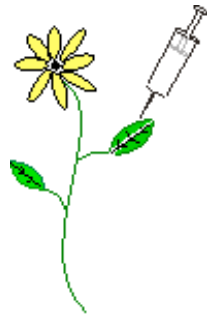


BIOL 161
Cell Biology & Genetics I: Biotechnology and Society



MWF 2:20-3:20
and T AM (lab/discussion section)

Course Instructor: Mary K. Montgomery (aka M²), Associate Professor

Tuesday Lab/Discussion Instructors: Devavani Chatterjea (8:30-10:00); M² (10:10-11:40)
office x6425

lab x8174

montgomery@macalester.edu

<http://www.macalester.edu/~montgomery/>

Office hours: Wed and Fri noon-1:00 or by appointment

Required Texts: *Cell Biology and Genetics*, 10th ed., by C. Starr & R. Taggart
(or Sadava's *Life* or Campbell's *Biology*)

Lords of the Harvest: Biotech, Big Money, and the Future of Food by D. Charles

Additional assigned reading material is listed below and will be posted on Moodle

Useful Websites: Cold Spring Harbor Laboratory (www.cshl.org/)

DNA Interactive (www.dnai.org)

The Biology Project at the University of Arizona (www.biology.arizona.edu/)

National Center for Biotechnology Information (www.ncbi.nlm.nih.gov/)

Course Description

This course will discuss the development and application of biotechnologies, and the impact these technologies have on society. The discussions will include genetic manipulation of organisms (ranging from agricultural plants and animals to gene therapy in humans), DNA fingerprinting and the polymerase chain reaction (with special attention to prenatal diagnosis and forensic applications), in vitro fertilization and pre-implantation diagnosis, and the human genome project. Basic concepts in genetics, cell biology, and molecular biology will be covered. This course is appropriate for both non-majors and students considering a major in Biology. This course fulfills 4 credits in the science distribution requirement and can serve as a pre-requisite for Cell Biology & Genetics II (offered Fall 2008 only). Three 'lecture' hours and 1.5 hours discussion/lab per week. Students must co-enroll in BIOL 161L, the discussion/lab section.

COURSE OBJECTIVES: Upon successful completion of this course, students should be able to demonstrate the following competencies:

- (1) knowledge of basic concepts in cell biology, genetics, and molecular biology and an introductory level understanding of the methodologies associated with those disciplines;
- (2) an understanding that science is a continual process of investigation and interpretation, and that scientific knowledge progresses via the support and rejection of competing hypotheses, collective decisions that are based on empirical evidence and logical interpretation using inductive and deductive reasoning;
- (3) improved research skills and the ability to critically assess the content value of different types of information;
- (4) enhanced critical inquiry skills through writing. Specifically, students should view writing as a tool to explore and express ideas, develop the ability to synthesize and critically evaluate information from multiple sources and viewpoints, and apply such information to the construction of an argument.

SCHEDULE (Subject to revision; readings from textbook will be posted on Moodle)

Jan 28	Introduction
Jan 29	Biology as a process of inquiry Reading posted on Moodle
Jan 30	Evolutionary origin of eukaryotic cells Margulis, L “Against orthodoxy” from <i>Symbiotic Planet</i> (1998) Thomas, L “The lives of a cell” from <i>The Lives of a Cell</i> (1974)
Feb 1	Cell structure and function
Feb 4	Macromolecules: carbohydrates and fatty acids
Feb 5	The nature and logic of science Reading(s) posted on Moodle
Feb 6	Macromolecules: proteins
Feb 8	Cell metabolism and the laws of thermodynamics, or why you need to eat
Feb 11	Macromolecules: nucleic acids
Feb 12	Research skills: accessing and critically evaluating sources of information; what constitutes good writing?
Feb 13	The discovery of the structure of DNA Watson, JD and FH Crick (1953) A structure for deoxyribonucleic acid. <i>Nature</i> 171, 737.
Feb 15	DNA replication Problem Set 1 due
Feb 18	The Central Dogma: transcription and translation
Feb 19	Video: After Darwin: genetics, eugenics, and the human genome Beckwith, J “Their own atomic history” from <i>Making Genes, Making Waves</i> (2002) Kitcher, P “Inescapable eugenics” from <i>The Lives to Come</i> (1997)

