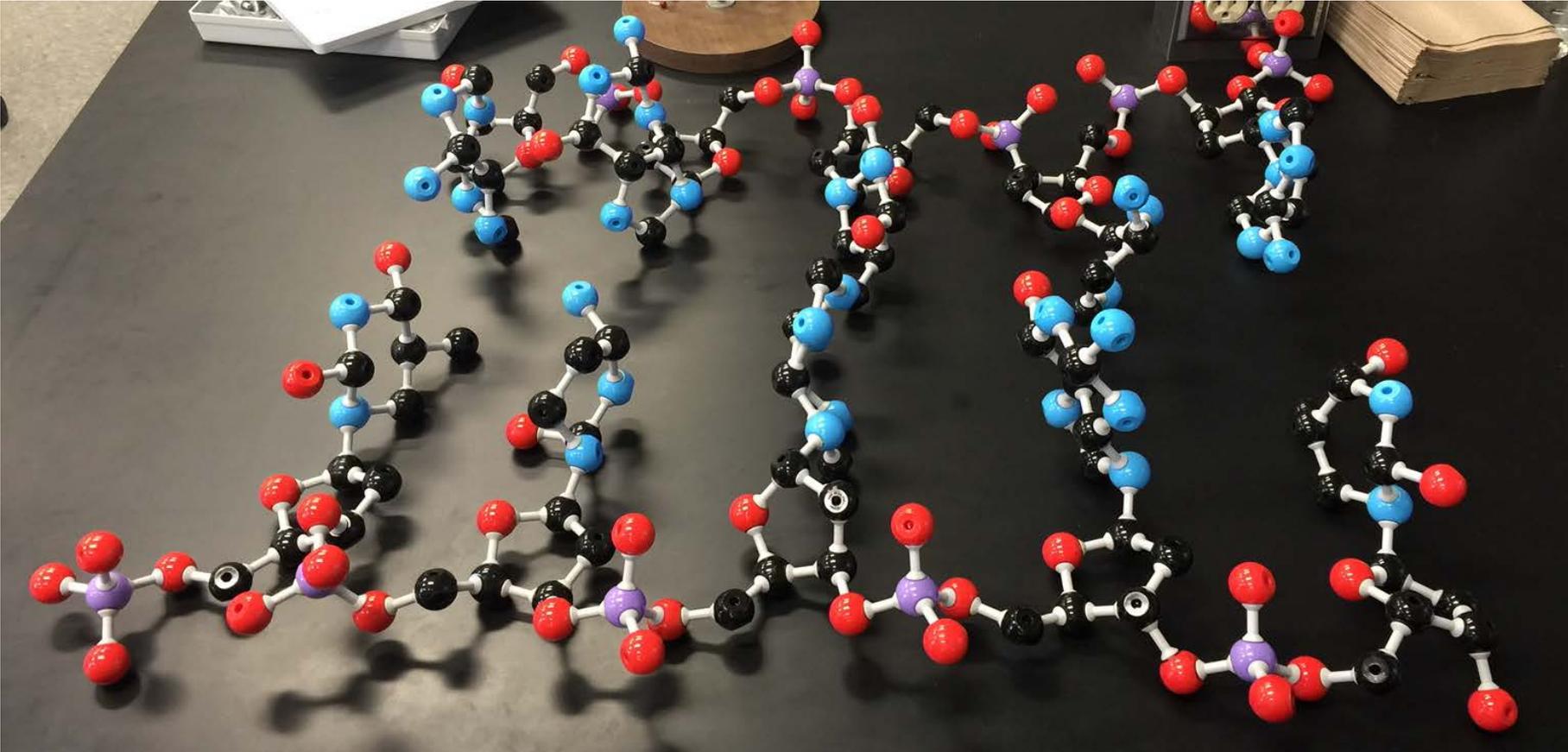
For the following molecules, determine where double bonds are needed without adding any H atoms.



# BI 306 Modeling DNA structure

3' OH

5' PO4



5' PO4

3' OH

# BI 306 Modeling DNA Replication

Leading strand !!

 ligase works here

Lagging strand ::

 Pol III works here

RNA primer 

 Pol I works here

RNA primer 

 direction of fork

RNA primer 

 5' end of parental DNA

5' end of Okazaki 

 3' end of parental DNA

3' end of Okazaki 

 helicase works here



## Molecule Quiz for Exam 2 (20 pts)

1. 13 pts Draw and label the spatial and polarity (5' and 3' ends) relationships among the following translational components:

Draw ribosome (small and large subunits)

Draw growing polypeptide chain

(Label N-terminal and C-terminal ends)

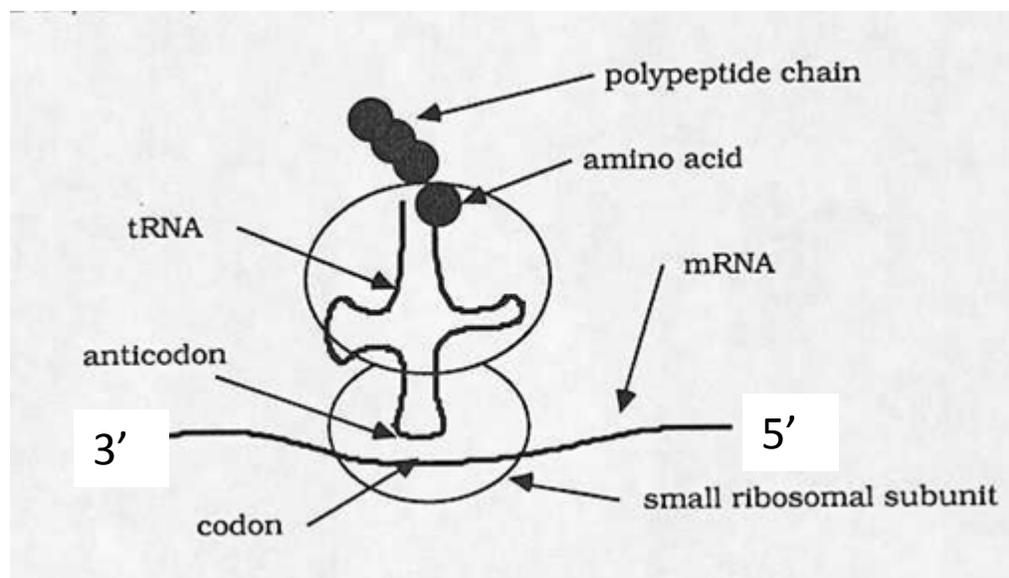
Draw amino acid attached to tRNA

Draw tRNA (Label 5' and 3' ends)

Draw mRNA (Label 5' and 3' ends),

Show codon AAG

Show anticodon UUC



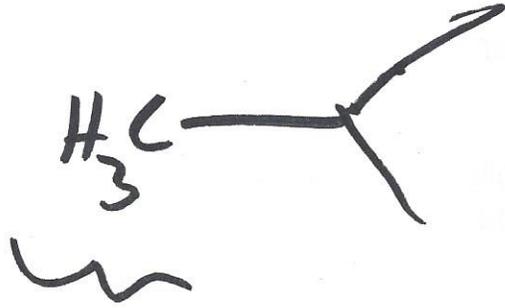
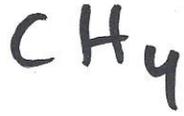
2. 2 pts Draw a generic amino acid (see powerpoint) Show both forms (charged and uncharged):



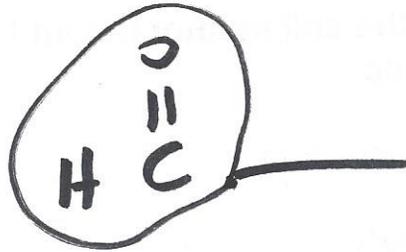
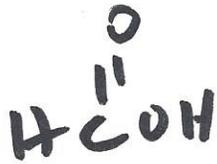
3. 5 pts Draw the peptide showing all atoms.  
Label the peptide bond  
Label the N terminus

Glycine glutamic acid tyrosine

BI 306 Molecule sketches during lecture

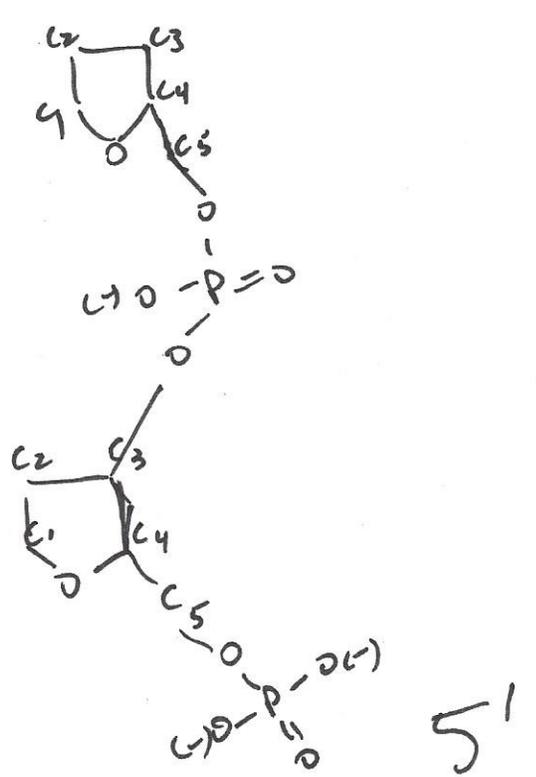
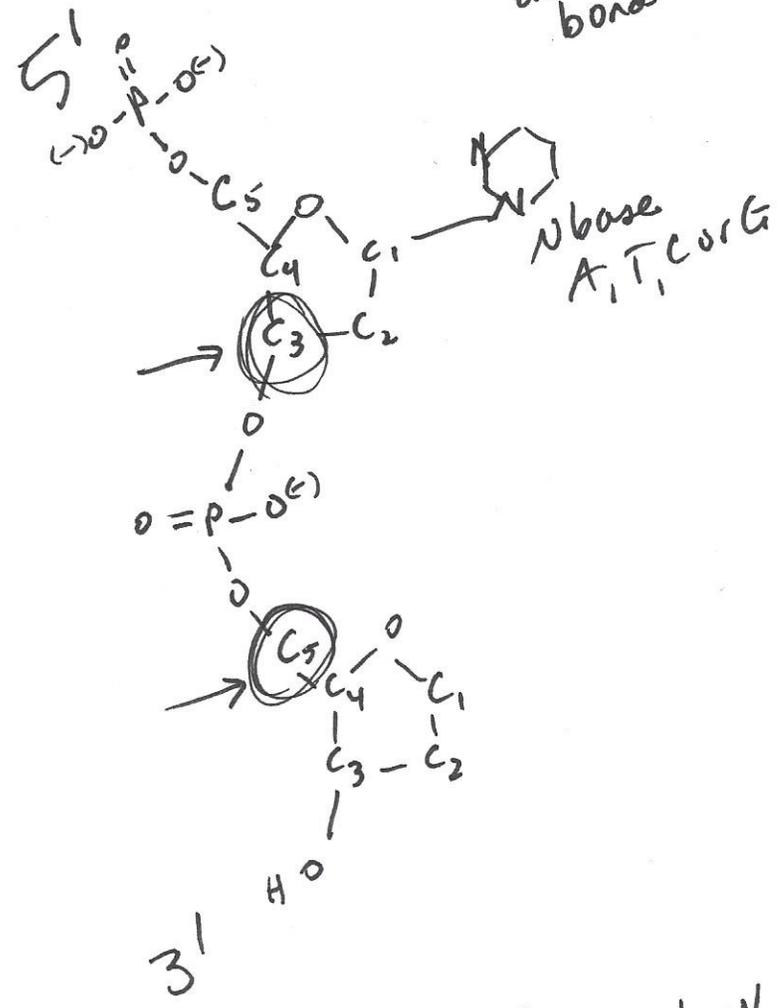
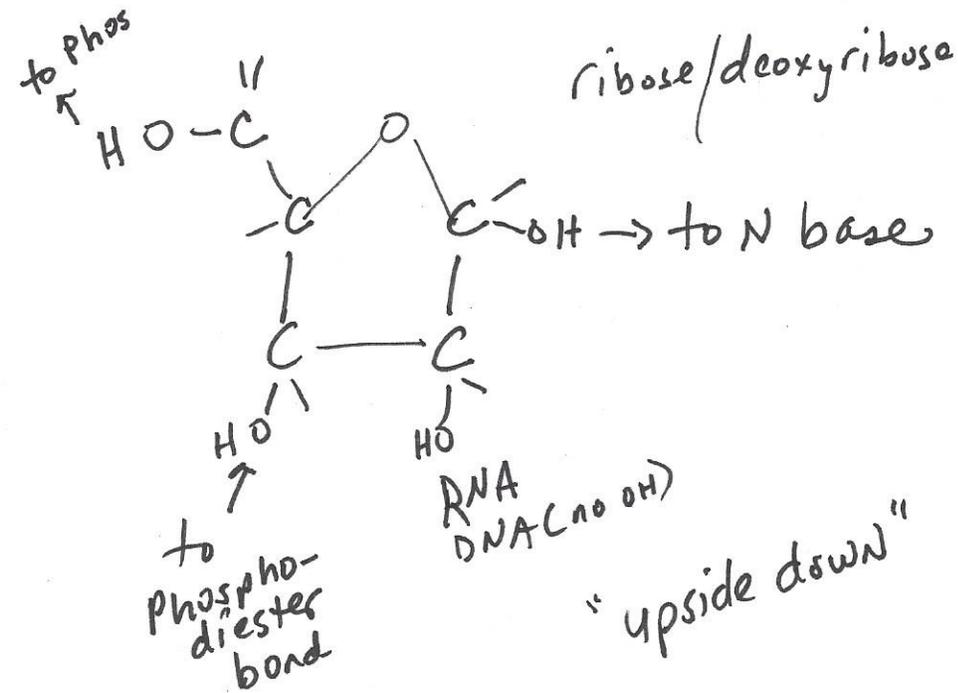


methyl



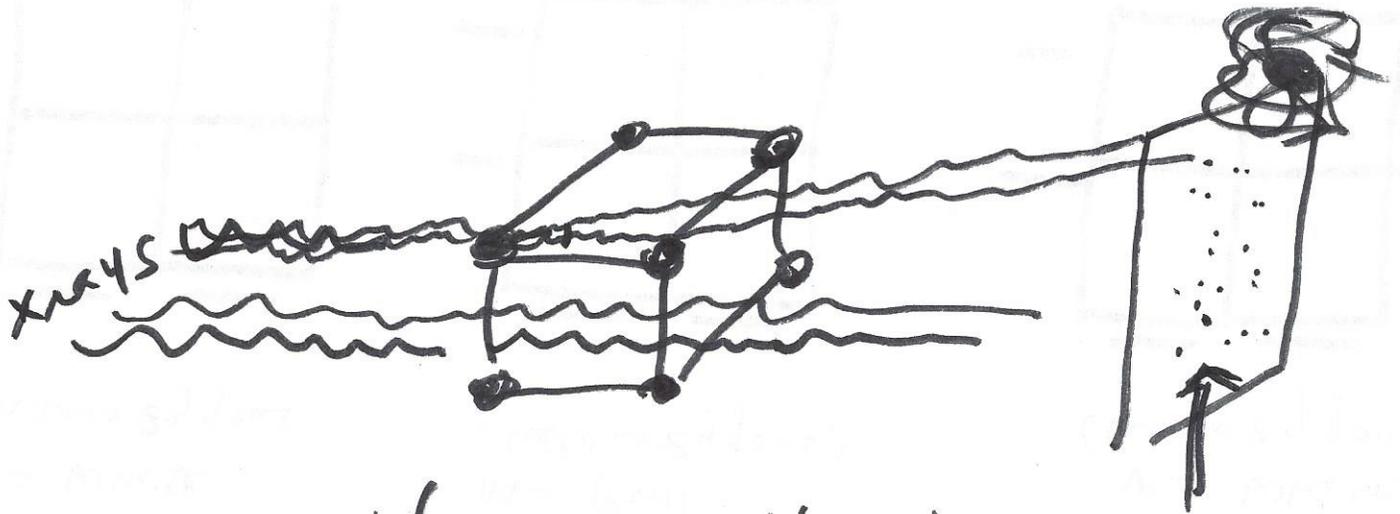
formyl

BI 306 Molecule sketches during lecture



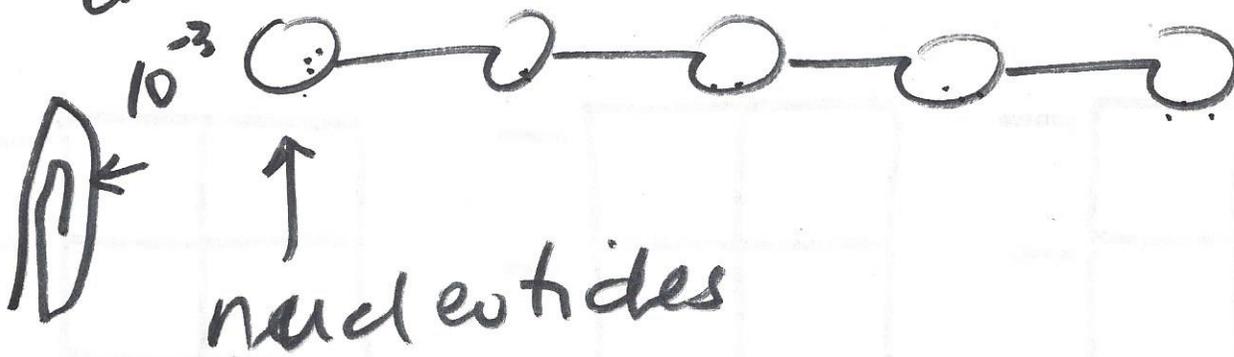
- C<sub>1</sub> — to N base
- C<sub>3</sub> — to PDB
- C<sub>5</sub> — to PDB

BI 306 Molecule sketches during lecture



nucleic acid  
lipid  
protein  
carbohydrate

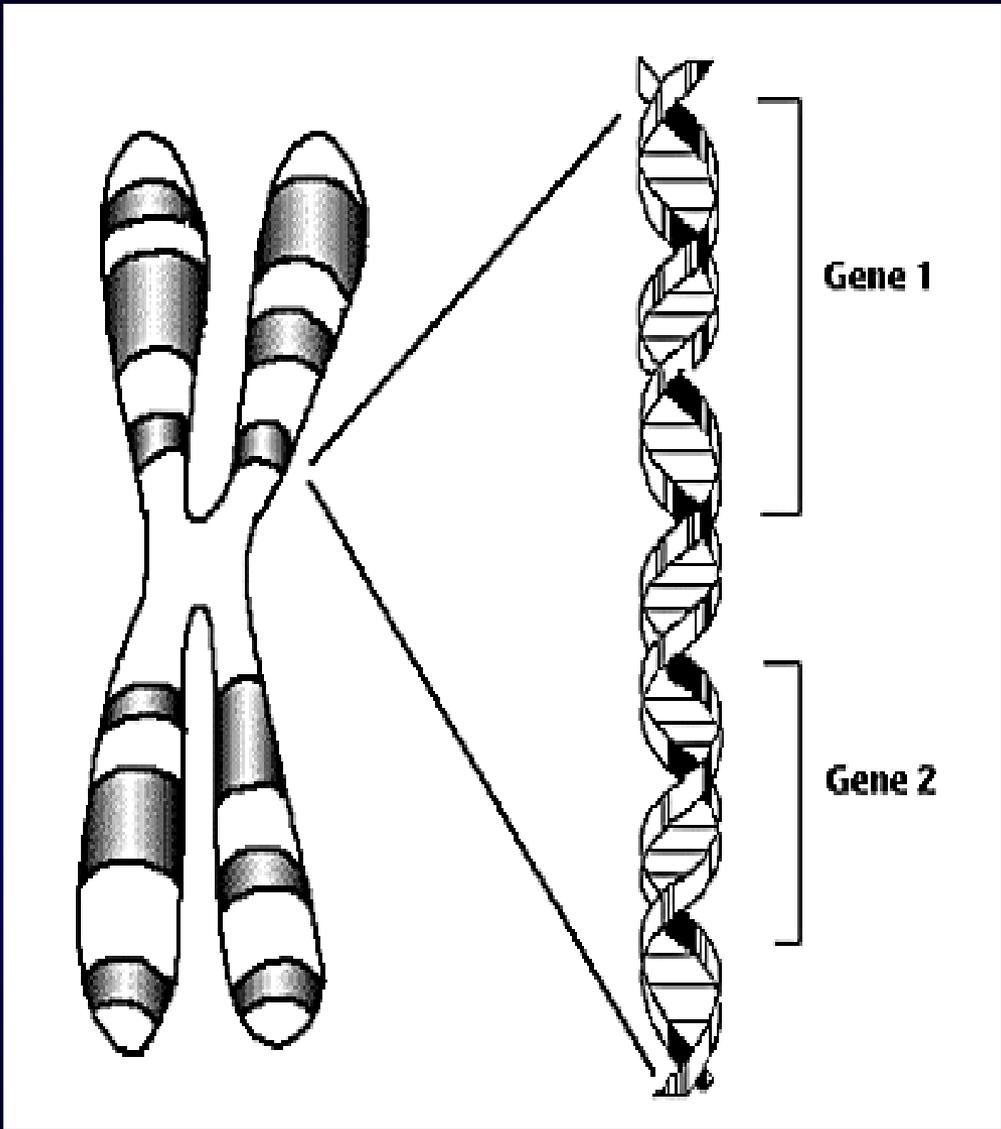
physics



nucleotides

AT
CG
GC
TA

backbone + information  
S + P  
 $10^{-9}$  m  
Nitrogenous base  
A, T, C, or G



# Genetics Chpt 4

## Modification of Mendelian Ratios

## Epistasis

One gene masks expression of another

Recessive epistasis - a homozygous recessive masks expression of another gene

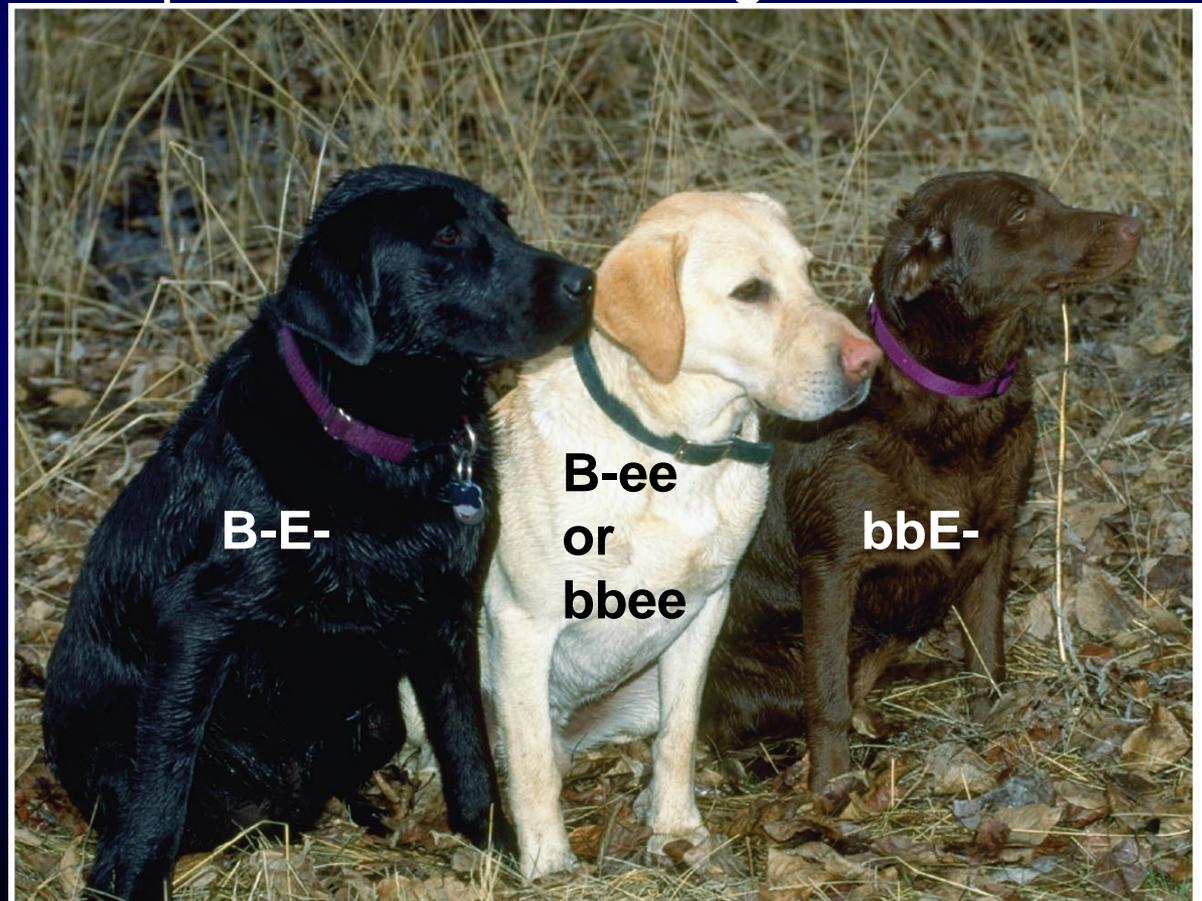
### The 1<sup>st</sup> gene:

B- = black pigment  
bb = brown pigment

### The 2<sup>nd</sup> gene:

E- allows B to be expressed  
ee does not

Epistasis:  
ee masks B



**The 1<sup>st</sup> gene:**

B- = black pigment  
bb = brown pigment

**The 2<sup>nd</sup> gene:**

E- allows B to be  
expressed  
ee does not

**Branch diagram - be able to do this!!!**

BbEe X BbEe

offspring phenotype ratio

	1/4 EE	1/16 BBEE	Black	
1/4 BB	2/4 Ee	2/16 BB Ee	Black	
	1/4 ee	1/16 BB ee	white	
				9 black
				3 brown
2/4 Bb	1/4 EE	2/16 BbEE	Black	4 white
	2/4 Ee	4/16 Bb Ee	Black	
	1/4 ee	2/16 Bb ee	white	
1/4 bb	1/4 EE	1/16 bbEE	Brown	
	2/4 Ee	2/16 bb Ee	Brown	
	1/4 ee	1/16 bb ee	white	

**Branch diagram - be able to do this!!!**

BbEe X BbEe

offspring phenotype ratio

3/4 E-  
1/4 ee

9/16 BBEE  
3/16 BBee

Black  
white

If BB and Bb  
have same  
phenotype

9 black  
3 brown  
4 white

1/4 bb

3/4 E-  
1/4 ee

3/16 bbEE  
1/16 bbee

Brown  
white

# BI 306 Genetics problems

## Chapter 3 Problems

Modes of Inheritance are autosomal dominant or autosomal recessive

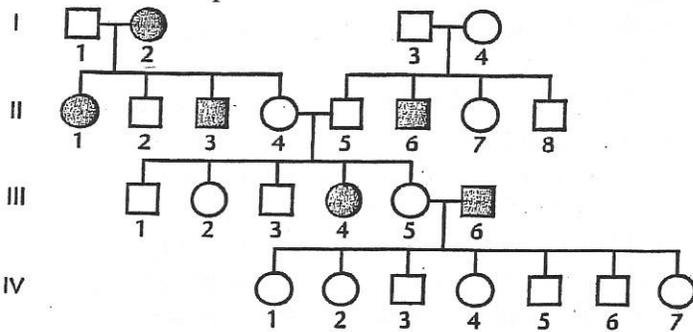
1) Determine the genotypes of the parental plants by analyzing the phenotypes of the offspring from the following crosses:

Parental Plants	Offspring
(a) round, yellow X round, yellow	3/4 round, yellow 1/4 wrinkled, yellow
(b) round, yellow X wrinkled, yellow	6/16 wrinkled, yellow 2/16 wrinkled, green 6/16 round, yellow 2/16 round, green
(c) round, yellow X wrinkled, green	1/4 round, yellow 1/4 round, green 1/4 wrinkled, yellow 1/4 wrinkled, green

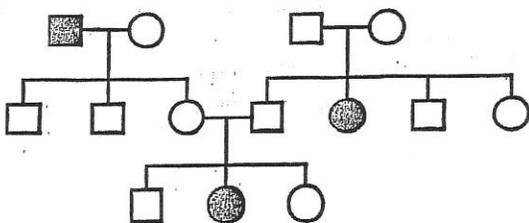
Hint for (b): Round vs Wrinkled  $\frac{8}{8} = \frac{1}{1}$

Yellow vs Green  $\frac{12}{4} = \frac{3}{1}$

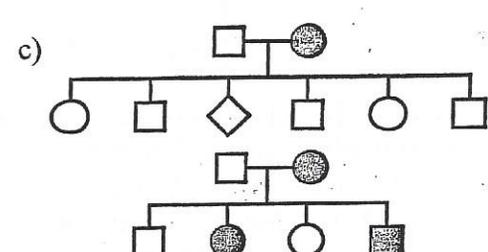
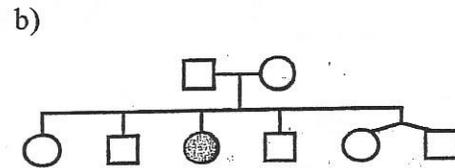
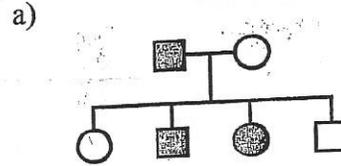
2) For the following pedigree, predict the mode of inheritance and the resulting genotypes of each individual. Assume that the alleles  $A$  and  $a$  control the expression of the trait.



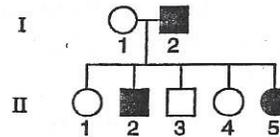
3) The following pedigree follows the inheritance of myopia (near-sightedness) in humans. Predict whether the disorder is inherited as a dominant or a recessive trait. Based on your predictions, indicated the most probable genotype for each individual.



4) Draw all possible conclusions concerning the mode of inheritance of the trait expressed in each of the following limited pedigrees. (Each case is based on a different trait.)



5) Consider the following pedigree, in which the allele responsible for the trait ( $a$ ) is recessive to the normal allele ( $A$ ):

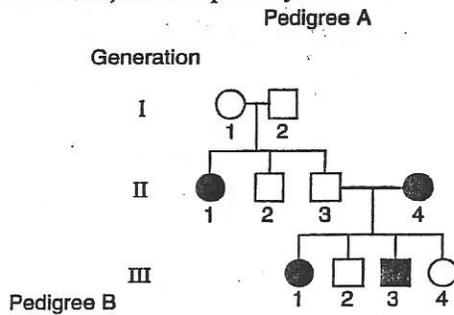


- What is the genotype of the mother?
- What is the genotype of the father?
- What are the genotypes of the children?
- Given the mechanism of inheritance involved, does the ratio of children with the trait to children without the trait match what would be expected? (Punnett square may be used to predict.)

# BI 306 Genetics problems

## Chapter 3 Problems

6) For the pedigrees A and B below, indicate whether the trait involved in each case could be recessive or dominant, and explain your answers.



7) How many different types of gametes can be formed by individuals of the following genotypes? What are they in each case? (a)  $AaBb$ , (b)  $AaBB$ , (c)  $AaBbCc$ , (d)  $AaBBcc$ , (e)  $AaBbcc$ , and (f)  $AaBbCcDdEe$ ? Use branch diagramming.

8) A geneticist, in assessing data that fell into two phenotypic classes, observed values of 250:150. He decided to perform chi-square analysis using two different null hypotheses: (a) The data fit a 3:1 ratio; and (b) the data fit a 1:1 ratio. Calculate the  $X^2$  values for each hypothesis. How would you do this and what do you conclude about each hypothesis?

9) Consider three independently assorting gene pairs,  $A/a$ ,  $B/b$ , and  $C/c$ , where each demonstrates typical dominance ( $A$ -,  $B$ -,  $C$ -) and recessiveness ( $aa$ ,  $bb$ ,  $cc$ ). What is the probability of obtaining an offspring that is  $AABbCc$  from parents that are  $AaBbCC$  and  $AABbCc$ ? Use branch diagramming.

10) Two true-breeding pea plants are crossed. One parent is round, terminal, violet, constricted, while the other expressed the contrasting phenotypes of wrinkled, axial, white, full. The four pairs of contrasting traits are controlled by four genes, each located on a separate chromosome. In the  $F_1$  generation, only round, axial, violet, and full are expressed. In the  $F_2$  generation, all possible combinations of these traits are expressed in ratios consistent with Mendelian inheritance.

- What conclusion can you draw about the inheritance of these traits based on the  $F_1$  results?
- Which phenotype appears most frequently in the  $F_2$  results?
- Which  $F_2$  phenotype is expected to occur least frequently?
- How often is either  $P_1$  phenotype likely to occur in the  $F_2$  generation?
- If the  $F_1$  plant is testcrossed how many different phenotypes will be produced, and how does this number compare to the number of different phenotypes in the  $F_2$  generation discussed in part (b)?

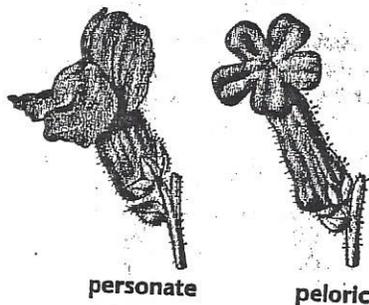
# BI 306 Genetics problems

## Chapter 4 Problems

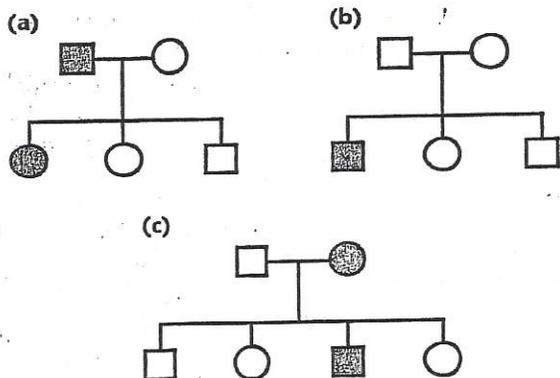
Chpt 4 Modes of Inheritance are autosomal dominant, autosomal recessive, OR X-linked recessive.

Suggested genotypes:  $TT, Tt, tt$   
 $RR, Rr, rr$   
 $PP, Pp, pp$

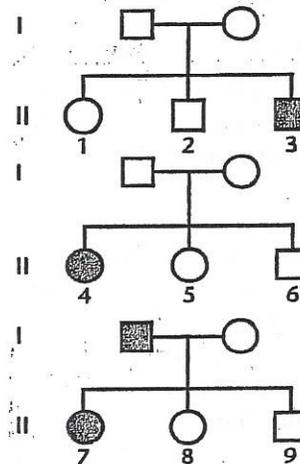
1) Three gene pairs located on separate autosomes determine flower color and shape as well as plant height. The first pair exhibits incomplete dominance, where color can be red, pink (the heterozygote), or white. The second pair produces the dominant personate or recessive peloric flower shape, while the third gene pair produces either the dominant tall trait or the recessive dwarf trait. Homozygous plants that are red, personate, and tall are crossed with those that are white, peloric, and dwarf. Determine the  $F_1$  genotype(s) and phenotype(s). If the  $F_1$  plants are interbred, what proportion of the offspring ( $F_2$  generation) will exhibit the same phenotype as the  $F_1$  plants? Use a branch diagram.



2) Below are three pedigrees. For each, consider whether it could or could not be consistent with an X-linked recessive trait. Explain why or why not.



3) Consider the following three pedigrees (from 3 different families), all involving the same human trait.



a) Which sets of conditions below, if any, can be excluded?

- dominant and autosomal
- recessive and X-linked
- recessive and autosomal (not x-linked)

b) For any set of conditions that you excluded, indicate the *single individual* in generation II (1-9) that was instrumental in your decision to exclude that condition.

4) The following genotypes of two independently assorting autosomal genes determine coat color in rats:

$A-B-$  (gray);  $A-bb$  (yellow);  $aaB-$  (black);  $aabb$  (cream)

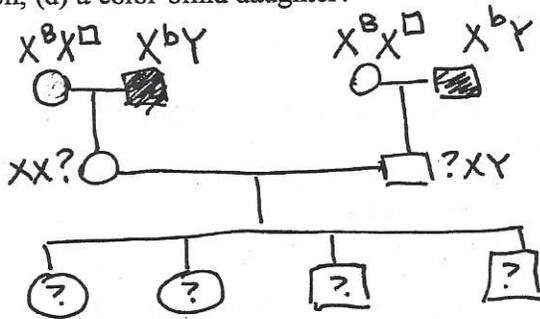
A third gene pair on a separate autosome determines whether any color will be produced. The  $CC$  and  $Cc$  genotypes allow color according to the expression of the  $A$  and  $B$  alleles present. Determine the  $F_1$  phenotypic ratio of the following crosses: (a)  $AAbbCC \times aaBBcc$ ; (b)  $AaBBCC \times AABbcc$ ; (c)  $AaBbCc \times AaBbcc$ . Use branch diagramming.

# BI 306 Genetics problems

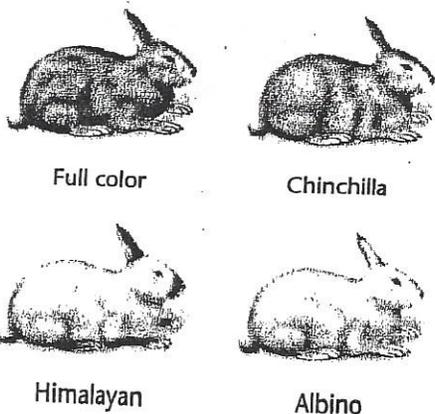
## Chapter 4 Problems

5) Given the inheritance pattern of coat color in rats described in Problem 4, predict the genotype and phenotype of the parents that produced the following  $F_1$  offspring: (a) 9/16 gray: 3/16 yellow: 3/16 black: 1/16 cream; (b) 9/16 gray: 3/16 yellow: 4/16 albino; (c) 27/64 gray: 16/64 albino: 9/64 yellow: 9/64 black: 3/64 cream. This is working backwards: Given offspring, determine parents.

6) A husband and wife have normal vision, although both of their fathers are red-green color-blind, inherited as an X-linked recessive condition. What is the probability that their first child will be (a) a normal son, (b) a normal daughter, (c) a color-blind son, (d) a color-blind daughter?



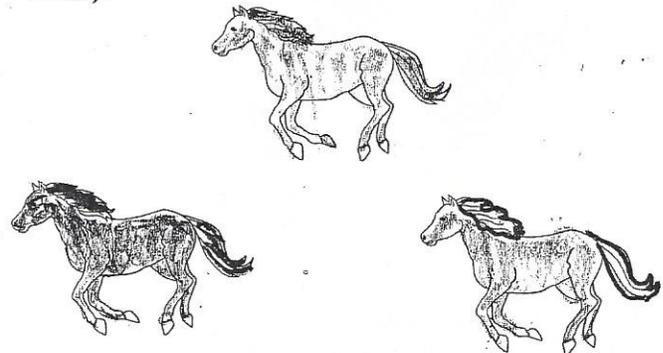
7) In rabbits, a series of multiple alleles, controls coat color in the following way:  $C$  is dominant to all other alleles and causes full color. The chinchilla phenotype is due to the  $c^{ch}$  allele, which is dominant to all alleles other than  $C$ . The  $c^h$  allele, dominant only to  $c^a$  (albino), results in the Himalayan coat color. Thus, the order of dominance is  $C > c^{ch} > c^h > c^a$ . For each of the following three cases, the phenotypes of the  $P_1$  generations of two crosses are shown, as well as the phenotype of one member of the  $F_1$  generation.



Determine the genotypes of the  $P_1$  generation of the  $F_1$  offspring for each case. Predict the results of making each cross between  $F_1$  individuals as shown (producing the  $F_2$  generation).

$P_1$ Phenotypes	→	$F_1$ Phenotypes
Himalayan X Himalayan	→	albino
		X → ??
full color X albino	→	chinchilla
albino X chinchilla	→	albino
		X → ??
full color X albino	→	full color
chinchilla X albino	→	Himalayan
		X → ??
full color X albino	→	Himalayan

8) Horses can be cremello (a light cream color), chestnut (a reddish brown color), or palomino (a golden color with white in the horse's tail and mane).



Of these phenotypes, only palominos never breed true. The following results have been observed:

cremello X palomino	→	1/2 cremello
		1/2 palomino
chestnut X palomino	→	1/2 chestnut
		1/2 palomino
palomino X palomino	→	1/4 chestnut
		1/2 palomino
		1/4 cremello

- From these results, determine the mode of inheritance by assigning gene symbols and indicating which genotypes yield which phenotypes.
- Predict the  $F_1$  and  $F_2$  results of matings between cremello and chestnut horses.

# BI 306 Genetics problems' answers on Canvas



⋮  Answers to Genetics Chpt 3 problems-1.docx

⋮  chpt4 modification of mend ratios.ppt

⋮  Ess Genetics Chpt 4 Outline.doc

⋮  Chpt 4 review.doc

⋮  Chpt4 text question solutions.doc



⋮  Answers to Genetics Chpt 4 problems.docx

⋮  Questions from text chpt 2 3 4.doc



⋮  Answers to MORE Lab genetics problems.docx

# BI 306 Genetics HHMI videos and outlines

## BI 306 Selected HHMI videos on Evolution

### The Making of the Fittest: Evolving Switches Evolving Bodies



Stickleback bodies have undergone a dramatic transformation, some populations completely losing long projecting body spines that defend them from large predators. Various scientists, including David Kingsley and Michael Bell, have studied living populations of threespine sticklebacks, identified key genes and genetic switches in the evolution of body transformation, and even documented the evolutionary change over thousands of years by studying a remarkable fossil record from the site of an ancient lake ten million years ago. Watch this film to learn about a species where we can study evolution in action, identify key genes, and peer deep into the evolutionary past.

<https://www.hhmi.org/biointeractive/making-fittest-evolving-switches-evolving-bodies>

### The Making of the Fittest: Got Lactase? The Co-evolution of Genes and Culture



Human babies drink milk; it's the food especially provided for them by their mothers. Various cultures have also added the milk of other mammals to their diet and adults think nothing of downing a glass of cows' milk. But worldwide, only a third of adults can actually digest lactose, the sugar in milk. In this short film we follow human geneticist Spencer Wells, Director of the Genographic Project of the National Geographic Society, as he tracks down the genetic changes associated with the ability to digest lactose as adults, tracing the origin of the trait to less than 10,000 years ago, a time when some human populations started domesticating animals, including goats, sheep, and cows. Combining genetics, chemistry, and

anthropology, this story provides a compelling example of the co-evolution of human genes and human culture.

<https://www.hhmi.org/biointeractive/film-guides-got-lactase-co-evolution-genes-and-culture>

# BI 306 Genetics HHMI videos and outlines

## The Making of the Fittest: Natural Selection and Adaptation



Not only is evolution happening right now everywhere around us, but adaptive changes can occur in a population with remarkable speed. This speed is essential if you're a desert mouse living in an environment where a volcanic eruption can reverse selective pressure in nearly an instant. The film features Dr. Michael Nachman, whose work in the field and in the lab has quantified the selective pressure of predators and identified the genes involved in adaptation. In a complete story, from ecosystem to molecules, pocket mice show us how random changes in the genome can take many paths to the same adaptation—a colored coat that hides them from predators.

<https://www.hhmi.org/biointeractive/making-fittest-natural-selection-and-adaptation>

## Outlines to accompany videos

### Howard Hughes Medical Institute: The Making of the Fittest: Evolving Switches, Evolving Bodies

Stickleback in northern oceans, spawns in fresh water

Some fish were cut off from sea water; how did they adapt to fresh water?

The freshwater species' are smaller, with color and skeleton changes.

Ancestors in ocean evolved bony plates and spines

In fresh water, spines decrease fitness.

Natural selection at work: fresh water fish have reduced their pelvic spines.

During development, gene expression changes to form adult from fertilized egg; the change in form is due to changes in genes

Crosses help to map genes' locations on chromosomes.

Cross fresh X sea water fish; produce F1 generation; then breed to produce F2 generation.

DNA markers link trait to a certain chromosome.

pitX1 coding sequences in gene were identical

Staining of the pitx1 gene expression showed that pitx1 expression was LOST in freshwater fish pelvis

A regulatory "switch" controls gene expression (analogous to promoter)

# BI 306 Genetics HHMI videos and outlines

You can track protein expression using a reporter gene. Cut the DNA region and attach it to a reporter gene.

Glowing indicates a region where gene expression occurs.

If fish had a pelvic spine and switch was deleted, pelvic spine did not form, then an advantage spread to new population.

The switch was reinserted into eggs, the fish developed spines.

Loss of the pelvic switch has occurred in other regions of the world.

Fossils of ancient stickleback: some had large pelvic bones or small pelvic bones

Archeological records

## **Howard Hughes Medical Institute: The Making of the Fittest: Got Lactase? The Co-evolution of Genes and Culture**

Hunter-gatherers, domesticating animals

Infant mammals can digest milk (lactose to galactose + glucose via lactase enzyme) , but adults cannot.

Those adults that CAN are called lactase persistent

Humans are the only mammal that can digest lactose as an adult.

You can measure this by establishing a baseline glucose, drinking milk, and then watching the rise in glucose in the blood.

In both groups (those that can and cannot metabolize lactose) the lactase gene is not different.

Switch was located on chromosome 2.

1 nucleotide difference was noticed in Finns

In other populations in Africa, a different mutation was involved in lactase persistence

Both cultures are pastoral.

Old clay pots (used for cooking) were used to detect milk fats that should float on the surface(along with other types of fats)

A chemical signature was discovered for milk fats. Milk fats were found in the cultures' pots.

Based on gene mutation rates, the lactase switch mutations were dated to about the same period as use of milk

Dairying is associated with persistence mutations

With milk around, persistence is an advantage.

If 5% advantage, 105/100 survive instead of 100.

Great nutritional value – protein and fat, uncontaminated, useful in case of famine.



# BI 306 Students' mutation & selection sketches

Sketch and label how Plasmodium falciparum is involved in natural selection.

1) Using 3 individuals AA AS and SS indicate how a mutation is an advantage in the presence of P. falciparum

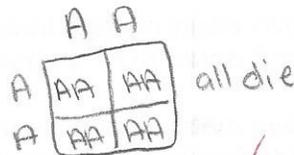
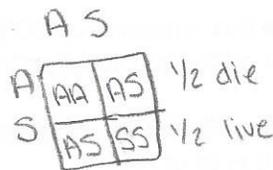
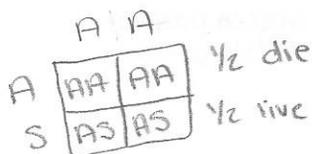
AA = would die from malaria  
 SS = would die from sickle cell anemia

AS = would live = advantage

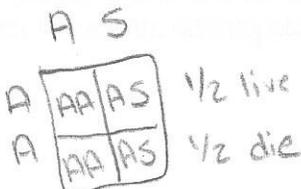
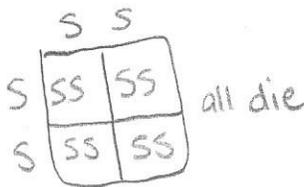


✓ - AS mutation makes the individual immune to malaria because the protizon can not complete its reproduction cycle.

2) Show how the parasite acts as a selective agent. E.g. what genotypes are expected to survive in regions where P. falciparum thrives versus regions with few P. falciparum?



AS = live  
 SS = die (sickle cell)  
 AA = die (malaria)



# BI 306 Students' mutation & selection essay questions

BONUS COMPLETE YOUR ANSWER ON BACK 3pts

"Studies in the field of Molecular Evolution suggest that Mutation and Selection cause changes in populations of (rather than individual) organisms"

a) What is the role of mutation in molecular evolution?

Mutations can occur in a population through DNA replication error or nonhomologous crossing over and they can be harmful, beneficial, or neutral to an individual. A nonfunctional gene mutation will be kept because it doesn't have a phenotypic effect (on introns or 3' flanking). A mutation on a functional gene (5' flanking, coding region), will affect a population and the individual's fitness.

b) What is the role of selection in molecular evolution?

Selection is the pressure that determines if a mutation remains in a population over time. A harmful mutation that gives an unfavorable phenotype will be "selected out" of a population because the individuals will not be the fittest. Beneficial and neutral mutations will be selected for and passed down.

c) What is the significance of "populations rather than individuals" in molecular evolution?

A mutation can only be viewed as harmful, beneficial, or neutral when viewed in a whole population. Populations weed out harmful genes under selective pressures and they change as a whole over time. The individual does not change.

# BI 306 Students' mutation & selection essay questions

BONUS COMPLETE YOUR ANSWER ON BACK 3pts

"Studies in the field of Molecular Evolution suggest that Mutation and Selection cause changes in populations of (rather than individual) organisms"

a) What is the role of mutation in molecular evolution?

Mutation creates variability in individual genotypes which then may be selected for if they are beneficial or harmful.

b) What is the role of selection in molecular evolution?

Selection weeds out harmful mutations by preventing or reducing reproduction by individuals with the harmful mutations. Beneficial and neutral/silent mutations are passed on via reproduction, with beneficial mutations possibly resulting in a higher survival and reproduction rate.

c) What is the significance of "populations rather than individuals" in molecular evolution?

Beneficial mutations will be seen in higher numbers among populations over time, while harmful ones will progressively lower. This can reverse course depending on what selecting pressures populations are experiencing. It is necessary to study populations to understand and recognize how mutations at the molecular level and selecting forces are driving the evolution of specific populations.

# Examples of Teaching Effectiveness

BI 306  
Genetics Lab

# BI 306 Lab

## BI 306 Lab PowerPoints

Including background and guidance on data interpretation

statistics use in data interpretation.xlsx	Gen Lab Activity Antibiotic Resistance.pptx	
genetics_structures.ppt	Gen Lab pGLOpart1.pptx	
principles of gel electrophoresis-1.pptx	Gen Lab pGLOpart2-1.pptx	HNPCC results.pptx
Edvotek 101 prin of electroph.pdf	fluorescence.pptx	HNPCC manual highlighted.pdf
Gen Lab Activity DNA modeling-2.pptx	pGLOinstructionmanualhighlight.pdf	Gen Lab Activity Microarrays.pptx
Gen Lab Activity Replication.pptx	pGLOquickguide.pdf	Edvotek235Microarrays.pdf
Gen Lab Activity PCR-1.pptx	Gen Lab Activity Sea Firefly.pptx	Answers to Protein Separation Lab.docx
Edvotek S-48.pdf	Gen Lab Activity LDH isoenzymes-1.pptx	Gen Lab Activity Anatofgenome.ppt
Gen Lab Activity PCR and globin-1.pptx	LDH pic.pptx	anatomy_of_genome.ppt
Gen Lab Activity PCR and pCi-neo.pptx	Gen Lab Mitosis Meiosis-1.pptx	Review for Lab Final fall 2015.doc
pCIneoseq_for_PCR_lab_Fall_2009.doc	Meiosis_qz_lab.docx	DNA_fingerprinting.ppt
neoPCR.JPG	alignment_outcomes.swf	Nucleosomes.ppt
	Gen Lab Activity PLant Genetics.pptx	promega_1_kb_DNA_ladder_for_PCR_p...

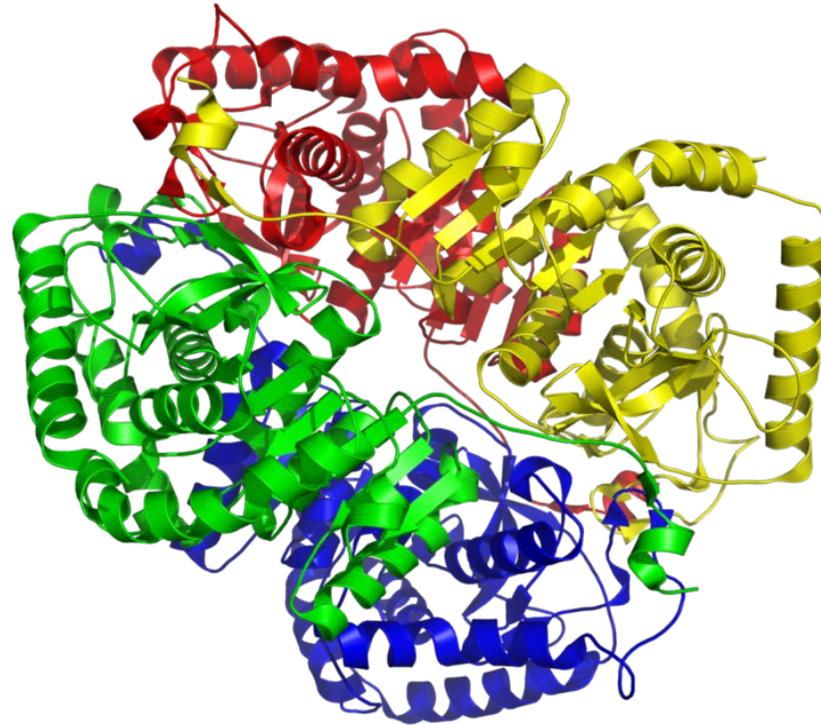
## Lactate Dehydrogenase Isoenzymes

A **protein isoform** is any of several different forms of the same [protein](#).

Different forms of a protein may be:  
produced from **very closely** related [gene duplicates](#) or  
may arise from the same gene by [alternative splicing](#).

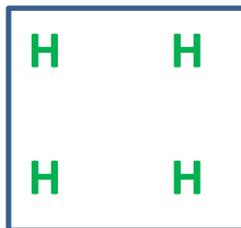
# Lactate Dehydrogenase Isoenzymes

**4 subunits**

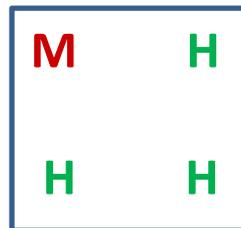


# BI 306 Sample Genetics Lab PowerPoint

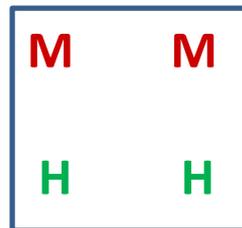
4 subunits ; each subunit may be H or M polypeptide chain



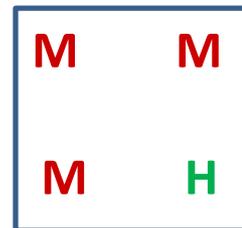
LDH 1



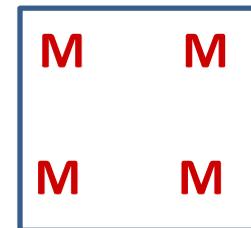
LDH 2



LDH 3



LDH 4



LDH 5

**M peptides** more efficiently perform **anaerobic** respiration  
(M skeletal muscle)

**H peptides** more efficiently perform **aerobic** respiration (H heart)



Found predominantly  
in heart



Found predominantly  
in skeletal muscle



# BI 306 Sample Genetics Lab PowerPoint

**H peptides** are more acidic (glutamic and aspartic acids)

## LDH H (LDH B)

1 matl**ek**lia pva**eee**atvp nnkitvvgvg qvgmacaisi lgkslad**ela** lvdv**led**klk  
61 gem**md**lqhgs lflqtpkiva **dk**dysvtans kivvvtagr q**qeg**esrlnl vqrvnvf**kf**  
121 iipqivkysp **dc**iiivvsnp **vd**iltyvtwk lsglpkhrvi gsgcn**lds**ar frylma**ek**lg  
181 ihpsschgwi lg**ehg**dssva vwsqvnvagv sl**qel**np**emg** t**dn**dsen**wke** v**h**kmv**ves**ay  
241 **ev**iklkgytn waigls**vad**l iesmlknlsr ihpvstmvkg mygi**ene**vfl slpcilnarg  
301 ltsvingklk **dde**vaqlkks **ad**tl**w**di**qkd** l**kd**l

## LDH M (LDH A)

1 mg**ep**sggyty tqtsiflfha kipfgsksm atlk**d**qliyn ll**ke**eqtpqn kitvvgvgav  
61 gmacaisilm **kdlad**elalv **dvi**edkl**ke** m**md**lqhgs**lf** lrtpkivsgk **dyn**vtanskl  
121 viitagarqq **eg**esrlnlvq rnvnikfii pnvvkyspnc kllivsn**pd** iltyvawkis  
181 gfpknrvigs gcn**lds**arfr ylm**ger**lgvh plschgwl**g** **ehg**dssvpvw sgmnvagvsl  
241 ktlhp**d**lgtd **kdke**q**wke**vh kqv**ves**ayev iklkgytswa igls**vad**lae simknlrrvh  
301 pvstmikgly gik**dd**vflsv pcilgqngis **dl**vkvtlt**se** **ee**arl**kksad** t**lw**gi**qkel**q  
361 f

# BI 306 Sample Genetics Lab PowerPoint

## Amino acid BLAST of LDH H vs LDH M

- = D or E present in H; absent in M

H	<u>Query</u> 1	MATLKEKLIAPVAEEEEATVPNNKITVVGVGQVGMACAISILGKSLADELALVDVLEDKLK	60
		MATLK++LI + +EE T P NKITVVGVG VGMACAISIL K LADELALVDV+EDKLK	
M	<u>Sbjct</u> 30	MATLKDQLIYNLLKEEQT-PQNKITVVGVGAVGMACAISILMKDLADELALVDVIEDKLK	88
	<u>Query</u> 61	GEMMDLQHGSFLQTPKIVADKDYSVTANSKIVVVTAGVRRQEGESRLNLVQRNVNVFKF	120
		GEMMDLQHGSFL+TPKIV+ KDY+VTANSK+V++TAG RQEGESRLNLVQRNVN+FKF	
	<u>Sbjct</u> 89	GEMMDLQHGSFLRTPKIVSGKDYNVTANSKLVIIITAGARQEGESRLNLVQRNVNIFKF	148
	<u>Query</u> 121	IIPQIVKYSPDCIIIVVSNPVDILTIVTWKLSGLPKHRVIGSGCNLDSARFRYLMAEKLG	180
		IIP +VKYSP+C +++VSNPVDILTIV WK+SG PK+RVIGSGCNLDSARFRYLM E+LG	
	<u>Sbjct</u> 149	IIPNVVKYSPNCKLLIVSNPVDILTIVAWKISGFPKNRVIGSGCNLDSARFRYLMGERLG	208
	<u>Query</u> 181	IHPSSCHGWILGEHGDSSVAVWSGVNVAGVSLQELNPEMGTDNDSENWKEVHKMVVESAY	240
		+HP SCHGW+LGEHGDSSV VWSG+NVAGVSL+ L+P++GTD D E WKEVHK VVESAY	
	<u>Sbjct</u> 209	VHPLSCHGWVLGEHGDSSVPVWSGMNVAGVSLKTLHPDLGTDKDKEQWKEVHKQVVESAY	268
	<u>Query</u> 241	EVIKLGKGYTNWAIGLSVADLIESMLKNLSRIHPVSTMVKMGYGIENEVFLSLPCILNARG	300
		EVIKLGKGYT+WAIGLSVADL ES++KNL R+HPVSTM+KG+YGI+++VFLS+PCIL G	
	<u>Sbjct</u> 269	EVIKLGKGYTSAIGLSVADLAESIMKNLRRVHPVSTMIKGLYGIKDDVFLSVPCILGQNG	328
	<u>Query</u> 301	LTSVINQKLKDDEVAQLKKSADTLWDIQKDLK	332
		++ ++ L +E A+LKKSADTLW IQK+L+	
	<u>Sbjct</u> 329	ISDLVKVTLTSEEEARLKKSADTLWGIQKELQ	360

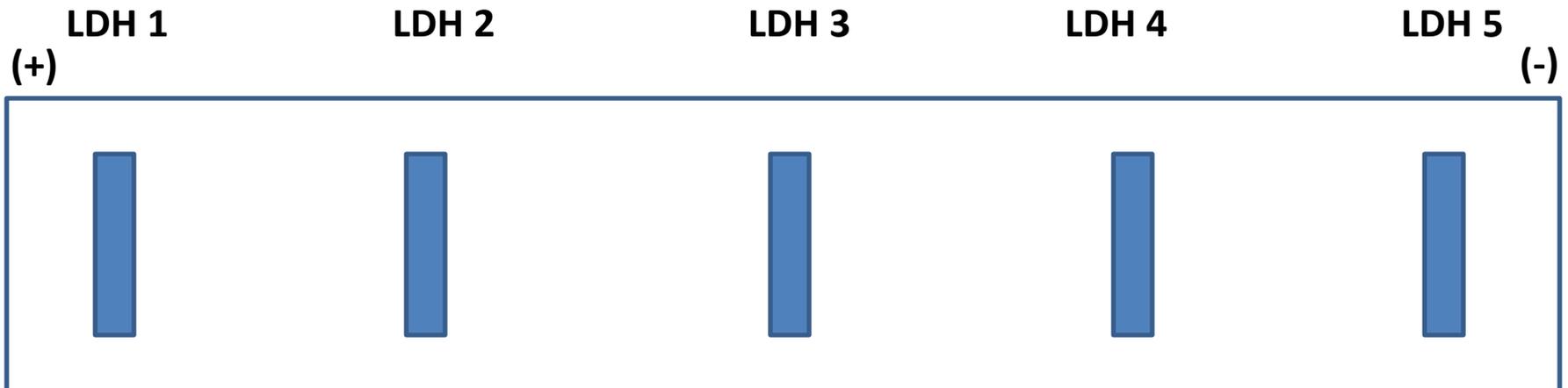
# BI 306 Sample Genetics Lab PowerPoint

So electrophoresis can be used to separate and detect different forms of LDH

Indicate certain disorders:

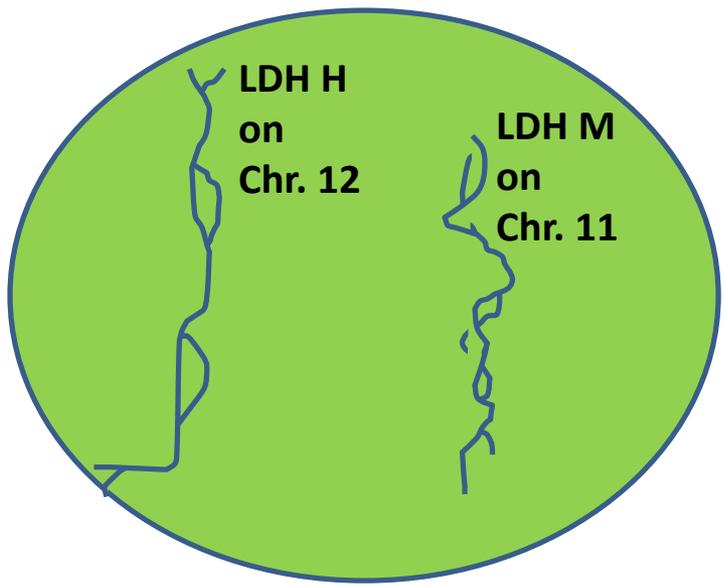
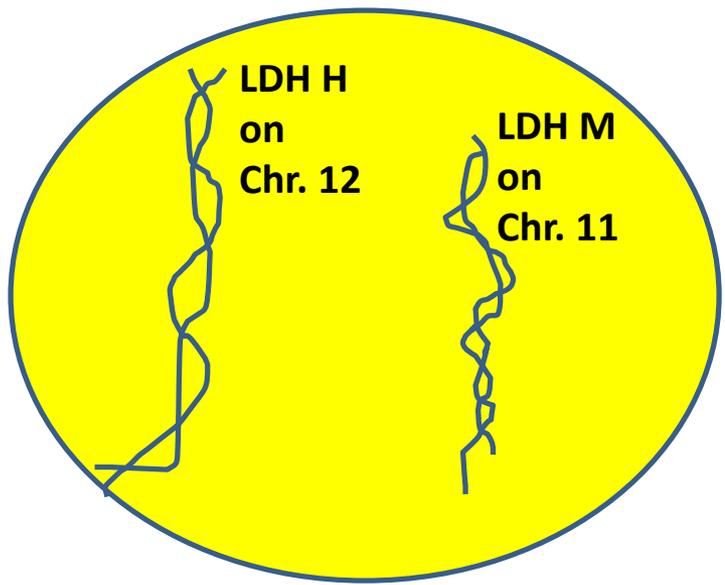
Heart attack

Muscular dystrophy

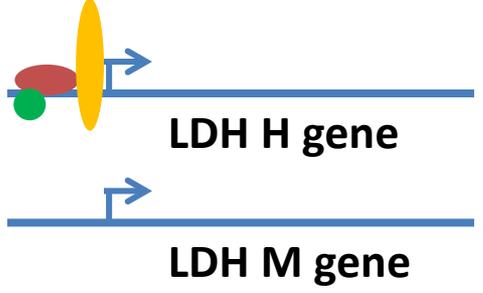


# BI 306 Sample Genetics Lab PowerPoint

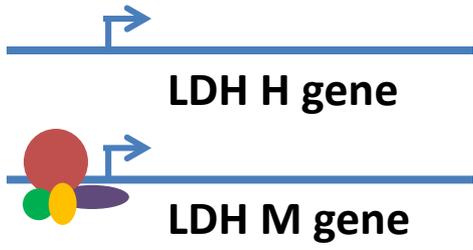
Tissue- or cell- specific gene expression controlled by transcription factors



Heart muscle cells



Skeletal muscle cells



# BI 306 Study guide for Lab Final

## Review for Lab Final Spring 2016

### Organic molecules

If given structures of nucleotides, amino acids and peptides, know how to identify the following:  
Phosphodiester bond, a nitrogenous base (you do not have to distinguish A,T,C,G), ribose, deoxyribose, amino and carboxy terminus of amino acid, R group on peptide.

### Gel electrophoresis

Positive and negative poles on a gel  
Purpose of TAE buffer  
Purpose of agarose; how it separates molecules  
Purpose of sample buffer  
Purpose of stain  
Relationship between size of DNA and migration through agarose gel  
What produces a smear and how it appears on a gel

### PCR amplification of hemoglobin gene

Steps in the PCR reaction.  
Purpose of all PCR reagents.  
Know the purpose of basic functional parts of the pUC18 vector (MCS, promoters, SV40 poly A region)

### Antibiotic resistance

Know what neomycin is and what the neomycin resistance gene (*neo*) produces  
Know how the product of the neomycin resistance gene, aminoglycoside phosphotransferase, inactivates neomycin  
Know why bacteria having a plasmid that contains the neomycin resistance gene survive in the presence of the antibiotic

### pGLO

Know the functional regions of the pGLO vector that we discussed for this lab  
Know about the arabinose-stimulated promoter for expressing the GFP gene  
Know what to expect when bacteria are transformed (or not) and plated on petri dishes containing antibiotic or arabinose  
Know how the product of the ampicillin resistance gene inactivates ampicillin

### Isoenzymes

Know about anaerobic versus aerobic respiration  
Know about the chemical properties of the H and M peptides (acidic versus basic)  
Know about tissue-specific expression of the H and M genes in muscle and heart  
What types of injury may be detected by high levels of H or M peptides?

### Meiosis / Mitosis

Identify any stage of Mitosis, Meiosis I, or Meiosis II from a diagram.  
Identify duplicated chromosomes vs. homologous pairs.  
Be able to sketch "random alignment of homologous pairs" in Metaphase I.

### Mendelian genetics

Given observed data for offspring and information about the parents (genotypes):  
Determine expected Mendelian ratio, perform chi square analysis, evaluate whether the null hypothesis is rejected, AND decide if the inheritance pattern follows classical mendelian predictions.

# BI 306 Study guide for Lab Final

## Chi Square Analysis

Use chi square analysis to determine if a set of experimental data agrees with a set of predicted values.

Know how to perform a testcross and why this is done.

## Pedigrees (**8<sup>th</sup> edition in bold**, 7<sup>th</sup> edition normal)

Know how to deduce the genotypes of individuals in a pedigree displaying:

Autosomal dominance such as **p52 fig 3-13(b)**; p53 fig 3-13(b)

Autosomal recessiveness such as **p52 fig 3-13(a)**; p53 fig 3-13(a)

**p57 # 21**, p58 # 24

x-linked recessiveness such as **p89 #33**, p91 # 36

## Genetics problems predicting offspring

Know how to set up the branch diagram to solve a problem involving

incomplete dominance such as **p86 #6**, p87 # 5 and **p88 #24**, p90 # 28

recessive epistasis such as **p86 #8**, p87 # 8

## HNPCC

Know how to interpret gel results from analysis of the MSH2 mutation in the HNPCC experiment

Know what is meant by “stepwise” development of cancer

Know the role of the MSH2 protein

Know why persons with one mutated allele are likely to develop cancer, while HNPCC tumors have both alleles mutated

Know why cancer commonly occurs in the colon

Know how PCR is used to prepare samples for analysis

Know how restriction enzymes are used to prepare samples for analysis

Know how to construct a pedigree

What is the risk (% chance) that Bob’s daughter, Claire, will pass the mutation to her children

# BI 306 New labs

New BI 306 Labs

From Modern Biology, Inc.

## Amplification of a Hemoglobin Gene by PCR (IND-7)

The polymerase chain reaction (PCR) is one of the most powerful techniques used in molecular biology. With this method, a few ng of DNA can be amplified millions of times in a test tube in a few hours. The PCR has been used extensively in studies of gene structure and function. The method is also becoming increasingly important in DNA typing procedures such as DNA fingerprinting and in the identification and characterization of mutations that cause human diseases. This exercise is designed to illustrate the PCR in the teaching laboratory. In the experiment, students use PCR to amplify a rabbit  $\beta$ -globin gene. The template for this reaction is a plasmid that contains this globin sequence. Following PCR amplification, the product of the reaction is analyzed on an agarose gel as shown on the below. The experiment was designed so that the PCR can be done manually provided that three standard water baths (45°C, 74°C, and 94°C) or three hot plates are available. The amplified globin DNA band can clearly be seen following staining of the agarose gels with methylene blue. The amplification reaction requires approximately 1.5 hours. Sufficient materials are provided so that 8 groups of students can perform the experiment.



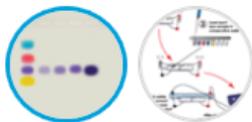
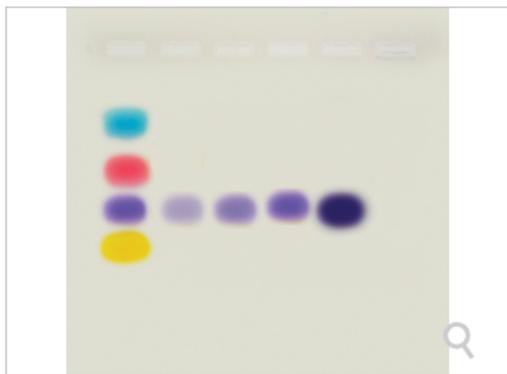
Rabbit  $\beta$ -globin genes were amplified by PCR and electrophoresed on lanes 4 and 7 of this agarose gel. Lanes 2 and 5 show DNA size markers.

## 803. Tissue-Specific Isoenzymes in the Cow (EXP-803)

Isoenzymes are different molecular forms of the same enzyme and five major lactate dehydrogenase (LDH) isoenzymes are found in vertebrate tissues. The amounts of the isoenzymes vary in a tissue specific manner and these differences can be readily detected by localizing LDH activity in an agarose gel after electrophoresis of tissue extracts. In this exercise, students prepare a tissue extract from calf thymus and then compare the LDH isoenzyme profile to those from calf serum, heart and muscle.



From Edvotek



### What Is PCR and How Does It Work?

Cat. #S-48



This simulation experiment demonstrates the process of DNA amplification by PCR and how the amplified product is detected by separating the reaction mixture by agarose gel electrophoresis.

 For 10 Lab Groups

 Complete in 45 minutes

 Download Instructions

# BI 306 New labs

From Carolina Biologicals



## HNPCC: Detecting Inherited Forms of Cancer GelGreen™ Kit

Item # 214821P **Exclusive**



[Write a review](#)

Cancer diagnostics and treatments are on the front line of the biotechnological revolution. Your students get into the action by taking on the roles of researcher, clinician, and genetic counselor as they attempt to diagnose a family of patients. Using pedigrees and a simulated DNA-based diagnostic, students explore the genes linked to hereditary nonpolyposis colorectal cancer (HNPCC) in a fictitious family. Kit uses GelGreen™ DNA stain. Includes perishable materials



## Genetic Corn Seed, Green:Albino

Item # 177130



[Read all reviews](#)

[Write a review](#)

4.8 / 5

### Study Dominant vs. Recessive Traits

- Easy to score
- Can see results in just 14 days
- For teaching dominance/recessiveness

3:1. In just 2 weeks, students can reap the benefits of growing their own corn that demonstrates dominant and recessive genes. From an albino strain giving a ratio of 3 green:1 albino in the seedlings.

# Examples of Teaching Effectiveness

BI 101  
Introductory Biology

## BI 101 Introductory Biology Spring 2016

Dr. Tina Hubler  
336 SETB  
765-4761  
[trhubler@una.edu](mailto:trhubler@una.edu)

- Office hours: M 11:30 -1:30 T 11:00 -2:00 W 11:30 -1:30  
Other times by appointment Research lab 345
- Text: Biology Today and Tomorrow, 5th Edition, Cecie Starr  
Students are responsible for reading textbook chapters corresponding to class lectures.
- Lab Manual: BI 101 Introductory Biology Laboratory Manual, ISBN:9781133886884.  
*Each student must have a new lab manual!*
- Course Objective: This course is an introduction to the unity and diversity of life on earth. We will learn about the composition of living things, how they function, where they live, and the impact of human activity on the biosphere. The overall goal is to develop an understanding of the interdependence of living and nonliving things on our planet. The laboratory exercises will provide reinforcement to key concepts we discuss in lecture.
- Classroom participation: It is expected that mature students participate in class by managing themselves so that other students have the maximum opportunity to learn. Distractive behavior, such as repeated tardiness, electronic devices out during class and private conversations during class, will result in loss of class participation points. All electronic devices (phones, computers, etc.) are to be turned off and kept out of sight while in the classroom.
- Attendance: Regular class attendance improves students' grades. Attendance will be taken (beginning of class) at each class. Excused absences require documentation e.g. physician note for illness; notice of required scheduled university-sponsored event; notice of death in family. Missed assignments or tests as a result of unexcused absences result in a grade of zero ("0").
- Tardiness is disruptive to class. Therefore, assigned seating has been arranged for tardy students..
- \*\*\*\* The student is responsible for all announcements, assignments, material discussed and missed work if absent or tardy. \*\*\*\***
- Assignments: Assignments are due on the designated date, regardless of whether the student is present in class when the assignment is made. Late work will not be accepted. If a student's absence is unexcused, the assignment will not be accepted. If the student's absence is excused, the student must provide documentation and the assignment 's due date will be scheduled.

Makeup exams: Make-up exams may be given only if the student contacts me by phone (not email) or in person BEFORE the exam and the absence is EXCUSED. The make-up exam may be a different exam and will be offered at the instructor's convenience.

Grading: **Lecture** 67% of grade  
Based on:  
four lecture tests (400 pts)  
online quiz (approximately 150 pts)  
other in-class assignments (approximately 40 pts)  
bonus points = sketches for first three exams. If all three are done completely, will contribute 1 point to OVERALL lecture grade  
class participation (10 pts) ~1.7 pt to OVERALL grade

Lecture Test: Questions derived from material discussed in class. Study notes from class lectures, using outlines as demonstrated in class. PowerPoints, outlines, Test Review Sheets and practice quizzes are available on Canvas.

Online quiz (10 pts each): Answer the Test Review Sheets (on Canvas) to prepare for one online quiz per chapter (on Canvas). The Test Review Sheet questions are NOT turned in. The online quiz must be completed during the online access period announced in class (usually 48 hours after chapter lecture completed). The lowest quiz grade will be dropped.

Bonus Points Sketches: Due at the exam class period. Must follow the instructions on Canvas, be drawn or traced (not printed from Canvas), neat, complete (all parts included), labeled with figure numbers **and stapled** to receive credit. No late work accepted.

**Lab** 33% of grade (see lab syllabus)

A = 90-100 B = 80-89 C = 70-79 D = 60-69 F = 59 or less

Any incident involving plagiarism or dishonesty results in a grade of "0".

**Lecture Schedule – Spring 2016**  
**NOTE: This is a tentative schedule**  
**Dates for exams to be announced in class!**

**Introduction**

Chpt 1	Invitation to Biology	note-taking	
Chpt 2	Molecules of life		
Chpt 3	Cell structure		
Chpt 4	Energy and Metabolism	(approximately mid Feb)	<b>Test # 1</b>
Chpt 5	Capturing and releasing energy: Photosynthesis		
	Respiration		
Chpt 8	How cells reproduce	(approximately mid Mar)	<b>Test # 2</b>
Chpt 6	DNA structure and function		
Chpt 7	Gene expression and control		
Chpt 9	Patterns of inheritance	(approximately mid Apr)	<b>Test # 3a,3b</b>
Chpt 12	Processes of evolution		
Chpt 13	Early life		
Chpt 14	Plant evolution	(on final exam day)	<b>Test # 4</b>



**Academic Honesty:** Students of the university academic community are expected to adhere to commonly accepted standards of academic honesty. Allegations of academic dishonesty can reflect poorly on the scholarly reputation of the University including students, faculty and graduates. Individuals who elect to commit acts of academic dishonesty such as cheating, plagiarism, or misrepresentation will be subject to appropriate disciplinary action in accordance with university policy.

Incidents of possible student academic dishonesty will be addressed in accordance with the following guidelines:

1. The instructor is responsible for investigating and documenting any incident of alleged academic dishonesty that occurs under the instructor's purview.
2. If the instructor finds the allegation of academic dishonesty to have merit, then the instructor, after a documented conference with the student, will develop a plan for disciplinary action. If the student agrees to this plan, then both instructor and student will sign the agreement. The faculty member will forward a copy of the signed agreement to the Office of Student Conduct for record-keeping purposes.
3. If the student disagrees with the instructor's proposed plan for disciplinary action and wishes to take further action, he/she is responsible for scheduling a meeting with the chair of the department where the course is housed to appeal the proposed disciplinary plan. The department chair shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the departmental level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the dean of the college where the course is housed to appeal the proposed disciplinary plan. The college dean shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the college level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the Vice President for Academic Affairs and Provost (VPAA/P) to appeal the proposed disciplinary plan. The VPAA/P shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. After reviewing all documentation, the VPAA/P may, at his/her discretion, choose either to affirm the proposed action, to refer the case to the Office of Student Conduct for further review, or to dismiss the matter depending on the merits of the case. The final disposition of the case will be disseminated to appropriate parties, including the Office of Student Conduct.
4. If a student is allowed academic progression but demonstrates a repeated pattern of academic dishonesty, the VPAA/P may, after consultation with the Office of Student Conduct, assign additional penalties to the student, including removal from the University.

#### **Communication:**

The official method of communication at UNA is UNA portal, with emphasis placed on University email.

#### **Disability Accommodations:**

In accordance with the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973, the University offers reasonable accommodations to students with eligible documented learning, physical and/or psychological disabilities. Under Title II of the Americans with Disabilities Act (ADA) of 1990, Section 504 of the Rehabilitation Act of 1973, and the Americans with Disabilities Amendment Act of 2008, a disability is defined as a physical or mental impairment that substantially limits one or more major life activities as compared to an average person in the population. It is the responsibility of the student to contact Disability Support Services to initiate the process to develop an accommodation plan. This accommodation plan will not be applied retroactively. Appropriate, reasonable accommodations will be made to allow each student to meet course requirements, but no fundamental or substantial alteration of academic standards will be made. Students needing assistance should contact Disability Support Services (256-765-4214).

#### **Title IX:**

The University of North Alabama has an expectation of mutual respect. Students, staff, administrators, and faculty are entitled to a working environment and educational environment free of discriminatory harassment. This includes sexual violence, sexual harassment, domestic and intimate partner violence, stalking, gender-based discrimination, discrimination against pregnant and parenting students, and gender-based bullying and hazing.

**Faculty and staff are required by federal law to report any observations of harassment (including online harassment) as well as any notice given by students or colleagues of any of the behaviors noted above.** Retaliation against any person who reports discrimination or harassment is also prohibited. UNA's policies and regulations covering discrimination and harassment may be accessed at [www.una.edu/titleix](http://www.una.edu/titleix). If you have experienced or observed discrimination or harassment, confidential reporting resources can be found on the website or you may make a formal complaint by contacting the Title IX Coordinator at 256-765-4223.

# BI 101 Five ways to succeed

Lecture Schedule – Spr 2016

NOTE: This is a tentative schedule

Dates for exams **to be announced** in class!

