Genetics Home Page

Here's a list of the schedule for presentation of news items in class.

We all know that "correlation is not causation" (and if you don't know that, you'd better just nod wisely and look it up, because if you *don't* know that, you're either not a scientist or an idiot scientist at best). Well, here's a hilarious demonstration of that truism.

French monks "petitioned the Pope, informing him that rabbits … were actually fish. The Pope agreed" — with line like that, how could you not want to read more about the genetic changes associated with the domestication of rabbits?

Fruit flies love the smell of beer (but then, who doesn't? — besides me, that is). And that's because of the smell of the yeast that gives beer its alcohol and some of its flavor. But what about the yeast? Why would it have evolved genes for enzymes that produce those aromas? As is so often the case, Science may have the answer.

NASA scientists are putting fruit flies in space, taking advantage of the genetic similarities between flies and humans to glean insights into possible effects of long-term space travel on astronauts.

Using modern molecular genetic techniques, and taking advantage of mitochondrial inheritance, a British businessman and a molecular geneticist have claimed to have solved the mystery of Jack the Ripper's identity; it's interesting to compare the version of the story in The Daily Mail to that in The Inquisitor among others.

Nothing's ever as simple as you might like. Despite the clarity and simplicity of Mendel's Law of Segregation, there are exceptions. Some genetic elements are able to get themselves inherited in more than half of an affected individual's progeny; such elements are called "segregation distorters" or "drive genes." Researchers have been using them to try to develop ways of controlling pest populations, with a new and very promising version described recently.

"CRISPR" is a term you may have heard before now, but you'll definitely be hearing more about it in future. It's an extremely versatile genetic technique for modifying genomes, and not only does it work *in vivo*, but researchers have recently used it to modify mice with a form of muscular dystrophy, significantly reducing their symptoms. In the not-too-distant future, genetic diseases in humans may be treatable in a similar way, diseases which have stalked us pretty much since there was an "us" — powerful stuff.

The ability to rapidly sequence and analyze entire genomes is enabling us to much more quickly and effectively deal with disease outbreaks. The recent emergence of Ebola in west Africa has enabled geneticists to study the pattern of viral spread, determine where it began and how it is changing as it moves from person to person. This has the potential to affect both clinical testing and vaccine development.

Women are just better. We all know it (though not many are willing to say so, for fear of hurting men's delicate sensibilities), and here's some more evidence: although women seem to carry more mutations associated with abnormal development of the nervous system, they also appear to be less affected by them. Men are just weaker; deal with it, ya crybabies! (And there's an interesting hypothesis developed recently explaining why men die younger than women, and not just because of testosterone-induced stupidity.)

And genetically, what makes men different from women developmentally? Not much, it seems. A very small region of the Y chromosome, called SRY, is enough to turn females into what look like males. The natural follow-up question? What happens when you remove SRY from males?

Bananas are grown clonally: new plants start out as cuttings of old ones. As a result, there is almost no genetic diversity among commercially-grown bananas. And this is a problem for any species, because it makes them more susceptible to disease. And this is exactly what's threatening the world's banana supply today.

There are 3 billion basepairs in the human genome, which contains roughly 35,000 genes (it's hard to be exact for a lot of reasons, which we'll talk about as the course progresses). For at least some blonds, their hair color arose as the result of a single one of those 3 billion bases changing.

Never let it be said that geneticists aren't concerned about making the world a better place. The first line of this story says it all: " Researchers have created a mutant worm that can never get drunk."

Would you expect that, if you were to study your genes and those of your friends, your genes would be more alike than expected by random chance? It's not like you're related (probably) to them. In some ways this would be surprising, but it's just what researchers have discovered.

Most people wouldn't be surprised to learn that while success in athletics depends not only on training and perseverance, but also on your genes: some people are born with innate advantages in certain sports. It might be more surprising to learn that the same is true for musicians.

Two things: one, even professionals make mistakes. Two, Statistics is Real Important. (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)

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.

In a somewhat lighter vein, here's a link to a classic comparison of genetic and biochemical approaches to a problem.

Lectures will be held in PPHAC 102
Mondays, Wednesdays, and Fridays, 7:30 am to 8:40 am

Lab meets in Room 302, Collier Hall of Science

Monday afternoons from 1:15 to 4:15
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 6th edition of *Essential Genetics: A Genomics Perspective*, by Daniel Hartl, published by Jones & Bartlett (2014).

