Genetics

The latest issue of *Science* (September 1 cover date) is just chock-full of genetics news:

- (p. 1203) Unlike newborn and hibernating animals, piglets do not have the protein UCP1, which helps regulate temperature by converting chemical energy directly into heat. A report in PLoS Genetics describes the degradation of this gene in pigs and related animals over evolutionary time.
- (p. 1213) Scientists report in the *Proceedings of the National Academy of Sciences* on an allelic variation in a gene responsible for PPROM, which causes a 2- to 3-fold increase in premature births among African-American women.
- (pp. 1217 & 1261) Genome analysis is revealing many of the strategies which make members of the genus *Phytophthora* so pernicious and deadly for many species of plants. One finding is that two species of these pathogens have a surprisingly large number of genes devoted to molecules to attack plants, and that these segments of their genomes are evolving particularly rapidly.
- (p. 1218) Northern Europe is finally seeing incursions of the virus responsible for the livestock disease bluetongue. The surprise for researchers is that the variants they're seeing Belgium, Germany, and the Netherlands are most closely related to the form of the virus found in Nigeria, rather than those found in the much-closer countries of Southern Europe.
- (p. 1301) A report from Eric Olson's lab describes a genetic screen in *Drosophila* to identify genes involved in heart development. Their results point to the mevalonate pathway (think "cholesterol biosynthesis") as being critical in heart formation, and suggest that this conserved pathway bears looking at for its role in congenital heart disease in humans.
- (p. 1304) Popesco et al. looked at variation in copy numbers of genes in humans and numerous great apes. They found that the number of a particular, previously unknown, sequence called DUF1220 is found in higher numbers in apes more closely related to humans, with the genome of *H. sapiens* having the greatest number. These sequences are turned on particularly in the brain's neocortex and in specific neurons, suggesting possible roles in cognition and nervous system function.

Classes

Lectures will be held in Room 335, Priscilla Payne Hurd Academic Complex
Mondays, Wednesdays, and Fridays, 7:50 am to 8:40 am

Lab

Lab meets in Room 301, Collier Hall of Science
Tuesday, Wednesday, and Friday afternoons, 12:45 to 3:45

Text

The text required for this course is the 6th edition of *Genetics: Analysis of Genes and Genomes*, by Daniel Hartl and Elizabeth Jones[1], published by Jones[2] and Bartlett, 2005.

Our text has (surprise!) an associated website.

[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.

Course Objectives

This is a one-semester course intended to give you a solid grounding in genetics, one of the keys (some would indeed argue **the** key) to understanding all the rest of biology. As Thedosius Dobzhansky famously said, "Nothing makes sense except in the light of evolution." Well, evolution doesn't make sense except in the light of genetics.

By the end of the semester, students should have an understanding of (and appreciation for):

- mitosis and meiosis
- the principles governing inheritance
- genetic linkage and recombination
- chromosomal and molecular mutations
- the basic structures and roles of DNA, RNA, and proteins
- the molecular processes governing genetic function
- quantitative genetics
- population and evolutionary genetics
- the techniques used in modern genetic investigations
- what kinds of questions can be answered using genetics

Students should be able to:

- predict and interpret the outcomes of genetic crosses
- read and understand primary articles in the genetics literature
- articulate current events in genetics research
- describe their research findings in standard format
- use a pooter

Course Policies

Below you will find various course policies, including:

- Reading
- Late Assignments
- Extra Credit
- Food
- Cell Phones
- Lab Conduct
- Group Lab Reports
- Studying Genetics
- Academic Honesty

Attendance

This is an early-morning class, and for many of us (including me), that ... isn't our favorite time. Too bad.

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(s) 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 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 (see below).

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 Genetics" below). Grades for this course will be determined as follows:

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 (see below), you can therefore calculate your own grade in the course at any time.

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 four hour-exams will each contribute 100 points toward your final grade, and the final exam will contribute 200 points.

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.

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 between 300 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*.)

I will probably give occasional **miscellaneous assignments** over the course of the semester. These will be worth whatever points I announce at the time. Late assignments **will not be accepted**. I anticipate that there will be a total of 100 to 200 points in this category by the end of the semester.

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.

Keeping an accurate, legible, and comprehensible **laboratory notebook** is an ***absolute requirement*** of this course. I've ordered lab notebooks for you to use for this course. We will go over some strategies for keeping notes in lab the first week. I will collect the copies (make sure you know how the notebook works!) at the end of the semester; your lab notes will be worth 200 points.

In addition, I will be asking for formal **lab reports** for our lab experiments; I'm still trying to figure out how many projects we'll be able to undertake without self-destructing, but I anticipate having about 3 reports worth a total of 700 points. **Laboratory technique** will account for another 100 points of your final grade.

In summary, then:

Attendance	210 points
Hour Exams	300 points total
Problem Sets	ca. 300 points

Misc. Assignments	100-200 points
Laboratory Notebooks, Reports, and Technique	1000 points
Final Exam	200 points

Anticipated Total 2110-2210 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.

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.

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" is a sham and a cheat.

Food

No eating in class, unless you can convince me it's medically necessary. *I* don't eat in class!

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 our loveable Republican "smaller 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 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.

Group Lab Reports

For certain labs I may require group (rather than individual) lab reports. When submitting group reports, please be sure to:

- Use "we", not "I" — this is to be a *group* effort.
- Include the title, date, and the names of your group members.
- Every member of the group must initial the report, indicating that they are satisfied with it and agree to its contents.

If you have any questions about this format, please don't hesitate to ask me.

Studying 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 for many of you. 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" 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.

Academic Honesty

I adhere to the Academic Honesty policy of the College. There is nothing more important to me than personal integrity - not 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.