## Introduction

Chpt 1 Invitation to Biology note-taking  
Chpt 2 Molecules of life  
Chpt 3 Cell structure  
Chpt 4 Energy and Metabolism  
(approximately mid February) **Test # 1**

Chpt 5 Capturing and releasing energy:  
Photosynthesis  
Respiration  
Chpt 8 How cells reproduce  
(approximately mid March) **Test # 2**

Chpt 6 DNA structure and function  
Chpt 7 Gene expression and control  
Chpt 9 Patterns of inheritance  
(approximately mid April) **Test # 3**

Chpt 12 Processes of evolution  
Chpt 13 Early life  
Chpt 14 Plant evolution  
(on final exam day) **Test # 4**



**5 Steps  
to success!**

1. Come to class

2. Take good notes

3. Test Review Questions

4. Test Review Quizzes

5. Prepare for Test

# BI 101 Recorded lectures on Canvas



☰ ▾ **chpt 7 gene expression**

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☰ 📄 chpt7 Gene expression and control.ppt

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☰ 📄 intro biol chpt7 gene expression outline.doc

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☰ 📄 practice quiz gene expression.ppt

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☰ 📄 chpt 7 part 1 video.htm

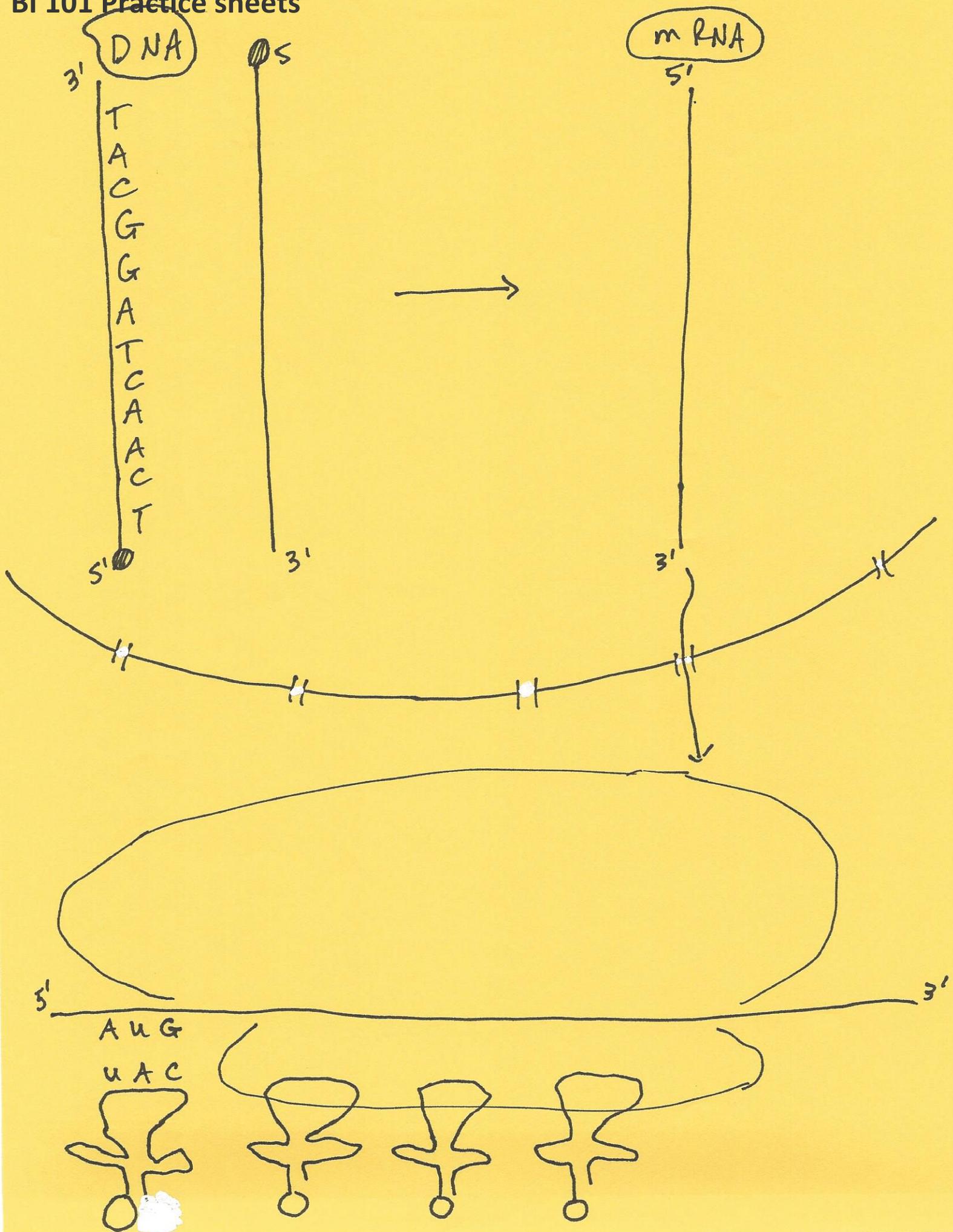
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☰ 📄 chpt 7 part 2 video.htm

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☰ 📄 YouTube links for chpt 6 and 7 videos.docx

BI 101 Practice sheets



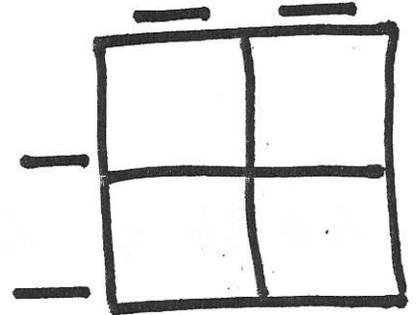
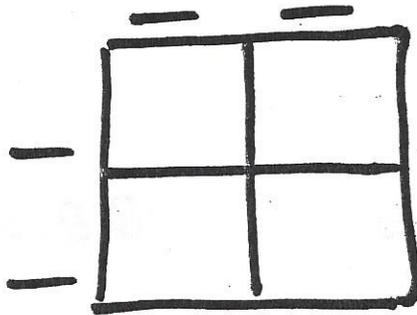
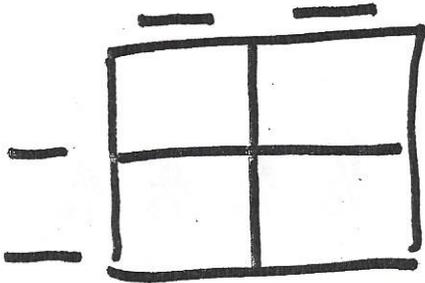
# Intro to Punnett Squares

BB = brown Bb = brown bb = blue **Complete dominance**

D = Brown eyes (homozygous)  
M = Blue eyes (homozygous)

D = Brown eyes (homozygous)  
m = brown eyes (heterozygous)

D = Brown eyes (heterozygous)  
M = Brown eyes (heterozygous)

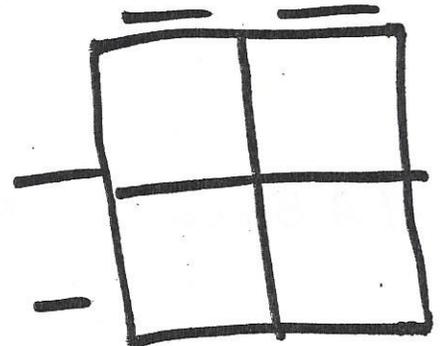
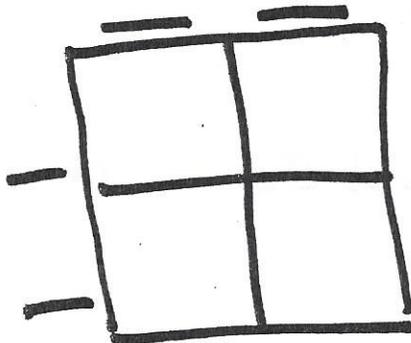
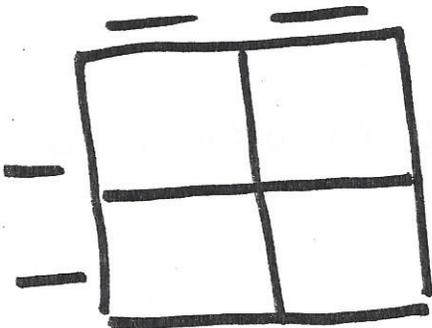


RR = red Rr = pink rr = white **Incomplete dominance**

D = Red (homozygous)  
M = White (homozygous)

D = Pink (heterozygous)  
M = Pink (heterozygous)

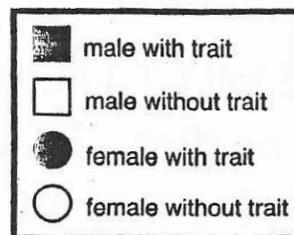
D = Pink (heterozygous)  
M = white (homozygous)



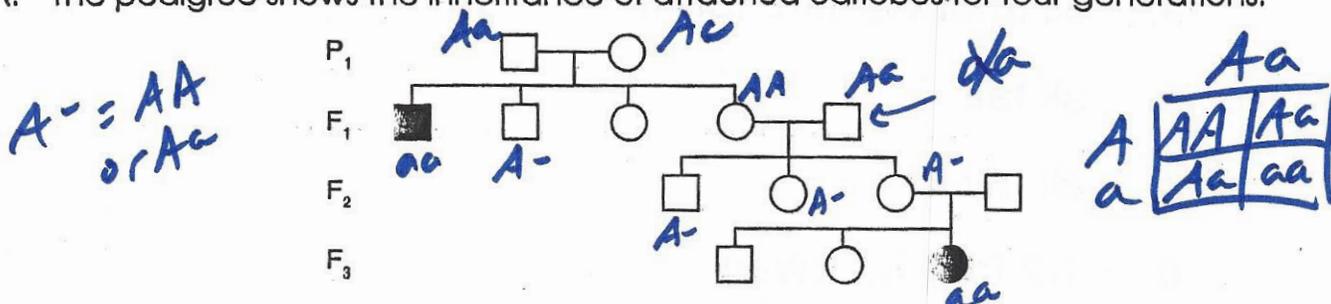
# HUMAN PEDIGREES

Name \_\_\_\_\_

By studying a human pedigree, you can determine whether a trait is dominant or recessive. To interpret the three pedigrees below, use the same key shown at the right. Of course, the individual with the trait could be homozygous dominant or heterozygous dominant.



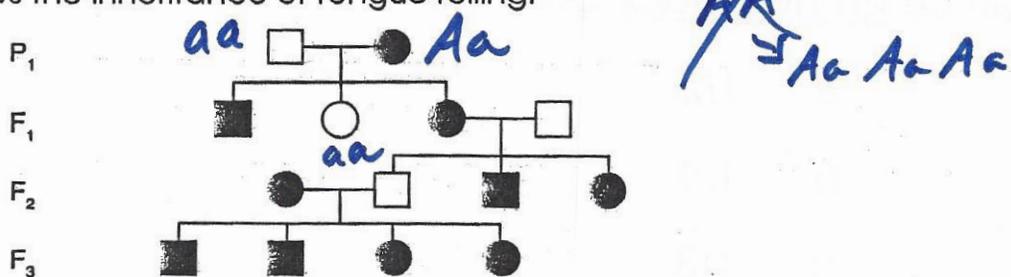
A. The pedigree shows the inheritance of attached earlobes for four generations.



Is the trait for attached earlobes, versus free earlobes, dominant or recessive?

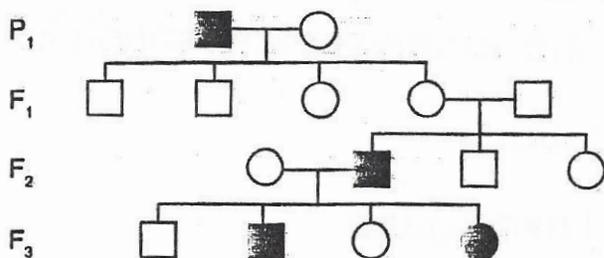
\_\_\_\_\_ How do you know? skips generation

B. The pedigree shows the inheritance of tongue rolling.



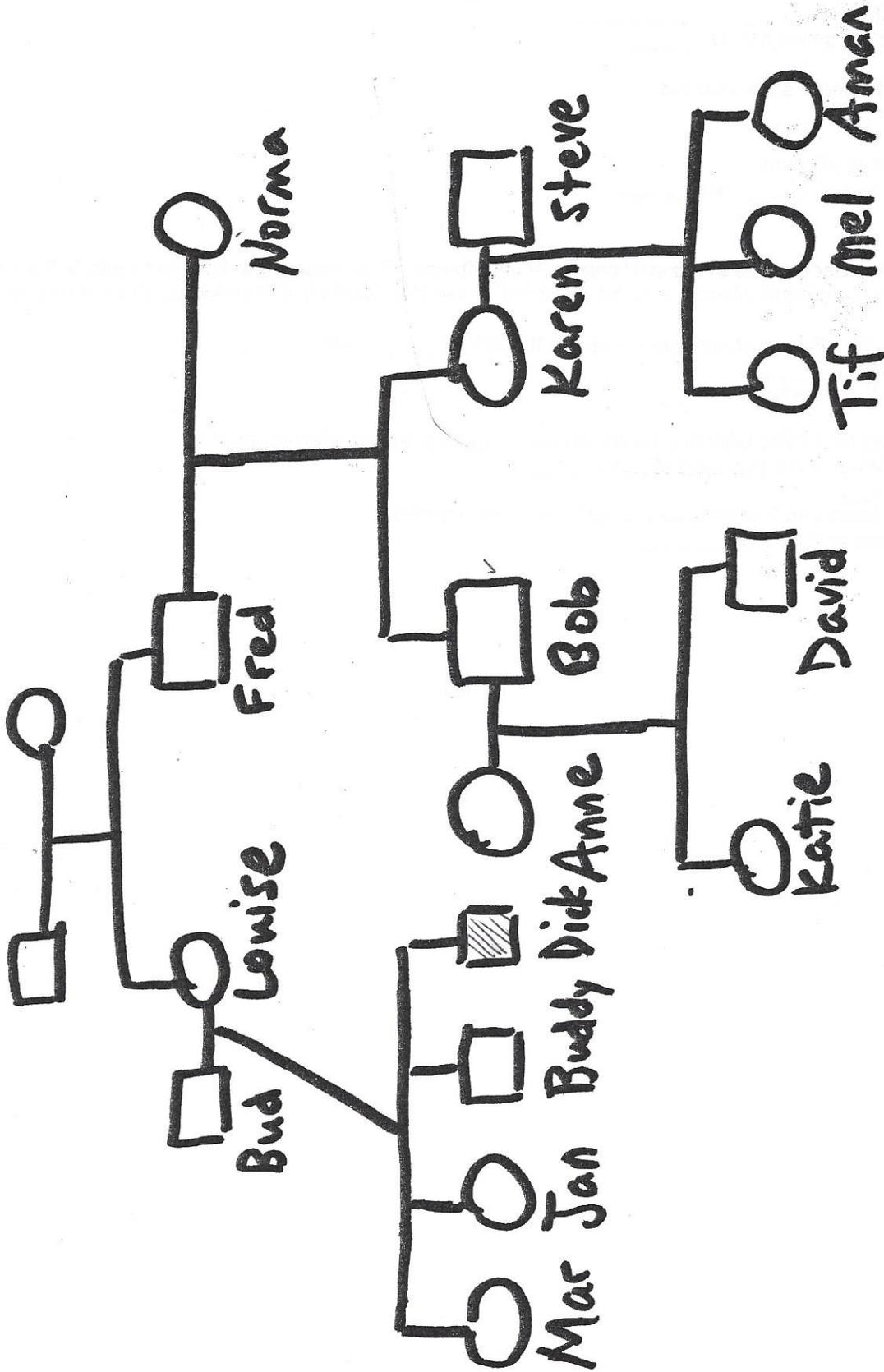
Is this trait dominant or recessive? dom Explain. every gen.

C. This pedigree shows the inheritance of colorblindness, a sex-linked trait.



Is this trait dominant or recessive? Rec Is the mother of the colorblind girl in the F<sub>3</sub> generation colorblind, a carrier, or a person with normal color vision?

\_\_\_\_\_ Explain. X-linked !! males!!



Practice

BI 101 Practice sheets

P<sub>1</sub> = Aa Bb Cc Dd Ee

P<sub>2</sub> = Aa Bb Cc Dd Ee

gametes ABCDE

abcde

offspring = Aa Bb Cc Dd Ee



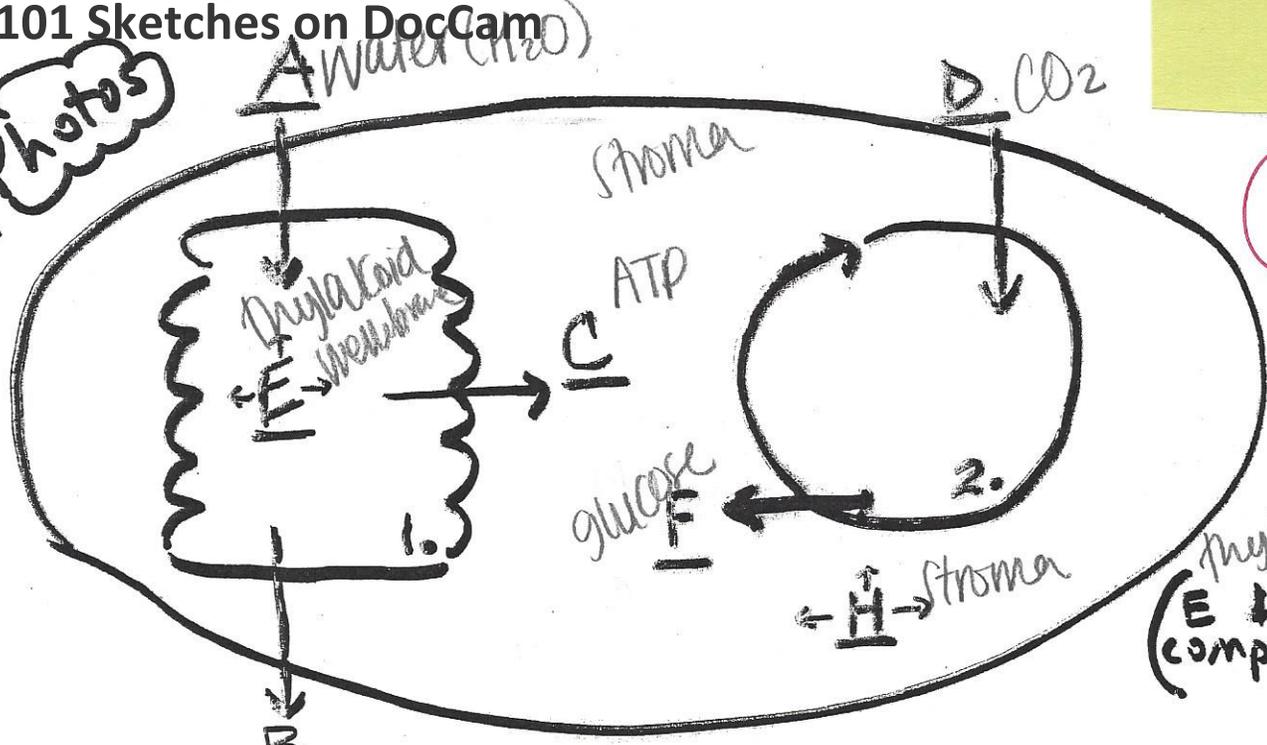
	homoz dominant AA	heteroz Aa	homoz recessive aa
A eyes			
B eyebrows			
C nose			
D mouth			
E ears			

Your offspring:



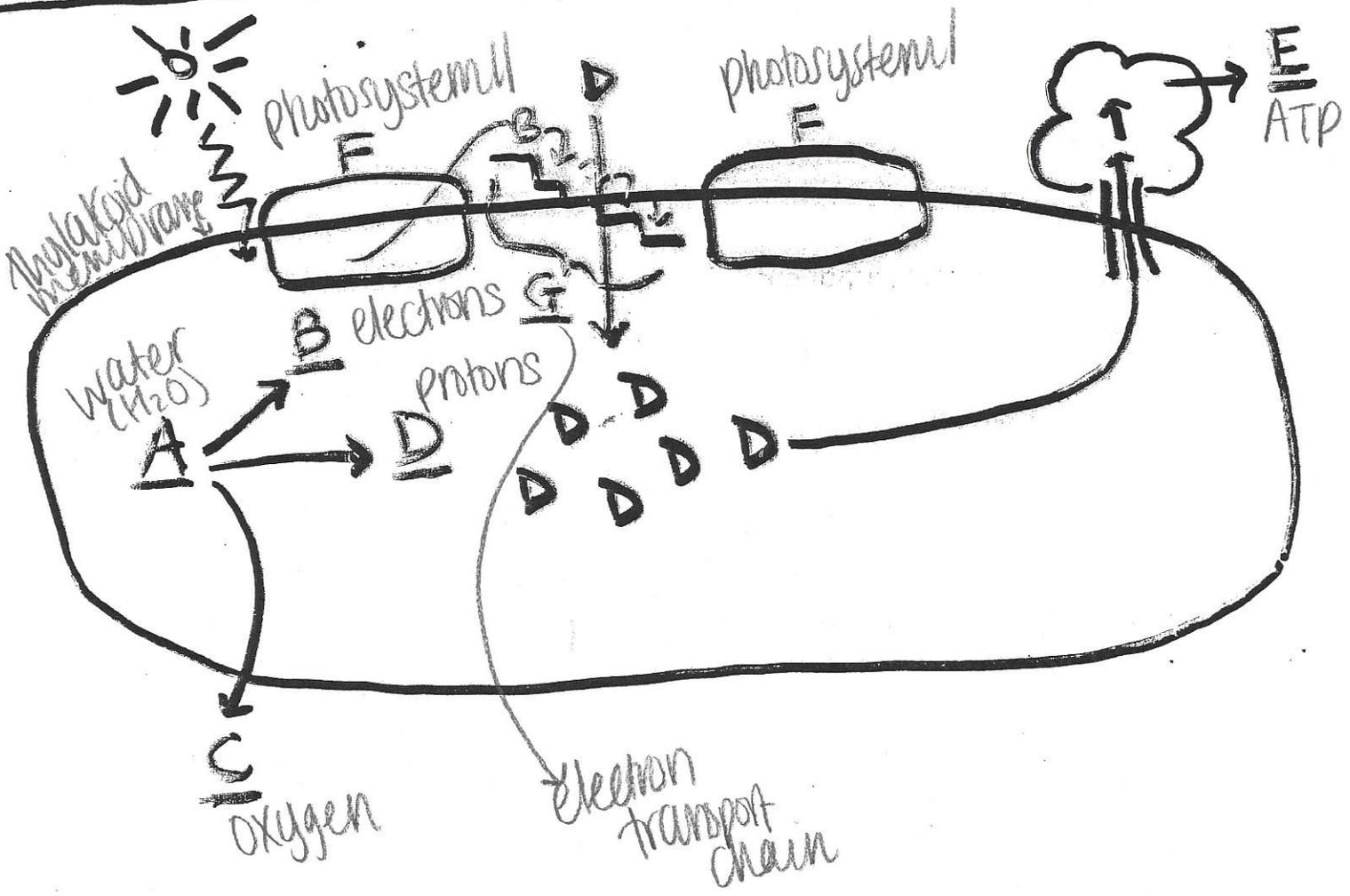
Name is Dr. Kitts

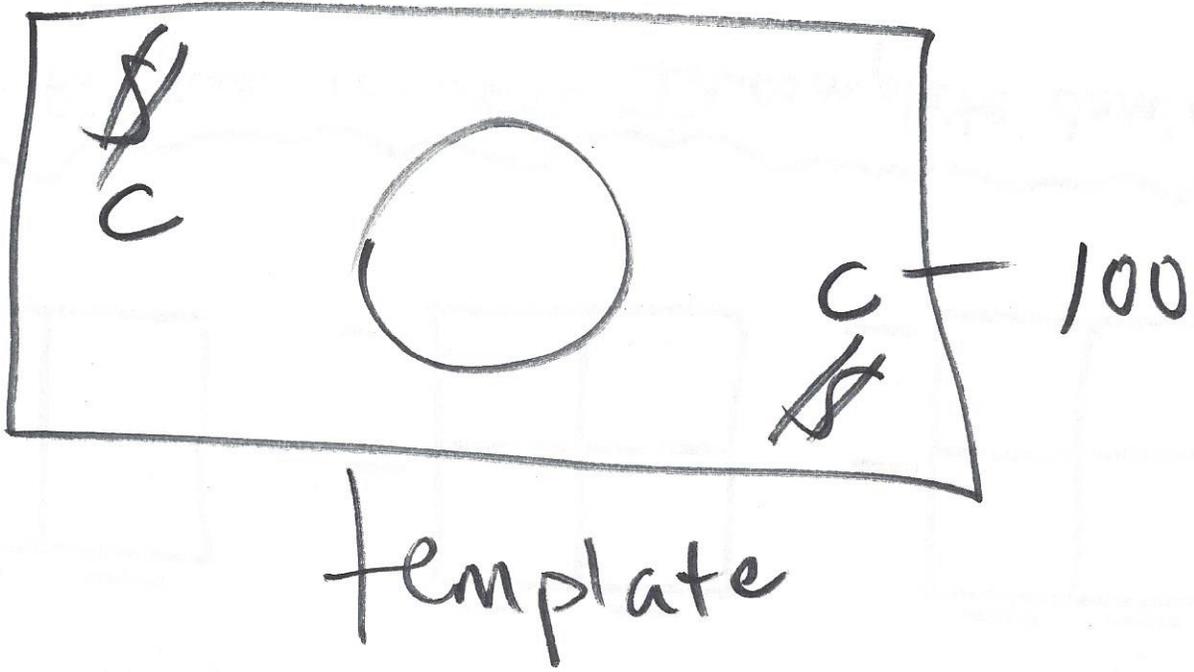
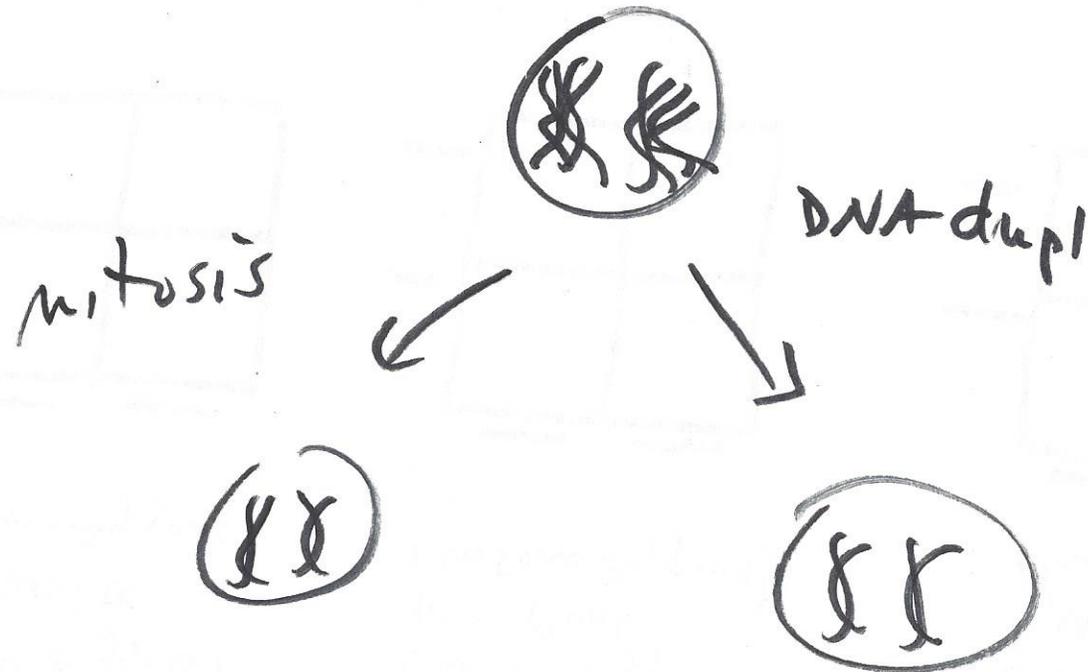
Photos



20

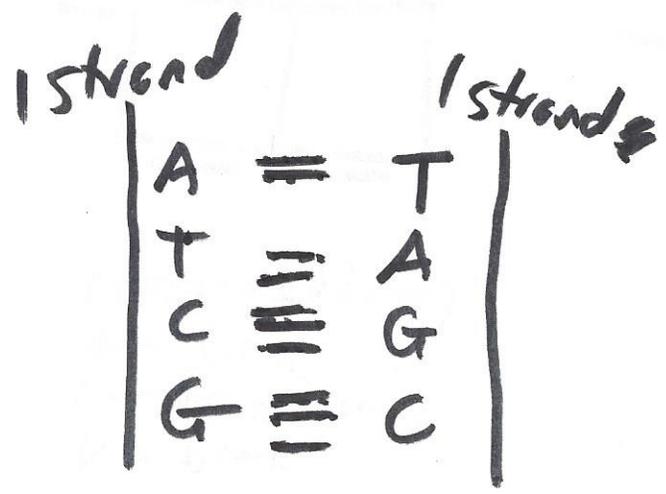
G Which is light dependent, 1, or 2.





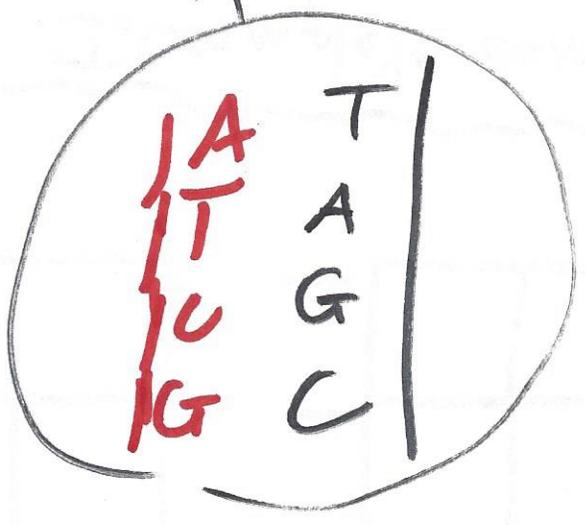
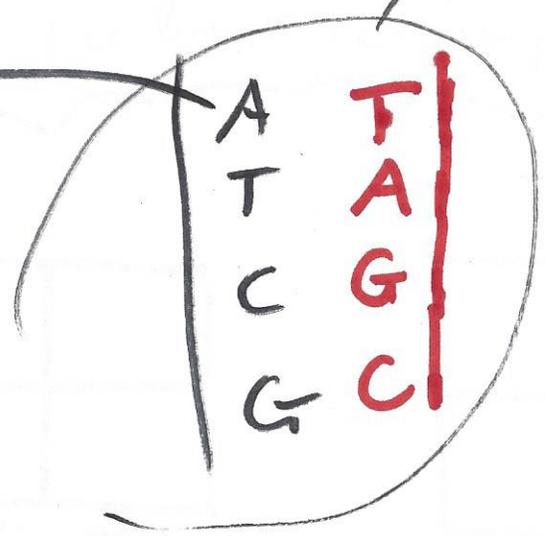
I X V C M

DNA dupl

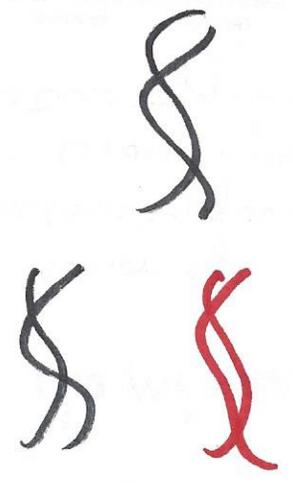


helicase

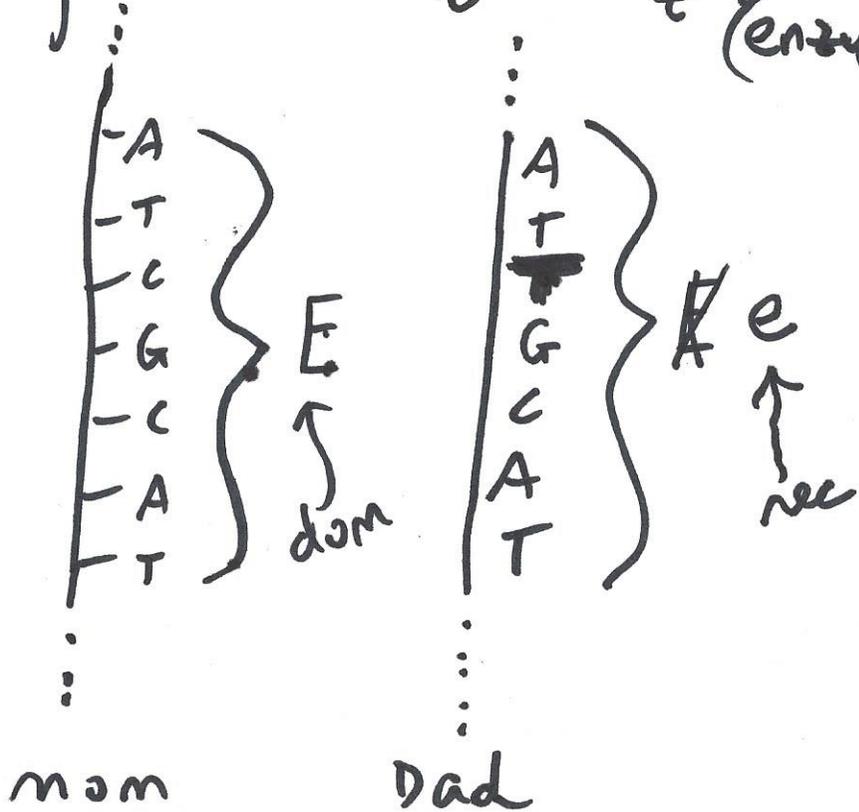
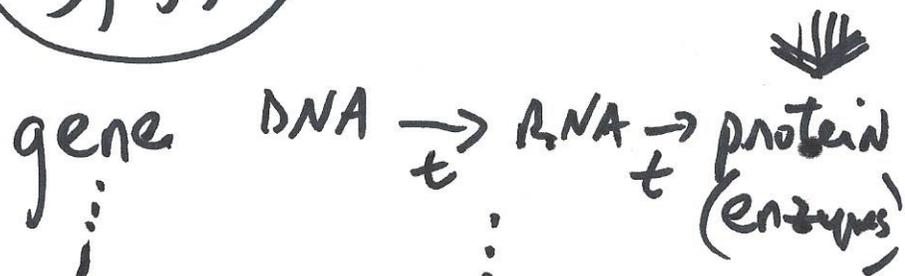
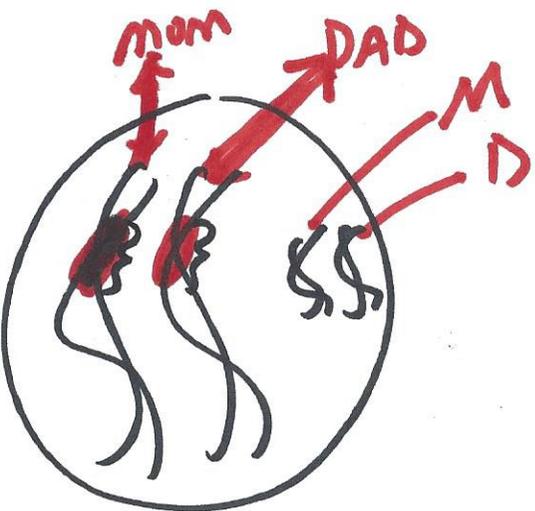
info



Complementary base pr



BI 101 Sketches on DocCam



Brown

blue



# BI 101 Outline on DocCam

## Intro Biol chpt 9 Outline

Mendel - monk, plant breeder, mathematician

Hypothesized: *parents give "info" to offspring*

### Genes:

Information in DNA

*traits ← proteins*

*Inheritance*

Heredity =

Locus = location on chromosome

*position*

e.g. ATP synthase has a specific location on human chromosome 7



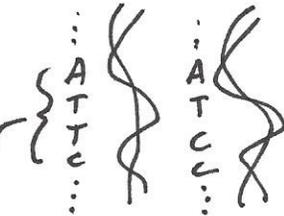
### Alleles

Homologous chromosomes

Pairs (one from mom; one from dad)

NOT IDENTICAL

Each chromosome has a copy of each gene



Allele = different versions of a gene

*ATTC vs. ATCC*

Different versions occur as a result of mutation

Dominant allele

Masking = we see the effects of one allele and not the other

*phenotype*

### Allele combinations

Homozygous = 2 of the same alleles

*AA*

Dominant

Recessive

*aa*

Heterozygous = 2 different alleles

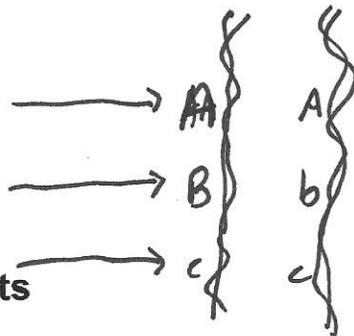
*Aa*

### Chromosomes

Alleles

Locus

Allele pairs

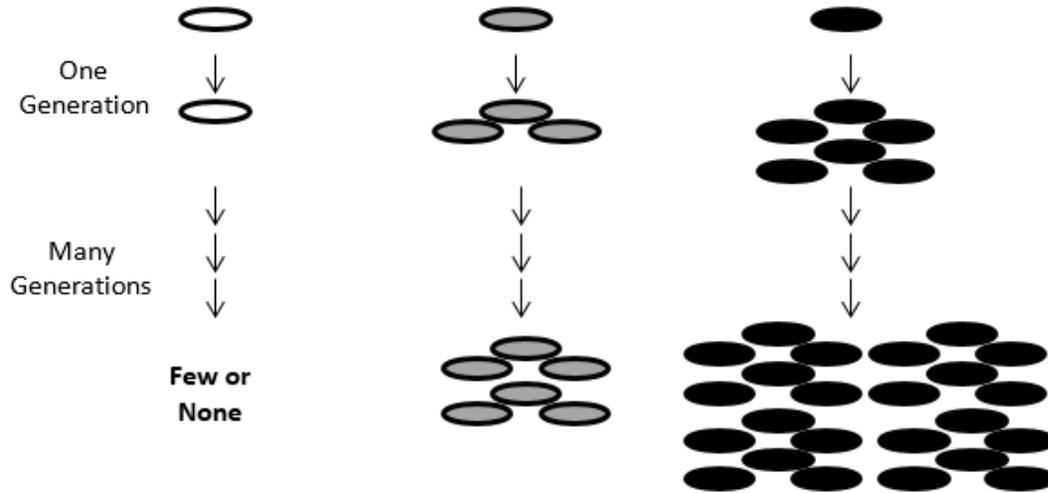


*3 Loci  
1 = homozygous dom  
1 = homozygous rec  
1 = heterozygous*

### Cross fertilization of pea plants

# BI 101 Diagram from published article used in lecture

Diagram selected from Hubler *et al.*, *Instant Update: Considering the Molecular Mechanisms of Mutation and Natural Selection* (The American Biology Teacher 77(1):6-9) for use in BI 101 evolution discussion.



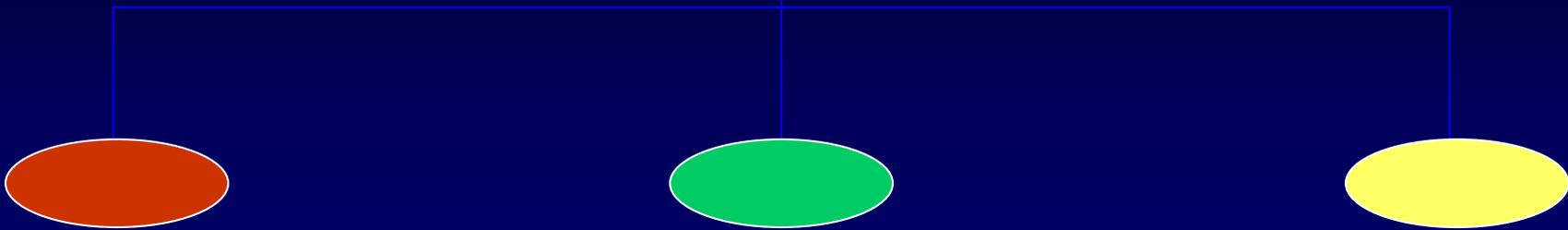
**Figure 2. The effect of selection on the number of surviving organisms (dots) carrying harmful (clear), neutral (gray) or beneficial (black) mutations.**

# Polymorphism



**How DNA mutations cause populations to change  
Over MANY generations by natural selection**

# BI 101 Population change PowerPoint



Harmful mutation

⋮  
A  
A  
C  
G  
⋮

“shorter life span”

Neutral mutation

⋮  
A  
→ T  
C  
G  
⋮

“normal life span”

Beneficial mutation

⋮  
A  
C  
C  
G  
⋮

“longer life span”

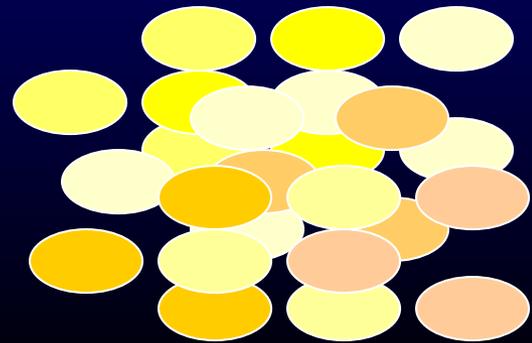
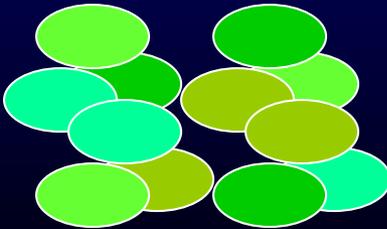
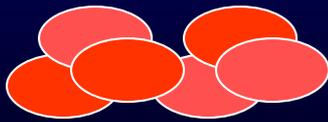
# BI 101 Population change PowerPoint

Male

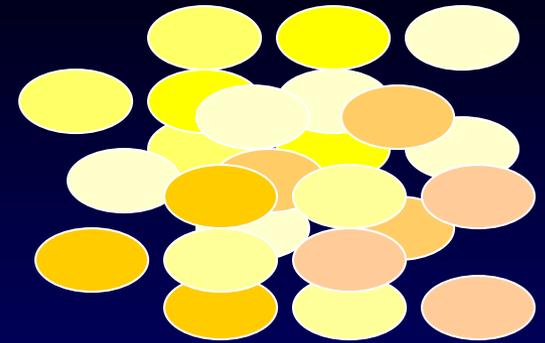
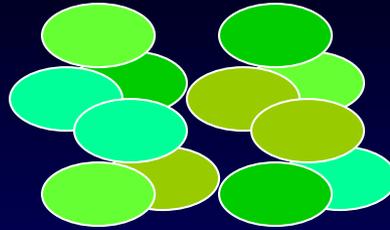
Female



More offspring

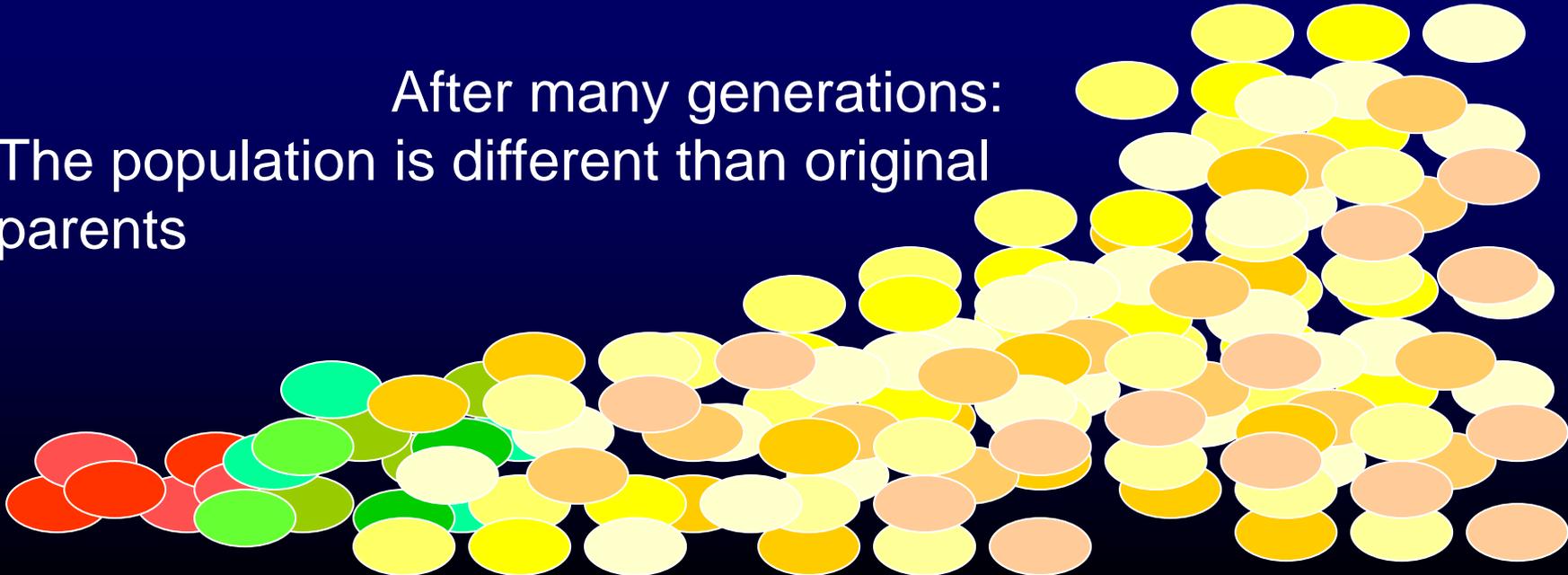


# BI 101 Population change PowerPoint



After several generations:  
The population is more varied than original parents

After many generations:  
The population is different than original  
parents



Populations  
Are  
Always  
Changing

# BI 101 HHMI videos

## BI 101 Howard Hughes Medical Institute - Videos on Evolution

### The Origin of Species: The Making of a Theory



In the early 1800s, most people, scientists included, accepted as fact that every species was specially created by God in a form that never changed. The epic voyages and revolutionary insights of two brave young British naturalists, Charles Darwin and Alfred Russel Wallace, overturned this

long-held idea. Prodigious collectors of animals and plants, each man developed a keen appreciation for the variation within species, the relatedness of species, and the patterns of geographic distribution—evidence that was hard to reconcile with special creation. This hard-earned knowledge led each to ask *why* and *how* creatures came to live in a given place.

<http://www.hhmi.org/biointeractive/origin-species-making-theory>

### The Origin of Species: The Beak of the Finch



Over the past four decades, evolutionary biologists Rosemary and Peter Grant have documented the evolution of the famous Galápagos finches by tracking changes in body traits directly tied to survival, such as beak length, and identified behavioral

characteristics that prevent different species from breeding with one another. Their pioneering studies have revealed clues as to how 13 distinct finch species arose from a single ancestral population that migrated from the mainland 2 million to 3 million years ago.

<http://www.hhmi.org/biointeractive/origin-species-beak-finch>

## The Making of the Fittest: natural selection and adaptation

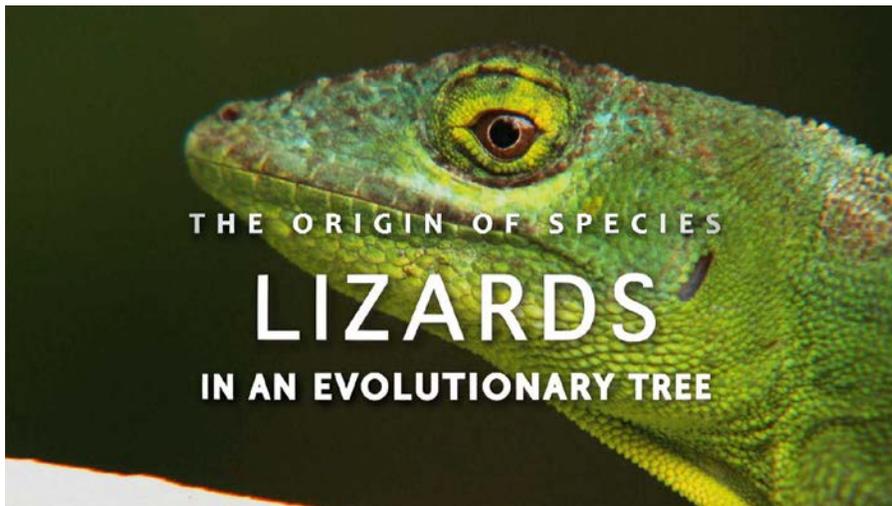


Not only is evolution happening right now everywhere around us, but adaptive changes can occur in a population with remarkable speed. This speed is essential if you're a desert mouse living in an environment where a volcanic eruption can reverse selective pressure in nearly an instant. The film features Dr. Michael

Nachman, whose work in the field and in the lab has quantified the selective pressure of predators and identified the genes involved in adaptation. In a complete story, from ecosystem to molecules, pocket mice show us how random changes in the genome can take many paths to the same adaptation—a colored coat that hides them from predators.

<http://www.hhmi.org/biointeractive/making-fittest-natural-selection-and-adaptation>

## The Origin of Species: Lizards in an Evolutionary Tree



Working in the islands of the Caribbean, biologist Jonathan Losos has discovered the traits that enable dozens of anole species to adapt to different vertical niches in the forest. While differences in limb length, body shape, and toepad size allow different species to flourish on the ground,

on thin branches, or high in the canopy, changes in other characters, such as their colorful dewlaps, have played a key role in reproductive isolation and the formation of new species.

<http://www.hhmi.org/biointeractive/origin-species-lizards-evolutionary-tree>

# BI 101 HHMI videos and outlines

Origin of Species Lizards

Anoles feed on spiders and insects

Their habitats may be divided vertically (distance from ground)

Bush anoles are long tailed

Trunk anoles have long legs

Twig anoles have short legs

Canopy anoles have large foot pads

Speeds of different species

Sprinter long- legged trunk anole

Scurrier – twig anole

Climbing large leaves

Trunk lizard cannot

Canopy lizard holds on w/ foot pads

Experiment:

Caribbean islands are “scrubbed free” of lizards by weather (hurricanes)

Makes a great laboratory

Female and male anoles were placed on an island

One year later, new populations of offspring were captured and leg lengths measured

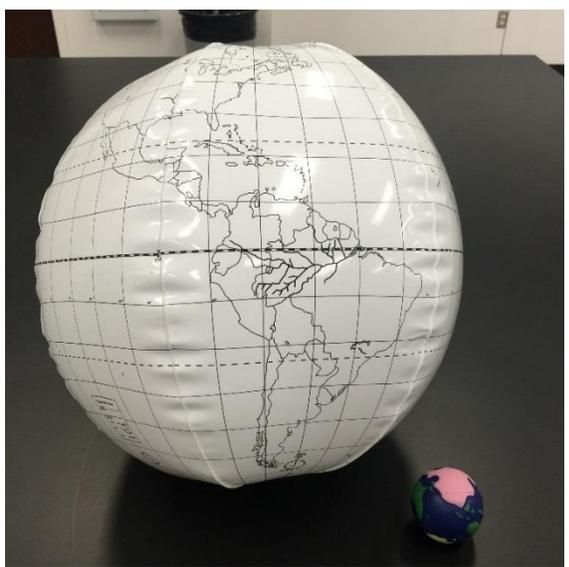
Returned each year

Over 4 years, average leg length shortened. HOW? WHY?

“Evolution can occur rapidly if the selection is strong”

# BI 101 Estimating percent surface water

Earth Models for estimating the surface area covered by water



Students toss the model from one person to the next randomly. If the person's right thumb lands on water we count 1 for water. Likewise for land. Then we tabulate:

<u>Water</u>	<u>Land</u>
### ##	### ##
### ##	
### ##	
###	

From these data we calculate the % water

$$(36 / 52) \times 100 = 69 \%$$

Next discuss the use of models, collecting data, interpreting data, repeating experiments, etc.

# BI 101 Pedigrees

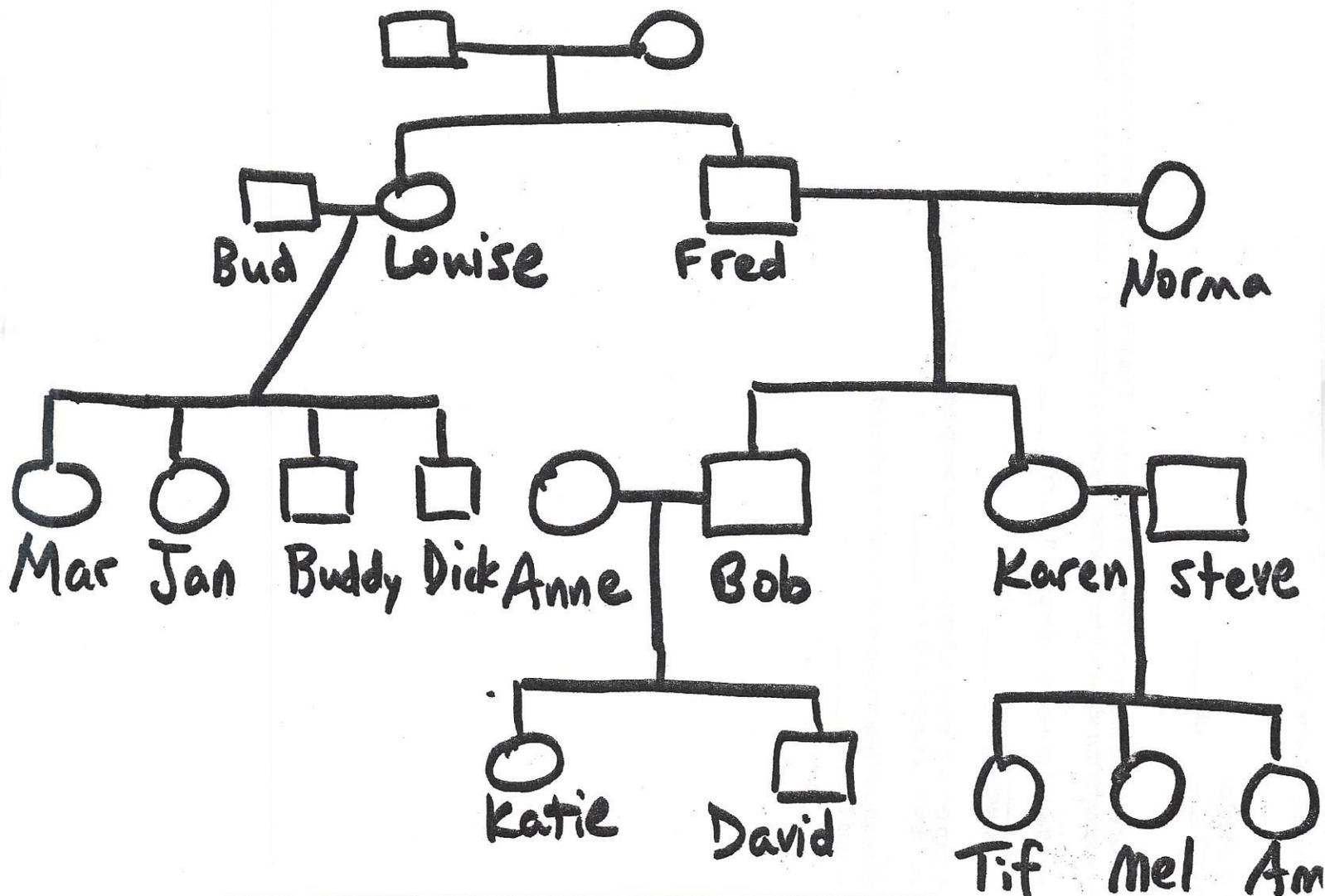
## Create a Blackett Family Pedigree

### Blackett Family Members

The Blackett Family DNA Activity is largely a genetic study of the inheritance of alleles in an extended family. Bob Blackett has tested DNA samples from himself and 13 other relatives. The first task of a human geneticist is the creation of a family tree, or **pedigree** to help with the interpretation of genotypes. From the following relationships, construct a pedigree for the Bob and his relatives. *Draw the tree.*

Person	Family Relationship
Bob	Our propositus
Anne	Wife
David	Son
Katie	Daughter
Fred	Father
Norma	Mother
Karen	Sister
Steve	Husband of Karen

Tiffany	Daughter of Karen and Steve
Melissa	Daughter of Karen and Steve
Amanda	Daughter of Karen and Steve
Louise	Sister of Fred; Bob's Aunt
Bud	Husband of Louise
Buddy	Son of Bud and Louise
Dick	Son of Bud and Louise
Marilyn	Daughter of Bud and Louise
Janet	Daughter of Bud and Louise



# BI 101 Cilia and flagella

Cilia and flagella

Cilia

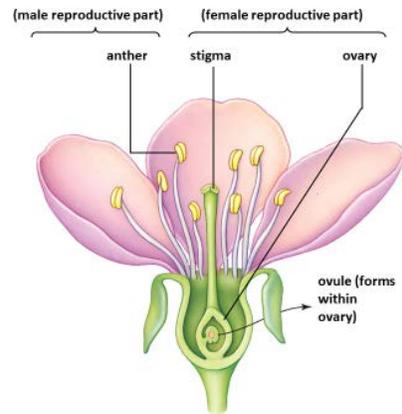


Wisteria vine flagellum



# BI 101 Plant reproduction on DocCam

BI 101 Flowering Plant Reproduction for genetics - gametes



Daffodils from my yard



# BI 101 Albino eyelashes

## Albino Eyelashes

Bob's



Tina's



# Examples of Teaching Effectiveness

BI 101  
Introductory Biology Lab

**BI 101 Introductory Biology Lab**  
**Spring 2016**

Dr. Tina Hubler      336 SETB  
256-765-4761      [trhubler@una.edu](mailto:trhubler@una.edu)

Office hours:      M 11:30 -1:30      T 11:00 -2:00      W 11:30 -1:30  
Other times by appointment      Research lab 345

Lab Manual:      BI 101 Introductory Biology Laboratory Manual, ISBN: 9781133886884.  
**Each student must have a new lab manual.**

Course Objective:      The Introductory Biology course is an introduction to the unity and diversity of life on earth. The overall goal is to develop an understanding of the interdependence of living and nonliving things on our planet. The laboratory experience is designed to help the student develop scientific skills such as observation, recording, and interpreting in addition to the use of scientific equipment. The laboratory exercises will provide reinforcement to key concepts discussed in lecture.

Laboratory participation:      It is expected that mature students participate in the lab by managing themselves so that other students have the maximum opportunity to learn. Repeated tardiness, private conversations during instruction, electronic devices out during lab or failure to clean up after lab will result in loss of lab participation points. Pertinent laboratory safety will be discussed at the beginning of each lab. Students are expected to adhere to these practices in order to participate in the lab. All electronic devices are to be turned off and kept out of sight while in the classroom.

Attendance:      Regular class attendance improves students' course grades. Attendance will be taken (beginning of lab). Excused absences require documentation e.g. physician note for illness; notice of required scheduled university-sponsored event; notice of death in family. Missed assignments or quizzes as a result of unexcused absences result in a grade of zero ("0"). You will be allowed to drop one zero resulting from an unexcused absence.

Tardy students will miss laboratory instructions and weekly lab quiz.  
Tardy students are not permitted to come into class and disrupt others for information while lab instructions are being given.

**\*\*\*\*\* The student is responsible for all announcements, assignments, material discussed and missed work, etc. if absent or tardy. \*\*\*\*\***

Assignments:      Assignments are due on the designated date, regardless of whether the student is present in class when the assignment is made. If the student's absence is unexcused, the assignment will not be accepted. For excused absences, class assignment is due at next lab meeting.

Makeup labs  
and quizzes:

No make-up labs will be offered. **The lab quiz may be made up for EXCUSED absences only and must be done within 1 week.**

Grading:

Lab 33% of grade for BI 101  
Based on:  
quizzes (one at beginning of each lab, 10 pts each)  
lab participation (5 pts each lab; 10 pts 1<sup>st</sup> lab)

A = 90-100 B = 80-89 C = 70-79 D = 60-69 F = 59 or less

Any incident involving plagiarism or dishonesty results in a grade of "0".

**Academic Honesty:** Students of the university academic community are expected to adhere to commonly accepted standards of academic honesty. Allegations of academic dishonesty can reflect poorly on the scholarly reputation of the University including students, faculty and graduates. Individuals who elect to commit acts of academic dishonesty such as cheating, plagiarism, or misrepresentation will be subject to appropriate disciplinary action in accordance with university policy.

Incidents of possible student academic dishonesty will be addressed in accordance with the following guidelines:

1. The instructor is responsible for investigating and documenting any incident of alleged academic dishonesty that occurs under the instructor's purview.
2. If the instructor finds the allegation of academic dishonesty to have merit, then the instructor, after a documented conference with the student, will develop a plan for disciplinary action. If the student agrees to this plan, then both instructor and student will sign the agreement. The faculty member will forward a copy of the signed agreement to the Office of Student Conduct for record-keeping purposes.
3. If the student disagrees with the instructor's proposed plan for disciplinary action and wishes to take further action, he/she is responsible for scheduling a meeting with the chair of the department where the course is housed to appeal the proposed disciplinary plan. The department chair shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the departmental level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the dean of the college where the course is housed to appeal the proposed disciplinary plan. The college dean shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. If a resolution is reached, the disposition of the case will be forwarded to the Office of Student Conduct. If a resolution at the college level is not reached and the student wishes to take further action, he/she is responsible for scheduling a meeting with the Vice President for Academic Affairs and Provost (VPAA/P) to appeal the proposed disciplinary plan. The VPAA/P shall mediate the matter and seek a satisfactory judgment acceptable to the faculty member based on meetings with all parties. After reviewing all documentation, the VPAA/P may, at his/her discretion, choose either to affirm the proposed action, to refer the case to the Office of Student Conduct for further review, or to dismiss the matter depending on the merits of the case. The final disposition of the case will be disseminated to appropriate parties, including the Office of Student Conduct.
4. If a student is allowed academic progression but demonstrates a repeated pattern of academic dishonesty, the VPAA/P may, after consultation with the Office of Student Conduct, assign additional penalties to the student, including removal from the University.

#### **Communication:**

The official method of communication at UNA is UNA portal, with emphasis placed on University email.

#### **Disability Accommodations:**

In accordance with the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973, the University offers reasonable accommodations to students with eligible documented learning, physical and/or psychological disabilities. Under Title II of the Americans with Disabilities Act (ADA) of 1990, Section 504 of the Rehabilitation Act of 1973, and the Americans with Disabilities Amendment Act of 2008, a disability is defined as a physical or mental impairment that substantially limits one or more major life activities as compared to an average person in the population. It is the responsibility of the student to contact Disability Support Services to initiate the process to develop an accommodation plan. This accommodation plan will not be applied retroactively. Appropriate, reasonable accommodations will be made to allow each student to meet course requirements, but no fundamental or substantial alteration of academic standards will be made. Students needing assistance should contact Disability Support Services (256-765-4214).

#### **Title IX:**

The University of North Alabama has an expectation of mutual respect. Students, staff, administrators, and faculty are entitled to a working environment and educational environment free of discriminatory harassment. This includes sexual violence, sexual harassment, domestic and intimate partner violence, stalking, gender-based discrimination, discrimination against pregnant and parenting students, and gender-based bullying and hazing.

**Faculty and staff are required by federal law to report any observations of harassment (including online harassment) as well as any notice given by students or colleagues of any of the behaviors noted above.** Retaliation against any person who reports discrimination or harassment is also prohibited. UNA's policies and regulations covering discrimination and harassment may be accessed at [www.una.edu/titleix](http://www.una.edu/titleix). If you have experienced or observed discrimination or harassment, confidential reporting resources can be found on the website or you may make a formal complaint by contacting the Title IX Coordinator at 256-765-4223.

BIOLOGY 101  
INTRODUCTORY BIOLOGY  
LABORATORY SCHEDULE / SPRING 2016

Science and Engineering Technology Building – Room 116

*(Monday – Thursday schedule)*

January 25 → January 28	Laboratory #1	Measurement and the Metric System
February 1 → February 4	Laboratory #2	Scientific Method
February 8 → February 11	Laboratory #3	Biochemistry
February 15 → February 18	Laboratory #4	Microscopy and Cell Structure
February 22 → February 25	Laboratory #5	Biological Membranes: Diffusion and Osmosis
February 29 → March 3	Laboratory #6	Enzyme Activity
March 7 → March 10	Laboratory #7	Respiration and Photosynthesis in Plants
March 14 → March 17	Laboratory #8	Mitosis and Embryology
March 21 → March 24	Laboratory #9	DNA Structure and Isolation from Plant Cells
March 28 → March 31	<i>LABS WILL NOT MEET THIS WEEK DUE TO SPRING BREAK</i>	
April 4 → April 7	Laboratory #10	Microevolution in Populations
April 11 → April 14	Laboratory #11	Biodiversity
April 18 → April 21	Laboratory #12	Foraging Ecology

Grading:

Lab

33% of grade for BI 101

Based on:

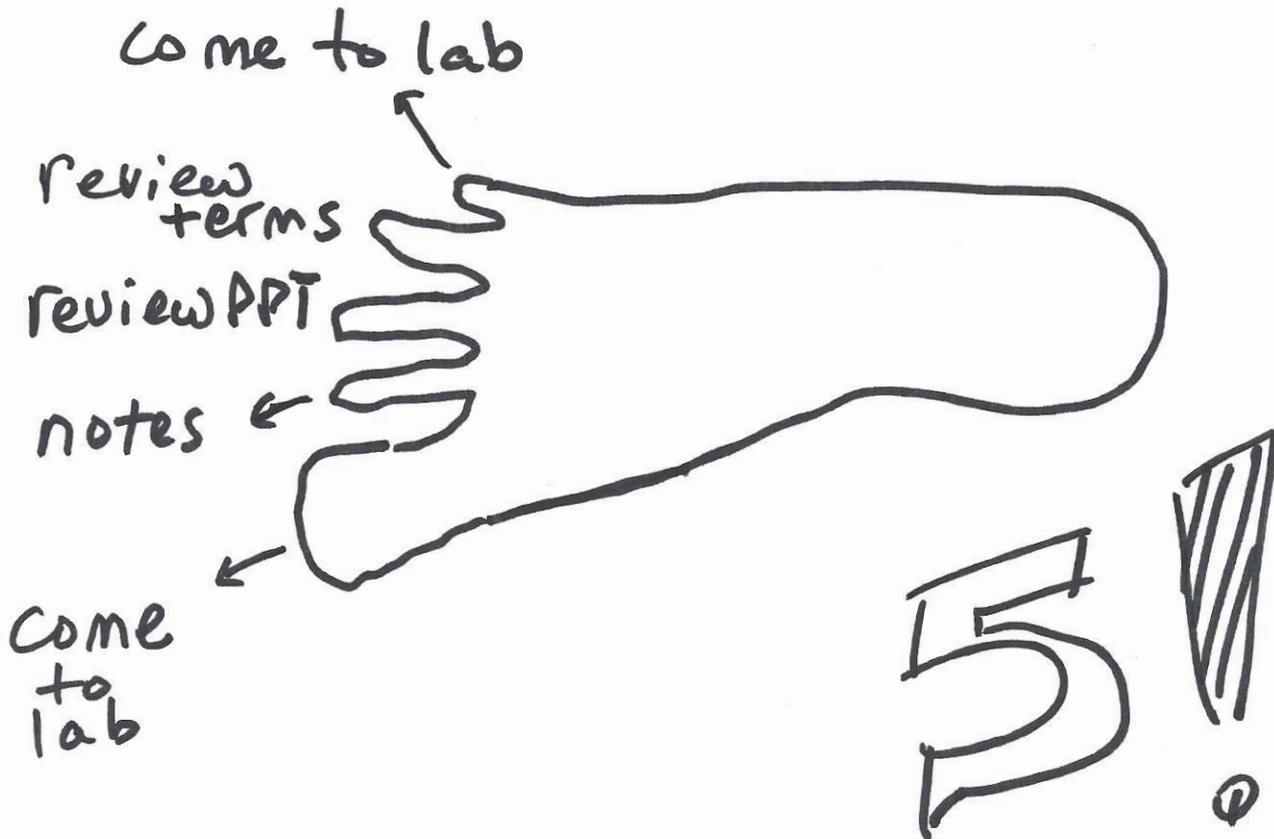
quizzes (one at beginning of each lab, 10 pts each)

lab participation (5 pts each lab; 10 pts 1<sup>st</sup> lab)

A = 90-100 B = 80-89 C = 70-79 D = 60-69 F = 59 or less

Any incident involving plagiarism or dishonesty results in a grade of "0".

# BI 101 Lab - Five ways to succeed

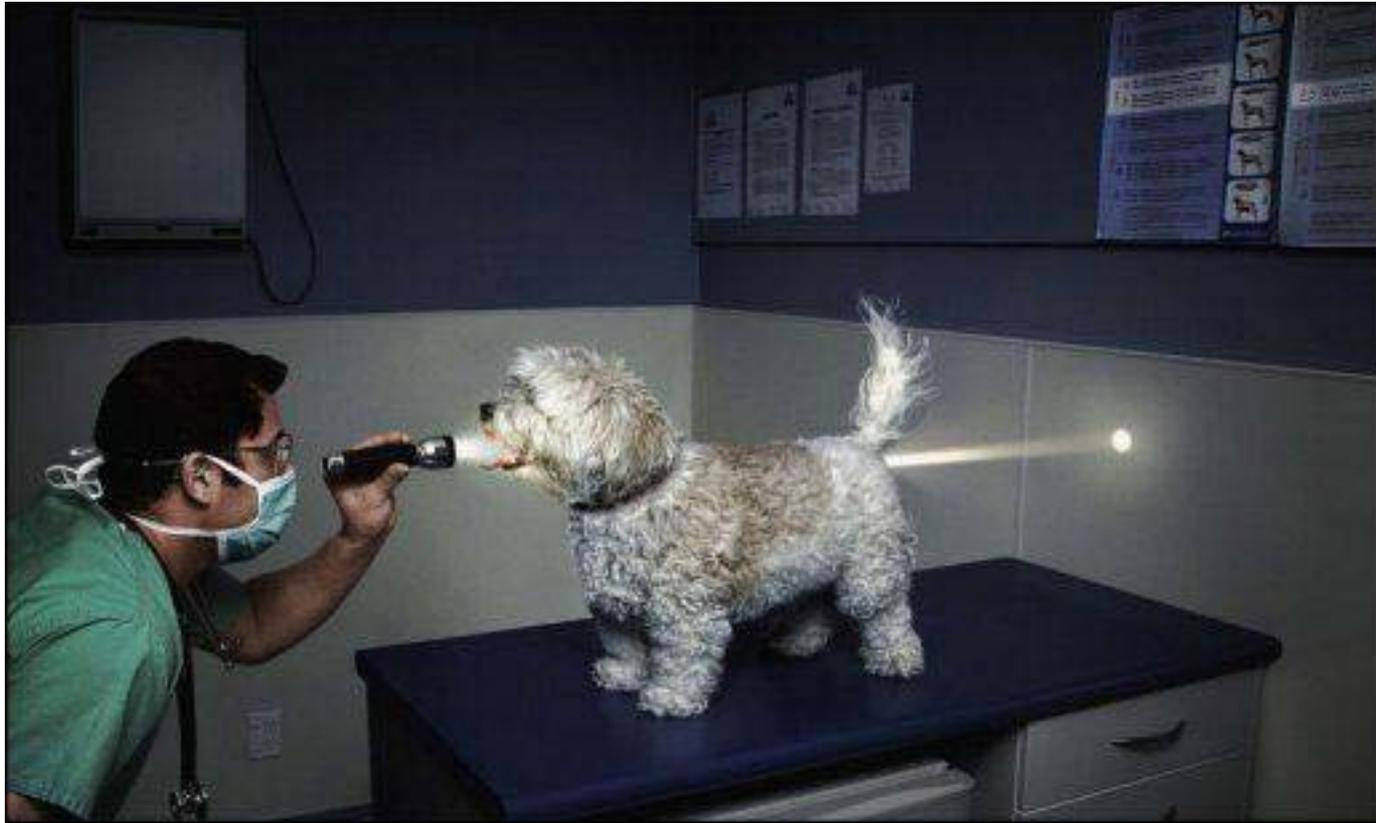


# BI 101 Lab PowerPoints

PowerPoints created for each BI 101 Lab and posted on Canvas. Includes: quiz topics, itinerary, background, safety and cleanup.

	 Bio Lab 1 Measurement.pptx		
	 Bio Lab 2 Sci Method.pptx		
	 Bio Lab 3 Biochemistry.pptx		
	 Bio Lab 4 Microscopy.pptx		
	 Bio Lab 5 diff osmosis.pptx		
	 Bio Lab 6 enzyme activity.pptx		
	 Bio Lab 7 photos resp.pptx		
	 Bio Lab 8 Mitosis Development.pptx		
	 Bio Lab 9 DNA.pptx		
	 Bio Lab 10 Microevolution.pptx		
	 Bio Lab 12 Foraging.pptx		

The digestive system is a tube



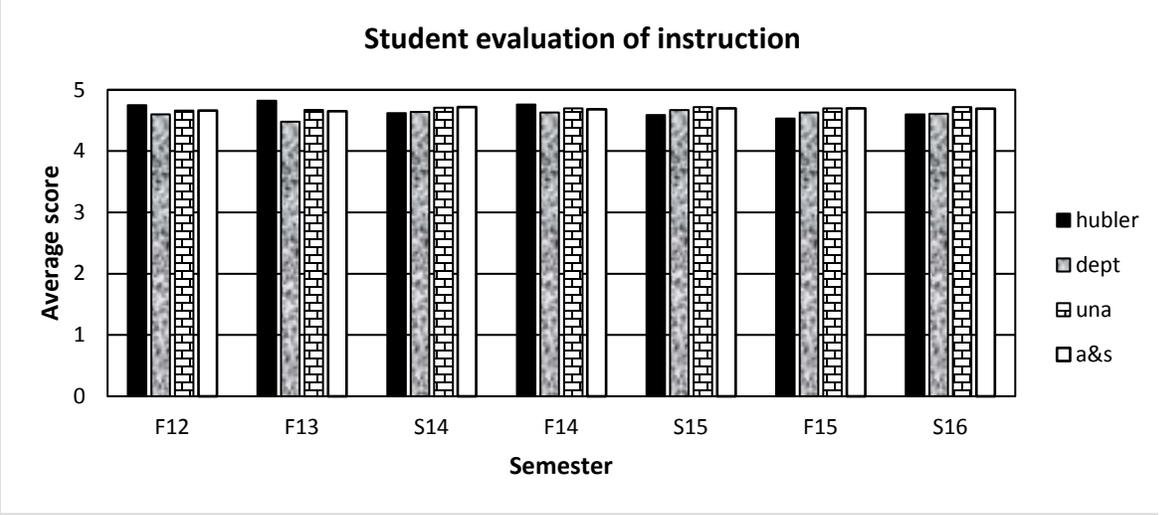
# Examples of Teaching Effectiveness

Student evaluations:  
Graphs  
Comments

# Graphs of student evaluation data

Lecture student evals

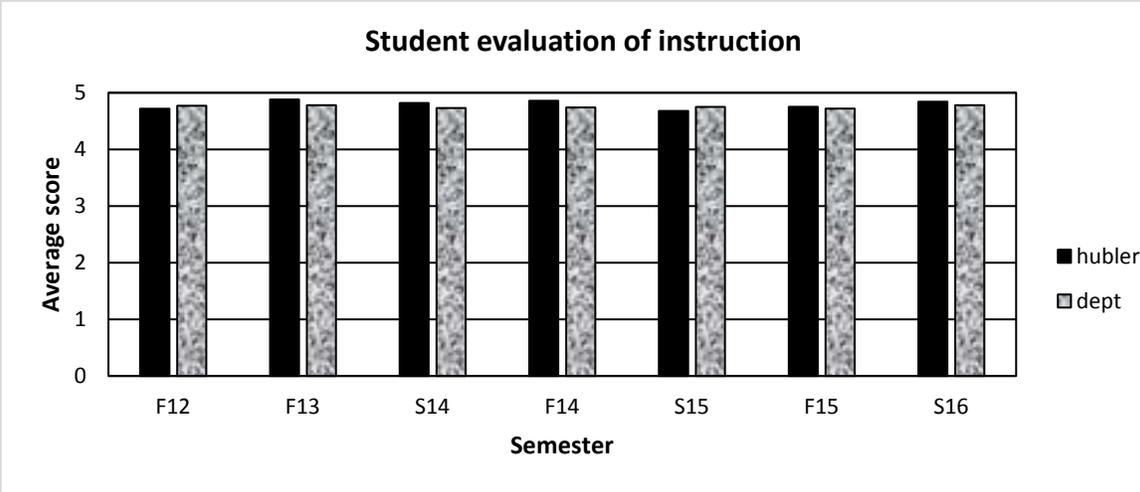
	F12	F13	S14	F14	S15	F15	S16
hubler	4.75	4.82	4.62	4.76	4.59	4.53	4.6
dept	4.6	4.48	4.64	4.63	4.67	4.63	4.61
a&s	4.66	4.65	4.72	4.68	4.7	4.7	4.69
una	4.66	4.67	4.71	4.7	4.72	4.7	4.72



# Graphs of student evaluation data

Lab student evals

	F12	F13	S14	F14	S15	F15	S16
hubler	4.72	4.88	4.82	4.86	4.68	4.75	4.84
dept	4.77	4.78	4.73	4.74	4.75	4.72	4.78



# Examples of student evaluation comments

## Selected students' evaluation comments

I attempted to not repeat previous comments and include new comments.

The negative comments with asterisks are examples of those I addressed by modifying my teaching.

### Positive comments

#### **Fall 2012**

She had a plan when she came to class

Best professor I have encountered to date; .. only asked us to do things (activities/quizzes)that helped us succeed in class

Very peppy

She explained everything in detail

She was a joy to be around

Very cheerful and happy to be here

She does not make anything boring

I am not a huge fan of biology. She made it enjoyable. Excellent instructor

Enthusiastic and easy to understand

Will recommend her to others

She has a real love for the material

Makes difficult concepts easy to understand

Not only cares if we do well on tests. She cares that we will be able to communicate proficiently about it (material). I liked..especially her drawings. Also that the material tested was the material covered in class.

Willing to go out of her way to help.

Seemed to know the material well.

She is an awesome teacher and very effective.

#### **Fall 2013**

She did a great job of helping us sum up the whole prodecure (which took weeks) from Mol Bio (note:student comment below in Fall 2012)

Application of lab techniques for future jobs

I love that she is constantly asking questions to make you think. Not just memorize. Many of her questions make you explain why.

# Examples of student evaluation comments

Always in a good mood

It is a very detailed class. Teaches you even the smallest things.

Organized, energetic, very knowledgeable

Easy to approach

Passion for subject

She wants every student to understand why we do things (in lab)

Shared historical importance and provided examples of cases that showed application of techniques

## **Spr 2014**

Probably the best teacher at UNA. Somewhat redundant, but I felt like I always left class understanding

She loves genetics and it rubs off on her students

Willing to break down difficult topics

Always had quizzes graded fast

Always willing to look up information she doesn't know

She gave us examples

There aren't any off the wall questions. If you pay attention and study, you will do well.

Outlines and PowerPoints on Canvas were helpful.

She had great lesson plans and very organized (Bio lab)

She wants to help you

Love her attitude

Seemed to really enjoy teaching

Not afraid to say she doesn't know something

The test reviews and outlines were great

Her enthusiasm and wanting us to learn

GREAT teacher

Many resources at our disposal

Thorough, knowledgeable, passionate

## **Fall 2014**

When I leave this class every T and Th, I leave with a clear understanding of the material (MolBio)

I could come talk to her about anything

# Examples of student evaluation comments

Many handouts to help with studying

Dr. Hubler genuinely cared.. she always came to class with a good attitude and ready to teach

Even when she missed class for a surgery she made sure there was plenty of information for us [by videoing lectures] and she made herself available for questions online

I feel my knowledge increased

She gave plenty of practice

Dr. Hubler describes material that can be somewhat abstract in a more practical and easy to understand way.

I felt she is the perfect teacher for this course. She just made this class the highlight of every day. Pursuing a career in genetics has now been cemented as my life goal.

Best professor ever!; Learned a lot.

She is very interested in what she does

She took questions with patience and offered multiple explanations for people who didn't understand

Always went out of her way to make sure you knew what you were doing (Gen Lab)

Learning about the practical applications of Genetics (Gen Lab)

Labs helped understand lecture (Gen Lab)

Fun (Bio Lab)

She made sure we knew what we were doing (Bio Lab)

I liked that she explained things about the lab before we got started (Bio Lab)

She works well with her students

So happy and makes my day

..loved and cared about her students

She explained exactly what she expected

## **Spr 2015**

You tube videos posted on Canvas very helpful

She was very organized

I liked the way she handled Evolution vs Religion. Sometimes being a Christian in a science class can be hard and I felt like you handled it very well.

She cares about her students

Online Canvas PowerPoints (Bio Lab)

# Examples of student evaluation comments

She Brought brownies and explains the experiments well

She's funny

She was helpful and kind

Tried her best even with physical injuries

She was patient and never interrupted lab unless we needed help

Kind and always willing to help

Videoed lectures

Made the course easy for me to understand and learn

Lectures were very informative

My favorite class ever. I love Dr. Hublers teaching style.

Plenty of material to help with concepts

Dr. Hubler is invested in seeing her students succeed. I think she does a great job of explaining complex topics

A+ teacher. No complaints

Very willing to take the time to make sure the students understand

Favorite professor

Easy to follow

Dr Hubler was willing to write tests that were full problems, not just multiple choice (Gen Lab)

Amazing job of explaining things. Molecular structures helped me learn the processes.

Made what I assumed to be a hard course relatively easy.

## **Fall 2015**

She let us know what was going on in the weeks to come

Always answered our questions

Very clear on instructions and had a good attitude (Bio Lab)

She loves to help her students

You tell she truly cares for her students

She showed us another way to look at things we learned in lecture

Returns exams/quizzes really quickly

Lots of grade opportunities

# Examples of student evaluation comments

One of my favorite classes

I feel I have a good understanding of genetics.

Always slow down to help

She does more than the average college professor by giving us study guides, questions/lab time to practice.

Explained difficult things clearly

Went over our quizzes before class

She seemed to love biology and labs

Loved her, So sweet and respectful

She talked to us and would interact (Bio Lab)

..and even explained some questions I had in lecture (Bio Lab)

It helped me to better understand lecture (Bio Lab)

Instead of making an impossible quiz, she told us what to study (Bio Lab)

She was very good at answering all questions we had (Bio Lab)

She was fair and articulate about what she wanted; she prepared us well for quizzes (Bio Lab)

Simple rules and regulations (Bio Lab)

Very engaged and concerned with student work

## **Spr 2016**

Organization and kindness (SAS)

Made the class as painless as possible (SAS)

Study aid material that was given to us (SAS)

Always said "come see me if you have any questions or don't understand something"

Eager to help

Dr Hubler is really great at breaking the material down so that it is clear

The results for each lab were discussed (Gen Lab)

She is very patient

Spoke clearly and deliberately

Exams dealt with things we actually learned in class (Gen)

Enthusiastic

# Examples of student evaluation comments

I liked that she provided secondary materials for students to use, but did not require them to be turned in. (Gen)

I loved all the handouts and practice problems and study materials (Gen)

Detail oriented

Clear and concise. Good humor (Bio Lab)

Gives us quizzes before tests and outlines (Bio)

Expectations made clear from the beginning

Lectures smooth and easy to follow

You tell she likes teaching (Bio)

Liked the things she brought to class as demonstrations of what we were learning about (Bio)

Dr. Hubler is a really good teacher. She made it easy to understand and she organized information in a way that made sense.

Explained things on our level (Bio)

Very creative (Bio)

Laid things out in Canvas

Best science teacher on campus. If a student doesn't an A in this class, it is because they didn't study. Outlines and practice quizzes are provided. Biology was extremely difficult for me to understand until I took this class. (Bio)

Also how you had a "surprise" for us everyday with something that related to what we were discussing (Bio)

She knew ways to help us understand

Wore white mascara for an exam (Bio)

Loved the way she brought things in to help us learn better and make class more interesting (Bio)

# Examples of student evaluation comments

## Negative comments

### **Fall 2012**

Powerpoints slightly confusing

\*\*\* Tell us everything at beginning of lab and let us work at our own pace.

\*\*\*Tests were too much from PP and not from text. I paid for the book and did not feel like it benefitted me.

Hard to stay organized/remember what experiments were done in previous classes.(Mol Bio)

### **Fall 2013**

Sometimes unorganized

### **Spr 2014**

Too much busy work (Gen lab)

Hairbrained; too many handouts

Could have made the class more interesting

I wish we had more tests with less content

\*\*\*She was not clear with instructions (Bio Lab)

Didn't give proper teaching of vocabulary (Bio Lab)

Unorganized; didn't explain things well

Way too much homework for a college course with no math involved (Genetics)

Too much material in one test (Bio)

### **Fall 2014**

Need to work on making the course more interesting; lectures were dull and monotone.

\*\*\*Canvas was difficult to navigate for this course (Genetics)

I understood the topic more than my grades have reflected

Teaching style boring and uninteresting

She talked way too fast. PowerPoint should have more words on them

\*\*\*How little we were able to use the lab equipment.