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
- understand the principles underpinning basic genetics laboratory techniques
- carry out those well-understood techniques!
- 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
- Tutoring
- Accommodations

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.

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, being prepared for each class meeting is critically important. Classtime will be spent discussing the material 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 — and the videos, 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, I do not anticipate any opportunity for extra credit in this course. Spend your energy learning the course material.

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

I don't like cell phones. I understand how useful they can be for some people, but far too often paying attention to your phone becomes an end in itself. When you're in class, it's important that you are *in class*, paying attention to what we're talking about. There will be times I ask you to use your phone for an in-class exercise, but other than that I don't want to see your phone out. It's probably a distraction for you (why else have it out?), and quite possibly for others around you — and that's just inconsiderate. If you can't live for an hour without checking your phone, you really should make an appointment with the counseling center, because you've got a serious problem.

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.

Syllabus

Meeting number	Date	In-Class	Background Reading
1	Mon., Aug. 31	organizational meeting	
2	Wed., Sept. 2	overview I	text sections 1.1–1.3
3	Fri., Sept. 4	overview II	text sections 1.3–1.4
4	Mon., Sept. 7	DNA structure & replication	text sections 6.1–6.4
5	Wed., Sept. 9	DNA replication and manipulation	text sections 6.5–6.8
6	Fri., Sept. 11	Protein structure and RNA processing	text sections 8.1–8.4
7	Mon., Sept. 14	Translation	text sections 8.5–8.7
8	Wed., Sept. 16	Gene regulation I	text sections 9.1–9.3
9	Fri., Sept. 18	Gene regulation II	text sections 9.4–9.5
10	Mon., Sept. 21	Gene regulation III	text sections 9.6–9.8
11	Wed., Sept. 23	Mendel and transmission genetics	text sections 2.1–2.2
12	Fri., Sept. 25	Hour Exam	text chapters 1, 6, 8, 9
13	Mon., Sept. 28	Segregation	text sections 2.3–2.5
14	Wed., Sept. 30	Dominance and epistasis	text sections 2.6–2.7
15	Fri., Oct. 2	Mitosis and meiosis	text sections 3.1–3.3
16	Mon., Oct. 5	Chromosome structure	text sections 3.4–3.5
17	Wed., Oct. 7	Probability and statistics	text sections 3.6–3.7
18	Fri., Oct. 9	Linkage and recombination	text sections 4.1–4.2
	Mon., Oct. 12	No Class (Fall Break)	
19	Wed., Oct. 14	Gene mapping	text sections 4.3–4.4
20	Fri., Oct. 16	Recombination mechanics; human chromosomes	text sections 4.6 and 5.1
21	Mon., Oct. 19	Chromosomal mutations and polyploidy	text sections 5.2 and 5.4
22	Wed., Oct. 21	Mutation I	text sections 1.5 and 5.3
23	Fri., Oct. 23	Hour Exam	text chapters 2, 3, 4, 5
24	Mon., Oct. 26	Mutation II	text sections 12.1–12.4
25	Wed., Oct. 28	Mutation III	text sections 12.5–12.7
26	Fri., Oct. 30	Cloning and annotation	text sections 10.1–10.2
27	Mon., Nov. 2	Genomics and genetic engineering	text sections 10.3–10.5
28	Wed., Nov. 4	Cell cycle	text sections 13.1–13.2
29	Fri., Nov. 6	Cancer genetics	text sections 13.3–13.5
30	Mon., Nov. 9	Bacterial genetics	text sections 7.1–7.4
31	Wed., Nov. 11	Viral genetics	text sections 7.5–7.7
32	Fri., Nov. 13	Developmental genetics I	text sections 11.1–11.2
33	Mon., Nov. 16	Hour Exam	text chapters 7, 10, 12, 13