Syllabus

Meeting number	Date	In-Class	Background Reading
1	Mon., Aug. 28	organizational meeting	
2	Wed., Aug. 30	intro to genetics and genomics	chapter 1
3	Fri., Sept. 1	DNA structure	chapter 2
	Mon., Sept. 4	No Class (Labor Day)	
4	Wed., Sept. 6	DNA analysis techniques	chapter 2
5	Fri., Sept. 8	DNA markers	chapter 2
6	Mon., Sept. 11	gene segregation	chapter 3
7	Wed., Sept. 13	pedigrees	chapter 3
8	Fri., Sept. 15	complications and complementation	chapter 3
9	Mon., Sept. 18	mitosis and meiosis	chapter 4
10	Wed., Sept. 20	sex linkage	chapter 4
11	Fri., Sept. 22	probability and goodness-of-fit	chapter 4
12	Mon., Sept. 25	hour exam	chapters 1–4
13	Wed., Sept. 27	linkage and recombination	chapter 5
14	Fri., Sept. 29	genetic mapping	chapter 5
15	Mon., Oct. 2	more genetic mapping	chapter 5
16	Wed., Oct. 4	DNA replication	chapter 6
17	Fri., Oct. 6	DNA sequencing models of recombination	chapter 6
	Mon., Oct. 9	No Class (Fall Break)	
18	Wed., Oct. 11	paper	TBA
19	Fri., Oct. 13	paper	TBA
20	Mon., Oct. 16	chromosome structure	chapter 7
21	Wed., Oct. 18	repetitive DNA	chapters 7 & 8

		karyotypes	
22	Fri., Oct. 20	chromosome aberrations	chapter 8
23	Mon., Oct. 23	bacterial & phage genetics	chapter 9
24	Wed., Oct. 25	RNA synthesis & processing	chapter 10
25	Fri., Oct. 27	translation	chapter 10
26	Mon., Oct. 30	hour exam	chapters 5–9
27	Wed., Nov. 1	transcriptional regulation	chapter 11
28	Fri., Nov. 3	other mechanisms of regulation	chapter 11
29	Mon., Nov. 6	molecular genetic techniques	chapter 12
30	Wed., Nov. 8	genetic engineering	chapter 12
31	Fri., Nov. 10	developmental genetics	chapter 13
32	Mon., Nov. 13	mutation	chapter 14
33	Wed., Nov. 15	DNA repair	chapter 14
34	Fri., Nov. 17	cell cycle	chapter 15
35	Mon., Nov. 20	cancer genetics	chapter 15
	Wed., Nov. 22	No Class (Thanksgiving Break)	
	Fri., Nov. 24	No Class (Thanksgiving Break)	
36	Mon., Nov. 27	hour exam	chapters 10–15
37	Wed., Nov. 29	extranuclear inheritance	chapter 16
38	Fri., Dec. 1	molecular evolution and population genetics	chapter 17
39	Mon., Dec. 4	factors affecting allele frequencies complex traits	chapters 17 & 18
40	Wed., Dec. 6	selection and heritability	chapter 18
41	Fri., Dec. 9	paper	TBA
42	Mon., Dec. 12	paper	TBA
		FINAL EXAM	

Life is fluid, so this syllabus is subject to change. This is only the second time I've taught this course, which is both good and bad: I may have to change the syllabus to best help you learn about genetics, but this is certainly preferable to rigidly adhering to some timetable in lockstep. So come to class and you'll always know what's going on with the syllabus; changes will of course also be posted here, but you should be in class anyway!

Exams

See http://home.moravian.edu/users/bio/mecjj01/bio210f06/exams/bio210exams.html

Homework

Here are my answers to problem set #1. The class average was 52.6 (out of 70, or about 75%) with a standard deviation of 9.5 points.

Here's problem set #2; it's due at the beginning of class next Wednesday, September 20th.

Lab Syllabus

Session	Date	Activity
1	Aug. 29–Sept. 1	Lab orientation & overview handling flies nomenclature basics
2	Sept. 5–8	Set up mapping cross 1 discuss genomic DNA preparation
3	Sept. 12–15	Prepare genomic DNA collect virgin females for mapping crosses 2 & 3
4	Sept. 19–22	"Is my insertion sex-linked?" review & set up mapping crosses 2 & 3 digest genomic DNA and run gel to confirm quality
5	Sept. 26–29	collect males & virgin females for mapping crosses 2 & 3 ligate DNA fragments and precipitate
6	Oct. 3–6	set up mapping crosses 2 & 3 (2nd generation) amplify insertion-site plasmids with PCR and run gel to confirm quality
Fall Break	Oct. 10–13	[no lab, but collect males & virgin females for mapping crosses 2, 3 & 4]
7	Oct. 17–20	"Is my insertion on an autosome? Which one?" "Is my insertion homozygous viable or lethal?" establish mutant stock review & set up mapping cross 4 Exo/SAP PCR products and run BigDye sequencing reactions
8	Oct. 24–13	collect virgin females for mapping cross 4 prepare competent bacteria
9	Oct.	set up mapping cross 4 (2nd generation)

	Oct. 31–Nov. 3	transform competent bacteria and plate for swarm assays
10	Nov. 7–10	discuss results discuss lab report format
11	Nov. 14–17	score progeny of mapping cross 4
12	Nov. 21–24	discuss results
13	Nov. 28–Dec. 1	discuss results
14	Dec. 5–8	clean up, finish any loose ends questions for lab reports

Life is fluid, so this syllabus is subject to change. I don't anticipate any significant deviations, but remember that it's written in electrons, not stone.