\*\*\*Did not have enough materials to work in pairs

She talked a lot about the lab before the lab (Bio Lab)

### **Spr 2015**

# Examples of student evaluation comments

She didn't like when we yawned. That's a little silly.

Interrupted class to tell late students they were a disruption; they were not.

If someone was even one minute late we had to sit in the back.

Not enough in class activities other than lecture

Too many online quizzes. Not wanting the students to take notes from her PowerPoints

Tests were hard and could not make them up even if you missed because of snow and ice (Bio Lab)

Monotone

Had trouble knowing what to study for tests

Sometimes lectures jump around

I wish there were more quizzes (Gen)

I wish the topics of the test were more focused on in detail in the lecture (Gen)

I did not find presentations organized (Gen)

Weather and her medical procedures made the class difficult (Gen Lab)

Some of the lectures tend to drag out (Gen Lab)

The material is presented harder than it really is.

I don't like that we cannot ask last minute questions (Gen Lab – right before quiz)

Wish there were more online quizzes (Gen Lab)

We need more hands on lab assignments (Gen Lab)

Calm voice made it easy to fall asleep

Hard to pay attention to

Her anger toward people who had their cell phones out or who were tardy. Too many handouts to keep up with

## **Fall 2015**

Difficult to study for lab quizzes

Contradicted herself

Drawing pictures and diagrams

Sometimes not clear on the information; specific things I needed to learn weren't in words on the PowerPoint

Too many drawings I could reread my notes; I'd like more notes.

# Examples of student evaluation comments

Discussed some small details without explaining the big picture.

The PowerPoints were difficult to study outside of class, (without notes)

Didn't always interact with us. (Bio Lab)

She could have been more interactive (Bio Lab)

She treats the students a little like "high schoolers" (Bio Lab)

Way too many instructions (Bio Lab)

Sometimes she came off a little rude; I was afraid to ask her things.

Overexplained things at the beginning (Bio Lab)

## **Spr 2016**

A better way to prepare. The flashcards and GRE book were only slightly helpful (SAS)

Not a lot of opportunity for points (SAS)

It would be better if professors would lecture their material (SAS)

I didn't like how the study material didn't match the quiz questions (SAS)

Would draw out simple subjects too long. (Bio Lab)

The notes were scattered and made it challenging to comprehend (Gen Lab)

Grading procedures were partial (Gen Lab)

Lecture was boring (Gen)

I felt like I had to teach myself the information (Gen)

Less pictures and more explanation on the PowerPoint slides (Gen)

No bullet points on lecture slides (Gen)

Trick questions help no one (Gen).

She repeats herself.

Rude comments about sleeping in class while trying to teach is worse than the student sleeping

Online quizzes were sometimes brought up "last minute"

Bought the book. Never used it.

# Examples of Teaching Effectiveness

Other:  
Appreciative comments

Graduate faculty  
appointment

# Appreciative comments from administrators, faculty and students

Caroline,

Thank you for your submission of an undergraduate research grant. Congratulations! Your research proposal has been selected for funding.

There were 36 proposals submitted and we have been able to increase the funding from the originally proposed 6 to a total of 18 funded grants! Special thanks to the College of Education and Human Sciences, the College of Business, the Library and Education Technology Services, the Office of Academic Affairs, and the Office of the Quality Enhancement Plan for contributing additional funds.

Each proposal was reviewed by seven reviewers representing all four academic colleges and the Library and Education Technology Services. Each reviewer evaluated the proposals on strengths and weaknesses; these comments and scores will be forwarded to each proposal team within the next two weeks.

All 18 awarded research grants will be attached to the same UNA Banner account, therefore charges or reimbursements will be made through the QEP Office and Lisa Keys-Mathews. Because of the change in the fiscal year, Dr. Hubler will receive an email with account information as soon as it is available. If you need to place orders, conference registrations, or reimbursements before you receive the information, please contact me at x4640 or by email.

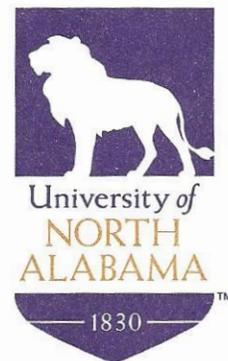
Finally please send a thank you note to Dr. John Thornell, Vice President for Academic Affairs for his support of undergraduate research.

Again, congratulations!

lkm

Lisa Keys-Mathews

# Appreciative comments from administrators, faculty and students



January 21, 2015

Dear Dr. Hubler,

Congratulations on your recent publication in *The American Biology Teacher*. It is very interesting and I appreciate your commitment to scholarship. Your students will benefit greatly.

Sincerely,

A handwritten signature in black ink that reads "Carmen Burkhalter".

Carmen L. Burkhalter

Dean

COLLEGE of ARTS and SCIENCES  
UNA Box 5021, Florence, AL 35632-0001  
P: 256.765.4288 | F: 256.765.4778 | [www.una.edu](http://www.una.edu)

Equal Opportunity / Equal Access Institution

# Appreciative comments from administrators, faculty and students



February 8, 2016

Dr. Tina Hubler  
Associate Professor  
Department of Biology

Dear Dr. Hubler,

Congratulations to you and your undergraduate student for receiving a Fall 2015 Research Grant from the Quality Enhancement Plan Office. Your student's research proposal, *Investigating the Correlation Between mRNA and Protein Levels of Two Hormone-Signaling Proteins, FKBP5 and FKBP4 in Human and Other Primate Cells*, shaped by your leadership, will always be a lasting piece of their academic history. You are a valued faculty member at this University and I am grateful to have you in the College of Arts and Sciences. Thank you.

Sincerely,

A handwritten signature in blue ink that reads "Carmen Burkhalter".

Carmen Burkhalter, Ph.D.

Dean

COLLEGE of ARTS and SCIENCES  
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# Appreciative comments from administrators, faculty and students

Vivian LeSende 2014

Hi,

For your enjoyment-

This web address is for one of our recent graduates that is now in a Ph.D. program at Ohio University. She graduated from our Cellular and Molecular Biology option in the Biology Department.

<http://www.ohio.edu/mcb/members/profiles.cfm?profile=7CBFCF5B-5056-A800-48F49B27FC0C4110>

I had to access this site using CTL + click

Tina

Hi Tina, this is impressive, nice tribute to department. Thanks for sharing. John

Dr. Thornell

Thanks, Tina. I know you are proud of Vivian. It appears she has gone to work with a very fine professor. It is a mark of our success as a university, and our individual faculty, to place our graduates in excellent programs. Well done by you!

Bill

Dr. Cole

# Appreciative comments

From: Burkhalter, Carmen L.

Sent: Monday, February 23, 2015 9:33 AM

To: Haggerty, Thomas M.

Subject: thank you

Tom,

I am in the process of interviewing prospective students to be a part of the College Ambassador program. One question I am asking each person is what course outside of their major have they enjoyed the most. Last week, a young man told me he most enjoyed Dr. Hubler's Genetics course. Please let her know that I am very appreciative of all she does for our students.

Carmen

Carmen Burkhalter, Ph.D.

Dean

# Appreciative comments from administrators, faculty and students

Letter from Bill Cale to Tom H

Tom,

Tina Hubler made an excellent presentation to UNA's Institute for Learning in Retirement this past Wednesday. I invited Tina to provide the group with the basics of genetics and the introduction of change into populations (such as resistance to antibiotics). She did a superb job, having created graphics that made her discussion of DNA structure and protein synthesis very understandable to an audience of bright people largely unfamiliar with this science. I would assume this same kind of clear and logic presentation characterizes her regular teaching as well. She made me proud, and I wanted to share that with you.

Best,

Bill

Tina,

See e-mail below from Dr. Cale.

It sounds like you wowed them!!

Thank you for representing our department and UNA so well to the public.

Tom

It's a good thing they liked it because I started with "I am here for you from UNA." !!!

Thank you for sharing.

Tina, thank you so much for your service.

Carmen

# Appreciative comments from administrators, faculty and students

In response to :

Hi Sarah and Caroline

I hope you are enjoying being out of school (for a while at least). I would like some feedback about our genetics course with respect to preparing you for standardized tests such as Major Field Test (MFT), Graduate Record Exam (GRE) or MCAT. In particular, I am interested in whether our time spent working genetics problems (in block 3) helped you answer word problems related to genetics.

Thanks for helping me evaluate how to spend our time, because we only have 1 semester to cover a lot of information.

Tina Hubler

Oh Dr. Hubler, your class helped me more than any other!!! I didn't feel near as prepared for any of the other parts of the MFT as I did the genetics part. And I definitely think the problems in block 3 helped train my brain on what to look for in the questions. I haven't taken the GRE yet, but I will let you know. I am very, very thankful for your class! Thanks for being such a wonderful teacher and slowly going through every part and making sure we understood it. It definitely paid off for me!!!

Sara Tingle

# Appreciative comments from administrators, faculty and students

Fall 2014

Dr. Hubler,

First of all, I would like to express my pleasure in attending your Genetics lecture this semester. The information is extremely intriguing, and it is hard to find many professors that are as enthusiastic about their area of expertise as you are. Coming from a family that has been victimized by cancer multiple times, it is somewhat comforting to learn about the molecular nature of cancer and other genetic mutations, and your enthusiasm for the subject makes the class all the more interesting.

I am emailing you today to request 5-10 minutes of your time to fill out an electronic reference form that is required in my application for a summer fellowship known as The Atlantis Project. It is a hospital fellowship conducted in Spain and Portugal that provides experience working with European doctors and allows for opportunities to earn community service hours. As a Biology major with hopes of attending Dental School in the future, The Atlantis Project would be a brilliant resume supplement. The form should not take too much time to fill out, but I would be honored if you would be one of my references. If you are unable to fill it out for any reason, please let me know.

Once again, thank you for your time and consideration. I appreciate everything you do to further my education at UNA, and I honestly respect your desire to teach others about such an important subject.

Very Respectfully,  
Cory McLeary

# Appreciative comments from administrators, faculty and students

Dr. Hubler

I'm so glad I took your class this semester.

You are really great professor and I love to listen your lecture.

Hope I can take your class again.

I'm so appreciate it.

You are really awesome.

I can't write well how I thanks to you

Sorry about my grammar.

Thanks again.

Dayeon Jang

# Appreciative comments from administrators, faculty and students

Dear Dr. Hubler,

I would like to thank both you and the Department of Biology at UNA for assisting me with my bioluminescence learning activity for the 21st Century After School Learning Program. With your donation of sea fireflies, I was able to provide an inquiry-based learning activity for my students to do that went along with our "Ted Talk" presentation about bioluminescence. The students all had questions about how the mechanisms of bioluminescence work when they discovered that the "sea firefly powder" glows (especially in the dark). All of my students really enjoyed the experience and always ask every week if I will be doing another science project with them.

The 21st Century After School Learning Program is a program that I am a part of. I tutor students after school, help to provide snacks and Physical Education opportunities, help with homework, and provide enrichment activities. This program has really helped me with my field experiences for secondary education general science. Again, I thank you for your support.

Sincerely,

Jacob Berry

# Appreciative comments from administrators, faculty and students

**From:** Collado, Cesar

**Subject:** Hey

**To:** Hubler, Tina

Just wanted to say thanks for the excellent class/semester! I really enjoyed the class and all the cookies!

good luck next semester!

Marla White Gen Spr 2013

It's just been a really rough past year for me. My father, uncle, && cousin all passed away within 9 months, && I'm really trying to get my mind back right. I'm getting better though. This is just more motivation because I was so close. **Thanks for being a great teacher, && your brownies were great!** Thanks! Happy summer to you too!

**Appreciative comments from administrators, faculty and students**

Cesar Thanks

## **Appreciative comments from administrators, faculty and students**

I just want to thank you for all of your time and attention and concern.

You, and Dr. Crews, are undoubtedly the biggest influences in my educational career and possibly my life.

I look forward to working with you again this semester!

thanks,  
c.c.

# Appreciative comments from administrators, faculty and students

If you marked any items as D or E, please indicate your reasons below.

On a scale of 1-10 (1= low, 10= high), what would be your overall rating of the instructor? 10

Indicate specifically what, if anything, you liked about the instructor:

I loved Dr. Hubler's overall personality both in and out of the classroom. I felt that she was the perfect teacher for this course. Her pacing and presentations were great and she just made this class and lab the highlight of every day.

Indicate specifically what, if anything, you liked about this class:

I loved all of the subject matter. Pursuing a career in genetics has now been cemented as my life goal thanks to Dr. Hubler and this class. It has shown me that I am capable of the work and learning all that I can about the field.

Indicate specifically what, if anything, you did not like about the instructor:

Indicate specifically what, if anything, you did not like about this class:

Dr. Hubler, you have been one of the most influential educators of my career. I will most certainly give you all of the credit when I win the Nobel Prize for curing cancer! 😊  
-Kelsa Walden

# Appreciative comments from administrators, faculty and students

Hubler

SAS

**4. Please comment on any courses that were particularly excellent or particularly poor?**

“BI ... 306 ... very good.”

“Excellent: Genetics, ...”

**5. What do you see as specific strengths of the biology department?**

“Genetics”

# Appreciative comments from administrators, faculty and students

Fall 2015

SAS

I've recieved an awesome education at UNA! Thank you Dr. Hubler for being a part of it! It is very evident in the classroom that you truly care about educating students, and from being one of your students in this course and genetics, I thought you should know, we appreciate you! Hope you have a great break and a happy new year!

Alexis Melton

# Appreciative comments from administrators, faculty and students

Hubler

SAS

## 4. Please comment on any courses that were particularly excellent or particularly poor?

“Molecular Biology, ..., ..., were all excellent.”

“Genetics – Excellent”

“... and ... needed more info, maybe genetics”

“.../genetics excellent”

“Human A&P was also excellent” (instructor not specified)

# Appreciative comments from administrators, faculty and students

Hubler SAS  
4. Please comment on any courses that were particularly excellent or particularly poor?

excellent: Genetics, Dr. Hubler. She is so excited about it that she keeps her students excited.

Genetics- excellent

Poor= genetics. Dr. Hubler needs more teaching experience.

5. What do you see as specific strengths of the biology department?

genetics, molecular

Genetics and ...

# Appreciative comments from administrators, faculty and students

Hubler

SAS

4. Please comment on any courses that were particularly excellent or particularly poor?

..., Genetics, ... were good

Genetics and ... were great.

I loved the ... but didn't like genetics because of the teacher being scatter brain.

My favorite classes have been ..., Genetics, and ...

Genetics and ...very excellent

Genetics & Molecular Biology were particularly well-taught. I learned a lot from these courses.

# Appreciative comments from administrators, faculty and students

I just wanted to say thank you for the brownies, they were great!

Also thank you for all the help I wish you were teaching bio 102 in the spring! Have a Merry Christmas! Thank you, Morgan Cooper

**Appreciative  
comments**

Dear Dr. Hubler,

Thank you so much for writing the letter of recommendation for me. I really appreciate it. I'm very excited about my application process for medical school and I am grateful for all that you've done helping me get this far. I will be sure to let you know what happens.

Sincerely,

Angelica Gonzalez

mon.04/14/14

# Appointment to Graduate Faculty



## MEMORANDUM

To: Dr. Tina Hubler

From: Dr. Leah S. Whitten, Chair  
UNA Graduate Council

Date: April 13, 2016

I am pleased to inform you that based on your application for graduate faculty status and based on your record of achievements presented, you have been nominated by the Graduate Council and approved by the Vice President for Academic Affairs and Provost to serve on the Graduate Faculty. Congratulations on your appointment.

rv

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# Examples of Scholarly Performance

## How it all started - Miniature Scammell Lab in FSB at UNA, 2007



**Dr. Scammell was my graduate school mentor at the University of South Alabama. This lab setup mimicked my research space in his lab.**

# Schol. Perf. - Science literacy crisis

## Evidence to support “national crisis in science literacy at the secondary level”

From Next Generation Science Standards, <http://www.nextgenscience.org/need-standards#Scientific%20Literacy>

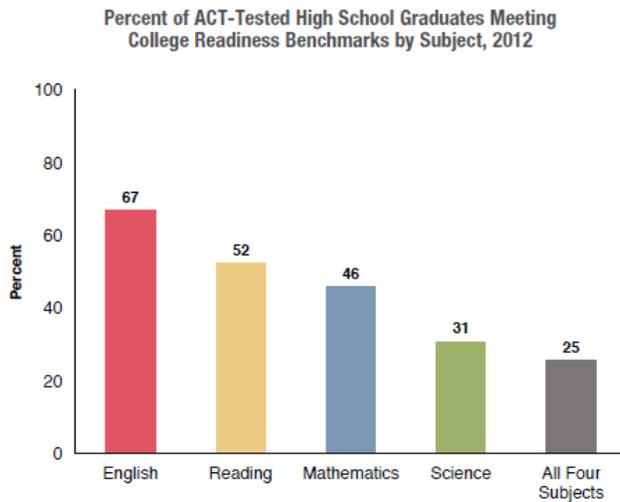
### Lagging achievement of U.S. students

- The 2012 Program for International Student Assessment (PISA) ranks the United States as **23rd in Science, 30th in Math, and 20th in Reading Literacy** out of 65 OECD education systems<sup>4</sup>.
- In 2011, the United States ranked **23rd in high school graduation rate** among OECD countries<sup>5</sup>.
- Over a **third of eighth-graders scored below basic** on the 2011 NAEP Science assessment<sup>6</sup>.
- In 2012, **54% of high school graduates** did not meet the ACT's college readiness benchmark levels in math, and **69% of graduates** failed to meet the readiness benchmark levels in science<sup>7</sup>.

<sup>4</sup> PISA, The Program for International Student Assessment, <https://nces.ed.gov/surveys/pisa/>

Most recent results are from 2012; On Dec 2016, results from 2015 testing will be released.

<sup>7</sup><http://media.act.org/documents/CCCR12-NationalReadinessRpt.pdf/>



# Schol. Perf. - Publications - Information about the American Biology Teacher journal (ABT) and the National Association of Biology Teachers (NABT)

Information about the National Association of Biology Teachers and the American Biology Teacher

From Jacki Reeves-Pepin, Executive Director, National Association of Biology Teachers

Hello Tina,

Thank you for your patience as I returned to my office this week. I have tried to answer your questions below, but there is some information that we will need to go our publisher for.

- NABT supports around 4000 members. We support biology teachers at all levels, but our three most prominent audiences are high school (61%), two-year college (14%) and four year college and university (23%).
- All NABT members receive a subscription to the ABT. At last count, we had 646 school and libraries also subscribe to *The American Biology Teacher* directly through our publisher, the University of California Press. In addition, the ABT is made available via the online aggregators BioOne, JSTOR, and HighWire. JSTOR had over 175,000 downloads of NABT articles each year and BioOne averages over 200,000. We just moved to HighWire with the 2016 volume and don't have data yet.
- I am not sure what the acceptance rate is for manuscripts, and have cc'd Dr. McComas on this email because he will have more current information than I. I saw that he also responded to your inquiry about impact factor and the ABT's IF of .229 being lower due to it being a practitioner focused referred publication vs. a research focused journal.
- I don't have specific details related to names or dates of the awards received by the ABT as these all predated my employment at NABT in 2007. These details are not readily available, and will not be for some time due to how and where our archival records are stored.

I hope this information helps, and let me know if there is anything else I can assist you with. I will be out of my office until September 20th but can be reached by email.

Have a great holiday weekend,

Jacki

**Jacki Reeves-Pepin, MBS**  
**Executive Director**  
National Association of Biology Teachers

Toll Free: (888) 501-NABT  
Direct: (719) 596-9782  
Email: [jreevespepin@nabt.org](mailto:jreevespepin@nabt.org)  
Web: [www.NABT.org](http://www.NABT.org)

# Schol. Perf. - Publications - Information about the American Biology Teacher journal (ABT) and the National Association of Biology Teachers (NABT)

From Bill McComas, editor, American Biology Teacher

The answer is easy. The impact factor relates to how frequently articles are cited (i.e. Impact) but ABT is a practitioner journal abc most practitioners are not writing / citing. ABT should not be compared w research journals but that doesn't mean it isn't of high quality.

Bill McComas  
University of Arkansas  
(479) 575-7525 office

The acceptance rate is about 68%.

Bill McComas  
University of Arkansas

# Schol. Perf. - Publications - Information about the American Biology Teacher journal (ABT) recommended on education resources websites



<http://www.ala.org/acrl/aboutacrl/directoryofleadership/sections/is/iswebsite/projpubs/journalsteachinglearning>

## A Selective List of Journals on Teaching & Learning

### Sciences and Mathematics

#### BIOLOGY



- [American Biology Teacher](#)
- [Biochemistry and Molecular Biology Education](#)
- [Journal of Microbiology and Biology Education](#)



INTERNET RESOURCES TO ACCOMPANY  
**THE SOURCEBOOK FOR TEACHING SCIENCE**  
NORMAN HERR, PH.D.  
Professor of Science Education  
California State University, Northridge  
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**Science Education Journals**

[https://www.csun.edu/science/ref/professional\\_development/sci\\_ed\\_journals.html](https://www.csun.edu/science/ref/professional_development/sci_ed_journals.html)

#### Biology Education



- [American Biology Teacher](#) - (NABT) National Association of Biology Teachers
- [Life Sciences Education](#) - (ASCB) The American Society for Cell Biology

# Schol. Perf. - Publications - Information about the American Biology Teacher journal (ABT) recommended on education resources websites

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7.60	0.11	0.8	1.99E-07
8.00	0.06	0.8	1.09E-07
8.40	0.98	0.8	2.31E-07
8.80	0.38	0.8	6.11E-07
9.00	0.09	0.7	1.09E-07
9.40	0.08	1.0	1.09E-07
9.80	0.09	0.8	1.09E-07
10.00	0.11	0.8	1.99E-07
10.20	0.11	0.8	1.99E-07
10.50	0.98	0.8	2.31E-07

<https://www.merlot.org/merlot/Biology.htm>

**JOURNALS & PUBLICATIONS**

- Advances in Physiology Education
- American Biology Teacher
- Biochemistry and Molecular Biology Education
- Bioscene: Journal of College Biology Teaching
- Bioscience Education E-Journal
- Cell Biology Education
- CourseSource
- International Journal of Science Education
- Journal of Biological Education

## Instant Update: Considering the Molecular Mechanisms of Mutation & Natural Selection

TINA HUBLER, PATTI ADAMS,  
JONATHAN SCAMMELL

### ABSTRACT

The molecular basis of evolution is an important concept to understand but one that students and teachers often find challenging. This article provides training and guidance for teachers on how to present molecular evolution concepts so that students will associate molecular changes with the evolution of form and function in organisms. Included are examples that illustrate how mutation followed by selection causes populations to evolve. Next month we will share lab activities that illustrate the concepts and reinforce the complementary roles of mutation and selection in the overall process of evolution.

**Key Words:** Molecular evolution; mutation; natural selection.

### ○ Introduction

Molecular evolution is a change in the chemical composition of molecules such as DNA, RNA, and proteins over time as a result of DNA mutation and selective pressure. While DNA mutations provide the raw material for evolution, conditions or pressures from the environment influence which organisms survive. With survival and reproduction comes a change in the frequencies of specific molecules that are observed within a population of organisms. The study of molecular evolution has blossomed in recent years with the development of technologies, such as DNA sequencing and bioinformatics, that allow us to determine and compare organisms' DNA sequences. This information has become so important for understanding evolution that numerous state and national science standards now include objectives related to the molecular basis of evolution. As an example, the *Next Generation Science Standards* (<http://www.nextgenscience.org>) contain two standards that address empirical evidence for biological evolution based on similarities in DNA sequences among organisms and genetic variation of individuals due to mutation. Despite this current emphasis, understanding the mechanisms that underlie molecular evolution

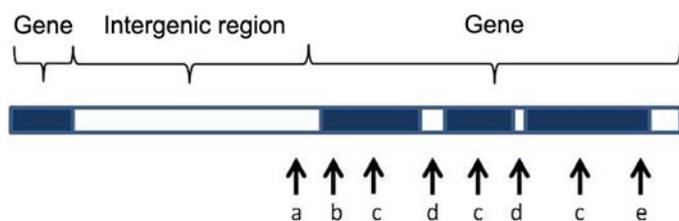
*While DNA mutations provide the raw material for evolution, conditions or pressures from the environment influence which organisms survive.*

is difficult for students. This article is designed to prepare teachers with the necessary background information so that, in turn, they can design lessons to help students understand important concepts in molecular evolution.

### ○ Molecular Evolution: A Review of Key Concepts

#### Genome Organization

Data from the Human Genome Project and similar sequencing projects revealed that a genome (all of the genetic information in an organism) is organized into genes (International Human Genome Sequencing Consortium [IHGSC], 2004; Alberts et al., 2007). The definition of a “gene” has been debated and revised, as scientists acquire a greater appreciation for the complexity of a genome (Gerstein et al., 2007). Genes may be described as DNA sequences used to produce functional products, such as protein or RNA. Eukaryotic genes include coding sequences called “exons” that provide the genetic information for the cell to assemble amino acids into specific proteins. These genes also include important non-coding sequences such as promoters, introns, 5′ and 3′ untranslated regions (UTRs), and RNA genes for transfer RNA (tRNA), ribosomal RNA (rRNA), small nuclear RNA (snRNA), and microRNA (miRNA). Promoters do not code for protein but are regulatory sequences associated with genes and control how genes are expressed. Introns are sequences that are removed from most RNAs after transcription. As introns are removed, exons are spliced together to form a “mature” messenger RNA that may be exported from the nucleus to the cytoplasm for translation into protein. The 5′ and 3′ UTRs are segments of messenger RNAs that are not translated into the amino acid subunits of proteins but that sometimes have regulatory roles. RNA genes are DNA sequences that are used to produce RNAs that



**Figure 1.** Schematic of the organization of DNA sequences composing a genome: a = promoter, b = 5' UTR, c = exon, d = intron, and e = 3' UTR.

**Table 1. DNA sequence classification.**

Examples of Functional DNA Sequences	Examples of Nonfunctional DNA Sequences
Protein coding sequences RNA genes Noncoding sequences: Promoters Other regulatory regions <sup>a</sup>	Noncoding sequences: Some 5' UTR, 3' UTR, intronic, and intergenic regions Pseudogenes

<sup>a</sup>Regulatory regions may be located in noncoding sequences such as introns, 5' and 3' UTRs, and intergenic regions.

have a variety of functions: translation (tRNA and rRNA), removal of introns (snRNA), and regulation of gene expression (miRNA). Figure 1 is a schematic of genome organization that may help students visualize the relative locations of some coding and noncoding components in a genome. It is included as a PowerPoint slide (see online Supplemental Materials).

A recent analysis of >3 billion nucleotides of the human genome surprisingly estimated that it included only 20,000 to 25,000 genes (IHGSC, 2004). However, in addition to the coding sequences found in genes, the human genome contains an abundance of noncoding DNA (Lander et al., 2001; IHGSC, 2004) that constitutes about 95% of the human genome (Elgar & Vavouri, 2008). Noncoding DNA may be classified as functional or nonfunctional. It is considered functional if it is associated with a role such as regulation of gene expression. Functional noncoding DNA includes promoters and other regulatory sequences that may occur in introns, 5' and 3' UTRs, and intergenic (between genes) regions. Nonfunctional noncoding sequences are also found in introns, 5' and 3' UTRs, and intergenic regions. "Nonfunctional" is a conventional term used to describe noncoding DNA sequences that have no currently known function. The status of a nonfunctional sequence may be revised to "functional" if a role is identified. For example, a number of sequences in introns and UTRs have been assigned regulatory roles (Barrett et al., 2012). Nonfunctional noncoding sequences also include pseudogenes that are presumed to be mutated remnants of functional genes. Table 1 may be used to help students classify genomic DNA into functional and nonfunctional sequences.

### The Dynamic Nature of the Genome

Data from sequencing projects also revealed that genomes are dynamic (Platzer, 2006). Mutations (changes in DNA sequences) occur spontaneously as a result of DNA replication error and recombination events. They may also be induced by physical agents

such as ultraviolet radiation, chemical agents such as polyaromatic hydrocarbons, or drugs such as doxorubicin. Although there are some regions of the genome that are frequently mutated ("hotspots"), mutations occur randomly in all regions of the genome. They appear throughout the genome as substitutions, insertions, deletions, and rearrangements. Therefore, as DNA is passed from one generation to the next, the genome accumulates variability.

The degree of variability observed after many generations is not the same in nonfunctional and functional regions. Nonfunctional regions are characterized by highly variable sequences. By contrast, functional regions such as those that encode important proteins are remarkably similar or conserved. The tendency for functional sequences to be conserved, while nonfunctional sequences accumulate variability, can be understood by considering the effect of natural selection.

### The Effect of Selection on the Genome

Because mutations that occur in gametes are inherited by offspring, they provide a continuous source of variation for future generations. Mutations may be classified as neutral, harmful, or beneficial, based on the effect they have on an organism's ability to survive and reproduce.

Mutations can have at least four possible types of effect on genome variability over many generations. First, any mutations in nonfunctional regions can be classified as "neutral" because they have no effect on the organism's phenotype. These mutations will be perpetuated in offspring because there is no disadvantage to the organism that carries them. In successive generations, mutations will accumulate in these regions because they are free from the constraint of selection. Therefore, these genomic regions exhibit high variability compared with other regions.

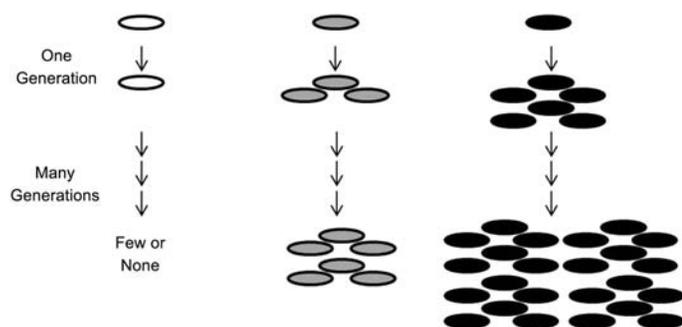
Second, mutations that occur in functional regions may also be classified as neutral if the changes do not affect the organism's phenotype. Examples of neutral mutations in functional regions are DNA substitutions that do not change the amino acid incorporated into a protein (a silent mutation) or DNA substitutions that change an amino acid to another with similar biochemical properties (a neutral mutation). As is the case with mutations in nonfunctional regions, neutral mutations in functional regions also accumulate over generations because there is no disadvantage to the organism that has these mutations. However, functional sequences will exhibit moderate to low variability compared with nonfunctional sequences because mutations in functional regions also have the potential to be harmful.

Third, as expected, harmful mutations in functional regions negatively influence the survivability of organisms. Fewer or no offspring may be produced, and these mutations will be found rarely, or not at all, in subsequent generations. So, harmful mutations may be "selected out" of the population and not observed in present-day genomes, even though the mutations occurred at some point in the past.

Fourth, beneficial mutations in functional regions confer an advantage to an organism. They positively influence survivability, which increases the production of offspring. These mutations will be inherited by offspring over multiple generations because it is unlikely that another random mutation will occur in the exact same location. Therefore, beneficial mutations tend to persist because survivability and reproduction are enhanced. In short, selection acts to remove

**Table 2. The effect of a mutation's location and type on genome variability as a consequence of selection.**

Mutation Location	Mutation Type	Effect on Organism	Effect on Variability Observed in Genome
Nonfunctional DNA	Neutral	None	DNA sequences are highly variable
Functional DNA	Neutral	None	DNA sequences are moderately variable
	Harmful	Deleterious	Rarely observed in genomes of surviving organisms
	Beneficial	Advantageous	DNA sequences are conserved

**Figure 2.** The effect of selection on the number of surviving organisms (dots) carrying harmful (clear), neutral (gray), or beneficial (black) mutations.

harmful DNA sequences and retain neutral and beneficial sequences. Table 2 summarizes the effect that the mutation's location and type have on the organism itself and on genome variability as a consequence of selection.

As discussed, the effect of selection on the nature of the genome is ultimately linked to survivability and reproduction. It may be helpful to present this schematically for students. Figure 2 can be used to illustrate the effect of selection on the number of surviving organisms (dots) carrying harmful (clear dots), neutral (gray dots), and beneficial (black dots) mutations. The schematic illustrates that, in comparison to organisms with neutral mutations, organisms with harmful mutations tend to produce fewer or no offspring. They may even become extinct. By contrast, organisms that acquire beneficial mutations tend to produce more offspring. After many generations, the surviving population consists mostly of organisms whose genomes house neutral and beneficial mutations. Two important points should be made to students: (1) Harmful mutations, particularly lethal ones, are removed from populations as a result of natural selection; and (2) beneficial mutations typically contribute to the production of larger numbers of offspring that carry the acquired mutation (as well as other mutations). This diagram is included as a PowerPoint slide (see online Supplemental Materials) to aid in the discussion of these concepts.

### Mutations as a Historical Record of Evolution

Researchers gain insight into past molecular changes by employing comparative genomics. This method compares the DNA or amino acid

sequences of multiple organisms using sequence alignment tools, such as the BLAST tool provided by the National Center for Biotechnology (<http://www.ncbi.nlm.nih.gov>). For example, the amino acid sequence of cytochrome *c* has been compared in organisms. Cytochrome *c* is an essential component of the electron transport chain in mitochondria, where it functions to transfer electrons from donor to acceptor molecules during cellular respiration. Because of its role in cellular respiration, it is an essential protein. As expected, the DNA sequence of the gene and the amino acid sequence of the protein are highly conserved among organisms. The degree of cytochrome *c* amino-acid-sequence

similarity between two organisms is related to the length of time since the organisms diverged from a common ancestor. In distantly related organisms (e.g., humans and fish), the sequences are less similar than in closely related organisms (e.g., humans and chimpanzees). This is true because, in distantly related organisms, more time has passed since their divergence from a common ancestor. More mutations have accumulated, making the genomes more different. Because of the relationship between sequence similarity and the length of time since organisms diverged from a common ancestor, it was once proposed that sequence variation in conserved proteins such as cytochrome *c* and hemoglobin could be used as “molecular clocks” (Kumar, 2005). It is now appreciated that factors other than the length of time since divergence affect the degree of sequence variation. These include the particular proteins being compared, changes in population size, and variable generation times for different organisms. Still, a generalization can be made that closely related organisms share greater sequence similarity than distantly related organisms.

By comparing the sequences of organisms, researchers have also uncovered a number of specific DNA mutations that have been implicated in evolution. For example, DNA mutations are associated with changes in the coat color of rock pocket mice (Nachman et al., 2003) and the production of antifreeze proteins in Antarctic fish (Chen et al., 1997). In each case, a random change in DNA sequence conferred a selective advantage that was perpetuated in offspring. It is useful to realize that an organism's genome may “record” the presence of ancestral genes that are found in other organisms, as well as new genes that have arisen through mutation. These examples of currently living organisms are valuable in helping students envision the process whereby populations of organisms change over time.

### Teaching the Concepts

We have found that teaching the concepts of mutation and selection as the molecular basis of evolution may best be divided into four stages. First is presentation of the concepts of sequence classification (noncoding, coding, nonfunctional, functional), mutations, selection, nonfunctional sequence variability, and functional sequence conservation. Second, students are prepared for laboratory activities by discussing polymerase chain reaction and electrophoresis. Third, laboratory activities are performed that expose students to basic principles of variable and conserved sequences. Finally, a reading assignment and video about icefish are employed to reinforce the evolutionary consequence of mutation and selection. Next month we will share a number of activities that concretely illustrate the concepts

# Schol. Perf. - Publication

and reinforce the complementary roles of mutation and selection in the overall process of evolution.

## ○ Supplemental Materials

Supplemental Materials are available at <http://www.buildingthepride.com/faculty/trhubler/>.

## ○ Acknowledgments

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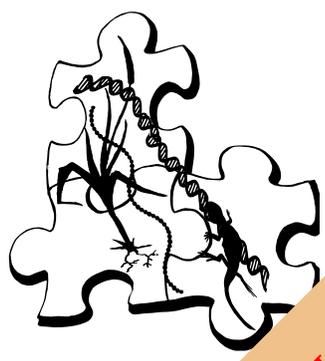
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### ABSTRACT

The molecular basis of evolution is an important and challenging concept for students to understand. In a previous article, we provided some of the scientific background necessary to teach this topic. This article features a series of laboratory activities demonstrating that molecular events can alter the genomes of organisms. These activities are most appropriate for undergraduate students in Honors Biology, Genetics, or Molecular Biology courses. Student laboratory instructions are included to allow students to conduct the activities, make observations, interpret the results, and draw conclusions.

**Key Words:** Molecular evolution; mutation; natural selection; conserved DNA sequences.

The exercises provided here are designed to help students visualize how molecular evolution occurs by acquainting students with the basic principles of variable and conserved DNA sequences. These activities also provide living examples of organisms that illustrate the roles that mutation and selection have played in their evolution. Prerequisites for the students are a basic understanding of DNA structure, replication, transcription, translation, and mutation. A recommended classroom discussion and lab activity sequence are shown in Table 1, student instruction sheets are included in Appendix 1, and Appendix 2 is the teachers' key for student instructions.

### ○ TASK 1

#### Classroom Discussion of Molecular Evolution Concepts

The activities described in this article should be prefaced with a classroom discussion of basic molecular evolution concepts. In a previous article, we provided some of the scientific background necessary to discuss the classification of genomic sequences, mutations, and the

effects of selective pressure on DNA sequence variability. Discussing these topics will help students understand the basis for the activity results they will observe.

### ○ TASK 2

#### Lab Preparation: The Principles of PCR & Electrophoresis

Because polymerase chain reaction (PCR) and electrophoresis are powerful tools that allow researchers to produce copies of selected regions of DNA and visualize them, instructors should discuss the basic components and steps involved (Table 2). Background information for discussing these techniques, as well as simple activities to enhance student understanding, are available in a file of Supplemental Materials at <http://www.buildingthepride.com/faculty/trhubler/>.

### ○ TASK 3 (Activity 1)

#### Variability of Nonfunctional DNA Sequences

Data from the Human Genome Project and similar sequencing projects have allowed researchers to compare the genomes of a variety of organisms. When DNA sequences of organisms are compared, the sequences located in nonfunctional regions of the genome tend to exhibit considerable variability among organisms. Activity 1 demonstrates the tendency for nonfunctional DNA sequences to exhibit variation, even in closely related organisms. In this activity, students first use PCR to amplify a nonfunctional DNA sequence from two closely related primate species and gel electrophoresis to visualize the PCR products. Next, students utilize the BLAST tool available from the National Center for Biotechnology website (<http://www.ncbi.nlm.nih.gov>) to investigate sequence variability between the two species and to identify a mobile genetic element that introduces changes in primate DNA sequences.

*The molecular basis of evolution is an important and challenging concept for students to understand.*

**Table 1. Summary of activities.**

Task Order <sup>a</sup>	Task	Topics	Time Allotment <sup>a</sup> & Description
1	Class discussion	Genome organization, mutations, selection	Discuss: sequence classification (noncoding, coding, nonfunctional, functional), mutations, selection, nonfunctional sequence variability, functional sequence conservation.
2	Lab preparation	Principles of PCR and electrophoresis	Lab (2–3 hours). Discuss PCR and electrophoresis. Pour agarose gels and set up PCR reactions for Lab Activities 1 and 2. Completed PCR cycling reactions and agarose gels may be refrigerated until the next lab period.
3	Activity 1	Variability of nonfunctional DNA sequences	Lab (2–3 hours). Discuss Alu elements and the BLAST tool while performing electrophoresis. Review variable nonfunctional sequences. Stain gels, interpret results. Perform BLAST analyses. Students complete Lab Worksheet.
4	Activity 2	Conservation of functional DNA sequences	Lab (2–3 hours). Discuss New World and Old World primate evolutionary relationships during electrophoresis. Review conserved functional sequences. Stain gels, interpret results. Perform BLAST analyses. Students complete Lab Worksheet.
5	Reinforcement	Icelfish as an example of molecular evolution	View the video about icelfish evolution. Assign the recommended article about icelfish evolution for reading.

<sup>a</sup>Instructors may need to adapt this to their available class and laboratory time.

**Table 2. Materials needed for Tasks 3 and 4.**

Plasmids: May be requested from corresponding author <sup>a</sup>
Primers <sup>a</sup>
Variable forward: 5'-AGTTCCTCTCTACCTTGACC-3'
Variable reverse: 5'-GCCCTACTCTTGCATTAATGC-3'
CG forward: 5'-GCACCAAGGATGGAGATG-3'
CG reverse: 5'-GCGGATTGAGAAGCCTTTA-3'
DNA ladder <sup>a</sup>
GoTaq Green PCR Master Mix <sup>a</sup>
Nuclease-free water <sup>a</sup>
PCR tubes, <sup>a</sup> appropriate for thermal cycler
Pipettors and tips <sup>a</sup>
Agarose gels (1% agarose in pH = 8 Tris acetate/EDTA electrophoresis buffer) <sup>a,b</sup>
Electrophoresis system: Power supply, electrophoresis cell, gel tray, comb, and gel caster <sup>c</sup>
Thermal cycler <sup>d</sup>
Methylene blue staining solution <sup>a</sup>

The following safety precautions should be observed:

<sup>a</sup>Wear gloves.

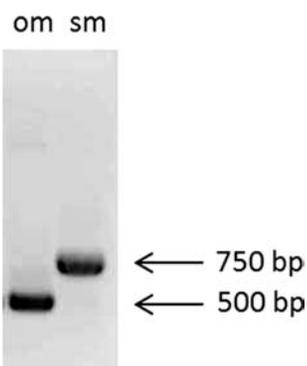
<sup>b</sup>Wear eye protection when pouring hot solutions.

<sup>c</sup>High voltage; disconnect power before opening chambers.

<sup>d</sup>Thermal cycler components reach high temperatures during PCR cycling.

Suggested vendors are listed in a file of Supplemental Materials at <http://www.buildingthepride.com/faculty/trhubler/>.

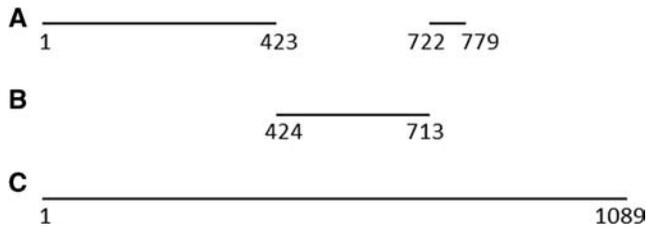
For each of the PCR reactions in Activity 1, the template DNA is provided in the form of plasmid DNA containing an intergenic region from owl monkey (om) or squirrel monkey (sm), two species of Platyrrhines, or New World monkeys. These plasmids



**Figure 1.** Results of PCR amplification of a variable region from two species of New World primates: owl monkey (om, *Aotus trivirgatus*) and squirrel monkey (sm, *Saimiri boliviensis*).

were developed in our research laboratories, specifically for use in Activity 1. Instructions for setting up the PCR reactions are included in Appendix 1. Figure 1 shows that PCR, gel electrophoresis, and staining reveal a 500-bp product from the owl monkey sample, whereas the squirrel monkey sample contains a 750-bp product. These data demonstrate that nonfunctional regions contain sequences that can differ, even among closely related organisms (two New World monkeys).

Next, students will use the BLAST tool to determine the reason for the difference in size of the PCR products. DNA sequences for the PCR products were either generated in our labs (owl monkey) or obtained from the Roos lab (squirrel monkey) (Osterholz et al., 2008). These DNA sequences are provided below and are available electronically in Supplemental Materials. When students compare the nucleotide sequences of these nonfunctional DNA regions, they should observe that the size difference in the PCR products results from an insertion into the squirrel monkey sequence.



**Figure 2.** Schematic of the results of BLAST alignment of DNA regions from squirrel monkey (sm, *Saimiri boliviensis*), owl monkey (om, *Aotus trivirgatus*), and human (h, *Homo sapiens*). (A) BLAST alignment of the sm and om variable regions. (B) BLAST alignment of the sm variable region and an Alu element database. (C) BLAST alignment of the sm, om, and human chorionic gonadotropin (CG) genes. The numbers below each alignment indicate the position in the sm DNA sequence.

Specifically, the two sequences align except in a region toward one end of the squirrel monkey sequence. This gap in alignment represents a region that is present in the squirrel monkey sequence but absent in the owl monkey sequence (Figure 2A).

### Squirrel monkey variable region (Alu element bold and underlined)

```

agttcctctc taccttgtac ctgttccaga cccccggcct
aggcctggac actaaggaaa ttcttactaa acaaatgctt
gccagctca tccgtccctc actcttctct acctctcacc
ttgattcccc agaggaggag ggggaagtgat aagagaactg
tcgagaacag ctgtcattta cccgggactt gctatgggcc
agggacttta cagacagcat cttgtctaag tttgacatca
tcccatgaag tggatcttac tattatcccc atttaacaaa
tgagaaatct gaggcattgg aaagttaagt gacttgtcca
agctcacata atgaagttag ggtaccaggc agaactggct
atataatctg tgggaccagc tgcaaaatga aaatgtgggg
cctctgttaa aaaactatta atcggccggg cgcggtggct
caagcctgta atcccagcac tttgggaggc cgaggtgggt
ggatcacaag gtcgagagat cgagaccatc ctgggtcaaca
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aggctgaggc aggagaattg cctgagccca ggaggcggag
gttgcggtga gccgagatcg cgccattgca ctccagcctg
ggaacaaga gcaaaactcc gtctcaaaaa aaaaaaaaaa
aaaaaaaaacta ttaatcattt caagaccagg acagaagagc
attaatgcaa gagttagggc
    
```

### Owl monkey variable region

```

tagttcctct ctaccttgta cctgtcccag acccccggcc
taggcctgga cactgaggag attcttacta acaaatgct
tgcccagctc atcctcccct cactcttctc tacctctcac
cttgattccc cagaggagga gggaaagggg gaggggaggg
gaagtggnnn gagaattgac gagaacagct gtcatttagc
cgggacttgc tatgggccag ggactttann nacagegctt
tgtctaagct tgacatcacc ccatgaagtg gatcttactg
ttatccccat ttaacaaatg agaaatctga ggcattgggaa
agttaagtga cttgtccaag ctcacataac caagtagtgt
accaggcaga actggctata taattttgtgg gaccagcgc
aaaatgaaaa tgtggggcct ctgttaaaaa accattaatc
atttcaagac caggacaaaag agcattaatg caagagttagg
gcta
    
```

Finally, students will use the BLAST tool to compare the squirrel monkey sequence to a database of currently known “Alu sequences,” a type of mobile genetic element. As diagrammed in Figure 2B, this will allow them to identify the inserted region in the squirrel monkey DNA as an Alu element. Mobile genetic elements are DNA sequences that can be inserted into new locations in the genome through the action of specific enzymes. Alu elements are a common type of mobile genetic element found in the human genome (Batzer & Deininger, 2002). Insertion of Alu sequences has several impacts on genomes. Not only do they produce genetic variation, they may also disrupt regulatory regions and coding regions (Schmitz, 2012). These data demonstrate that one source of genomic variability is the insertion of DNA sequences via mobile genetic elements.

“Student Instructions for Activity 1: Variability of Nonfunctional DNA Sequences” in Appendix 1 provides guidance for students to perform the activity. BLAST results showing actual sequence alignments and additional information about Alu elements as important mechanisms of molecular evolution are provided in a file of Supplemental Materials at <http://www.buildingthepride.com/faculty/trhubler/>. Some important points to discuss with students are that Alu elements (1) are mobile, (2) are inserted >1 million times in the human genome, (3) contribute to a dynamic expansion of primate genomes, and (4) are known to cause human diseases such as hemophilia and breast cancer, as a result of disrupting gene coding sequences (Batzer & Deininger, 2002; Kramerov & Vassetzky, 2005).

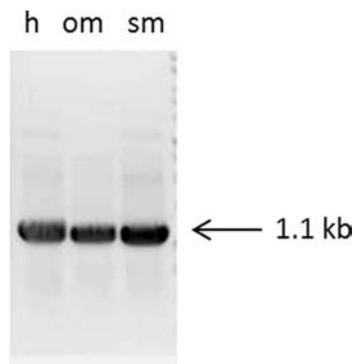
## ○ TASK 4 (Activity 2)

### Conservation of Functional DNA Sequences

The sequencing and comparison of genomes from a variety of organisms have revealed that although genomes are constantly changing, some regions exhibit remarkable similarity among organisms. As a result of comparative genomics, it is now understood that DNA sequences that perform important cellular functions tend to be similar, or conserved. Lab Activity 2 is intended to help students visualize conservation of functional DNA sequences. PCR is used to demonstrate that the DNA sequence of an important gene is conserved among two groups of primates: Catarrhines and Platyrrhines.

Catarrhines include Old World monkeys such as macaques and baboons, as well as chimpanzees, apes, and humans; they are found primarily in Africa and southern Asia, with the exception of humans, which are widespread. Platyrrhines include the New World monkeys, such as squirrel monkeys and owl monkeys, that inhabit Central and South America. Catarrhines and Platyrrhines diverged from a common ancestor >35 million years ago (Goodman et al., 1998; Schrago & Russo, 2003; Perelman et al., 2011). Although Catarrhines and Platyrrhines have evolved genetic and physiological differences over millions of years in geographic isolation (Müller et al., 2004; Westberry et al., 2006; Ward & Vallender, 2012), many functional DNA sequences, including genes coding for peptide hormones, have been conserved.

In Activity 2, students will (1) use PCR to amplify the chorionic gonadotropin (CG) gene from three primate species, (2) analyze the PCR products by electrophoresis, and (3) perform sequence comparisons to demonstrate that functional DNA sequences are conserved. CG is a peptide hormone made in primates by placental cells



**Figure 3.** Results of PCR amplification of the chorionic gonadotropin gene from human (h, *Homo sapiens*), owl monkey (om, *Aotus trivirgatus*), and squirrel monkey (sm, *Saimiri boliviensis*).

**Table 3. Comparison of the nucleotide similarity of selected genes**

Genes compared <sup>a</sup>	Percent Identical Nucleotides
h CG vs om CG	83
h CG vs. sm CG	80
sm CG vs. om CG	92
h CG vs. h Growth Hormone	No similarity
h CG vs. h Oxytocin	No similarity

<sup>a</sup>Abbreviations: h = human, om = owl monkey, sm = squirrel monkey, and CG = chorionic gonadotropin.

during the first 10 weeks of pregnancy. It supports the implantation and development of the fetus (Hanson et al., 1971). CG therefore represents a critical gene for reproductive success in primates.

Plasmids containing the CG gene from humans, owl monkeys, or squirrel monkeys were developed in our research laboratories for use as the template for PCR. Instructions for setting up the PCR reactions are included in Appendix 1. Figure 3 shows that PCR, electrophoresis, and staining reveal a 1.1-kb PCR product in each sample lane.

Next, students will determine the similarity between Catarrhine and Platyrrhine CG gene sequences using the BLAST tool. The DNA sequences for BLAST analyses are available electronically in a file of Supplemental Materials at <http://www.buildingthepride.com/faculty/trhubler/> or can be obtained from NCBI (<http://www.ncbi.nlm.nih.gov>) using the following accession numbers: human CG (X00265.1), squirrel monkey CG (GU117708.1), owl monkey CG (JN613228), human growth hormone (E00140.1), and human oxytocin (M11186.1). The squirrel monkey and owl monkey CG sequences were generated in our research labs (Vasauskas et al., 2010). DNA sequences for growth hormone and oxytocin are employed as examples of unrelated genes. Figure 2C shows graphically that the squirrel monkey, owl monkey, and human DNA sequences align throughout the entire length of the PCR products. The BLAST results will also display the percent identical nucleotides and should agree with the information in Table 3. These data (1) provide students with a

method for quantitative assessment of sequence similarity, (2) demonstrate that functional DNA sequences are similar among organisms, (3) reveal higher sequence conservation among Platyrrhines than between Catarrhines and Platyrrhines, and (4) indicate the degree of similarity that is observed in conserved DNA sequences. We do not expect 100% identity, because neutral mutations contribute to variability. “Student Instructions for Activity 2: Conservation of Functional DNA Sequences” in Appendix 1 provides guidance for students in performing the activity.

## ○ TASK 5 (Reinforcement)

### Icelfish as an Example of Molecular Evolution

After observing examples of variable and conserved sequences, we suggest that teachers emphasize the mutually important roles of mutation and selection by providing a living example of the effect of beneficial mutations on organisms. Icelfish are believed to have evolved from a population of temperate-environment fish. The fish were exposed, over time, to a significant drop in water temperature due to changes brought about by continental drift. Because of mutations, some fish produced a protein that defended them against freezing temperatures. Fish with this increased hardiness survived and passed the new trait and the gene that controlled it to their offspring. This is a classic example of natural selection.

To reinforce how molecular changes contribute to survival and diversity, we recommend a short video about icelfish that is found on the DVD titled *The Making of the Fittest*. It is available at no charge from the Howard Hughes Medical Institute (<http://www.hhmi.org>) and contains high-quality videos on natural selection in fish, rock pocket mice, and humans. Additionally, we recommend the story “In Cold Blood: The Tale of the Icelfish” for students with some knowledge of genetics (Carroll, 2009). In the story, Sean Carroll provides a vivid historical account of the discovery of the icelfish and its evolutionary implications. A question sheet to help students read the article is available in a file of Supplemental Materials (<http://www.buildingthepride.com/faculty/trhubler/>). These examples elucidate a definitive relationship between mutations, selection, and evolution.

## ○ Summary

To conceptualize the process of molecular evolution, students need to understand mechanisms that contribute to the dynamic nature of genomes and the effect that natural selection has on sequence conservation. Our instructional series includes classroom discussion of basic molecular-evolution concepts followed by two lab activities. The activities use analyses of variable and conserved DNA sequences to demonstrate how selective pressure affects the persistence of mutations in populations. For reinforcement of the process by which evolution occurs, the molecular evidence recorded in the genome of the icelfish is used to explain how mutation followed by natural selection produces changes in organisms.

## ○ Acknowledgments

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## Appendix 1

### Student Instructions for Activity 1: Variability of Nonfunctional DNA Sequences

#### PCR of Nonfunctional DNA Sequences

This activity will be used to illustrate that nonfunctional DNA sequences are variable, even in closely related organisms. PCR will be performed to show that an intergenic nonfunctional region exhibits variability in two species of New World monkeys: squirrel monkeys and owl monkeys. DNA sequences for the variable region will be used to identify the nature of the variation.

Plasmid DNA containing the variable region from owl monkeys or squirrel monkeys is used as the template for PCR. The components needed for a 25- $\mu$ L reaction in a 200- $\mu$ L PCR tube and the PCR conditions are listed below (Table A1). Following PCR, samples are loaded onto 1% agarose gels and electrophoresed at 100 V for 55–60 minutes. A DNA ladder should be loaded into a separate well to estimate PCR product size. The gels are stained with methylene blue gel stain according to the manufacturer's instructions. PCR products are visualized by placing the gel on a white illuminated surface.

#### Investigating the Reason for the Difference in Size of the PCR Products

The DNA sequence for the squirrel monkey PCR product will be provided electronically. The insertion of a DNA sequence into the squirrel monkey variable region can be detected by accessing the BLAST page (<http://blast.ncbi.nlm.nih.gov/Blast.cgi>) and following these steps. Select “Align” under Specialized BLAST. Copy and paste the squirrel monkey sequence into the query box and the owl monkey sequence into the subject box. Select “somewhat similar sequences” under Program Selection. At the bottom of the page select “BLAST.” Next, the insertion can be identified as an Alu element, a type of mobile DNA sequence, by following these steps at the BLAST page. Select “nucleotide blast.” Copy and paste the squirrel monkey sequence into the query box. In the second box, select the database “Human Alu repeat elements” from the dropdown list. At the bottom of the page select “BLAST.”

**Table A1. PCR setup.**

PCR Components	
Component	Volume (μL)
DNA template (dilute to 10 ng/μL)	1.0
Forward primer (10 μM) 5'-AGTTCCTCTCTACCTTGACC-3'	1.0
Reverse primer (10 μM) 5'-GCCCTACTCTTGACATTAATGC-3'	1.0
GoTaq Green Master Mix	12.5
Nuclease-free water	9.5

PCR Conditions		Record of PCR Observations	
Stage	Conditions	Sample	PCR Product Size
Initial denaturation	94°C, 1 minute	1. Owl monkey	
		2. Squirrel monkey	
Cycling (30 times):	Denaturation		
	Annealing		
	Elongation		
Final extension	72°C, 5 minutes		

**BLAST Interpretations**

1. Sketch the results of the BLAST of sm and om variable regions. Approximately how many nucleotides are inserted into the squirrel monkey region? Indicate this on your sketch.
2. Sketch the results of the BLAST of the sm variable region and the database of Alu sequences. How does this compare to the sketch above?

**Concluding Questions**

1. Owl monkeys and squirrel monkeys are closely related primates of the parvorder Platyrrhini (New World monkeys). What do your observations of PCR products tell you about DNA sequences in nonfunctional regions of closely related organisms?
2. In this example, what is the form of genetic variability (substitution, insertion, or deletion) that occurs in a nonfunctional region of the genome?
3. Based on lecture discussions of mutation and natural selection, describe in your own words why mutations in nonfunctional regions may persist over many generations and lead to high variability in these regions.

**Student Instructions for Activity 2: Conservation of Functional DNA Sequences**

Students who complete this activity will use PCR to begin to understand conservation of functional DNA sequences among two groups of primates: Catarrhines and Platyrrhines. Catarrhines include Old World monkeys such as baboons and rhesus macaques as well as chimpanzees, apes, and humans. Catarrhines primarily inhabit Africa and southern Asia, with the exception of humans, whose distribution is widespread. By contrast, Platyrrhines such as squirrel monkeys, marmosets, and owl monkeys inhabit Central and South America. Catarrhines and Platyrrhines evolved independently from a common ancestor >35 mya. Still, functional DNA sequences have been conserved. The sequences of the PCR products will be provided electronically for evaluation of the similarity in the DNA sequences.

In this activity, the size and DNA sequence of the primate chorionic gonadotropin (CG) gene will be compared. CG is a peptide hormone made in primates by placental cells during the first 10 weeks of pregnancy. It supports the implantation and development of the fetus. CG therefore represents a critical gene for reproductive success in primates.

Plasmid DNA containing the CG gene from humans, owl monkeys, or squirrel monkeys will be used as the template for PCR. The PCR components and settings are indicated below (Table A2). PCR products are fractionated and visualized using methylene blue stain as in Lab Activity 1.

**Table A2. PCR setup.**

PCR Components	
Component	Volume (μL)
DNA template (dilute to 10 ng/μL)	1.0
Forward primer (10 μM) 5'-GCACCAAGGATGGAGATG-3'	1.0
Reverse primer (10 μM) 5'-GCGGATTGAGAAGCCTTTA-3'	1.0
GoTaq Green Master Mix	12.5
Nuclease-free water	9.5

PCR Conditions		Record of PCR observations	
Stage	Conditions	Sample	PCR Product Size
Initial denaturation	94°C, 1 minute	1. Owl monkey	
		2. Squirrel monkey	
		3. Human	
Cycling (30 times): Denaturation Annealing Elongation	94°C, 1 minute		
	54°C, 30 seconds		
	72°C, 90 seconds		
Final extension	72°C, 5 minutes		

### **Determining the Similarity between Catarrhine & Platyrrhine CG Gene Sequences**

DNA sequences for the PCR products and for the unrelated genes, growth hormone and oxytocin, will be used for sequence comparisons. On the BLAST web page (<http://blast.ncbi.nlm.nih.gov/Blast.cgi>), select “align two sequences.” Copy and paste the human sequence into the query box. Copy and paste the squirrel monkey sequence into the subject box. At the bottom of the page select “BLAST.” Results will list the percent identical nucleotides. Repeat this to compare the other sequences.

### **BLAST Interpretations**

Genes Compared	Percent Identical Nucleotides
1. hCG vs. om CG	
2. hCG vs. sm CG	
3. sm vs. om CG	
4. hCG vs. h growth hormone	
5. h CG vs. h oxytocin	

### **Concluding Questions**

1. What do these results suggest about the similarity of functional DNA sequences?
2. Why do you think the sequence similarity is higher among Platyrrhines?
3. Why do you think 100% sequence similarity is not observed in the functional sequences?
4. Based on lecture discussions of mutation and natural selection, describe in your own words why conserved sequences persist in functional regions of genomes.

## APPENDIX 2: Teachers' Key for Student Instructions

### Activity 1: Variability of Nonfunctional DNA Sequences

#### PCR Observations

1. 500 bp
2. 750 bp

#### BLAST Interpretation

1. The sketch should show that the sequences align, except that there is a gap toward one end of the sm sequence, representing a region that is NOT found in the om sequence (250 bp).
2. The sketch should show that the region missing in the sm sequence in the first sketch is the same region that aligns with an Alu sequence, thus identifying it as similar to an Alu sequence.

#### Conclusions

1. The sequences can be variable, even among closely related organisms.
2. Alu insertion
3. Mutations in nonfunctional regions have no effect on organism survival and are not selected out (organisms are not weakened or do not die).

### Activity 2: Conservation of Functional DNA Sequences

#### PCR Observations

1. 1100 bp
2. 1100 bp
3. 1100 bp

#### BLAST Interpretation

1. 83%
2. 80%
3. 92%
4. No similarity
5. No similarity

#### Conclusions

1. Functional sequences remain similar among organisms.
2. Organismal relationships are based on morphological and physiological characteristics. These characteristics result from the use of DNA sequences that are used to produce proteins. Platyrrhines are more closely related to one another than Platyrrhines are to Catarrhines; thus, their DNA sequences are expected to be more similar.
3. Neutral and beneficial mutations persist because they either have no effect or provide an advantage to the organism, respectively.
4. Harmful mutations in functional sequences weaken organisms, reduce their reproductive capacity, and/or cause them to die. Therefore, harmful mutations are not likely to be passed to offspring. Neutral mutations in functional sequences contribute to some variability. Beneficial mutations in functional regions confer an advantage and may increase life span and/or reproduction. If reproduction is enhanced, more offspring harbor the beneficial mutation and it is passed to future generations. Therefore, as a result of removal of harmful mutations and transmission of beneficial mutations, functional sequences remain similar (conserved) from one generation to the next.

# Schol. Perf. - Publications - Colleagues' requests for materials

Request materials for 80 students working in pairs

Dr. Hubler,

I was hoping that you would be willing to share the plasmids that you used for Activity 1 and Activity 2 in the article that was published in the February 2015 edition of ABT. I would like to use your activities in my AP Biology and honors classes this semester.

My contact information is below:

Adam Bergeron  
Parkway Central High School  
369 North Woods Mill Road  
Chesterfield, MO 63017

Would you also be willing to share primers? If not, I will place an order with IDT.

Thanks for your help and wonderful teaching tools!

Best,

ALB

Adam Bergeron <abergeron@pkwy.k12.mo.us>

1/19/2016

It worked well! It was a challenge to help 10th grade students understand the "ins and outs" of PCR but I think the results of the experiment spoke volumes about the genetic differences that can exist between members of different species. I plan on trying the experiment again with this year's class.

ALB

Adam Bergeron  
Science Teacher  
Boys' Cross Country Coach  
Parkway Central High School  
<http://www.edline.net/pages/ParkwayCentralHS/Classes/ABergeron-050-2014>  
(314) 415-5950

# Schol. Perf. - Publications - Colleagues' requests for materials

Finco, Tim <tfinco@agnesscott.edu>

1/8/2016

Dear Dr. Hubler,

I read with interest the article you and your colleagues published in *The American Biology Teacher* (Vol. 77, #2, Feb. 2015), and would like to adopt the labs for our introductory biology course. I am writing to inquire whether it would be possible for you to send aliquots (+ maps) of the plasmids needed to perform this set of experiments?

If you are able to send the plasmids, you are welcome to ship them using the department's FedEx number (119837600).

Thank you,

Tim Finco, PhD  
Department of Biology  
Agnes Scott College  
141 East College Avenue  
Decatur, GA 30030

## Schol. Perf. - Publications - Colleagues' requests for materials

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**From:** Marcos Méndez Iglesias [mailto:[marcos.mendez@urjc.es](mailto:marcos.mendez@urjc.es)]  
**Sent:** Monday, January 12, 2015 12:29 PM  
**To:** Adams, Patti W.  
**Subject:** Reprint request

Dear Dr. Adams,  
I would appreciate a reprint of your paper:

Hubler et al. (2015). Am. Biol. Teach. 77 (1): 6-9.

Thanks in advance,

Marcos

Marcos Méndez Iglesias  
Área de Biodiversidad y Conservación  
Universidad Rey Juan Carlos  
c/ Tulipán s/n.  
E-28933 Móstoles (Madrid)  
España - Spain - Spanien  
Fusklandet (=La banana mecánica)  
Phone: +34 91 4888249  
e-mail: [marcos.mendez@urjc.es](mailto:marcos.mendez@urjc.es)

# Schol. Perf. - Student research enrollment

Data on Student Research Enrollment 2012-16

Row Labels	Sum of Student Count	Sum of Credit Hours	% of Student Count
<b>Hubler, Tina Reinschmidt</b>	<b>18</b>	<b>22</b>	<b>17.65%</b>
Fall 2012	2	3	1.96%
Fall 2013	4	5	3.92%
Fall 2014	1	1	0.98%
Fall 2015	1	2	0.98%
Spring 2013	3	3	2.94%
Spring 2014	4	5	3.92%
Spring 2016	2	2	1.96%
Summer 2013	1	1	0.98%

## Mentored student research

**Nicole Gallups 2016 Honors capstone project ongoing**

**Caroline Thomas 2015-16 QEP Undergrad. Research Award, Honors capstone project**

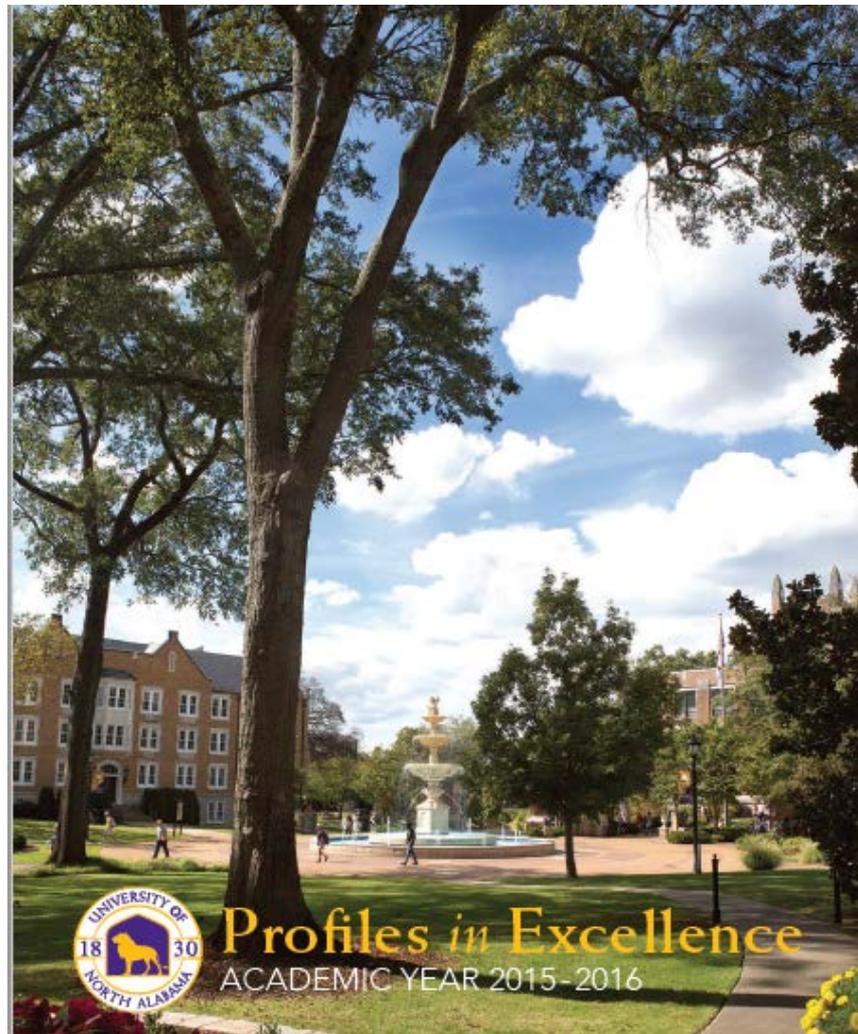
**Rosmely Hernandez, Rachel Herwick 2014-15**

**Matt Cooper, Angelica Gonzalez, Avisek Praisai, Chelsea Moon 2013-14**

**Vivian Lesende, 2012-13 QEP Undergrad. Research Award, Honors capstone project**

**Cesar Collado, Courtney Hamner 2012-13**

**Schol. Perf. -  
Student  
presentations**



**Hubler, Tina - Associate Professor of Biology**

Co-presented with C. Thomas, "Stressed? How FKBP proteins can help", Alabama Academy of Science, Florence, Alabama, February 2016.

# STRESSED?

## How FKBP Proteins Can Help!

Investigating the correlation between mRNA and protein levels of two hormone-signaling proteins, FKBP4 and FKBP5 in human and other primate cells.

Caroline Thomas  
University of North  
Alabama

# Overview

## Background

Stress-response proteins, FKBP4 and FKBP5  
How protein levels are controlled in cells

## Methods

Western blot  
qPCR

## Results

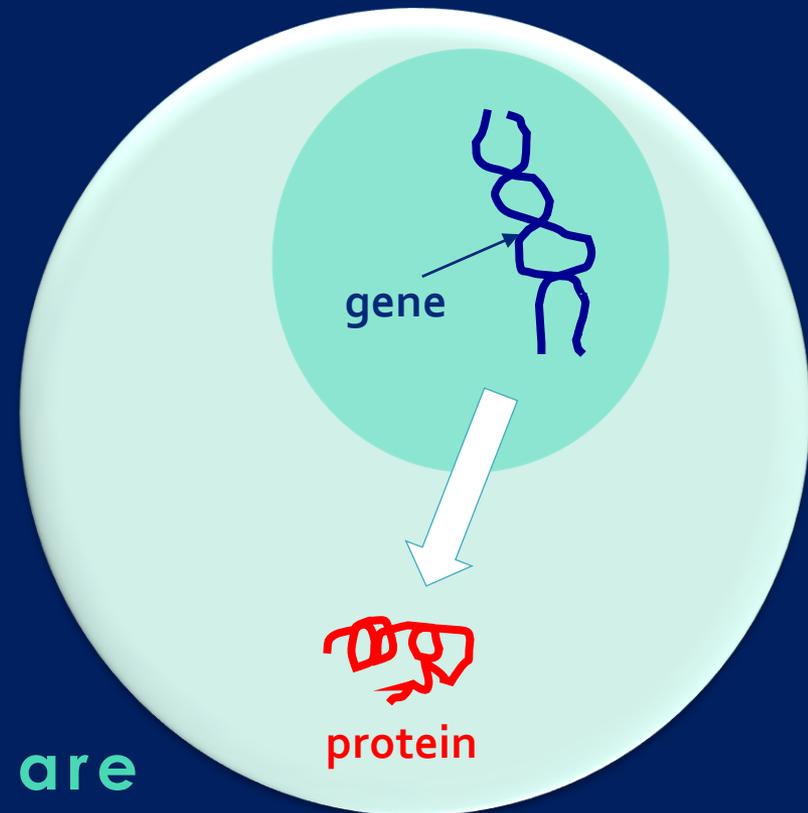
## Conclusions

# FKBP4 & FKBP5 are Proteins

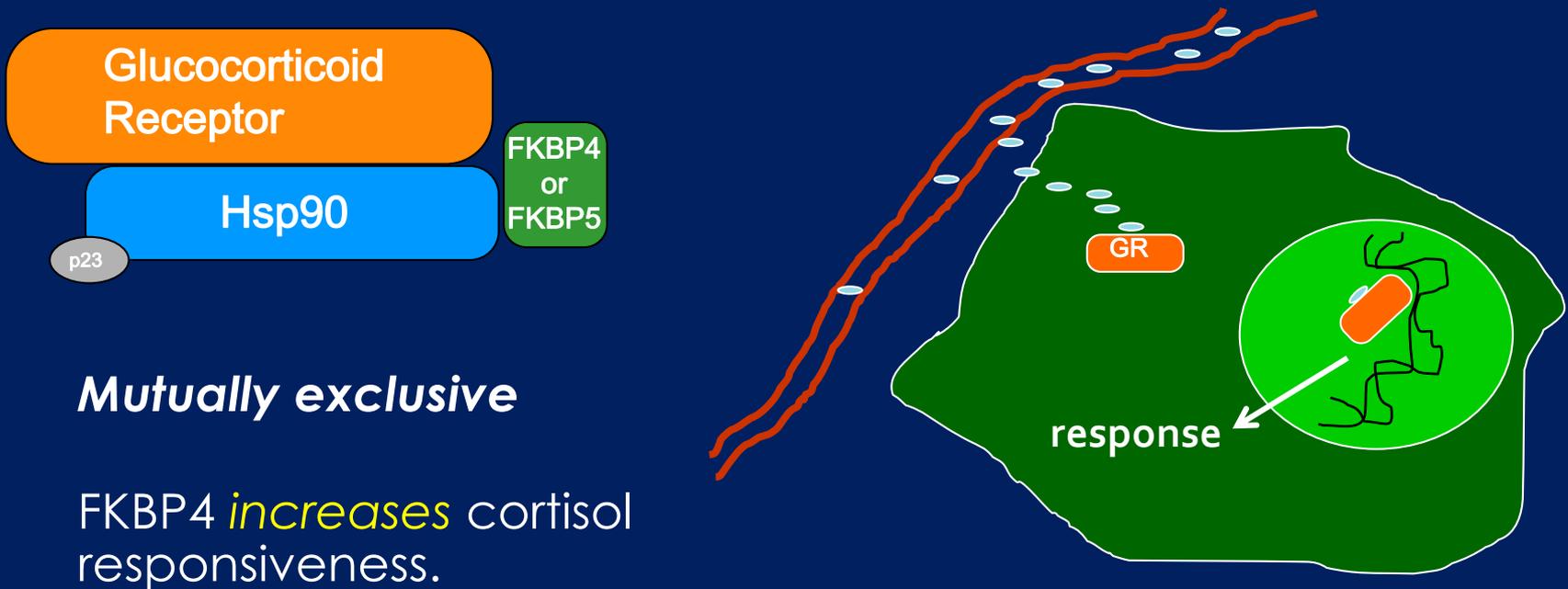
**Proteins** are the basis for all **functions** in a cell.

In cells proteins are made from segments of DNA called **genes**.

Important to my research are  
2 proteins  
involved in the stress response



# FKBP4 and FKBP5 proteins have opposing effects on a stress receptor



## ***Mutually exclusive***

FKBP4 *increases* cortisol responsiveness.

FKBP5 *decreases* cortisol responsiveness.

The *relative levels* of FKBP4 and FKBP5 proteins are important for overall responsiveness.



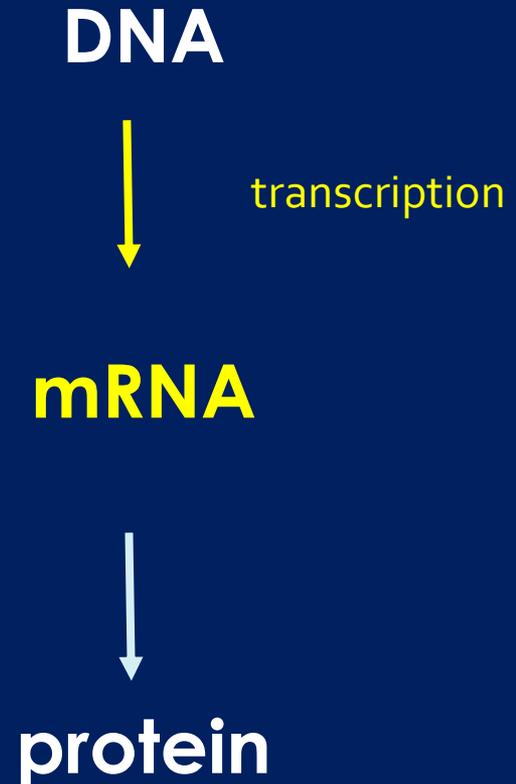
# Regulation of gene expression

Central Dogma of  
Molecular Biology

Primary regulation:  
transcriptional  
mechanisms

To begin to understand how FKBP4 and FKBP5  
gene expression is regulated,

**we will determine if protein and  
mRNA levels correlate.**



# Methods

## Purpose

Measure protein levels in two cell lines that exhibit differential expression of FKBP4 and FKBP5

Measure mRNA levels in the same cell lines

## Technique

Western Blot

Quantitative PCR

# Methods

## Purpose

Measure protein levels in two cell lines that exhibit differential expression of FKBP4 and FKBP5

Measure mRNA levels in the same cell lines

## Technique

Western Blot

Quantitative PCR

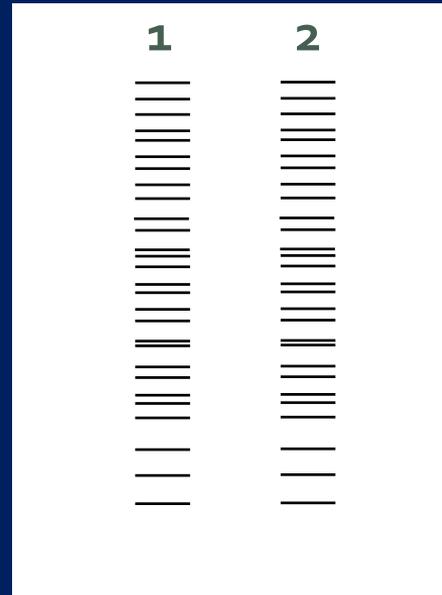
# Assaying Protein Levels by Western Blot

- antibodies to target **specific proteins**
- comparison of their levels

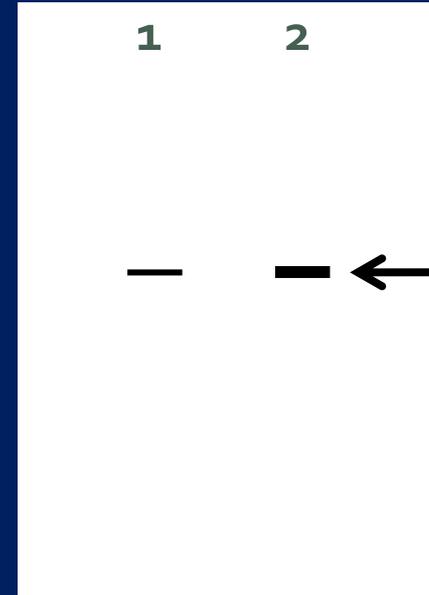
Gel electrophoresis to separate proteins



Proteins on membrane used as solid support

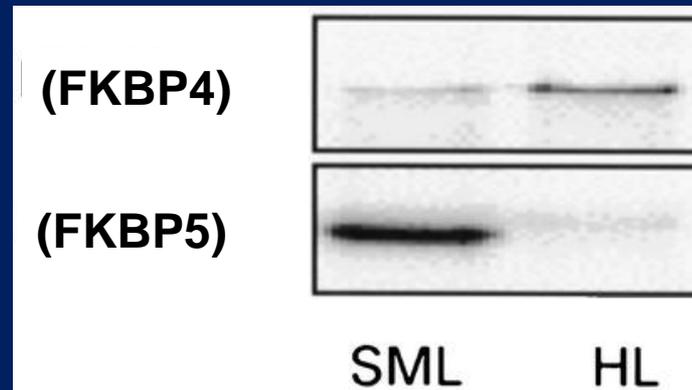


Ponceau stain of membrane



Detection of a single protein by antibody

# Models of differential expression of FKBP4 and FKBP5: SML & HL

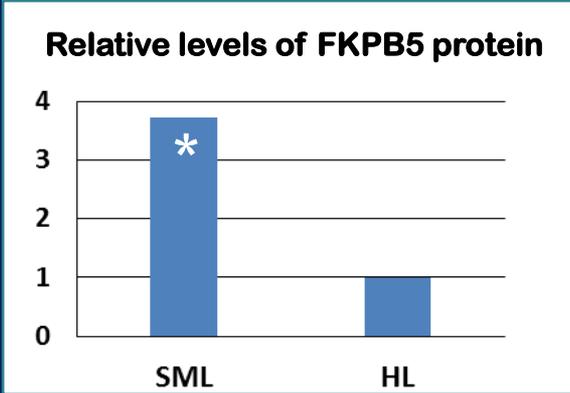
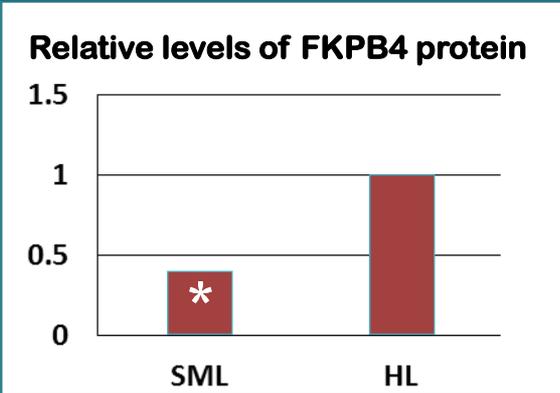


FKBP4 protein levels are **lower** in SML than HL

FKBP5 protein levels are **higher** in SML than HL

Glucocorticoid resistance in the squirrel monkey is associated with overexpression of the immunophilin FKBP51. Reynolds PD, Ruan Y, Smith DF, Scammell JG. J Clin Endocrinol Metab. 1999 Feb;84(2):663-9.