“Using genetic tests. Ashkenazi Jews vanquish a disease” NYT (18 Feb 2003)

Ridley, M “Chromosome 5: Environment” from *Genome: The Autobiography of a Species in 23 Chapters* (1999)

Hughes, J “What comes after humans?” New Scientist (2006)
(A reflection paper is due with these reading assignments)

Feb 20	TBA
Feb 22	The genetic code
Feb 25	Exam 1
Feb 26	IVF Policy Reports: Country by Country
Feb 27	Mitosis and Meiosis
Feb 29	Karyotyping, amniocentesis, sex selection, aneuploidies
Mar 3	Mendelian patterns of inheritance Mendel, Gregor (1865) Versuche über Pflanzen-Hybriden (Experiments in Plant Hybridization)
Mar 4	Discussion of Lords of the Harvest by D. Charles (Ch 1 – 9)
Mar 5	Incomplete dominance and other patterns of inheritance NYT Report 1 due
Mar 7	Human genetics
Mar 10	Control of gene expression: regulating transcription Problem Set 2 due
Mar 11	Discussion of Lords of the Harvest by D. Charles (Ch 10 – Epilogue)
Mar 12	No Class
Mar 14	No Class
Mar 17-21	SPRING BREAK
Mar 24	Control of gene expression: regulating transcription
Mar 25	Bioinformatics Lab
Mar 26	Control of gene expression: translational and post-translational controls
Mar 28	Exam 2
Mar 31	Recombinant DNA and genetic engineering: PCR Saiki, RK, S Scharf, F Faloona, KB Mullis, G Horn, HA Erlich, and N Arnheim (1985) Enzymatic amplification of beta-globin genomic sequences and restriction site analysis for diagnosis of sickle cell anemia. <i>Science</i> 230, 1350-4.
Apr 1	Lab Project: DNA extraction and PCR
Special Note: Evening Lecture by Daniel Dennett EC for attendance!	
Apr 2	Recombinant DNA and genetic engineering: slicing and splicing Cohen, SN, AC Chang, HW Boyer, and RB Helling (1973) Construction of biologically functional bacterial plasmids in vitro. <i>PNAS</i> 70, 3240-4.

- Video: Boyer and Cohen
- Apr 4 Recombinant DNA and genetic engineering: transformation
- Apr 7 Recombinant DNA and genetic engineering: blotting and probing
- Apr 8 **Lab Project: Gel Electrophoresis**
- Apr 9 Forensics DNA technology
The Innocence Project (www.innocenceproject.org)
- Apr 11 IVF and pre-implantation diagnosis
Additional readings will be posted on Moodle
NYT Report 2 due
- Apr 14 Gene therapy
“Questions and answers about gene therapy” National Cancer Institute
(http://cis.nci.nih.gov/fact/7_18.htm)
Problem Set 3 Due
- Apr 15 **Lab Project: Data Analysis**
- Apr 16 Gene therapy: Jesse Gelsinger, the X-SCID Trials, and more
Stolberg, SG “The biotech death of Jesse Gelsinger” NYT Magazine
(28 Nov 1999)
“Second child in French trial is found to have leukemia” Science (17
Jan 2003)
RNAi-based and other gene therapy approaches to combating macular
degeneration
- Apr 18 Genetically modified crops
J. Rauch, “Will frankenfood save the planet?” Atlantic Monthly (Oct
2003)
- Apr 21 Genetically modified animals: silk in the milk and the biotech barnyard
“Got Silk? GE goats turned into factories” NYT Magazine (16 June
2002)
“Spinning gold from goats” Washington Post (31 May 2002)
Lee SJ and McPherron AC (2001) Regulation of myostatin activity
and muscle growth. Proc Natl Acad Sci 98, 9306-11.
rBGH: cause for concern?
- Apr 22 **Lab Project: Oral Presentations; Scientific Abstracts due**
- Apr 25 Protein function and regulation: the cell cycle
- Apr 25 Cell signaling, cell death, and cancer
- Apr 28 Embryonic development, stem cells, and cloning
“Stem cells: a primer” (www.nih.gov/news/stemcell/primer.htm#6)
- Apr 29 **The Interviews**
- Apr 30 Mammalian cloning
Wilmut I *et al.* (1997) Viable offspring derived from fetal and adult
mammalian cells. *Nature* 385, 810-3.
- May 2 Human stem cells and cloning

