Genetics Home Page

Here's a link to the MathBench module on basic probability.

Here's a link to the MathBench module on Punnett squares.

Here's a link to the MathBench module on the χ^2 test.

Here's a link to the MathBench module on serial dilutions.

Promega is a major bioreagent supplier, and they have a number of helpful videos available, including one on the basics of PCR.

The DNA Learning Center at Cold Spring Harbor Laboratory has a number of good animations of molecular genetic techniques, including ones for gel electrophoresis, PCR, and cycle DNA sequencing.

There are several good animations of molecular processes online, including several from Prof. John Giannini at St. Olaf College, including DNA replication, transcription, and translation. Another animation of transcription is at biostudio.com.

Okay, this isn't genetics news, but it is so very cool that I know you'll be interested: computer game-players solve a problem that professional scientists have been struggling with for a decade!

As I pointed out in class this morning, traits are very often affected by both genetics and environment. Researchers at Vanderbilt University have now shown in a model of Fragile X syndrome in *Drosophila* that neuroanatomical defects caused by the condition can be alleviated by pharmaceutical or genetic intervention. (read more)

From a few years ago: "Word that genetic researchers had discovered a cell of rice contains more genes than a human cell caused widespread outrage as people across the globe attempted to prove that humans are easily as smart as a grain of rice." (read more)

Lectures will be held in Collier 202 (Mellon Lecture Hall)
Mondays, Wednesdays, and Fridays, 10:20 am to 11:10 am

Problem sessions will be held in Collier 123
Mondays 1:10 to 2:00 pm and Wednesdays 11:45 am to 12:35 pm

Lab meets in Room 301, Collier Hall of Science

Wednesday afternoons from 1:15 to 4:15
Thursday afternoons from 12:45 to 3:45
Friday afternoons from 1:15 to 4:15

The text required for this course is the 5th edition of *Essential Genetics: A Genomics Perspective*, by Daniel Hartl, published by Jones[1] & Bartlett, 2011.

Our text has (surprise!) an associated website.

[1]No relation.[2]

[2]To me, anyway.[3]

[3]As far as I know.

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, you 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 basic 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

You should be able to:

- predict and interpret the outcomes of genetic crosses
- read and understand primary articles in the genetics literature
- articulate current discoveries in genetics research
- accurately and concisely describe your own research findings
- use a pooter

Course Policies

Below you will find various course policies, including:

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

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.

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.

You want to learn genetics. I want to help you learn genetics. It's imortant that you come to class prepared, and I'm going to assume that you will do so. If not — if it becomes clear to me that many of you are not doing the necessary reading before class — I will start giving **quizzes** at the beginning of class. **IF** I give quizzes, they will be very low-impact individually, but how much (if anything) they contribute to your grade will depend on how many there are.

There will be three **hour exams** in this course, plus a 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. Yes, that means that the final will be cumulative. Each hour exam will contribute 100 points toward your final grade, and the final exam will contribute 300 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 around 600 points or so.

I will probably give occasional **miscellaneous assignments** over the course of the semester. These will be worth whatever points I announce at the time. I anticipate that there will be a total of 100 to 200 points in this category by the end of the semester.

Late assignments — including problem sets — will not be accepted.

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 should have a reasonable idea of what is meant by the term "participation." I assume a certain amount of participation on everyone's part; I will award up to 25 points for participation "above and beyond" at the end of the semester toward your final grade. Conversely, I will also dock up to 25 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!) throughout the semester; your lab notes will be worth 200 points.

In addition, I will be asking for **lab reports** for our lab experiments. I anticipate having 7 reports all told, worth a combined total of 700 points. **Laboratory technique** will account for another 100 points of your final grade.

In summary, then:

Hour Exams	300 points
Problem Sets	600 points
Misc. Assignments	100-200 points
Laboratory Notebook, Reports, and Technique	1000 points
Final Exam	300 points
Anticipated Total	**2300–2400 points**

I reserve the right to tweak these distributions as I see fit.

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.

Note that there isn't a whole lot of emphasis on *knowledge* here (as traditionally defined). Which is odd, but in any event, these descriptions are guidelines, not absolute criteria for a given grade. If you work independently, think originally, and are able to acquire and effectively use knowledge, but don't know squat about genetics at the end of the course, that's simply not "A" work. Context is important, people.

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.

Assignments turned in late will not be accepted. Period.