# Results: FKBP5 and FKBP4 Protein levels in SML and HL



FKBP4 protein levels are **lower** in SML than HL

FKBP5 protein levels are **higher** in SML than HL

# Methods

## Purpose

Measure protein levels in two cell lines that exhibit differential expression of FKBP4 and FKBP5

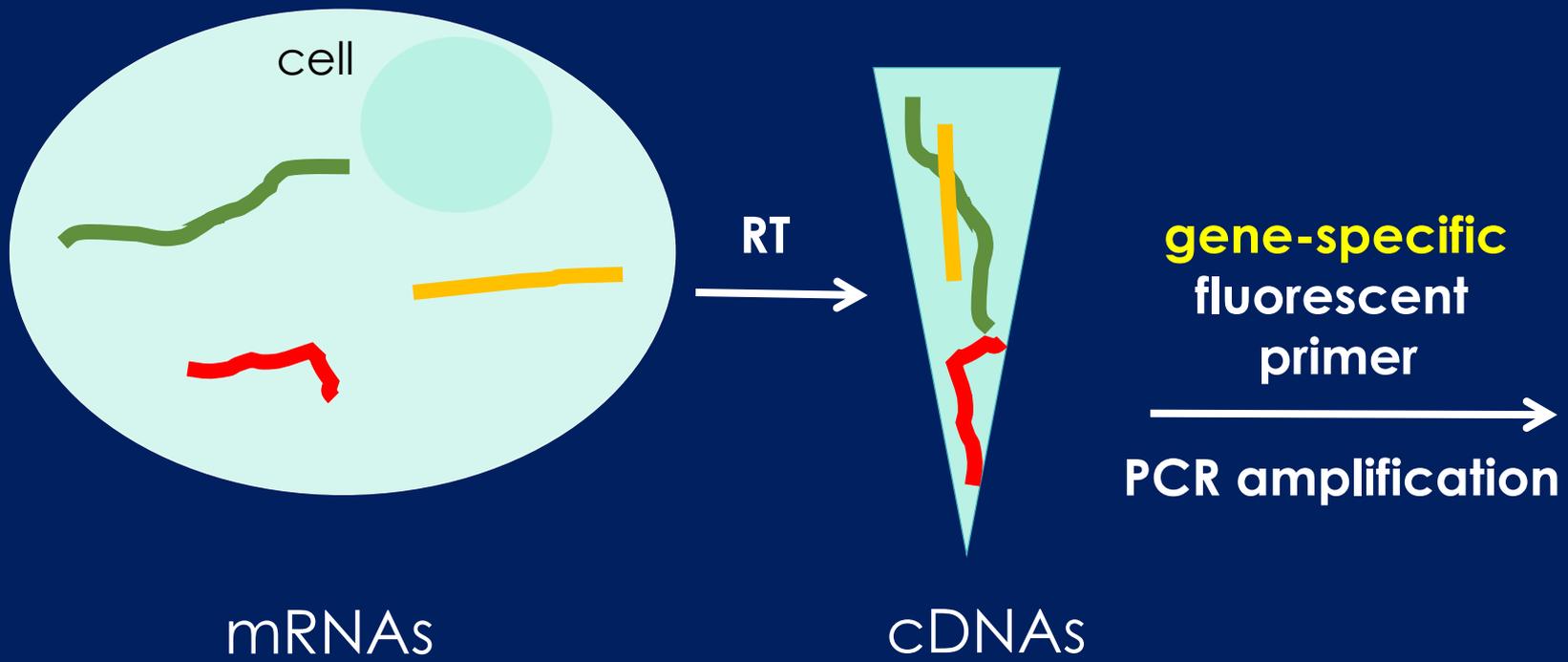
Measure mRNA levels in the same cell lines

## Technique

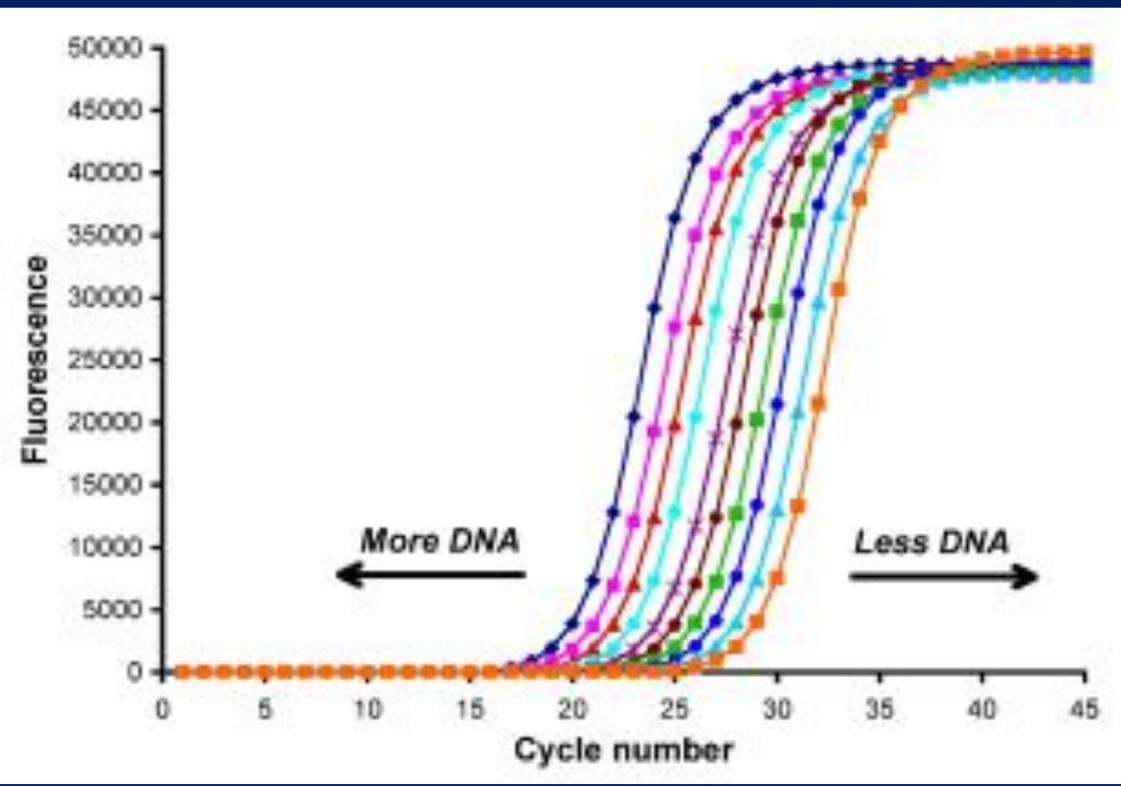
Western Blot

Quantitative PCR

# Comparing mRNA levels by qPCR

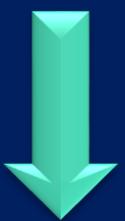


# Comparing mRNA levels by qPCR



# of copies of cDNA (mRNA)

# of cycles needed to detect the PCR product



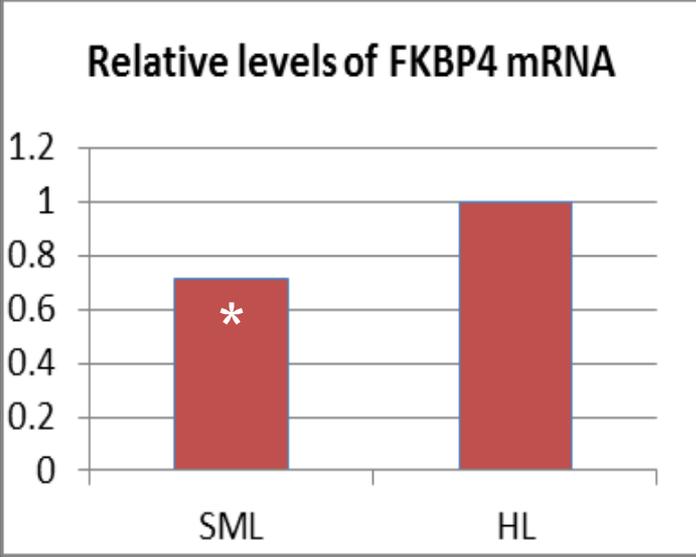
2

33

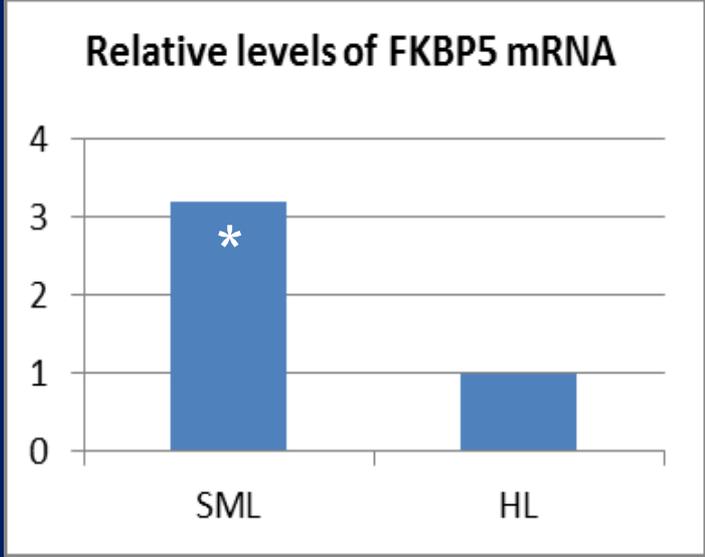
10

22

# Results: qPCR graphs

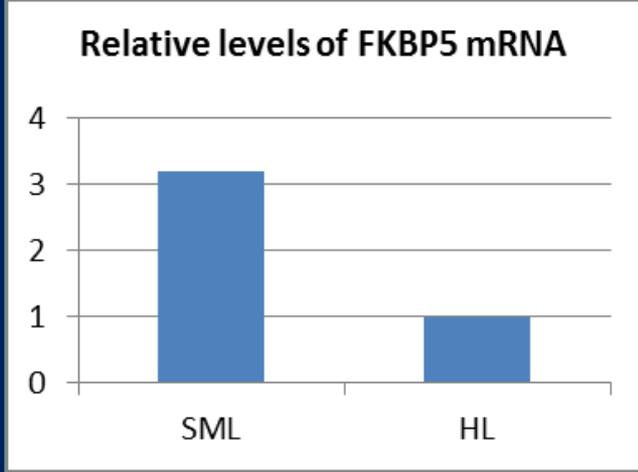
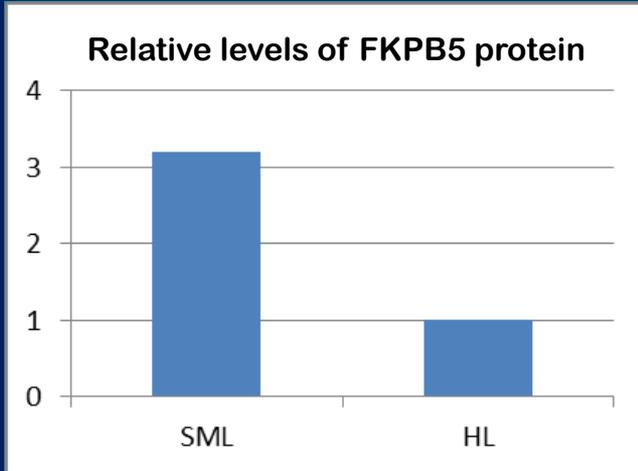
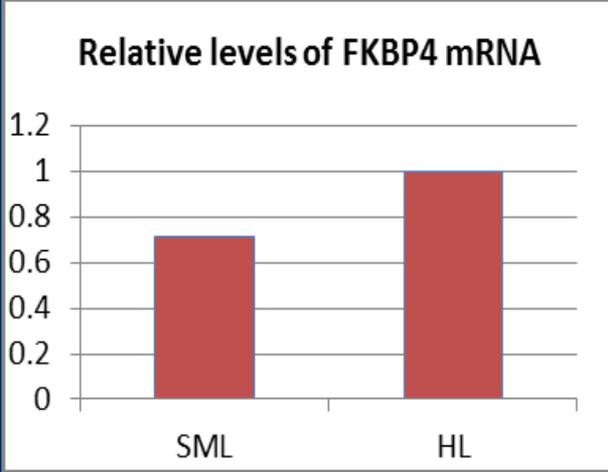
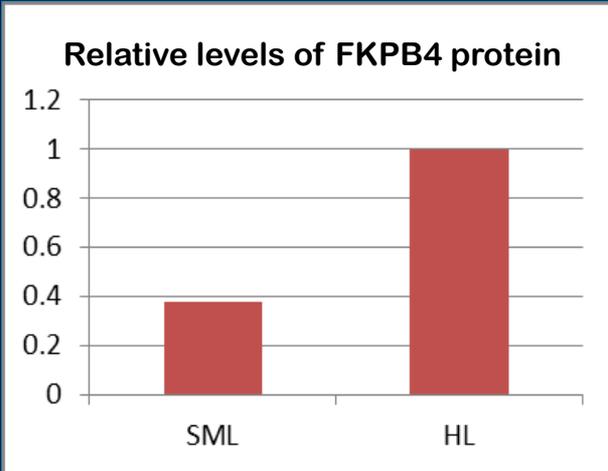


FKBP4 mRNA levels are lower in SML than HL



FKBP5 mRNA levels are higher in SML than HL

# Conclusion

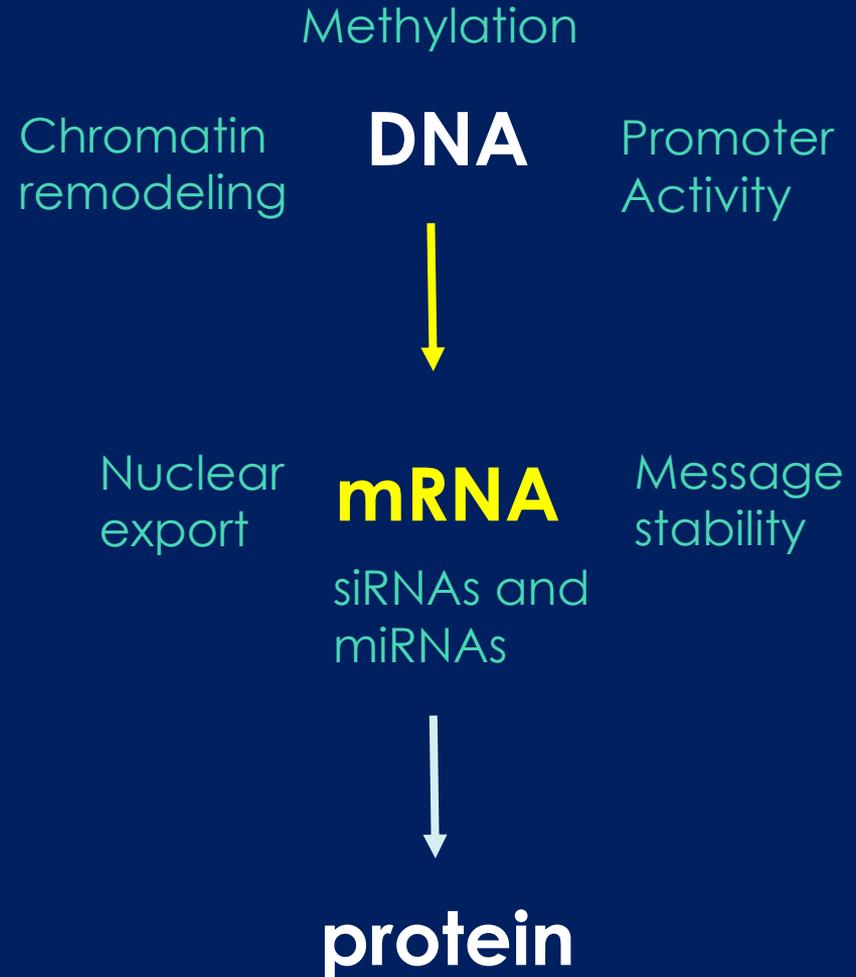


# Conclusion

## What's next?

1. Use our models (SML and HL cells) to evaluate differences in promotor activities

2. Watch literature for reports of miRNAs affecting FKBP5 or FKBP4



# Acknowledgments

- UNA Quality Enhancement Plan  
Student Research Grant
- UNA CAS grant
- Department of Biology
  
- Dr. John Repass, ARQ Genetics
- Dr. Tina Hubler

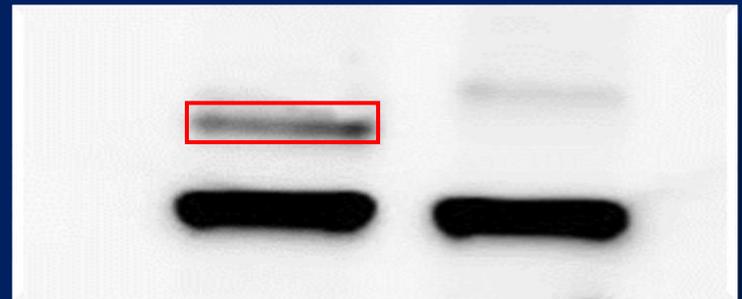
# Schol. Perf. - Student presentations

# Cell Culture

- RPMI – growth media
- Incubator: 37°C      5% CO<sub>2</sub>      humidified
- Suspension cells – collected by centrifugation
- Lysed with RIPA buffer (protease inhibitors)
- Protein concentration determined by Bradford Assay
- Standard curve using albumin
- Adjusted samples to [1ug/uL] with sample buffer

# Densitometry

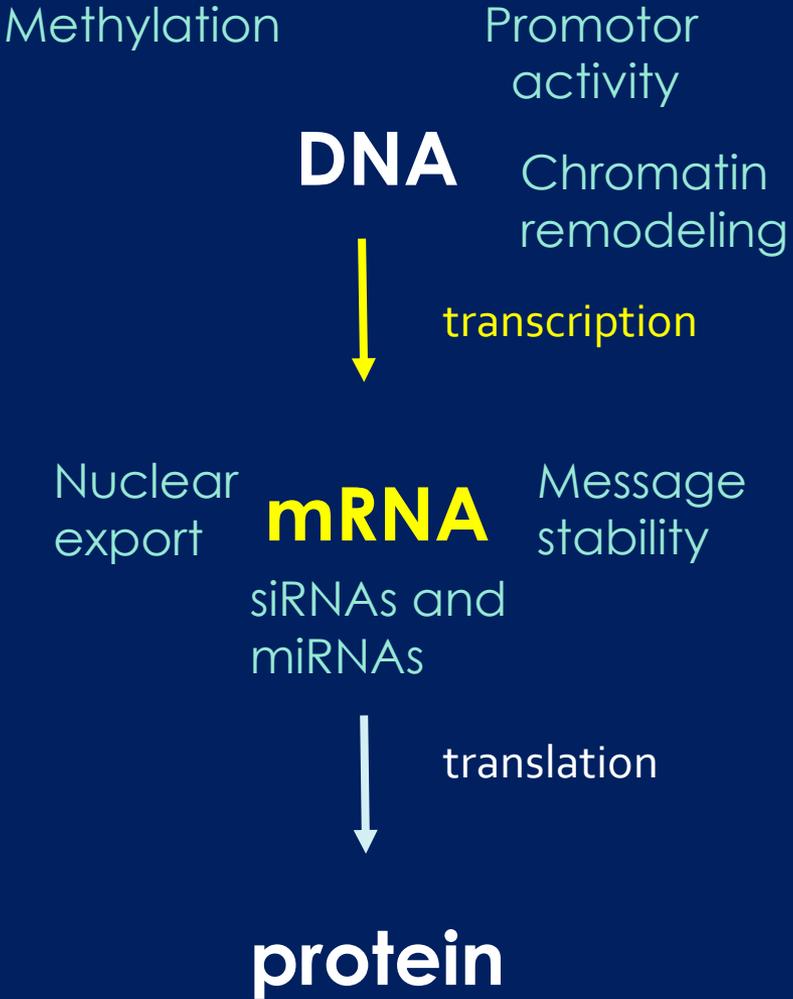
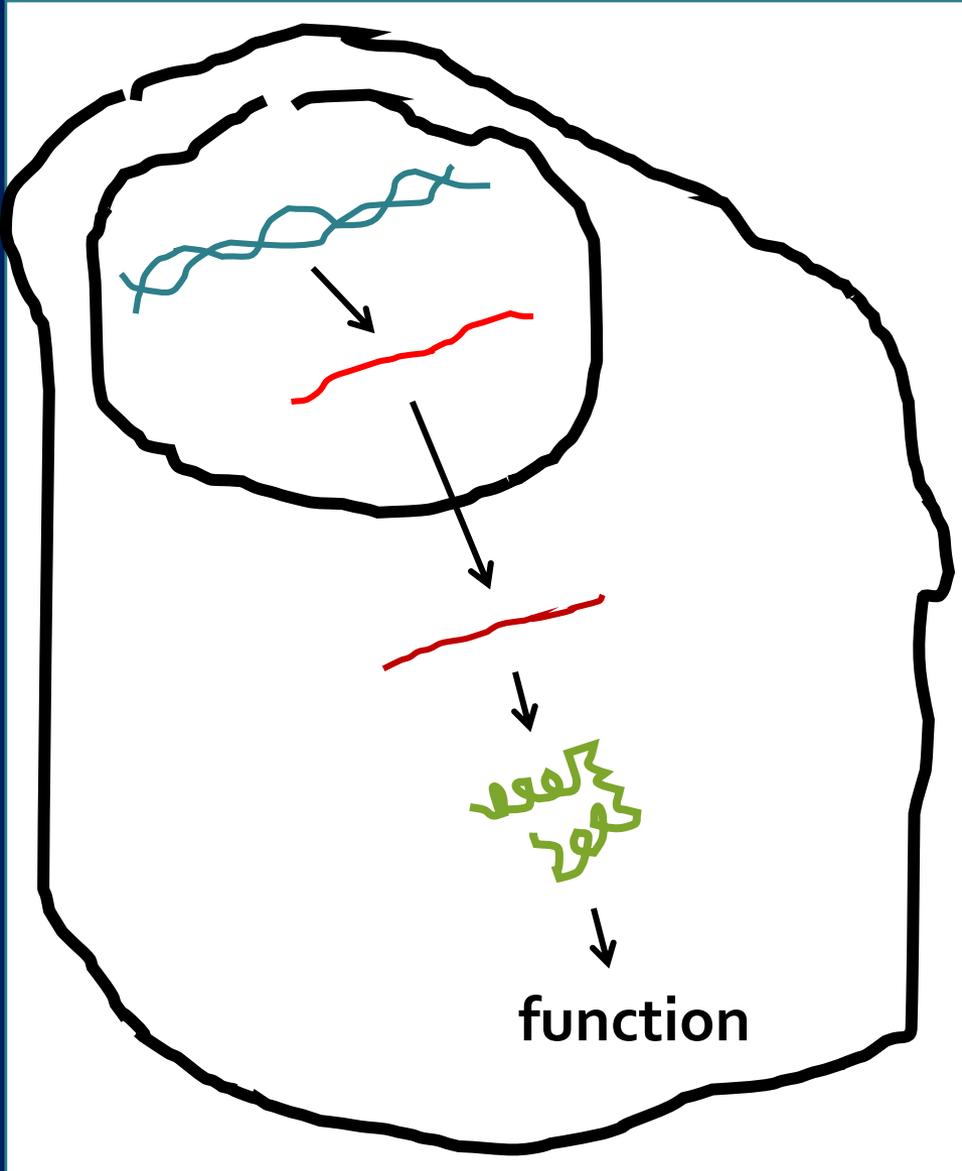
- PDF of Western Blot image
- Select area around protein band analyzing
- Program counts dark pixels
- Reports quantity representing protein levels
- Data normalized to actin (control)
- Normalize to HL for graph of relative levels
- Subjective, but results trusted



# Statistical Analysis

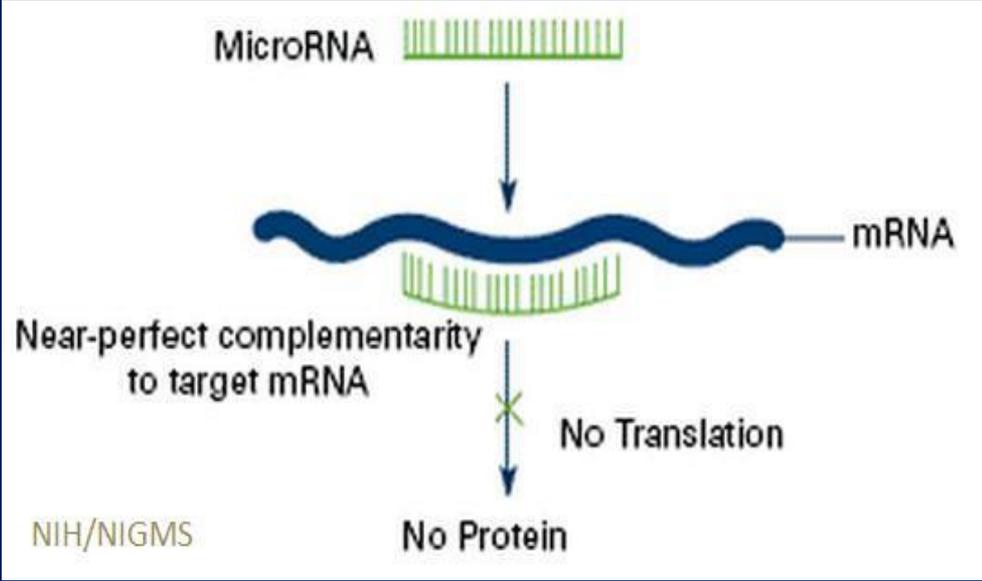
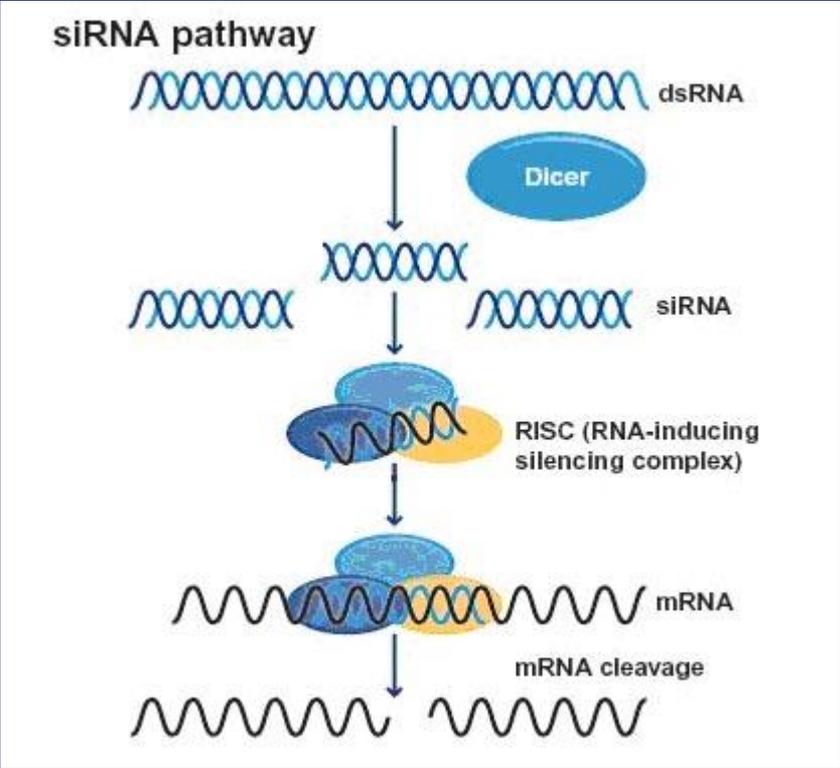
- Boot strap
  - Sampling with replacement
  - Determining variance around the mean
  - P value  $< 0.05$  (probability that two data sets are the same)
  
- T test
  - abs. value of T stat  $> t$  crit
  - P value  $< 0.05$

# Mechanisms of Regulation

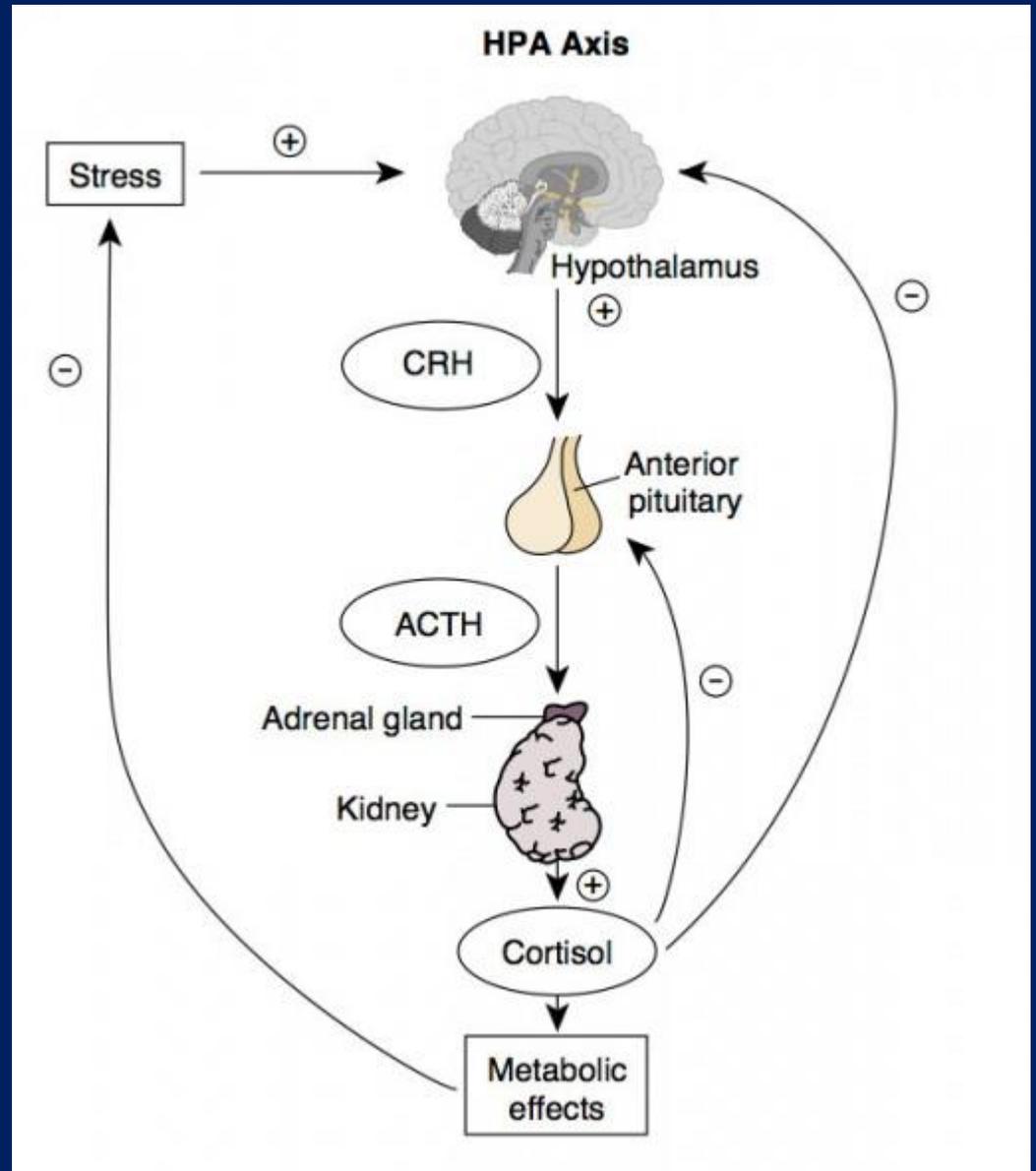


# Other regulatory mechanisms

The field of epigenetics focuses on mechanisms of control such as gene silencing.

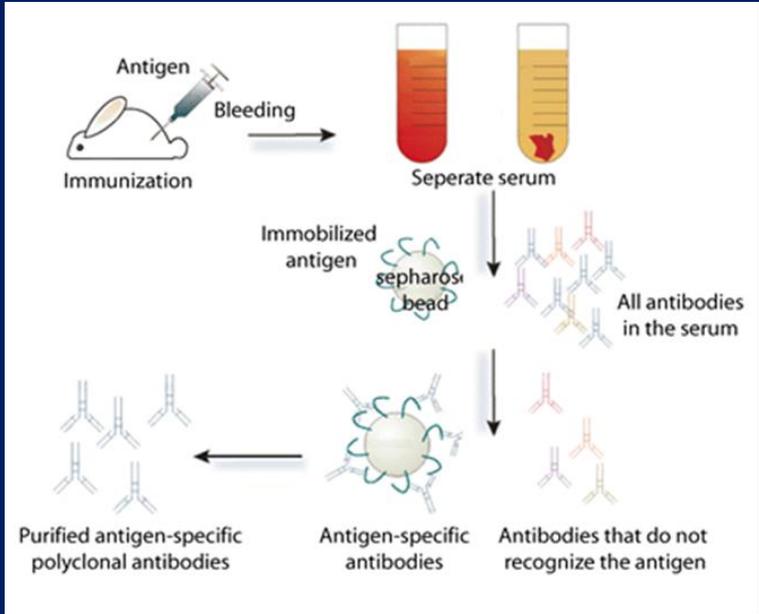


# Stress and the HPA Axis

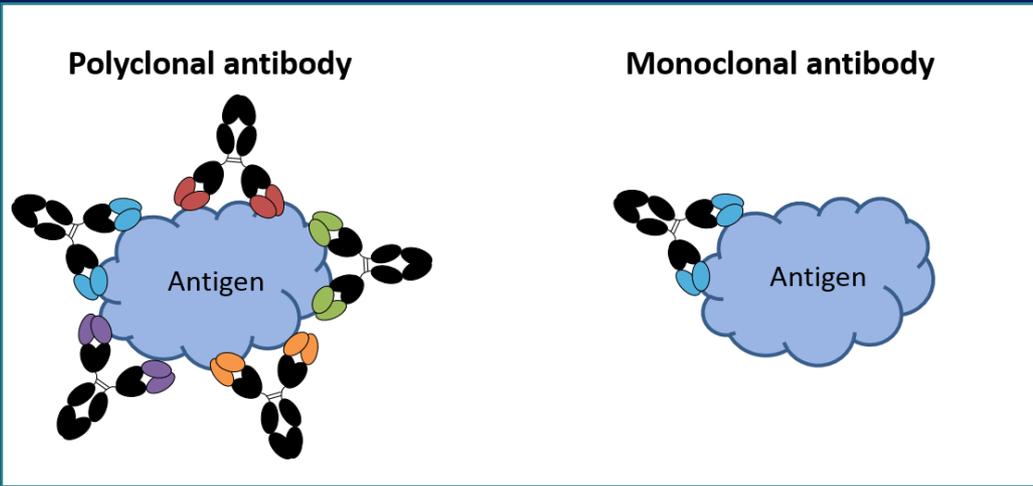
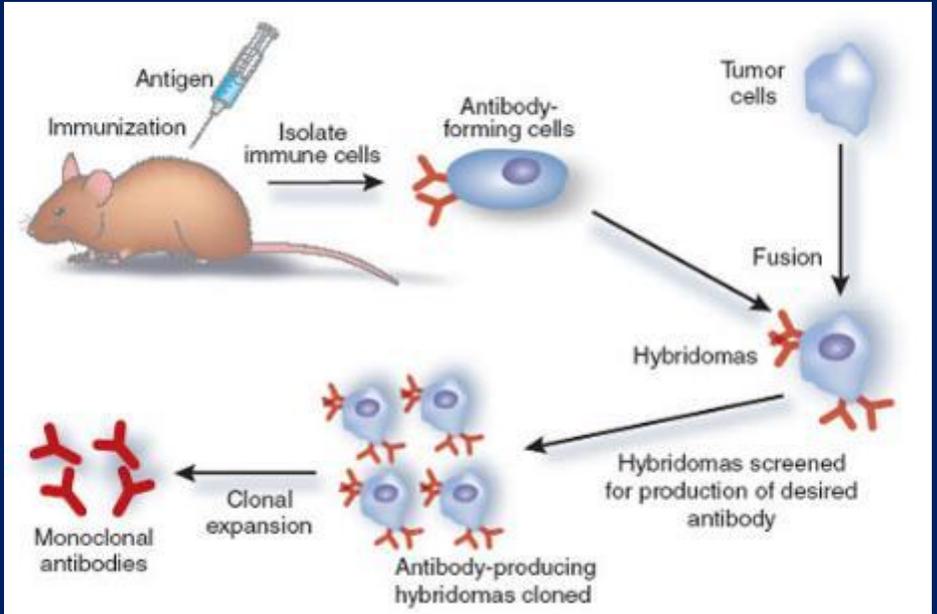


# Schol. Perf. - Student presentations

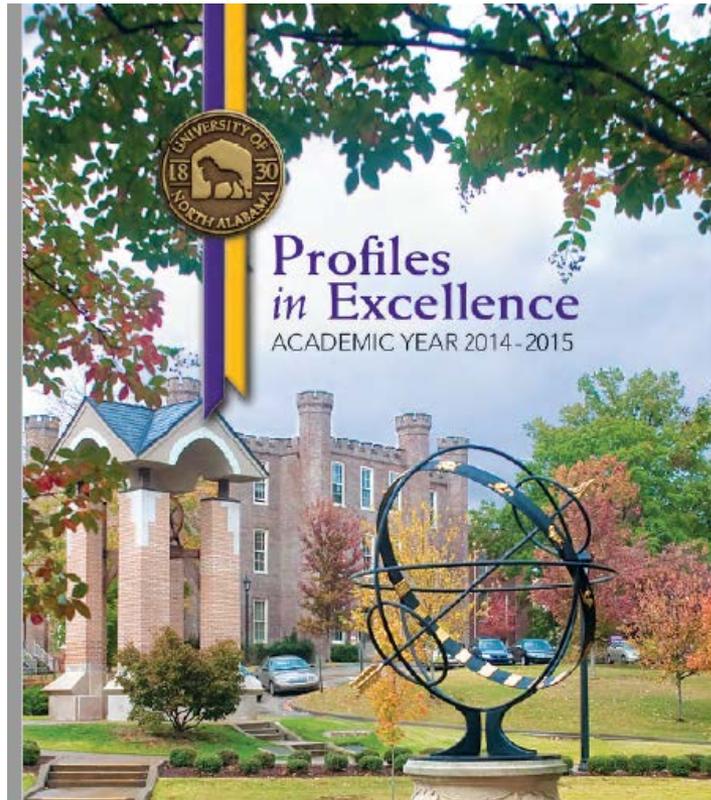
## Polyclonal antibodies



## Monoclonal antibodies



## Schol. Perf. - Student presentations



### **Hubler, Tina** - *Associate Professor of Biology*

Coauthored with P. Adams and J. Scammell, "Instant Update: Considering the Molecular Mechanisms of Mutation & Natural Selection," *The American Biology Teacher*, 77: 6-9.

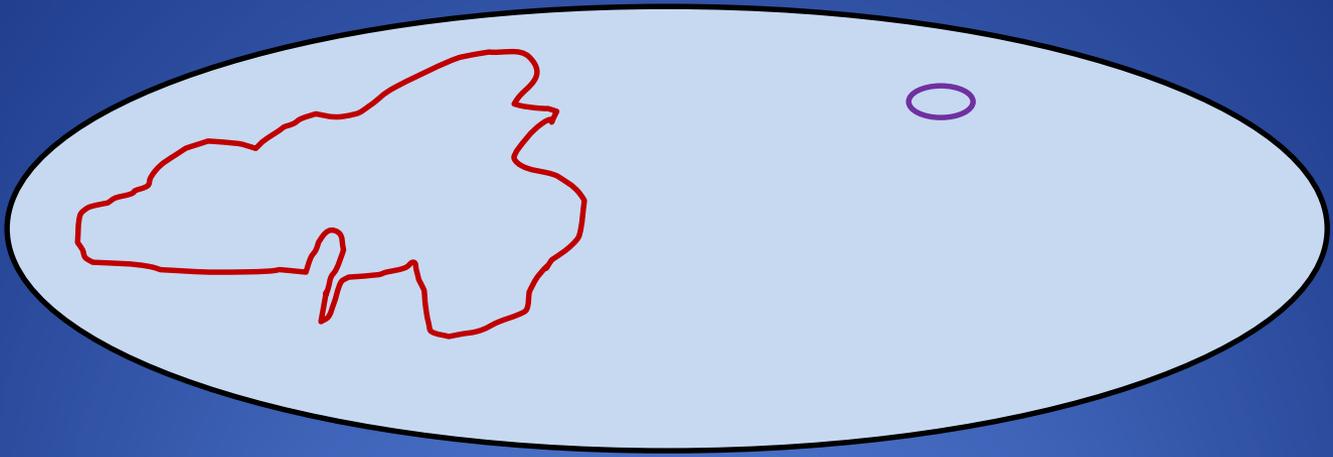
Coauthored with P. Adams and J. Scammell, "Laboratory Activities to Support Student Understanding of the Molecular Mechanisms of Mutation & Natural Selection," *The American Biology Teacher*, 77: 118-125.

Co-Presented, "Techniques for the Rapid Detection of KPC-Positive Bacteria Isolated from Clinical Sputum Samples Using PCR Amplification," Association of Southeastern Biologists and Southeastern Region of Tri-Beta Honor Society, Chattanooga, TN, April 2015.

# Techniques for the Rapid Detection of KPC Gene Isolated from Bacteria found in Sputum Samples using PCR Amplification.

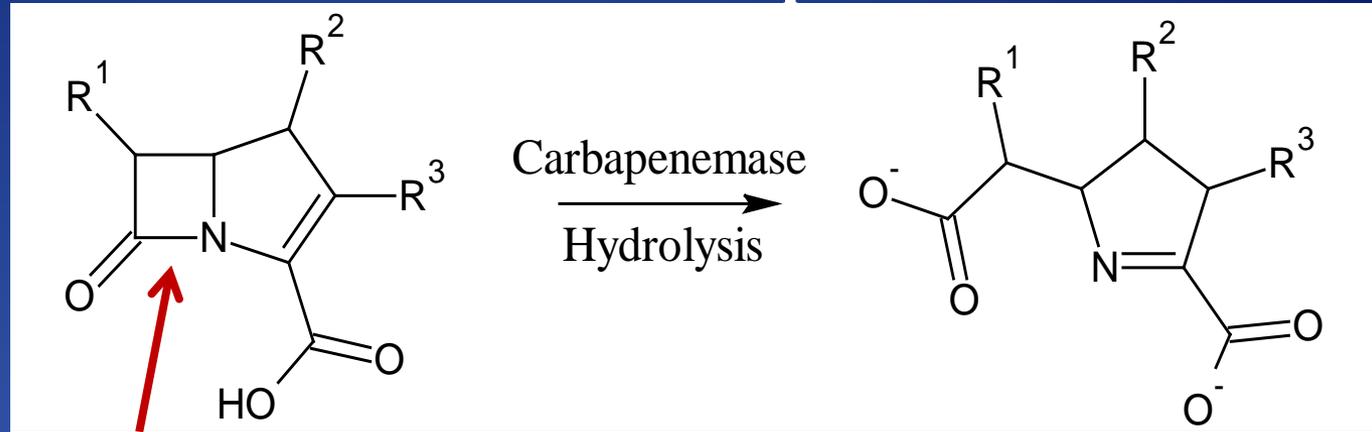
Rosmely Hernandez  
Department of Biology  
UNA

Some bacteria produce carbapenemase from a KPC gene on genomic or plasmid DNA.



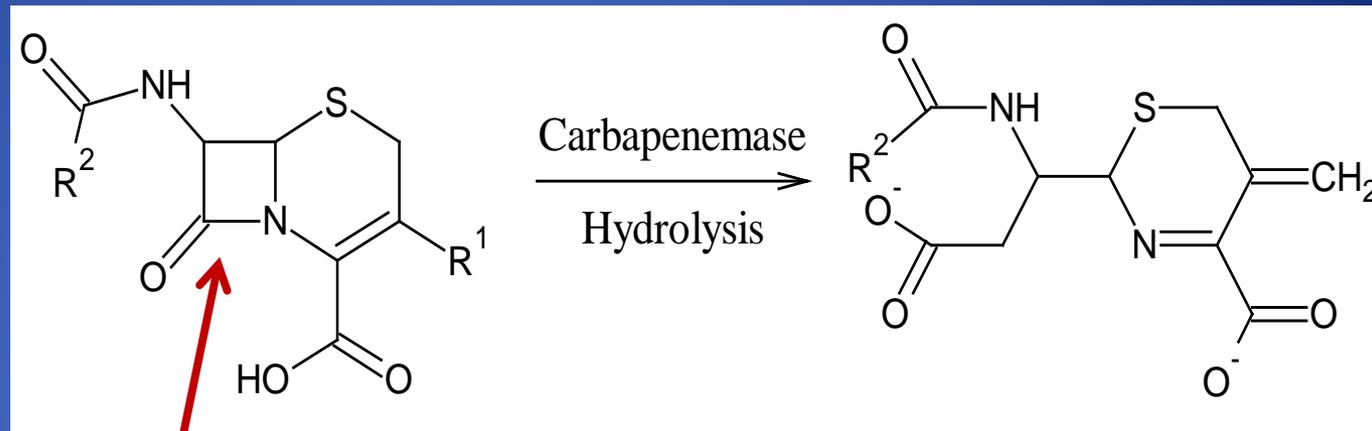
# Mechanism of action of carbapenemase

**Carbapenem**



**Site of beta lactamase action**

**Cephalosporin**



**Site of beta lactamase action**

## Families of antibiotics affected by carbapenemases

Penicillins	Carbapenems	Monobactams	Cephalosporins
Penicillin G	Imipenem	Aztreonam	Cefacetrile
Penicillin V	Meropenem		Cefadroxil
Ampicillin	Ertapenem		Cefalexin
Amoxicillin	Doripenem		Cefaloglycin
Methicillin			Cefalonium
Oxacillin			Cefaloridine
Piperacillin			Cefalotin

**Importance of identifying KPC<sup>+</sup> bacteria**

## Experimental design

- I. Design primers for PCR of KPC gene
- II. Isolate DNA from KPC<sup>+</sup> and KPC<sup>-</sup> bacteria
- III. Perform PCR for KPC gene and a control gene
- IV. Electrophoretic analysis of PCR products
- V. Gel extraction and DNA sequencing to confirm KPC gene detection

# Primer Design for PCR

*Klebsiella pneumoniae* class A carbapenemase coding sequence

NCBI Accession No. NC\_014312.1

```
1  atgtcaactgt atcgccgtct agttctgctg tcttgtctct catggccgct ggctggcttt
61 tctgccaccg cgctgaccaa cctcgtcgcg gaaccattcg ctaaactcga acaggacttt
121 ggcggctcca tcggtgtgta cgcgatggat accggctcag gcgcaactgt aagttaccgc
181 gctgaggagc gcttcccact gtgcagctca ttcaagggct ttcttgctgc cgctgtgctg
241 gctcgcagcc agcagcaggc cggcttgctg gacacacca tccgttacgg caaaaatgcg
301 ctggttccgt ggtcacccat ctcggaaaaa tatctgacaa caggcatgac ggtggcggag
361 ctgtccgcgg ccgccgtgca atacagtgat aacgccgccg ccaatttgtt gctgaaggag
421 ttgggcggcc cggccgggct gacggccttc atgcgctcta tcggcgatac cacgttccgt
481 ctggaccgct gggagctgga gctgaactcc gccatcccag gcgatgcgcg cgatacctca
541 tcgccgcgcg ccgtgacgga aagcttacia aaactgacac tgggctctgc actggctgcg
601 ccgcagcggc agcagtttgt tgattggcta aagggaaca cgaccggcaa ccaccgcac
661 cgcgcggcgg tgccggcaga ctgggcagtc ggagacaaaa ccggaacctg cggagtgtat
721 ggcacggcaa atgactatgc cgtcgtctgg cccactgggc gcgcacctat tgtgttggcc
781 gtctacacc gggcgctaa caaggatgac aagcacagcg aggccgtcat cgccgctgcg
841 gctagactcg cgctcgaggg attgggcgtc aacgggcagt aa
```

**68 °C improves specificity**

# Isolation of DNA from KPC<sup>+</sup> and KPC<sup>-</sup> bacteria

## Handling of KPC<sup>+</sup> bacteria

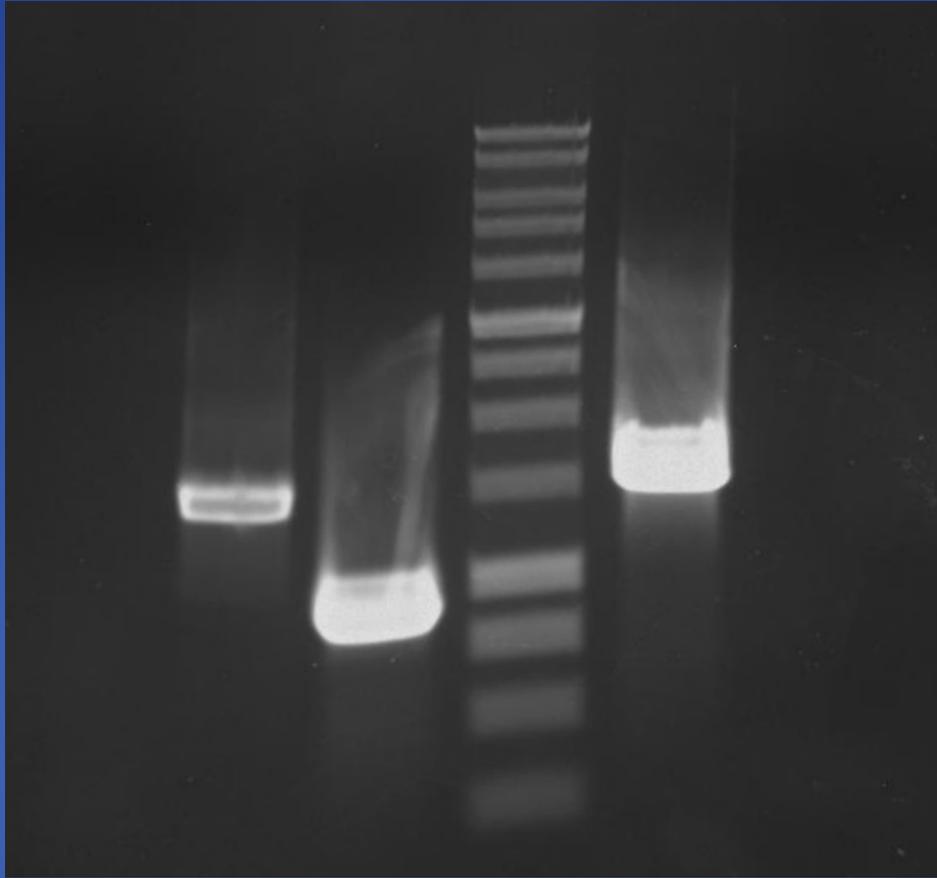
- Why should we be very careful?
- Precautions during DNA isolation
  - Gloves, goggles, lab coat, and face mask

# Electrophoretic Analysis of PCR

<b>Template</b>	None	KPC+ gDNA	KPC+ gDNA	KPC- gDNA	KPC- gDNA
<b>Primers</b>	None	rDNA	KPC	rDNA	KPC

DNA ladder, bp

1500  
1000  
750  
500  
250



Band sizes, bp

← 1484  
← 882

# BLAST of PCR product sequence to KPC gene sequence

PCR →  
KPC →

<u>Query</u> 1	GGCCGCTGGCTGGCTTTTCTGCCACCGCGCTGACCAACCTCGTCGCGGAACCATTTCGCTA	60	
<u>Sbjct</u> 44	GGCCGCTGGCTGGCTTTTCTGCCACCGCGCTGACCAACCTCGTCGCGGAACCATTTCGCTA	103	
<u>Query</u> 61	AACTCGAACAGGACTTTGGCGGCTCCATCGGTGTGTACGCGATGGATAACGGCTCAGGCG	120	
<u>Sbjct</u> 104	AACTCGAACAGGACTTTGGCGGCTCCATCGGTGTGTACGCGATGGATAACGGCTCAGGCG	163	
<u>Query</u> 121	CAACTGTAAGTTACCGCGCTGAGGAGCGCTTCCCCTGTGCAGCTCATTCAAGGGCTTTC	180	
<u>Sbjct</u> 164	CAACTGTAAGTTACCGCGCTGAGGAGCGCTTCCCCTGTGCAGCTCATTCAAGGGCTTTC	223	
<u>Query</u> 181	TTGCTGCCGCTGTGCTGGCTCGCAGCCAGCAGCAGGCCGGCTTGTGGACACACCCATCC	240	
<u>Sbjct</u> 224	TTGCTGCCGCTGTGCTGGCTCGCAGCCAGCAGCAGGCCGGCTTGTGGACACACCCATCC	283	
<u>Query</u> 241	GTTACGGCAAAAATGCGCTGGTTCCGTGGTCACCCATCTCGGAAAAATATCTGACAACAG	300	
<u>Sbjct</u> 284	GTTACGGCAAAAATGCGCTGGTTCCGTGGTCACCCATCTCGGAAAAATATCTGACAACAG	343	
<u>Query</u> 301	GCATGACGGTGGCGGAGCTGTCCGCGGCCGCCGNGCAATACAGTGATAACGCCGCCGCCA	360	
<u>Sbjct</u> 344	GCATGACGGTGGCGGAGCTGTCCGCGGCCGCCGNGCAATACAGTGATAACGCCGCCGCCA	403	
<u>Query</u> 361	ATTNGTTGCTGAATGAGTTGGGCGGC	386	Identity- 99%
<u>Sbjct</u> 404	ATTTGTTGCTGAAGGAGTTGGGCGGC	429	

## Next steps

**Isolate genomic and plasmid DNA from resistant sputum isolates**

**Perform PCR**

**Identify whether isolate is KPC<sup>+</sup> or KPC<sup>-</sup>**

## Conclusion

**PCR may be used to detect KPC<sup>+</sup> bacteria  
and  
aid in treatment of infections.**

# Acknowledgments

**BBB Research Grant**

**Dept. of Biology, University of North Alabama**

**Dr. Tina Hubler and Dr. Lisa Ann Blankinship**

Baker, G., Smith, J.J., Cowan, D.A. (2003). Review and re-analysis of Domain-specific 16S primers, *Journal of Microbiological Methods* 55 (3): 541-555. doi:10.1016/j.mimet.2003.08.009

# Schol. Perf. - Student presentations

Rachel Herwick at UNA's first 3 Minute Thesis Competition

MicroRNAs: Big things Come in Small Packages

Abstract: Monkeys and humans are extremely similar genetically, morphologically and physiologically. Differences in these two organisms may be explained by the Central Dogma of Molecular Biology which states the genetic material, DNA, is used to make proteins that are responsible for an organisms' appearance and function. Recent discoveries suggest that there are many different ways that DNA is used to produce proteins. Our research involves a newly discovered mechanism of controlling protein production.

The image shows a presentation board for the University of North Alabama's Three Minute Thesis Competition. The board is divided into two main sections. The left section is a purple vertical banner with white text and logos. The right section is a white horizontal banner with black text and a small portrait photo of Rachel Herwick.

**UNIVERSITY OF NORTH ALABAMA**

**Three Minute Thesis Competition**

April 9, 2014

The Commons  
Room 330

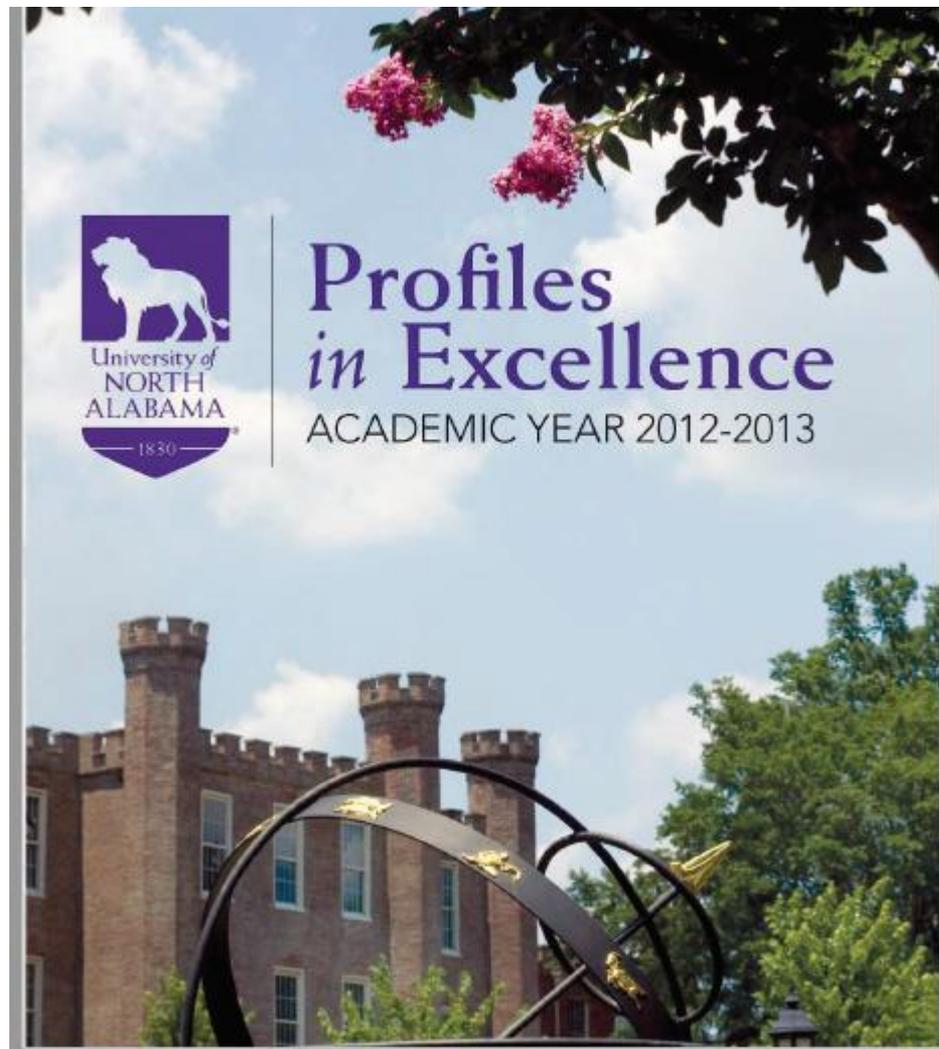
**Department of Biology**

Rachel Herwick  
Mentor: Dr. Tina Hubler

**MicroRNA: Big Things Come in Small Packages**

Abstract: Monkeys and humans are extremely similar genetically, morphologically, and physiologically. Differences in these two organisms may be explained by the Central Dogma of Molecular Biology which states that the genetic material, DNA, is used to make proteins that are responsible for an organism's appearance and function. Recent discoveries suggest that there are many different ways that DNA is used to product protein. Our research involves a newly discovered mechanism of controlling protein production.

Schol. Perf. -  
Student  
presentations



**Hubler, Tina** – *Associate Professor of Biology*

Co-presented with Vivian Lesende, "Using Comparative Genomics to Study Molecular Evolution in New World and Old World Monkeys," Alabama Academy of Science, Birmingham, AL, March 2013.

Using Comparative Genomics  
to  
Study Molecular Evolution  
in  
New World  
and  
Old World Primates



# Comparative Genomics

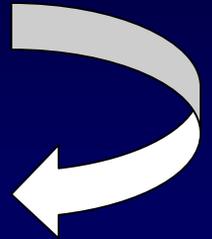


Comparative genomics : genome sequences of different species are compared

## Molecular Evolution

Molecular Evolution  
changes in DNA sequences over time

changes in organisms' phenotype over time  
e.g. primate evolution



## Molecular Evolution

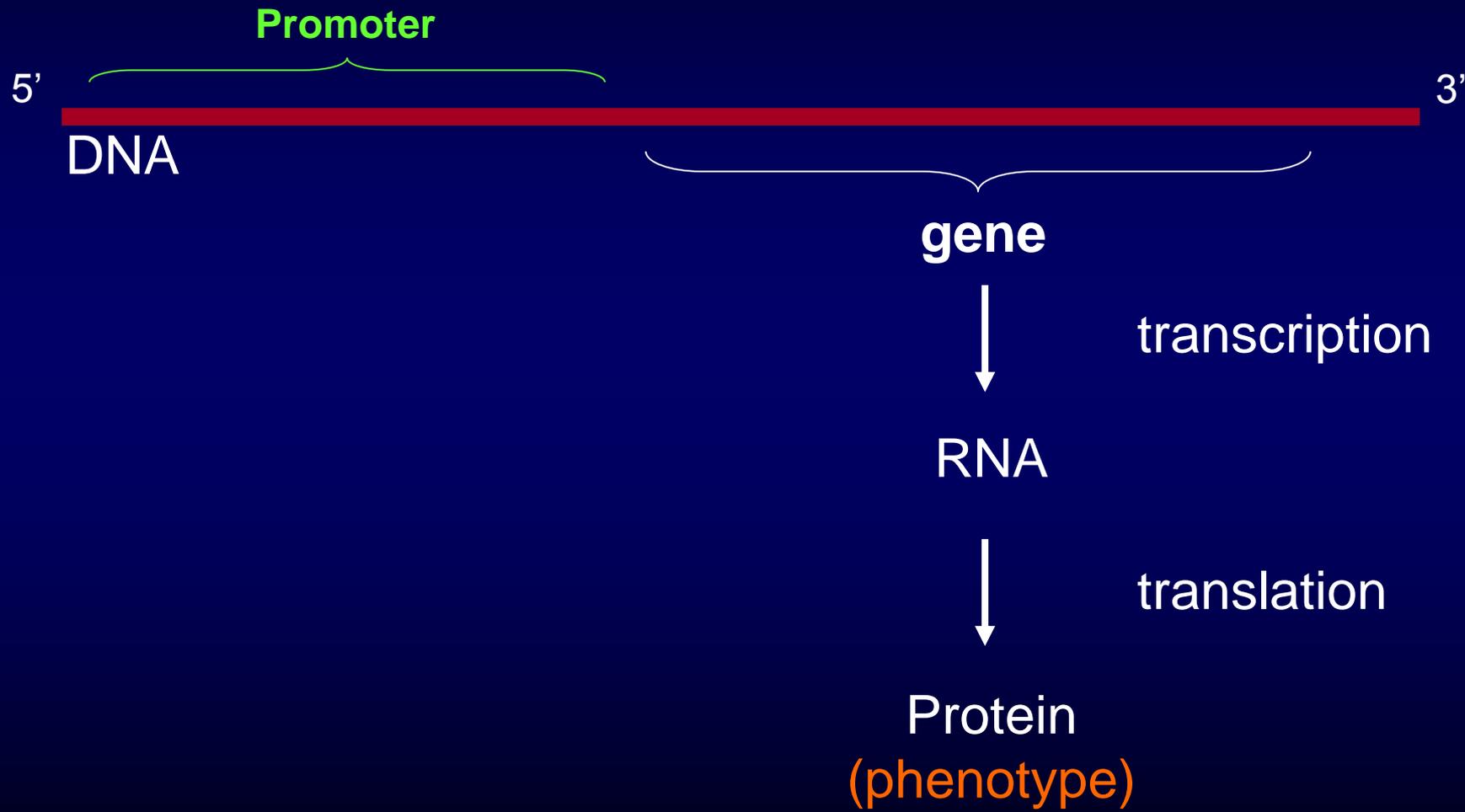
Mutation

Deletion

Insertion

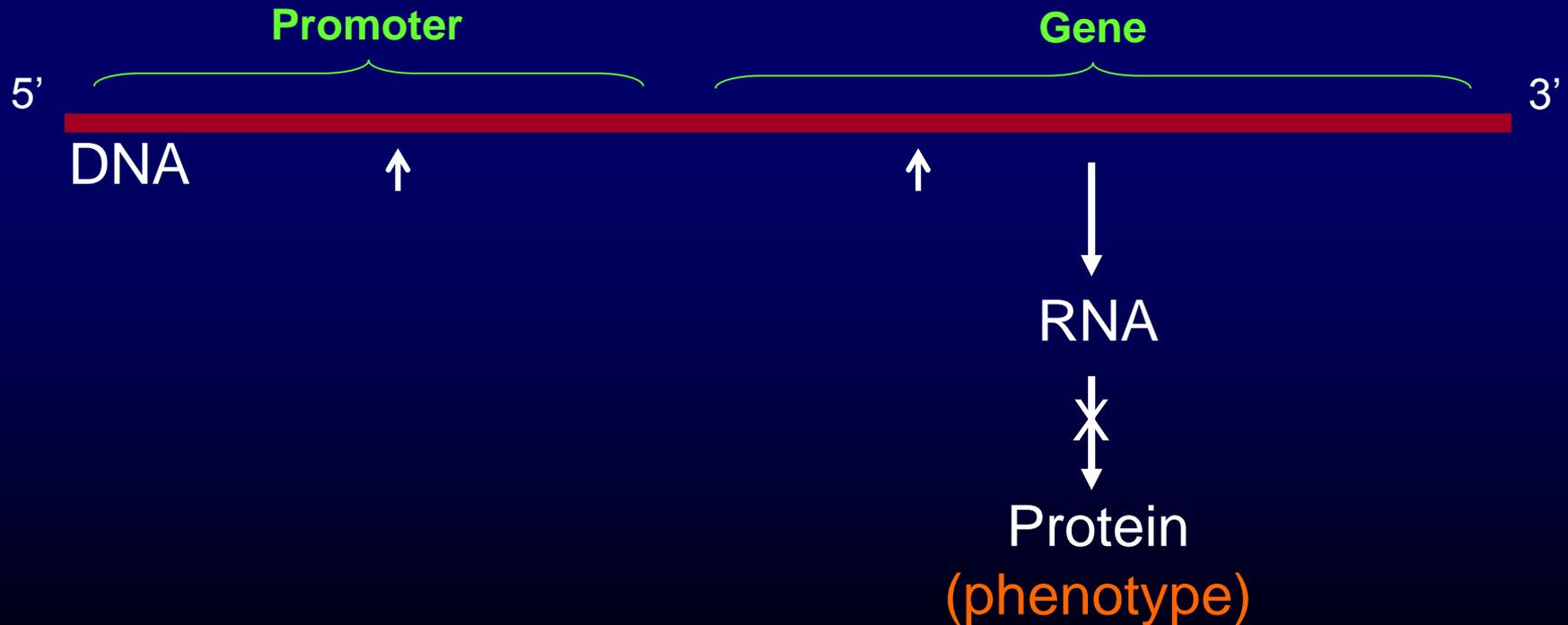
How might insertions change phenotype?

# Genes and Promoters



## Insertions and Molecular Evolution

- Insertion into:
- a) promoters
  - b) gene coding regions



## Insertions

**Transposon = mobile DNA sequences**

SINES ----- < 500 bp in length  
repeated 500,000 times  
~ 13% of human genome

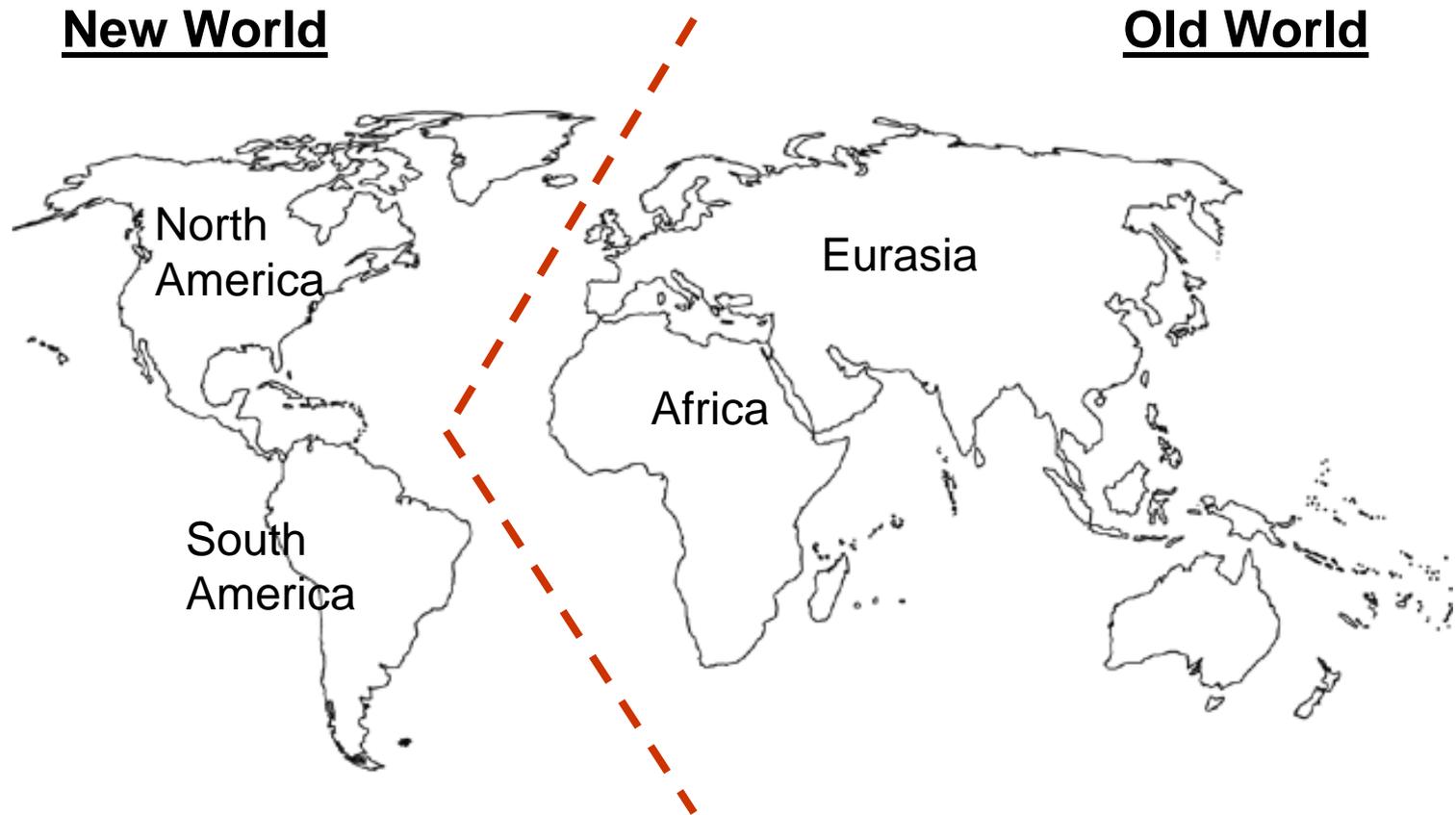
**e.g. Alu repeat**

Schmitz J. Genome Dynamics 2010 7:92. SINEs as driving forces in genome evolution.

# NWP vs OWP

## New World primates

## Old World primates



Independent evolution for more than 25 million years led to physiological and biochemical divergence

# New World Primates



Squirrel monkey



Marmoset



Tamarin



Capuchin

# Old World Primates



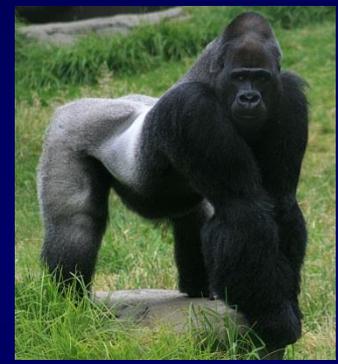
Gibbons



Rhesus monkey



Chimpanzee



Gorilla

*Saimiri sp.*

Squirrel monkeys

*Callithrix sp.*

Marmosets

*Saguinus sp.*

Tamarins

*Cebus sp.*

Capuchins

*Aotus sp.*

Owl monkeys

*Homo sp.*

Humans

*Macaca sp*

Rhesus

*Nomascus sp.*

Gibbons

*Gorilla sp.*

Gorillas

*Pan sp.*

Chimpanzees

# New World Primates



Squirrel monkey



Marmoset



Tamarin



Capuchin

# Old World Primates



Gibbons



Chimpanzee



Rhesus monkey



Gorilla

*Saimiri sp.*

Squirrel monkeys

*Callithrix sp.*

Marmosets

*Saguinus sp.*

Tamarins

*Cebus sp.*

Capuchins

*Aotus sp.*

Owl monkeys

*Homo sp.*

Humans

*Macaca sp*

Rhesus

*Nomascus sp.*

Gibbons

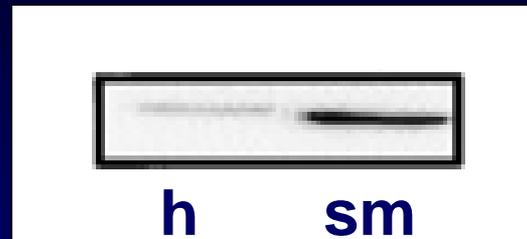
*Gorilla sp.*

Gorillas

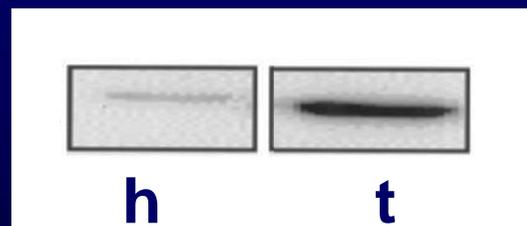
*Pan sp.*

Chimpanzees

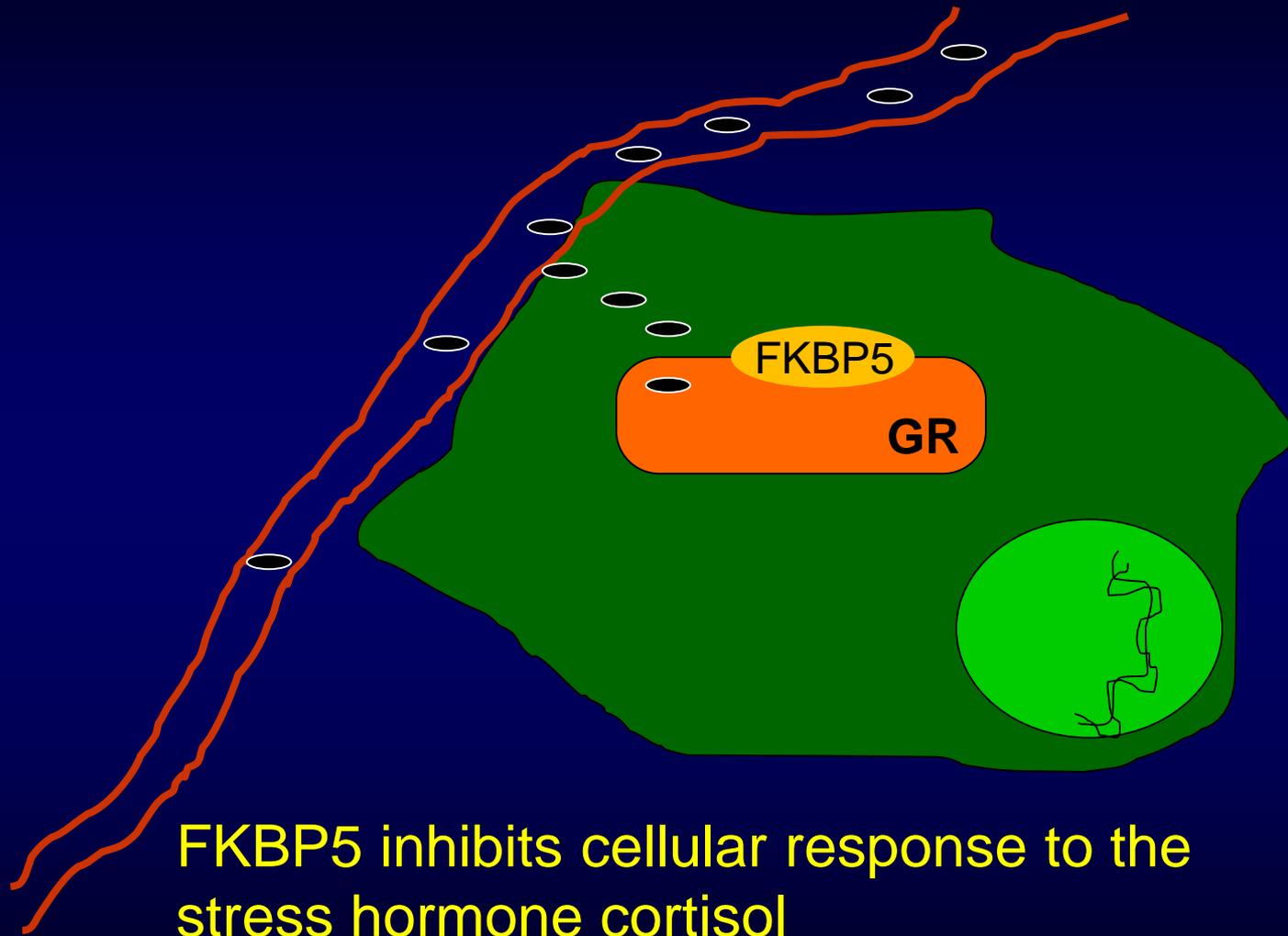
FKBP5 protein levels in human and squirrel monkey  
(OWP) (NWP)



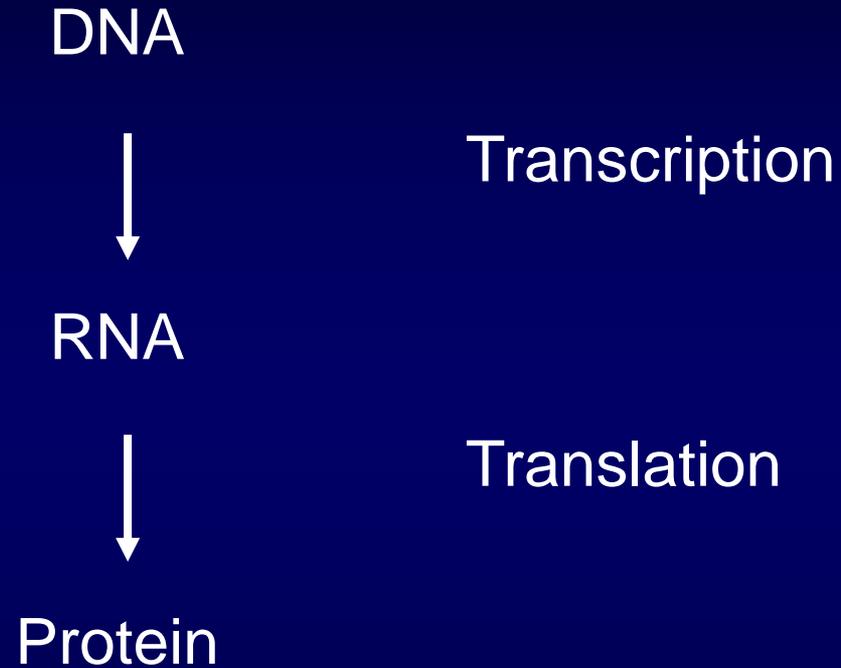
FKBP5 levels in human and tamarin  
(OWP) (NWP)



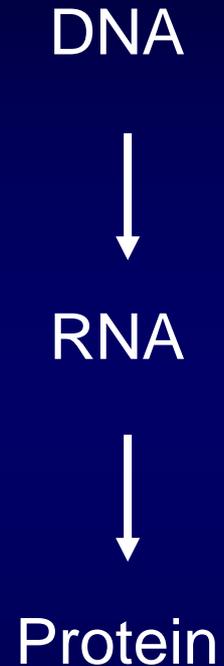
## Protein FKBP5 levels differ in NWP and OWP



# Central Dogma of Molecular Biology



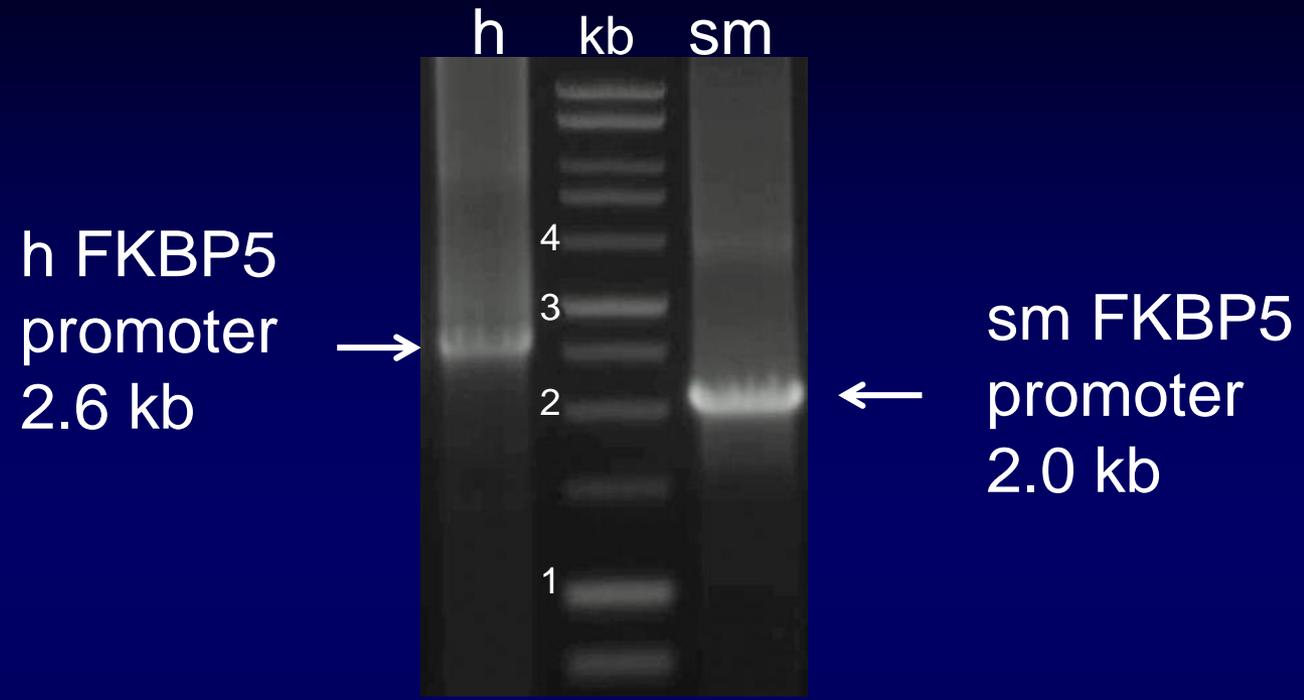
## Central Dogma of Molecular Biology



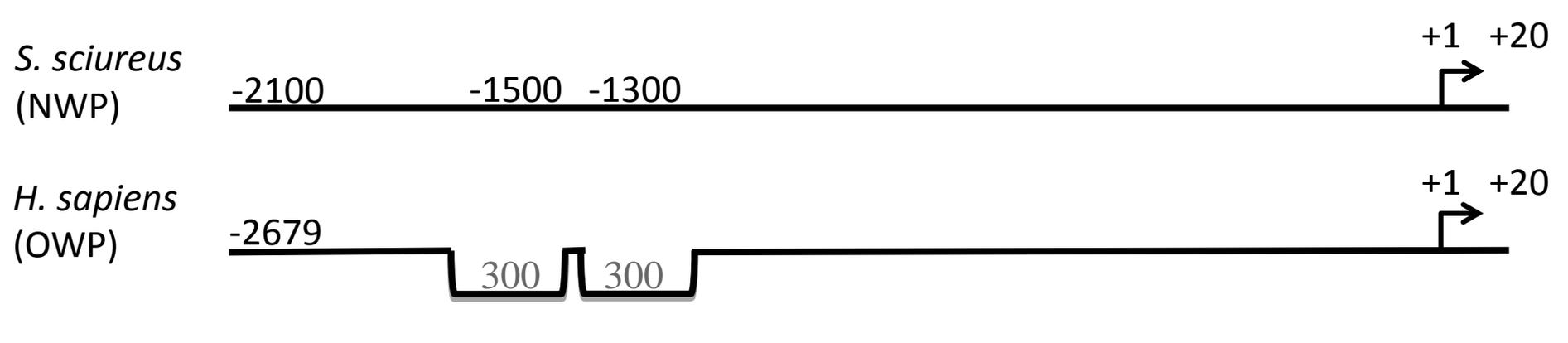
Transcription  
Controlled through  
the  
gene promoter

