BIO210

Genetics

Fall 2010

Genetics Home Page

Survey

Before class on Friday morning, September 3rd, please take the pre-course survey. It's worth 35 points toward your final course grade.

Study Aids

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.

News

August 28, 2010. One of the many areas of biology which genetics has profoundly affected is determining evolutionary relationships among living species. A German research group has used molecular characterization of transposable elements, familiarly called "jumping genes," to disentangle the family tree of marsupials. (read more)

September 2010. This month's issue of *National Geographic* shows another, related, use for genetics: unraveling the family relationships of the boy pharaoh Tutankhamun, who died 3,333 years ago. (read more)

August 27, 2010. Ants are cool. Not as cool as fruit flies, perhaps, but hey, what could be? Anyway, researchers have sequenced the entire genomes of two species of ant, which opens a window into understanding the genetic underpinnings of behavioral (and other) differences between the two species. (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)

Classes

Lectures will be held in PPHAC 101
Mondays, Wednesdays, and Fridays, 10:20 am to 11:10 am

Lab

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

Text

The text required for this course is the 7th edition of *Essentials of Genetics*, by Klug, Cummings, Spencer, and Palladino, published by Benjamin Cummings, 2010.

For reasons that are not entirely clear to me, Moravian College considers this to be a personal page. Therefore it is incumbent on me to point out that "The views expressed on this page are the responsibility of the author, Christopher Jones (cjones-at-moravian-dot-edu) and do not necessarily reflect Moravian College or Moravian Theological Seminary policies or official positions."

[Prof. Jones' homepage] [Moravian College] [Moravian Biology] [XHTML 1.0] [CSS]

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 events in genetics research
- describe your research findings in standard AIMRD format
- 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. **Quizzes** are a demonstrably valuable tool to help learning. Ergo, I will be giving quizzes throughout the semester. They will be very low-impact individually, but I expect they will cumulatively be worth 100 points or so by the end of the semester. If you're not in class for a quiz, there will be no opportunity to make it up. However, I will be dropping several of the lowest quiz grades, so missing a few quizzes won't do your grade irreparable harm.

There will be only two **exams** in this course, a mid-term and 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. The mid-term exam will contribute 150 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. 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 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 formal **lab reports** for our lab experiments. I anticipate having 3 mini-reports and 4 full reports all told, worth a combined total of 750 points. **Laboratory technique** will account for another 50 points of your final grade.

In summary, then:

Quizzes	100 points
Mid-term Exam	150 points
Problem Sets	600 points
Misc. Assignments	100-200 points
Laboratory Notebook, Reports, and Technique	1000 points
Final Exam	300 points
Anticipated Total	**2250-2350 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 150-point exam, I will give you 165 points-worth of questions. Thus, you can miss (nearly) 10% of the questions on any hour exam and still get the full 150 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 mark 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. 30	organizational meeting	
2	Wed., Sept. 1	genetics overview	chapter 1
3	Fri., Sept. 3	What is the "genetic material"?	chapter 9 sections 9.1–9.5
	Mon., Sept. 6	No Class (Labor Day)	
4	Wed., Sept. 8	DNA and RNA structure	chapter 9 sections 9.6–9.9
5	Fri., Sept. 10	The genetic code	chapter 12 sections 12.1–12.7
6	Mon., Sept. 13	Transcription & mRNA splicing	chapter 12 sections 12.8–12.12
7	Wed., Sept. 15	Translation	chapter 13 sections 13.1–13.4
8	Fri., Sept. 17	Proteins	chapter 13 sections 13.5–13.9
9	Mon., Sept. 20	Gene mutations	chapter 14 sections 14.1–14.3
10	Wed., Sept. 22	DNA repair & transposition	chapter 14 sections 14.4–14.8
11	Fri., Sept. 24	Expression regulation in prokaryotes	chapter 15 sections 15.1–15.5
12	Mon., Sept. 27	Expression regulation in eukaryotes	chapter 15 sections 15.6–15.12
13	Wed., Sept. 29	Chromosomes	chapter 11
14	Fri., Oct. 1	DNA replication & recombination	chapter 10
15	Mon., Oct. 4	Mitosis & meiosis	chapter 2
16	Wed., Oct. 6	Bacterial & viral genetics	chapter 8
17	Fri., Oct. 8	Transmission genetics I	chapter 3 sections 3.1–3.4
	Mon., Oct. 11	No Class (Fall Break)	
18	Wed., Oct. 13	Transmission genetics II	chapter 3 sections 3.5–3.9
19	Fri., Oct. 15	Modifications of Mendelian ratios	chapter 4 sections 4.1–4.8
20	Mon., Oct. 18	Other complexities in transmission genetics	chapter 4 sections 4.9–4.14

