

Advanced Topics in Genetics and Molecular Biology Biology 142 – Spring 2009

Lecture Instructor: Dr. Anupama Shanmuganathan (Dr. Anu Shanmug)
Office: Pierce Hall # 105 Phone: 770-784-4678
E-mail: ashanmu@learnlink.emory.edu (This is the best way to reach me).

Office hours: Tues: 9am – noon; Monday and Friday: 1-3 pm. If you find me in the office, please feel free to stop by.

Class hours

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|----------------|-----|--------------------|----|-------------------|-------------------|
| Lecture hours: | MWF | 9.35 am -10. 25 am | or | 10.40 am-11.30 am | Pierce Hall # 102 |
| Lab hours: | Tu | 2.30 pm-5.30 pm | or | W – 2pm -5pm | Pierce Lab #125 |

Required – texts and materials

- Lecture and lab topics: *Genetics, A Conceptual Approach*, Benjamin A. Pierce, Third Edition. W. H. Freeman and company.
- Lab: Lab manual - There is no published laboratory lab manual.
Lab book – A laboratory research notebook should be purchased in the lab from the instructor.
Lab binder – Weekly laboratory exercises must be downloaded and printed from the blackboard site and brought to lab each week in a specifically designated 3-ring binder.

Highly recommended materials

- For solving problems: *Solutions and Problem-Solving Manual to accompany Genetics – A Conceptual Approach*. Third Edition.
- For written assignments: *A Student Handbook for Writing in Biology*, Karen Knisely, 2005, 2nd edition, W.H. Freeman and Co.

Course Objectives

- Critical thinking and scientific thinking will be emphasized during this course
- DNA as the secret of life and genetics as a core-concept of biology will be detailed
- Gene structure, expression, genomic diversity and genetic basis of traits will be understood
- Practical applications of genetics in the field of medicine and basic scientific research will be underlined
- Genetic and the molecular basis of several traits and diseases including cancer will be discussed in detail

Tentative lecture schedule for Spring 2009

| Date | Day | Topic | Assigned reading | Dues |
|---------------|-----------|---|--|--------------------------------------|
| Jan 14 | W | Introduction to this course Why study genetics? | Ch. 1 | |
| Jan 16 | F | The history of genetics and DNA | Ch. 1; Ch 10 | |
| Jan 19 | M | <i>*MLK Day – Holiday*</i> | | |
| Jan 21 | W | DNA: The secret of life | Ch. 1; Ch 10 | |
| Jan 23 | F | DNA structure and DNA technology | Ch. 10; Ch. 19- P. 503-509; 513-516 | |
| Jan 26 | M | Chromosomes and cell division | Ch 2 | |
| Jan 28 | W | Transmission genetics, probability | Ch 3 | |
| Jan 30 | F | Sex determination and sex linkage | Ch 4 | Lab assignment due in class |
| Feb 2 | M | Genetic phenomena | Ch 5 – P. 99-119 | |
| Feb 4 | W | Genetic phenomena | Ch 5 – P. 99-119 | |
| Feb 6 | F | Human pedigree analysis | Ch 6 – P. 134-142 | |
| Feb 9 | M | Human pedigree analysis | Ch 6 – P. 134-142 | |
| Feb 10 | Tu | EXAM 1 (Ch 1 -6; Excerpts from Ch 10 and 19) | | |
| Feb 11 | W | Linkage and recombination | Ch 7- P. 160-185 | |
| Feb 13 | F | Linkage and gene mapping | Ch 7- P. 160-185 | Lab assignment due in class |
| Feb 16 | M | Genetics of bacteria and viruses | Ch8 – P. 200-210; 215-219 228-230 | |
| Feb 18 | W | Case study discussion | | |
| Feb 20 | F | Cytogenetics: Chromosome variations | Ch9 | Lab assignment due in class |
| Feb 23 | M | Cytogenetics: Chromosome structure | Ch11 – P. 285-296 | |
| Feb 25 | W | Transposable elements | Ch11 – P. 297-309 | |
| Feb 27 | F | Current research article discussion | | Journal article summary due in class |
| Mar 2 | M | DNA replication | Ch 12 – P. 315-335 | |
| Mar 4 | W | DNA replication and DNA technology | Ch 12 – P. 315-335 | |
| Mar 5 | Th | EXAM 2 (Ch 7, 8, 9, 11 and 12) | | |
| Mar 6 | F | Gene expression: transcription | Ch 13 | |