Takahashi K *et al.* (2007) Induction of pluripotent stem cells from adult human fibroblasts by defined factors. *Cell* 131, 861-72.
Dunn, K “Cloning Trevor” *Atlantic Monthly* (Jun 2002)

May 5 Wrap Up and Review; Policy Reports due

May 8 **Final Exam 1:30-3:30**

EXPECTATIONS AND EVALUATION

	<u>% Final Grade</u>
Exams	30%
Quizzes	4%
Problem Sets	12%
IVF Policy Report	4%
Lab Project Scientific Abstract	10%
Lab Project Oral Presentation	5%
NYT Reports	5%
The Interview	10%
Policy Paper	10%
Other short writing and discussion assignments	10%

Final Grade Determination:

>91%	A- to A
80-91%	B to B+
75-79%	B-
70-74%	C+
65-69%	C
60-64%	C-
50-59%	D
<50%	NC

Below are brief descriptions of each assignment. Detailed information for each assignment will be posted on Moodle well in advance of any due dates. Study guides will be made available prior to each exam. Moreover, a comprehensive set of learning objectives (similar to a study guide) for the entire course will be posted on Moodle the first week of classes.

Exams

Three exams covering critical course content will be given. The exam format will be a mixture of multiple choice, matching, and short answer questions (ranging from single phrase to short paragraph answers). Exams will primarily test your ability to apply concepts and problem-solving approaches to new problems and to interpret/analyze data. In addition, three 15-minute quizzes will be offered to help you prepare for the exams (and let you become familiar with the way I test before the stakes are high). You will be allowed to drop the lowest quiz score from your final grade. Quizzes cannot be made up if missed.

Problem Sets

You will be given three problem sets to work on outside of scheduled class time. You will be able to work with other students in the course on the problems, but you will not be able to ask for help on these specific problems from others outside the course. Each student must turn in an individual set of answers to be graded. Additional problems will be presented in class, and you will be given class time to discuss and work on. You will not be graded on your answers to these in-class assigned problems; but if you fail to actively engage with the problem and participate in group discussions, your final grade will be negatively impacted.

Lab Project

This course meets three times per week for lecture/discussion (MWF) and has an additional 1.5 hour discussion/lab section that meets on Tuesdays. Some written and oral assignments will be due during the Tuesday meetings (see the course schedule and below). In addition you will carry out a multiple-week lab project in which you will use molecular techniques to amplify specific gene segments using a technique called PCR and then analyze using a variety of techniques, including gel electrophoresis. Your results from the lab project will be written up as a scientific abstract and will also be presented orally to the class.

Additional Writing and Oral Assignments

IVF Policy Report

Working in pairs, you will choose a country and find out what, if any, specific government policies exist regulating *in vitro* fertilization and related reproductive medical technologies. You will prepare a brief (approximately one-page) report that summarizes policies concerning IVF for your specific country, including a list of sources you used to gather your information; you and your partner will present your findings to the class during a 5-8 minute oral presentation.

The interview

You will be expected to make contact with an individual off-campus who works in a field highly impacted by biotechnology (e.g., forensic technologist, genetics counselor, bioethicist, farmer using 'conventional' versus 'organic' farming practices, research scientist working in private industry). Students will work in pairs to choose and contact individuals for an interview. Prior to the visit, you and your partner will develop a list of questions to ask during the interview. Following the visit, each pair of students will give a 10-minute oral/video presentation. In addition, each student will be asked to write a short reflection on the experience.

The policy paper

You will be asked to develop a policy paper addressing the regulation of a specific biotechnology (genetic testing and privacy, egg donation for research purposes, 'race-based' and/or 'personalized' medicine, human 'enhancement' through genetic engineering, testing and release of transgenic crops, or other relevant topic). You will work with three other students on this project. The policy report is expected to be a 12-15 page paper with 4 sections: a description of the technology, the history of its discovery and development, a

discussion of societal and ethical concerns, and specific recommendations or guidelines for regulating the technology.