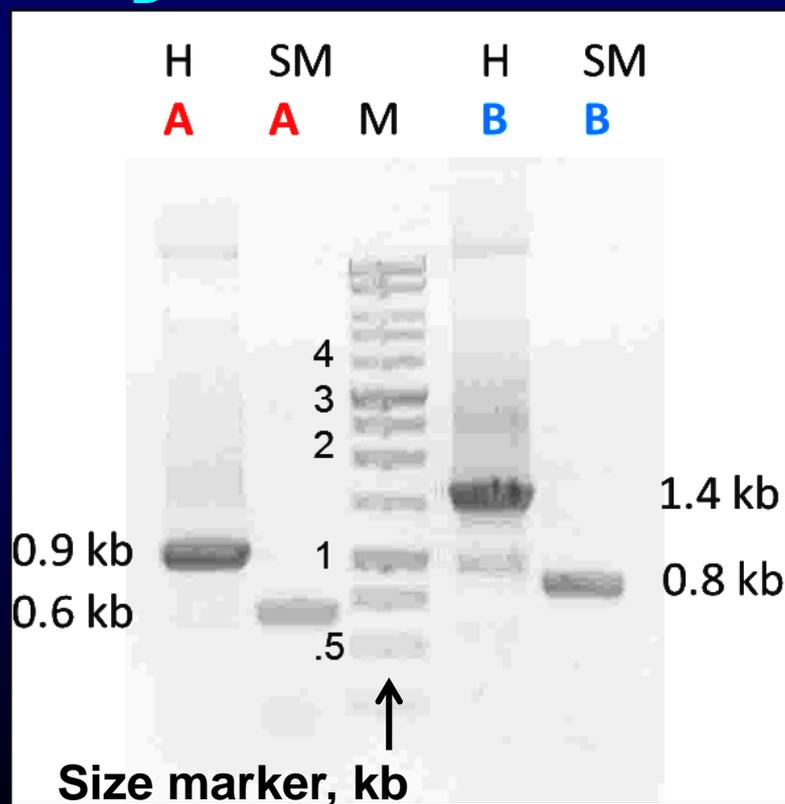
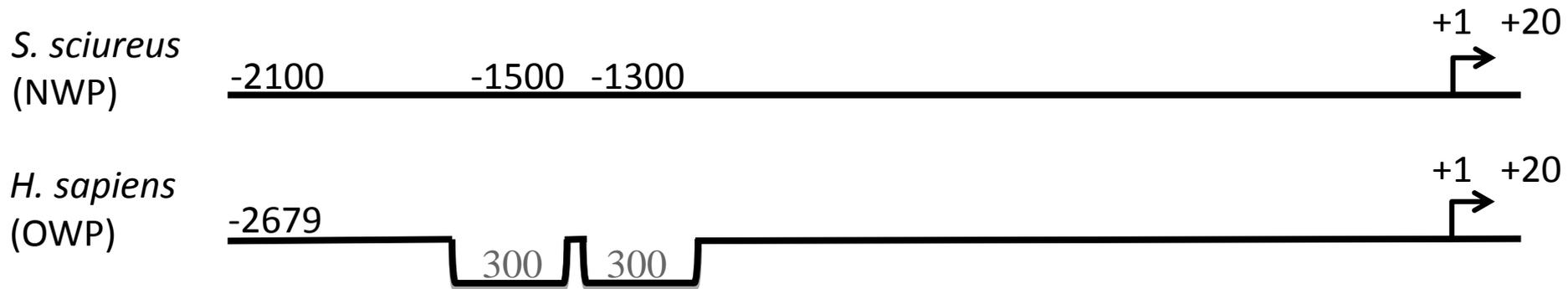


2600 bp of h promoter corresponds to 2000 bp of sm promoter



sm promoter lacks two distinct regions

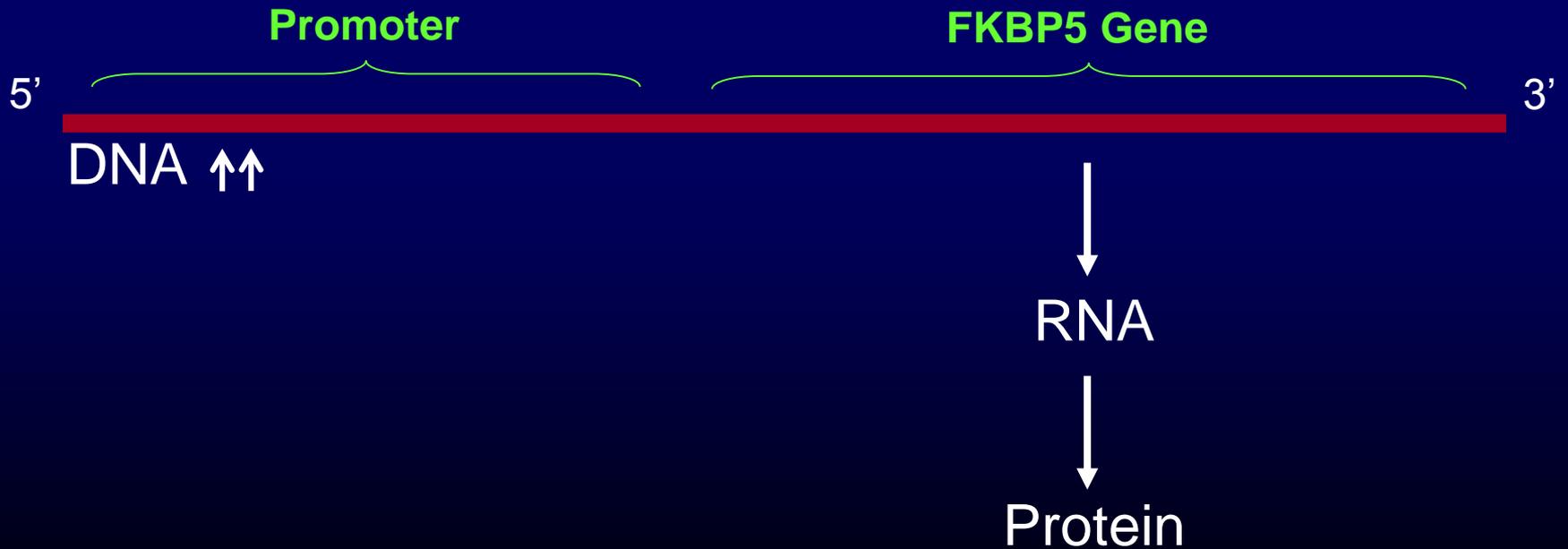
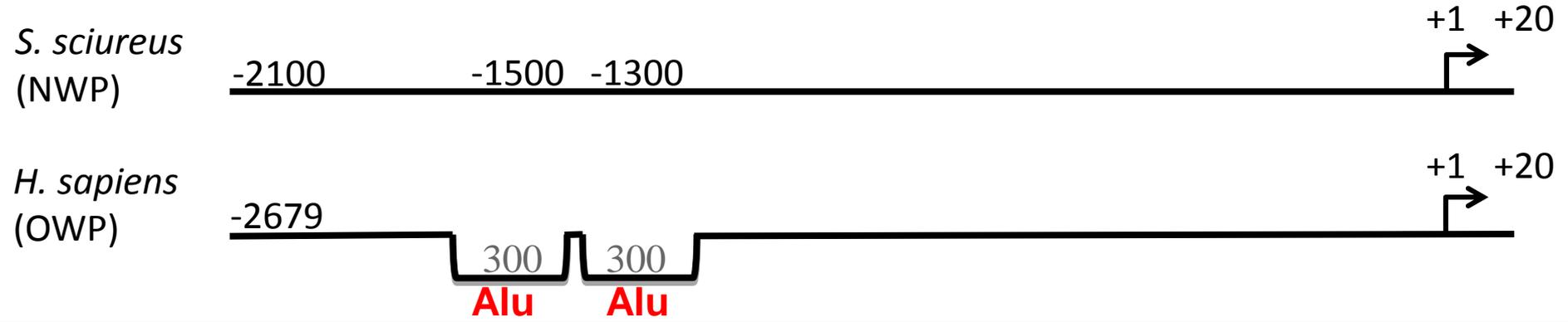




$\Delta = 300$  bp

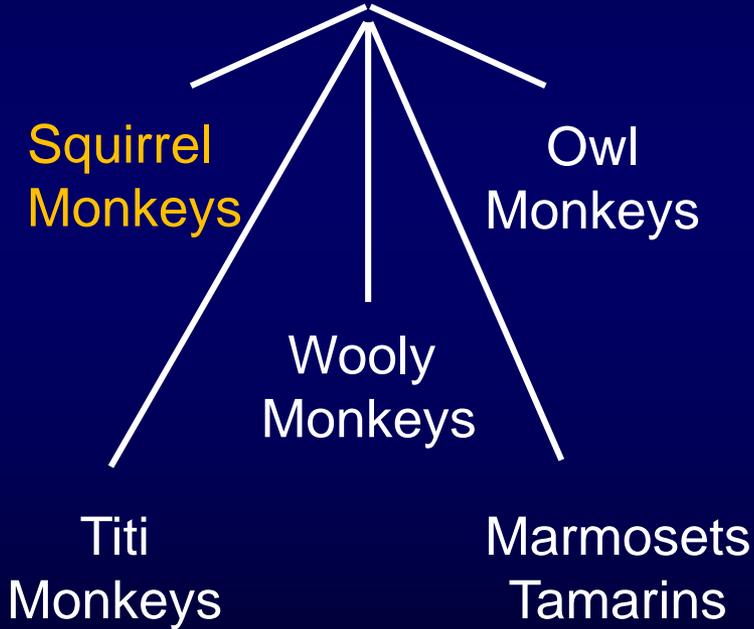
$\Delta = 600$  bp

# Insertions in human promoter are Alu repeats

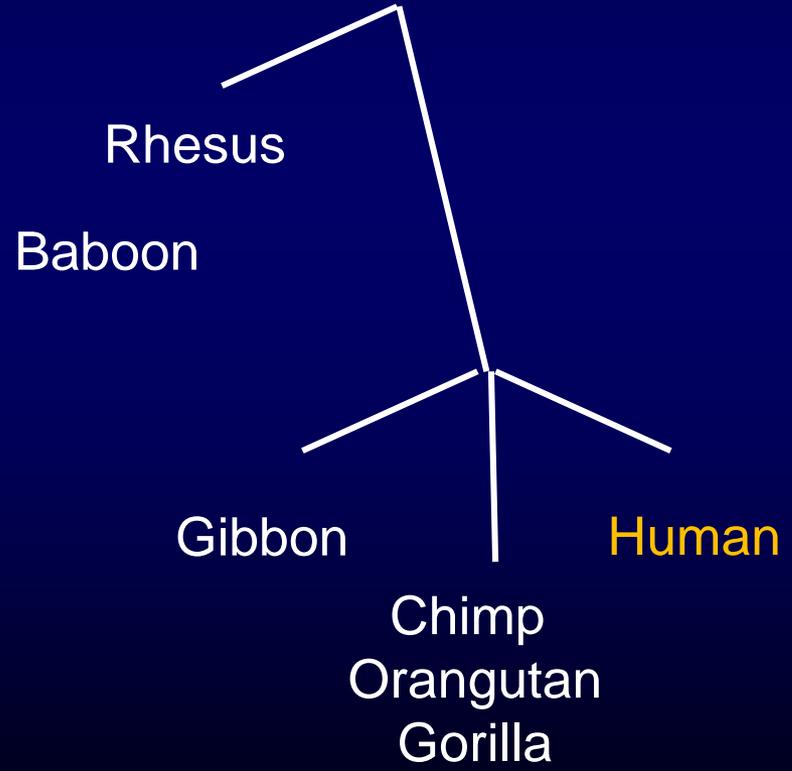


# Primates

## New World Primates

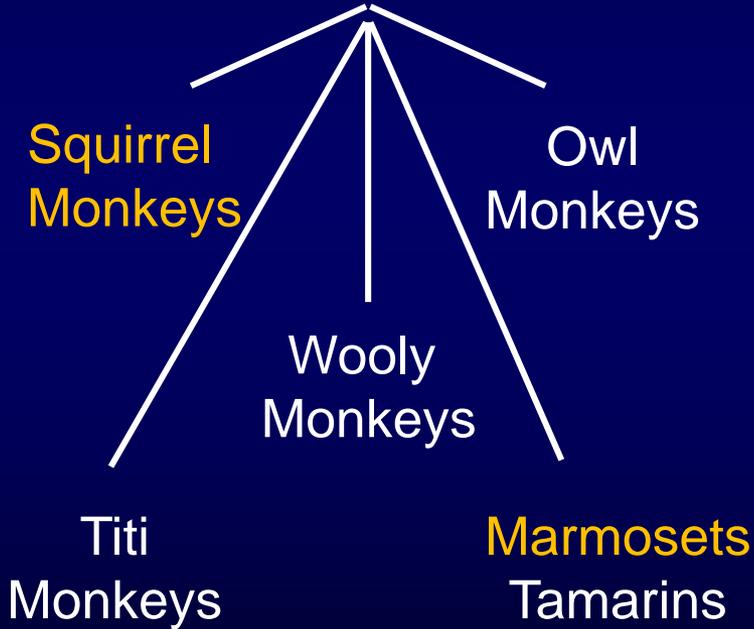


## Old World Primates

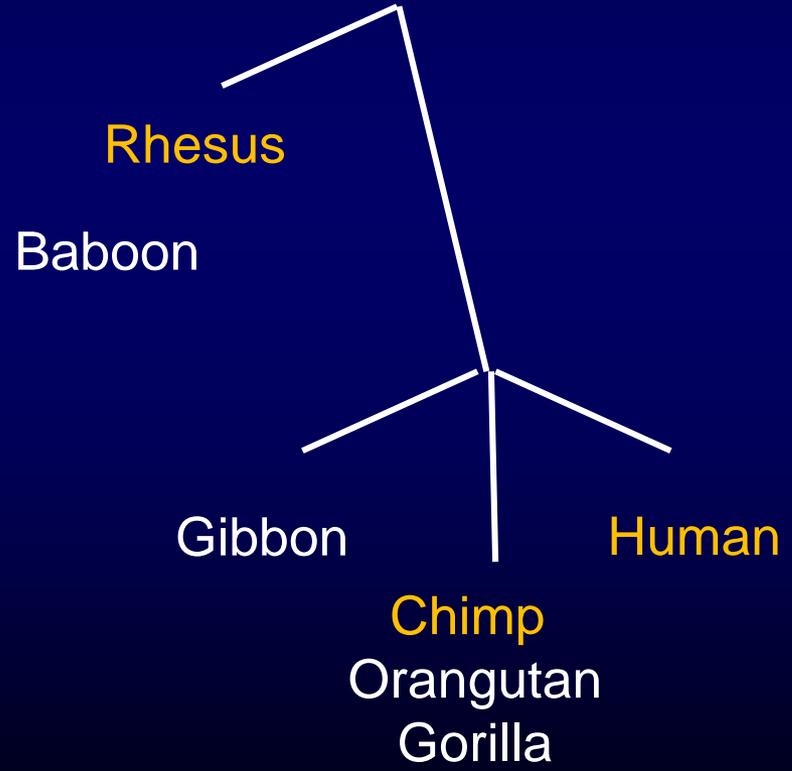


# Primates

## New World Primates

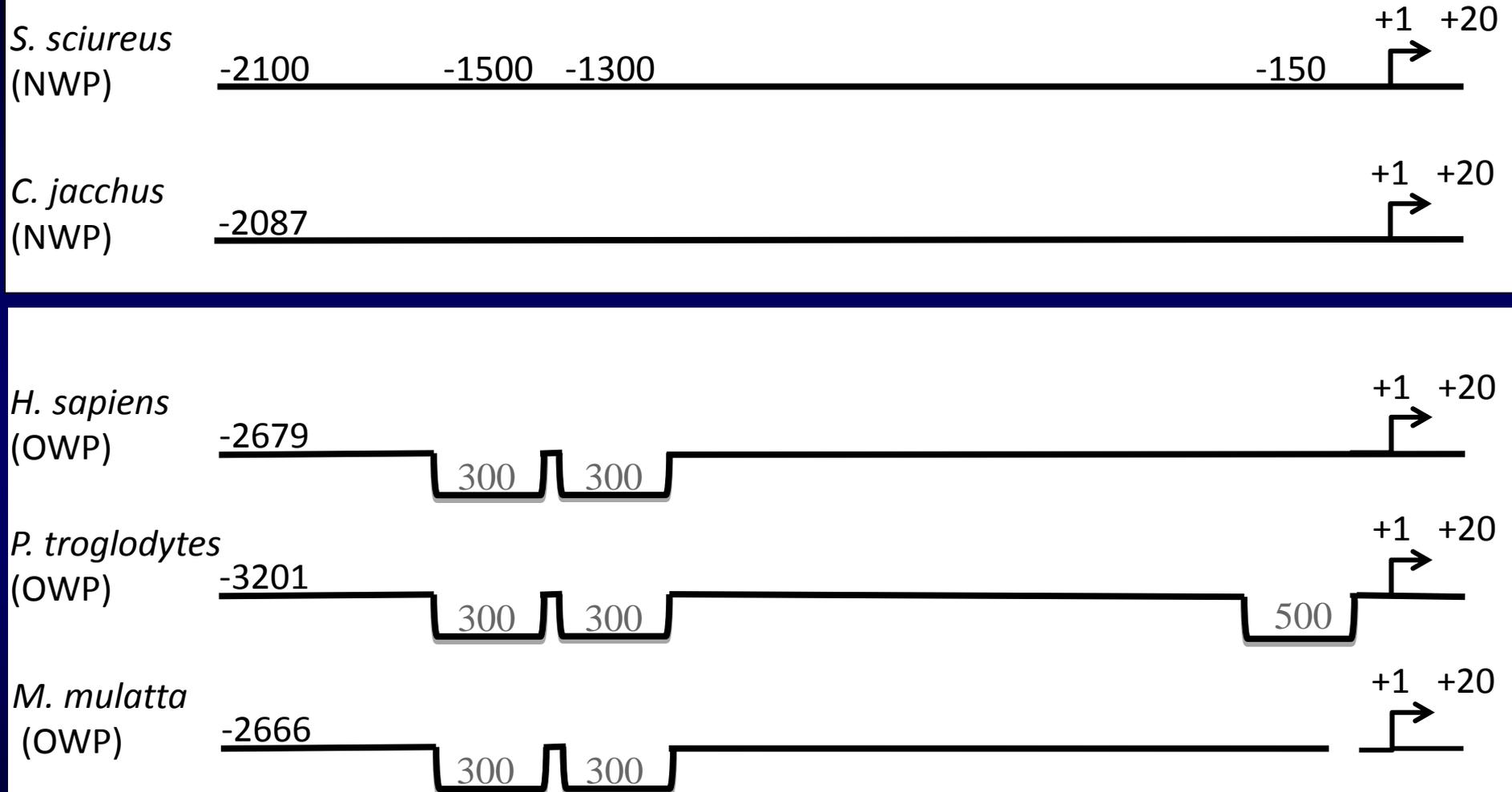


## Old World Primates



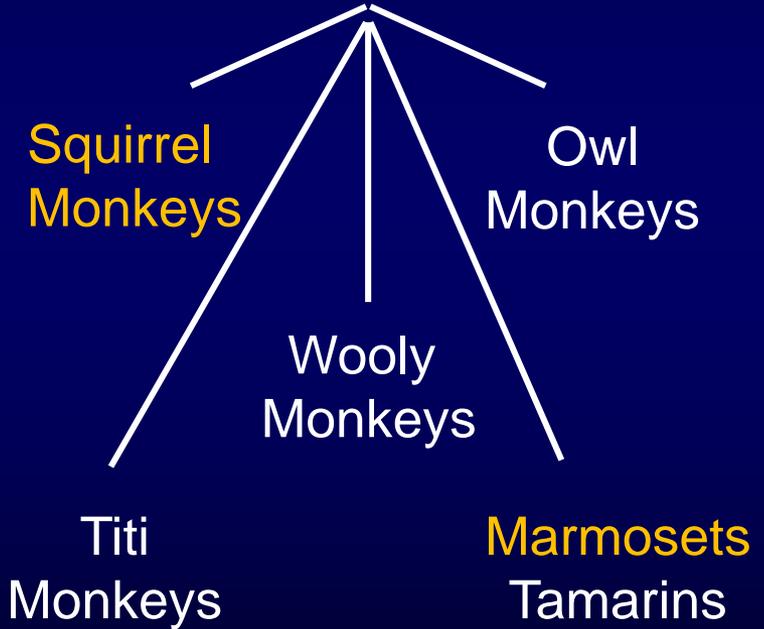
# Schol. Perf. - Student presentations

## Comparison of FKBP5 promoters in NWP and OWP

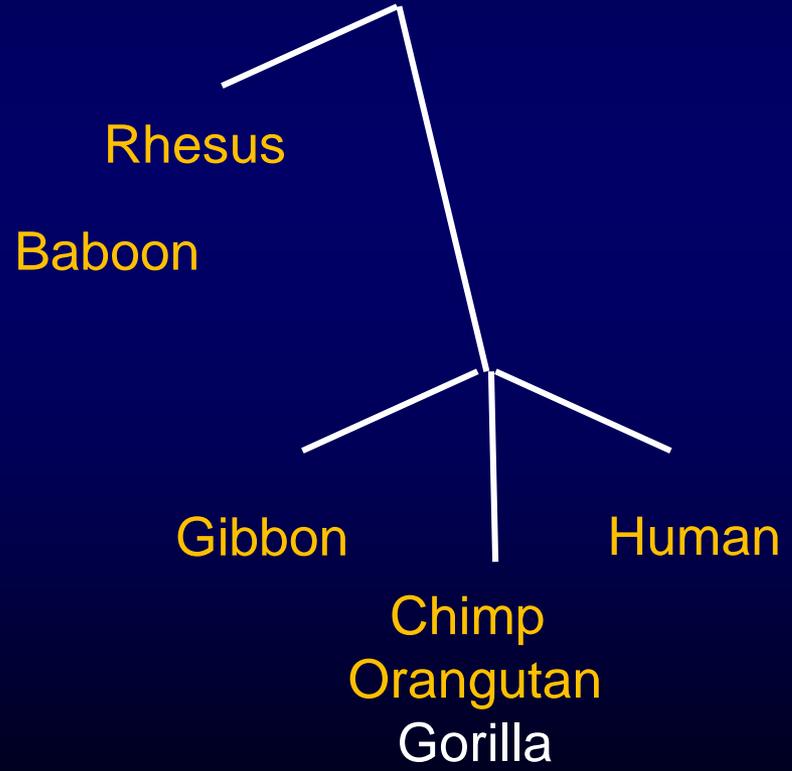


# Primates

## New World Primates

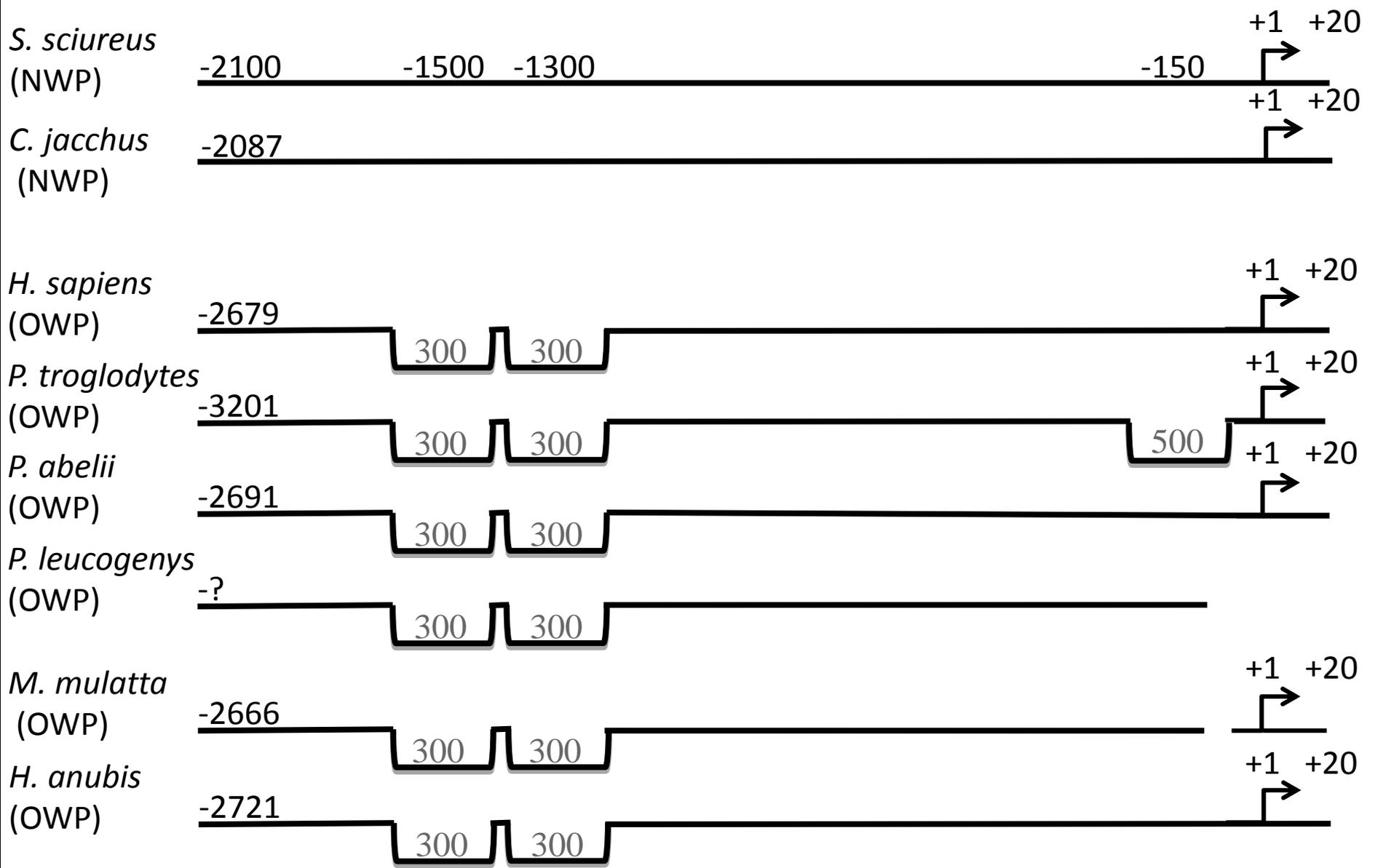


## Old World Primates



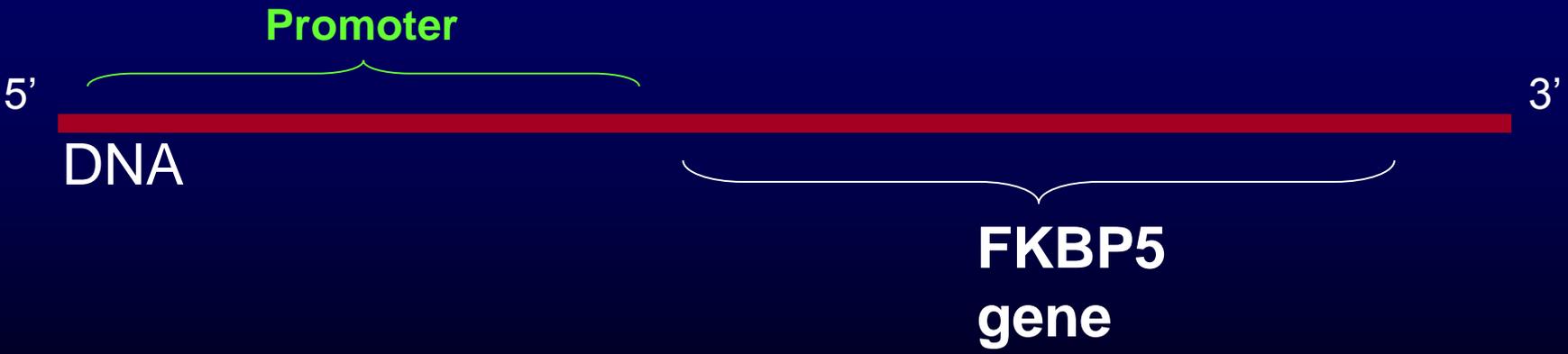
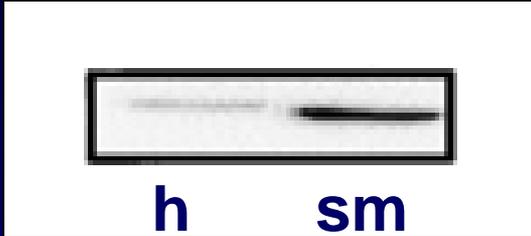
# Schol. Perf. - Student presentations

## Comparison of FKBP5 promoters in NWP and OWP

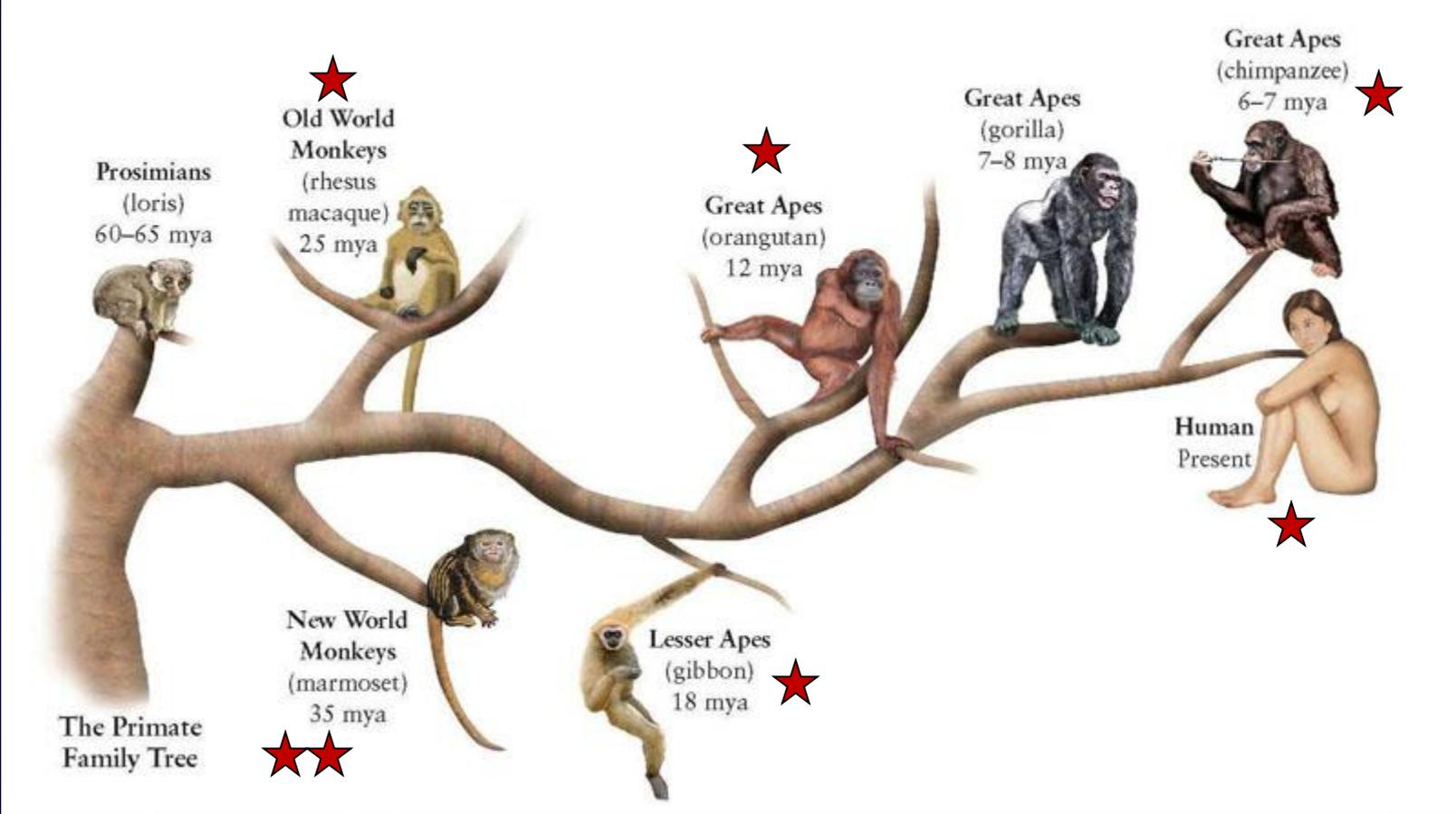


# Conclusion

## FKBP5 protein levels in OWP and NWP



# Schol. Perf. - Student presentations

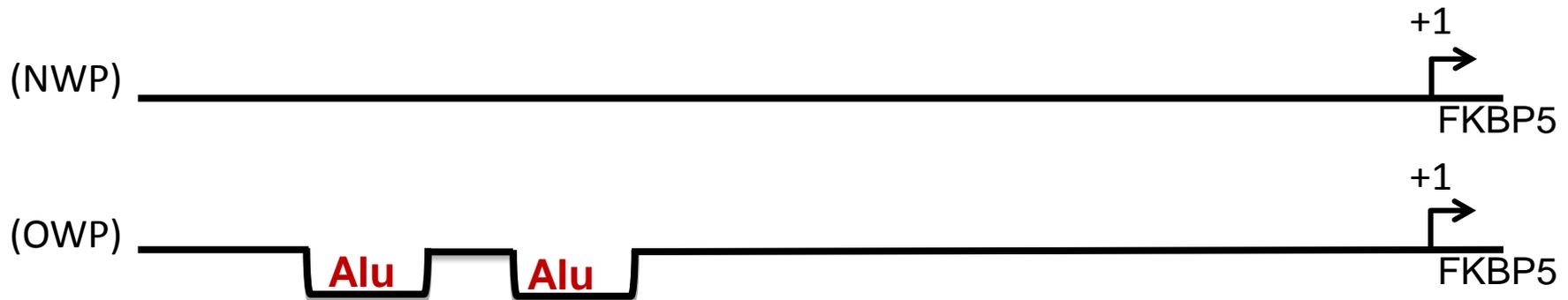


NWP

OWP

## Conclusion

### NWP FKBP5 promoters lack Alu repeats



Does this explain FKBP5 protein levels in NWP and OWP?

### What's next ?

- 1) Promoters from other NWP species will be examined
- 2) The FKBP5 promoter activities will be compared in promoter-reporter assays

## Acknowledgements

URP grant UNA (VL)

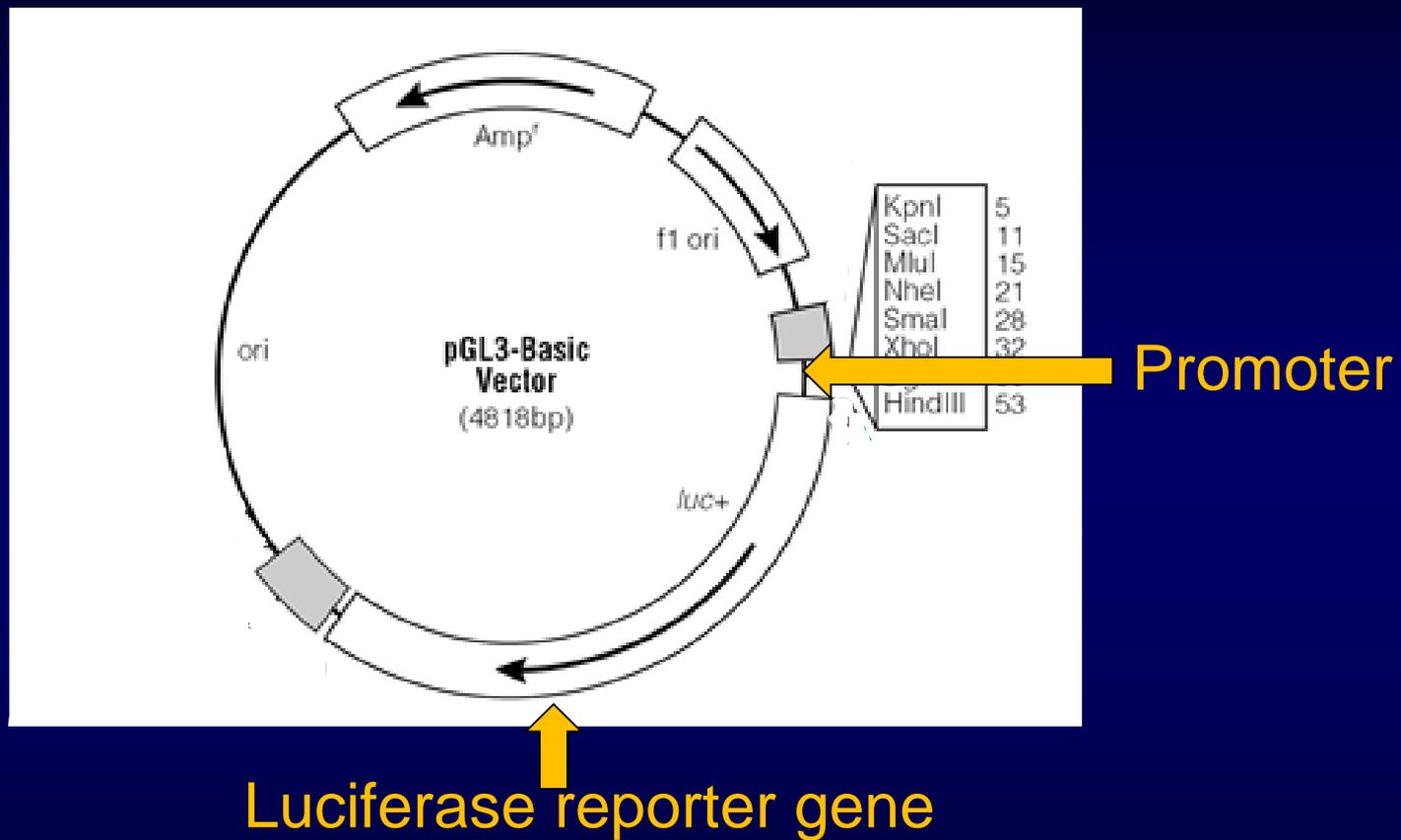
CAS grant UNA (TH)

Dept Bio funding (UNA)

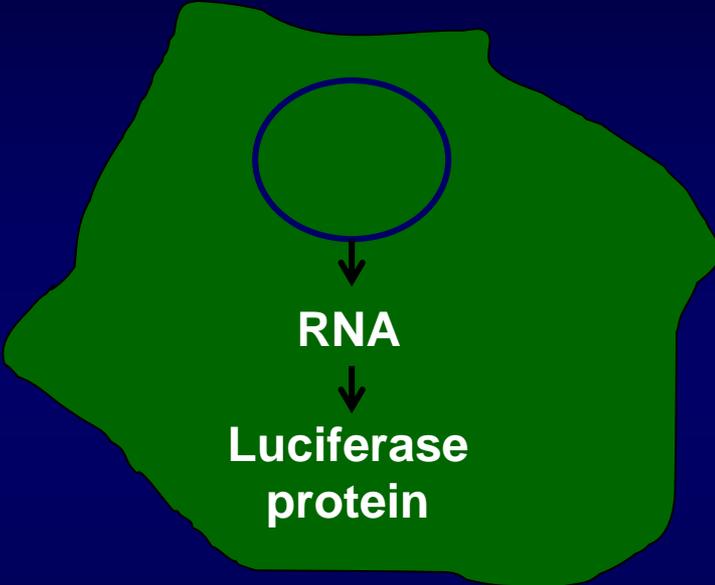
TH (UNA)

JGS (USA)

## Promoter-reporter Assay



# Promoter-reporter Assay



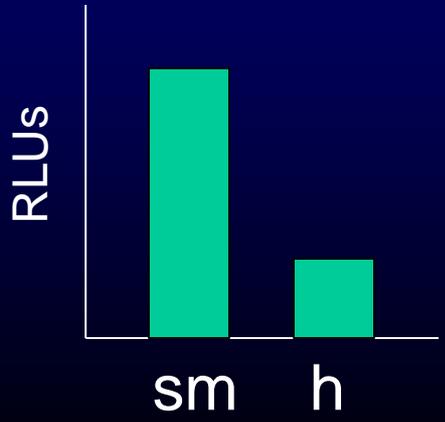
Transfection

lysis →

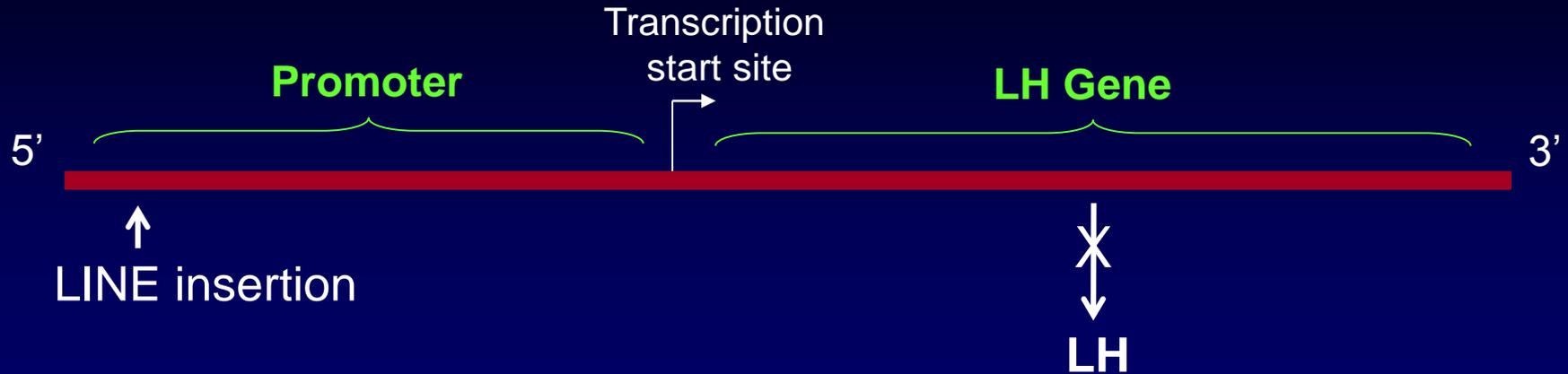
Luciferase  
+  
substrate

→

Light  
measured  
by  
Luminometer,  
RLUs



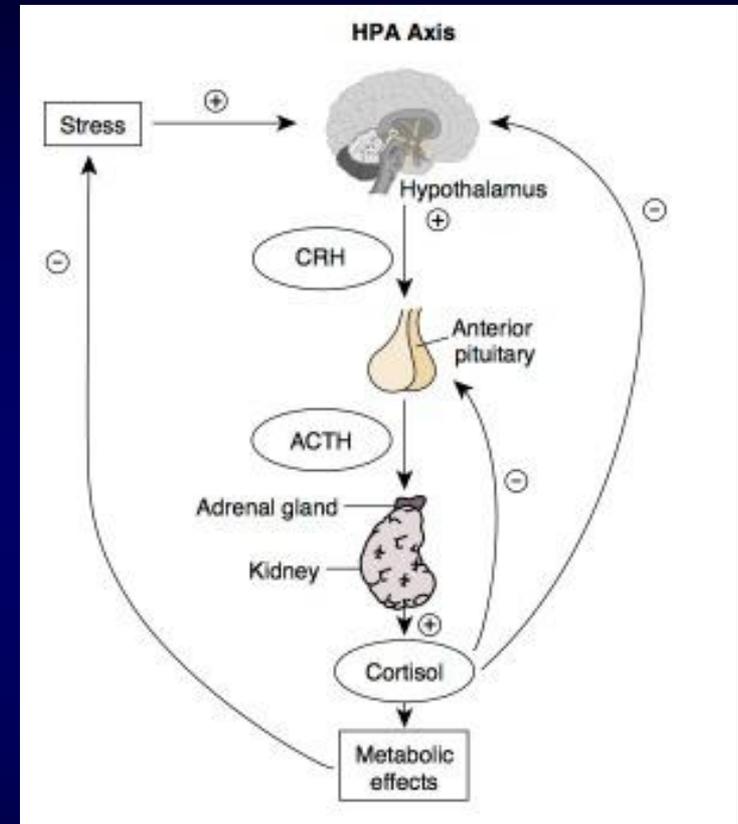
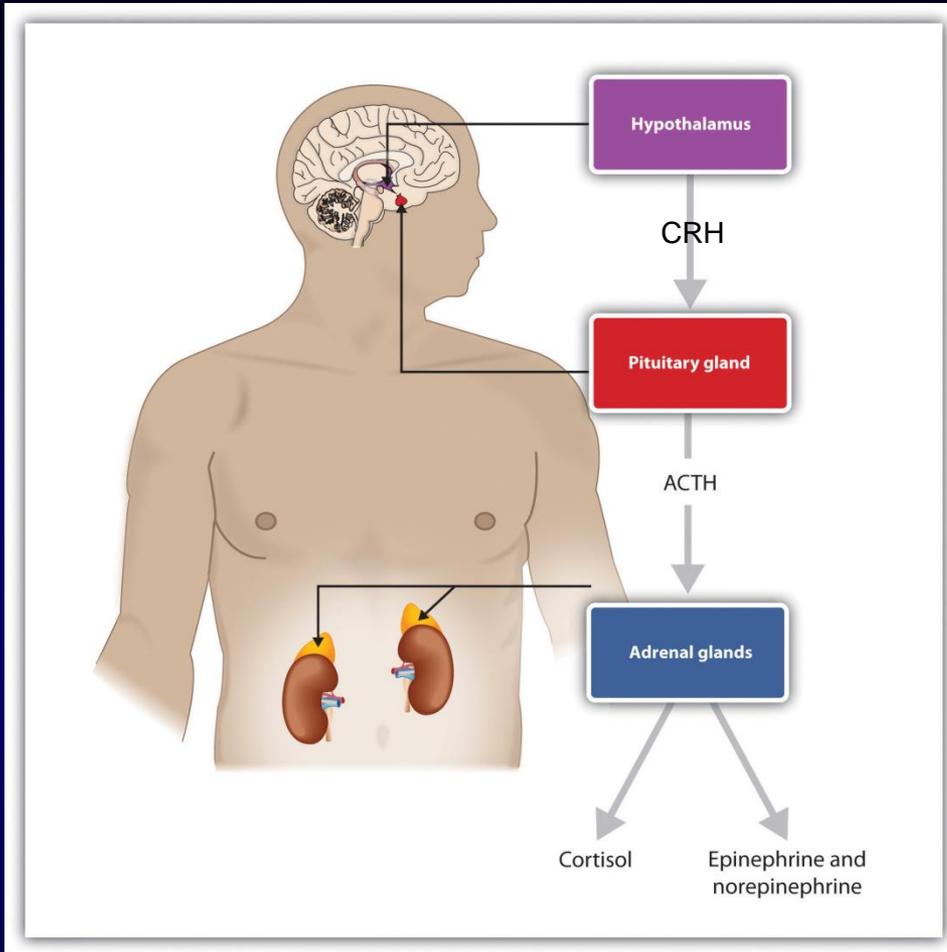
## Insertions and Molecular Evolution



LINES ----- “long” ~ 6000 bp  
repeated 850,000 times  
e.g. L1 family  
~ 21% of human genome

Müller T, Simoni M, Pekel E, Luetjens CM, Chandolia R, Amato F, Norman RJ, Gromoll J. J Mol Endocrinol. 2004 Feb;32(1):115-28.

# Schol. Perf. - Student presentations



## Table 1.3

## Examples of Scientific Theories

Theory	Main Premises
Atomic theory	All substances consist of atoms.
Big bang	The universe originated with an explosion and continues to expand.
Cell theory	All organisms consist of one or more cells, the cell is the basic unit of life, and all cells arise from existing cells.
Evolution	Change occurs in the inherited traits of a population over generations.
Global warming	Human activities are causing Earth's average temperature to increase.
Plate tectonics	Earth's crust is cracked into pieces that move in relation to one another.

# Evolution

DNA mutation

+

Selection



Changes in organisms  
comprising a population

# Schol. Perf. - Grants

## COLLEGE OF ARTS & SCIENCES RESEARCH AND DEVELOPMENT GRANT APPLICATION FORM for 2015-2016

Applicant:

Title:

Department:

e-mail:

Grant activities and/or needs; Funding for the research project titled:

Research Grant:  Development Grant:  (check type of grant)

### Budget Summary\*

Amount Required  
(round to nearest \$)

- 1. Travel.....
- 2. Registration fees .....
- 3. Meals .....
- 4. Lodging .....
- 5. Tuition .....
- 6. Equipment .....
- 7. Supplies .....
- 8. Other.....
- 9. Department Travel Money and/or Support Money ..... -

Total amount requested \$

By submitting this form you agree to:

- Return the funds to the Office of the Dean of Arts & Sciences **by August 31, 2016** if it is not possible to complete the research.
- Acknowledge the financial support of the University of North Alabama in all publications, exhibitions, or performances resulting from this grant.
- Submit a written grant report to the Office of the Dean of Arts & Sciences **no later than September 30, 2016, or to request a rollover of funds into the 2016-17 fiscal year.**

**Please submit by email to artsandsciences@una.edu a single PDF file <LastName\_Department\_{DEV or RES}.pdf> containing, in order 1) this application, 2) one page vitae, and 3) proposal narrative by 4:30 p.m. on Friday, Jan. 15, 2016.**

Failure to submit **all** of the requested materials will result in the application being **disqualified**. Please make sure that all proposal requirements have been met before submitting your application.

\* An itemized budget with justification and documentation **must be included** in the proposal narrative.

# Schol. Perf. - Grants

Tina Hubler, Department of Biology

Using polyclonal antibodies to perform Western Blotting on human and squirrel monkey cellular extracts

## Background

The stress hormone cortisol circulates in the blood and elicits changes throughout the body by interacting with glucocorticoid receptors that are present within some cells. The receptor attaches to cortisol and initiates a signaling response inside the cell. This allows a cell to make changes in response to circulating cortisol. Included in the receptor complex are the glucocorticoid receptor and one of two proteins that have opposite effects on the receptor. The proteins FKBP5 and FKBP4 modulate the responsiveness of the receptor by either enhancing (FKBP4) or inhibiting (FKBP5) the attachment of cortisol (Davies, Ning et al. 2005) (Cheung and Smith 2000).

FKBP5 protein is overexpressed (occurs at higher levels) in squirrel monkeys and other New World monkeys (NWM), relative to humans (Denny, Valentine et al. 2000, Scammell, Denny et al. 2001). In addition to differences in the expression of FKBP5, FKBP4 expression differs in humans and New World primates. Figure 1 shows the levels of FKBP5 and FKBP4 that we measured in squirrel monkey and human cells. These data confirm differential levels of FKBP5 and FKBP4 protein in the cells we are using for our research.



Figure 1. Comparison of FKBP5 and FKBP4 protein levels in human and squirrel monkey lymphocyte cellular extracts by Western blot.  $\beta$ -actin was used as a loading control.

## Goal of this project

# Schol. Perf. - Grants

For our Western Blots we used monoclonal antibodies that were generated in response to a portion of the protein. The region of the protein that is recognized by the antibody (epitope) is not known. One concern when measuring proteins from different species, is whether the antibody recognizes the protein equally well in each species. For example, as shown in Figure 1, there is a difference in the position of FKBP5 in humans and squirrel monkeys that is probably due to a difference in overall charge of the protein. Does this affect the recognition of the protein by the antibody? We don't know. If the epitope were known, we could evaluate whether the epitope site is the same in human and squirrel monkeys. Because that cannot be done, another approach is to utilize polyclonal antibodies, which are a mixture of antibodies recognizing different portions of the protein. This increases the likelihood that proteins from closely related species will be recognized equivalently. Additionally, the epitope is known for many commercially available polyclonal antibodies and we could ensure that the region is the same in both species.

**Our hypothesis is:** Western Blot using polyclonal antibodies to FKBP5 and FKBP4 will demonstrate differential expression of FKBP5 and FKBP4 proteins from cellular extracts of humans and squirrel monkeys.

My proposal requests funds to purchase a polyclonal antibody to FKBP5. The Department of Biology is purchasing the polyclonal antibody to FKBP4. These antibodies, as well as Western Blotting reagents already provided by the Department of Biology, will be used for a UNA student's (Nicole Gallups) honors capstone project.

## Procedures

Cell extracts have already been prepared for Western Blotting. If needed, cells may be grown and harvested to prepare new extracts. Western blot for FKBP5 and FKBP4 will be performed on human and squirrel monkey lymphocyte extracts. This technique involves protein separation by denaturing

# Schol. Perf. - Grants

electrophoresis, electrophoretic transfer of protein to membrane, immunoblotting for proteins of interest and chemiluminescent imaging. The Department for Biology purchased the equipment for imaging three years ago. The procedure requires two days, 4 hours each day, and will include optimization (determining the optimal amounts of antibody to use).

## **Time line**

The research will be completed by Nicole Gallups and Tina Hubler during the Spring and Fall 2016 semesters. Nicole will present her results in the Spring 2017 semester.

## **Expected Study Results**

These results will allow us to confirm differential expression of FKBP5 and FKBP4 in two different species: human and squirrel monkey. This will be a vital piece of information to include in the manuscript that we are preparing in which we describe our work to date. Potential journals for submission include *Genomics* and *G3: Genes, Genomes and Genomics*.

## **Applicant's qualifications**

I recently published two articles in *The American Biology Teacher* (January 2015, February 2015), in which work from our research lab was used to develop a laboratory activity for Honors and Molecular Biology courses. I have completed projects funded by the UNA College of Arts and Sciences research grants and have included undergraduate students in each of these projects. Students have made oral presentations at scientific meetings and participated each year in UNA Research Day. My doctoral research focused on molecular evolution and gene expression and I currently teach Genetics and the Molecular Biology course required for the Cellular and Molecular Biology option in the Department of Biology.

## **Hazardous material disposal**

# Schol. Perf. - Grants

We have the appropriate Biosafety Level 2 cabinets for handling and collecting cells. Liquid waste containing cells will be disinfected with 10% bleach or autoclaved, and solid waste will be autoclaved prior to disposal. These are the recommended disposal procedures according to the manufacturers' MSDS (Material Safety Data Sheet).

## **Budget**

This application is to purchase a polyclonal antibody for Western Blotting FKBP5.

<b><u>Item</u></b>	<b><u>Cost</u></b>
FKBP5 polyclonal antibody, Thermofisher PA1-020 uL	379.00
Estimated shipping	60.00
FKBP4 antibody Abgent, 80 uL sample size	89.00
Estimated shipping	60.00
<b>Total</b>	<b>\$ 588.00</b>

## **Department of Biology Travel Funds Policy**

I am not requesting funds for travel, however the Department of Biology's Travel Fund Policy is at least \$500.00 available per faculty member for travel.

## **References**

Cheung, J. and D. F. Smith (2000). "Molecular chaperone interactions with steroid receptors: an update." Mol. Endocrinol. **14**(7): 939-946.

Davies, T. H., et al. (2005). "Differential control of glucocorticoid receptor hormone-binding function by tetratricopeptide repeat (TPR) proteins and the immunosuppressive ligand FK506." Biochemistry **44**(6): 2030-2038.

Denny, W. B., et al. (2000). "Squirrel monkey immunophilin FKBP51 is a potent inhibitor of glucocorticoid receptor binding." Endocrinology **141**(11): 4107-4113.

Scammell, J. G., et al. (2001). "Overexpression of the FK506-binding immunophilin FKBP51 is the common cause of glucocorticoid resistance in three New World primates." Gen. Comp. Endocrinol. **124**(2): 152-165.

# Schol. Perf. - Grants

Thank you so much for submitting a grant proposal to the Office of the Quality Enhancement Plan.

I am sending you the reviewers' average scores of the criteria on which your proposal was judged, along with comments (when supplied by the reviewer). We hope this may be useful to you in preparing future proposals, whether for UNA or somewhere else.

Each category was scored from 4 to 0 points (4 being the highest). These scores represent the average of the seven reviewers who studied your proposal.

Overview—4.0

Goals—3.63

Delineation of Responsibilities—3.38

Budget—3.88

Timeline for Research—3.75

Quality of Writing—3.88

Total Average Score— 22.50

Total Score (out of 192)—180

Comments:

Excellent proposal.

Lots of detail, vague timelines.

-----

If you have any questions, please let us know. Thank you again—

BJ Wilson

QEP

# Schol. Perf. - Grants

University of North Alabama

Quality Enhancement Plan Undergraduate Research Grant

Title: Investigating the correlation between mRNA and protein levels of two hormone-signaling proteins, FKBP5 and FKBP4 in human and other primate cells.

Caroline Thomas

Dr. Tina Hubler

September 2015

# Schol. Perf. - Grants

## 1. Overview of Research Objective

Genetics research is currently seeking to understand the genetic material (DNA) in organisms and how DNA segments, or genes, are regulated. Within the field of genetics, genes are being studied to learn how a body functions at the cellular level in response to different stimuli including hormones, nutrients, temperature, etc. A major motivation for many researchers is to develop ways to treat diseases that occur due to DNA mutations or abnormal regulation of a gene by chemicals or proteins. The research team composed of Dr. Tina Hubler and senior Biology student, Caroline Thomas, will collect data to add to the current knowledge about the FKBP genes, commonly studied for their role in diseases in which they affect hormone signaling and calcium channel function.

## 2. Goals of Research Project

### 2.a. Overview

The goal of this research is to better understand how the FKBP4 and FKBP5 genes are controlled. By understanding how the FKBP4 and FKBP5 genes are regulated, further research may determine how to manipulate the genes for therapeutic purposes. It is hypothesized that the regulation of these genes occurs during a specific cellular process that involves an intermediate molecule, messenger RNA. Testing this hypothesis will require culturing five cell lines, performing Western blots, sending cells to be analyzed by quantitative polymerase chain reaction (qPCR), and interpreting qPCR data. Upon completion of the research, Caroline Thomas will deliver two oral presentations and compose a final report summarizing all results.

### 2.b. Background

# Schol. Perf. - Grants

DNA is used in cells to produce proteins, the chemical molecules that form the basis for physiological and morphological characteristics of an organism. Proteins are produced in a step-wise manner using information contained in the DNA molecule. DNA is used as a template, or guide, to make messenger RNA (mRNA). This process is called transcription. mRNA is then used as a template to synthesize proteins during the process of translation.

Dr. Tina Hubler, associate professor at the University of North Alabama, has been studying how the FKBP5 and FKBP4 genes are utilized in cells to make the proteins FKBP5 and FKBP4 (Cioffi, Hubler *et al.*, 2011). Both genes and proteins are conserved throughout the tree of life, and are being studied for their possible use in the treatment of diseases such as hormone-dependent cancers in humans (Jiang *et al.*, 2008). Both FKBP proteins are important regulators of the cellular response to the stress hormone cortisol (Davies *et al.* 2005) and it is known that the relative levels of the two proteins mediate overall hormone signaling (Davies *et al.*, 2001).

The final level of a protein in a cell may be controlled at multiple stages during its synthesis. If the rate-limiting step in the synthetic pathway involves the intermediate molecule mRNA, the protein levels will be correlated with the mRNA levels. To gain insight into how the levels of these two proteins are regulated, we will evaluate the levels of protein and mRNA for FKBP5 and FKBP4 in a variety of cells having different levels of these two proteins.

Previous research performed by Denny, Reynolds, and Scammell has shown that New World primates (NWP) naturally produce elevated levels of FKBP5 protein relative to FKBP4 protein (Reynolds *et al.*, 1999; Denny *et al.*, 2000). In contrast, Old World monkeys (OWM) and humans produce lower levels of FKBP5 protein relative to FKBP4.

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(Scammell *et al.*, 2000). Therefore, NWP may be useful as models for the role of elevated FKBP5 protein levels in human conditions such as stress disorders (Reynolds *et al.*, 1999). In our research, we use NWP cells as models of high FKBP5 levels relative to FKBP4 and we use Old World monkey (OWM) and human cells as models of low FKBP5 relative to FKBP4. The NWP cell lines we will use are squirrel monkey kidney (Pindak) and squirrel monkey lymphocytes (SML). The OWM cell line is African green monkey kidney (COS) and the human cell lines are kidney (HEK) and lymphocyte (HL).

Previously in Dr. Hubler's lab the levels of FKBP5 protein were measured in NWP Pindak cells and OWM COS-7 cells. Figure 1 confirms that NWP express higher levels of FKBP5 protein. To evaluate the relative levels of FKBP5 and FKBP4 protein, we will extend this work by measuring the level of FKBP5 protein in HEK, HL, and SML cells and the level of FKBP4 in all of the cell lines.

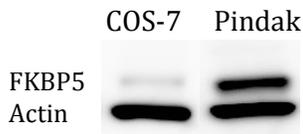


Figure 1. Comparison of FKBP5 protein levels in African green monkey COS-7 and squirrel monkey Pindak cells by Western blot.  $\beta$ -actin was used as a loading control.

Previously in Dr. Hubler's lab the levels of FKBP5 mRNA were compared in human HL and NWP SML cells using the technique of qPCR. Figure 2 suggests that NWP cells contain higher levels of FKBP5 mRNA. To evaluate the relative levels of FKBP5 and FKBP4 mRNA, we will extend this work by comparing the level of FKBP5 mRNA in HEK, COS, and Pindak cells, and the level of FKBP4 mRNA in all of the cell lines.

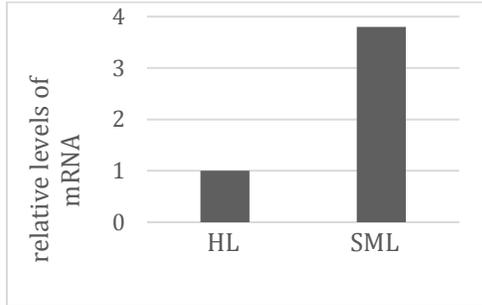


Figure 2. Comparison of the FKBP5 mRNA levels in human lymphocytes (HL) and squirrel monkey lymphocytes (SML) cells by qPCR.

## 2.c. Hypothesis

**My hypothesis is:**

**The levels of FKBP5 and FKBP4 protein are correlated with the levels of their corresponding mRNAs in cells from a variety of humans and other primate species.**

If the hypothesis is supported, the data will suggest that the mechanisms largely responsible for regulation of the genes involve transcription or mRNA stability. This information will help us to identify specific mechanisms by which FKBP5 and FKBP4 levels are controlled.

## 2.d. Procedures

The procedures for analysis of the cell cultures will include Western blot to measure protein levels and qPCR to measure the level of mRNA in each cell line. Western blotting will be performed in our new research facility at UNA. However, isolation of mRNAs involves hazardous chemicals, RNAs are very susceptible to degradation and qPCR requires specific instrumentation we do not have. For these reasons, we plan to outsource the qPCR

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analysis to a company that specializes in this area. We previously employed ARQ Genetics for preliminary analyses (Figure 2) and are pleased with the quality of their service.

## 2.e. Safety

We have the appropriate Biosafety Level 2 cabinets for handling and collecting cells. Liquid waste containing cells will be disinfected with 10% bleach or autoclaved, and solid waste will be autoclaved prior to disposal. These are the recommended disposal procedures according to the manufacturers' MSDS (Material Safety Data Sheet).

## 3. Budget

<u>Item</u>	<u>Cost</u>
qPCR service (ARQ Genetics)	
RNA extraction	60.00
qPCR, 2 samples; 2 targets each, plus one control each)	370.00
Western blot reagents	
Bradford protein assay kit	145.00
10X running buffer (2)	56.00
10X transfer buffer (2)	56.00
Clarity ECL substrate	130.00
Pre-cast gels (10 gel)	130.00
Nitrocellulose membranes	59.00
Goat anti-mouse IgG-HRP conjugate	170.00
Microtubes (1 box)	11.00
Cell culture reagents	

# Schol. Perf. - Grants

Serological pipets, 25 mL (2 cases)	114.00
Serological pipets, 10 mL (2 cases)	122.00
Serological pipets, 5 mL (2 cases)	110.00
Serological pipets, 2 mL (1 case)	52.00
DMEM, cell culture media (3 bottles)	27.00
Phosphate buffered saline (PBS)(4 bottles)	36.00
Trypsin	8.00
Gloves (4 boxes)	32.00
Tissue culture flasks (100/case)	159.00
Penicillin/streptomycin solution	13.00
Shipping cells for qPCR	40.00
Student membership Alabama Academy of Science	20.00
Student member registration for Alabama Academy of Science	75.00
<b>TOTAL</b>	<b>1995.00</b>

## 4. Delineation of Responsibilities

Dr. Tina Hubler's Responsibilities:

- Aid in composition of proposal
- Supervise laboratory work
- Provide supplies and procedures for experiments
- Ship samples for qPCR analysis
- Mentor Caroline Thomas on preparation of oral presentations and final paper
- Manage safety and hazardous waste

# Schol. Perf. - Grants

Caroline Thomas' Responsibilities:

- Read assigned literature and discuss with Dr. Hubler
- Search literature as needed for information vital to project
- Meet on a regular basis to plan lab experiment, interpret experimental results, troubleshoot if problems arise, and outline contents of oral presentations
- Perform laboratory duties such as maintaining cell cultures, conducting experiments, recording results, and interpreting and discussing data
- Outline oral presentations, consult with Dr. Hubler and utilize designated collaborative space in Collier library to practice presentations
- Present at the Alabama Academy of Sciences meeting (2016) and the Three Minute Thesis Competition as part of UNA Research Days (2016)
- Work with Dr. Hubler to provide a final report on research, and submit to the QEP office less than one month after project completion

## **5. Timeline of Research Project**

Summer 2015 – Research with Dr. Hubler in the lab, literature research, preparation of proposal

Fall 2015 – Research in the lab

November 2015 – Start working on spring presentations

Feb 17-19, 2016 – AL Academy of Science meeting (at UNA)

April 2016 – 3 Minute Thesis for UNA Research Days

# Schol. Perf. - Grants

April-May 2016 – Finalize report to submit to QEP office

## 6. References

Cioffi, D.L., Hubler, T.R., Scammell, J. G. 2011 Organization and function of the FKBP52 and FKBP51 genes. *Curr Opin Pharmacol* 4: 308-313.

Davies, T.H., Y.M. Ning, and E.R. Sanchez, 2005 Differential control of glucocorticoid receptor hormone-binding function by tetratricopeptide repeat (TPR) proteins and the immunosuppressive ligand FK506. *Biochemistry* 44: 2030-2038.

Davies T.H., Ning Y.M., Sánchez E.R. A new first step in activation of steroid receptors: hormone-induced switching of FKBP51 and FKBP52 immunophilins. *J Biol Chem.* 2002 Feb 15;277(7):4597-600.

Denny, W.B., D.L. Valentine, P.D. Reynolds, D.F. Smith, and J.G. Scammell, 2000 Squirrel monkey immunophilin FKBP51 is a potent inhibitor of glucocorticoid receptor binding. *Endocrinology* 141: 4107-4113.

Jiang, W., S. Cazacu, C. Xiang, J.C. Zenklusen, H.A. Fine *et al.*, 2008 FK506 binding protein mediates glioma cell growth and sensitivity to rapamycin treatment by regulating NF-kappaB signaling pathway. *Neoplasia* 10: 235-243.

Reynolds, P.D., Y. Ruan, D.F. Smith, and J.G. Scammell, 1999 Glucocorticoid resistance in the squirrel monkey is associated with overexpression of the immunophilin FKBP51. *J. Clin. Endocrinol. Metab.* 84: 663-669.

Scammell, J. G., Denny, W.B., Valentive, D. L., Smith D. F. 2001 Overexpression of the FK506-binding immunophilin FKBP51 is the comon cause of glucocorticoid resistance in three New World primates. *Gen Comp Endocrinology* 124:152-65.



# Schol. Perf. - Grants

Comparing the mRNA transcript levels of FKBP5 in New World and Old World monkeys

Tina Hubler, Department of Biology

## Background

Overexpression of FKBP5 protein has been implicated in human disorders such as cancer, depression, post-traumatic stress and resistance to treatment with corticosteroids [1-3]. New World monkeys, such as squirrel monkeys, have high levels of FKBP5 protein. Therefore they may serve as naturally occurring models of overexpression of FKBP5 and be useful to study how FKBP5 overexpression occurs in disease states.

Over the past five years, I have studied the mechanism by which the levels of the FKBP5 protein are controlled in squirrel monkey cells. This protein is overexpressed (occurs at higher levels) in squirrel monkeys and other New World monkeys (NWM), relative to humans, apes and Old World monkeys (OWM) such as African green monkeys [4, 5]. Figure 1 shows the levels of FKBP5 that we measured in NWM and OWM cells used for some of our experiments. These results confirm the overexpression of FKBP5 in NWM, as described earlier in the literature.

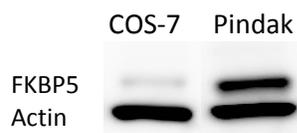


Figure 1. Comparison of FKBP5 protein levels in African green monkey COS-7 (OWM) and squirrel monkey Pindak (NWM) cells by Western blot.  $\beta$ -actin was used as a loading control.

To study how control of gene expression occurs we need to understand how DNA is used by a cell (Figure 2). Expression of a protein involves the use of a DNA sequence (a gene) that contains the information to make that protein. Use of the information in the gene is most often under the control of another DNA sequence that precedes the gene, called the promoter. If the promoter is “activated”, the gene information

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is used and the cell synthesizes a molecule of RNA (ribonucleic acid) that serves as an intermediate messenger molecule (mRNA). mRNA is then used as the molecular information or “recipe” to make the protein. This pathway is called gene expression and has multiple steps at which the final level of protein may be affected.

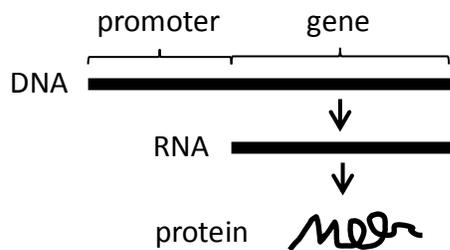


Figure 2. Schematic of a cell’s utilization of DNA to make a protein

Thus far, we have examined two possible mechanisms that could explain how FKBP5 protein levels are elevated in New World monkeys. The mechanisms we investigated involved the activity of the FKBP5 gene promoter and the stability of the FKBP5 mRNA. To summarize, neither mechanism explains how FKBP5 is overexpressed in NWM. This work was supported by UNA intramural funding and I have included a discussion of the results in the Appendix.

## Goal of this project

A vital piece of information that is missing in the literature, is the level of FKBP5 mRNA in NWM relative to OWM. The FKBP5 gene yields four different mRNAs called transcripts. Knowing the relative levels of these transcripts either individually or in sum, in NWM versus OWM, will shed light on which step(s) in the gene expression pathway we should investigate next.

**Our hypothesis is:** FKBP5 mRNA transcripts occur at higher levels in NWM than in OWM

The levels of mRNA transcripts can be measured in cells by using either Northern Blot or qPCR (quantitative polymerase chain reaction). One difficulty encountered with both techniques is the isolation of RNA from cells. RNA is very susceptible to degradation, requiring ultra-clean workspaces and hazardous

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reagents that we do not routinely use. The currently preferred method for measuring RNA transcripts is qPCR, for which we do not have the equipment or expertise. In addition, the four transcripts differ only slightly in their sequences, which may make distinguishing them very challenging. The alternative method, Northern blot, may also not be able to distinguish the four transcripts, but would be able to provide a comparison of the total transcript levels. Northern blotting requires an ultra-clean RNase-free environment and equipment (DNA crosslinker and hybridization oven) that we currently do not have. By using both of these approaches, we will obtain complementary information about the relative levels of FKBP5 transcripts in cell lines representing the NWM and OWM groups.

My proposal requests funds to send frozen cells from our lab to two outside facilities that will perform qPCR and Northern blot analyses on FKBP5 mRNAs from squirrel monkey (NWM) and human (OWM) cells. The Department of Biology is willing to purchase two cell lines for the analyses.

## **Procedures**

Cells will be grown in a 37C incubator and then collected by centrifugation. The cells will be sent for qPCR and Northern blot analysis by shipping on dry ice (purchased from a local gas supply company).

## **Time line**

Cells can be delivered within one month after we begin this work. The service provider may require several months to complete the analysis. We anticipate that at least some of the results may be obtained before the reporting deadline of September 30 2015.

## **Expected Study Results**

These results will help us gain insight into the mechanism of overexpression of FKBP5 in NWM. If we observe a difference in the levels of mRNA transcripts in NWM versus OWM, the data will suggest that either the production of or the stability of FKBP5 mRNA plays an important role in the overexpression of FKBP5

# Schol. Perf. - Grants

protein in the squirrel monkey. This will be a vital piece of information to include in the manuscript that we are preparing in which we describe our work to date. Potential journals for submission include *Genomics* and *G3:Genes, Genomes and Genomics*.

## **Applicant's qualifications**

I recently published an article in *The American Biology Teacher* (January 2015), in which work from our research lab was used to develop a laboratory activity for Honors and Molecular Biology courses. A second article has been accepted for publication in the February 2015 issue. I have completed projects funded by the UNA College of Arts and Sciences research grants and have included undergraduate students in each of these projects. Two students have made oral presentations at scientific meetings and at least one has participated each year in UNA Research Day. My doctoral research focused on molecular evolution and gene expression and I currently teach the Molecular Biology course required for the Cellular and Molecular Biology option in the Department of Biology.

## **Hazardous material disposal**

We have the appropriate Biosafety Level 2 cabinets for handling and collecting cells. Liquid waste containing cells will be disinfected with 10% bleach or autoclaved, and solid waste will be autoclaved prior to disposal. These are the recommended disposal procedures according to the manufacturers' MSDS (Material Safety Data Sheet).

## **Budget**

This application is to purchase qPCR service from the Arqgenetics Lab and Northern blotting from the Lofstrand Lab. We will also pay for the shipment of cells. I requested quotes from four qPCR service providers and obtained two quotes, one of which was >\$5000.00 from TATAA Biocenter in Europe. I was not able to obtain quotes from more than one Northern blot service provider.

# Schol. Perf. - Grants

<u>Item</u>	<u>Cost</u>
qPCR service	
RNA extraction	100.00
qPCR, 2 samples; 2 targets each, plus one control each	400.00
Northern blot service, 2 samples	
total RNA isolation	250.00
polyA RNA isolation	200.00
radioactive probe labeling	160.00
Northern blot and hybridization	900.00
preparation and delivery of digital and hard copy results	50.00
Dry ice for shipping cells	50.00
Estimated shipping of cells	50.00
Two cells lines (ATCC; 459.19 each plus shipping)	970.00
<b>Subtotal</b>	<b>\$3130.00</b>
- Department of Biology contribution	-1000.00
<b>TOTAL</b>	<b>\$2130.00</b>

## References

1. Binder, E.B., et al., *Polymorphisms in FKBP5 are associated with increased recurrence of depressive episodes and rapid response to antidepressant treatment*. Nat Genet, 2004. **36**(12): p. 1319-25.
2. Bortsov, A.V., et al., *Polymorphisms in the glucocorticoid receptor co-chaperone FKBP5 predict persistent musculoskeletal pain after traumatic stress exposure*. Pain, 2013. **154**(8): p. 1419-26.
3. Ellsworth, K.A., et al., *Contribution of FKBP5 genetic variation to gemcitabine treatment and survival in pancreatic adenocarcinoma*. PLoS One, 2013. **8**(8): p. e70216.
4. Denny, W.B., et al., *Squirrel monkey immunophilin FKBP51 is a potent inhibitor of glucocorticoid receptor binding*. Endocrinology, 2000. **141**(11): p. 4107-4113.
5. Scammell, J.G., et al., *Overexpression of the FK506-binding immunophilin FKBP51 is the common cause of glucocorticoid resistance in three New World primates*. Gen. Comp. Endocrinol., 2001. **124**(2): p. 152-165.

## Appendix – Summary of prior research on FKBP5 expression

We have examined two possible mechanisms that could explain how FKBP5 protein levels are elevated in New World monkeys. The first involved the FKBP5 gene promoter, because the promoter usually controls the rate-determining step in gene expression. We found by comparing the promoter activity of the FKBP5 gene in NWM and humans that the squirrel monkey promoter exhibited only 1.7 times the activity as the human promoter (Figure 3).

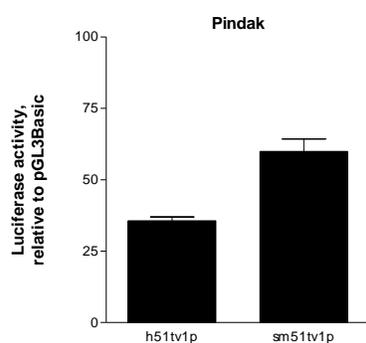


Figure 3. A comparison of the human and squirrel monkey FKBP5 promoter activities in squirrel monkey (Pindak) cells. n=4; bars represent standard error of the mean (SEM).

Because the squirrel monkey promoter activity does not adequately explain the higher level of protein observed in NWM relative to OWM, we examined another possible mechanism. MicroRNAs (miRs) are small RNAs that are involved in a gene silencing phenomena known as RNAi. MiRs target messenger

# Schol. Perf. - Grants

RNAs (mRNAs) if the miR has an appropriate complementary sequence to the messenger RNA. The targeted mRNA is degraded and gene expression is silenced. In 2010, miR-100 was reported to decrease human FKBP5 protein levels by this mechanism. If miR-100 does not effectively target squirrel monkey FKBP5 mRNA (due to differences in the composition or sequence of the squirrel monkey mRNA), the lack of its activity may result in higher levels of FKBP5 protein. We evaluated whether miR-100 decreased NWM FKBP5 by treating cells and measuring protein levels by Western blot. As Figure 4 shows, miR-100 reduces squirrel monkey FKBP5, suggesting that miR-100 activity is not responsible for elevated FKBP5 protein in NWM.

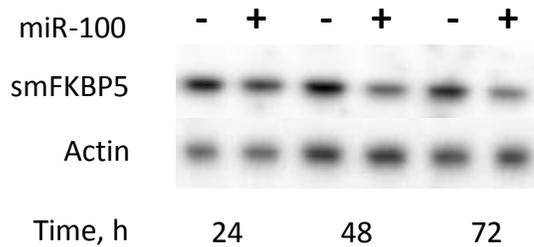


Figure 4. The effect of miR-100 on FKBP5 protein expression in squirrel monkey cells. Squirrel monkey (Pindak) cells were transfected with 50 nM miR-100 and assayed for FKBP5 protein by Western Blotting. Beta actin protein was assayed simultaneously as a loading control.

Because these mechanisms do not explain how FKBP5 is overexpressed, other stages in the gene expression pathway should be investigated. Before pursuing alternatives, it would be informative to know how mRNA levels compare in NWM and OWM. The mRNA comparison will tell us if differences in gene expression occur before or after this stage.

# Schol. Perf. - Grants

## COLLEGE OF ARTS & SCIENCES RESEARCH AND DEVELOPMENT GRANT APPLICATION FORM for 2013-2014

Applicant: Tina R. Hubler \_\_\_\_\_ Title: \_Associate Professor\_\_\_\_\_

Department: Biology \_\_\_\_\_ e-mail: \_trhubler@una.edu\_\_\_\_\_

Grant activities and/or needs: Funding for the research project titled: MicroRNAs that control the levels of human FKBP5 protein may explain the differential expression of FKBP5 genes in Old World and New World primates

Date Submitted: \_11/04/13\_\_\_\_\_ Research Grant \_\_\_X\_\_\_ Development Grant \_\_\_\_\_ (check type of grant)

Proposal narrative (on separate sheet): Describe why the grant activities/needs should be supported (see College of Arts & Sciences Development or Research Grant Guidelines).

<b>Budget Summary*</b>	Amount Required (round to nearest \$)
1. Travel.....	_____
2. Registration fees .....	_____
3. Meals .....	_____
4. Lodging.....	_____
5. Tuition .....	_____
6. Equipment.....	_____
7. Supplies .....	\$2107.00 _____
8. Other .....	_____
9. Department Funds available for this project.....	please see narrative ____
Total amount requested	\$2107.00 _____

If it is not possible to complete the research, I agree to return the remaining funds to the Office of the Dean of Arts & Sciences **by April 11, 2014**. I agree to acknowledge the financial support of the University of North Alabama in all publications, exhibitions, or performances resulting from this grant. I also agree to submit a written grant report to the Office of the Dean of Arts & Sciences **no later than September 30, 2014, or to request a rollover of funds into the 2014-15 fiscal year.**

**Applicant _____ Date _____	**Department Chairperson _____ Date _____
Department Chair: Please list department funds available for this project: Amount: \$ _____	

Dean, College of Arts & Sciences _____ Date _____	Chairperson, Arts & Sciences _____ Date _____ Research and Development Committee
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**Please submit by email to [dkhtubbs@una.edu](mailto:dkhtubbs@una.edu) (Debbie Tubbs) a single PDF file <LastName\_Department\_{Dev or Res}.pdf> containing, in order 1) this application form, 2) one page vitae, and 3) proposal narrative and deliver a paper copy of the one-page application form with both the applicant's and department chair's signature to the Office of the Dean of Arts & Sciences (Wesleyan 129) by 4:30 p.m. on Friday, Nov. 15, 2013.**

\* An itemized budget with justification **must be included** in the proposal narrative

\*\* Signature required for grant application submission

# Schol. Perf. - Grants

Tina Hubler, Department of Biology

## Title

MicroRNAs that control the levels of human FKBP5 protein may explain the differential expression of FKBP5 genes in Old World and New World primates.

## Introduction: significance and purpose

The overall goal of this project is to determine how the glucocorticoid receptor-associated protein FKBP5 is expressed at high levels in certain primates. Cellular receptors such as the glucocorticoid receptor (GR) receive a molecular signal by interacting with hormones that cause cells to respond. The protein FKBP5 was discovered as a constituent of the glucocorticoid receptor complex that modulates cellular response to the hormone cortisol in humans and other primates [1]. Our lab became interested in FKBP5 when it was observed that the amount of FKBP5 is elevated in New World primates (NWP, such as squirrel monkeys) relative to Old World primates (OWP, such as humans) (Figure 1) [2, 3].

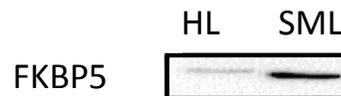


Figure 1. Results of a Western Blot protein assay showing the levels of FKBP5 in human lymphocytes (HL) and squirrel monkey lymphocytes (SML).

FKBP5 is now known to decrease the effects of cortisol on the cortisol receptor (GR). This reduces the responsiveness of NWP cells to circulating cortisol. As a result, NWP are considered “natural models of cortisol resistance” [4, 5]. Historically, abnormalities in cortisol signaling have been attributed to defects in the GR [6]. So the discovery of the role of FKBP5 in GR signaling revealed another way that cellular responsiveness to the hormone cortisol can be altered.

Numerous additional roles for FKBP5 have since been identified. Changes in the levels of FKBP5 protein are associated with depression, post traumatic stress disorder, resistance to chemotherapy-induced

# Schol. Perf. - Grants

apoptosis and pathways involved in gene silencing [7-10]. Due to an increased understanding of its importance, there is interest in how the levels of FKBP5 are controlled.

