

<p style="text-align: center;"><b>Biology 142 – Advanced Topics in Genetics and Molecular Biology</b> <b>Course Syllabus</b> <b>Spring 2006</b></p>
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**Faculty Information:** Dr. Nitya Jacob, *Office:* Room 104, Pierce Hall; *Phone:* 770-784-8346  
*Office Hours:* T 9:30-10:30 AM and Th 3:30-4:30 PM, or by appointment  
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**Lecture:** MWF 9:35-10:25 AM, Room 102, Pierce Hall

**Laboratory:** Wednesday 2:00-5:00 PM, Room 123, Pierce Hall

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**Required Books:**

Text: *Genetics – Analysis of Genes and Genomes*. Sixth Edition. By Daniel L. Hartl and Elizabeth W. Jones. 2005. Jones and Bartlett Publishers, Inc. This book will be used in lecture and lab.

Lab Book: Laboratory research notebook. This notebook should be purchased in the lab from the instructor. We will not be using a published laboratory manual for this course. Laboratory exercises will be provided as handouts prior to lab.

Reference Book: *Biology*, N.A. Campbell and J. B. Reese. 2002. Sixth edition. Benjamin/Cummings Publishing Co., Inc.

**Course Objectives:** Biology 142 examines how genetic and molecular mechanisms feature in multiple aspects of biological life. Physical and chemical properties of genes, transmission mechanisms, and processes by which genes are manifested as physical characteristics in a whole organism will be covered in further detail. Control of gene expression, especially during organism development, is an important concept covered in this course. The causes of mutations and resulting genetic disorders, such as cancer, will also be explored. Major technological advances have greatly facilitated the study of genetics. You will be introduced to techniques in the laboratory such as DNA analysis, recombinant DNA technology, analysis of gene transmission, transformation, bioinformatics and mutation analysis. The laboratory portion of this course encompasses the theme “genes, organisms and the environment.” The laboratory exercises will involve a field study, introducing you to the use of genetic analysis to examine biodiversity in the environment. Practical applications of genetics in the areas of two major human concerns - medicine and agriculture - will be discussed in the laboratory and the classroom. An emphasis will be placed on recognizing social, ethical and environmental impacts of current advances in genetic research. Critical thinking and scientific communication skills will be developed throughout the semester in laboratory and lecture.

**Biology 142 – Advanced Topics in Genetics and Molecular Biology  
Lecture Schedule**

<u>Date</u>	<u>Topic</u>	<u>Assigned Reading</u>
W, Jan 18	Introduction	
F, Jan 20	The DNA revolution Important people and history	Ch. 1
M, Jan 23	Major topics in genetics	Ch. 1
W, Jan 25	DNA structure	Ch. 2
F, Jan 27	Transmission of genes Human pedigree analysis	Ch. 3
M, Jan 30	Gene-gene interactions	Ch. 3
W, Feb 1	Meiosis and gene shuffling	Ch. 4: p.136-149
F, Feb 3	Sex and inheritance, pedigrees	Ch. 4: p.150-158
M, Feb 6	Discussion day	Article
W, Feb 8	Linkage and chromosome maps	Ch. 5: p.176-194
F, Feb 10	Linkage and chromosome maps	Ch. 5: p.203-212
M, Feb 13	Application: genetics and the environment	Handout
W, Feb 15	DNA replication and recombination	Ch. 6: p.222-241 p.245-252
<b>Thurs, Feb 16</b>	<b>EXAM I - 8:00-9:30 AM, Chs 1-5, discussion and application</b>	
F, Feb 17	Bacteria and viruses	Ch. 9
M, Feb 20	Bacteria and viruses	Ch. 9
W, Feb 22	Chromosome organization	Ch. 7
F, Feb 24	Polyploidy	Ch. 8
M, Feb 27	DNA markers and applications	Ch. 2
W, Mar 1	DNA sequencing	Ch. 6: p.241-245
F, Mar 3	Discussion day	Article
M, Mar 6	Colinearity and transcription	Ch. 10
W, Mar 8	Translation	Ch. 10
F, Mar 10	Review and catch up	
<b>Mar 13-17</b>	<b>SPRING BREAK!</b>	