On a 100-point 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" in a college course is almost always a sham and a cheat.

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

Cell phones, like television, 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 can expect me to penalize you some number of points, based entirely on my whim. Someday this will be looked on as one of my loveable eccentricities, but until then you'll just have to put up with my sociopathy.

My antipathy extends to Blackberries and other such devices as well. If you want to text, tweet, IM, email, browse the web, check your stocks, shop, or do anything else that you feel is more important than paying attention in class, go for it. But don't do it in this class: if I notice anything like that going on, I will fail you. For. The. Course. You have been warned.

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 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.

For certain labs I will 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.

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 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 grade on your transcript, but also for the sake of your own intellectual development, 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.

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

Per Moravian College policy: "Students who wish to request accommodations in this class for a disability should contact Mr. Joe Kempfer, Assistant Director of Learning Services for Disability Support, 1307 Main Street (extension 1510). Accommodations cannot be provided until authorization is received from the office of Learning Services."

Syllabus

Meeting number	Date	In-Class	Background Reading
1	Mon., Aug. 29	organizational meeting	
2	Wed., Aug. 31	Overview I	chapter 1 sections 1.1–1.3
3	Fri., Sept. 2	Overview II	chapter 1 sections 1.4–1.7
	Mon., Sept. 5	No Class (Labor Day)	
4	Wed., Sept. 7	Mendel's discoveries	chapter 2 sections 2.1–2.4
5	Fri., Sept. 9	Pedigrees, dominance, and epistasis	chapter 2 sections 2.5–2.7
6	Mon., Sept. 12	Mitosis, meiosis, and chromosome structure I	chapter 3 sections 3.1–3.4
7	Wed., Sept. 14	Chromosome structure II, sex linkage, and probability	chapter 3 sections 3.5–3.7
8	Fri., Sept. 16	Linkage and recombination	chapter 4 sections 4.1–4.2
9	Mon., Sept. 19	Genetic mapping	chapter 4 sections 4.3–4.4
10	Wed., Sept. 21	Recombination mechanisms	chapter 4 sections 4.5–4.6
11	Fri., Sept. 23	Dosage compensation and chromosomal abnormalities	chapter 5 sections 5.1–5.2
12	Mon., Sept. 26	Chromosomal rearrangements and polyploidy	chapter 5 sections 5.3–5.5
13	Wed., Sept. 28	DNA structure and replication I	chapter 6 sections 6.1–6.4
14	Fri., Sept. 30	**hour exam**	chapters 1–5
15	Mon., Oct. 3	DNA replication II and laboratory manipulation	chapter 6 sections 6.5–6.8
16	Wed., Oct. 5	Bacterial genetics	chapter 7 sections 7.1–7.4
17	Fri., Oct. 7	Viral genetics	chapter 7 sections 7.5–7.7
	Mon., Oct. 10	No Class (Fall Break)	
18	Wed., Oct. 12	Gene expression overview and transcription	chapter 8 sections 8.1–8.3
19	Fri., Oct. 14	RNA processing and translation I	chapter 8 sections 8.4–8.5
20	Mon., Oct. 17	Translation II	chapter 8 sections 8.6–8.7
21	Wed., Oct. 19	Gene regulation in prokaryotes	chapter 9 sections 9.1–9.3
22	Fri., Oct. 21	Gene regulation in eukaryotes: transcription and processing	chapter 9 sections 9.4–6
23	Mon., Oct. 24	Translational regulation and DNA rearrangements	chapter 9 sections 9.7–9.8
24	Wed., Oct. 26	DNA cloning and genomics I	chapter 10 sections 10.1–10.2
25	Fri., Oct. 28	**hour exam**	chapters 6–9
26	Mon., Oct. 31	DNA microarrays & two-hybrid analysis	chapter 10 section 10.3
27	Wed., Nov. 2	Reverse genetics and genetic engineering	chapter 10 sections 10.4–10.5
28	Fri., Nov. 4	Development of yeast and worms	chapter 11 sections 11.1–11.2
29	Mon., Nov. 7	Development of flies and flowers	chapter 11 sections 11.3–11.4
30	Wed., Nov. 9	DNA mutations and transposable elements	chapter 12 sections 12.1–12.4
31	Fri., Nov. 11	Molecular mechanisms of mutation and repair	chapter 12 sections 12.5–12.7

