BIO365 (Molecular Genetics) - Spring 2010

Main || Objectives || Components || Policies || Syllabus || Exams || Homework || Labs || Prof. Jones

> Genetic engineering is to traditional crossbreeding what the nuclear bomb was to the sword.
>
> Andrew Kimbrell

Classes

Classes will be held in Room 202 (Mellon Lecture Hall), Collier Hall of Science
Mondays, Wednesdays, and Fridays from 8:55 am to 9:45 am

Labs

Labs will be held in Room 301, Collier Hall of Science
Tuesdays from 12:45 pm to 3:45 pm

Text

The text for this course is *Genetics: Analysis of Genes and Genomes* by Daniel Hartl and Elizabeth Jones[1], published by Jones[2] and Bartlett.

[1]No relation.

[2]Also no relation[3].

[3]To me, anyway[4].

[4]I can't speak to the author's relationship[5].

[5]Jones's, that is[6].

[6]Or Hartl's for that matter, I suppose.

Other readings will be provided throughout the semester.

L i n k s

Our textbook has an associated website.

Here's a link to the story about that fascinating animal-plant hybrid, *Elysia chlorotica*.

Course Objectives

My goal for Bio365 is to make you comfortable with the terms, concepts, and practices of modern molecular genetics. As this field is built on classical genetics, we'll be spending a little time reviewing the latter (and perhaps using some of its techniques in lab) as well.

In addition to the text, we'll be using articles from the primary literature to hone your skills in analyzing the work of other researchers as well as to see how what we're learning in the classroom relates to what's going on in genetics labs today.

In the laboratory, each of you will be spending time annotating a chunk of genomic DNA sequence, identifying the location of a transposable element in *Drosophila melanogaster*, and designing and carrying out an experiment using DNA microarrays. These experiments will not only give you hands-on experience with the techniques, but also the experimental strategies of molecular genetics.

By the end of the semester, you should:

- understand the terms and concepts of molecular and classical genetics
- be able to explain those terms and concepts clearly to others
- be able to solve molecular genetics problems
- be able to carry out many common molecular genetic laboratory procedures
- understand ***why*** you're carrying them out!
- be able to read a research article *in any area you're at least somewhat familiar with* and be able to confidently analyze its conclusions, strengths, and weaknesses
- be able to devise experimental strategies to answer research questions

in molecular genetics

In short, by May I hope that you will feel (and be!) fairly self-sufficient in navigating the ins and outs of a significant part of that area of modern biology called "molecular genetics." More importantly, you'll feel confident in being able to learn what you need on your own — no one course, or even 4 years of them, can prepare you with everything you're going to need to know.

Course Components

A note on grading: I do not grade on a curve, so I hope that each of you will do your best to help your fellow students: if they benefit, it does you no harm. In fact, one of the best ways to learn something is to explain it to someone else, so talk to your classmates (see Studying Molecular Genetics in the "Policies" section).

Here are the basic (by which I mean "important" (by which I mean "they affect your grade" (of course))) components of this course — in alphabetical order.

- Attendance
- Exams
- Lab Reports
- Lab Technique
- Paper
- Participation
- Presentations
- Problem Sets

Attendance

It's important that you be in class. As you will discover, there will be no lecture notes for me to give you should you miss a meeting, no little PowerPoint handouts. Classes will be devoted to reviewing the topic for the day, informed by your preparatory reading. Needless to say, that reading is critical to your ability to participate in class, clarify any difficulties you're having, and succeed in learning as much as you can about molecular genetics.

To emphasize how important I think attendance is, every day you're in class (and awake) is worth 5 points toward your final grade. Being in lab is worth 10 points. If you're late, I will dock 1 point for every 3 minutes you're late (or fraction thereof).

Exams

There will be three exams, not including the final. Each will focus primarily on the material covered since the previous exam, but anything covered during the semester up to that point is fair game. The final will be "semi-cumulative": about half of the exam will focus on material since the previous hour exam, but the other half will range over material from the entire semester. Barring extenuating circumstances (and it is entirely up to me to decide what is an acceptable circumstance), no make-up exams will be given. The hour exams will each contribute up to 100 points toward your final grade, and the final exam will contribute up to 200 points (but see my policy on extra credit).

