BZ476 Topics in Advanced Genetics Fall 2006
9:00-9:50 am MWF E112 A/Z

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This course is designed to follow an introductory course in genetics and molecular biology (BZ350, LS201 or SC330), for advanced undergraduates or beginning graduate students wishing to pursue advanced topics in genetics. Gene systems in diverse organisms will be covered, including those of prokaryotes, fungi, plants and animals. The course is not intended to be comprehensive-- rather, a number of topics will be covered in some depth. Reading materials for this course, including current review articles from scientific journals, will be made available in the Mail Room of the Biology Department or electronically. We will also be using material from textbooks that are available on line. We will note which textbook a figure is taken from, you can access the relevant portion at:
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books
One goal of this course is to demonstrate the range of biological problems that can be addressed using classical and molecular genetics. Another goal is to have students critically evaluate and present a scientific paper from a leading journal on a topic in genetics. Grades will be based on a total of 500 points. In Dr. Bedinger's half of the course, one 10 point pre-quiz, three problem sets (10 points each), and two 80 point exams will be given. Dr. Garrity's half will involve four problem sets (10 pts each) and two 80 point exams. Students will also make a PowerPoint presentation of a recent journal paper, worth 100 points (20% of the final grade).

COURSE TOPICS
Molecular techniques: Analyzing DNA (including genomes), RNA and proteins
Genetic techniques: Identifying and analyzing mutants, forward and reverse genetics
Bacteria, not as simple as you think
    Advantages of prokaryotic systems
    Chemotaxis, a simple signal transduction pathway
Saccharomyces cerevisiae (budding yeast), a unicellular eukaryote
    Gene replacement and artificial chromosomes
    Dissection of the cell cycle
Arabidopsis thaliana, a plant model
    Plant strategies in development
    How does an organ know what it is? Floral organ development
Development and disease: using genetics to dissect developmental processes
Caenorhabditis elegans, a simple multicellular organism
    Building a genetic pathway: vulva development
Drosophila melanogaster, genetic tools extraordinaire
    Genes that interact: eye development
Zebrafish (*Danio rerio*), new insights into vertebrate development
    Is organogenesis modular?
Mouse, models for human disease

The power of targeted mutagenesis: *Hox* genes and body plan
Stem cells, the potential and the problems, Cancer and genetics

Schedule of lectures

August	21	Introduction to model organisms
	23	Analyzing DNA and cloning
	25*	DNA sequencing, Genomics
	28	Analyzing gene expression – RNA, Review quiz on genetics and molecular biology
	30	Microarrays
September	1*	Analyzing gene expression – Proteins (Bedinger problem set #1 due)
	4	Labor Day, no class
	6	Forward genetics: mutagenesis and analyzing mutants
	8*	Making transgenic organisms
	11	Reverse genetics (Bedinger problem set #2 due)
	13	EXAM I – molecular and genetic techniques
	15*	Bacteria as a genetic system
	18	Bacterial chemotaxis I
	20	Bacterial chemotaxis II
	22*	Yeast as a genetic system
	25	Genetics of the cell cycle I
	27	Genetics of the cell cycle II
	29*	Arabidopsis, a model for plant developmental genetics
October	2	Floral organ formation I (Bedinger problem set #3 due)
	4	Floral organ formation II
	6	EXAM II
	9	Using genetics to study development
	11	*C elegans:* a simple multicellular organism
	13*	Identifying essential genes
	16	Vulva development: Ordering genes into a pathway
	18	*Drosophila*: genetics extraordinaire [Problem set #1 due]
	20*	Genetic mosaics
	23	Eye development: suppressor and enhancer screens
	25	Genomics: the *Drosophila* genome project [Problem set #2 due]
	27	EXAM III [Selection of scientific paper approved by this date]
	30	Zebrafish: new insights into vertebrate development
November	1	Approaches to genetic screens in vertebrates
	3*	The genetic basis of organogenesis I
	6	The genetic basis of organogenesis II
	8	Mouse: a model for human disease [Problem set #3 due]
	10*	Using transgenic tools [talk outline and reference list due]
	13	Hox genes and body plan
	15	The mouse model for cystic fibrosis
	17*	Stem cells [Problem set #4 due]
	20-24	THANKSGIVING BREAK
	27	Genetics of cancer
	29	EXAM 4
December	1	student presentations
	4	student presentations
	6	student presentations
	8	student presentations

*Genetics in the News

Grading

1. Review quiz (10 points):
A list of genetic and molecular biology terms and basic problems from introductory genetics will be presented the first day of class. An in-class quiz on this material will be conducted on August 28, based on short definitions of a selection of terms and problems. This exercise is an opportunity to refresh your memory and will allow the class to proceed at an advanced level.