The NYT Science Times reports

Twice during the semester you will be required to choose an article from a current New York Times (NYT) Science Times (which is published as a separate section of the paper every Tuesday) and write about the news item being discussed (you may choose an article from any issue published in the previous 6 weeks). This report will be a combination of reflection on why this news item is important in general (i.e., why were the Times' editors convinced that this bit of science was 'fit to print'), important to you (i.e. why did you pick this particular article), as well as require you to follow up on at least one primary source that the article cites or that you can find in the professional literature that allows you to make some conclusions about the discovery/news item independent of those of the reporter. These assignments will be due on Moodle.

Additional short writing assignments

In addition to the policy paper and other writing assignments described above, there will be several short writing assignments designed to help you to view writing as a process by which you can critically engage with a text, explore ideas, and organize your thoughts. Examples are 1-2 paragraph summaries of assigned readings, reflection papers, concept maps, and analyses of technical writing/primary literature. Moreover, most of these short writing assignments will serve to improve the level of discussion in class. These written assignments will be graded on a 'check-plus, check, check-minus' scale for completeness.

Some Dry (but Important) Legalese: The only acceptable excuses for missing an exam are severe personal illness, a death in the family, or other emergency of similar nature. You will need to show me some form of documentation should such a situation arise and you return to class to make up an exam. If you cannot take an exam on the assigned day because of participation in a sporting event or other official Macalester activity, you must notify me ahead of time (i.e., BEFORE the day of the exam) so that we can schedule an appropriate time for you to take the exam.

Assignments handed in late will suffer a 20% penalty or "late fee" for each 24 –hour period turned in after the due date/time.

Plagiarism will be handled according to the Macalester policy on academic integrity in the student handbook, with which you need to be familiar (www.macalester.edu/~dstudent/handbook/academic_policies.html)

How to Succeed in this Course:

- (1) Attend all class meetings. Pay attention, take notes, ask questions.
- (2) Use the lecture outlines to organize your notes, but *not* as a substitute for taking your own notes.
- (3) Read the assigned texts *before* coming to class.
- (4) Test your understanding of some of the material using online problem sets and tutorials, such as those found at The Biology Project: <http://www.biology.arizona.edu/default.html>; Make flashcards for yourself to help with learning the enormous volume of new vocabulary.
- (6) Turn in assignments on time. Similar to credit card company late fees, assignments turned in after the due date will be penalized 20% for each day late.
- (7) Show up on time for exams to give yourself all the allotted time to work on the exam. Because many students have a class directly after this one, I will not be able to provide extra time to work on exams after the class period has ended. However, if you have a diagnosed learning disability or English is not your first language, please speak with me about making alternative arrangements for test-taking.*
- (8) Process the information you are learning in as many different ways as possible: by reading, writing, listening, speaking. Typically you will hear or read a concept or idea first in a passive setting (reading, listening). You then need to *actively* engage the material by doing problem sets, or writing a short paper, or explaining the material to someone else (e.g., your classmates). Understanding what you've just read or heard is *not* the same as knowing something well enough to explain it to others or being able to solve problems on your own. Only when you can do the latter will you be ready for the exams-- and only then will you have really learned what this course has to offer.
- (9) Spend on average 2-3 hours studying material outside class for each hour in class. Manage your time well. Set aside a block of time several times per week to do the readings and practice problems, and to go over your notes. For each lecture you might consider writing a summary of what you've learned and what questions remain unclear. Bring your questions to the next class meeting or email them to me or stop by my office during office hours.
- (9) Form a study group. Get together with 2 or 3 of your classmates and meet on a regular basis (e.g., 1-2 hours per week). A useful way to run a study group session is for each member to have completed a problem set on his/her own and then get together with the group to go over the answers. If members are coming up with different answers for the same problem, often much learning can take place by discussing the problem and each person's approach to solving it.

(10) Come talk with me during my office hours. I will do my best to identify problem areas during class time; but, “the squeaky wheel gets greased” and you will get the best help when you ask for it. Don’t wait until you are feeling overwhelmed or do poorly on an exam—come talk to me the minute you are feeling confused or uncomfortable in class. And come talk to me when things are going well! I’d love to hear for example when you’ve made a connection between what you are learning in the classroom and life outside it, or when you find a particular topic intellectually engaging. Those are the moments we professors live for.

*If you need special accommodation for note-taking or test-taking, e.g. due to ESL or a learning disability, please feel free to discuss your situation with me. I will do my best to accommodate your needs and help you achieve your full potential in my course.



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