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|--------------|-----------|---|--------------------|--------------------------------------|
| Mar 9 | M | <i>*Spring break*</i> | | |
| Mar 11 | W | <i>*Spring break*</i> | | |
| Mar 13 | F | <i>*Spring break*</i> | | |
| Mar 16 | M | Gene expression: RNA processing | Ch 14 – P. 368-385 | |
| Mar 18 | W | Gene expression: Translation | Ch 15 | |
| Mar 20 | F | Current research article discussion | | Journal article summary due in class |
| Mar 23 | M | Principles of gene regulation | Ch 16 – P. 425-435 | |
| Mar 25 | W | Transcriptional regulation in prokaryotes – Lac operon | Ch 16 – P. 436-445 | |
| Mar 27 | F | Mutations in the Lac operon; Trp operon | Ch 16 – P. 436-445 | |
| Mar 30 | M | Gene regulation in eukaryotes | Ch 17 | |
| Apr 1 | W | Gene regulation in eukaryotes | Ch 17 | |
| Apr 3 | F | Mutations, effects and repair | Ch 18 | |
| Apr 6 | M | Current research article discussion | | Journal article summary due in class |
| Apr 7 | Tu | EXAM 3 (Ch 13, 14, 15, 16 and 17) | | |
| Apr 8 | W | Mutations, effects and repair | Ch 18 | |
| Apr 10 | F | Mutations, scientific inquiry and biotechnology | Ch 19; P-530-540 | |
| Apr 13 | M | Review | | |
| Apr 15 | W | Cell cycle regulation | Ch. 23 | |
| Apr 17 | F | Curing cancer – a film | | |
| Apr 20 | M | Genetics of cancer | Ch 23 | |
| Apr 22 | W | Stem cells - a case study | | |
| Apr 24 | F | Stem cells – a case study | | |
| Apr 27 | M | Genetics: Biological, social and ethical considerations | | Final lab research paper due |

The instructor reserves the right to modify the lecture and / or lab syllabus during the course of the semester. If and when such changes occur, the students will be informed in advance in the classroom or via the learnlink conference and the blackboard site. It is your responsibility to keep track of such changes

Final Exam: 10A class - Apr 30th, Thursday 2 pm – 5 pm
9A class – May 4th, Monday, 2pm – 5 pm

Guide to BIO 142

Tips for success

1. **Class notes** – Please make it a habit to take good notes in class, since we will not cover everything in the textbook and some of the examples discussed in class may not be in the textbook. Exam questions come out of what is taught in class and not necessarily what is in the textbook.
2. **Textbook** – Please read the assigned chapters in the textbook before coming in to class. Always have your textbook in class. Reading the textbook material ahead of time will serve as a preview of what we will work on in class. After the class, be sure to compare and integrate lecture notes with textbook reading. Your textbook has “concept check” questions in each chapter. Work on the “Concept Checks” regularly
3. **Homework and assignments** – You will be assigned problems and review homework regularly during the course of the semester. Problem solving skills and critical thinking are much emphasized in this course. So, please solve all assigned problems on time when assigned. In addition, also solve the “Comprehensive Questions” in the textbook as well as the “Application Questions” and a few of the “Challenge questions” in the textbook. I will regularly provide via learnlink the assigned problems
4. **Be prepared but do not get overwhelmed** – This course is intense and rigorous. In order to succeed and avoid being overwhelmed, it is important to work on the assigned reading right from the start of the semester. Taking good class notes and keeping up with the assigned problems will be of immense help. Please attend SI sessions regularly and practice problems. Be consistent, regular and organized.

Learnlink and blackboard: This course will be available on learnlink as 142-Shanmug. Please check this learnlink conference regularly for class information, powerpoints from class, study guides, additional problems as well as course announcements. All students are responsible for keeping up with the postings and announcements on the learnlink and blackboard sites.

Honor Code: All the exams and writing assignments in this course come under regulations of the Oxford College Honor Code. Any form of cheating, copying and plagiarism will not be tolerated. Ignorance is not excusable. Please refer to http://www.oxford.emory.edu/audiences/current_students/academics/academic_success/honor_code.dot

Absences: The policies for absences are outlined in a separate handout. Students are allowed only 4 lecture class absences. **All labs are mandatory.** Missing more than one lab will result in an ‘F’ grade. Unexcused absences and tardiness may result in the reduction of your grade.

Supplemental Instruction: Chinar Sanghvi will be the SI for this course. There will be two SI sessions per week. The information for SI sessions is available in the class conference SI folder.

Class Participation: This course has been designed with the idea of being interactive. Active student participation and discussions are strongly encouraged. As with any other course, the more you invest (time and energy), the more you will learn. There are 25 points assigned for class participation in this course. These points will be awarded based upon active engagement in the classroom, level of preparation for each class, problem solving in the class and your performance on homework assignments

Discussion of Current Research Articles: During this semester, we will be discussing 3 scientific articles on three different days as outlined in the syllabus. Copies of the research article will be provided to you in advance. Every student is required to read and understand the scientific article and come to class prepared to discuss the main points of the article. A one-page summary of the research article under discussion is also required, which outlines the goal, methods and conclusions of the investigation. Both the written summary and class participation during discussion count towards grade assessment (worth 30 points).

Film Discussions and Application Topics Discussions: This course will involve case studies and short films that deal with the practical and applied aspects of genetics and molecular biology. Your engagement and participation are strongly encouraged and required.