According to the Central Dogma of Molecular Biology, DNA molecules contain the instructions used by cells to make proteins. The multistep process of synthesizing proteins using DNA as the template (or guide) is called gene expression and is controlled at multiple levels. The most common level of control occurs through DNA regions called promoters that precede the instructional regions (the genes). Our research focuses on understanding the mechanism by which the human FKBP5 (hFKBP5) and squirrel monkey FKBP5 (smFKBP5) genes are differentially “expressed” (used to make protein). So far we have isolated, compared and conducted activity assays on promoters that control FKBP5 gene expression in squirrel monkeys and humans [11]. Research efforts were supported by UNA intramural grants, the Department of Biology, undergraduate research students at UNA and collaborators at the University of South Alabama (USA). Because we found little difference in the DNA sequences and activities of the promoters, data from this work suggests that the squirrel monkey and human promoters do not mediate the differential expression of FKBP5 in NWP and OWP.

Recently, Kandpal reported that hFKBP5 protein levels are decreased by microRNAs (miRs), specifically miR100 and miR99a [12]. MiR control of gene expression is a new and rapidly advancing field. Rather than occurring through the gene promoter, it involves the destruction of intermediates (messenger RNAs) in the pathway to protein synthesis. In the last few years, miRs have been shown to control the expression of genes involved in human disorders such as cancer, inflammation, and kidney, lung and liver diseases. Because the mechanism of microRNA gene regulation is distinct from promoter-mediated regulation, miR100 and miR99a effects in NWP versus OWP warrant investigation. **We plan to test the following hypothesis: MiR100 and/or miR99a mediate differential expression of FKBP5 genes in squirrel monkey and human cells. The testing of this hypothesis consists of answering two questions: 1) does miR100 and/or miR99a decrease FKBP5 protein levels in NWP? and 2) are miR100 and/or miR99a levels higher in OWP than in NWP?**

# Schol. Perf. - Grants

To begin to understand the role of miRs in smFKBP5 gene expression, we conducted preliminary studies by treating squirrel monkey cells with miR100 and measuring protein levels by Western Blot protein assay. Figure 2 shows that miR100 reduces smFKBP5 protein levels in NWP cells.

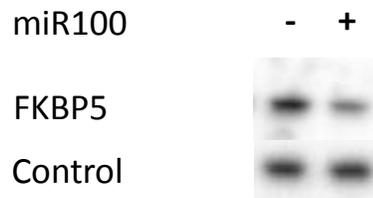


Figure 2. Results of a Western Blot protein assay showing the effect of miR100 on the level of FKBP5 protein in squirrel monkey cells.

These data suggest that the smFKBP5 gene is affected by miR100. We plan to repeat this experiment and perform the same experiment with miR99a. We then need to determine if the levels of miR100 and/or miR99a are higher in humans than in squirrel monkeys, as this may explain the relatively lower level of FKBP5 protein in humans. To accomplish this, we have initiated a collaboration with Dr. Bill Gerthoffer's lab at the University of South Alabama (USA) to quantify miR100 and miR99a levels in NWP and OWP cells (collaboration confirmation attached at the end of this document). RNAs are prone to degradation in the laboratory and therefore require a designated ultra clean labspace. Their lab personnel include a graduate student specializing in miR analysis. They have the necessary equipment and reagents to perform several trial runs and have agreed to do this at their expense. We will prepare squirrel monkey and human cells to ship to USA along with reagents needed to perform the remaining assays.

## Procedures

Western Blot protein assays (at UNA): Squirrel monkey cells will be grown in a 37°C incubator and then treated with miR99a and a control miR for 48, 72 and 96 hours. Cells will be lysed and the lysate analyzed by Western Blot for FKBP5 and a control protein. Proteins will be detected by chemiluminescence (producing results similar to Figure 2) and protein levels will be quantified using the UVP Gel Doc-It system recently purchased by the Department of Biology.

# Schol. Perf. - Grants

miR quantitation assays: Squirrel monkey and human cells will be grown for 24 hours and then collected using Cell Protect Reagent. This reagent stabilizes cells for shipment so that RNA may be isolated in the Gerthoffer lab at USA. The Gerthoffer lab will measure levels of miR100 and miR99a in squirrel monkey and human cell extracts by qPCR. qPCR is a technique in which millions of copies of a specific RNA (miR100 or miR99a in this case) are generated, allowing one to calculate the initial number of copies in a cell extract.

Time line: Cell extracts will be prepared for Western Blot analysis and the experiments will be performed in spring semester, 2014. Cells will be sent to the Gerthoffer lab in November or December 2013 for trial assays. We anticipate three to five months to complete the analyses.

## **Expected Study Results**

If we observe a difference in the levels of miRs in squirrel monkey and human cells, the data will suggest that miR100 and/or miR99a play a role in the elevated levels of FKBP5 protein in squirrel monkeys. We will determine what additional experiments should be performed to substantiate the role of miRs before preparing a manuscript for publication. Potential journals for submission include *General and Comparative Endocrinology* and *Genomics*.

## **Applicant's qualifications**

My doctoral research focused on molecular evolution and gene expression and I currently teach the Molecular Biology course required for the Cellular and Molecular Biology Option in the Department of Biology. I have completed projects funded by the UNA College of Arts and Sciences and have included undergraduate students in each of these projects. Two students have made oral presentations at scientific meetings and at least one has participated each year in UNA Research Day.

## **Hazardous material disposal**

Liquid waste containing DNA or cells will be disinfected with 10% bleach or autoclaved, and solid waste will be autoclaved prior to disposal. These are the recommended disposal procedures according to the

# Schol. Perf. - Grants

manufacturers' MSDS. Hazardous waste (e.g. ethidium bromide solution) will be included in the "used chemicals" stream generated by the chemistry and biology programs as in previous years.

# Schol. Perf. - Grants

## Budget

The Department of Biology recently purchased a chemiluminescent imager for detecting and quantifying proteins after Western Blot analysis (~ \$20,610.00). Additionally the Department purchased reagents needed for Western Blot analysis (antibodies, buffers, detection reagents, standards, membranes, electrophoresis power supplier and chambers, ~ \$1500.00) and reagents for the maintenance of cell cultures (media, antibiotics, serum, flasks, carbon dioxide, etc., ~ \$109.00). Collaborators at USA are planning to assay trial samples for us *at their expense*. This application is to purchase reagents for Western Blotting here at UNA and for reagents that we will supply to the Gerthoffer lab at USA.

<u>Item</u>	<u>Cost</u>
miR99a (Western Blot)	\$258.00
control miR (Western Blot)	266.00
Immun-Star Chemiluminescent detection kit 170-5043 (Western Blot)	335.00
Cell protect Reagent (Gerthoffer lab miR assay)	302.00
miR100 qPR assay (Gerthoffer lab miR assay)	173.00
miR99a qPCR assay (Gerthoffer lab miR assay)	173.00
TaqMan Master Mix kit for qPCR (Gerthoffer lab miR assay)	400.00
Estimated shipping (10%)	200.00
<b>Total</b>	<b>\$2107.00</b>

# Schol. Perf. - Grants

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# Schol. Perf. - Grants

## Evidence of collaboration with Dr. Gerthoffer at University of South Alabama

Dear Tina,

Brian Comer and I are looking forward to working with you on assessing miRNA levels in squirrel monkey cells. We are conducting quantitative PCR studies on a number of microRNAs and are quite interested in the outcome of your studies.

Best regards,  
Bill Gerthoffer

William T. Gerthoffer, Ph.D.  
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## Application for College of Arts and Sciences Research Grant

**2012-2013**

Applicant: Tina R. Hubler Ph.D.

Department: Biology

### **Research project title**

Analysis of the promoter activity of glucocorticoid receptor-associated FKBP51 in the squirrel monkey *Saimiri boliviensis*.

### **Introduction: Significance and Purpose of the Project**

This work is a continuation of research started in spring 2011. The overall goal is to determine whether differential expression of two genes (FKBP51 and FKBP52) in squirrel monkeys versus humans is due to DNA sequences (gene promoters) that control gene expression at the transcriptional level (synthesizing RNA from DNA).

New World primates (NWP) such as the squirrel monkey and common marmoset have been used extensively as animal models for human studies due to their close evolutionary relationship to humans, their small size and ease of maintenance in captivity (1). However there are important differences between Old World primates (OWP), such as humans, and NWP with regard to certain hormones. For example, there are dramatic differences between OWP and NWP with regard to cortisol responsiveness (how cells respond to the endocrine hormone cortisol). The squirrel monkey has serum cortisol levels that are up to 100-fold higher than in humans (2). Despite these high circulating levels of cortisol, the squirrel monkey does not exhibit symptoms of hypercortisolemia such as osteoporosis, muscle weakening and wasting, high blood pressure, increased abdominal fat deposition, immune dysfunction and steroid-induced diabetes (3-5). Evidence suggests that squirrel monkey tissues are “protected” from high cortisol levels by the action of a protein associated with the

## Schol. Perf. - Grants

receptor for cortisol, the glucocorticoid receptor (GR). GR responsiveness to cortisol is affected by a protein that associates with the receptor: FKBP51. When FKBP51 is associated with GR, its responsiveness is reduced five-fold (6-8). FKBP51 protein levels have been measured in a number of cells and tissues from NWP and OWP. These analyses consistently show that FKBP51 protein is overexpressed (levels are higher) in NWP (9, 10). Therefore, elevated levels of FKBP51 in NWP partially explain how squirrel monkey tissues are shielded from high serum cortisol levels: the GR is rendered less responsive to the hormone.

The purpose of this project is to understand how FKBP51 is expressed at higher levels in squirrel monkeys than in humans. To begin to understand expression of the squirrel monkey gene, we first need to determine its promoter sequence (DNA sequences that control gene expression) and compare it to the respective human promoter sequence. Next, to compare the *activities* of the human and squirrel monkey promoters, we need to put these DNA sequences into reporter vectors (a commercially available DNA that produces a recordable signal that is proportional to DNA activity). The DNA sequences for the human FKBP51 gene promoter was determined and inserted into a reporter vector previously by the applicant (11, 12).

So far we have determined the smFKBP51 promoter sequence, compared its sequence to the human FKBP51 promoter (>90% identical) and prepared a reporter vector containing 500 nucleotides of smFKBP51 promoter. Last year we tested the activity of the smFKBP51 promoter relative to the human promoter in OWP cells. There was no difference in the activity of squirrel monkey and human promoters. These data suggest that the promoter DNA sequence alone cannot explain how FKBP51 protein is expressed at higher levels in NWP than in OWP. Therefore another possibility should be considered. NWP cells may contain transcription factors (proteins in the nucleus that

# Schol. Perf. - Grants

control gene expression by their interaction with DNA promoter sequences) that selectively stimulate the squirrel monkey promoter. This would cause elevated gene expression in NWP cells but not in OWP cells. This hypothesis can be tested by comparing the squirrel monkey and human promoter activities in NWP cells.

<u>Objective</u>	<u>Completed</u>	<u>To be completed</u>
Obtain hFKBP51 promoter sequence	X	
Insert human promoter into reporter vector	X	
Obtain smFKBP51 promoter sequence	X	
Insert sm promoter into reporter vector	X	
Compare sm and h promoters in OWP cells	X	
Compare sm and h promoters in NWP cells		X

## **Hypothesis:**

- a) NWP cells contain factors that selectively affect the activity of the smFKBP51 promoter.

## **The specific objectives of this project are:**

- a) To determine the activity of the smFKBP51 promoter sequence and compare it to the hFKBP51 promoter activity in SQMK cells.

## **Review of Literature**

In OWP such as human, the endocrine hormone cortisol is produced in the adrenal cortex and circulates in the blood to elicit responses in cells that contain glucocorticoid receptors (GR). Cytoplasmic GR binds cortisol once it diffuses across a cell membrane. The GR becomes “activated” and travels to the cell nucleus, where it

# Schol. Perf. - Grants

initiates expression of specific genes. The resulting changes in gene expression are observed as a cellular response. GR exists in a complex with other proteins that influence its activity (13). Two of these proteins, FKBP51 and FKBP52, have opposite effects on GR's ability to bind cortisol and elicit a cellular response. When human FKBP52 is associated with GR, cellular response to cortisol occurs within the expected physiological concentration range for endocrine hormones (nM) (7, 8). When human FKBP51 is associated with GR, cellular response to cortisol is reduced five-fold (6). So, the two proteins modulate GR function through their association with the receptor and FKBP51 inhibits GR function.

Our research interest is how the gene for smFKBP51 is overexpressed and the gene for smFKBP52 is underexpressed relative to the human genes. For most genes, regulation of expression occurs through the promoter. Therefore, to begin to answer this question, the promoters for these genes will be examined to determine if transcriptional regulation (occurring through the promoter) may contribute to the differences in protein levels we observe in OWP versus NWP.

## **Procedures**

Site and Tools: FKBP51 promoter activity – SQMK cells will be purchased from American Type Culture Collection and grown in an incubator in the Molecular Biology lab in the Department of Biology. Procedures involving live cells will be performed in a Biosafety Level II cabinet certified by Southeastern Certification (TN) and housed in the Molecular Biology lab. The promoter activity assay will be done using a luminometer (an instrument that detects and quantifies light emission) that the Department of Biology purchased in 2009.

Analysis: To analyze the activity of sm and human FKBP51 promoters, cells will be transfected (the addition of foreign DNA) with reporter vectors containing the

# Schol. Perf. - Grants

FKBP51 promoters and grown for 24 hours. During this time, cells will synthesize quantities of luciferase protein that are proportional to the activity of the promoter. Cells will be lysed and centrifuged to collect a cytoplasmic suspension that contains luciferase protein that was produced over the 24 hour period. The promoter activity will be analyzed using a luciferase reporter assay kit that is commonly referenced in the literature (14). In this assay luciferase reacts with another molecule (a substrate) and releases light as a by-product of the enzymatic reaction. The emitted light is quantified by the luminometer as RLU's (relative light units). Data will be represented in graphical form showing the comparison of RLU's obtained for the smFKBP51 and hFKBP51 promoters.

Time frame: I anticipate completing analysis of the FKBP51 promoter in SQMK cells by September 2012.

## **Expected Study Results**

If these experiments reveal a difference in promoter activities in the NWP cells, the data suggest that NWP cells contain factors that selectively activate the smFKBP51 promoter. If no difference is observed, our next step is to isolate a larger region of the smFKBP51 promoter for comparison to the human promoter. This stage of the project is already underway and we are gathering preliminary data.

This project will contribute to comparative genomics studies of NWP and OWP species in collaboration with Dr. Jonathan Scammell at the University of South Alabama. So far, as a result of this collaboration, we have coauthored three manuscripts (15-17), four abstracts to meetings and submitted three completed squirrel monkey gene sequences to the NCBI database over the period 2007-2012. We have also presented four posters at UNA Research Day in April 2008, 2009, 2010 (2011

# Schol. Perf. - Grants

cancelled due to weather) and 2012. Two students are scheduled to participate in this research and will present a poster at UNA Research Day in spring 2013.

## **Applicant's qualifications**

The applicant's doctoral research (2006) focused on molecular evolution and gene expression. Molecular biology techniques were the primary tools used in my research, therefore I have over ten years of experience with the techniques needed to successfully complete this project. In 2008 I developed our Molecular Biology course, BI415, that is now required for the Cellular and Molecular Biology option in the Department of Biology. In addition, I also completed productive projects funded by UNA College of Arts and Sciences Research Grants in Fall 2007, Spring 2011, Fall 2011 and by University Research Grants in Fall 2008 and Fall 2009.

## **Hazardous materials disposal**

Liquid waste containing DNA or cells will be disinfected with 10% bleach or autoclaved, and solid waste will be autoclaved prior to disposal. These are the recommended disposal procedures according to the manufacturers' MSDS. Hazardous waste (e.g. ethidium bromide solution) will be included in the "used chemicals" stream generated by the chemistry and biology programs as in previous years (email from Dr. Kittle, Chair, Department of Biology included).

## **Budget**

The luminometer required for promoter reporter assays was purchased by the Department of Biology for research and for our recently developed Molecular Biology course. Supplies to begin this project were purchased through the Department of Biology and College of Arts and Sciences Research grants. This application is for supplies to analyze the activity of promoter DNA sequences. The reagents needed are categorized in the itemized budget to include those for: a) growing cells and b) promoter

## Schol. Perf. - Grants

reporter assay. The cost for all supplies has been estimated to include shipping charges.

# Schol. Perf. - Grants

## Itemized budget

<u>Item</u>	<u>Purpose</u>	<u>Cost</u>
<u>Equipment</u>		
Drummond Pipet-Aid pipetting device	Cell growth	300.00
<u>Supplies for cell growth</u>		
Fetal bovine serum	Cell growth	70.00
Cell culture media (4)		65.00
Trypsin		12.00
Penicillin/streptomycin		15.00
Tissue culture flasks (case)		194.00
Tissue culture plates (case)		115.00
Sterile 5 mL pipets (case)		85.00
Sterile 10 mL pipets (case)		85.00
Gloves, med		60.00
Gloves, large		60.00
<u>Supplies for luciferase assay</u>		
Qiagen miniprep kit 250	DNA for transfection	395.00
Qiagen maxiprep kit 10		287.00
Superfect	Transfection	253.00
PCR water, sterile, RNase-free, 10 x 1mL		90.00
Promega luciferase assay kit (3)	Activity assay	270.00
<b>Total</b>		<b>2356.00</b>

# Schol. Perf. - Grants

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# Schol. Perf. - Grants

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## **Research project title**

Regulation of expression of squirrel monkey FKBP51.

## **Abstract**

Squirrel monkeys have higher levels of the protein FKBP51 than humans. FKBP51 controls responsiveness to the stress hormone cortisol. Proteins are produced from DNA by the cellular processes of transcription and translation. Most often the final amounts of a protein are controlled by a specific DNA sequence called a promoter. In this project the promoter sequences controlling FKBP51 gene expression in humans and in squirrel monkeys will be examined. Whereas human DNA sequences can be obtained from several public domain databases, the squirrel monkey DNA sequences cannot. Comparative genomics has recently emerged to study similarities and differences in the DNA sequences of related organisms. Researchers in this field use databases that contain DNA sequences from a wide variety of organisms ranging in complexity from bacteria to humans. We will utilize a database at the National Center for Biotechnology Information to compare the DNA sequences of closely related organisms (e.g. humans and other primates) and obtain information needed to isolate the squirrel monkey FKBP51 promoter from squirrel monkey lymphocyte DNA.

# Schol. Perf. - Grants

## Narrative

### Background

DNA is composed of building blocks called nucleotides which contain the molecules adenine (A), guanine (G), cytosine (C), and thymine (T). A DNA sequence is a particular order in which these molecules occur, for example AGTC or ATCG. This order of nucleotides determines what other molecules, such as proteins, can be synthesized by a cell. A gene is a DNA sequence that is used to synthesize a molecule that performs a function. In order to synthesize molecules such as proteins, the DNA information (sequence) contained in a gene is converted into different molecular forms during the processes of transcription and translation. One of the primary factors that determine the amount of protein synthesized is the DNA promoter region. DNA promoter regions are segments of DNA that lie just before the gene and function to control the rate at which a gene is transcribed into mRNA and is later translated into a functional protein.

The DNA of monkeys and humans is greater than 95% identical, making the differences in sequences between the two species particularly important. The small number of differences in DNA sequences is what distinguishes humans (h) from other primates such as squirrel monkeys (sm). The field of comparative genomics has emerged to study the importance of similarities and differences in DNA sequences of closely related organisms. This field of research utilizes DNA sequence information that has been deposited into a public domain database maintained by the National Center for Biotechnology Information ([www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)). The database contains sequences from a variety of organisms ranging in complexity from bacteria to humans. It includes DNA sequences from primates such as humans, chimpanzees, rhesus monkeys and common marmosets. In this project, the database will be utilized to help isolate an unknown DNA sequence from the squirrel monkey and compare it to the same DNA region in humans.

Often differences in DNA are studied because of a difference that is observed between two organisms. It has been discovered that squirrel monkey tissues contain more FKBP51 protein than human tissues. FKBP51 regulates the body's response to the stress hormone cortisol by binding to and inhibiting the glucocorticoid receptors that recognize cortisol. Therefore, FKBP51 levels can affect an organism's responsiveness to cortisol. Because squirrel monkey cells produce higher levels of FKBP51 than humans, squirrel monkey cells are much less responsive than human cells to cortisol circulating in the blood (1). The overall goal of this research is to determine if the FKBP51 gene promoter causes the difference in FKBP51 protein levels in human and squirrel monkeys.

### Research objective and hypothesis

Because gene promoters control the use of specific DNA sequences, it has been suggested that higher levels of FKBP51 protein may result from a squirrel monkey gene promoter that is more active than the human promoter. Therefore, to begin to understand how squirrel monkeys produce more FKBP51 protein than humans, the promoters for the squirrel monkey and human FKBP51 gene were isolated. In previous research projects conducted at the University of North Alabama, 500 nucleotides of promoter region of the FKBP51 gene were isolated from squirrel monkey and human DNA to determine whether there is a difference in activity. This is a relatively short fragment of promoter DNA sequence; promoter regions may extend several thousand nucleotides in length. However, less than 1000 nucleotides often contain the necessary

# Schol. Perf. - Grants

information to control gene usage by a cell (2, 3). The two promoter regions were tested and found to have no difference in activity. Subsequent experiments revealed that a longer squirrel monkey promoter region (>2000 nucleotides) lacks two segments that are present in the human. This may indicate that larger segments of the promoter from the two species must be isolated to identify differences in activity. Once larger segments are isolated, they can be tested to compare their levels of activity.

## **Hypothesis:**

The smFKBP51 gene promoter causes higher expression (use of the DNA sequence) than the hFKBP51 gene promoter.

## **Research project objective:**

To isolate a 2500 nucleotide fragment of the FKBP51 promoter region from squirrel monkey and human DNA.

To prepare a reporter vector containing each of the fragments for use in analysis of the squirrel monkey and human promoter activities.

## **Contribution to current research base**

The results of this research will be used to try to explain how squirrel monkeys express high levels of FKBP51 protein. FKBP51 has been implicated in a number of human disorders such as depression and cancer (4, 5). Therefore identifying DNA promoter sequences that control this gene may have applications in human health. For example, humans may acquire similar mutations in their DNA that cause increased expression of the gene and production of the FKBP51 protein. Secondly, this research enhances our understanding about the ways in which gene expression is controlled. Although regulation through the promoter is the most common level of control, there are other stages in the pathway to protein synthesis that can determine the final levels of a protein in a cell. Thirdly, this research increases our appreciation of the minute DNA differences between organisms that can have significant effects on anatomy and physiology.

## **Significance to student's field of study**

The applicant is enrolled in the Honors Program at UNA and is conducting this research for her Senior Capstone Project. Her major is Biology (Cellular and Molecular Biology option) and her current GPA is 3.86. This research utilizes the techniques and procedures learned in several courses at UNA, including genetics, molecular biology and cell biology. It will provide a research experience to prepare the student for graduate school upon graduation from UNA. Research experience is a valued credential for a student applying to graduate school. The results of this research will also give future UNA students an opportunity to continue to investigate this question with their own research.

## **Methodological Approach**

This project relies primarily on the polymerase chain reaction procedure (PCR). It is a technique frequently used in molecular biology and many other fields to make millions of copies of a piece of DNA which may then be used for downstream research applications. PCR results in the production of thousands to millions of copies of DNA because the copies that are generated act as a template for the creation of more copies, resulting in exponential growth. In this research, PCR will be used to duplicate the FKBP51 human and squirrel monkey promoters so they may then be assayed to determine the activity of each.

During PCR, DNA fragments called primers bind to the area of the DNA strand that is to be copied. Attachment of the primers precedes DNA polymerase (the enzyme that copies DNA) and is required to begin copying the DNA in that location. The primers must be synthesized and purchased from a biotechnology company to match the region of DNA that one plans to copy. Most of the squirrel monkey DNA sequence is not known. Therefore, we will use DNA sequences of closely related organisms to determine positions in the DNA that are similar amongst them all and therefore suitable as sites to start our copying reactions (PCR). This is an application of comparative genomics. We will utilize the NCBI database (<http://www.ncbi.nlm.nih.gov/>) to locate human, chimpanzee and rhesus monkey DNA sequences preceding the FKBP51 genes in these organisms. The primers will be ordered to match these sites.

The PCR procedure involves three main steps that must take place at very specific temperatures in order for the reaction to be successful. The first step, the denaturing step, is used to break down the double-stranded DNA into single-stranded DNA so that the primers and DNA polymerase may bind. This step must take place at a very high temperature (~94°C) in order to separate the DNA into individual strands. The next step, the annealing step, takes place at a much lower temperature (~60°C) and involves the binding of primers and DNA polymerase to the single strands. In the final step, the elongation step (~72°C), the DNA polymerase synthesizes new DNA strands.

Once the FKBP51 gene promoters are copied they will each be inserted into a commercially-available DNA used for promoter activity analysis (reporter vector). This will allow us to a) determine the sequence of the 2500 nucleotide fragments b) compare the human and squirrel monkey sequences and c) analyze the activity of the promoters. If time allows, the activity analyses will be performed using standard promoter activity assays.

## **Potential Applications/Use of Expected Outcomes**

If the two promoter regions exhibit no difference in activity, other processes involved in gene expression (e.g. RNA processing, RNA stability, translational efficiency and protein stability) must be considered to account for the difference in protein levels. If the proposed hypothesis is supported, a research manuscript will be prepared once all work is completed. In either case, the experimental results will be presented as an oral PowerPoint presentation and/or poster presentation at either the TriBeta Biological Honors Society meeting (UNA) or the Alabama Academy of Science meeting in February 2013 (Birmingham, AL).

# Schol. Perf. - Grants

## Itemized budget

<u>Item</u>	<u>Purpose</u>	<u>Cost</u>
PCR water, sterile, RNase-free, 5 x 1mL	DNA isolation	45.00
Invitrogen NTPs, 50 uL	DNA isolation	55.00
PCR primers, Eurofins	DNA isolation	
\$8.00/primer x 4 primers		32.00
\$8.00 shipping x 2		16.00
Agarose, 25g	DNA isolation	90.00
100X TBE electrophoresis buffer, 100mL	DNA isolation	40.00
Qiagen gel extraction kit	Insertion into reporter vector	150.00
Restriction enzymes	Insertion into reporter vector	200.00
Invitrogen competent cells	Insertion into reporter vector	220.00
Qiagen miniprep kit 50	Insertion into reporter vector	95.00
Shipping charges	Varies by vendor	55.00
<b>Total</b>		<b>998.00</b>

# Schol. Perf. - Grants

## Budget Narrative

The budget includes supplies needed to conduct the research project. Expenses for travel to present research results will be paid by the Department of Biology.

The following reagents will be used to isolate the DNA promoter sequence from human and squirrel monkey genomic DNA:

PCR water. This water is needed to suspend the components of the PCR reaction (genomic DNA to be copied, nucleotides, DNA polymerase, buffer, primers). The water must be pure, to avoid contamination while making millions of copies of DNA. It is also guaranteed to be RNase-free, which is necessary if performing reactions using RNA as the template.

NTP's. These are the nucleotides (A,T,C,G) that are the building blocks for the synthesis of new DNA during the PCR reaction.

Primers. These short DNA sequences must be ordered by the researcher and synthesized by a provider to match the desired location in the human or squirrel monkey DNA that is to be copied.

Agarose. This is used to prepare semisolid gels used to separate components of the PCR reaction after it is completed. The agarose gel separates molecules according to size so that a specific length of DNA (~ 2000 nucleotides) can be identified.

TBE electrophoresis buffer. The concentrated solution is diluted to prepare a solution (running buffer) in which agarose gel separation of molecules is conducted.

The following reagents will be used to insert the DNA promoter sequence from human or squirrel monkey into a reporter vector DNA that will allow us to analyze its activity:

Qiagen gel extraction kit. If DNA of the appropriate size is produced, it will be seen in the agarose gel and needs to be extracted from the gel. These reagents allow for extraction and purification of DNA so it can be used for the next procedure: insertion into the reporter vector

Restriction enzymes. These enzymes cut the reporter vector so that human or squirrel monkey promoter sequence can be inserted.

Competent cells. Once the DNA is inserted into the reporter vector, many copies of the molecule are made by adding it to bacterial cells. As the cells reproduce by mitosis, both the bacterial and foreign DNA is copied.

Qiagen miniprep kit. Bacteria divide and copy DNA many times while they are incubated overnight in broth containing nutrients. These reagents allow for the collection of bacteria and the isolation and purification of the DNA that is needed for our research.

Shipping charges vary at different times of the year, mainly due to weather conditions and fuel costs. For example, some reagents must be shipped on dry ice in the summer. Often the vendor provides an estimated shipping cost that will be slightly different when the invoice is received.

# Schol. Perf. - Grants

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- 5.) Li, L., Z. Lou & L. Wang. (2011) "The role of FKBP5 in cancer aetiology and chemoresistance." *British Journal of Cancer*. 104: 19-23.

# Examples of Service

# Academic service - scholarship awards



## MEMORANDUM

**To:** Dr. Tom Haggerty  
Chair, Department of Biology

**From:** Don Roush *DR*  
Faculty Advisor, Beta Zeta Chapter  
Beta Beta Beta

**Date:** March 24, 2016

**Subject:** Beta Beta Beta Scholarship

Our committee has convened and evaluated candidates to receive the Beta Beta Beta Scholarships. Based on the guidelines, our committee has selected two candidates. They both are well qualified and are conducting research in the department. Conducting research is one of the guidelines for this scholarship.

Ashlee Breanna Littrell	L00599037
Jacob Dawson	L00601462

Breanna is a professional biology major chemistry minor with a current GPA of 3.54. She has been active in the chapter having served as vice president and is currently serving as president.

Jacob is an environmental biology major with a current GPA of 3.82. He also has participated in chapter activities.

The award for each is \$500.00 to be used in the fall term 2016. It is NOT to be divided over the fall and spring terms as some scholarships.

If our committee can be of any further assistance, please feel free to contact me.

**Cc:** Dr. Lisa Ann Blankinship  
Dr. Tina Hubler

DEPARTMENT of BIOLOGY  
College of Arts and Sciences

UNA Box 5048, One Harrison Plaza, Florence, AL 35632-0001  
P: 256.765.4394 | F: 256.765.4430 | [www.una.edu](http://www.una.edu)

# Academic service - scholarship awards



## MEMORANDUM

**To:** Dr. Tom Haggerty  
Chair, Department of Biology

**From:** Don Roush *DR*

**Date:** March 24, 2016

**Subject:** Francis Martin Scholarship

Our committee has convened and evaluated candidates to receive the Francis Martin Scholarship. Based on the guidelines provided, our committee has selected:

Natalie Poer                      L00602422

Natalie is a professional biology (pre-med) major with a minor in chemistry. Her current GPA is a 3.96. She currently works two jobs to support her coming to UNA and well deserves consideration for this award.

The committee recommends that she receive the full amount commencing in the fall 2016.

If our committee can be of any further assistance, please feel free to contact me.

**Cc:** Dr. Lisa Ann Blankinship  
Dr. Tina Hubler

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College of Arts and Sciences  
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# Academic service - scholarship awards



## MEMORANDUM

**To:** Dr. Tom Haggerty  
Chair, Department of Biology

**From:** Don Roush *DRK*  
Faculty Advisor, Beta Zeta Chapter  
Beta Beta Beta

**Date:** March 24, 2016

**Subject:** John and Mary Holland Scholarship Selections

Our committee has convened and evaluated candidates to receive the John and Mary Holland Scholarship. Based on the guidelines provided, our committee has selected:

Kerri Colwell                      L00605283

Kerri is a biology major with a minor in chemistry who is contemplating going to graduate school. Her current GPA is 3.52. She has been very active in the chapter for the last academic year as well as being inline to become an officer of the chapter at our elections later this spring. The committee feels she represents an excellent candidate to receive the John and Mary Holland Scholarship. Our recommendation is that she receive the total amount for the fall semester 2016.

If our committee can be of any further assistance, please feel free to contact me.

**Cc:** Dr. Lisa Ann Blankinship  
Dr. Tina Hubler

DEPARTMENT of BIOLOGY  
College of Arts and Sciences  
UNA Box 5048, One Harrison Plaza, Florence, AL 35632-0001  
P: 256.765.4394 | F: 256.765.4430 | [www.una.edu](http://www.una.edu)

# Academic service = volleyball scholarship prospect

Volleyball  
Scholarship  
prospect

McCall, Jennifer S.

Reply all |

To: Hubler, Tina R.; Maddox, Lamont E.;

Thu 3/17/2016 12:33 PM

Alexa Goulding Bio.docx  
219 KB

Download Save to OneDrive - University of North Alabama

Thank you to all of you for your time! It is appreciated!

I am attaching a brief bio on [Alexa Goulding](#) for you.

We look forward to seeing each of you tomorrow and she is excited about her visit to campus.

I have the itinerary for your meetings with her as follows:

11:00am – Dr. Hubler – meet you in SET room 111  
11:30am - Dr. Maddox – meet you in the common lobby area of the SET  
11:50am – Dr. Haggerty – meet you at your office – SET room 392

If any of these are incorrect please let me know.

Roar Lions!

Jenn

# Academic service - Chair, Laura M. Harrison award committee

## MEMORANDUM

TO: Dr. William Cale, Jr.

FROM: Dr. Tina Hubler, Chair, Laura M. Harrison Professor of English Award Selection Committee

RE: Recommendation of Award Recipient

DATE: March 5, 2014

As Chair of the Selection Committee for the Laura M. Harrison Professor of English Award, I would like to recommend Dr. Tammy Winner for the Award. The committee feels that both applicants are capable and creative and both of their proposed projects are worthy. The decision to award one over the other was a difficult one. We evaluated each applicant and scored them based on three criteria we established from the Award Statement of Purpose and Qualifications of Applicants. These are:

- 1) Project would enable applicant to advance to higher levels of scholarship or creative work.
- 2) Project would enable applicant to advance to a higher level of teaching skill.
- 3) Project would effect improvement of writing and speaking skills among UNA students.

We employed a scoring system that produced both an average score and an average ranking. In both cases the committee supports Tammy Winner as the recipient of the Laura M. Harrison Professor of English Award. We would encourage the other applicant to submit her proposal again next year.

Please do not hesitate to contact me if I or the committee may be of further assistance.

pc: Dr. John G. Thornell, Vice President for Academic Affairs

Dr. Vagn Hansen, Dean, College of Arts and Sciences

# Academic service - Chair, Faculty search committee

Dear Candidate:

The Department of Biology at the University of North Alabama has selected you for an on-campus interview. Please e-mail me as soon as possible and indicate which of the potential dates, listed below, will fit your schedule to visit campus (PLEASE SELECT 2 POTENTIAL DATES).

Tuesday - Feb 25, 2014

Wednesday - Feb 26, 2014

Thursday - Feb 27, 2014

Tuesday - Mar 4, 2014

Wednesday – Mar 5, 2014

During your visit, you will meet with all department faculty members and the Dean of the College of Arts and Sciences, and have the opportunity to tour the UNA campus. The search committee would like for you to make a 20 minute teaching presentation to the entire biology faculty on the topic of GLOMERULAR FILTRATION and a 20 minute presentation on your research interests.

It is highly recommended that you arrive here in Florence the afternoon/evening BEFORE your interview date. The interview process will take an entire day, with your first appointment at 8:00 a.m. Expenses related to your visit (travel, lodging, food) will be reimbursed by the University, provided original receipts are submitted. Please be sure to keep ALL RECEIPTS. If air travel is required, you are to make your own arrangements. In the event that your airfare exceeds \$600, please inform me immediately. Airfare in excess of \$600 dollars must be approved by the University. Air travel is available locally through Muscle Shoals Airport (MSL), and Huntsville Airport (HSV). If you arrive in Huntsville, you will need to arrange a rental car to travel to and from Florence. Once your interview date is confirmed, the Department of Biology will book your sleeping accommodations (Hampton Inn or Marriott Shoals).

Once again, the Department of Biology is pleased to invite you to the campus of UNA. The entire faculty and staff look forward to meeting you!

Dr. Tina R. Hubler, Chair  
Search Committee

# Academic service - Integrative Health Program

Tina Hubler

Department of Biology

University of North Alabama

My research focuses on understanding how differences in gene expression produces distinct characteristics in two groups of primates (Old World and New World primates). One such physiological difference we have studied involves the physiological response to the stress hormone cortisol. New World primates make a protein (FKBP5) that causes their cells to be less responsive to cortisol than Old World primates. As a result of negative feedback mechanisms, they synthesize, secrete and circulate more cortisol. A number of stress-related disorders such as depression and PTSD, as well as cancers, have been correlated with abnormal expression of this protein in humans (Old World primates). Standard treatments are sometimes ineffective for individuals exhibiting aberrant FKBP5 expression. If specific DNA sequences can be identified as contributing to abnormal gene expression, these could be used to test individuals for their potential responsiveness to standard therapies. So, there is currently considerable interest in understanding how the gene for this protein is expressed.

Our work has focused on determining the location and DNA sequences of important regulatory regions for this gene and testing whether they play a role in differential gene expression in humans versus New World primates. This work uses basic molecular biology techniques such as PCR, cloning, Western blotting, and enzyme activity assays.

# Academic service - Chair, Interdisciplinary Studies Degree committee

## Tina Hubler, Chair, Interdisciplinary Studies Degree Committee

### IDS committee comments on MPS HEA

I think this is a great track and certificate to offer. The only other MPS program with which I have some familiarity is the one offered by the Tennessee Board of Regents. I do not see this track listed. I think the syllabi presented are appropriate. I don't want my comments to delay or derail the proposal. I attempted to anticipate questions others will ask and also plug a couple of related ideas.

### **Possible Questions from Graduate Council or Some Other Body:**

Does UNA currently enroll graduate students in **certificate programs** through continuing ed? Is this the first such certificate offered by UNA? How is tuition charged (isn't continuing end traditionally cheaper) and how would faculty be compensated? Would continuing end faculty pay not normally be less? I assume the classes would be attached more to the degree than the certificate but this seems to crop up.

### **Comments on course offerings:**

Would be good to see coursework that addresses some of the issues facing higher ed? From my observation the following skills are lacking by many higher ed employees (Admin and below)—fundraising, leadership skills, and technology awareness. It is possible that much of this content will be covered in other courses; however, it might be good for potential employers to see some of these explicitly called out on transcripts.

- 1) A course dealing with fundraising, foundations, etc. in higher ed.
- 2) Course on leadership (this could perhaps be cross listed with proposed undergrad leadership track and lead to potential for leadership track at the MPS level). I noticed some Higher Ed programs offer such a course.
- 3) As David Black pointed out in our meeting, some type of technology course would be nice. I believe he suggested a db course. Perhaps db plus other technology. While this may not be a common offering in Higher Ed programs it might prove a nice boost for the uniqueness at UNA.
- 4)

**Unrelated Comment:** Unrelated to the proposal so just throwing this out there .... it would be nice if UNA offered some type of salary bump for staff upon successful completion of the certificate program.

\*\*\*\*\*

# Academic service - Chair, IDS committee continued

All,

I may not have the most critical eye when it comes to evaluating course syllabi, but I think each of these looks good. Prof. Jennifer Hoffman, whose course on Intercollegiate Athletics is represented here, is a personal friend and former colleague at the University of Washington. She will be quite honored to learn that UNA is using her syllabus as a template in our proposed HEA concentration.

\*\*\*\*\*

I have gone through the 13 syllabi. They look good to me, w/a nice variety of sources.

\*\*\*\*\*

I am ok with the proposal.

\*\*\*\*\*

For the Introduction to Higher Administration (first class listed?) I was wondering if this Masters' program would be offered online. I ask to inquire how students would be expected to do a group project (just coming from the prospective of a student!) I do love the consistent concept of Experimental Learning! These syllabi perfectly balanced groupwork and research projects. I was most impressed with HEA 607-the Budget Management course, in both the course objectives and assignments. Lastly, I really enjoyed the idea of instructor-led forums and informational interviews. Over the past coursework I've had, I've retained some of the most information from these teaching methods. I apologize for not responding more promptly! Thank you for all of your hard work!

\*\*\*\*\*

I have 2 comments:

- 1) Consider an alternative name for the degree program that a student and other institutions will not confuse with "Administration" being Deans, VPs and Presidents.
- 2) I think these courses are all offered online? Who is teaching these courses (e.g. if the professors in the syllabi are teaching, what arrangements have been made to do this)?

Thanks, Tina Hubler

---

## Academic service - meeting with Marshall Flight Center

Thanks to Paul for presenting and for each of you for visiting with the folks from Marshall Flight Center. I joined them shortly after I saw you and was impressed with the possibilities. I hope that partnership develops into something beneficial for our students and for UNA. It appears the early opportunity is for some of our students to be placed as interns there. Thanks for your willingness to do the extra things that make a difference. John

*John G. Thornell, Ph.D.*

*Vice President for Academic Affairs and Provost*

*University of North Alabama*

*UNA Box 5041*

*Florence, AL 35632-0001*

*Phone: 256-765-4258*

*Fax: 256-765-4632*

*E-mail: [jthornell@una.edu](mailto:jthornell@una.edu)*

# Academic service - Chair, Academic Affairs subcommittee of Faculty Senate

## University of North Alabama Final Grade Appeals Form

### 1. Background Information:

Name of Student \_\_\_\_\_ Student Number L \_\_\_\_\_  
Phone \_\_\_\_\_ Email \_\_\_\_\_ Major \_\_\_\_\_

### 2. Course or Academic Evaluation: (please check)

Course Grade (provide course number & name) \_\_\_\_\_  
 Comprehensive oral exam  Comprehensive written exam  Thesis defense

Course Term:  Fall  Spring  Summer \_\_\_\_\_ Year \_\_\_\_\_

Course Instructor: \_\_\_\_\_

Grade Received or Academic Action Taken: \_\_\_\_\_

Desired Outcome: \_\_\_\_\_

### 3. Nature of Complaint: (Check the grounds for the appeal that applies to this case)

Arithmetical or clerical error  
 Arbitrary or inequitable evaluation on the part of the instructor.  
 Substantial failure of the instructor to follow course syllabus or other announced grading policy.  
 Other (Briefly state) \_\_\_\_\_

On a separate page or pages, explain your reason(s) for filing this complaint. In particular, describe how the grounds indicated above apply in this case. Attach any documentation that supports your complaint. **Clarity and thoroughness in documentation are important factors in determining whether this complaint will be dismissed or heard by the appropriate administrative unit.**

Number of pages attached: \_\_\_\_\_

Have you attempted to resolve this matter with the instructor?  Yes  No

Was your attempt to resolve this matter with the instructor completed?  Yes  No

Date of informal meeting with instructor: \_\_\_\_\_

Outcome of meeting with instructor (If no meeting took place, explain why): \_\_\_\_\_

Is this appeal to the department chair within the required 6-week time frame?  Yes  No

Grade Appeals Form Received by: \_\_\_\_\_ (Signature: Department Chair) \_\_\_\_\_ (Date)

**A COPY OF THIS SIGNED AND DATED GRADE APPEALS FORM HAS BEEN RETURNED TO ME:**

Student Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Commented [L1]:** If we are going to use a form, we should probably include language to that effect in the grade appeals policy...including where to get it (VPAA website??) and where to deliver it (department chair).

**Commented [L2]:** Do we want to insert the word "Final" in this to cover final grades, or are we going to go through all of this for the grade on a single paper, etc.? Suggest we place it in the form.

**Commented [u3]:** I think it should be used for final grades

**Commented [WU4]:** Obtain from VPAA website, Submit to Dept chair, final housing in VPAA office

**Commented [u5]:** I could go either way on this. It might be helpful to the VPAA committee

**Commented [L6]:** I'm not sure this is relevant, but it might be useful for follow-up information. Some schools include it, others don't. Someone might want to speak with the students advisor???, or maybe that is taboo. Is this useful or not?

**Commented [u7]:** I would love to know how common issues like this come up with masters level work. Will see what Alex says.

**Commented [WU8]:** Include and add "graduate level" oral or comp exam so that it applies to graduate school

**Commented [L9]:** Do we want to include language that also covers grade-like issues in graduate school such as these? USA does this.

**Commented [L10]:** This wording wasn't used at USA but was used at other schools and seemed relevant.

**Commented [u11]:** I think this addition works

**Commented [WU12]:** Include. This might immediately rule out the need for further investigation and will be found in the explanation anyway

**Commented [L13]:** Do we really want to have an "Other" category. Most schools that I checked did not have this. And they give NO other options and state specifically that it can only be appealed on grounds of one of the three listed reasons...can you think of any other reason for a grade appeal that is legit? Anything legal (state law) covering when a student can appeal a grade?

**Commented [L14]:** Not sure what wording we want to use for this "administrative unit"...since it needs clarity for review at each stage. Some word to cover dept chair, dean, committee & VPAA

**Commented [WU15]:** personnel

**Commented [u16]:** Personnel maybe instead of unit?

**Commented [L17]:** We have to decide when the clock starts ticking on this...is it when the student meets with the professor or when they "formally" appeal a grade to the department chair, etc.. If the 6 week frame is to contact the professor, then do we need a deadline for the "formal" appeal. I think this might work better if we start the clock with the formal appeal to the dept chair...at which point they start this form.

**Commented [u18]:** I think the six weeks start with the time the official grade is given to the student. This is not about how quickly we have to act, although if a student is graduating this may have to be expedited.

**Commented [WU19]:** Six weeks from time semester ends which should be the time the grade is available.

# Academic service - Chair, Academic Affairs subcommittee continued

Recommendations from the Academic Affairs committee on the effectiveness of new faculty orientation. These recommendations arise from comments provided to us by new faculty 2012.

General:

- 1) Develop an evaluation form to gather input from new faculty. Ask them to complete it at the beginning of the next semester (e.g. in Jan)
- 2) Establish a dedicated website for Faculty Orientation. This will include all information and must be updated. It could include videos of personnel presenting information .
- 3) Have orientation for 2 days the week before classes start (rather than spread out over several months on Friday afternoons) OR

Have an orientation component on Monday afternoon before classes start for 2-4 hours followed by a dinner with administrators. During this time, chosen topics would be discussed and additional info available on a Faculty Orientation website. Invite a new faculty member from the previous year to speak before the dinner and discuss “what I needed to know” and answer questions.

- 4) Possibly develop a “course” on ANGEL for new faculty to complete that will cover all info not addressed at the orientation.

Specific:

- 1) provide enough ANGEL and Banner training at orientation to allow faculty to start their classes (post syllabi, lessons, set up gradebook, check class rosters)
- 2) campus tour
- 3) discuss tenure and promotion procedures at the university level and ask departments to provide information about dept guidelines
- 4) encourage faculty mentorship

Perceived as not beneficial:

- 1) procedures for billing, purchasing, fax and phone usage

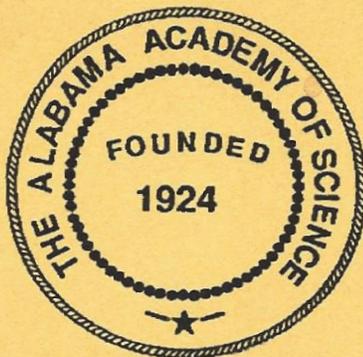
# Academic service - Letters of recommendation for students

Recommendations since Fall 2012

-  angelica gonzalez 2013
-  angelica gonzalez 2014SHEP
-  angelica gonzalez med school 2014
-  Anna Hinson LaGrange 2013
-  avi prasai 2014
-  Brandon Hester Oct 2012
-  brandon landis med school 2014
-  carley andrews 2013
-  Caroline Thomas med sch 2016
-  Caroline Thomas NSC Apr2015
-  Caroline ThomasCollege of Arts and Sciences Excellence Award as a Senior Student2016
-  chase rains uab nov 2012
-  chelsea moon 2013
-  chelsea moon 2015
-  DeAngelo recom 2016
-  Ethel grad school Jan 2013
-  Ethel grad school Oct 2013
-  Jasmine spencer2015
-  Jasmine spencerSept2015
-  john loftis med school 2014
-  joseph grad school Sept2015
-  joseph schaffer grad school May2015
-  lauren baeder med school 2014
-  Mackenzie seal cheerleading 2016
-  Matthew Engelthaler Mar2012
-  rachel herwick 2014
-  rachel herwick 2015
-  rosemely hernandez2014
-  sidney wright dental school 2014
-  vivian2013
-  vivianvet school2014

# Professional service - Judge for Alabama Junior Academy of Science

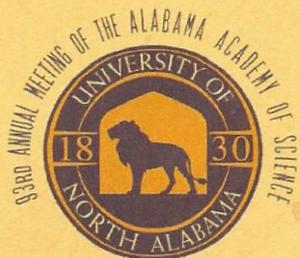
NINETY-THIRD ANNUAL MEETING  
of the  
ALABAMA ACADEMY OF SCIENCE, INC.



Meeting Jointly With

ALABAMA JUNIOR ACADEMY OF SCIENCE  
GORGAS SCHOLARSHIP COMPETITION

February 17-19, 2016  
Science and Engineering Technology Building  
University of North Alabama  
Florence, AL



COLLEGE OF  
ARTS and SCIENCES

[www.alabamaacademyofscience.org](http://www.alabamaacademyofscience.org)

# Professional service - Manuscript reviews

American Biology Teacher

<onbehalf+managingeditor+nabt.org@manuscriptcentral.com>

Dear Dr. Hubler:

Thank you for agreeing to review Manuscript ID ABT-2016-0065 entitled "Modeling Evolution in the Classroom: An Interactive LEGO® Simulation" for American Biology Teacher. Please try your best to complete your review by 20-Aug-2016.

In your review, please answer all questions. On the review page, there is a space for "Comments to Editor" that only the editor will see and a space for "Comments to the Author." Please be sure to put your comments to the author in the appropriate space.

onbehalf+managingeditor+nabt.org@manuscriptcentral.com

on behalf of

managingeditor@nabt.org

28-Mar-2016

Dear Dr. Hubler:

Thank you for agreeing to review Manuscript ID ABT-2016-0025 entitled "Learning about Enzyme Specificity with an Interactive Enzyme Model: Influences on Student Motivation, Mental Effort, and Knowledge" for American Biology Teacher. Please try your best to complete your review by 27-Apr-2016.

In your review, please answer all questions. On the review page, there is a space for "Comments to Editor" that only the editor will see and a space for "Comments to the Author." Please be sure to put your comments to the author in the appropriate space.

onbehalf+ksj002+uark.edu@manuscriptcentral.com

on behalf of

ksj002@uark.edu

18-Jul-2014

Dear Dr. Hubler:

Thank you for reviewing manuscript # ABT-2014-0124 entitled "Grocery store genetics: a PCR based genetics lab that links genotype to phenotype" for the American Biology Teacher.

On behalf of the Editors of the American Biology Teacher, we appreciate the voluntary contribution that each reviewer gives to the Journal. We thank you for your participation in the online review process and hope that we may call upon you again to review future manuscripts.

Sincerely,

Mrs. Kimberly Murie

Associate Editor, American Biology Teacher

[ksj002@uark.edu](mailto:ksj002@uark.edu)

# Professional service - Manuscript reviews

onbehalfof+ABTEditor+nabt.org@manuscriptcentral.com

on behalf of

ABTEditor@nabt.org

23-Apr-2014

Dear Dr. Hubler:

Thank you for reviewing manuscript # ABT-2014-0039 entitled "The Role of Need for Cognition (NFC) in Introductory Biology Students' Acceptance of Anthropogenic Climate Change (ACC) and Evolution" for the American Biology Teacher.

On behalf of the Editors of the American Biology Teacher, we appreciate the voluntary contribution that each reviewer gives to the Journal. We thank you for your participation in the online review process and hope that we may call upon you again to review future manuscripts.

Sincerely,

Dr. William McComas

Associate Editor, American Biology Teacher

ABTEditor@nabt.org

# Professional service - Chair, ASB Diversity committee

Hi, Tina,

Thank you very much. Your report is now in the archives to be viewed by historians 100 years from now.

John Herr

## ASSOCIATION OF SOUTHEASTERN BIOLOGISTS EXECUTIVE COMMITTEE MEETING WEDNESDAY, 02 APRIL 2014 SPARTANBURG, SOUTH CAROLINA COMMITTEE CHAIR REPORT

**Committee Name**     **ASB Diversity Committee**

### **Executive Summary**

Provide a summary (**100 words or less**) of your accomplishments over the past year.

Zack Murrell asked us to brainstorm about suggestions to increase diversity participation at ASB in the upcoming years. He suggested I contact Drs. Mary Smith (North Carolina A&T State University) and Dr. Lisa Kelly (University of North Carolina Pembroke) for input. Dr. Kelly received some suggestions from the UNCP Office for Diversity and Inclusion. We discussed and provided to Zack a list of suggestions.

Dr. Frank Day (Old Dominion University) volunteered to speak at the 2014 ABS Diversity Committee luncheon to provide a brief historical perspective of the committee and share his experiences.

### **Report**

Provide your complete report here if longer than the above summary.

Suggestions:

1. Contact Department of Biology chairs in southeastern institutions
  - a. Encourage participation by offering 2 travel awards to minority students
  - b. Send survey to department chairs:
    - Do they have a TriBeta chapter?
    - Have minority students participated in TriBeta or ASB?
    - Are students aware of TriBeta or ASB?

# Professional service - Chair, ASB Diversity committee

Do students know the benefits of participating?

Are students receiving advertisements of the upcoming TriBeta or ASB meetings?

Do students know about travel grants?

2. The ASB should move away from the term “minority” students. Minority has negative connotations.

3. The biology profession should increase its faculty of color. For example, UNCP only has 5 faculty of color.

4. The ASB should increase diversification in its governance (e.g. officers).

5. Within ASB’s governance, is it possible to have a student position or positions? If so, we should aim for good ethnic student representation. Allowing a qualified student to be part of the decision making process would be an incentive.

6. Create a student of color mentoring program

7. Reach out to students via listservs.

## **Dr. Day’s agreement to speak (03/17/14)**

Zack and Tina,

I would be glad to give a brief historical perspective (the origins only as I have not followed the progress of the committee since early on). No PowerPoint; I'll just talk. I could also relate my diversity experiences with SWS and the newly established LTER Diversity Committee, of which I am a member. Perhaps some of these experiences can suggest new initiatives for ASB.

Frank

Frank P. Day, Ph.D.

Professor and Eminent Scholar

Department of Biological Sciences

Old Dominion University

Norfolk, VA 23529

757-683-4198

fday@odu.edu

**Respectfully Submitted,**

**Committee Chair’s Name Dr. Tina Hubler (University of North Alabama)**

**Date 03/27/14**

Community service - LLR





**Loss of  
wisdom teeth ?**

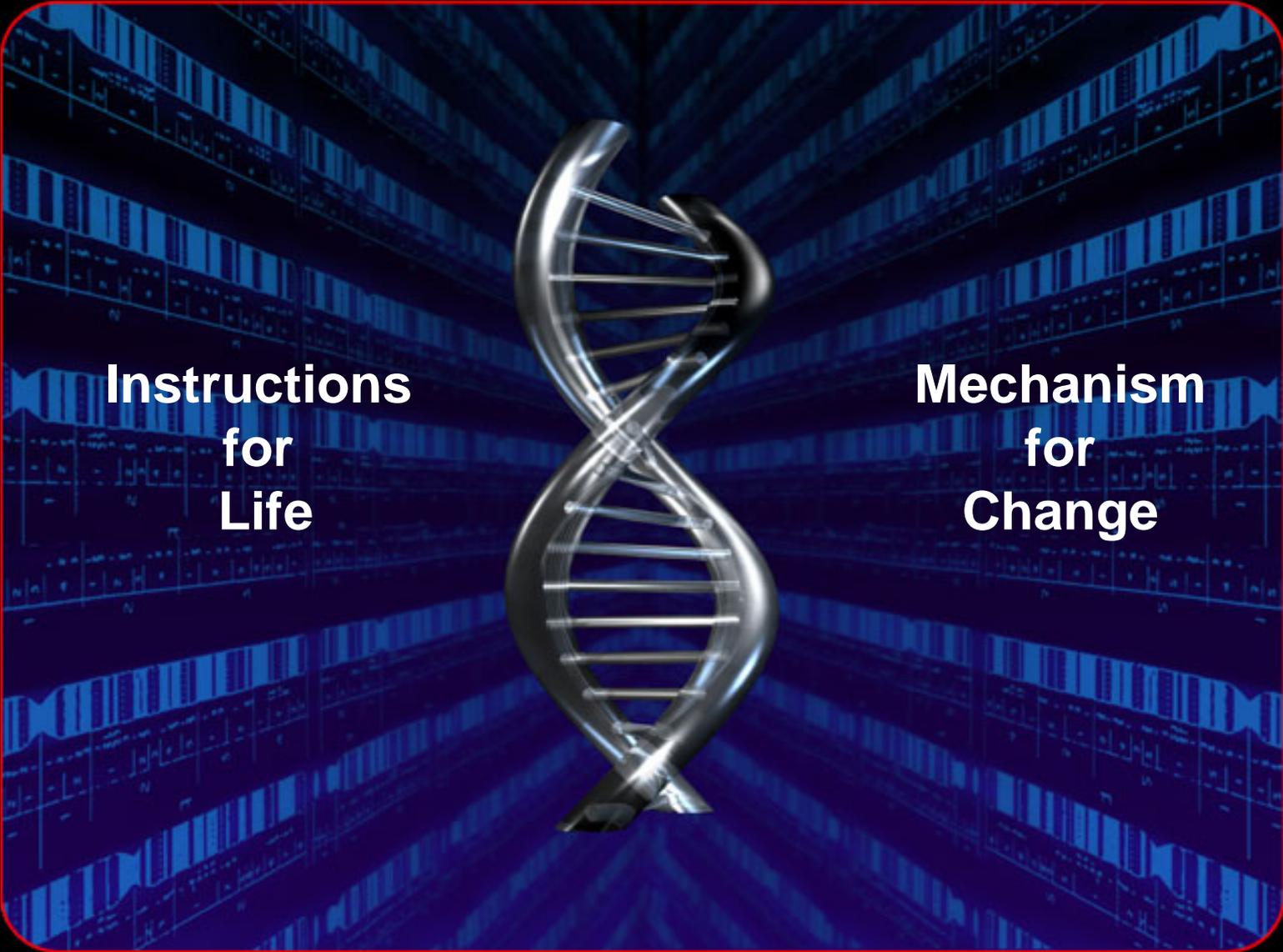
**Cure for  
cancer ?**

**We only know that change occurs**

# Change is What the Future Holds: a Genetics Perspective

Tina Hubler Ph.D.

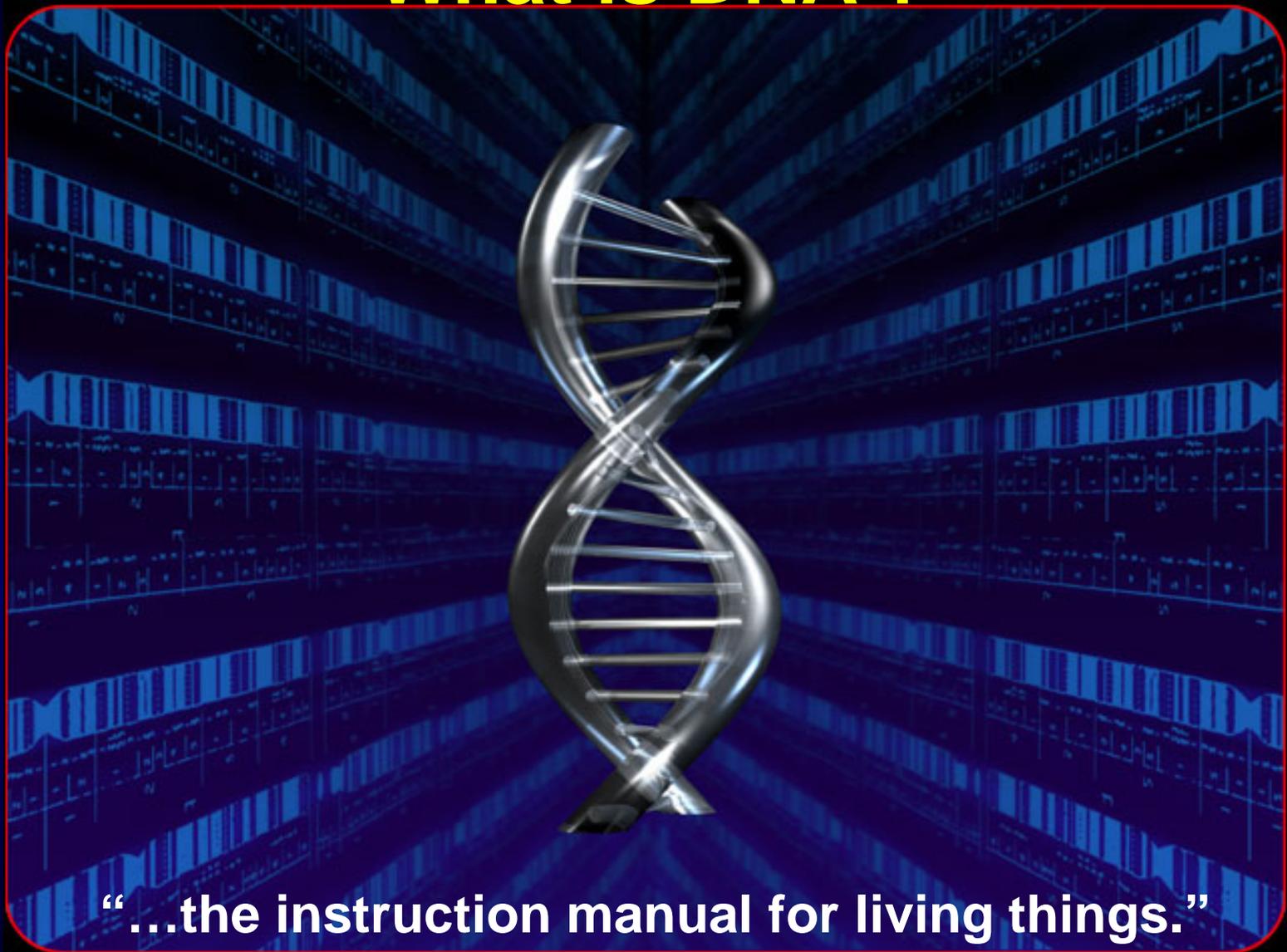
# DNA



**Instructions  
for  
Life**

**Mechanism  
for  
Change**

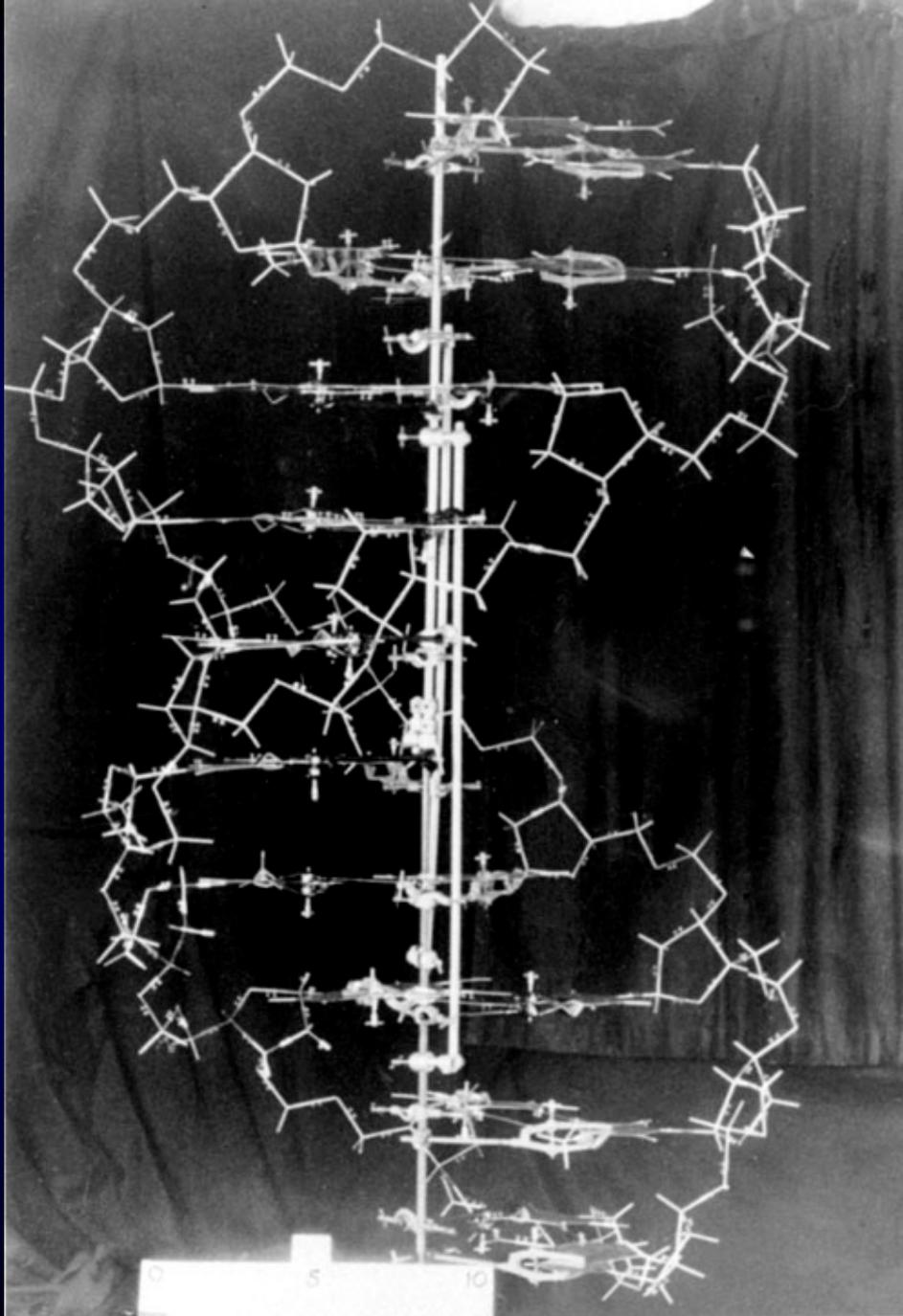
# What is DNA ?



**“...the instruction manual for living things.”**

Francis Collins, director of Human Genome Project at NIH

# Revolutionary



Original DNA demonstration model (scale gives distance in Angstroms)

Cold Spring Harbor Laboratory Archives



Watson and Crick walk along the Backs

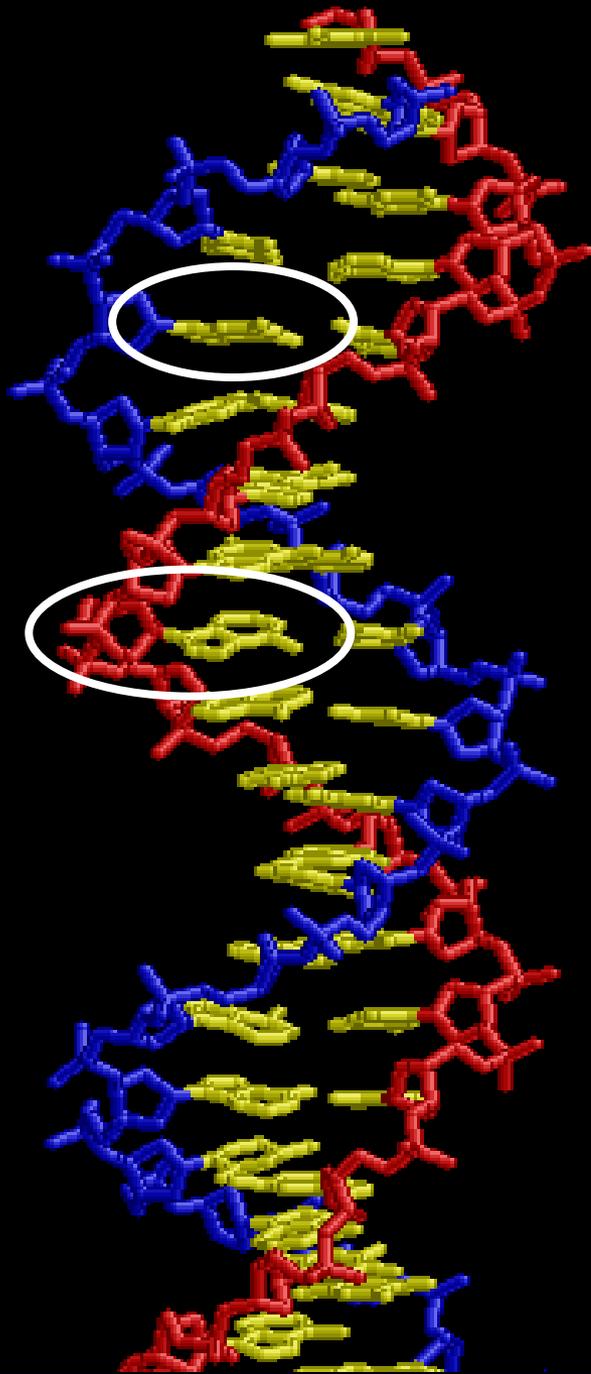
Cold Spring Harbor Laboratory Archives

**The original DNA model  
designed by Watson and Crick  
1953**

**HHMI**

# DNA

A	---	T
C	---	G
G	---	C
T	---	A
A	---	T
C	---	G
C	---	G



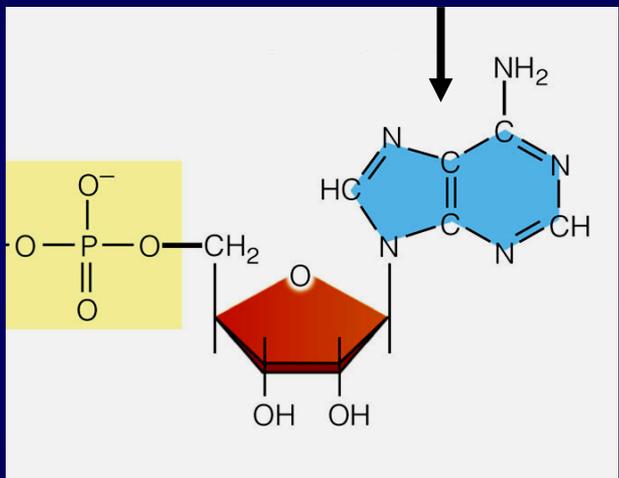
2 helices =  
“backbone”

Interior =  
“instructions”

Building blocks

# The DNA “building block”

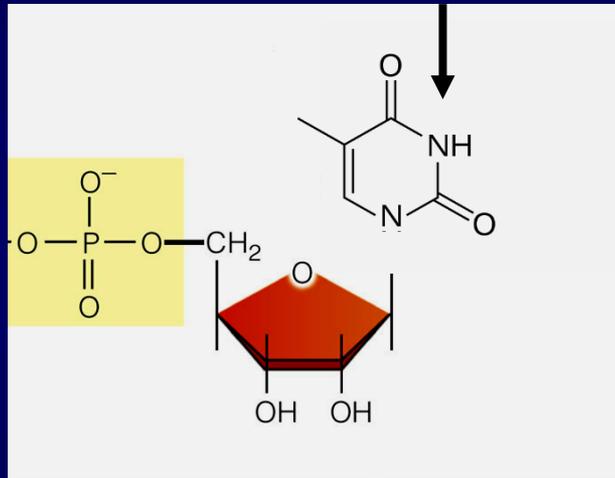
**A, C, G or T**



**Backbone**

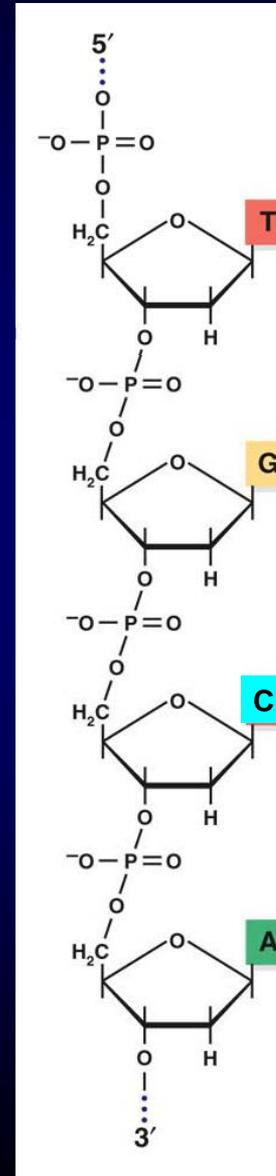
# The DNA "building block"

**A, C, G or T**



**Backbone**

# Synthesis of one "strand"



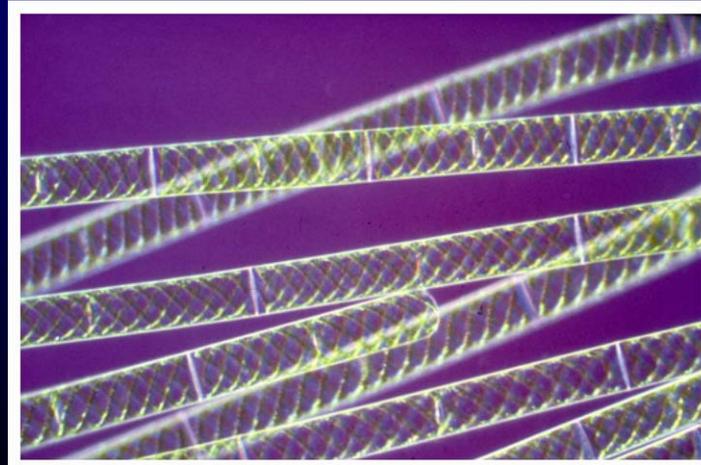
**instructions**

# Why is DNA important ?

DNA instructs the CELLS  
of  
living organisms

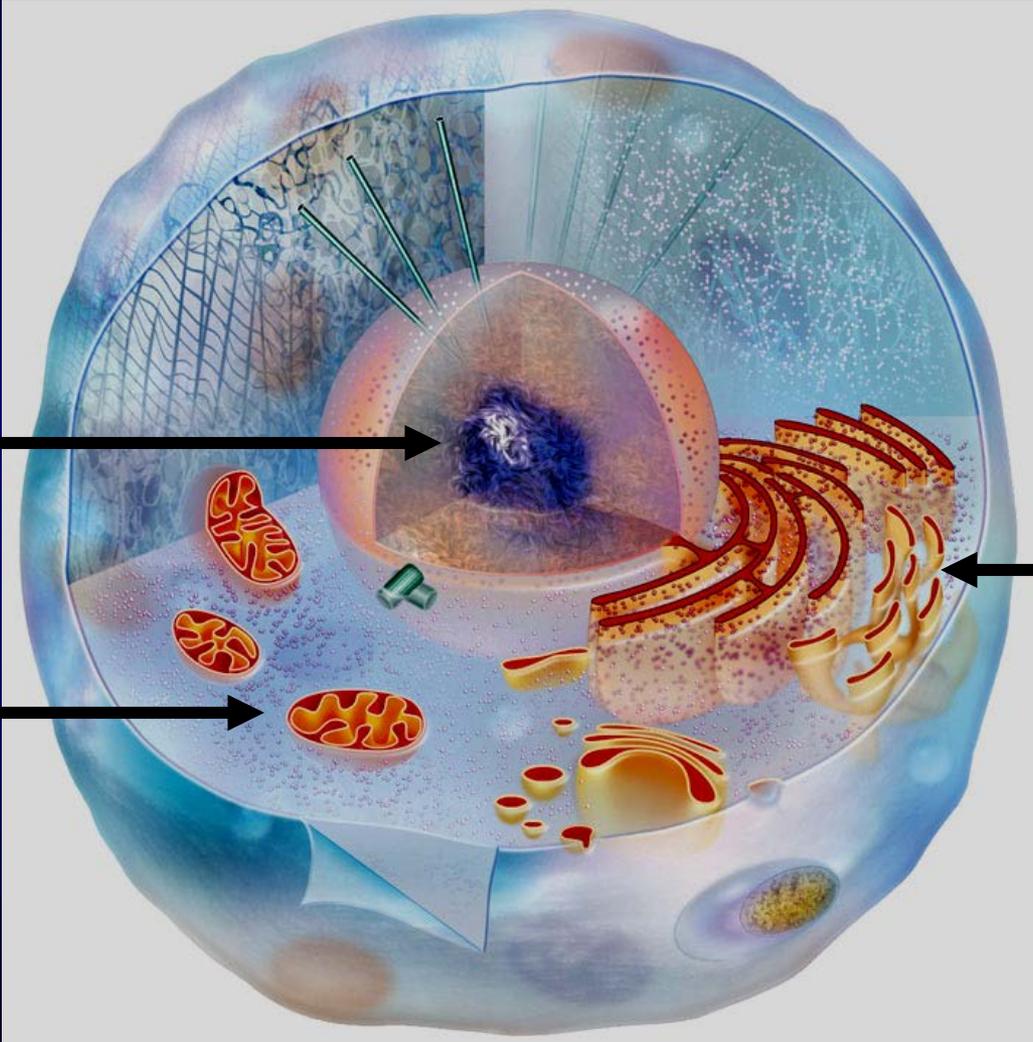
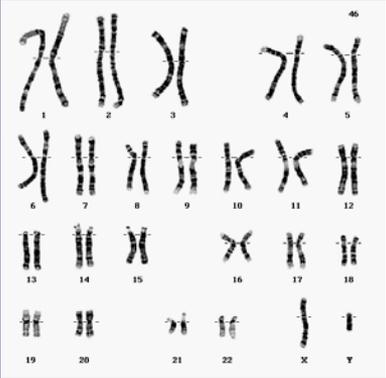
# Cell Theory

All living things are composed of cells

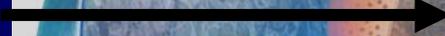


# Cells Perform Work

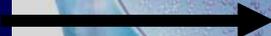
Human DNA



DNA



ATP

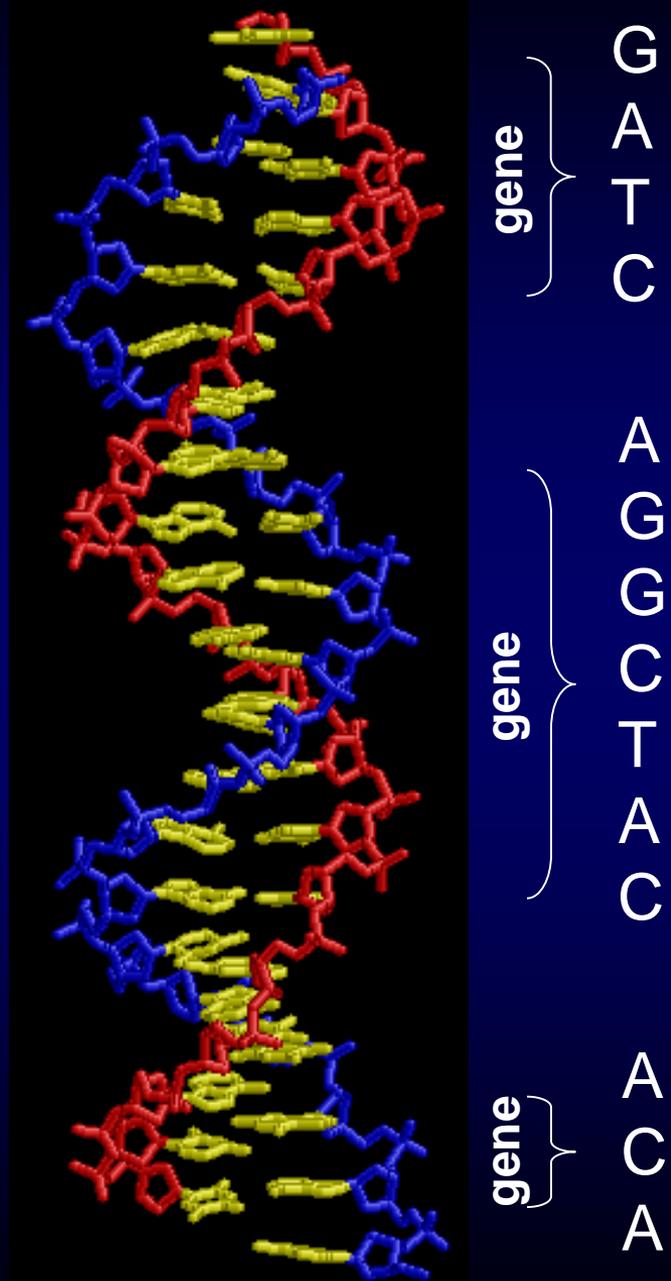
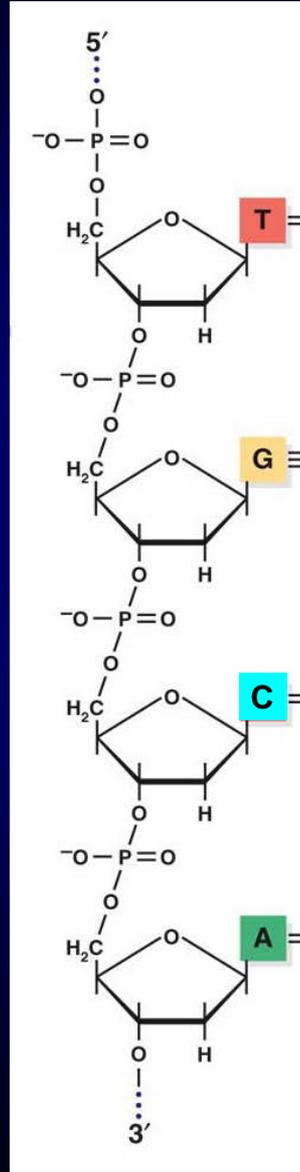


Proteins  
(enzymes)

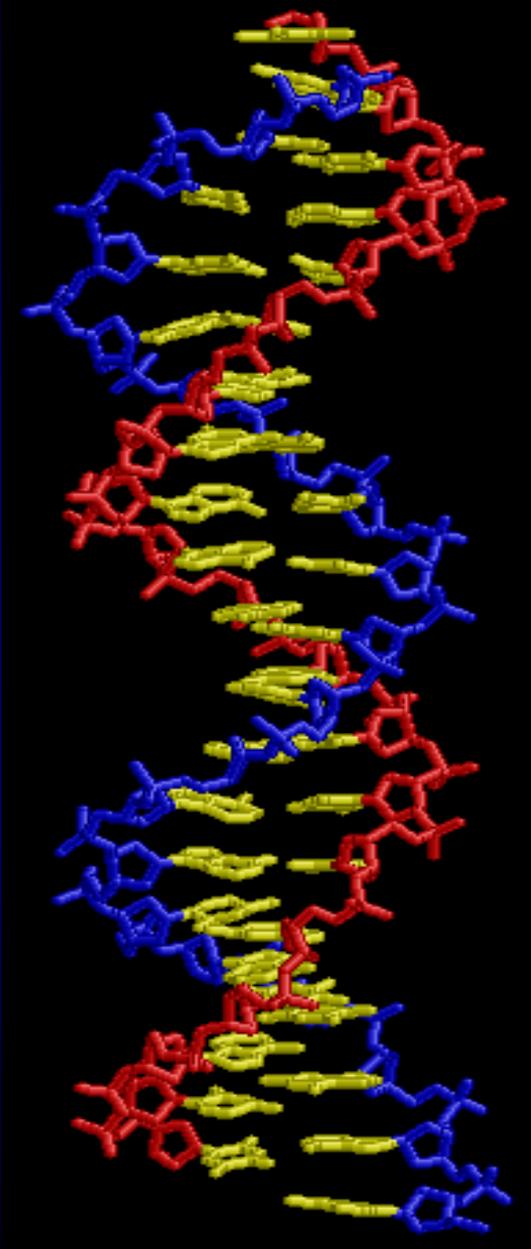


DNA  
contains  
instructions  
to make  
proteins :