There will be no make-up exams except in cases where I had advanced warning of your missing the exam, or you were unable to notify me due to circumstances beyond your control. Note that in **any** case, I may decide not to allow a make-up exam regardless of circumstance.

Lab Reports

I will be asking for formal lab reports for our lab experiments; I anticipate that we will tackle 3 projects this semester:

- annotating a portion of genomic DNA from a *Drosophila* species
- identifying a P-element insertion site using standard molecular genetic techniques
- microarray analysis of *Drosophila*, with the specifics yet to be determined

There will be one report for each of these projects, worth a total of 500

points. Unless I tell you otherwise, each will be in the standard AIMRD format (Abstract, Introduction, Materials & Methods, Results, Discussion).

Lab Technique

Those of you who have had me in previous classes know that "getting the right answer" in lab isn't something that I put a lot of emphasis on. Real science isn't so neat and tidy that coming up with the correct answer (even if you or I know what that is, which often won't be the case in this course) is a reliable measure of how good you are.

That said, being right is hella better than being wrong. And having good lab technique is invaluable for getting the right answer. Consequently I will be evaluating your skills in lab. Being prepared (by doing the necessary background reading), following instructions, paying attention, and being careful with your manipulations are all important parts of this. As you'll learn, some of the reagents we'll be using are expensive and/or irreplaceable, and I abhor waste, so just being awake and aware of what's going on will serve you in very good stead. (Actually, being awake and aware is excellent advice in life in general, not just this lab.) I will give you up to 100 points for technique.

Paper

You will have a paper due at the end of the semester which reviews some aspect of molecular genetics and incorporates findings from at least 3 articles from the primary research literature. It must be a minimum of 1000 words long and and should show evidence not only of simply understanding the material you present, but also something deeper: how these results fit into the larger picture, how they might be most profitably extended, or ways in which they are flawed, for example. It should be written in the style of a Perspectives article from *Science*; more on this later. This assignment will be worth up to 100 points toward your final grade.

Participation

Class participation will necessarily be somewhat subjective, but will encompass just that: participating in class. Asking questions, answering questions, being prepared to discuss whatever topics arise, doing your share of the work in lab — you're not children, you know what is meant by the term "participation." I assume a certain amount of participation on everyone's part; I will award up to 50 points for participation "above and beyond" at the end of the semester toward your final grade. Conversely, I will also dock up to 50 points for anyone who is not holding up their end in class.

Presentations

On each day of class beginning April 12th, two of you will each give brief presentation on a journal article of your choice which involves some aspect of molecular genetics; I recommend (but do not require) that it be one of the articles you will use for your paper (see above). Plan for 10 minutes with a few minutes for questions; 15 minutes total at most. It will be evaluated by your classmates and myself based on criteria which we will mutually establish.

I'll be giving more specifics about this assignment later in the semester; it will be worth up to 100 points toward your final grade.

Problem Sets

Homework problem sets will be assigned. I will be selecting them throughout the semester, based on our pace and what I feel will be most helpful to you. I will assign points to these based on how difficult I feel they are. As I don't have them all mapped out, I can't know how much they will contribute to your final grade, but I estimate 500 points or so.

(I may, at my discretion, drop the lowest grade from the homework assignments. Do not count on this. If you find yourself thinking that you're sunk if I don't drop those scores, you'd better come talk to me. *Immediately.*)

Course Policies

Below you will find various course policies, including:

Grading

I'm going to be using the point system for this course, so you don't have to worry about calculating percentages for individual components. I'll try to keep an up-to-date total here on the website, so you can always determine your grade so far by comparing what you've earned with the max possible. (And don't you just hate Max, that little weenie?) Given my grading scale, you can therefore calculate your own grade in the course at any time.

I've laid out the course components and their point values separately, but to summarize:

Lecture Attendance	180 points
Hour Exams	3 @ 100 points = 300 points total
Problem Sets	ca. 500 points
Paper	100 points

Presentation	100 points
Final Exam	200 points
Laboratory Attendance	120 points
Laboratory Technique	100 points
Laboratory Reports	500 points
Anticipated Total	**2400 points**

(I reserve the right to tweak these distributions as I see fit: if for example no one appears to be doing the reading, I may institute short, sporadic quizzes. These will in all likelihood be given in the first few minutes of class, and no make-ups will be given. In order for them to be taken seriously, I will have to shoehorn them into the grading scheme outlined above.)