Laboratory: There is no published lab manual for this course. All the material for each of the labs will be made available in the blackboard site one week in advance. Please keep these handouts in a 3-ring binder and bring to lab each week. The labs are designed to be carried out as if in a research setting with clear documentation of results as well as critical thinking and solving problems on your own. The results must be clearly recorded in a laboratory notebook that must be purchased from the instructor during the first lab. A field study research project involving microbes of the granite outcrops will form a big part of the laboratory schedule. Students will work in groups, collect samples from the granite outcrops, come up with a research proposal on their own and carry out experiments to test your hypothesis in the lab. The project will culminate in a research symposium held in lab, where the students will present their work. A full-length scientific paper on this research project will also be required of the students.

Cell phones: All cell phones must be turned off during the lecture and lab and must be left in the front of the class room during tests and exams.

Evaluations

Your performance in this course will be evaluated based upon written exams, writing assignments and class room participation. The lecture exams will include multiple choice questions, short answer, essays as well as problem solving and critical thinking. The material for the exams will come from what is covered in lecture, assigned textbook readings as well as problem solving. The final exam will cover the last portion of the course material and will also include comprehensive material from the entire semester. There will be no lab exams. The split of points for various criteria are outlined below

Lecture

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|-----------------------------|------------|
| 3 lecture exams: | 300 points |
| General class participation | 25 points |
| Film responses | 10 points |
| Article Discussions | 30 points |
| Final Exam | 170 points |

Lab

| | |
|---|-----------|
| Human genotyping paper (labs 1 and 2) | 30 points |
| Research proposal and literature summary | 15 points |
| Lab notebooks | 40 points |
| Introduction; Materials and Methods – Draft | 10 points |
| Symposium presentation | 20 points |
| Full length scientific paper | 80 points |

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| Total | 730 points |
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Final grade will be determined as below (Plus and minus grades will be given.)

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

Lab schedule

Please read the laboratory material in advance so that lab time is used effectively.

| Date | Topic | Assignment Dues |
|-----------------|---|--|
| Jan 20 / 21 | Molecular biological techniques I Human genomic DNA extraction PCR set up | Introduction and Materials and Methods Due in class Friday, Jan 30 |
| Jan 27 / 28 | Molecular biological techniques II Human genotype analysis | Complete paper (labs 1 and 2) due in class Friday, Feb 13th Lab notebooks due at end of the lab |
| Feb 3 / 4 | Microbes and granite outcrops Literature search for research project | Research proposal due at the end of lab |
| Feb 10/11 | Field trip to Granite outcrops Sample collection | Literature summary due in class On Feb 23, Monday |
| Feb 17 / 18 | Observance of collections and sample selection | |
| Feb 24 / 25 | Bacterial DNA extraction and PCR | |
| Mar 3 / 4 | Purification of PCR products and Restriction enzyme digest | Lab notebooks due at the end of lab |
| Mar 10 / 11 | <i>*Spring Break*</i> | |
| Mar 17 / 18 | RFLP analysis of rDNA | Draft of Introduction and Materials and Methods Due at the beginning of lab |
| Mar 24 / Mar 25 | Bioinformatics and analysis tools Exercise in sequence analysis | Lab notebooks due at the end of lab |
| Mar 31 / Apr 1 | Sequence analysis of outcrop microbes | |
| Apr 7 / 8 | Preparation for research symposium | |
| Apr 14 / 15 | Research symposium - presentations | |
| Apr 21 / 22 | Yeast mutations I | Final paper due Monday, Apr 27 |
| Apr 28 / 24(F) | Yeast mutations II | Lab notebooks due at the end of lab |

Important dates for BIO 142 – Spring 2009

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|-----------------|-------------------------------------|-------|---|
| January | 27 th / 28 th | T / W | Lab notebooks due at the end of lab |
| | 30 th | F | Introduction + Materials and Methods for human genotyping paper - due in class |
| February | 3 rd / 4 th | T/W | Research proposal due at the end of lab |
| | 10 th | T | EXAM 1 |
| | 13 th | F | Complete paper – human genotyping (labs 1 and 2) due in class |
| | 23 rd | M | Literature summary for research project due in class |
| | 27 th | F | Journal article summary due in class |
| March | 3 rd / 4 th | T / W | Lab notebooks due at the end of lab |
| | 5 th | Th | EXAM 2 |
| | 17 th / 18 th | T / W | Introduction + Materials and Methods draft due at the end of lab |
| | 20 th | F | Journal article summary due in class |
| | 24 th / 25 th | T | Lab notebooks due |
| April | 6 th | M | Journal article summary due |
| | 7 th | T | EXAM 3 |
| | 14 th / 15 th | T / W | Research symposium in lab & Last day to turn in research paper drafts in lab (optional) |
| | 27 th | M | Final research paper is due in class |
| | 28 th / 29 th | T / W | Lab notebooks due |