The Order  
of  
A, T, C, G



# How DNA instructs cells



gene

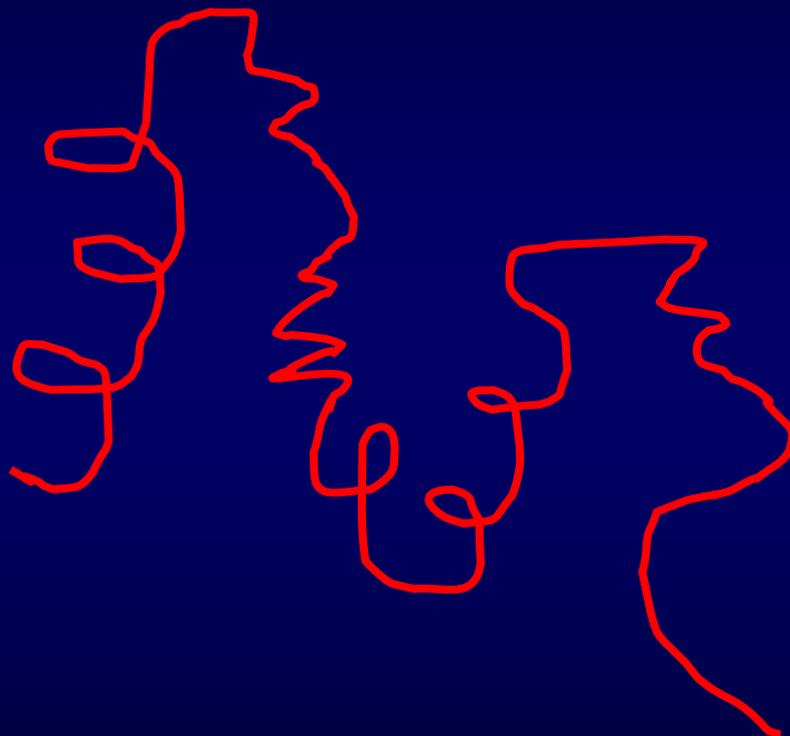
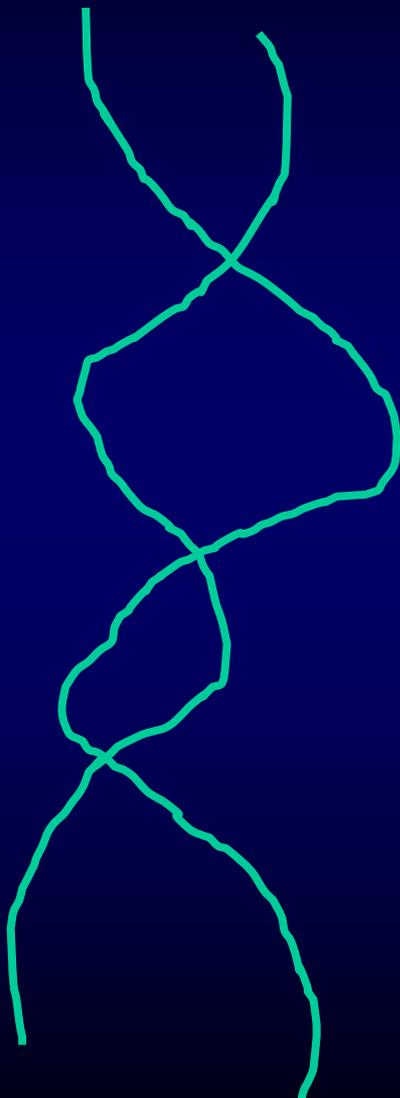


<u>Cell</u>	<u>Protein</u>	<u>Function</u>
stomach	H <sup>+</sup> pump	digestion
RBC	hemoglobin	oxygen
muscle	myosin	contraction

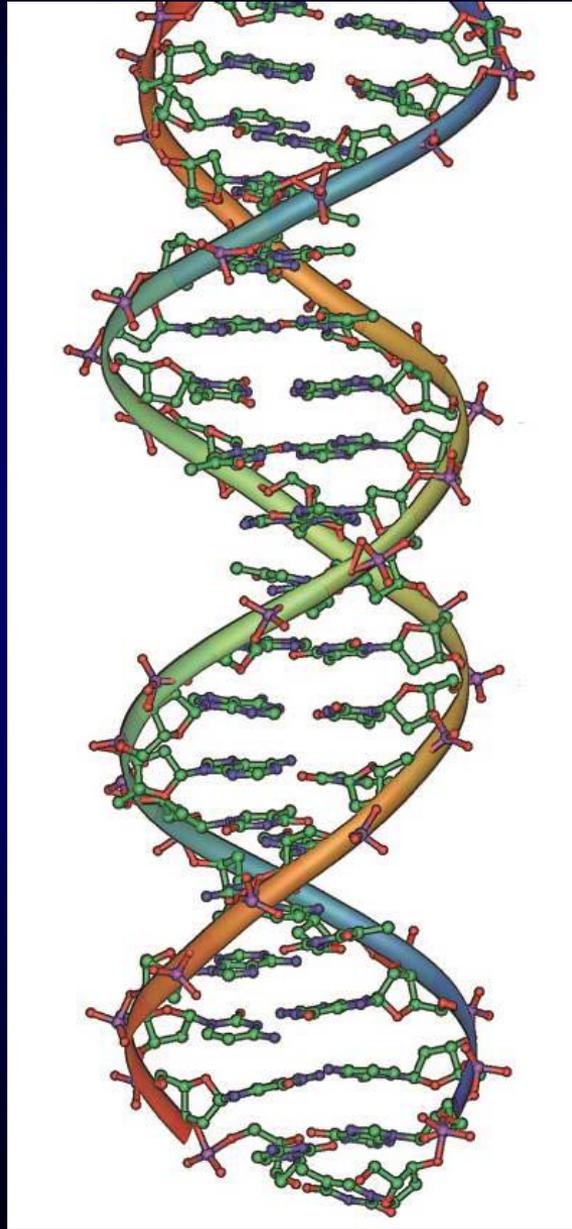
**DNA**

**vs**

**protein**

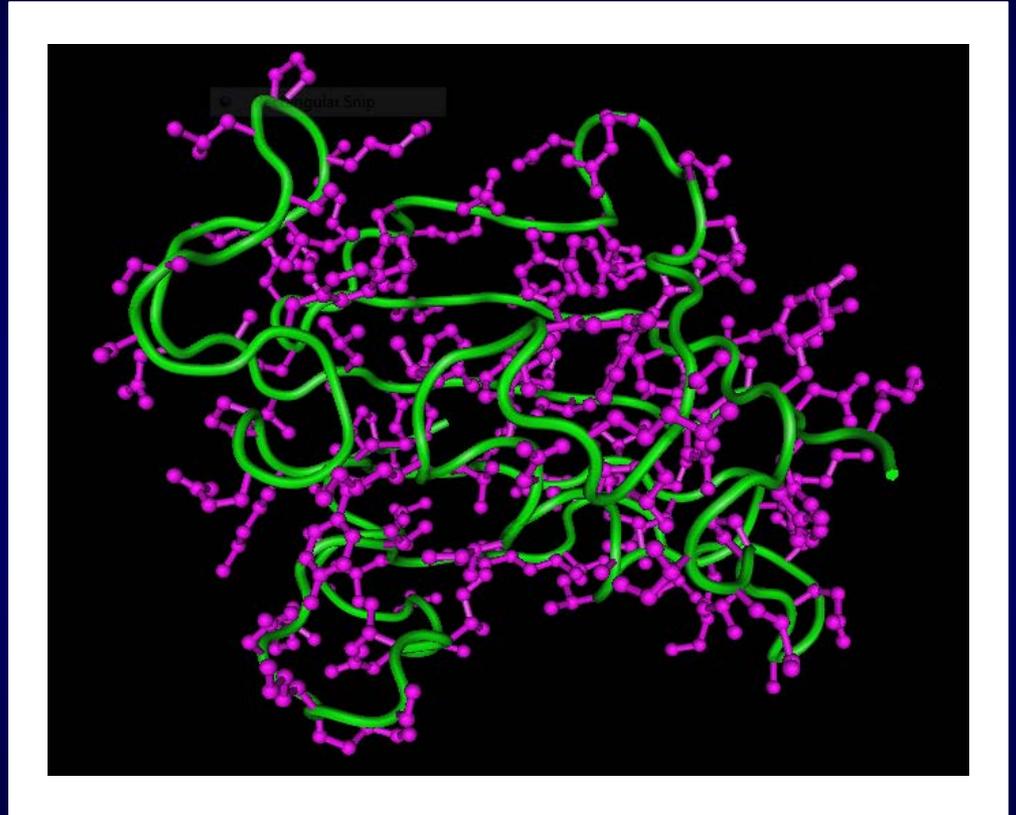


# DNA

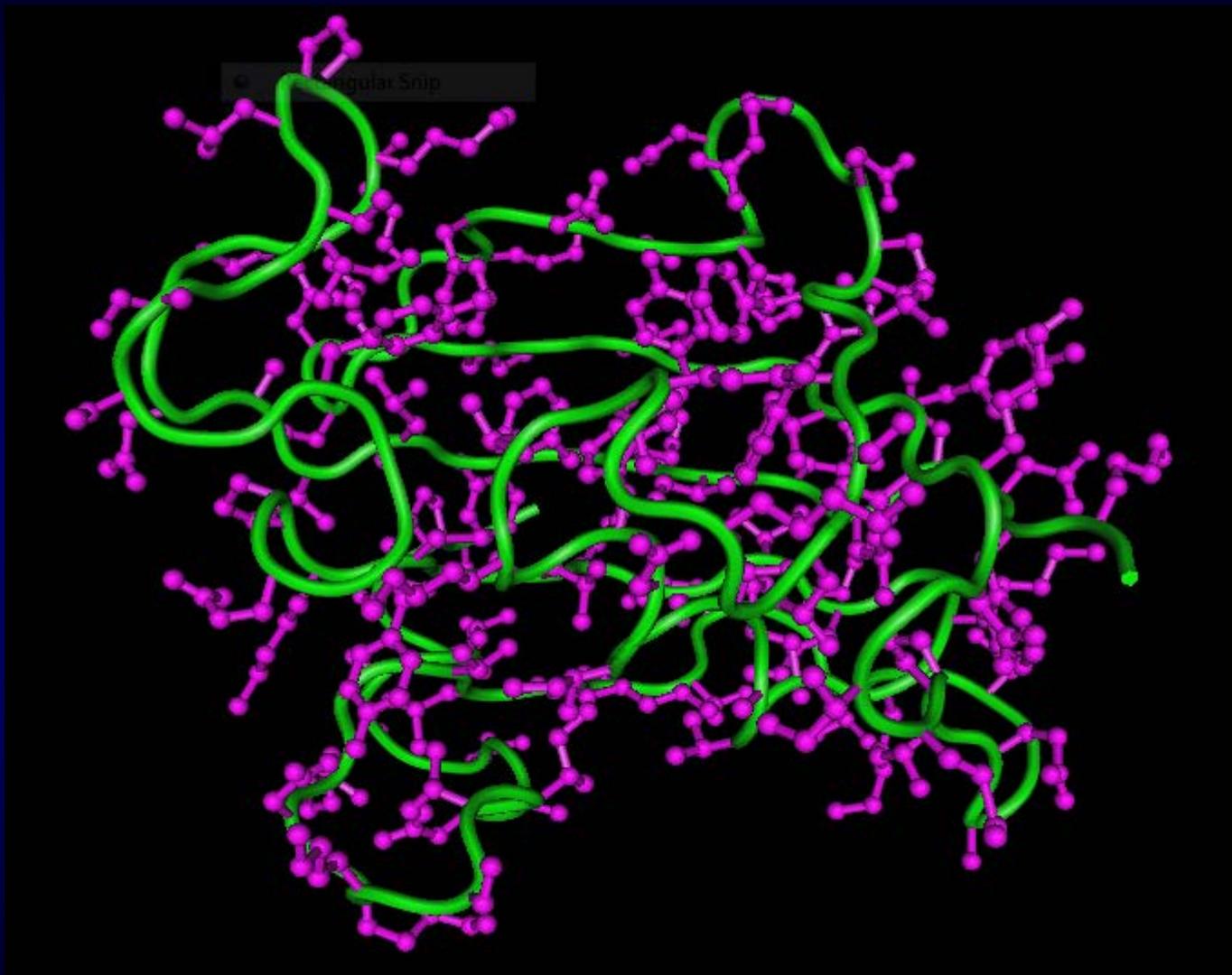


vs

# protein



# Cn3D



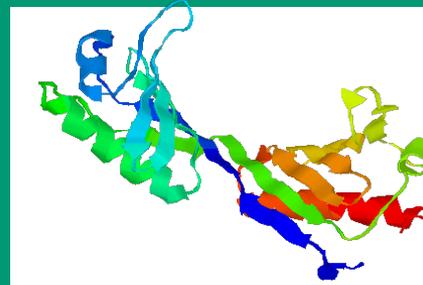
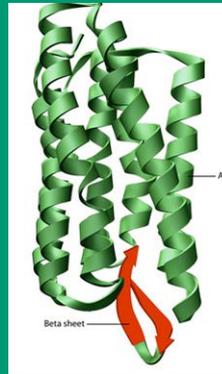
<http://www.ncbi.nlm.nih.gov/Structure/mmdbsrv.cgi?uid=3673>

<http://www.ncbi.nlm.nih.gov/Structure/mmdbsrv.cgi?uid=90961>

# DNA = information to make protein



nucleus



cytoplasm

Community service

# Human DNA has been “sequenced”

The order of A, T, C, Gs  
is known

20 sequencing centers  
in 6 countries

1000 bases per second

24 hrs a day

7 days a week

10 years

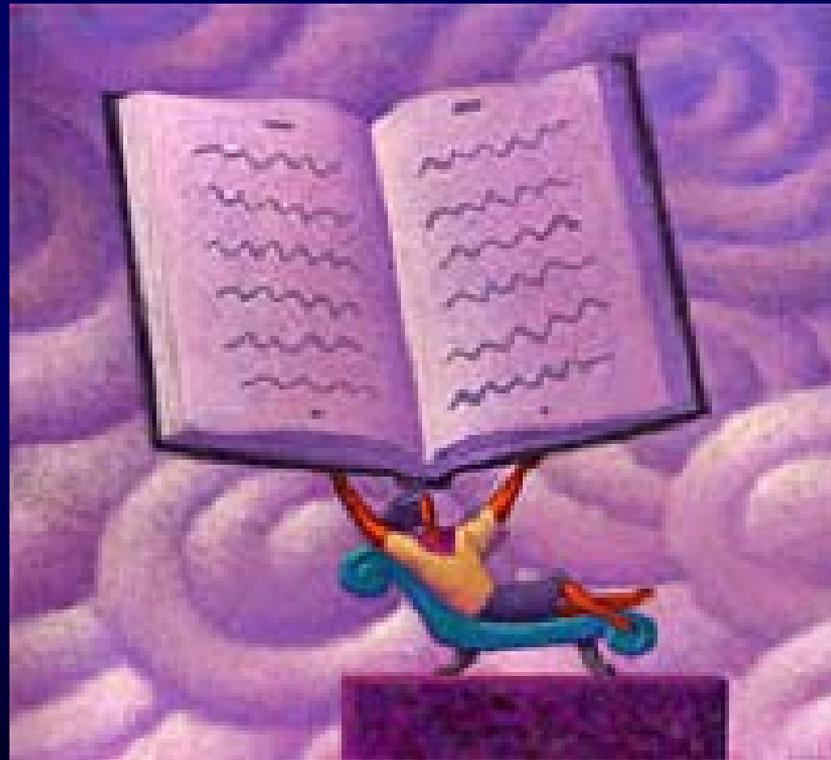


Francis Collins at National Center  
for Human Genome Research 1992

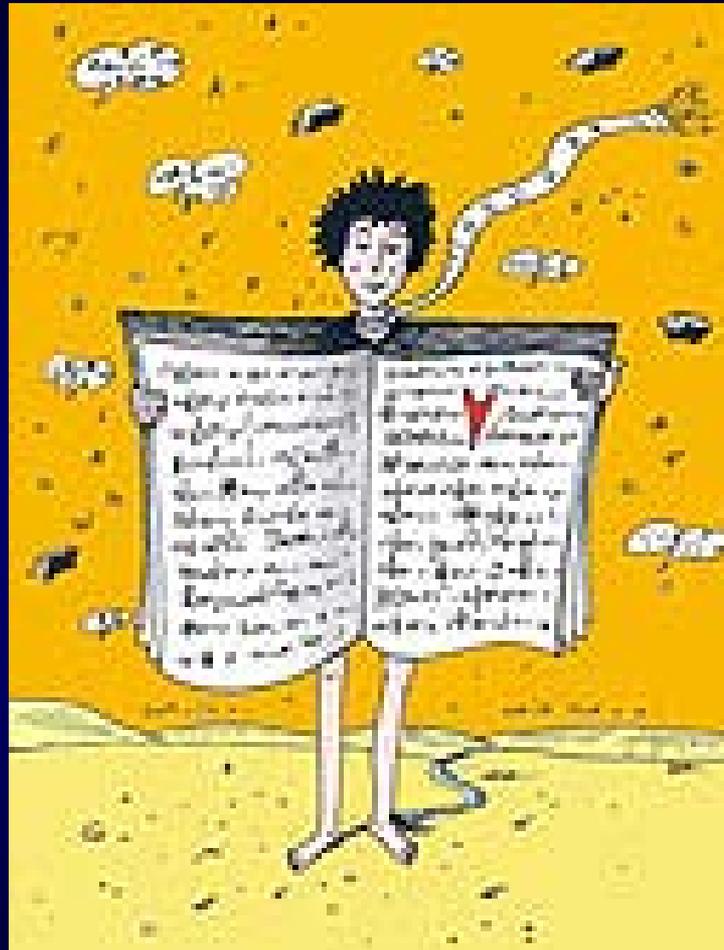
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## Community service

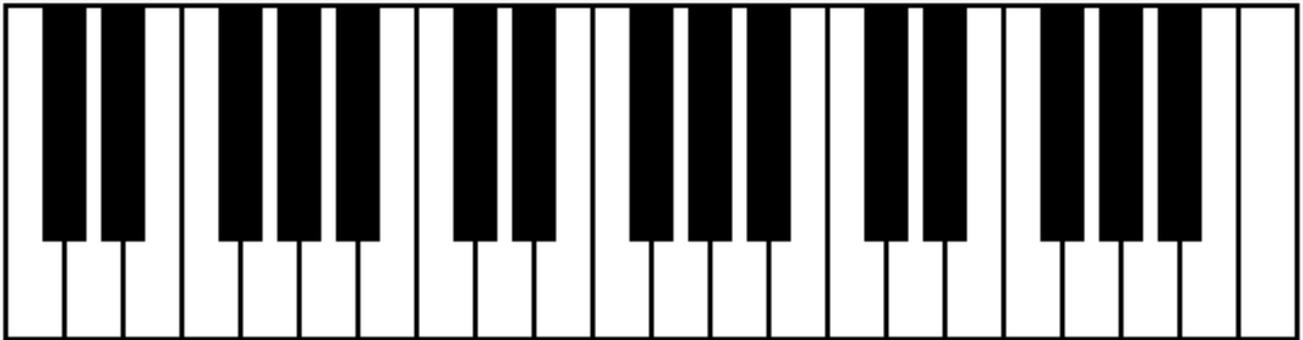
“~ 3.5 billion letters in the human genome. If it were a book and you could read 10 letters every second, it would take 10 years to recite.” Craig Venter



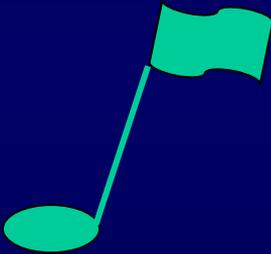
# We are more than a book of genes



# Community service



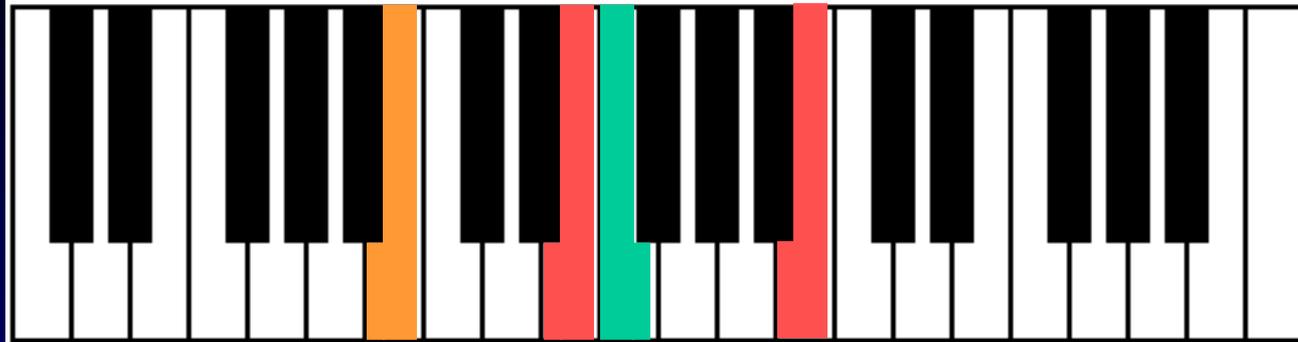
insulin



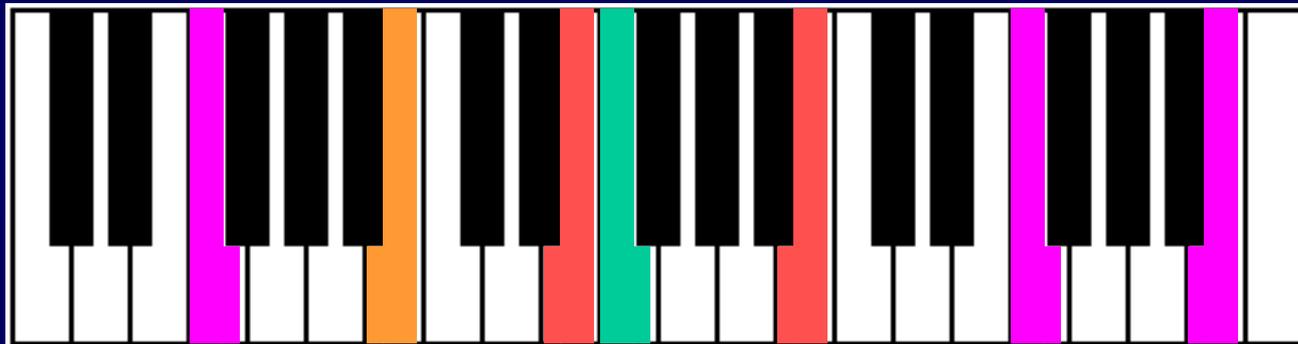
transporter



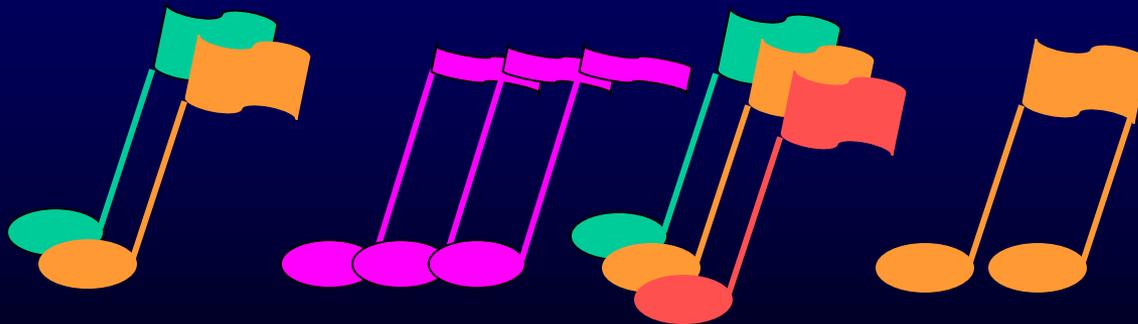
# Community service



hemoglobin

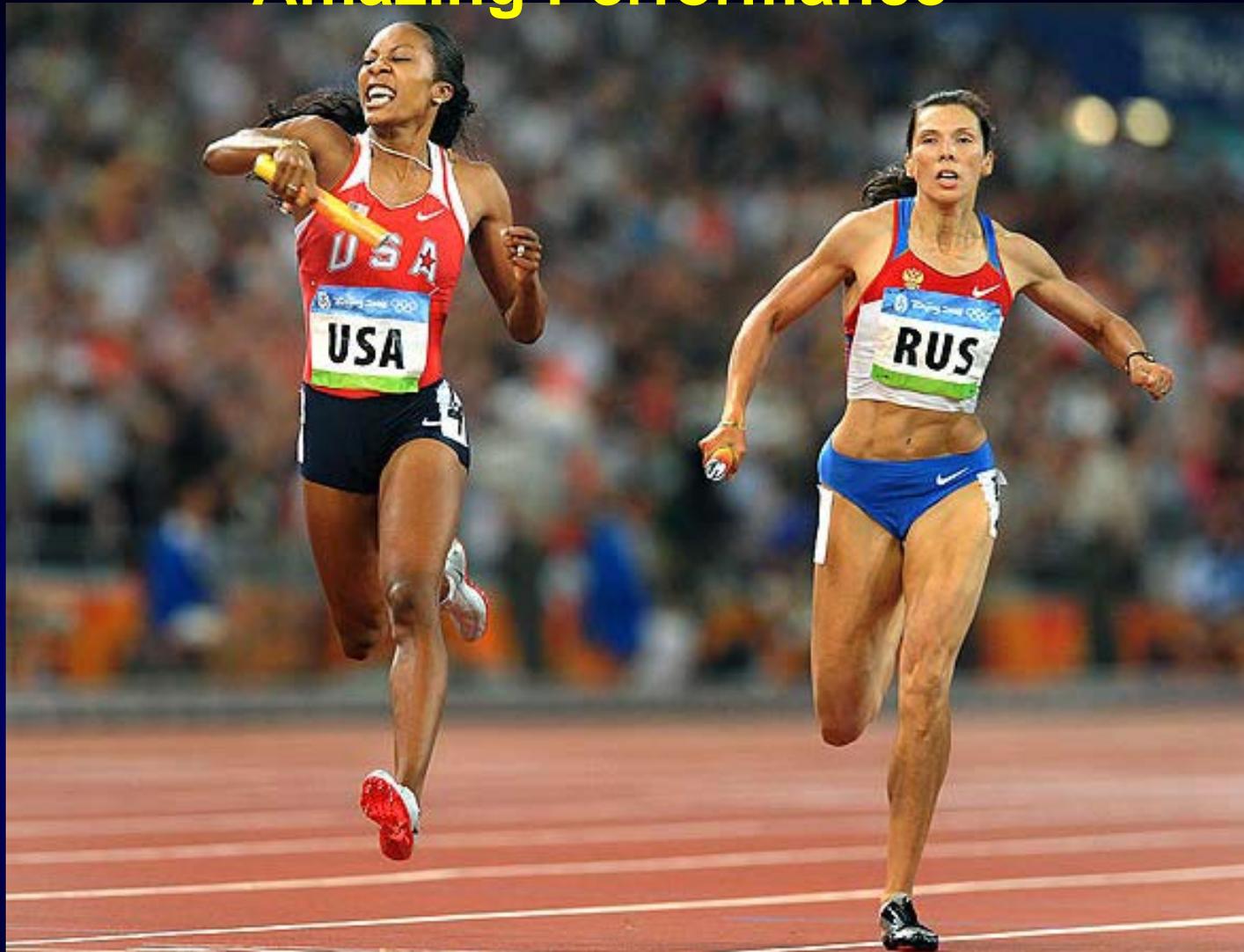


muscle proteins



Community service

## Amazing Performance



<https://www.youtube.com/watch?v=iZE-zMsWDtE>

Sanya Richards (U.S.) passes Russia's Kapachinskaya in the final meters to help her team win the women's 4 X 400 relay **GOLD**.

August 23, 2008

Community service

# Amazing Performance

[www.flowerpictures.net](http://www.flowerpictures.net)



# DNA

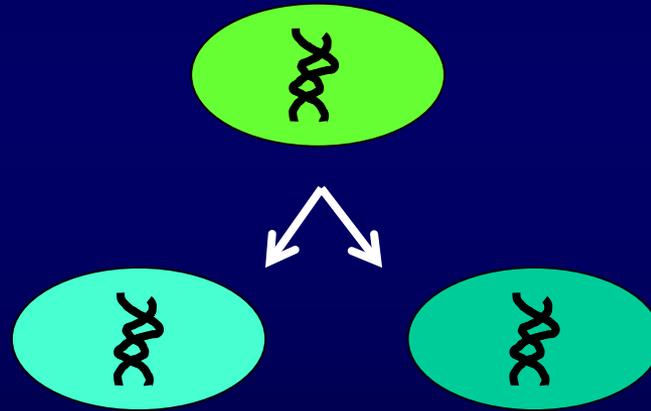
**Instructions  
for  
Life**



**Mechanism  
for  
Change**

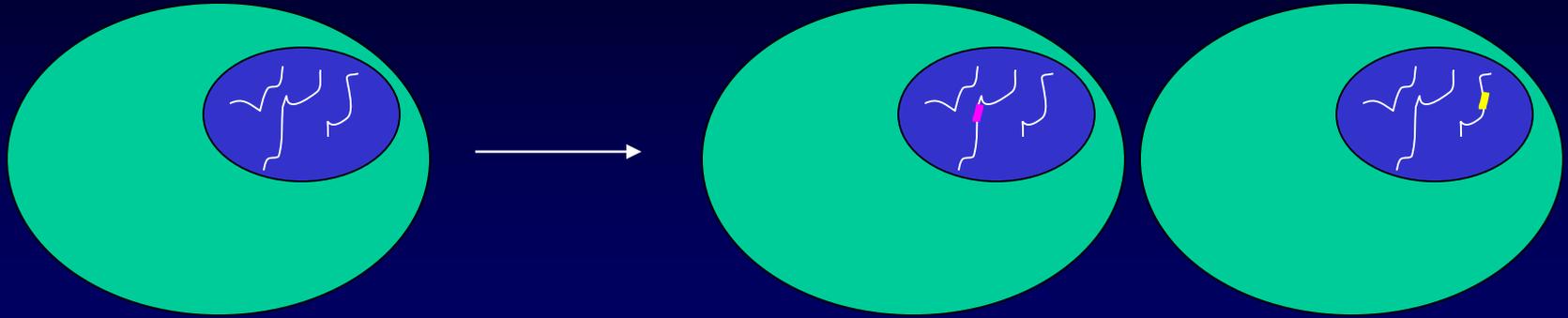
# DNA Replication

Copying is necessary



Mistakes happen

# How DNA changes



DNA  
copied

Mistakes =  
**Mutations**

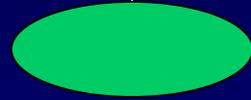
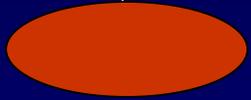
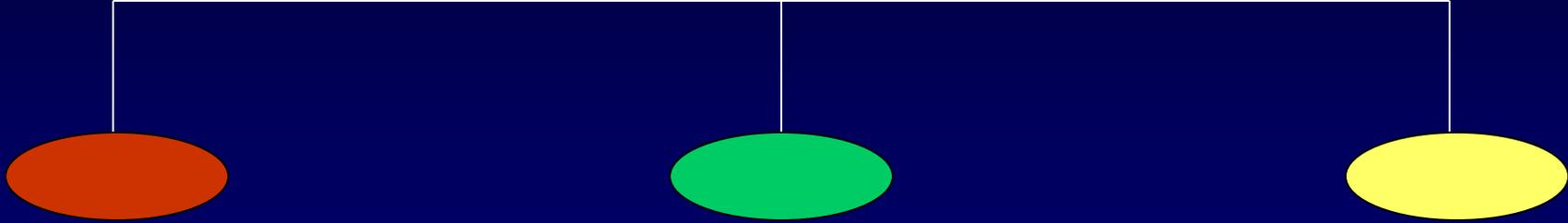
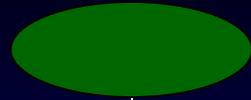
Rate of mutation

slow  
random  
continuous  
inherited

→ **variation**

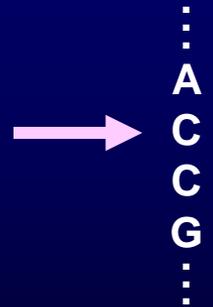
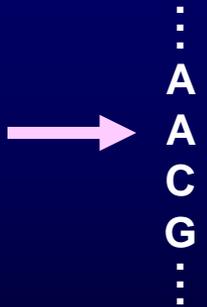
Community service

Single-celled organism



Harmful  
mutation

Beneficial  
mutation

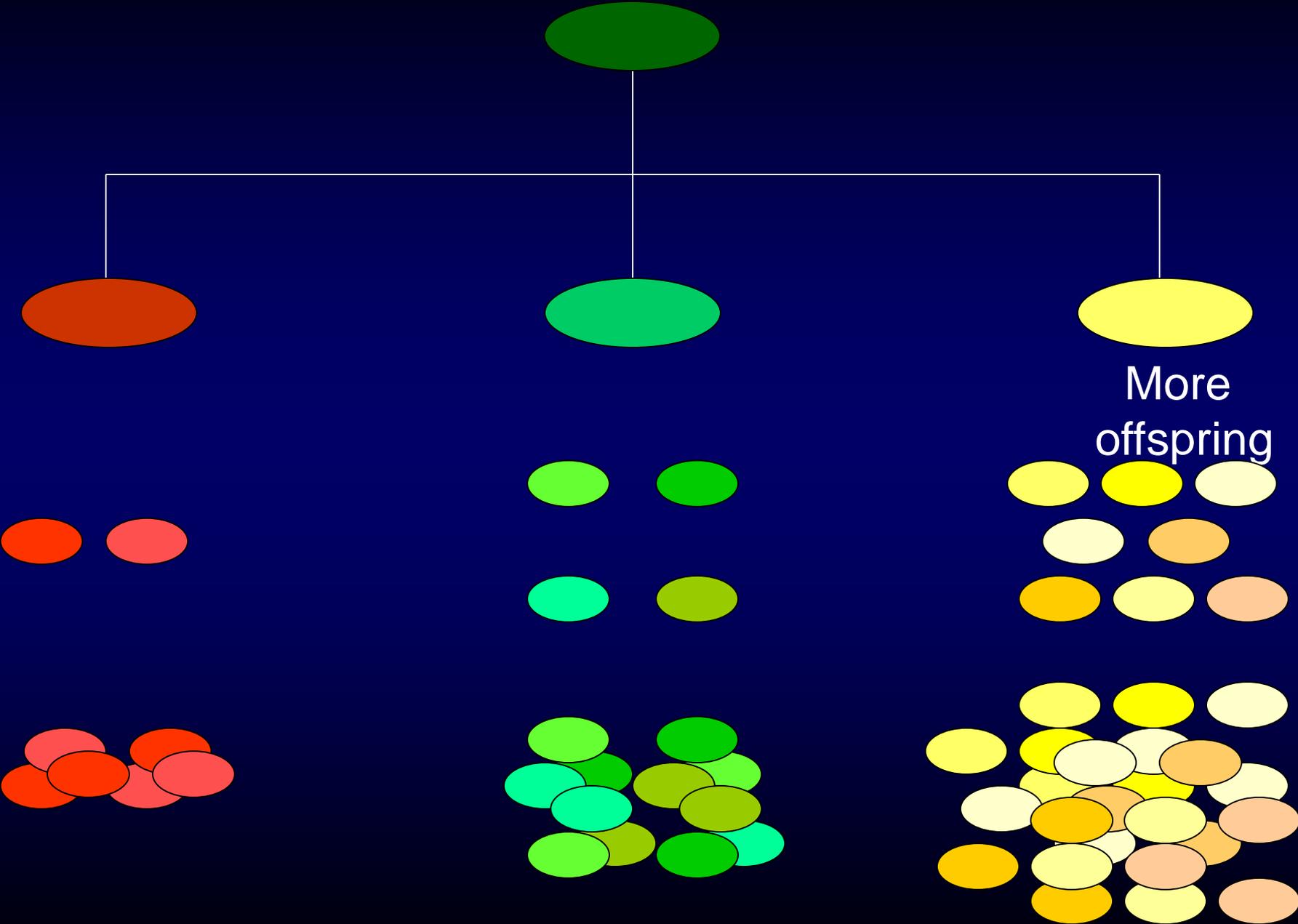


“shorter  
life span”

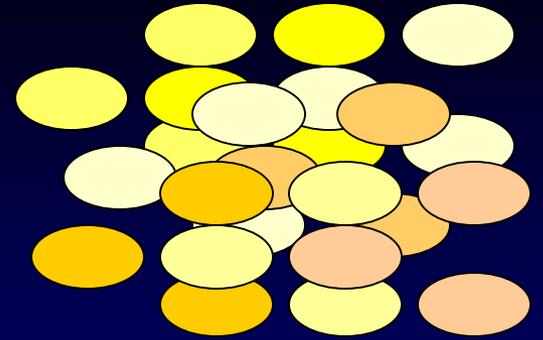
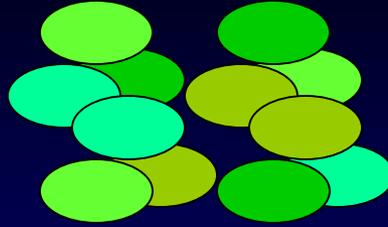
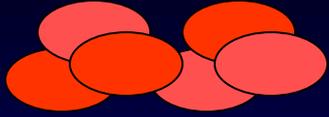
“normal  
life span”

“longer  
life span”

# Community service



**Community service**

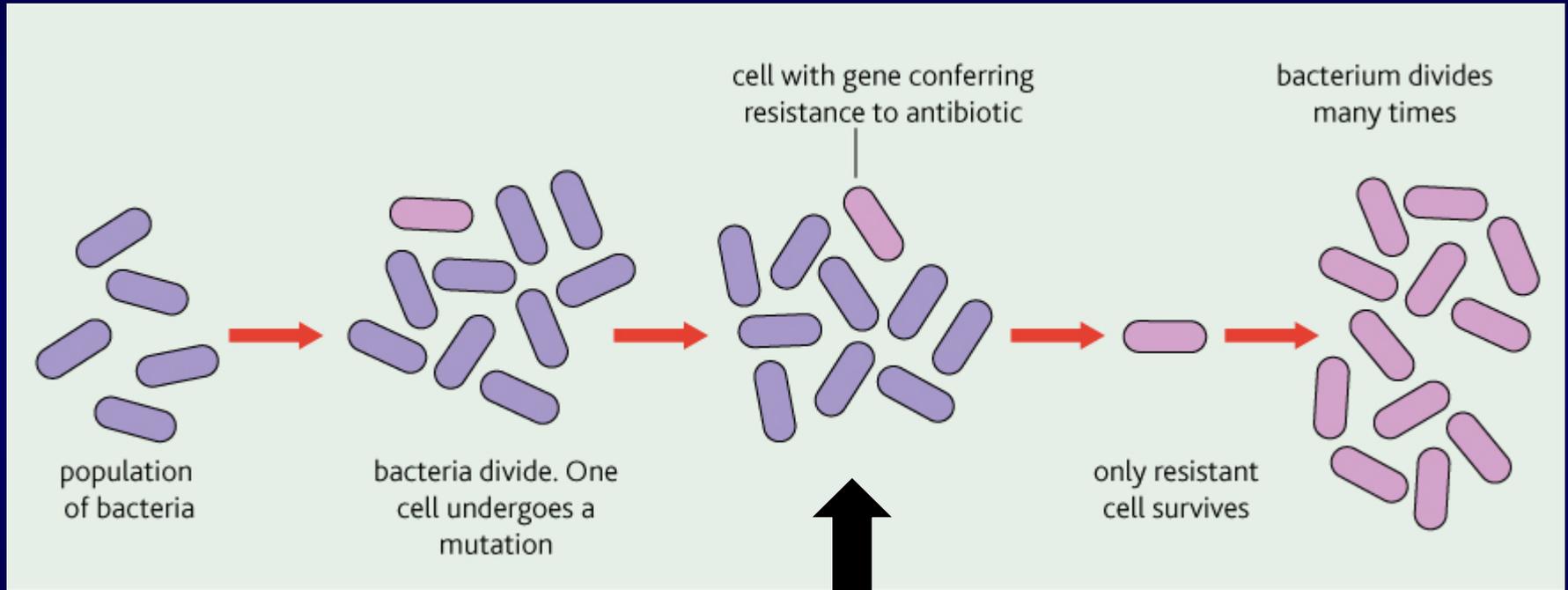


**After several generations**

**After many generations**



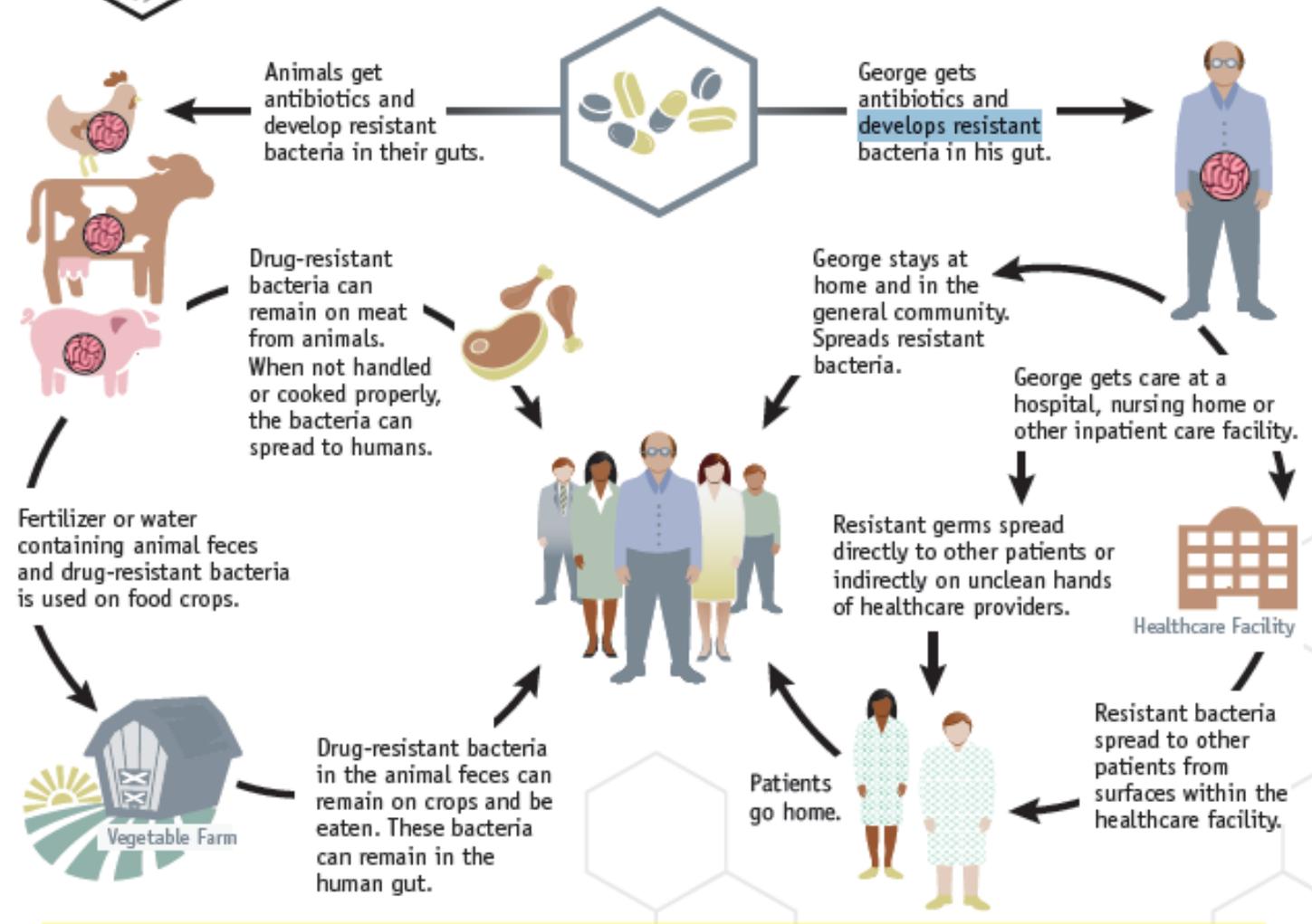
# Antibiotic Resistance



Antibiotics  
used to treat  
infection



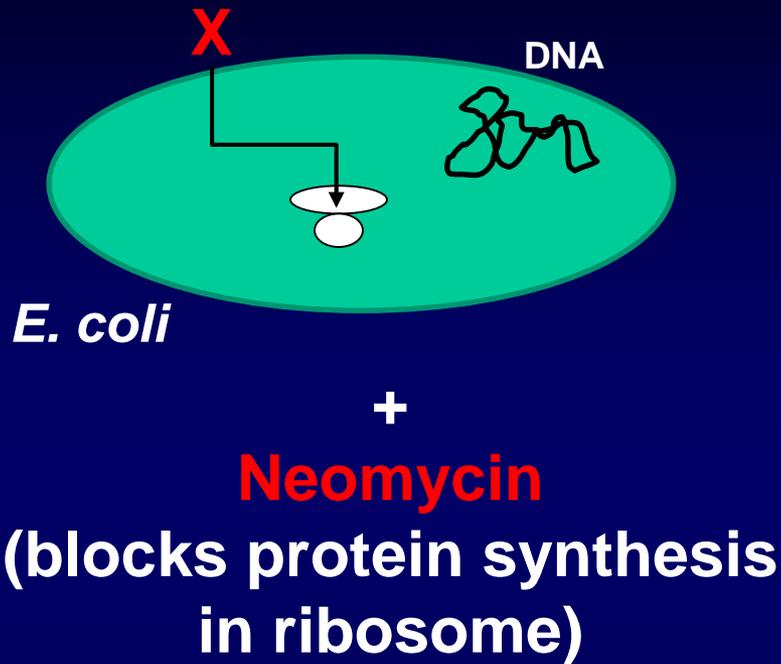
# Examples of How Antibiotic Resistance Spreads



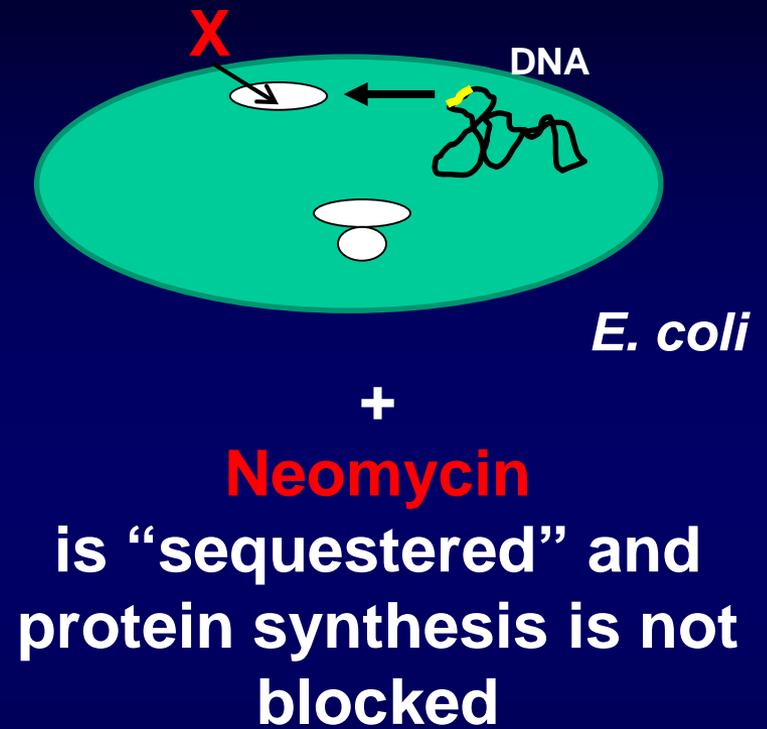
Simply using antibiotics creates resistance. These drugs should only be used to treat infections.

In U.S. ~ 2M illnesses ; ~23K deaths  
<http://www.cdc.gov/drugresistance/threat-report-2013>

# Antibiotic resistance conferred by a DNA gene



RIP



# Can We Correct Disease-causing Mutations ?

## Gene Therapy

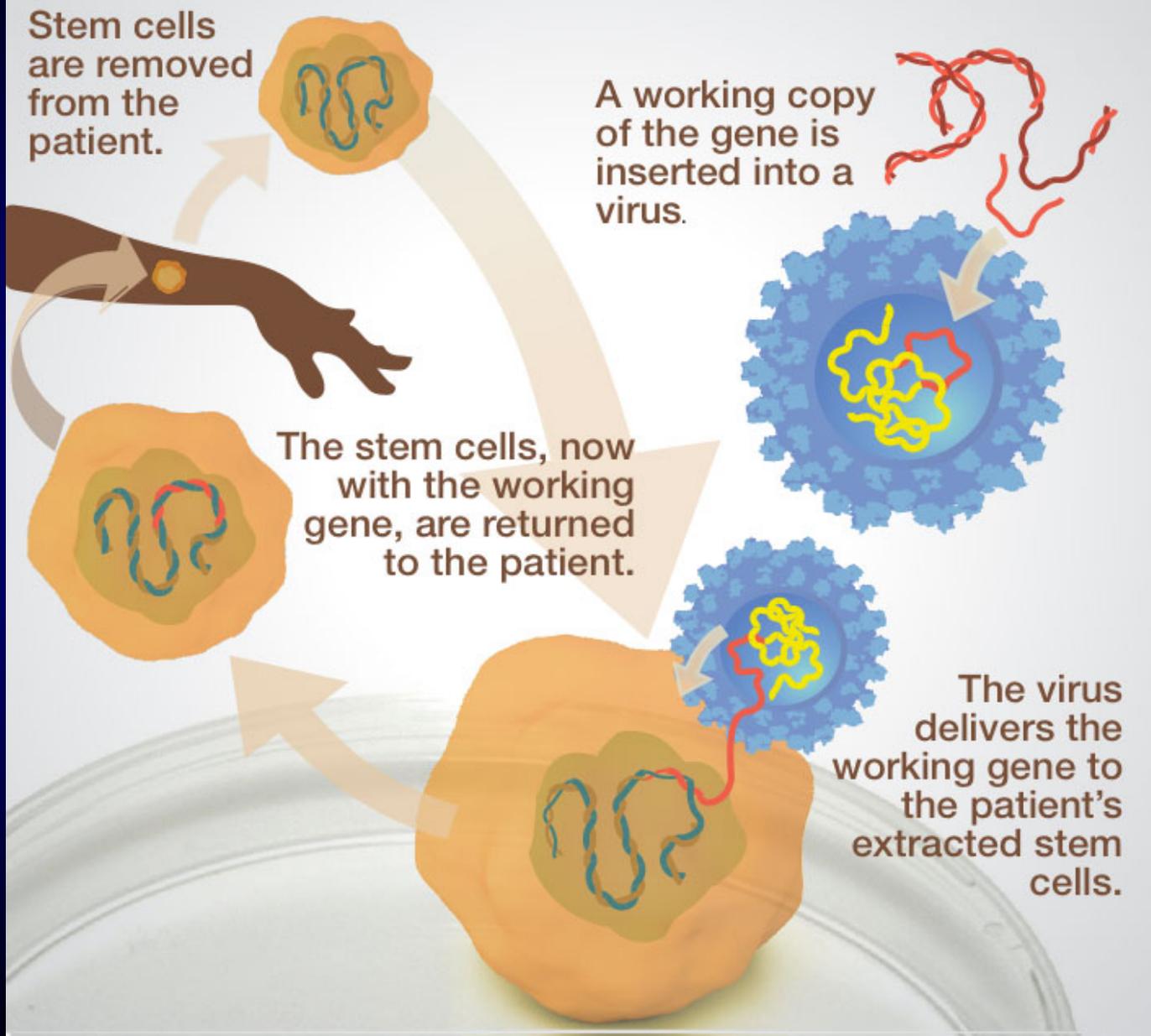
“A promise not yet realized”  
but research continues....  
e.g. RNAi

<http://www.mayoclinic.org/tests-procedures/gene-therapy/basics/definition/PRC-20014778>

<http://learn.genetics.utah.edu/content/genetherapy/gtsuccess/>

Bone marrow

# Immune Deficiency Gene Therapy



# Types of genetic testing

## Newborns

Detecting phenylketonuria



## Diagnostic, affecting treatment

Detecting estrogen receptors in breast cancer

## Carrier

Sickle cell anemia, cystic fibrosis

## Prenatal

Chromosome damage

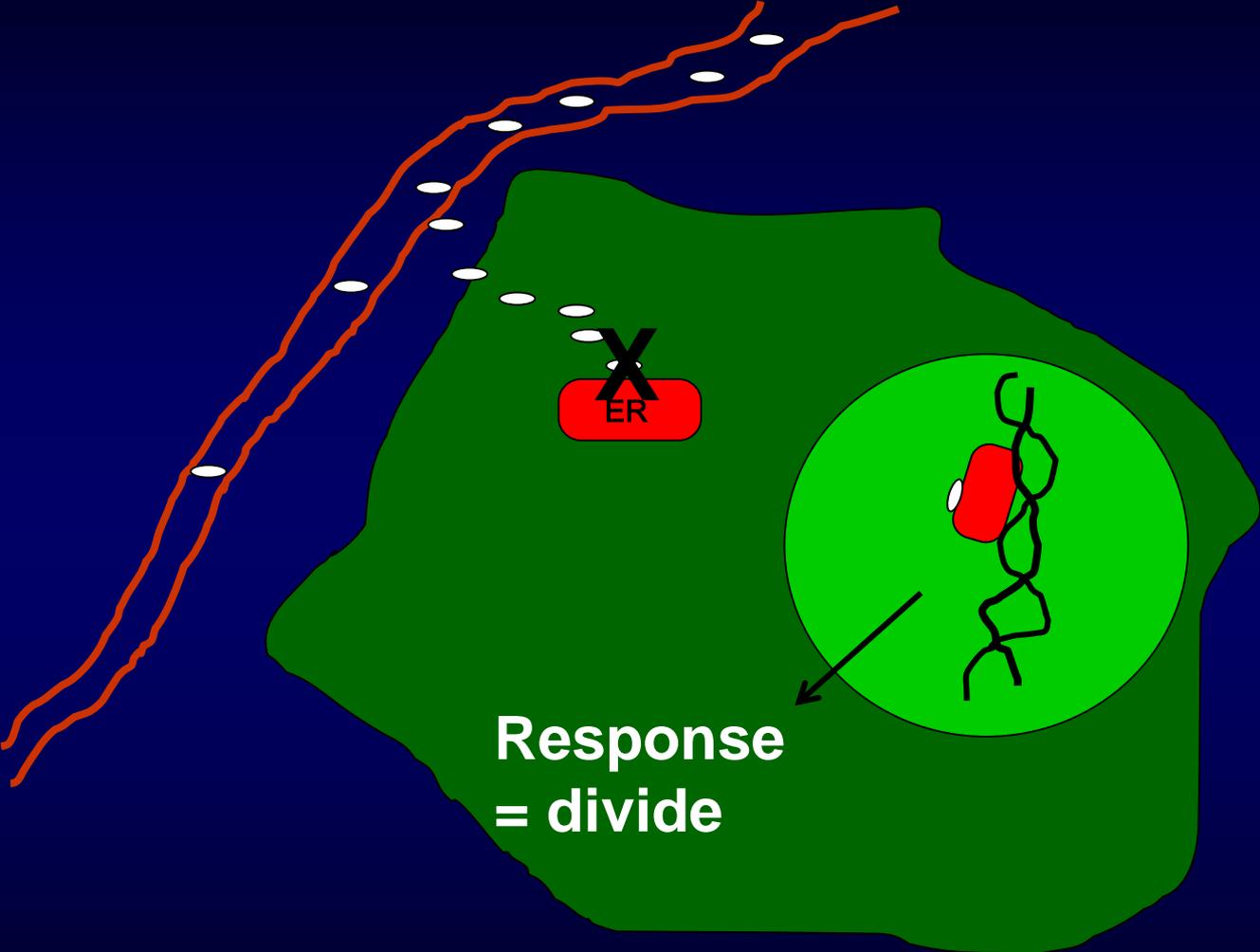
## Predictive

Predisposed to colon cancer, breast cancer

## Forensic

Fingerprinting

# Estrogen Receptors



# Current Pharmaceutical strategy: Target Proteins

Estrogen receptor blockers – Cancer

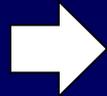
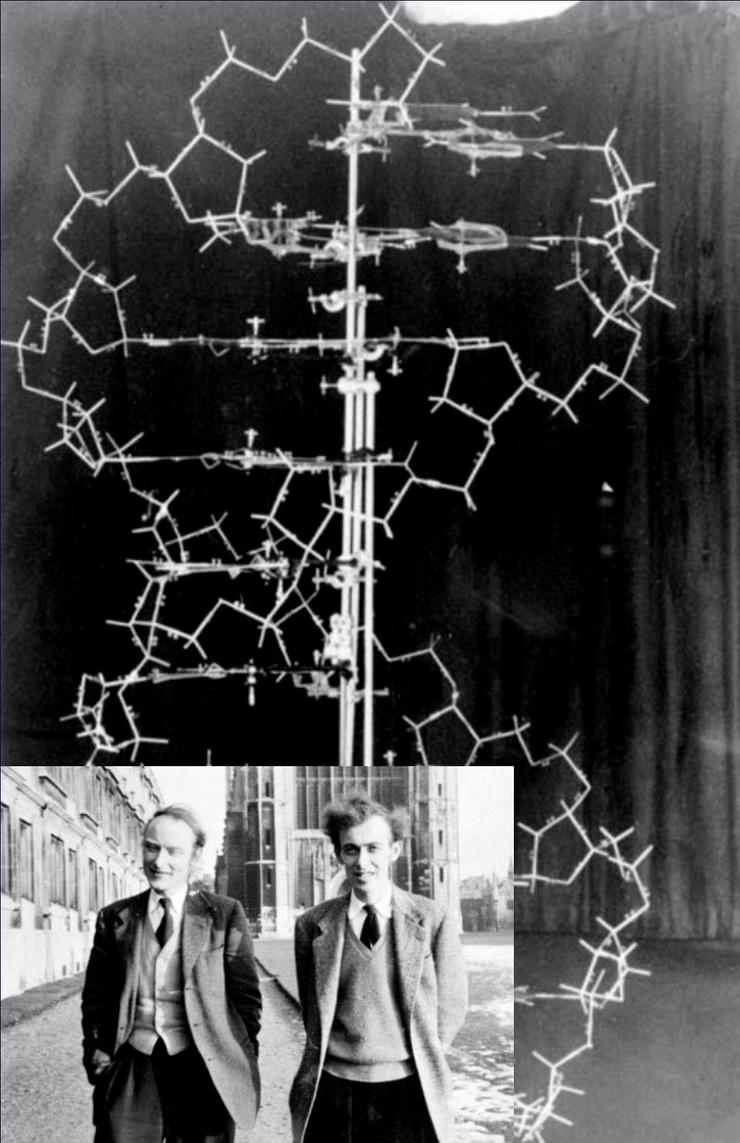
Ca channel blockers – Heart disease

COX-2 inhibitors – Inflammation

Na channel blockers – Neuropathy

...

# Summary



```
ttcactttca gatccagaga ccaggacaac  
gccacagaga caggacagat tcgcccacct  
tagccagact ccagatatag acgagcagtc  
attaggaac cacatcagca ctatcagcca  
acagatgac cagtcactc ccaggccata  
cttatactct tctgattctg gacgtgaaaa  
gtgcaccagt cacagtataa gagtcaaaaa  
cagagtagag agtagctttc ttcgattaac  
tcagattcta cagtatgagc gaaagcgtag  
attgtagata cccttcagtg tgattcagga  
taaattctg atgaagcagt ttgagctcgt  
ttccagtaga ataagactta ctactgaatg  
aggagtagtt attttcattg tcttccatt
```



## Mutations and Disease

- Antibiotic resistance
- ER, BRCA - breast cancer
- p53 - colon cancer
- AR - prostate cancer

## How large is DNA ?

Nanometer =  $10^{-9}$  meter

1 m

---

1 dm

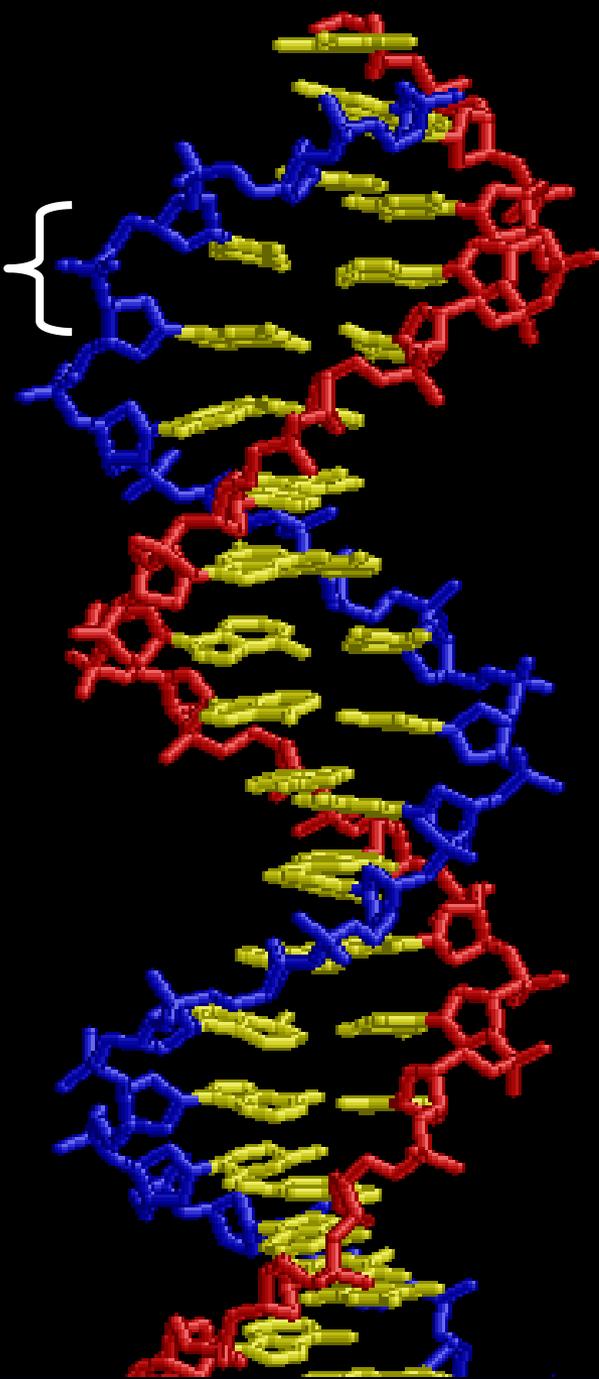
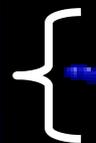
1 cm

÷ 10

7 more times

Community service

3.4 nm



1 human DNA  
~ 1 million subunits

~ 3 mm  
(~ 1/8 inch)

# Community service - Kilby 3rd Grade

Info to Tom for Kilby 3<sup>rd</sup> Graders at SETB April 26 2016 10-12 am Rm 116 (with Evelyn's permission)

Kim Morris teacher, Tina Hubler, John Thomas

Students collected items for microscopic observation on their way over to SETB.

Taught how to use stereomicroscope and observed various items that they shared amongst each another (flowers, grass, pennies, dead insects, etc.)

Wrote a note to person of choice using grass-printed envelopes, sealed with insect and plant stickers

Used black scratch art paper to sketch microorganisms (given a selection of protozoa)

Performed sea firefly experiment with test tubes, dried crustaceans, water and stir rods.



# Community service - Deibert Park Children's Museum

Deibert Park Children's Activity

Bacteriophage



# Appendix

**University of North Alabama**  
**FACULTY PERFORMANCE REPORT**  
Academic Period 2014-2015

**NAME:** Tina Hubler **Rank** Associate professor **#Years Full-Time**9

**List Courses/Clinicals/Labs Currently Teaching** Genetics, Genetics Lab, Molecular Biology, Molecular Biology Lab, Introductory Biology, Introductory Biology Lab

**Additional Assignments (professorship, grant, release-time, etc.)**

**DEPARTMENT:** Biology

**I. What were your professional goals this year as related to departmental and/or college performance guidelines?**

**Teaching Effectiveness:**

Genetics: Include HHMI DVDs on pocket mice, icefish and sickle cell anemia into unit on molecular evolution. Assign an essay question on mutation and natural selection for the Final Exam.

Intro biology: Create a new outline for the new lecture presentation of evolution including topics: millions of years, conflicts with religion, rock dating, sedimentary rock, fossils, scientific method and evidence.

Mol. Biology: Use PCR lab recently developed to replace kits from vendor that have been problematic..

**Research, Scholarship, and Other Creative Activities:**

Continue research comparing squirrel monkey and human DNA sequences. Include at least one student in undergraduate research project.

Have student(s) participate in UNA Research Day. Begin draft of Genes, Genomes, and Genetics manuscript describing our progress on explaining the elevated expression of FKBP5 in New World primates.

**University, Community, and Professional Service:**

University: Faculty Senate. Chair, Interdisciplinary Studies committee. Investigate AP Biology and GRE Biology review software for use in BI495.

Community: Secretary, Board of Unitarian Universalist Congregation of the Shoals. Help Center volunteer, summer 2014.

**II. What was accomplished relative to these goals?**

**Teaching Effectiveness:**

Genetics: Included HHMI DVDs on icefish, stickleback fish and sickle cell anemia into unit on molecular evolution. Assigned an essay question on mutation and natural selection for the Final Exam.

Intro biology: Created a new outline and PowerPoint for the new lecture presentation of evolution in Spring 2015. Included topics: millions of years, conflicts with religion, rock dating, sedimentary rock, fossils, scientific method and evidence. Included two HHMI videos on natural selection, with outlines for use in class. Included questions pertaining to videos on final exam.

Mol. Biology: Used PCR lab recently developed to study molecular evolution..

**Research, Scholarship, and Other Creative Activities:**

Assisted LABlanckinship's research student with PCR analysis for her project. Assisted student with oral presentation for ASB meeting and for UNA Research Day. Published two papers in The American Biology Teacher: Jan and Feb 2015. Reviewed two manuscripts for The American Biology Teacher. Prepared draft of Genes, Genomes, and Genetics manuscript describing our progress on explaining the elevated expression of FKBP5 in New World primates. Decided to perform qPCR before submission, and submitted samples for qPCR analysis.

**University, Community, and Professional Service:**

University: Faculty Senate. Food Service committee. Interdisciplinary Studies committee. Selected AP Biology flash cards for use in BI495. Search committee, part-time aid for Administrative Assistant, Department of Biology.

Community: Secretary, Board of Unitarian Universalist Congregation of the Shoals.

# Performance evaluations

- III. **After evaluating your goals/accomplishments for the current year, indicate your measurable goals/objectives for the upcoming year.**

## **Teaching Effectiveness:**

Genetics: Include HHMI Supplemental Materials for natural selection videos in Genetics lab activities (modeling natural selection)

Intro biology: Utilize one of the HHMI activities for classroom activity on natural selection.

Mol. Biology: Use HHMI materials for discussion of laboratory techniques and methods used in stickleback and lactase –persistence videos.

## **Research, Scholarship, and Other Creative Activities:**

Continue research comparing squirrel monkey and human DNA sequences. Include at least one student in undergraduate research project. Have student(s) participate in UNA Research Day or other presentation. Continue draft of Genes, Genomes, and Genetics manuscript, incorporating qPCR analyses started May 2015.

## **University, Community, and Professional Service:**

University: Distance learning committee of Shared Governance. Interdisciplinary Studies committee. Direct the BI495 course.

Community: Help Center volunteer, summer 2015. Children's activity at Kilby school.

- IV. **Evaluation by Department Chair related to departmental and/or college performance guidelines (to be completed annually by September 15 for non-tenured faculty and every two years for tenured faculty).**

# Performance evaluations

**Teaching Effectiveness:**

Was evaluated by Dr. Kittle in Fall 2014.

**Research, Scholarship, and Other Creative Activities:**

Was evaluated by Dr. Kittle in Fall 2014.

**University, Community, and Professional Service:**

Was evaluated by Dr. Kittle in Fall 2014.

*Tina R. Hubler*  
Faculty Member Signature

September 8, 2015  
Date

*Thomas M. Haggerty*  
Department Chair Signature

September 7, 2015  
Date

\_\_\_\_\_  
Dean Signature

\_\_\_\_\_  
Date

Optional Comments by Dean:

**\*Attach updated vita per Faculty Handbook**

# Performance evaluations

VITA

**Name:** Tina R. Hubler

**Department of:** Biology

**Current Faculty Rank and Discipline:** Associate Professor of Biology

## Education and Professional Experience

Academic Degrees			
Ph. D.	Basic Medical Sciences	University of South Alabama	2005
M.A.	Educational Leadership	University of West Florida	1996
B.S.	Chemistry	Auburn University	1981
A.S.	Science	Pensacola Junior College	
Other Relevant Credentials and Professional Development			
Postdoctoral Fellow		University of South Alabama	
Higher Education Teaching and/or Administrative Experience			
University of North Alabama, Associate Professor of Biology, 2013-present			
University of North Alabama, Assistant Professor of Biology, 2006-2013			
Spring Hill College, Adjunct Instructor in Nursing, 2005			
Pensacola Junior College, Adjunct Instructor in Medical Terminology, 1997			
Other Relevant Professional Experience			
High school math and science teacher, Northview High School, Pensacola FL, 1995-1999			
Ernest Ward High School, Walnut Hill, FL, 1994-1995			
Chemist, University of West Florida Institute for Coastal and Estuarine Research, Pensacola FL, 1992-1994			
Chemist, State of Florida Department of Agriculture, Dairy Division, Pensacola FL, 1987-1991			
Associate Chemist, Southern Research Institute, Birmingham AL, 1983-1987			
Chemist, State of Florida Department of Environmental Regulation, Pensacola FL, 1981-1983			
Honors/Awards Received for Academic and/or Professional Achievement			
University of South Alabama Graduate Student Travel Award, 2002			
Northview High School Teacher of the Year, Pensacola FL, 1998			
Graduate Fellowship: Department of Educational Leadership, University of West Florida, 1991, 1993			
Thomas Price Scholarship and Undergraduate Analytical Chemistry Award: Auburn University, 1980-1981			
Academic scholarship: Pensacola Junior College, 1979-1981			

## Intellectual, Literary, and Artistic Contributions

Peer Reviewed Scholarly, Literary, and/or Artistic Publications
Hubler TR, Adams P, Scammell JG 2015, Instant Update: Considering the Molecular Mechanisms of Mutation & Natural Selection, <i>The American Biology Teacher</i> , 77(1): 6-9.
Hubler TR, Adams P, Scammell JG 2015, Laboratory Activities to Support Student Understanding of the Molecular Mechanisms of Mutation & Natural Selection, <i>The American Biology Teacher</i> , 77(2): 118-125.

# Performance evaluations

## VITA

<p>Cioffi DL, Hubler TR, Scammell JG 2011 Organization and function of the FKBP52 and FKBP51 genes. <i>Current Opinions in Pharmacology</i> 11:308-313.</p> <p>Vasauskas AA, Hubler TR, Boston L, Scammell JG 2011 Tissue-specific expression of squirrel monkey chorionic gonadotropin. <i>General and Comparative Endocrinology</i> 170:509-513.</p> <p>Vasauskas AA, Hubler TR, Mahanic C, Gibson S, Kahn AG, Scammell JG 2011 Regulation and distribution of squirrel monkey chorionic gonadotropin and secretogranin II in the pituitary. <i>General and Comparative Endocrinology</i> 170:514-521.</p> <p>Gross KL, Westberry JM, Hubler TR, Sadosky PW, Singh RJ, Taylor RL, Scammell JG 2008 Androgen resistance in squirrel monkeys. <i>Comparative Medicine</i> 58:381-388.</p> <p>Scammell JG, Westberry JM, Sadosky PW, Hubler TR, Williams LE, Gibson SV, Singh RJ, Taylor RL, Shackleton CH 2006 Adaptive mechanisms of squirrel monkeys that minimize effects of extremely high cortisol levels on electrolyte balance and other physiological parameters. <i>Comparative Medicine</i> 56:393-394.</p> <p>Westberry JM, Sadosky PW, Hubler TR, Gross KL, Scammell JG 2006 Glucocorticoid resistance in squirrel monkeys results from a combination of a transcriptionally incompetent glucocorticoid receptor and overexpression of the glucocorticoid receptor co-chaperone FKBP51. <i>Journal of Steroid Biochemistry and Molecular Biology</i> 100:34-41.</p> <p>Scammell JG, Westberry JM, Sadosky PW, Hubler TR, Williams LE, Gibson SV, Singh RJ, Taylor RL, Shackleton CH 2006 Cortisol metabolism in the Bolivian squirrel monkey (<i>Saimiri boliviensis boliviensis</i>). <i>Comparative Medicine</i> 56:128-35.</p> <p>Hubler TR and Scammell JG 2004 Intronic hormone response elements mediate regulation of <i>FKBP5</i> by progestins and glucocorticoids. <i>Cell Stress and Chaperones</i> 9: 243-252.</p> <p>Scammell JG, Hubler TR, Denny WB and Valentine DV 2003 Organization of the human FK506-binding immunophilin FKBP52 protein gene (<i>FKBP4</i>). <i>Genomics</i> 81:640-643.</p> <p>Hubler TR, Denny WB, Valentine DV, Cheung-Flynn J, Smith DF and Scammell JG 2003 The FK506-binding immunophilin FKBP51 is transcriptionally regulated by progestin and attenuates progestin responsiveness. <i>Endocrinology</i> 144:2389-2382.</p>
<b>Other Scholarly, Literary, and/or Artistic Publications</b>
<p>GenBank submissions:</p> <p>JX503530 <i>Saimiri boliviensis</i> FKBP5 gene promoter, 2012</p> <p>JN613228 <i>Aotus trivirgatus</i> chorionic gonadotropin promoter and cds, 2011</p> <p>GU117708 <i>Saimiri boliviensis</i> chorionic gonadotropin promoter and cds, 2009</p> <p>GU132857 <i>Saimiri boliviensis</i> secretogranin II gene promoter and cds, 2009</p> <p>AY167569 <i>Homo sapiens</i> FKBP4 gene promoter and 5' UTR, 2002</p> <p>AY114286 <i>Homo sapiens</i> FKBP5 gene promoter and exon 1, 2002</p>
<b>Presentations to Scholarly, Literary, and/or Artistic Meetings</b>
<p>Rosmely Hernandez 2015 Techniques for the Rapid Detection of KPC-Positive Bacteria Isolated from Clinical Sputum Samples Using PCR Amplification. UNA student's presentation at Association of Southeastern Biologists and Southeastern Region of Tri-Beta Honor Society, Chattanooga, TN, and at UNA Research Day</p> <p>Rachel Herwick and Tina Hubler 2014 MicroRNAs: Big Things Come in Small Packages. Three Minute Thesis Competition, University of North Alabama</p> <p>Vivian Lesende and Tina Hubler 2013 Using Comparative Genomics to Study Molecular Evolution in New</p>

# Performance evaluations

## VITA

World and Old World Primates. UNA student's oral presentation at the Alabama Academy of Science Meeting, Birmingham AL, and at UNA Research Day.

Caitlin Tidwell and Tina Hubler 2012 Does the FKBP51 Promoter Cause Elevated Gene Expression in Squirrel Monkeys? UNA student's poster presentation at UNA Research Day.

Christiana Daily and Tina R. Hubler 2011 Isolation of the Chorionic Gonadotropin Beta Subunit Gene Promoter in the Owl Monkey, *Aotus nancymaae*. UNA student's oral presentation at the Annual Meeting of the Association of Southeastern Biologists, Huntsville AL.

Chase Mitchell and Tina R. Hubler 2011 Organization of the Chorionic Gonadotropin Beta Subunit Gene in the Owl Monkey, *Aotus nancymaae*. UNA student's poster presentation at the Annual Meeting of the Association of Southeastern Biologists, Huntsville AL.

Hubler TR and Scammell JG 2010 Comparative Genomic Analysis of the FKBP51 Promoter in New World and Old World Primates, *Saimiri boliviensis*, *Aotus nancymaae* and *Homo sapiens*. Poster presentation at UNA Research Day.

Vasauskas AA, Hubler TR, Scammell JG 2009 Proximal and distal Egr-1 sites mediate GnRH-responsiveness of the squirrel monkey chorionic gonadotropin beta-subunit promoter in LbetaT2 cells. Poster presentation at FASEB meeting, FASEB J. 23:598.20.

Tina R. Hubler, Natasha C. Sanderfer, and Jonathan G. Scammell 2009 Determination of the Promoter Sequence for the Glucocorticoid Receptor-Associated Protein FKBP51 in the Squirrel Monkey, *Saimiri boliviensis*. UNA student's poster presentation at UNA Research Day.

Hubler TR, Vasauskas AA, Brackin LB, Scammell JG 2008 Distinct promoter sequences mediate pituitary- and placenta-specific expression of squirrel monkey chorionic gonadotropin beta-subunit. Poster presentation at 3<sup>rd</sup> International Primate Genomics Conference: Primate Genomics and Human Disease, Seattle WA.

Kyle Morton and Tina R. Hubler 2008 Using Comparative Genomics to Isolate the Secretogranin II gene promoter in *Saimiri boliviensis*. UNA student's oral presentation at TriBeta, University of North Alabama.

Hubler TR, Vasauskas AA, Brackin LB, Scammell JG 2008 Distinct promoter sequences mediate pituitary- and placenta-specific expression of squirrel monkey chorionic gonadotropin beta-subunit. UNA student's poster presentation at UNA Research Day.

Lori Brackin and Tina Hubler 2007 The Chorionic Gonadotropin Gene in the Squirrel Monkey. UNA student's oral presentation at TriBeta, University of North Alabama.

Brackin LB, Hubler TR, and Scammell JG 2007 Organization of the Chorionic Gonadotropin Beta Subunit Gene in the Squirrel Monkey (*Saimiri boliviensis*). UNA student's oral presentation at NSF-REU Research Day, University of South Alabama, Mobile AL.

Pannell LK, Ruiz JC, Zuzo A, Jones NE, Hubler TR 2006 Towards automated glycoanalysis of proteomes: partial fractionation and limited database deployment. Poster presentation at 54<sup>th</sup> ASMS Conference on Mass Spectrometry, Seattle WA.

Ruiz JC, Hubler TR, Zuzo A, Samant L, Pannell LK 2006 Identification of changes in glycosylation associated with prostate cancer biomarkers. USA student's poster presentation at 54<sup>th</sup> ASMS Conference on Mass Spectrometry, Seattle WA.