Those of you paying attention may have noticed that the individual assignments above only add up to 2100 points. You may assign the remaining 300 points to exams, the presentation, the paper, and/or the lab reports, depending on your own strengths. Within one week after I've returned your first exams, you should email me with instructions on how you'd like those points distributed.

Here is the grading scale I use in all my classes:

numeric grade	**letter grade**
93.3 - 100	A
90.0 - 93.2	A-
86.7 - 89.9	B+
83.3 - 86.6	B
80.0 - 83.2	B-
76.7 - 79.9	C+
73.3 - 76.6	C
70.0 - 73.2	C-

66.7 - 69.9	D+
63.3 - 66.6	D
60.0 - 63.2	D-

Just to review, this is what the Student Handbook has to say about grades:

A and A-

These grades are given for achievement of the highest caliber. They reflect independent work, original thinking, and the ability to acquire and effectively use knowledge.

B+, B, and B-

These grades are given for higher than average achievement. Evidence of independent work and original thinking is expected.

C+, C, and C-

These grades are given when the student has devoted a reasonable amount of time, effort, and attention to the work of the course and has satisfied the following criteria: familiarity with the content of the course, familiarity with the methods of study of the course, and active participation in the work of the class.

D+, D, and D-

These grades are given for unsatisfactory work, below the standard expected by the College. They indicate work which in one or more important aspects falls below the average expected of students for graduation. The work is, however, sufficient to be credited for graduation, if balanced by superior work in other courses.

A t t e n d a n c e

If you are going to be absent from class or (Heavens forbid!) lab, please do me the courtesy of letting me know in advance if at all possible. Don't forget that it is *your* responsibility to notify me if you will be away for a field trip, sporting event, or other school-related function. It is not my responsibility to keep up with all the myriad activities which you might be involved in, according to the student handbook.

Reading

In this course, the reading is critically important. Classtime will be spent discussing the reading for that day; I will not be lecturing. If you don't keep up with the reading — and by that I mean **active** reading, not just using a highlighter — you won't be able to keep up in class, you won't fully understand what's being taught, the class will rapidly become a waste of time for you.

Late Assignments

Assignments turned in late will not be accepted. Period.

Extra Credit

On a 100-point hour exam, I will give you 110 points-worth of questions. Thus, you can miss (nearly) 10% of the questions on any hour exam and still get the full 100 points. With the exception of these additional points on exams, there will be no opportunity for extra credit in this course. Spend your energy learning the course material; "extra credit" activities are a sham and a cheat.

Cell Phones

Cell phones are tools of Satan. They are without significant positive value in my world and while I don't expect you to share my view of them, I expect you to spare me from being rudely reminded of their existence. If you are expecting an ***urgent*** phone call while in class or lab, alert me to that fact ahead of time. Otherwise, if your cell phone goes off in class or lab, you might as well pack up your things and go home, because I won't give you any credit for being there. Some day this will be looked on as one of my loveable eccentricities, but until then you'll just have to put up with my sociopathy.

Lab Conduct

There is to be ***NO*** food or drink in the lab at ***ANY*** time. Rules have

gotten stricter, fines have gotten much higher, and the government is coming after undergraduate institutions like never before. If I see any comestibles or potables in lab you will be docked points in accordance with my mood; if I see you put anything into your mouth, I may well dock you several hundred (yes, *hundred*) points. This is a serious infraction of laboratory protocols.

The only thing worse is endangering other students or their data, whether through carelessness or malice. If I find anyone doing something which might result in harm to another student or compromise their experimental results, I will fail the perpetrator for the entire course. I am by and large a fairly easy-going guy, but there are some things which are simply beyond the pale; this is one of them.

Studying Molecular Genetics

Science is a collaborative venture. I urge you to get together with your fellow students as much as possible to study the material for this course in groups. Discussing problems, studying for exams with other students, and asking each other questions on the reading assignments are all examples of activities which will benefit you and which I encourage. Obviously you cannot consult with others during exams or quizzes, but the homework may be something of a grey area foryou. For my courses, you must prepare your own answers to assigned problems, but I feel that getting together with other students in the course to discuss and think through problems together is not only perfectly acceptable, it is a very good idea. If you have arrived at what you believe to be the correct answer, put it aside for fifteen minutes before writing it down; this way you can be more confident that you really know what it is you're saying, and your answers won't be identical to your partners'.