21	Wed., Oct. 20	paper	
22	Fri., Oct. 22	**midterm exam**	
23	Mon., Oct. 25	exam review	
24	Wed., Oct. 27	paper	
25	Fri., Oct. 29	Sex determination I	chapter 5 sections 5.1–5.3
26	Mon., Nov. 1	Sex determination II	chapter 5 sections 5.4–5.7
27	Wed., Nov. 3	Linkage & crossing over	chapter 7 sections 7.1–7.3
28	Fri., Nov. 5	Linkage mapping	chapter 7 sections 7.4–7.9
29	Mon., Nov. 8	Cancer & the cell cycle	chapter 16
30	Wed., Nov. 13	Recombinant DNA technology	chapter 17 sections 17.1–17.7
31	Fri., Nov. 12	Genomics	chapter 18
32	Mon., Nov. 15	Ethical issues and modern genetics	chapter 19
33	Wed., Nov. 17	Developmental genetics	chapter 20
34	Fri., Nov. 19	Behavior genetics	chapter 21
35	Mon., Nov. 22	Quantitative genetics	chapter 22
	Wed., Nov. 24	No Class (Thanksgiving Break)	
	Fri., Nov. 26	No Class (Thanksgiving Break)	
36	Mon., Nov. 29	Population genetics	chapter 23 sections 23.1–23.5
37	Wed., Dec. 1	Evolutionary genetics	chapter 23 sections 23.6–23.10
38	Fri., Dec. 3	Conservation genetics	chapter 24
39	Mon., Dec. 6	paper	
40	Wed., Dec. 8	paper & review	
	Tues., December 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!

Exams

Here are the ground rules for all of my exams (unless I explicitly tell you otherwise):

- Write your exam in pen, not pencil.
- Don't forget to write your name on the front page!
- Only calculators may be used during exams — no cell phones/PDAs/other electronic gizmos
- For every 100 points on an exam, I present 110 total points possible; I will only count questions you get right, which means that you can miss up to 1/10th of the total points and still get "100%" for the exam. So I recommend doing what you're most sure of first, then struggling with the more difficult questions.
- Guess if you must, but don't b.s. and don't "core-dump" — answer the questions directly and concisely.
- If you feel that a question cannot be answered as it is stated without making an assumption, go ahead and make that assumption, but **note** that you are making it!
- No question should require more than three sentences to answer; if you think you have to write more, go ahead, but it shouldn't be necessary. Feel free to continue on the back of the page, but **note** that you are doing so! It's your responsibility to make clear to me which is your (final) answer in all cases.
- If someone is absent for an exam, don't discuss the exam with **anyone** until I say otherwise.

Lab Syllabus

Week	Date	Activity	Reading
1	Sept. 1–3	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 pp. 434–435)
2	Sept. 8–10	review fly nomenclature (2) run 16S PCR reactions on bacterial unknowns (3) examine & score wild-type flies & "alphabet" mutants	Polymerase Chain Reaction (text pp. 357–359)
3	Sept. 15–17	**(1) *Drosophila* life cycle report due** (2) run gel on 16S PCR products (3a) review & set up mapping cross 1	Gel electrophoresis (text p. 199; online animation)
4	Sept. 22–24	(3b) review & set up mapping crosses 2 & 3 (5) set up mutagenesis cross with dysgenic male	Transposons (text p. 289; 299–300) P-element Transposons (text p. 302)
5	Sept. 29–Oct. 1	(2) DNA sequence analysis (3a) examine & score mapping cross 1 F_1 flies (3a) set up F_1 cross (4) review & set up recombination mapping cross (6) bacterial dilution & plating	DNA sequencing (text pp. 366–368) using BLAST (text pp. 380–381) recombination mapping (text pp.133–143)
6	Oct. 6–8	**(2) bacterial unknown identification report due** (3b) set up mapping crosses 2 & 3 F_1 crosses (5) set up expansion cross with new mutant male (6) bacterial UV mutagenesis	UV mutation (text p. 291)
7	Oct. 13–15	(3a) characterize cross 1 progeny (4) characterize recombination cross 1 F_1 flies (4) set up recombination mapping F_1 cross (6) β-galactosidase assays	
8	Oct. 20–22	(3b) characterize cross 2 & 3 progeny (5) set up mapping and viability crosses (6) plasmid isolation	
9	Oct. 27–	**(3) alphabet mutant report due** (4) characterize recombination cross	

	29	progeny (6) plasmid gel electrophoresis
10	Nov. 3–5	(5) examine progeny to assess location & viability (6) *lac* gene PCR
11	Nov. 10–11	**(4) recombination mapping report due** (6) PCR product gel
12	Nov. 17–19	**(5) *Drosophila* mutagenesis report due**
	Nov. 24–26	[no lab — Thanksgiving break]
13	Dec. 1–3	**(6) *lac* mutant report due**

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 textbooks, 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 9 am to 10 am Mondays and Fridays, and 11:30 to 12:30 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.