Krulla KT, Ruiz JC, Hubler TR, Fodstad O, Shevde LA, Samant RS, Ofori-Acquah S, Pannell LK 2005 Identification of cell surface antigens that are characteristic of metastatic melanoma. USA

# Performance evaluations

## VITA

<p>student's poster presentation at 53<sup>rd</sup> ASMS Conference on Mass Spectrometry and Allied Topics, San Antonio TX.</p> <p>Hubler TR, Krulla KT, Torres RA, Mbeunkui F, Ruiz JC, Shevde LA, Samant RS, Pannell LK 2005 Automated glycoanalysis of cancer-related proteins. Poster presentation at the Sixth Principal Investigators Meeting of the Innovative Molecular Analysis Technologies Program, Washington DC.</p> <p>Hubler TR and Scammell JG 2004 Intronic hormone response elements mediate regulation of <i>FKBP5</i> by progestins and glucocorticoids. Poster presentation at The Endocrine Society's 86th Annual Meeting, Endo 2004 Programs and Abstracts, p.197.</p> <p>Hubler TR, Valentine DV and Scammell JG 2002 The progesterone receptor-associated immunophilin FKBP51 is regulated by progestins in T-47D cells. Poster presentation at FASEB meeting, FASEB J. 16:A198.</p>
<b>Artistic Performances and Exhibitions</b>
<b>Grants and Contracts Received (note whether internal or external)</b>
<p>College of Arts and Sciences Research and Development Grant: University of North Alabama, 2015 (internal)</p> <p>College of Arts and Sciences Research and Development Grant: University of North Alabama, 2013-2014 (internal)</p> <p>College of Arts and Sciences Research and Development Grant: University of North Alabama, 2012-2013 (internal)</p> <p>College of Arts and Sciences Research and Development Grant: University of North Alabama, 2011-2012 (internal)</p> <p>College of Arts and Sciences Research and Development Grant: University of North Alabama, 2011 (internal)</p> <p>University Research Grant: University of North Alabama, 2008-2009 (internal)</p> <p>University Research Grant: University of North Alabama, 2007-2008 (internal)</p> <p>College of Arts and Sciences Research and Development Grant: University of North Alabama, 2006-2007 (internal)</p> <p>American Heart Association Southeast Affiliate Pre-doctoral Fellowship: University of South Alabama, 2002-2004 (external)</p> <p>Title IV and Foundation for Excellence in Education mini-grants for classroom teachers: Northview High School, 1996-1998 (within county school system)</p>

## Service

<b>Service to the Department, College, and/or University</b>
<p>Member, Department of Biology Staff Search Committee, 2014</p> <p>Member, Department of Biology Promotions Committee, 2014</p> <p>Chair, Department of English Laura Harrison Award Committee: University of North Alabama, 2014</p> <p>Chair, Department of Biology Faculty Search Committee: University of North Alabama, 2014</p> <p>Committee to award Beta Beta Beta Scholarship, John and Mary Holland Scholarship, Francis Martin Scholarship Spring 2014</p> <p>Chair, Interdisciplinary Studies committee, 2013-14</p> <p>Vice chair, Interdisciplinary Studies committee, 2013</p> <p>Member, Department of Biology Faculty Search Committee: University of North Alabama, 2013</p> <p>Chair, Faculty Senate Academic Affairs Committee, 2012-2013</p> <p>Chair, Department of Biology Tenure Committee, 2012</p>

# Performance evaluations

## VITA

<p>Faculty Senator, Department of Biology, University of North Alabama, 2012-2015</p> <p>Member, Arts and Sciences Faculty Research and Development Grant committee, University of North Alabama, 2012</p> <p>Member, Interdisciplinary Studies committee, University of North Alabama, 2011-2014</p> <p>Member, Food Services Committee, University of North Alabama, 2011-2014</p> <p>Member, BI 101 Laboratory Manual revision: University of North Alabama, 2011</p> <p>Member, Department of Biology Tenure Committee, 2011</p> <p>Member, Academic Affairs Award for Outstanding Scholarship/Research Committee : University of North Alabama, 2011</p> <p>Contributing author of BI 101 Laboratory Manual: University of North Alabama, 2009-2010</p> <p>Member, SACS Subcommittee for Faculty Credentials and Responsibilities: University of North Alabama, 2010-present</p> <p>Member, Department of Biology Faculty Search Committee: University of North Alabama, 2010</p> <p>Member, BI 101 Laboratory Manual Committee: University of North Alabama, 2007-2010</p> <p>Member, General Education Assessment Advisory Committee: University of North Alabama, 2007-2010</p> <p>Chair, Department of Biology Faculty Search Committee: University of North Alabama, 2008</p> <p>Tutor, Academic Resource Center, biology and genetics: University of North Alabama, 2008</p> <p>Member, Department of Biology Faculty Search Committee: University of North Alabama, 2008</p> <p>Chair, Molecular Biology Option Committee: University of North Alabama, 2007-2008</p> <p>Chair, Department of Biology Faculty Search Committee: University of North Alabama, 2007</p>
<b>Service to the Profession</b>
<p>Textbook chapter review Pierce Genetics Essentials, Chapter 5 (Linkage, Recombination and Gene Mapping) and 6 (Chromosome Variation) 2014</p> <p>Manuscript review American Biology Teacher 2014 “An Enduring Legacy: The Luria-Delbruck Fluctuation Test as a Classroom Investigation in Darwinian Evolution”</p> <p>Manuscript review American Biology Teacher 2014 “Grocery store genetics: a PCR based genetics lab that links genotype to phenotype”</p> <p>Manuscript review, Wassenburg D 2014 The Role for Need for Cognition in Introductory Biology Students’ Acceptance of Anthropogenic Climate Change and Evolution. American Biology Teacher.</p> <p>Chair Association of Southeastern Biologists diversity committee 2014</p> <p>Member Association of Southeastern Biologists diversity committee 2012-2014</p> <p>Member, National Association of Southeastern Biologists 2014-present.</p> <p>Member, National Association of Biology Teachers 2013-present.</p> <p>Member, Alabama Academy of Science, 2012-present</p> <p>Invited presentation to Humanists of the Shoals: The Genetics of Cancer. 2012</p> <p>Judge, student biology videos. Educational Technology Services Department Leo Learning Project with Muscle Shoals School System 2011</p> <p>Member, Association of Southeastern Biologists, 2010-present</p> <p>Invited presentation to Unitarian Universalist Congregation of the Shoals: Francis Collins and The Language of God. 2008</p> <p>Invited presentation to Cherokee Lion’s Club: How Humans May Be Different in One Million Years, Cherokee AL, 2008</p> <p>Manuscript review: Zhang X, Clark A, Yorio T 2007 FK506-binding protein 51 regulates nuclear transport of the glucocorticoid receptor beta and glucocorticoid responsiveness. American Journal of Physiology.</p> <p>Invited presentation to TriBeta, University of North Alabama: Animal Models of Molecular Evolution, 2007</p> <p>Invited presentation to College of Allied Health, University of South Alabama: Steroid hormone resistance, 2006</p> <p>Member, Women in Science: University of South Alabama, Mobile AL, 2001-2006</p> <p>Student member, American Association for the Advancement of Science, 2001-2006</p> <p>Invited presentation to Cancer Research Institute, University of South Alabama: Using molecular biology to study mechanisms of steroid hormone resistance, 2005</p> <p>Student representative, Graduate Program in Basic Medical Sciences Curriculum Committee: University of</p>

# Performance evaluations

VITA

South Alabama, Mobile AL, 2003-2004 Invited presentation to Cell Signaling Seminar Series, University of South Alabama: FK506-binding immunophilin FKBP51: regulation and physiological implications, 2003 Member, Basic Medical Sciences Student Organization (department representative 2004): University of Alabama, Mobile AL, 2001-2003
<b>Service to the Community/Society</b>
Help Center, Florence AL Summer 2012-2013 Science Fair Judge, Riverhill Elementary School, Florence AL 2012 NW AL Community Health and Dental Clinic brochures assembly, Florence AL 2011 Granny's Kitchen Thanksgiving Day, Florence AL 2011 Hospice of the Shoals volunteer, Florence AL, 2010-present Secretary of the Board for Unitarian Universalists Congregation of the Shoals, Florence AL 2009-2015 PAWS (Pets Are Worth Saving) volunteer, Petco adoption day, Florence AL, 2009 Shoals Environmental Alliance Native Plant Garden clean up, Florence AL, 2008 Shoals Habitat for Humanity, Inc. construction volunteer, Florence AL 2007 Home of Grace Recovery Center for Women volunteer, Mobile AL, 2004-2006 Workshop presenter, Expanding Your Horizons (outreach to middle school girls): University of South Alabama, Mobile AL, 2001-2003

**Date Updated:** April 30, 2015

**University of North Alabama**  
**FACULTY PERFORMANCE REPORT**  
**Academic Period 2015-2016**

**NAME:** Tina Hubler **Rank** Associate Professor **#Years Full-Time**10

**List Courses/Clinicals/Labs Currently Teaching** Genetics, Genetics Lab, Introductory Biology, Introductory Biology Lab, Molecular Biology, Senior Assessment Seminar

**Additional Assignments (professorship, grant, release-time, etc.)** Research internships for students

**DEPARTMENT:** Biology

## I. What were your professional goals this year as related to departmental and/or college performance guidelines?

### Teaching Effectiveness:

Genetics: Include HHMI Supplemental Materials for natural selection videos in Genetics lab activities (modeling natural selection)

Intro biology: Utilize one of the HHMI activities for classroom activity on natural selection.

Mol. Biology: Use HHMI materials for discussion of methods used in stickleback and lactase –persistence videos

### Research, Scholarship, and Other Creative Activities:

Continue research comparing squirrel monkey and human DNA sequences.  
Include at least one student in undergraduate research project.  
Have student(s) participate in UNA Research Day or other presentation.  
Continue draft of Genes, Genomes, and Genetics manuscript, incorporating qPCR analyses started May 2015.

### University, Community, and Professional Service:

University: Distance learning committee of Shared Governance.  
Direct the BI495 course.

Community: Help Center volunteer, summer 2015.  
Children's activity at Kilby school.

## II. What was accomplished relative to these goals?

### Teaching Effectiveness:

Genetics: We did not discuss Natural Selection in lab this year, as it is the last topic we discuss in Genetics lecture. However, we tried a new lab activity: growing genetic variants of corn to illustrate Mendelian inheritance. We then used the class results (offspring) and statistical analysis to determine if our data agreed with Mendelian inheritance.  
I have incorporated use of the Doc Cam and transparency film to replace drawing previously done on whiteboard  
I have prepared Powerpoint presentations for each Lab to enhance prelab instruction

Intro biology: Utilized the HHMI video to present and discuss natural selection in finches on Galapagos Islands.  
I have prepared Powerpoint presentations for each Lab to enhance prelab instruction

Mol. Biology: Was not taught this semester.

### Research, Scholarship, and Other Creative Activities:

Continued research comparing squirrel monkey and human DNA sequences.  
Included two students in separate undergraduate research projects.  
One student participated in UNA Research Day (3MT Competition) and won first place for her oral presentation at Alabama Academy of Science. The second student has learned a new technique and will be mentoring two students next fall 2016.  
Continued draft of Genes, Genomes, and Genetics manuscript, discussing with collaborator, Dr. Jonathan Scammel at University of South Alabama, and incorporating qPCR analyses completed October 2015.

# Performance evaluations

## University, Community, and Professional Service:

- University: Directed the BI495 (Senior Assessment Seminar) course.  
Served on committee to award Beta Beta Beta Scholarship, John and Mary Holland Scholarship, Francis Martin Scholarship Spring 2016
- Community: Kilby 3<sup>rd</sup> graders visited the SETB. We conducted experiments with microscopes and microorganisms, as well as activities involving art and letter writing.  
Presented "Change is what the future holds: a Genetics perspective" for Lifelong Learning in Retirement group, Florence AL
- Professional: Reviewed manuscript "Learning about Enzyme Specificity with an Interactive Enzyme Model: Influences on Student Motivation, Mental Effort, and Knowledge" for the American Biology Teacher  
Judged and recruited a judge for the Junior Alabama Academy of Science (held on a University holiday) presentations.

### III. After evaluating your goals/accomplishments for the current year, indicate your measurable goals/objectives for the upcoming year.

#### Teaching Effectiveness:

- Genetics: Reschedule teaching to provide time for HHMI Supplemental Materials on natural selection (videos and lab activities). This will be challenging because the foundational material must be covered first, and currently this requires most of the semester.
- Intro biology: Utilize the outlines I have on canvas in class with Doc Cam to teach students how to take notes. Discussing with Dr. Roush the possibilities of providing outline packages for students.  
After working with a graduate student in education this semester, plan to divide the Genetics unit into two sections for testing.

#### Research, Scholarship, and Other Creative Activities:

- Continue research comparing squirrel monkey and human DNA sequences.  
Include three students in undergraduate research project.  
Have student(s) participate in UNA Research Day or other presentation.  
Continue draft of Genes, Genomes, and Genetics manuscript, incorporating sequence analysis of FKBP5 SNPs in monkeys and humans.

## University, Community, and Professional Service:

- University: Direct the BI495 (Senior Assessment Seminar) course.  
Serve on search committee for new faculty position following Paul Kittle's retirement  
Serve on committee to award Beta Beta Beta Scholarship, John and Mary Holland Scholarship, Francis Martin Scholarship  
Mentor young faculty (Dr. Ping Zhao), particularly about research purchases and grant applications  
Mentor colleague (Dr. Lisa Ann Blankinship) teaching Genetics Lab
- Community: Plan to invite Ms. Morris' Kilby 3<sup>rd</sup> graders to visit the SETB and conduct science and art activities.
- Professional: Current member National Association of Biology Teachers, Alabama Academy of Science, Association of Southeastern Biologists

### IV. Evaluation by Department Chair related to departmental and/or college performance guidelines (to be completed annually by September 15 for non-tenured faculty and every two years for tenured faculty).

# Performance evaluations

## Teaching Effectiveness:

Dr. Hubler is an effective teacher. During the 2015-2016 academic year, Dr. Hubler was evaluated by 219 students from 11 course sections. Her overall mean score from the 12 sections was 4.70 (out of 5.00); results that are very good. Most of the student comments were positive. Dr. Hubler recently started teaching Senior Assessment Seminar (BI 498) and from her efforts we are seeing an improvement in our graduates standardized test scores on our Exit Exam. Dr. Hubler should receive considerable credit for this improvement. Dr. Hubler takes her teaching very seriously and is never afraid to try new things to help keep her students engaged.

## Research, Scholarship, and Other Creative Activities:

Dr. Hubler is an active scholar. She published two research papers in a referred journal in 2015 and she presented some of her research findings at a professional meeting in 2016. Since the fall of 2012, the biology department has had 102 research students working with faculty and Dr. Hubler has had 18% (18) of them; well above the department average (7.3). It is also noteworthy that Dr. Hubler often obtains funding for the research that she does with her students. A number of the students that Dr. Hubler has mentored have gone on to graduate or professional school. Her current research goals clearly indicate that she understands the importance of staying engaged in her discipline.

## University, Community, and Professional Service:

In the areas of service activity, Dr. Hubler continues to be active. For example, she served on the department's scholarship committees, participated in outreach activities involving school and retirement groups, and served as a reviewer for a professional journal.

In summary, I am very pleased with Dr. Hubler's performance as a faculty member and she is a very valuable member of the biology department.

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**Faculty Member Signature**

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**Date**

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**Department Chair Signature**

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**Date**

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**Dean Signature**

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**Date**

Optional Comments by Dean:

**\*Attach updated vita per Faculty Handbook**

# Performance evaluations

VITA

**Name:** Tina R. Hubler

**Department of:** Biology

**Current Faculty Rank and Discipline:** Associate Professor of Biology

## Education and Professional Experience

Academic Degrees			
Ph. D.	Basic Medical Sciences	University of South Alabama	2005
M.A.	Educational Leadership	University of West Florida	1996
B.S.	Chemistry	Auburn University	1981
A.S.	Science	Pensacola Junior College	
Other Relevant Credentials and Professional Development			
Postdoctoral Fellow		University of South Alabama	
Higher Education Teaching and/or Administrative Experience			
University of North Alabama, Associate Professor of Biology, 2013-present			
University of North Alabama, Assistant Professor of Biology, 2006-2013			
Spring Hill College, Adjunct Instructor in Nursing, 2005			
Pensacola Junior College, Adjunct Instructor in Medical Terminology, 1997			
Other Relevant Professional Experience			
High school math and science teacher, Northview High School, Pensacola FL, 1995-1999			
Ernest Ward High School, Walnut Hill, FL, 1994-1995			
Chemist, University of West Florida Institute for Coastal and Estuarine Research, Pensacola FL, 1992-1994			
Chemist, State of Florida Department of Agriculture, Dairy Division, Pensacola FL, 1987-1991			
Associate Chemist, Southern Research Institute, Birmingham AL, 1983-1987			
Chemist, State of Florida Department of Environmental Regulation, Pensacola FL, 1981-1983			
Honors/Awards Received for Academic and/or Professional Achievement			
University of South Alabama Graduate Student Travel Award, 2002			
Northview High School Teacher of the Year, Pensacola FL, 1998			
Graduate Fellowship: Department of Educational Leadership, University of West Florida, 1991, 1993			
Thomas Price Scholarship and Undergraduate Analytical Chemistry Award: Auburn University, 1980-1981			
Academic scholarship: Pensacola Junior College, 1979-1981			

## Intellectual, Literary, and Artistic Contributions

Peer Reviewed Scholarly, Literary, and/or Artistic Publications
Hubler TR, Adams P, Scammell JG 2015, Instant Update: Considering the Molecular Mechanisms of Mutation & Natural Selection, <i>The American Biology Teacher</i> , 77(1): 6-9.
Hubler TR, Adams P, Scammell JG 2015, Laboratory Activities to Support Student Understanding of the Molecular Mechanisms of Mutation & Natural Selection, <i>The American Biology Teacher</i> , 77(2): 118-125.

# Performance evaluations

## VITA

<p>Cioffi DL, Hubler TR, Scammell JG 2011 Organization and function of the FKBP52 and FKBP51 genes. <i>Current Opinions in Pharmacology</i> 11:308-313.</p> <p>Vasauskas AA, Hubler TR, Boston L, Scammell JG 2011 Tissue-specific expression of squirrel monkey chorionic gonadotropin. <i>General and Comparative Endocrinology</i> 170:509-513.</p> <p>Vasauskas AA, Hubler TR, Mahanic C, Gibson S, Kahn AG, Scammell JG 2011 Regulation and distribution of squirrel monkey chorionic gonadotropin and secretogranin II in the pituitary. <i>General and Comparative Endocrinology</i> 170:514-521.</p> <p>Gross KL, Westberry JM, Hubler TR, Sadosky PW, Singh RJ, Taylor RL, Scammell JG 2008 Androgen resistance in squirrel monkeys. <i>Comparative Medicine</i> 58:381-388.</p> <p>Scammell JG, Westberry JM, Sadosky PW, Hubler TR, Williams LE, Gibson SV, Singh RJ, Taylor RL, Shackleton CH 2006 Adaptive mechanisms of squirrel monkeys that minimize effects of extremely high cortisol levels on electrolyte balance and other physiological parameters. <i>Comparative Medicine</i> 56:393-394.</p> <p>Westberry JM, Sadosky PW, Hubler TR, Gross KL, Scammell JG 2006 Glucocorticoid resistance in squirrel monkeys results from a combination of a transcriptionally incompetent glucocorticoid receptor and overexpression of the glucocorticoid receptor co-chaperone FKBP51. <i>Journal of Steroid Biochemistry and Molecular Biology</i> 100:34-41.</p> <p>Scammell JG, Westberry JM, Sadosky PW, Hubler TR, Williams LE, Gibson SV, Singh RJ, Taylor RL, Shackleton CH 2006 Cortisol metabolism in the Bolivian squirrel monkey (<i>Saimiri boliviensis boliviensis</i>). <i>Comparative Medicine</i> 56:128-35.</p> <p>Hubler TR and Scammell JG 2004 Intronic hormone response elements mediate regulation of <i>FKBP5</i> by progestins and glucocorticoids. <i>Cell Stress and Chaperones</i> 9: 243-252.</p> <p>Scammell JG, Hubler TR, Denny WB and Valentine DV 2003 Organization of the human FK506-binding immunophilin FKBP52 protein gene (<i>FKBP4</i>). <i>Genomics</i> 81:640-643.</p> <p>Hubler TR, Denny WB, Valentine DV, Cheung-Flynn J, Smith DF and Scammell JG 2003 The FK506-binding immunophilin FKBP51 is transcriptionally regulated by progestin and attenuates progestin responsiveness. <i>Endocrinology</i> 144:2389-2382.</p>
<b>Other Scholarly, Literary, and/or Artistic Publications</b>
<p>GenBank submissions:</p> <p>JX503530 <i>Saimiri boliviensis</i> FKBP5 gene promoter, 2012</p> <p>JN613228 <i>Aotus trivirgatus</i> chorionic gonadotropin promoter and cds, 2011</p> <p>GU117708 <i>Saimiri boliviensis</i> chorionic gonadotropin promoter and cds, 2009</p> <p>GU132857 <i>Saimiri boliviensis</i> secretogranin II gene promoter and cds, 2009</p> <p>AY167569 <i>Homo sapiens</i> FKBP4 gene promoter and 5' UTR, 2002</p> <p>AY114286 <i>Homo sapiens</i> FKBP5 gene promoter and exon 1, 2002</p>
<b>Presentations to Scholarly, Literary, and/or Artistic Meetings</b>
<p>Caroline Thomas and Tina Hubler 2016 Stressed? How FKBP proteins can help! UNA student's oral presentation at the Alabama Academy of Science Meeting (awarded 1<sup>st</sup> Place), Florence AL, and Three Minute Thesis Competition at UNA Research Day</p> <p>Rosmely Hernandez 2015 Techniques for the Rapid Detection of KPC-Positive Bacteria Isolated from Clinical Sputum Samples Using PCR Amplification. UNA student's presentation at Association of Southeastern Biologists and Southeastern Region of Tri-Beta Honor Society, Chattanooga, TN, and at UNA Research Day</p>

# Performance evaluations

## VITA

- Rachel Herwick and Tina Hubler 2014 MicroRNAs: Big Things Come in Small Packages. Three Minute Thesis Competition, University of North Alabama
- Vivian Lesende and Tina Hubler 2013 Using Comparative Genomics to Study Molecular Evolution in New World and Old World Primates. UNA student's oral presentation at the Alabama Academy of Science Meeting, Birmingham AL, and at UNA Research Day.
- Caitlin Tidwell and Tina Hubler 2012 Does the FKBP51 Promoter Cause Elevated Gene Expression in Squirrel Monkeys? UNA student's poster presentation at UNA Research Day.
- Christiana Daily and Tina R. Hubler 2011 Isolation of the Chorionic Gonadotropin Beta Subunit Gene Promoter in the Owl Monkey, *Aotus nancymae*. UNA student's oral presentation at the Annual Meeting of the Association of Southeastern Biologists, Huntsville AL.
- Chase Mitchell and Tina R. Hubler 2011 Organization of the Chorionic Gonadotropin Beta Subunit Gene in the Owl Monkey, *Aotus nancymae*. UNA student's poster presentation at the Annual Meeting of the Association of Southeastern Biologists, Huntsville AL.
- Hubler TR and Scammell JG 2010 Comparative Genomic Analysis of the FKBP51 Promoter in New World and Old World Primates, *Saimiri boliviensis*, *Aotus nancymae* and *Homo sapiens*. Poster presentation at UNA Research Day.
- Vasauskas AA, Hubler TR, Scammell JG 2009 Proximal and distal Egr-1 sites mediate GnRH-responsiveness of the squirrel monkey chorionic gonadotropin beta-subunit promoter in LbetaT2 cells. Poster presentation at FASEB meeting, FASEB J. 23:598.20.
- Tina R. Hubler, Natasha C. Sanderfer, and Jonathan G. Scammell 2009 Determination of the Promoter Sequence for the Glucocorticoid Receptor-Associated Protein FKBP51 in the Squirrel Monkey, *Saimiri boliviensis*. UNA student's poster presentation at UNA Research Day.
- Hubler TR, Vasauskas AA, Brackin LB, Scammell JG 2008 Distinct promoter sequences mediate pituitary- and placenta-specific expression of squirrel monkey chorionic gonadotropin beta-subunit. Poster presentation at 3<sup>rd</sup> International Primate Genomics Conference: Primate Genomics and Human Disease, Seattle WA.
- Kyle Morton and Tina R. Hubler 2008 Using Comparative Genomics to Isolate the Secretogranin II gene promoter in *Saimiri boliviensis*. UNA student's oral presentation at TriBeta, University of North Alabama.
- Hubler TR, Vasauskas AA, Brackin LB, Scammell JG 2008 Distinct promoter sequences mediate pituitary- and placenta-specific expression of squirrel monkey chorionic gonadotropin beta-subunit. UNA student's poster presentation at UNA Research Day.
- Lori Brackin and Tina Hubler 2007 The Chorionic Gonadotropin Gene in the Squirrel Monkey. UNA student's oral presentation at TriBeta, University of North Alabama.
- Brackin LB, Hubler TR, and Scammell JG 2007 Organization of the Chorionic Gonadotropin Beta Subunit Gene in the Squirrel Monkey (*Saimiri boliviensis*). UNA student's oral presentation at NSF-REU Research Day, University of South Alabama, Mobile AL.
- Pannell LK, Ruiz JC, Zuzo A, Jones NE, Hubler TR 2006 Towards automated glycoanalysis of proteomes: partial fractionation and limited database deployment. Poster presentation at 54<sup>th</sup> ASMS Conference on Mass Spectrometry, Seattle WA.

# Performance evaluations

## VITA

Ruiz JC, Hubler TR, Zuzo A, Samant L, Pannell LK 2006 Identification of changes in glycosylation associated with prostate cancer biomarkers. USA student's poster presentation at 54<sup>th</sup> ASMS Conference on Mass Spectrometry, Seattle WA.

Krulla KT, Ruiz JC, Hubler TR, Fodstad O, Shevde LA, Samant RS, Ofori-Acquah S, Pannell LK 2005 Identification of cell surface antigens that are characteristic of metastatic melanoma. USA student's poster presentation at 53<sup>rd</sup> ASMS Conference on Mass Spectrometry and Allied Topics, San Antonio TX.

Hubler TR, Krulla KT, Torres RA, Mbeunkui F, Ruiz JC, Shevde LA, Samant RS, Pannell LK 2005 Automated glycoanalysis of cancer-related proteins. Poster presentation at the Sixth Principal Investigators Meeting of the Innovative Molecular Analysis Technologies Program, Washington DC.

Hubler TR and Scammell JG 2004 Intronic hormone response elements mediate regulation of *FKBP5* by progestins and glucocorticoids. Poster presentation at The Endocrine Society's 86th Annual Meeting, Endo 2004 Programs and Abstracts, p.197.

Hubler TR, Valentine DV and Scammell JG 2002 The progesterone receptor-associated immunophilin FKBP51 is regulated by progestins in T-47D cells. Poster presentation at FASEB meeting, FASEB J. 16:A198.

### Artistic Performances and Exhibitions

### Grants and Contracts Received (note whether internal or external)

College of Arts and Sciences Research and Development Grant: University of North Alabama, 2015-2016 (internal)

College of Arts and Sciences Research and Development Grant: University of North Alabama, 2015 (internal)

College of Arts and Sciences Research and Development Grant: University of North Alabama, 2013-2014 (internal)

College of Arts and Sciences Research and Development Grant: University of North Alabama, 2012-2013 (internal)

College of Arts and Sciences Research and Development Grant: University of North Alabama, 2011-2012 (internal)

College of Arts and Sciences Research and Development Grant: University of North Alabama, 2011 (internal)

University Research Grant: University of North Alabama, 2008-2009 (internal)

University Research Grant: University of North Alabama, 2007-2008 (internal)

College of Arts and Sciences Research and Development Grant: University of North Alabama, 2006-2007 (internal)

American Heart Association Southeast Affiliate Pre-doctoral Fellowship: University of South Alabama, 2002-2004 (external)

Title IV and Foundation for Excellence in Education mini-grants for classroom teachers: Northview High School, 1996-1998 (within county school system)

## Service

### Service to the Department, College, and/or University

Committee to award Beta Beta Beta Scholarship, John and Mary Holland Scholarship, Francis Martin Scholarship Spring 2016

Committee to award Beta Beta Beta Scholarship, John and Mary Holland Scholarship, Francis Martin

# Performance evaluations

## VITA

<p>Scholarship Spring 2015</p> <p>Faculty Senator, Department of Biology, University of North Alabama, 2012-2015</p> <p>Member, Department of Biology Staff Search Committee, 2014</p> <p>Member, Department of Biology Promotions Committee, 2014</p> <p>Chair, Department of English Laura Harrison Award Committee: University of North Alabama, 2014</p> <p>Chair, Department of Biology Faculty Search Committee: University of North Alabama, 2014</p> <p>Committee to award Beta Beta Beta Scholarship, John and Mary Holland Scholarship, Francis Martin Scholarship Spring 2014</p> <p>Chair, Interdisciplinary Studies committee, 2013-14</p> <p>Vice chair, Interdisciplinary Studies committee, 2013</p> <p>Member, Department of Biology Faculty Search Committee: University of North Alabama, 2013</p> <p>Chair, Faculty Senate Academic Affairs Committee, 2012-2013</p> <p>Chair, Department of Biology Tenure Committee, 2012</p> <p>Member, Arts and Sciences Faculty Research and Development Grant committee, University of North Alabama, 2012</p> <p>Member, Interdisciplinary Studies committee, University of North Alabama, 2011-2014</p> <p>Member, Food Services Committee, University of North Alabama, 2011-2014</p> <p>Member, BI 101 Laboratory Manual revision: University of North Alabama, 2011</p> <p>Member, Department of Biology Tenure Committee, 2011</p> <p>Member, Academic Affairs Award for Outstanding Scholarship/Research Committee : University of North Alabama, 2011</p> <p>Contributing author of BI 101 Laboratory Manual: University of North Alabama, 2009-2010</p> <p>Member, SACS Subcommittee for Faculty Credentials and Responsibilities: University of North Alabama, 2010-present</p> <p>Member, Department of Biology Faculty Search Committee: University of North Alabama, 2010</p> <p>Member, BI 101 Laboratory Manual Committee: University of North Alabama, 2007-2010</p> <p>Member, General Education Assessment Advisory Committee: University of North Alabama, 2007-2010</p> <p>Chair, Department of Biology Faculty Search Committee: University of North Alabama, 2008</p> <p>Tutor, Academic Resource Center, biology and genetics: University of North Alabama, 2008</p> <p>Member, Department of Biology Faculty Search Committee: University of North Alabama, 2008</p> <p>Chair, Molecular Biology Option Committee: University of North Alabama, 2007-2008</p> <p>Chair, Department of Biology Faculty Search Committee: University of North Alabama, 2007</p>
<b>Service to the Profession</b>
<p>Judged and recruited a judge for the Junior Alabama Academy of Science 2016 (held on a University holiday) presentations.</p> <p>Manuscript review American Biology Teacher 2016 “ Learning about enzyme specificity with an interactive enzyme model: influences on student motivation, mental effort and knowledge”</p> <p>Member, National Association of Southeastern Biologists 2014-present.</p> <p>Member, National Association of Biology Teachers 2013-present.</p> <p>Member, Alabama Academy of Science, 2012-present</p> <p>Textbook chapter review Pierce Genetics Essentials, Chapter 5 (Linkage, Recombination and Gne Mapping) and 6 (Chromosome Variation) 2014</p> <p>Manuscript review American Biology Teacher 2014 “An Enduring Legacy: The Luria-Delbruck Fluctuation Test as a Classroom Investigation in Darwinian Evolution”</p> <p>Manuscript review American Biology Teacher 2014 “Grocery store genetics: a PCR based genetics lab that links genotype to phenotype”</p> <p>Manuscript review, Wassenburg D 2014 The Role for Need for Cognition in Introductory Biology Students’ Acceptance of Anthropogenic Climate Change and Evolution. American Biology Teacher.</p> <p>Chair Association of Southeastern Biologists diversity committee 2014</p> <p>Member Association of Southeastern Biologists diversity committee 2012-2014</p> <p>Invited presentation to Humanists of the Shoals: The Genetics of Cancer. 2012</p> <p>Judge, student biology videos. Educational Technology Services Department Leo Learning Project with Muscle Shoals School System 2011</p> <p>Member, Association of Southeastern Biologists, 2010-present</p>

# Performance evaluations

## VITA

Manuscript review: Zhang X, Clark A, Yorio T 2007 FK506-binding protein 51 regulates nuclear transport of the glucocorticoid receptor beta and glucocorticoid responsiveness. American Journal of Physiology.

Invited presentation to TriBeta, University of North Alabama: Animal Models of Molecular Evolution, 2007

Invited presentation to College of Allied Health, University of South Alabama: Steroid hormone resistance, 2006

Member, Women in Science: University of South Alabama, Mobile AL, 2001-2006

Student member, American Association for the Advancement of Science, 2001-2006

Invited presentation to Cancer Research Institute, University of South Alabama: Using molecular biology to study mechanisms of steroid hormone resistance, 2005

Student representative, Graduate Program in Basic Medical Sciences Curriculum Committee: University of South Alabama, Mobile AL, 2003-2004

Invited presentation to Cell Signaling Seminar Series, University of South Alabama: FK506-binding immunophilin FKBP51: regulation and physiological implications, 2003

Member, Basic Medical Sciences Student Organization (department representative 2004): University of Alabama, Mobile AL, 2001-2003

### Service to the Community/Society

Invited presentation to Lifelong Learning in Retirement, "Change is what the future holds: a genetics perspective" 2016

Kilby School 3<sup>rd</sup> graders visited the SETB to conduct experiments with microscopes and microorganisms, as well as activities involving art and letter writing 2016.

Secretary of the Board for Unitarian Universalists Congregation of the Shoals, Florence AL 2009-2015

NW Al Community Health and Dental Clinic appreciation letters, Florence AL 2014

Help Center, Florence AL Summer 2012-2013

Science Fair Judge, Riverhill Elementary School, Florence AL 2012

NW Al Community Health and Dental Clinic brochures assembly, Florence AL 2011

Granny's Kitchen Thanksgiving Day, Florence AL 2011

Hospice of the Shoals volunteer, Florence AL, 2010-2012

PAWS (Pets Are Worth Saving) volunteer, Petco adoption day, Florence AL, 2009

Invited presentation to Unitarian Universalist Congregation of the Shoals: Francis Collins and The Language of God. 2008

Invited presentation to Cherokee Lion's Club: How Humans May Be Different in One Million Years, Cherokee AL, 2008

Shoals Environmental Alliance Native Plant Garden clean up, Florence AL, 2008

Shoals Habitat for Humanity, Inc. construction volunteer, Florence AL 2007

Home of Grace Recovery Center for Women volunteer, Mobile AL, 2004-2006

Workshop presenter, Expanding Your Horizons (outreach to middle school girls): University of South Alabama, Mobile AL, 2001-2003

**Date Updated:** April 30, 2015

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	0.00	2.74	1.37	2.74	93.15	73	4.86	4.85	4.85	4.85
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	2.74	4.11	8.22	13.70	71.23	73	4.47	4.57	4.63	4.65
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	0.00	0.00	2.74	5.48	91.78	73	4.89	4.78	4.74	4.76
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	2.74	4.11	4.11	12.33	76.71	73	4.56	4.54	4.62	4.64
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	2.74	1.37	2.74	6.85	86.30	73	4.73	4.70	4.71	4.74
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	2.74	2.74	4.11	12.33	78.08	73	4.60	4.53	4.65	4.69
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	0.00	0.00	1.37	6.85	91.78	73	4.90	4.79	4.80	4.81
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	1.37	2.74	12.33	8.22	75.34	73	4.53	4.36	4.58	4.63
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	1.39	1.39	9.72	9.72	77.78	72	4.61	4.53	4.65	4.68
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	1.37	0.00	1.37	4.11	93.15	73	4.88	4.85	4.81	4.83
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	1.37	5.48	16.44	16.44	60.27	73	4.29	4.51	4.67	4.70
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	1.37	6.85	6.85	21.92	63.01	73	4.38	4.55	4.67	4.70
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	2.74	8.22	5.48	16.44	67.12	73	4.37	4.56	4.66	4.69
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	1.37	0.00	6.85	13.70	78.08	73	4.67	4.70	4.74	4.76
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	4.11	6.85	9.59	15.07	64.38	73	4.29	4.37	4.56	4.61
OVERALL SUMMARY	1.74	3.11	6.22	11.06	77.88	1094	4.60	4.61	4.69	4.72

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	0.00	0.99	0.00	10.89	88.12	101	4.86	4.89	4.87	4.85
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	0.00	0.99	6.93	12.87	79.21	101	4.70	4.73	4.65	4.65
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	0.00	0.00	2.97	15.84	81.19	101	4.78	4.79	4.74	4.75
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	0.00	2.00	17.00	16.00	65.00	100	4.44	4.57	4.62	4.63
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	0.00	1.98	6.93	14.85	76.24	101	4.65	4.66	4.71	4.73
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	0.00	2.97	5.94	16.83	74.26	101	4.62	4.65	4.67	4.69
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	0.00	0.99	0.99	11.88	86.14	101	4.83	4.79	4.81	4.81
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	0.00	0.99	0.99	10.89	87.13	101	4.84	4.58	4.59	4.62
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	0.00	0.99	4.95	15.84	78.22	101	4.71	4.69	4.68	4.67
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	0.00	0.00	0.00	12.87	87.13	101	4.87	4.83	4.83	4.82
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	0.00	0.00	4.04	22.22	73.74	99	4.70	4.58	4.66	4.67
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	0.00	1.01	3.03	15.15	80.81	99	4.76	4.66	4.67	4.67
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	0.00	0.00	6.06	9.09	84.85	99	4.79	4.67	4.66	4.66
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	0.00	0.00	2.02	14.14	83.84	99	4.82	4.71	4.74	4.74
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	0.00	2.02	11.11	21.21	65.66	99	4.51	4.45	4.56	4.57
OVERALL SUMMARY	0.00	1.00	4.85	14.69	79.45	1504	4.73	4.68	4.70	4.70

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	0.00	0.00	0.00	14.81	85.19	54	4.85	4.88	4.86	4.86
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	0.00	7.41	7.41	25.93	59.26	54	4.37	4.60	4.63	4.65
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	0.00	1.85	11.11	18.52	68.52	54	4.54	4.75	4.75	4.76
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	0.00	3.70	5.56	18.52	72.22	54	4.59	4.59	4.63	4.65
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	1.85	0.00	5.56	22.22	70.37	54	4.59	4.76	4.74	4.75
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	0.00	1.85	3.70	31.48	62.96	54	4.56	4.60	4.68	4.70
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	1.85	0.00	7.41	18.52	72.22	54	4.59	4.84	4.79	4.80
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	0.00	5.56	3.70	24.07	66.67	54	4.52	4.39	4.58	4.62
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	0.00	1.85	1.85	31.48	64.81	54	4.59	4.63	4.66	4.68
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	0.00	0.00	0.00	20.37	79.63	54	4.80	4.88	4.85	4.85
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	0.00	3.70	9.26	20.37	66.67	54	4.50	4.64	4.69	4.71
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	0.00	1.85	0.00	27.78	70.37	54	4.67	4.62	4.68	4.69
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	1.85	0.00	5.56	20.37	72.22	54	4.61	4.62	4.67	4.69
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	0.00	0.00	5.66	22.64	71.70	53	4.66	4.77	4.76	4.77
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	1.92	1.92	7.69	26.92	61.54	52	4.44	4.46	4.57	4.60
OVERALL SUMMARY	0.50	1.98	4.96	22.92	69.64	807	4.59	4.67	4.70	4.72

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	0.00	0.00	0.00	13.04	86.96	46	4.87	4.85	4.84	4.85
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	0.00	2.17	4.35	17.39	76.09	46	4.67	4.63	4.61	4.62
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	0.00	0.00	4.35	6.52	89.13	46	4.85	4.76	4.74	4.75
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	0.00	0.00	13.04	6.52	80.43	46	4.67	4.53	4.60	4.62
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	0.00	0.00	4.35	10.87	84.78	46	4.80	4.66	4.73	4.74
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	2.17	0.00	6.52	8.70	82.61	46	4.70	4.48	4.65	4.67
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	0.00	0.00	2.17	8.70	89.13	46	4.87	4.83	4.80	4.79
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	0.00	4.35	4.35	6.52	84.78	46	4.72	4.37	4.54	4.58
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	2.17	0.00	2.17	10.87	84.78	46	4.76	4.58	4.65	4.66
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	0.00	0.00	2.17	6.52	91.30	46	4.89	4.83	4.83	4.82
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	2.17	0.00	6.52	10.87	80.43	46	4.67	4.61	4.67	4.69
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	0.00	4.35	4.35	6.52	84.78	46	4.72	4.55	4.65	4.67
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	0.00	0.00	8.70	8.70	82.61	46	4.74	4.59	4.65	4.67
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	0.00	0.00	0.00	10.87	89.13	46	4.89	4.70	4.74	4.74
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	2.22	2.22	4.44	13.33	77.78	45	4.62	4.42	4.56	4.58
OVERALL SUMMARY	0.58	0.87	4.50	9.72	84.33	689	4.76	4.63	4.68	4.70

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	1.67	0.00	1.67	11.67	85.00	60	4.78	4.86	4.86	4.85
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	1.67	1.67	5.00	21.67	70.00	60	4.57	4.52	4.66	4.64
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	1.67	0.00	11.67	11.67	75.00	60	4.58	4.72	4.74	4.73
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	1.67	1.67	10.00	20.00	66.67	60	4.48	4.50	4.65	4.64
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	1.67	0.00	10.00	18.33	70.00	60	4.55	4.70	4.74	4.74
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	1.67	3.33	3.33	21.67	70.00	60	4.55	4.64	4.69	4.68
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	1.67	0.00	0.00	8.33	90.00	60	4.85	4.84	4.80	4.79
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	1.67	1.67	5.00	21.67	70.00	60	4.57	4.41	4.61	4.62
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	1.67	0.00	5.00	20.00	73.33	60	4.63	4.61	4.69	4.67
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	1.67	0.00	1.67	10.00	86.67	60	4.80	4.85	4.84	4.83
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	1.67	0.00	10.00	26.67	61.67	60	4.47	4.63	4.72	4.71
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	1.67	3.33	5.00	16.67	73.33	60	4.57	4.55	4.70	4.69
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	3.33	5.00	0.00	18.33	73.33	60	4.53	4.58	4.69	4.69
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	1.67	1.67	1.67	13.33	81.67	60	4.72	4.75	4.76	4.76
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	1.72	0.00	5.17	22.41	70.69	58	4.60	4.52	4.62	4.61
OVERALL SUMMARY	1.78	1.22	5.01	17.48	74.50	898	4.62	4.64	4.72	4.71

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	0.00	3.85	0.00	3.85	92.31	26	4.85	4.77	4.84	4.83
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	0.00	3.85	3.85	15.38	76.92	26	4.65	4.47	4.58	4.59
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	0.00	3.85	0.00	7.69	88.46	26	4.81	4.69	4.71	4.72
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	0.00	0.00	0.00	15.38	84.62	26	4.85	4.40	4.57	4.59
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	0.00	0.00	0.00	7.69	92.31	26	4.92	4.57	4.70	4.71
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	0.00	0.00	3.85	7.69	88.46	26	4.85	4.29	4.61	4.62
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	0.00	3.85	3.85	3.85	88.46	26	4.77	4.78	4.78	4.77
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	0.00	0.00	7.69	3.85	88.46	26	4.81	4.17	4.51	4.55
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	0.00	0.00	7.69	3.85	88.46	26	4.81	4.30	4.61	4.62
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	0.00	0.00	0.00	11.54	88.46	26	4.88	4.82	4.81	4.81
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	0.00	0.00	7.69	3.85	88.46	26	4.81	4.47	4.66	4.67
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	0.00	0.00	0.00	11.54	88.46	26	4.88	4.43	4.62	4.64
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	0.00	0.00	3.85	7.69	88.46	26	4.85	4.32	4.60	4.63
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	0.00	3.85	3.85	3.85	88.46	26	4.77	4.61	4.71	4.72
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	0.00	0.00	4.17	8.33	87.50	24	4.83	4.12	4.52	4.54
OVERALL SUMMARY	0.00	1.29	3.09	7.73	87.89	388	4.82	4.48	4.65	4.67

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	0.00	0.00	0.00	11.86	88.14	59	4.88	4.81	4.83	4.82
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	0.00	1.69	1.69	20.34	76.27	59	4.71	4.69	4.61	4.60
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	0.00	0.00	5.08	8.47	86.44	59	4.81	4.70	4.70	4.70
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	0.00	0.00	1.69	15.25	83.05	59	4.81	4.52	4.57	4.58
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	1.69	1.69	3.39	10.17	83.05	59	4.71	4.62	4.68	4.70
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	0.00	5.08	1.69	16.95	76.27	59	4.64	4.48	4.60	4.61
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	0.00	0.00	0.00	6.78	93.22	59	4.93	4.80	4.78	4.77
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	1.69	1.69	3.39	16.95	76.27	59	4.64	4.32	4.52	4.55
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	0.00	1.69	5.08	18.64	74.58	59	4.66	4.53	4.61	4.61
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	0.00	0.00	0.00	5.08	94.92	59	4.95	4.84	4.81	4.80
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	0.00	0.00	8.47	20.34	71.19	59	4.63	4.49	4.66	4.67
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	0.00	0.00	1.69	18.64	79.66	59	4.78	4.59	4.63	4.63
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	0.00	1.69	8.47	10.17	79.66	59	4.68	4.60	4.62	4.63
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	0.00	0.00	1.69	13.56	84.75	59	4.83	4.69	4.71	4.70
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	0.00	3.45	6.90	15.52	74.14	58	4.60	4.41	4.54	4.54
OVERALL SUMMARY	0.23	1.13	3.28	13.91	81.45	884	4.75	4.60	4.66	4.66

DEPARTMENT: BIOLOGY

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR HAS A THOROUGH KNOWLEDGE OF THE SUBJECT MATTER	0.00	0.00	0.00	17.65	82.35	17	4.82	4.88	4.86	4.85
Q02 THE INSTRUCTORS COURSE PRESENTATIONS WERE WELL-ORGANIZED	0.00	5.88	35.29	11.76	47.06	17	4.00	4.59	4.63	4.64
Q03 THE INSTRUCTOR HAD OFFICE HOURS POSTED AND WAS AVAILABLE DURING THOSE HOURS	0.00	0.00	5.88	5.88	88.24	17	4.82	4.76	4.73	4.75
Q04 THE INSTRUCTOR PROVIDED ADEQUATE FEEDBACK AND/OR EVALUATION OF STUDENT PERFORMANCE	0.00	5.88	17.65	17.65	58.82	17	4.29	4.52	4.62	4.63
Q05 THE INSTRUCTOR DEALT FAIRLY AND IMPARTIALLY WITH ALL CLASS MEMBERS	0.00	0.00	11.76	5.88	82.35	17	4.71	4.73	4.72	4.73
Q06 THE INSTRUCTOR HAS EFFECTIVE ORAL COMMUNICATION SKILLS	0.00	11.76	23.53	11.76	52.94	17	4.06	4.53	4.67	4.68
Q07 THE INSTRUCTOR WAS ON TIME FOR CLASS AND THE CLASS MET AS SCHEDULED	0.00	0.00	0.00	5.88	94.12	17	4.94	4.86	4.82	4.81
Q08 THE INSTRUCTOR PROVIDED LEARNING ENHANCEMENT ACTIVITIES OTHER THAN LECTURE	0.00	0.00	5.88	17.65	76.47	17	4.71	4.30	4.57	4.60
Q09 OVERALL, THE INSTRUCTOR WAS AN EFFECTIVE TEACHER	0.00	5.88	23.53	17.65	52.94	17	4.18	4.57	4.67	4.67
Q10 COURSE OBJECTIVES AND METHODS OF EVALUATION WERE DISTRIBUTED VIA THE CLASS SYLLABUS	0.00	0.00	0.00	17.65	82.35	17	4.82	4.87	4.83	4.83
Q11 INSTRUCTIONAL MATERIALS, INCLUDING THE TEXTBOOK, WERE ADEQUATE AND APPROPRIATE	0.00	0.00	0.00	29.41	70.59	17	4.71	4.57	4.67	4.68
Q12 THE EVALUATION PROCEDURES USED PROVIDED ME WITH AN ADEQUATE OPPORTUNITY TO DEMONSTRATE MY UNDERSTANDING OF THE COURSE CONTENT	0.00	5.88	11.76	11.76	70.59	17	4.47	4.55	4.66	4.67
Q13 THE COURSE IMPROVED MY UNDERSTANDING OF CONCEPTS AND PRINCIPLES IN THE SUBJECT MATTER COVERED	0.00	0.00	17.65	17.65	64.71	17	4.47	4.55	4.65	4.66
Q14 THE REQUIREMENTS AND CRITERIA STATED IN THE SYLLABUS ACCURATELY DESCRIBED THOSE APPLIED IN THE COURSE	0.00	0.00	0.00	11.76	88.24	17	4.88	4.72	4.74	4.74
Q15 I WOULD RECOMMEND THIS CLASS TO OTHER STUDENTS	0.00	5.88	23.53	23.53	47.06	17	4.12	4.39	4.57	4.57
OVERALL SUMMARY	0.00	2.75	11.76	14.90	70.59	255	4.53	4.63	4.69	4.70

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR WAS USUALLY PRESENT AND ON TIME FOR LABORATORY MEETINGS	0.00	0.00	0.00	2.33	97.67	43	4.98	4.94	4.94	4.94
Q02 THE INSTRUCTOR PROVIDED A SYLLABUS WHICH MADE THE COURSE OBJECTIVES, REQUIREMENTS, BASIS FOR GRADE DETERMINATION, AND OFFICE H	0.00	0.00	2.33	9.30	88.37	43	4.86	4.88	4.88	4.88
Q03 THE INSTRUCTOR WAS WELL PREPARED FOR LABORATORY	0.00	2.33	2.33	13.95	81.40	43	4.74	4.87	4.87	4.87
Q04 THE INSTRUCTOR WAS AVAILABLE DURING OFFICE HOURS	0.00	0.00	9.52	9.52	80.95	42	4.71	4.72	4.72	4.72
Q05 THE INSTRUCTOR ADEQUATELY EXPLAINED UNFAMILIAR SCIENTIFIC VOCABULARY	2.33	2.33	2.33	20.93	72.09	43	4.58	4.67	4.67	4.67
Q06 THE INSTRUCTOR SEEMED INTERESTED IN TEACHING THE LABORATORY	0.00	2.33	2.33	20.93	74.42	43	4.67	4.75	4.75	4.75
Q07 ADEQUATE INSTRUCTIONS WERE GIVEN AT THE BEGINNING OF THE LABORATORY	0.00	4.65	0.00	18.60	76.74	43	4.67	4.81	4.81	4.81
Q08 LABORATORY CLEANLINESS AND GOOD LABORATORY TECHNIQUES WERE EMPHASIZED	0.00	2.33	2.33	9.30	86.05	43	4.79	4.83	4.83	4.83
Q09 THE INSTRUCTOR WAS AVAILABLE TO ANSWER QUESTIONS AS THEY AROSE DURING THE LABORATORY PERIOD	0.00	4.65	4.65	6.98	83.72	43	4.70	4.85	4.85	4.85
Q10 THE INSTRUCTOR CLEARLY DESCRIBED AND EXPLAINED ANY PARTS OF THE LABORATORY PROCEDURE WHICH MIGHT HAVE BEEN DANGEROUS, OR WHICH	0.00	4.65	4.65	13.95	76.74	43	4.63	4.79	4.79	4.79
Q11 GRADING PROCEDURES WERE IMPARTIAL	0.00	4.76	4.76	7.14	83.33	42	4.69	4.69	4.69	4.69
Q12 THERE WAS A SUFFICIENT NUMBER OF EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS	0.00	0.00	4.76	9.52	85.71	42	4.81	4.77	4.77	4.77
Q13 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS WERE RETURNED WITHIN A REASONABLE AMOUNT OF TIME	0.00	0.00	2.38	7.14	90.48	42	4.88	4.84	4.84	4.84
Q14 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS THOROUGHLY TESTED KNOWLEDGE OF THE MATERIAL	0.00	4.76	2.38	9.52	83.33	42	4.71	4.77	4.77	4.77
Q15 THE LABORATORY CONTRIBUTED SIGNIFICANTLY TO MY UNDERSTANDING OF THE COURSE	0.00	4.76	7.14	16.67	71.43	42	4.55	4.58	4.58	4.58

(Continued)

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q16 IF I WERE TAKING ANOTHER BIOLOGY COURSE, I WOULD LIKE TO HAVE THIS INSTRUCTOR AGAIN	2.50	0.00	17.50	10.00	70.00	40	4.45	4.51	4.51	4.51
OVERALL SUMMARY	0.29	2.36	4.27	11.63	81.44	679	4.72	4.77	4.77	4.77

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR WAS USUALLY PRESENT AND ON TIME FOR LABORATORY MEETINGS	0.00	0.00	0.00	0.00	100.00	23	5.00	4.95	4.95	4.95
Q02 THE INSTRUCTOR PROVIDED A SYLLABUS WHICH MADE THE COURSE OBJECTIVES, REQUIREMENTS, BASIS FOR GRADE DETERMINATION, AND OFFICE H	0.00	0.00	4.35	0.00	95.65	23	4.91	4.89	4.89	4.89
Q03 THE INSTRUCTOR WAS WELL PREPARED FOR LABORATORY	0.00	0.00	0.00	8.70	91.30	23	4.91	4.88	4.88	4.88
Q04 THE INSTRUCTOR WAS AVAILABLE DURING OFFICE HOURS	0.00	0.00	4.35	4.35	91.30	23	4.87	4.74	4.74	4.74
Q05 THE INSTRUCTOR ADEQUATELY EXPLAINED UNFAMILIAR SCIENTIFIC VOCABULARY	0.00	0.00	0.00	17.39	82.61	23	4.83	4.72	4.72	4.72
Q06 THE INSTRUCTOR SEEMED INTERESTED IN TEACHING THE LABORATORY	0.00	0.00	8.70	13.04	78.26	23	4.70	4.89	4.89	4.89
Q07 ADEQUATE INSTRUCTIONS WERE GIVEN AT THE BEGINNING OF THE LABORATORY	0.00	0.00	4.35	8.70	86.96	23	4.83	4.86	4.86	4.86
Q08 LABORATORY CLEANLINESS AND GOOD LABORATORY TECHNIQUES WERE EMPHASIZED	0.00	0.00	0.00	13.04	86.96	23	4.87	4.89	4.89	4.89
Q09 THE INSTRUCTOR WAS AVAILABLE TO ANSWER QUESTIONS AS THEY AROSE DURING THE LABORATORY PERIOD	0.00	0.00	0.00	8.70	91.30	23	4.91	4.89	4.89	4.89
Q10 THE INSTRUCTOR CLEARLY DESCRIBED AND EXPLAINED ANY PARTS OF THE LABORATORY PROCEDURE WHICH MIGHT HAVE BEEN DANGEROUS, OR WHICH	0.00	0.00	0.00	8.70	91.30	23	4.91	4.88	4.88	4.88
Q11 GRADING PROCEDURES WERE IMPARTIAL	0.00	0.00	0.00	9.09	90.91	22	4.91	4.62	4.62	4.62
Q12 THERE WAS A SUFFICIENT NUMBER OF EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS	0.00	0.00	0.00	13.64	86.36	22	4.86	4.83	4.83	4.83
Q13 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS WERE RETURNED WITHIN A REASONABLE AMOUNT OF TIME	0.00	0.00	0.00	13.64	86.36	22	4.86	4.59	4.59	4.59
Q14 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS THOROUGHLY TESTED KNOWLEDGE OF THE MATERIAL	0.00	0.00	0.00	9.09	90.91	22	4.91	4.69	4.69	4.69
Q15 THE LABORATORY CONTRIBUTED SIGNIFICANTLY TO MY UNDERSTANDING OF THE COURSE	0.00	0.00	0.00	9.09	90.91	22	4.91	4.60	4.60	4.60

(Continued)

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q16 IF I WERE TAKING ANOTHER BIOLOGY COURSE, I WOULD LIKE TO HAVE THIS INSTRUCTOR AGAIN	0.00	0.00	4.55	9.09	86.36	22	4.82	4.52	4.52	4.52
OVERALL SUMMARY	0.00	0.00	1.66	9.12	89.23	362	4.88	4.78	4.78	4.78

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR WAS USUALLY PRESENT AND ON TIME FOR LABORATORY MEETINGS	0.00	0.00	0.00	3.77	96.23	53	4.96	4.92	4.92	4.92
Q02 THE INSTRUCTOR PROVIDED A SYLLABUS WHICH MADE THE COURSE OBJECTIVES, REQUIREMENTS, BASIS FOR GRADE DETERMINATION, AND OFFICE H	0.00	0.00	0.00	5.66	94.34	53	4.94	4.88	4.88	4.88
Q03 THE INSTRUCTOR WAS WELL PREPARED FOR LABORATORY	0.00	0.00	0.00	9.43	90.57	53	4.91	4.82	4.82	4.82
Q04 THE INSTRUCTOR WAS AVAILABLE DURING OFFICE HOURS	0.00	0.00	3.77	18.87	77.36	53	4.74	4.77	4.77	4.77
Q05 THE INSTRUCTOR ADEQUATELY EXPLAINED UNFAMILIAR SCIENTIFIC VOCABULARY	0.00	0.00	1.89	15.09	83.02	53	4.81	4.75	4.75	4.75
Q06 THE INSTRUCTOR SEEMED INTERESTED IN TEACHING THE LABORATORY	0.00	0.00	0.00	5.66	94.34	53	4.94	4.85	4.85	4.85
Q07 ADEQUATE INSTRUCTIONS WERE GIVEN AT THE BEGINNING OF THE LABORATORY	0.00	1.89	1.89	9.43	86.79	53	4.81	4.74	4.74	4.74
Q08 LABORATORY CLEANLINESS AND GOOD LABORATORY TECHNIQUES WERE EMPHASIZED	0.00	0.00	0.00	9.43	90.57	53	4.91	4.81	4.81	4.81
Q09 THE INSTRUCTOR WAS AVAILABLE TO ANSWER QUESTIONS AS THEY AROSE DURING THE LABORATORY PERIOD	0.00	0.00	0.00	9.43	90.57	53	4.91	4.85	4.85	4.85
Q10 THE INSTRUCTOR CLEARLY DESCRIBED AND EXPLAINED ANY PARTS OF THE LABORATORY PROCEDURE WHICH MIGHT HAVE BEEN DANGEROUS, OR WHICH	0.00	0.00	0.00	16.98	83.02	53	4.83	4.84	4.84	4.84
Q11 GRADING PROCEDURES WERE IMPARTIAL	0.00	0.00	5.66	13.21	81.13	53	4.75	4.68	4.68	4.68
Q12 THERE WAS A SUFFICIENT NUMBER OF EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS	0.00	1.89	3.77	9.43	84.91	53	4.77	4.74	4.74	4.74
Q13 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS WERE RETURNED WITHIN A REASONABLE AMOUNT OF TIME	1.89	0.00	0.00	7.55	90.57	53	4.85	4.37	4.37	4.37
Q14 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS THOROUGHLY TESTED KNOWLEDGE OF THE MATERIAL	0.00	0.00	0.00	18.87	81.13	53	4.81	4.66	4.66	4.66
Q15 THE LABORATORY CONTRIBUTED SIGNIFICANTLY TO MY UNDERSTANDING OF THE COURSE	0.00	3.85	1.92	23.08	71.15	52	4.62	4.53	4.53	4.53

(Continued)

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q16 IF I WERE TAKING ANOTHER BIOLOGY COURSE, I WOULD LIKE TO HAVE THIS INSTRUCTOR AGAIN	0.00	3.85	7.69	13.46	75.00	52	4.60	4.51	4.51	4.51
OVERALL SUMMARY	0.12	0.71	1.65	11.82	85.70	846	4.82	4.73	4.73	4.73

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR WAS USUALLY PRESENT AND ON TIME FOR LABORATORY MEETINGS	0.00	0.00	0.00	0.00	100.00	21	5.00	4.92	4.92	4.92
Q02 THE INSTRUCTOR PROVIDED A SYLLABUS WHICH MADE THE COURSE OBJECTIVES, REQUIREMENTS, BASIS FOR GRADE DETERMINATION, AND OFFICE H	0.00	0.00	0.00	9.52	90.48	21	4.90	4.88	4.88	4.88
Q03 THE INSTRUCTOR WAS WELL PREPARED FOR LABORATORY	0.00	0.00	0.00	0.00	100.00	21	5.00	4.86	4.86	4.86
Q04 THE INSTRUCTOR WAS AVAILABLE DURING OFFICE HOURS	0.00	0.00	4.76	4.76	90.48	21	4.86	4.69	4.69	4.69
Q05 THE INSTRUCTOR ADEQUATELY EXPLAINED UNFAMILIAR SCIENTIFIC VOCABULARY	4.76	0.00	0.00	14.29	80.95	21	4.67	4.64	4.64	4.64
Q06 THE INSTRUCTOR SEEMED INTERESTED IN TEACHING THE LABORATORY	0.00	0.00	0.00	4.76	95.24	21	4.95	4.87	4.87	4.87
Q07 ADEQUATE INSTRUCTIONS WERE GIVEN AT THE BEGINNING OF THE LABORATORY	0.00	0.00	0.00	9.52	90.48	21	4.90	4.70	4.70	4.70
Q08 LABORATORY CLEANLINESS AND GOOD LABORATORY TECHNIQUES WERE EMPHASIZED	0.00	0.00	0.00	14.29	85.71	21	4.86	4.81	4.81	4.81
Q09 THE INSTRUCTOR WAS AVAILABLE TO ANSWER QUESTIONS AS THEY AROSE DURING THE LABORATORY PERIOD	0.00	0.00	4.76	0.00	95.24	21	4.90	4.88	4.88	4.88
Q10 THE INSTRUCTOR CLEARLY DESCRIBED AND EXPLAINED ANY PARTS OF THE LABORATORY PROCEDURE WHICH MIGHT HAVE BEEN DANGEROUS, OR WHICH	0.00	0.00	4.76	0.00	95.24	21	4.90	4.81	4.81	4.81
Q11 GRADING PROCEDURES WERE IMPARTIAL	0.00	0.00	0.00	5.00	95.00	20	4.95	4.61	4.61	4.61
Q12 THERE WAS A SUFFICIENT NUMBER OF EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS	0.00	0.00	5.00	0.00	95.00	20	4.90	4.75	4.75	4.75
Q13 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS WERE RETURNED WITHIN A REASONABLE AMOUNT OF TIME	0.00	0.00	0.00	5.00	95.00	20	4.95	4.66	4.66	4.66
Q14 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS THOROUGHLY TESTED KNOWLEDGE OF THE MATERIAL	0.00	0.00	5.00	0.00	95.00	20	4.90	4.76	4.76	4.76
Q15 THE LABORATORY CONTRIBUTED SIGNIFICANTLY TO MY UNDERSTANDING OF THE COURSE	5.00	0.00	5.00	10.00	80.00	20	4.60	4.52	4.52	4.52

(Continued)

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q16 IF I WERE TAKING ANOTHER BIOLOGY COURSE, I WOULD LIKE TO HAVE THIS INSTRUCTOR AGAIN	10.00	0.00	5.00	5.00	80.00	20	4.45	4.48	4.48	4.48
OVERALL SUMMARY	1.21	0.00	2.12	5.15	91.52	330	4.86	4.74	4.74	4.74

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR WAS USUALLY PRESENT AND ON TIME FOR LABORATORY MEETINGS	0.00	1.75	0.00	8.77	89.47	57	4.86	4.92	4.92	4.92
Q02 THE INSTRUCTOR PROVIDED A SYLLABUS WHICH MADE THE COURSE OBJECTIVES, REQUIREMENTS, BASIS FOR GRADE DETERMINATION, AND OFFICE H	0.00	0.00	3.51	10.53	85.96	57	4.82	4.88	4.88	4.88
Q03 THE INSTRUCTOR WAS WELL PREPARED FOR LABORATORY	0.00	1.75	0.00	8.77	89.47	57	4.86	4.86	4.86	4.86
Q04 THE INSTRUCTOR WAS AVAILABLE DURING OFFICE HOURS	0.00	1.75	15.79	5.26	77.19	57	4.58	4.74	4.74	4.74
Q05 THE INSTRUCTOR ADEQUATELY EXPLAINED UNFAMILIAR SCIENTIFIC VOCABULARY	1.75	1.75	5.26	8.77	82.46	57	4.68	4.67	4.67	4.67
Q06 THE INSTRUCTOR SEEMED INTERESTED IN TEACHING THE LABORATORY	0.00	0.00	0.00	19.30	80.70	57	4.81	4.81	4.81	4.81
Q07 ADEQUATE INSTRUCTIONS WERE GIVEN AT THE BEGINNING OF THE LABORATORY	0.00	0.00	3.51	15.79	80.70	57	4.77	4.77	4.77	4.77
Q08 LABORATORY CLEANLINESS AND GOOD LABORATORY TECHNIQUES WERE EMPHASIZED	0.00	0.00	1.75	14.04	84.21	57	4.82	4.84	4.84	4.84
Q09 THE INSTRUCTOR WAS AVAILABLE TO ANSWER QUESTIONS AS THEY AROSE DURING THE LABORATORY PERIOD	0.00	0.00	0.00	8.77	91.23	57	4.91	4.85	4.85	4.85
Q10 THE INSTRUCTOR CLEARLY DESCRIBED AND EXPLAINED ANY PARTS OF THE LABORATORY PROCEDURE WHICH MIGHT HAVE BEEN DANGEROUS, OR WHICH	0.00	0.00	0.00	12.28	87.72	57	4.88	4.83	4.83	4.83
Q11 GRADING PROCEDURES WERE IMPARTIAL	0.00	0.00	8.77	17.54	73.68	57	4.65	4.67	4.67	4.67
Q12 THERE WAS A SUFFICIENT NUMBER OF EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS	1.75	1.75	3.51	24.56	68.42	57	4.56	4.73	4.73	4.73
Q13 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS WERE RETURNED WITHIN A REASONABLE AMOUNT OF TIME	0.00	3.51	1.75	14.04	80.70	57	4.72	4.71	4.71	4.71
Q14 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS THOROUGHLY TESTED KNOWLEDGE OF THE MATERIAL	1.75	3.51	1.75	26.32	66.67	57	4.53	4.71	4.71	4.71
Q15 THE LABORATORY CONTRIBUTED SIGNIFICANTLY TO MY UNDERSTANDING OF THE COURSE	3.51	7.02	8.77	22.81	57.89	57	4.25	4.55	4.55	4.55

(Continued)

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q16 IF I WERE TAKING ANOTHER BIOLOGY COURSE, I WOULD LIKE TO HAVE THIS INSTRUCTOR AGAIN	0.00	11.32	13.21	18.87	56.60	53	4.21	4.43	4.43	4.43
OVERALL SUMMARY	0.55	2.09	4.19	14.76	78.41	908	4.68	4.75	4.75	4.75

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR WAS USUALLY PRESENT AND ON TIME FOR LABORATORY MEETINGS	0.00	1.19	0.00	9.52	89.29	84	4.87	4.90	4.90	4.90
Q02 THE INSTRUCTOR PROVIDED A SYLLABUS WHICH MADE THE COURSE OBJECTIVES, REQUIREMENTS, BASIS FOR GRADE DETERMINATION, AND OFFICE H	0.00	0.00	1.19	13.10	85.71	84	4.85	4.86	4.86	4.86
Q03 THE INSTRUCTOR WAS WELL PREPARED FOR LABORATORY	0.00	0.00	2.38	17.86	79.76	84	4.77	4.82	4.82	4.82
Q04 THE INSTRUCTOR WAS AVAILABLE DURING OFFICE HOURS	0.00	1.20	16.87	15.66	66.27	83	4.47	4.61	4.61	4.61
Q05 THE INSTRUCTOR ADEQUATELY EXPLAINED UNFAMILIAR SCIENTIFIC VOCABULARY	0.00	2.38	5.95	16.67	75.00	84	4.64	4.60	4.60	4.60
Q06 THE INSTRUCTOR SEEMED INTERESTED IN TEACHING THE LABORATORY	0.00	1.19	2.38	17.86	78.57	84	4.74	4.75	4.75	4.75
Q07 ADEQUATE INSTRUCTIONS WERE GIVEN AT THE BEGINNING OF THE LABORATORY	0.00	1.19	1.19	13.10	84.52	84	4.81	4.72	4.72	4.72
Q08 LABORATORY CLEANLINESS AND GOOD LABORATORY TECHNIQUES WERE EMPHASIZED	0.00	1.19	0.00	9.52	89.29	84	4.87	4.85	4.85	4.85
Q09 THE INSTRUCTOR WAS AVAILABLE TO ANSWER QUESTIONS AS THEY AROSE DURING THE LABORATORY PERIOD	0.00	0.00	1.19	15.48	83.33	84	4.82	4.80	4.80	4.80
Q10 THE INSTRUCTOR CLEARLY DESCRIBED AND EXPLAINED ANY PARTS OF THE LABORATORY PROCEDURE WHICH MIGHT HAVE BEEN DANGEROUS, OR WHICH	0.00	0.00	0.00	11.90	88.10	84	4.88	4.80	4.80	4.80
Q11 GRADING PROCEDURES WERE IMPARTIAL	0.00	0.00	4.88	20.73	74.39	82	4.70	4.59	4.59	4.59
Q12 THERE WAS A SUFFICIENT NUMBER OF EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS	0.00	0.00	1.22	15.85	82.93	82	4.82	4.76	4.76	4.76
Q13 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS WERE RETURNED WITHIN A REASONABLE AMOUNT OF TIME	0.00	0.00	3.66	7.32	89.02	82	4.85	4.78	4.78	4.78
Q14 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS THOROUGHLY TESTED KNOWLEDGE OF THE MATERIAL	0.00	0.00	2.44	14.63	82.93	82	4.80	4.71	4.71	4.71
Q15 THE LABORATORY CONTRIBUTED SIGNIFICANTLY TO MY UNDERSTANDING OF THE COURSE	0.00	1.22	8.54	20.73	69.51	82	4.59	4.50	4.50	4.50

(Continued)

# Stud. Eval. Lab

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q16 IF I WERE TAKING ANOTHER BIOLOGY COURSE, I WOULD LIKE TO HAVE THIS INSTRUCTOR AGAIN	0.00	3.85	12.82	15.38	67.95	78	4.47	4.37	4.37	4.37
OVERALL SUMMARY	0.00	0.83	3.99	14.69	80.48	1327	4.75	4.72	4.72	4.72

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q01 THE INSTRUCTOR WAS USUALLY PRESENT AND ON TIME FOR LABORATORY MEETINGS	0.00	0.00	2.22	6.67	91.11	45	4.89	4.90	4.90	4.90
Q02 THE INSTRUCTOR PROVIDED A SYLLABUS WHICH MADE THE COURSE OBJECTIVES, REQUIREMENTS, BASIS FOR GRADE DETERMINATION, AND OFFICE H	0.00	2.22	2.22	0.00	95.56	45	4.89	4.90	4.90	4.90
Q03 THE INSTRUCTOR WAS WELL PREPARED FOR LABORATORY	0.00	0.00	0.00	0.00	100.00	45	5.00	4.87	4.87	4.87
Q04 THE INSTRUCTOR WAS AVAILABLE DURING OFFICE HOURS	0.00	0.00	4.44	4.44	91.11	45	4.87	4.79	4.79	4.79
Q05 THE INSTRUCTOR ADEQUATELY EXPLAINED UNFAMILIAR SCIENTIFIC VOCABULARY	0.00	0.00	2.22	8.89	88.89	45	4.87	4.71	4.71	4.71
Q06 THE INSTRUCTOR SEEMED INTERESTED IN TEACHING THE LABORATORY	0.00	0.00	0.00	6.67	93.33	45	4.93	4.87	4.87	4.87
Q07 ADEQUATE INSTRUCTIONS WERE GIVEN AT THE BEGINNING OF THE LABORATORY	0.00	0.00	4.44	8.89	86.67	45	4.82	4.79	4.79	4.79
Q08 LABORATORY CLEANLINESS AND GOOD LABORATORY TECHNIQUES WERE EMPHASIZED	0.00	0.00	0.00	4.44	95.56	45	4.96	4.86	4.86	4.86
Q09 THE INSTRUCTOR WAS AVAILABLE TO ANSWER QUESTIONS AS THEY AROSE DURING THE LABORATORY PERIOD	0.00	0.00	0.00	2.22	97.78	45	4.98	4.88	4.88	4.88
Q10 THE INSTRUCTOR CLEARLY DESCRIBED AND EXPLAINED ANY PARTS OF THE LABORATORY PROCEDURE WHICH MIGHT HAVE BEEN DANGEROUS, OR WHICH	0.00	0.00	2.22	4.44	93.33	45	4.91	4.86	4.86	4.86
Q11 GRADING PROCEDURES WERE IMPARTIAL	2.22	0.00	4.44	8.89	84.44	45	4.73	4.71	4.71	4.71
Q12 THERE WAS A SUFFICIENT NUMBER OF EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS	0.00	0.00	0.00	11.11	88.89	45	4.89	4.79	4.79	4.79
Q13 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS WERE RETURNED WITHIN A REASONABLE AMOUNT OF TIME	0.00	0.00	0.00	4.44	95.56	45	4.96	4.68	4.68	4.68
Q14 EXAMINATIONS, QUIZZES, OR OTHER EVALUATION INSTRUMENTS THOROUGHLY TESTED KNOWLEDGE OF THE MATERIAL	0.00	2.22	0.00	11.11	86.67	45	4.82	4.76	4.76	4.76
Q15 THE LABORATORY CONTRIBUTED SIGNIFICANTLY TO MY UNDERSTANDING OF THE COURSE	2.22	4.44	6.67	11.11	75.56	45	4.53	4.60	4.60	4.60

(Continued)

# Stud. Eval. Lab

DEPARTMENT: BIOLOGY LAB

INST 27	PERCENTAGE RESPONSE					RESP	INST MEAN	DEPT MEAN	COLL MEAN	UNA MEAN
	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	N				
Q16 IF I WERE TAKING ANOTHER BIOLOGY COURSE, I WOULD LIKE TO HAVE THIS INSTRUCTOR AGAIN	2.33	4.65	13.95	16.28	62.79	43	4.33	4.49	4.49	4.49
OVERALL SUMMARY	0.42	0.84	2.65	6.82	89.28	718	4.84	4.78	4.78	4.78

# Grade distribution calculations

## Grade distributions Fall 2102 - Spring 2016

	A	B	C	D	F	WD	total	%A	%B	%C	%D	%F	%WD
hubler	<b>160</b>	<b>191</b>	<b>171</b>	<b>47</b>	<b>11</b>	<b>35</b>	615	26	31	28	8	2	6
bio	586	712	561	236	103	187	2,385	25	30	24	10	4	8
una	21,030	13,969	7,233	2,548	2,172	2,828	49,780	42	28	15	5	4	6

## Withdrawals calculations

	W	WD	WF	WP	total
hubler	<b>15</b>	<b>1</b>	<b>4</b>	<b>15</b>	35
bio	62	9	9	107	187
una	1,323	172	353	980	2,828

# Grade distribution data

University of North Alabama

Grade Distribution

Dr. Tina Hubler

Fall 2012 - Spring 2016

Final Grade	A	AU	B	C	D	F	NG	W	WD	WF	WP	Total
Fall 2012	23	0	21	21	7	1	56	1	1	1	3	135
BI101	15	0	10	14	4	1	26	0	1	1	1	73
BI306	3	0	9	6	3	0	24	1	0	0	2	48
BI415	3	0	2	1	0	0	6	0	0	0	0	12
BI495	2	0	0	0	0	0	0	0	0	0	0	2
Fall 2013	13	1	12	4	1	0	55	3	0	0	1	90
BI101	0	0	0	0	0	0	24	0	0	0	0	24
BI306	7	1	7	4	1	0	24	3	0	0	1	48
BI415	2	0	5	0	0	0	7	0	0	0	0	14
BI495	4	0	0	0	0	0	0	0	0	0	0	4
Fall 2014	9	0	7	7	1	1	51	1	0	0	0	77
BI101	0	0	0	0	0	0	26	0	0	0	0	26
BI306	7	0	7	6	1	1	23	1	0	0	0	46
BI415	1	0	0	1	0	0	2	0	0	0	0	4
BI495	1	0	0	0	0	0	0	0	0	0	0	1
Fall 2015	11	0	12	11	3	1	95	4	0	0	2	139
BI101	0	0	0	0	0	0	72	0	0	0	0	72
BI306	5	0	4	9	1	1	23	2	0	0	1	46
BI495	1	0	0	0	0	0	0	0	0	0	0	1
BI498	5	0	8	2	2	0	0	2	0	0	1	20
Spring 2013	30	0	46	46	8	3	64	1	0	0	5	203
BI101	15	0	33	33	6	3	24	1	0	0	5	120
BI306	12	0	13	13	2	0	40	0	0	0	0	80
BI495	3	0	0	0	0	0	0	0	0	0	0	3
Spring 2014	21	0	23	26	7	1	64	3	0	1	2	148
BI101	10	0	12	17	2	0	26	0	0	0	1	68
BI306	7	0	11	9	5	1	38	3	0	1	1	76
BI495	4	0	0	0	0	0	0	0	0	0	0	4
Spring 2015	15	0	24	23	10	1	63	1	0	2	2	141
BI101	6	0	8	13	10	0	25	1	0	0	2	65
BI306	9	0	16	10	0	1	38	0	0	2	0	76

# Grade distribution data

University of North Alabama  
 Grade Distribution  
 Dr. Tina Hubler  
 Fall 2012 - Spring 2016

Spring 2016	28	0	33	23	9	2	56	1	0	0	0	152
BI101	15	0	11	12	3	1	24	1	0	0	0	67
BI306	3	0	14	8	6	1	32	0	0	0	0	64
BI495	2	0	0	0	0	0	0	0	0	0	0	2
BI498	7	0	8	3	0	0	0	0	0	0	0	18
BI602	1	0	0	0	0	0	0	0	0	0	0	1
Summer 2013	3	0	5	5	0	0	12	0	0	0	0	25
BI306	2	0	5	5	0	0	12	0	0	0	0	24
BI495	1	0	0	0	0	0	0	0	0	0	0	1
Summer 2014	7	0	8	5	1	1	0	0	0	0	0	22
BI241	7	0	8	5	1	1	0	0	0	0	0	22
<b>Overall Total</b>	<b>160</b>	<b>1</b>	<b>191</b>	<b>171</b>	<b>47</b>	<b>11</b>	<b>516</b>	<b>15</b>	<b>1</b>	<b>4</b>	<b>15</b>	<b>1,132</b>

Final Grade	Null	A	B	C	D	F	NG	W	WD	WF	WP	Total
Biology*	1	586	712	561	236	103	2,115	62	9	9	107	4,501

\*Undergraduate Biology grades only

Final Grade	Null	A	AU	B	C	D	F	I	IP	NC	NG	P	S	U	W	WD	WF	WP	WS	WU	Total
UNA*	56	21,030	29	13,969	7,233	2,548	2,172	417	10	320	4,052	31	1,092	336	1,323	172	353	980	1	3	56,127

\*UNA undergraduate grades only

**COLLEGE OF ARTS AND SCIENCES**  
**DEPARTMENT OF BIOLOGY**  
**GUIDELINES FOR TENURE AND PROMOTION**

**Introduction**

This document provides information relative to this department's expectations of faculty and the criteria by which individuals will be evaluated for tenure and promotion. Each tenure or promotion case is unique and will be treated as such. However, each case will be evaluated within the general context of the following expectations. These expectations are clarifications and interpretations of the standards specified in the *Faculty Handbook* regarding tenure or promotion. The University requirements for tenure and promotion articulated in the *Faculty Handbook* are minimum requirements (see Section 2.5 of the *Faculty Handbook*, available at <http://www2.una.edu/vpaa/Handbook/fh3.doc>). The requirements specified here are the bare minimums below which tenure and/or promotion should not be granted unless treated as an overt exception. Exceptions will be rare and used only in extreme, unique cases. The department will be reluctant to recommend exceptions to these bare minimums, and then only when a compelling case has been made for the need to do so. This need should be based on departmental, college, and institutional benefits to be derived from the exception.

The structure of tenure and promotion committees is described in the *Faculty Handbook*. Committee members will review a candidate's portfolio for tenure or promotion and consider three categories of activities: (a) teaching, (b) research and scholarship, and (c) service. Committee members will rate faculty performances in these categories as excellent (3 points), favorable (2 points), satisfactory (1 point), or unsatisfactory (0 points). Average scores in each category will be calculated from the individual scores given by committee members and rounded to the nearest whole number.

In considerations of promotion at all ranks, evaluations will reflect the evolution of the candidate's credentials since the last promotion or job action. Specifically, what the candidate has accomplished in each area *since the last time the candidate was promoted or appointed to a given rank* will be evaluated. In other words, the key determinant is... "What have you done since your last promotion or appointment to warrant the currently requested promotion?" Within this context, the standards outlined below are applied.

**Teaching**

Effective teaching evaluation should include multiple measures, not a single instrument or scale of success. The evaluation program should involve a variety of methods for assessing both strengths and weaknesses. Evidence of effective teaching may include items from each of the following categories:

Self Review

- A self-evaluation statement that relates the instructor's goals and the means to achieve those goals and that describes the degree of achievement of those goals.
- Course materials (syllabi, assignments, quizzes, exams, *etc.*) which reflect the current knowledge of the discipline and sound pedagogy.
- Active participation in workshops, seminars, programs or other relevant instructional issues.
- Innovations in teaching and learning concepts, applications, technologies, *etc.*
- Responses to feedback from student course evaluations, annual reviews and/or external reviews.
- Written materials, workbooks, lab manuals, and other documents prepared by the instructor that enhances teaching in one's field.
- Activity in teaching-focused professional organizations.
- Results of nationally administered tests designed to measure student learning.
- Records of professional communication with students.
- Grade distributions.
- Other.

#### Student Review

- Evaluations by students via formal instruments and including accompanying comments.
- Written testimony from former students.
- Achievements of past students directly related to the faculty member's influence as a teacher.

#### Peer Review

- Recognition by peers for teaching achievements.
- Local, regional or national teaching awards.

#### *Tenure*

In order to be recommended for tenure, a person should have completed the Ph.D. and have a total of at least five points. The total of five points must include a minimum score of two points in teaching.

#### *Promotion*

In order to be recommended for promotion from instructor to assistant professor, a person should have completed the Ph.D. and have a total of at least five points. The total of five points must include a minimum score of two points in teaching. In order to be recommended for promotion from assistant professor to associate professor, a person should have a total of at least six points. The total of six points must include a minimum score of two points in teaching. In order to be recommended for promotion from associate professor to professor, a person should

have completed the Ph.D. and have a total of at least seven points. The total of seven points must include a minimum score of two points in teaching.

### **Scholarly or Creative Performance**

Scholarship is the documented and demonstrated dissemination of information grounded in research or creative activity. Such information is made available to peers or peer groups for evaluation, either through presentation of the research at professional conferences, publication in journals, books, or some similar forum. Evidence of activities in scholarship may be in the form of:

- Papers presented at scholarly meetings.
- Publication in refereed journals.
- Publication of books, textbooks, or book chapters.
- Grant proposals and contracts (funded and unfunded).
- Supervision of student research projects.
- Publication in pedagogical journals.
- Papers presented at faculty workshops.
- Development of computer software.
- Review of manuscripts and technical papers.
- Field collections for dissemination to herbaria or museums.
- Technical reports resulting from consulting activities.
- Other.

### *Tenure*

In order to be recommended for tenure, a person should have completed the Ph.D. and have a total of at least five points. The total of five points must include a minimum score of one point in research and scholarship. A person must have published at least one article in a refereed journal and must have been the lead author of this article (or otherwise be able to demonstrate a major contribution).

### *Promotion*

In order to be recommended for promotion from instructor to assistant professor, a person should have completed the Ph.D. and have a total of at least five points. The total of five points must include a minimum score of one point in research and scholarship. A person must have published at least one article in a refereed journal and must have been the lead author of this article (or otherwise be able to demonstrate a major contribution). In order to be recommended for promotion from assistant professor to associate professor, a person should have a total of at least six points. The total of six points must include a minimum score of one point in research and scholarship. A person must have published at least one article in a refereed journal and must have been the lead author of this article (or otherwise be able to demonstrate a major contribution). In order to be recommended for promotion from associate professor to professor, a person should have completed the Ph.D. and have a total of at least seven points. The total of

seven points must include a minimum score of two points in research and scholarship. A person must have published at least one article in a refereed journal and must have been the lead author of this article (or otherwise be able to demonstrate a major contribution).

## **Service**

The department expects all members of its faculty to demonstrate good citizenship through service to the University, the college, the department, the profession, and the larger community of which the University is a part. Evidence of service activities may include:

- Student advisement.
- Mentoring colleagues.
- Participation in department committees.
- Service as program director.
- Advising a university-recognized student organization.
- Participation in department, college, or university committees.
- Participation in Faculty Senate or Graduate Council.
- Activities in professional organizations.
- Advising or assisting civic organizations, public outreach, and community activities.
- Activities related to the recruitment of students.
- Activities in the community related to the advancement of the profession.
- Letters of recommendation written for students.
- Service on professional advisory boards.
- Professional consulting activities.
- Other.

## *Tenure*

In order to be recommended for tenure, a person should have completed the Ph.D. and have a total of at least five points. The total of five points must include a minimum score of one point in service.

## *Promotion*

In order to be recommended for promotion from instructor to assistant professor, a person should have completed the Ph.D. and have a total of at least five points. The total of five points must include a minimum score of one point in service. In order to be recommended for promotion from assistant professor to associate professor, a person should have a total of at least six points. The total of six points must include a minimum score of one point in service. In order to be recommended for promotion from associate professor to professor, a person should have completed the Ph.D. and have a total of at least seven points. The total of seven points must include a minimum score of two points in service.