2. Exams (4 X 80 points = 320 points)
Exams will be a combination of fill-in-the-blank, short answer, essay and problem-solving. You will be expected to not only know definitions, but also to be able to apply your knowledge to answering questions using genetic approaches

3. Problem sets (7@ 10 pts each)
Problem sets will consist of 4-6 questions covering the essential concepts of the previous week. The idea is to get you thinking about how you could apply the material we cover in a new context. The problems will focus on: 1) molecular techniques – which one to use when? 2) genetics of the organism – what are the progeny and where did they come from? 3) genomics – what information is out there and how do you get it?

Problems are due at the **beginning of class** on the following dates:
Bedinger Problem set #1: September 1
Bedinger Problem set #2: September 11
Bedinger Problem set #3: October 2
Garrity Problem set #1: October 18
Garrity Problem set #2: October 25
Garrity Problem set #3: November 8
Garrity Problem set #4: November 17

PLEASE NOTE: Once problem sets are turned in, we will go over the answers briefly in class. Therefore, late submissions will not be accepted (whether you attend class or not.)

6. EXTRA CREDIT OPPORTUNITY- Genetics in the News
A total of 10 extra credit points is possible for students presenting news articles about genetics (must include a genetic trait or gene or genome) to the class on Fridays (2 extra credit points for each presentation). Articles should have been published in the popular press (not technical journals) within the past 6 months, preferably even more recently. Presentations should not exceed 2 minutes each, and there will be a maximum of five presentations each Friday. Presenters need to sign up Monday or Wednesday with the source and topic in order to present that Friday.

5. Presentations (100 points):
Each of you will select a paper from a recent Nature or Science or similar journal that needs to be approved by Dr. Garrity or Dr. Bedinger by **October 27**. The paper needs to be focused on a gene or set of genes. You will need to identify and READ at least three "support papers" including review articles, previous work etc. A <u>one-page outline</u> of your talk, including list of references, is due **November 10**. Each presentation should be 15 minutes in length. Practice, and time yourself (it may be helpful to get together with other class members for this). You should be using about 15 slides per presentation. Slides should be legible, interesting and to-the-point (don't make them

overly complex). Drs. Garrity and Bedinger will be happy to offer suggestions on drafts of talks, so long as you make appointments at least a week in advance of your talk.

How to structure your talk

Make slides with these subtitles: The Question, Introduction/Background, Methods, Results (several), Conclusions/Summary, Future Questions

I. Introduction (5 minutes):
   A. The mystery, reason for caring, paradox, curiosity
   B. Background (AVOID USING JARGON--or if you do, define terms well)
      Described the biology of the organism/system being studied
      What has been done in the past that is relevant?
      Limitations of past experiments
      How old results raised current questions

II. Results (10 minutes)
   A. Experimental design (including methods)

Explain a small number of key experiments (if time is limited, give results without experiments rather than unclear experiments). In other words <u>show primary data</u>, but be judicious (select the most important figures to show). Make figures BIG so the audience can see them – in some cases only show part of a figure if the entire figure is too complex

   B. Avoid tables whenever possible, or just show the most important part of a table
   C. Never show data you do not discuss
   D. Summarize the conclusions of the paper, and comment on the remaining questions, and what you think the next experiments will be

BE CRITICAL -- could there have been better controls, or a different interpretation of the results? If there are ethical considerations, what are they?

Grading of presentations will focus on the following:

20 Outline and references complete and turned in on time
20 Is the rationale for the experiments in the paper clear, and is sufficient background provided?
20 Are illustrations clear and useful? Are the results clear?
20 Is jargon used (-10)? Are <u>controls</u> discussed (+10)?
20 Are conclusions clearly reviewed, and are future questions discussed?