**Bio 142 Lecture Schedule (continued)**

Date	Topic	Assigned Reading M,
Mar 20	Operons	Ch. 11
W, Mar 22	Prokaryotic and eukaryotic gene regulation	Ch. 11
<b>Thurs, Mar 23</b>	<b>EXAM II - 8:00-9:30 AM, Chs 6-10, discussion and application</b>	
F, Mar 24	Eukaryotic gene regulation	Ch. 11
M, Mar 27	Types of mutations	Ch. 14
W, Mar 29	Causes of mutations	Ch. 14
F, Mar 31	Repairing mutations	Ch. 14
M, Apr 3	Karyotypes and chromosome mutations	Ch. 8
W, Apr 5	Cell cycle genes and proteins	Ch. 15
F, Apr 7	The genetics of cancer	Ch. 15
M, Apr 11	Discussion day - cancer research	Article
W, Apr 13	Application: Gene Therapy	Handout
F, Apr 15	Genetic Control of Development	Ch. 13
M, Apr 17	Genetic Control of Development	Ch. 13
W, Apr 19	Application: Stem Cells	
<b>Thurs, Apr 20</b>	<b>EXAM III - 8:00-9:30 AM, Chs. 11, 12, 15, discussion</b>	
F, Apr 21	Review and catch up	
M, Apr 24	Complex inheritance - selected topics	Ch. 18: p.761-774
W, Apr 26	Application: Genetically Modified Organisms	Handout
F, Apr 28	The DNA revolution - ethics and environment	
M, May 1	Future directions	

**\*\* FINAL EXAMINATION\*\* TBA****Comprehensive***Syllabus continues on next page*

**Biology 142 - Advanced Topics in Genetics and Molecular Biology**  
**Laboratory Schedule - Spring 2005**  
**Dr. Nitya Jacob**

<u>Date</u>	<u>Topic</u>	<u>Writing Assignment</u>
Jan 18	No Lab	
Jan 25	Molecular Biology Techniques PCR, Restriction Enzymes, Gel Electrophoresis	
Feb 1	Introduction to Model Organisms	
Feb 8	Introduction to Microbes and Granite Outcrops Literature Search for Research Project	
Feb 15	Field Trip to Rock Outcrops Sample Collection	
Feb 22	Bacterial DNA Extraction and PCR	
Mar 1	Analysis of PCR products Cloning of 16S rDNA sequences	
Mar 8	RFLP analysis of bacterial rDNA	
<i>Mar 15</i>	<b><i>SPRING BREAK</i></b>	
Mar 22	Bioinformatics and Analysis Tools Exercise in Sequence Analysis and Tree Building	
Mar 29	Sequence Analysis and Phylogeny of Outcrop Microbes	
Apr 5	Completion of Research Projects	
Apr 12	Research Symposium - Presentations	
Apr 19	Yeast Mutations	
Apr 26	Future Questions and Research	

## GUIDE TO BIOLOGY 142

Please read this syllabus carefully and please be sure to clarify any doubts. This handout is your map to Biology 142! Please pay full attention to the information contained in this syllabus. Information in this syllabus is subject to change according to my discretion, so please pay attention to any changes made during the semester. Please check the class conference regularly for announcements and changes.

**Expectations/ Study tips.** You are expected to read the assigned chapters from the book as well as any supplemental materials for both lab and lecture. You must read these assignments BEFORE you come to class or lab. If you are not prepared for class, you will certainly fall behind in your understanding, thereby affecting your performance on exams. You are expected to attend every lab and lecture (see absence policy). Please pay attention to the explanations that I give in class and take good notes. Good communication is always the key to success. Please take advantage of my office hours or make appointments with me to communicate any doubts, concerns or questions. I am always ready to listen. We will be covering a vast amount of information in a short period of time, so please make a habit of reviewing the course material on a weekly basis. Please remember that exams and lab exercises will test your ability to think analytically as well as your ability to remember facts and terminology. It is extremely important that you solve practice problems and questions at the end of each chapter regularly to help your analytical thinking.