32	Mon., Nov. 14	Cell cycle and cancer I	chapter 13 sections 13.1–13.3
33	Wed., Nov. 16	Cancer II	chapter 13 sections 13.4–13.5
34	Fri., Nov. 18	Molecular evolution	chapter 14 sections 14.1–14.4
35	Mon., Nov. 21	Population genetics	chapter 14 sections 14.5–14.10
	Wed., Nov. 23	No Class (Thanksgiving Break)	
	Fri., Nov. 25	No Class (Thanksgiving Break)	
36	Mon., Nov. 28	**hour exam**	chapters 10–14
37	Wed., Nov. 30	Complex traits	chapter 15 sections 15.1–15.2
38	Fri., Dec. 2	Artificial selection and QTL mapping	chapter 15 sections 15.3–15.5
39	Mon., Dec. 5	primary journal article TBA	
40	Wed., Dec. 7	primary journal article TBA	
	Tues., December 13 8:30 am	**FINAL EXAM**	

Life is fluid, so this syllabus is subject to change. 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!

Lab Syllabus

Week	Date	Activity	Reading
1	Aug. 31–Sept. 2	Lab orientation & overview handling flies (1) examine wild-type flies and begin life-cycle observations	"In the Laboratory of Agassiz" (handout) "Overview of *Drosophila* Development" (text fig. 11.12)
2	Sept. 7–9	(1) continue life-cycle observations (2) examine & score "alphabet" mutants (3) collect genomic DNA from cheek cells	*Drosophila* morphology handout
3	Sept. 14–16	**(1) *Drosophila* life cycle report due** review fly genetic nomenclature (2) review & set up "alphabet" mutant mapping cross 1 (3) carry out PCR on human genomic DNA	review the basics of PCR before lab "Mapping cross #1" handout
4	Sept. 21–23	(2) review & set up "alphabet" mutant mapping crosses 2 & 3 (3) carry out restriction digests on PTC amplicons and run electrophoresis gels (4) bacterial plating & serial dilutions (5) examine dysgenic male flies & set up cross	"Mapping cross #2" and "Mapping cross #3" handouts
5	Sept. 28–30	(2) examine & score mapping cross 1 F_1 flies (2) set up mutant mapping cross 1 F_1 cross (4) UV mutagenesis of bacteria	
6	Oct. 5–7	(2) set up mutant mapping crosses 2 & 3 F_1 crosses (3) analyze PTC gene sequence data (4) β-gal assays of bacteria (5) identify & set up cross with new mutant male (6) set up alphabet mutant recombination mapping cross #4 (7) discuss iPlant initiative and sample collection	"Mapping cross #4" handout
7	Oct. 12–14	(2) score mapping cross 1 progeny **(3) PTC allele analysis report due** (4) isolate plasmid DNA (7) plant DNA extraction and PCR	
8	Oct. 19–21	(2) score mapping crosses 2 & 3 progeny (4) agarose gel analysis of plasmids (4) complementation testing of bacteria (6) examine & score mapping cross 4 F_1 flies (5) set up mutagenesis F_1 crosses (6) set up mutant mapping cross 4 F_1 cross (7)agarose gel analysis of PCR amplicons	
9	Oct. 26–28	(4) PCR amplification of *lac* genes	
10	Nov. 2–4	**(2) alphabet mutant chromosomal mapping report due** (4) agarose gel analysis of PCR amplicons (5) examine F_1 progeny (6) score mapping cross 4 progeny (7) analyze *rbcL* gene sequence data	
11	Nov. 9–10	(4) analyze *lac* gene sequence data **(7) iPlant species identification report due**	
12	Nov. 16–18	**(4) bacterial mutagenesis report due** **(5) *Drosophila* mutagenesis report due** **(6) alphabet mutant recombination mapping report due**	
	Nov. 23–25	[no lab — Thanksgiving break]	
13	Nov. 30–Dec. 2	Nothing's scheduled this week, but doubtless we'll need it as a buffer…	

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.

Prof. Jones

If you ever have questions that you can't answer yourself using the textbook, the Web, or even (gasp!) *thinking*, realize that there are a lot of additional resources available to you: your classmates and me. Don't be shy about asking for help. This is part of my job, and one which I don't shirk. Depending on what the problem is, the most reliable method to contact me 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 11:30 am to 12:30 pm Mondays and Fridays, and 4 to 5 pm Thursdays. 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). That said, 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.