Note that the idea of collaborative learning in this way does not mean that you should ask for answers from others who have already taken this or a similar course, nor should you necessarily just accept an answer from a classmate whom you think is likely to be right.

Everybody is mistaken sometimes, and if you don't understand **why** his or her answer is the right one, well, then you don't understand it. And that is not where you want to be. Conversely, if you're sure you've got the right answer, don't just tell your study group and be done with it. Try to help them arrive at the same conclusion you did step by step; someone else may come up with a very different view of the problem which forces you to rethink your approach. And rethinking your approach, even if it doesn't turn out to change your mind about your answer, is critical to your success as a scientist.

My concern is not that you "learn" molecular genetics, seeing it as a (very large) pile of facts, but that you **understand** it. Your fellow students and I are resources to help you; it's up to you to do the work necessary to gain that understanding.

You should expect to spend ***at least*** 2 hours studying on your own for every hour in the classroom. At a ***minimum***. That's true for every class, not just mine. If you're content to just slouch through, willing to trade a better grade in the course for whatever you think is more important than your studies, you're welcome to do so. But if you want to excel, not only for the sake of a higher mark on your transcript, but also for the sake of your education, you owe it to yourself to put in enough effort that you can honestly say to yourself at the end of the semester, "I did my best, and I learned as much as I could in that course." If you do, I'll do everything I can to make this a worthwhile experience for you.

A c a d e m i c H o n e s t y

I adhere to the Academic Honesty policy of the College. There is nothing more important to me than personal integrity - not molecular genetics, not happiness, not power, nothing - and I conduct myself and all of my classes in that spirit. If you're not familiar with College policy, you should be.

Course Syllabus

Meeting number	Date	In-Class	Background Reading
1	Mon., Jan. 18	organizational meeting	
2	Wed., Jan. 20	review	text chapter 1
3	Fri., Jan. 22	more review	text chapter 1
4	Mon., Jan. 25	transcription	text sections 10.1 through 10.4
5	Wed., Jan. 27	RNA processing	text section 10.5
6	Fri., Jan. 29	translation & the genetic code	text sections 10.6 through 10.8
7	Mon., Feb. 1	transcriptional regulation in prokaryotes	text sections 11.1 through 11.3
8	Wed., Feb. 3	transcriptional regulation in phage and eukaryotes	text sections 11.1 through 11.3
9	Fri., Feb. 5	transcriptional regulation in phage and eukaryotes	text sections 11.4 and 11.5
10	Mon., Feb. 8	additional regulatory mechanisms	text sections 11.4 and 11.5

11	Wed., Feb. 10	additional regulatory mechanisms	text sections 11.6 through 11.10
12	Fri., Feb. 12	additional regulatory mechanisms	text sections 11.6 through 11.10
13	Mon., Feb. 15	review for Exam 1	
14	Wed., Feb. 17	article	Hiller et al. (2007) "Pre-mRNA Secondary Structures Influence Exon Recognition" PLoS Genetics **3**(11):e204
15	Fri., Feb. 19	article	Hiller et al. (2007) "Pre-mRNA Secondary Structures Influence Exon Recognition" PLoS Genetics **3**(11):e204
16	Mon., Feb. 22	DNA cloning I	text sections 12.1 and 12.2
17	Wed., Feb. 24	DNA cloning II	text sections 12.3 and 12.4
18	Fri., Feb. 26	DNA microarrays and 2-hybrid screens	text section 12.4
19	Mon., Mar. 1	transgenic organisms and genetic engineering	text sections 12.5 and 12.6
20	Wed., Mar. 3	DNA mutations	text sections 14.1 and 14.2
	Fri., Mar.	transposable elements and	