**Supplemental Instruction.** Biology 142 has an SI program. You must attend your SI sessions on a regular basis to be able to perform well in this course. Beth Siddiqui will offer weekly help sessions to review course material. Please check Learnlink for the specific times.

**Examinations:** The lecture exams will be a combination of multiple choice, short answer and short essay questions. Exams will cover all material in lecture in addition to assigned textbook readings. The final examination is comprehensive. Students should feel free to ask me about any questions about the material on the exam.

**Discussion days.** There are 3 scheduled discussion days for this course. I will assign an article from a scientific journal for each discussion day prior to the class meeting. Every student is required to read the article before class. For each discussion day, certain students will be selected to act as “discussion leaders”. On the day of the discussion, leaders must be prepared to present the article to the class and raise questions about the subject of the article. Every student in the class will have to be a discussion leader once during the semester. Discussion leaders must submit their pre-prepared notes for credit at the end of the discussion. Students who do not serve as leaders for a particular discussion must turn in a 1-2 page (double spaced) summary of the article.

**Laboratory.** There is no published lab manual for this course. I will supply handouts describing the lab exercise one week prior to the lab. These handouts will also be available on Learnlink. I suggest keeping these handouts in a 3-ring binder so that they are easily

available for use in lab. You are expected to read each exercise thoroughly and be fully prepared for each lab. The laboratory portion of Biology 142 resembles a research lab setting, where students are expected to think critically, troubleshoot problems and learn to clearly document observations and analysis. The laboratory encompasses a field study on local granite rock outcrops. Samples will be collected from these outcrops and brought back to the laboratory for genetic analysis. Students will work in research teams, develop an independent question about these organisms and their environment, and will be expected to communicate results in the form of an oral presentation and a full length scientific paper. There will be a few other short written assignments during the semester. No lab practicals will be conducted. You will also maintain a lab notebook which be collected for grading twice during the semester. Lab notebooks will be purchased from me on the first day of lab.

**Class Participation and Learnlink Conference.** Biology 142 is an interactive course. Class participation will be assessed according to your vocal interaction in the classroom, and your active contribution the learnlink conference. A class conference for Biology 142 is available on Learnlink. The conference will be used extensively for this course. Use the conference to bring up discussion points, post your own interests in genetics, and/or to post interesting websites related to genetics. Please check and use this conference on a regular basis. Please be professional and respectful when making your comments.

**Application Topics:** During the course we will focus on the practical aspect of genetics and molecular biology on several occasions. There will be discussions on topics such as stem cell research, gene therapy, genetically modified organisms (GMOs), sustainable agriculture and GMOs, social and ethical concerns. You will be expected to participate in the discussions, complete related readings and view related films on the topics.

**Honor Code:** All examinations and work for credit in this course come under the regulations of the Honor Code. Please uphold the Honor Code and include your signature on your work as your pledge.

**Absences:** The policy on absences is provided in a separate handout. Unexcused absences or a failure to follow the procedures outlined in that handout will result in a reduction in your grade. Any questions about absences should be asked immediately.

**Evaluation:** Students are evaluated on their performance in the classroom and the laboratory. Please see page 7 for the distribution of points.

**Evaluation:**

**Lecture:**

Lecture exams (3)	300 points
Discussion and participation	30 points
Final exam	150 points
Case Studies	30 points

**Laboratory:**

PCR Results and discussion report	25 points
Literature Search and Proposal	10 points
Bioinformatics	10 points
Lab notebooks	60 points
Research Project w/paper	100 points

**Total**            **715 points**

**Final grade determination**

*(Plus and minus grades are given)*

90 - 100%	A
80 - 89%	B
70 - 79%	C
60 - 69%	D
<60	F

## **Biology 142 – Advanced Topics in Genetics and Molecular Biology**

I attended the Piedmont Project to develop an environmental component for my Spring 2006 course – Biology 142. Biology 142 is the second course in the Introductory Biology curriculum at Oxford College. The purpose of this course is to take students to the next level of concepts in the field of genetics, after an initial introduction to the subject in Biology 141 – Cell Biology and Genetics. Biology 142 covers cellular mechanisms in genetics, molecular structures and the study of DNA and RNA in detail. The cellular and molecular focus of this course often leaves the student removed from the whole organism.