34	Wed., Nov. 18	Developmental genetics II	text sections 11.3–11.4
35	Fri., Nov. 20	Evolutionary genetics I	text sections 1.6–1.7 and 5.5
36	Mon., Nov. 23	Evolutionary genetics II	text sections 14.1–14.2
	Wed., Nov. 25	No Class (Thanksgiving Break)	
	Fri., Nov. 27	No Class (Thanksgiving Break)	
37	Mon., Nov. 30	Evolutionary genetics III	text sections 14.3–14.5
38	Wed., Dec. 2	Population genetics	text sections 14.6–14.10
39	Fri., Dec. 4	Quantitative genetics I	text sections 15.1–15.2
40	Mon., Dec. 7	Quantitative genetics II	text sections 15.3–15.5
41	Wed., Dec. 9	"A Single Amino Acid Mutation Contributes to Adaptive Beach Mouse Color Pattern"	Hoekstra *et al*. (2006) *Science* **313**:101–104
42	Fri., Dec. 11	"A Single Amino Acid Mutation Contributes to Adaptive Beach Mouse Color Pattern"	Hoekstra *et al*. (2006) *Science* **313**:101–104
	Mon., Dec. 14 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!

The Academic Support Center houses Disability Support and Greyhound Tutoring on the first floor of Monocacy Hall and can be reached at 610-861-1401. Greyhound Tutoring provides course-specific tutors to Moravian students, free of charge. If you would like to work with a Greyhound Tutor to boost your academic success, please request a tutor through http://bit.ly/NeedTutorMC (case-sensitive). Plan ahead! It takes 2–3 business days to connect you with a tutor. Please email Dana Wilson (wilsond@moravian.edu), Tutor Coordinator, for more information about tutoring. Please email Laurie Roth (rothl@moravian.edu), Director of Academic and Disability Support, for more information about disability support.

Per Moravian College policy: "Students who wish to request accommodations in this class for a disability should contact the office of Academic Support Services, located on the first floor of Monocacy Hall (extension 1401). Accommodations cannot be provided until authorization is received from the Academic Support Services office."

Lab Syllabus

Week	Date	Activity	Preparatory Materials
1	Aug. 31–Sept. 4	Lab orientation & overview handling flies (1) examine wild-type flies and begin life-cycle observations	"In the Laboratory of Agassiz"
2	Sept. 7–11	(2) plant genomic DNA prep (3) set up cross 1 for mutant mapping	
3	Sept. 14–18	**(1) Life Cycle report due** (2) run PCR reactions on plant DNA	PCR protocol review PCR in our text (pp. 217–218) review PCR animations online (ask Prof. Google or refer to the "Study Aids" section on the course homepage)
4	Sept. 21–25	(2) run agarose gel on PCR products (3) score mutant mapping cross 1 F_1 progeny, set up F_1 cross (3) set up mutant mapping crosses 2 & 3 for mutant mapping	video on fly genetic nomenclature review pouring an agarose gel and gel electrophoresis; videos are available online from many sources, including benchfly, Bio-Rad (both pouring and running), and jove
Here is a link to pictures of the PCR gels; note that the red pixels visible on some images simply means that the signal was so strong there that it saturated the detector.			
5	Sept. 28–Oct. 2	DNA sequence analysis [**Collier 206 Monday & Wednesday** **PPHAC 331 Thursday & Friday**]	
6	Oct. 5–9	(2) sequence analysis (3) score mutant mapping cross 1 F_2 progeny (3) score mutant mapping crosses 2 & 3 F_1 progeny, set up F_1 cross	
7	Oct. 12–16	**(Fall Break)**	
8	Oct. 19–23	**(2) Plant Identification report due** (3) score mutant mapping crosses 2 & 3 F_2 progeny (4) set up recombination mapping crosses	
9	Oct. 26–30	(5) purify human buccal cell DNA	
10	Nov. 2–6	**(3) Mutant Mapping report due** (4)set up recombination mapping F_1 crosses (5) run PCR on buccal cell DNA	review the crossing schemes for crosses 2 and 3 review PCR basics
11	Nov. 9–13	(5) run gel on buccal cell PCR products	
12	Nov. 16–20	(4) score recombination mapping crosses progeny **(5) Blood Genotyping report due**	
13	Nov. 23–27	[no lab — Thanksgiving break]	
14	Nov. 30–Dec. 4	**(4) Recombination Mapping report due**	
15	Dec. 7–11		

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. If I'm not in my office (Room 319, Collier Hall of Science), try my lab (Room 227, Collier Hall of Science — between the elevator and the loading dock on the main floor). That said, my office hours are really a formality; 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.