21	Fri., Mar. 5	elements and spontaneous mutations	text sections 14.3 and 14.4
	Mon., Mar. 8	No Class (Spring Break)	
	Wed., Mar. 10	No Class (Spring Break)	
	Fri., Mar. 12	No Class (Spring Break)	
22	Mon., Mar. 15	mutagens and repair	text sections 14.5 through 14.7
23	Wed., Mar. 17	article	Gray et al. (2010) "The *IGF1* small dog haplotype is derived from Middle Eastern grey wolves " BMC Biology 8:16
24	Fri., Mar. 19	article	Gray et al. (2010) "The *IGF1* small dog haplotype is derived from Middle Eastern grey wolves " BMC Biology 8:16
25	Mon., Mar. 22	Hour Exam 2	chapters 12 and 14; Hiller paper
26	Wed., Mar. 24	discuss criteria for presentations	
27	Fri., Mar. 26	molecular evolution I	text section 17.1
28	Mon., Mar. 29	molecular evolution II	text section 17.1
29	Wed., Mar. 31	cell cycle	text sections 15.1 through 15.3
	Fri., Apr. 2	No Class (Easter Break)	

	Mon., Apr. 5	No Class (Easter Break)	
30	Wed., Apr. 7	cell cycle checkpoints & cancer genetics	text sections 15.4 through 15.7
	Fri., Apr. 9	No class today (*Drosophila* Research Conference)	
31	Mon., Apr. 12	presentations by Hadia & Meinardo	
32	Wed., Apr. 14	presentations by Jess & Kanizeh	
33	Fri., Apr. 16	presentations by Alex & Troy	
34	Mon., Apr. 19	presentations by Michael & Hazar article	
35	Wed., Apr. 21	presentations by Leslie & Asma article	
36	Fri., Apr. 23	presentations by Jimmy & Jake article	
37	Mon.,	Hour Exam 3	

37	Apr. 26	Hour Exam 3
38	Wed., Apr. 28	presentations by Christian & Ryan
39	Fri., Apr. 30	presentations by Jared & Stephen
	Wed., May 5 1:30 pm	**FINAL EXAM**

Life is fluid, so this syllabus is subject to change. I will do my best to adhere to it, but helping you learn as much as you can about molecular genetics trumps any satisfaction I might glean by marching us in lockstep through the semester.

L a b s

Meeting number	Date	Lab	Background Reading
1	Tues., Jan. 19	organizational meeting	
2	Tues., Jan. 26	genomic DNA annotation	
3	Tues., Feb. 2	genomic DNA annotation	
4	Tues., Feb. 9	*Drosophila* genomic DNA prep	
5	Tues., Feb. 16	DNA digestion and agarose gel	
6	Tues., Feb. 23	DNA ligation	
7	Tues., Mar. 2	inverse PCR and agarose gel	
	Tues., Mar. 9	No Lab (Spring Break)	
8	Tues., Mar. 16	inverse PCR and agarose gel	
9	Tues., Mar. 23	inverse PCR sample cleanup and agarose gel	
10	Tues., Mar. 30	*Drosophila* RNA prep	
11	Tues., Apr. 6	label cDNA probes	
12	Tues., Apr. 13	microarray wash and hybridization	

13	Tues., Apr. 20	microarray analysis
14	Tues., Apr. 27	more microarray analysis

Prof. Jones

If you ever have questions that you can't answer yourself, realize that there are a lot of resources available to you: if your classmates can't help you, feel free to ask me. This is part of my job, and one which I don't shirk. Depending on what the problem is, the most reliable method is probably email (I sometimes don't realize I have voicemail for a day or two). My email address is cjones [at] moravian [dot] edu and my office (and lab) phone number is 610-861-1614.

If you need to speak with me sometime when I'm not on campus (a rare event!), call me at home any time between 9 am and 9 pm. Students often tell me they don't feel comfortable calling me at home because they think I mind. Consider the logic here: there's nothing that says I have to give you my home phone number, yet I have done so in class. So ***why*** would I give you that number if I didn't want you to use it? Note that "use" is not the same thing as "abuse": don't call me at 3 am the day before an assignment is due and expect much sympathy (or pleasant conversation)!

Here's a copy of my current class schedule. My official office hours are from 1 pm to 3 pm Monday and 10 am to noon Tuesday. That said, official hours are all but irrelevant to me. If I'm not in my office (Room 310, Collier Hall of Science), try my lab (Room 233, Collier Hall of Science -- between the elevator and the loading dock on the main floor). Feel free to get hold of me any time; if I can't spare the time to talk then, I'll tell you so, and we can set up an appointment at our mutual convenience.