I will be introducing a new laboratory research module into Biology 142 in Spring 2006 to help the students to understand genetics from the perspective of the whole organism. The research module will be conducted over the length of the whole semester. The laboratory is developed on the theme “genes, organisms and the environment” with the objective of providing students with a combined experience field and laboratory bench work. Students will take a field trip to two local granite outcrops near Oxford, GA, where they will be introduced to the ecology of the unique environment at these locations. The lab field visit will introduce students to rock outcrops, diversity of organisms, local ecological history, etc. They will collect microbial samples from various niches within this environment for further study. Students will be divided into research teams and each team will select a different question for investigation about their microbe collections. The questions should be related towards examining the diversity of microbes in specific areas of the outcrops. Investigations may be conducted on differences between outcrops, differences in microbial diversity on the outcrops versus an artificially constructed environment, and so on. While developing their investigation questions, students will automatically think about associations between organisms and their environment. The microbes collected from the outcrops will be taken back to the laboratory and during successive laboratory exercises (see syllabus), teams will extract DNA from their samples, conduct the process of PCR (polymerase chain reaction) to specifically isolate ribosomal DNA fragments from their bacterial colonies. They will then proceed to clone and sequence these fragments. The resulting rDNA sequences will be analyzed using bioinformatics computer software. At the end of the project, each research team will have an assessment of biological diversity via DNA sequence analysis, and other observations. Although all research teams will be conducting the same procedures in the laboratory, each will be examining a different question regarding microbial diversity.

The lecture component of the course will leave room for discussion of applied topics and ethical concerns in the field of genetics. The syllabus allots specific days for students to examine topics such as genetics and the environment, genetically modified organisms, ethics and sustainability of a biological ecosystem, which are directly related to the laboratory research module. These will be discussed both in the class and the laboratory. For example, students will be learning the methods of gene cloning and genetic transformation in the laboratory and will also discuss the applications of these techniques in class. This will spark discussion about the environmental impact of genetic applications.

At the Piedmont Project workshop, I learned about several concepts that are important while teaching with an environmental theme. The following are the ways in which Biology 142 will connect with certain themes I learned in the workshop:

“A Sense of Place” – The field visit with my students will give them a better understanding of local resources and ecology. They will have a clear view of the environment in which a variety of organisms flourish. This will give them an opportunity to appreciate a living environment, rather than having a purely laboratory view of biological life. Rather than working with organisms supplied to them (usually ordered from biological supply companies), they will be in touch with actual physical environment of the rock outcrop organisms.

“Sustainability” – The laboratory project will help the students understand the concept of sustainability in a biological ecosystem. Their laboratory research on biodiversity and interaction of plants and microbes will provide a premise to discuss sustainability in our surrounding environments. The outcrops contained disturbed areas where students can carry out investigations, which can also be useful in teaching them about sustainability.



"Impact on Human Life" - Students will learn about genetic analysis through their laboratory project. In the classroom we will discuss the impact of such technology on human life especially medical and agricultural practices. They will be given an opportunity to reflect on the future directions in genetic research and how this might affect human life.

"Hidden Curriculum" - I hope that the field experience, the discussions and assignments in Biology 142 will lead the students to have an increased awareness of biological life in their surrounding areas. Even as they pursue further studies in the area of genetics and genetic engineering, I would like them think objectively about the benefits and drawbacks of genetic technology. I hope that this course will bring them in contact with social, ethical, and environmental issues, which they can also think about in other aspects of their lives.