Biology 3325: Genetics
Seattle Pacific University
Winter Quarter, 2020

Instructor: Jenny Tenlen, Ph.D.	**Course Information:**
Office: Eaton 113 *Phone:* 206-281-2007 *Email*: tenlenj@spu.edu	*Lecture:* MWF, 9:30 – 10:50 am, Bertona 3
Office hours: *MWF 1:30 pm – 3:00 pm, or by appointment, or drop in when my door is open.*	*Labs*: Tues., 8:00 am – 10:50 am, Eaton 134 Tues., 12:00 pm – 2:50 pm, Eaton 134 Thurs., 12:00 pm – 2:50 pm, Eaton 134 *Lab TAs*: Lauren Valentine, Suzie Ruskin and Beth Gebre

"*Seattle Pacific University is a Christian university fully committed to engaging the culture and changing the world by graduating people of competence and character, becoming people of wisdom, and modeling grace-filled community.*"
[SPU Mission Statement]

Textbooks and other materials

Required textbook:

Hartwell, et al. (2017) *Genetics: From Genes to Genomes*, 6th edition. ISBNs: 1259700909 / 9781259700903

Note: the 5th ed. may be used instead. Some content in the 6th ed. may not be available in the 5th. I will post a chapter equivalency guide on Canvas.

Other materials:

I will post other class readings, assignments and lab materials on the course Canvas site. For lab, you will need goggles, and are required to bring your own Sharpie pen (either extra-fine or ultra-fine tip) since you will be labeling a lot of tubes and plates.

Course Description

Welcome to Genetics! Genetics is the study of heredity – the nature of genes, and how specific traits are passed on from parent to offspring. This course has three areas of focus:

First, we will focus on the experiments in heritability and variation that have contributed to our current understanding of the field. Starting with Gregor Mendel's pioneering experiments in peas, we will uncover the core principles of genetics, and analyze the data that informed these principles. This portion of the course will address three questions:

1. How are traits passed from parent to offspring (how does a person's genotype become reflected in their phenotype)?
2. How do researchers identify, define and study genes?
3. How are genes regulated at the molecular level, and how does this regulation contribute to a phenotype?

Second, you will have the opportunity to participate in an original research project that aims to identify new genes that affect embryo development in a classic model organism, the

nematode *Caenorhabditis elegans*. This research project will allow you to apply concepts learned in class to a specific research question, and to gain experience with common techniques in genetics and molecular biology.

Finally, we will discuss the ethical and social implications of genetics research. With the explosion of data from the Human Genome Project, the ever-increasing availability of genetic testing, and the emergence of new technologies (such as CRISPR/Cas9-mediated gene editing), it is critical that we examine issues in genetics in a manner that integrates our scientific knowledge with our moral and faith-based values.

An understanding of these foundations will not only help you to understand the broad field of genetics, but will teach you to integrate information across disciplines within the logical framework provided by the scientific method. This ability will allow you to apply what you have learned in your courses to real world problems and to make informed critical decisions that will affect your future and that of our world. As Christians who seek to '*engage the culture and change the world,*' it is our mandate to hone these skills, a process that will begin during your college career and hopefully continue throughout your lives.

(Course description from the SPU catalog) "Prerequisites: A C- or better in BIO 2101 and MAT 2360, BioCore Placement level 3 and student must be accepted into a major. Introduces inheritance of specific traits through the study of transmission genetics. Focuses on the biology of gene transmission, nucleic acids, chromosome structure, regulation, epigenetics, genetic disease and biotechnology. Research methods are stressed throughout the course."

Course Learning Objectives

1. Describe fundamental principles of inheritance, and explain how perturbations of genetic mechanisms affect human health.
2. Explain how key experiments in genetics contributed to our understanding of the field.
3. Connect genetic principles, moral and faith-based values in resolving ethical dilemmas in genetics.
4. Learn to read and analyze primary scientific literature, both classic and modern.
5. Apply the scientific method of acquiring data and presenting information to a specific research question.
6. Learn to work effectively in collaborative groups.
7. Acquire, synthesize and present new information in both written and oral venues.

Biology Department: The objectives of the Biology Department can be found online at: http://spu.edu/academics/college-of-arts-sciences/biology/about/mission-goals-and-objectives. We will specifically address these outcomes:

1. Students learn the major themes and core concepts of cell biology, molecular biology, genetics, organismal biology, ecology, and evolution by natural selection.
2. Students use appropriate supporting data and analyses to effectively communicate in oral and written forms.
3. Students explore the integration of science with a Christian worldview.
4. Students participate in authentic laboratory or field research.

University Objectives: The mission statement and goals of Seattle Pacific University can be found online at: http://spu.edu/about-spu/mission

Assignments and Assessments

Problem Sets: There will be 5 problem sets, designed to help you practice applying the concepts and skills learned in class to different scenarios and problems. To receive full credit, you must explain how you arrived at your answer. For example, if you are asked to determine the genotypes of possible offspring of a mating, your answer should document how you arrived at your answer (either by applying probability rules or by setting up a Punnett Square).

Position Papers: Whether in our professional or personal lives, we will all face ethical dilemmas related to some aspect of genetics (such as genetic testing, editing of an embryo's genome, etc.) As part of the course, we will examine two case studies that will help you to make decisions that are grounded in science and consistent with your moral and faith-based values. For each case study, you will write a short paper that discusses the issue from the point of view of a stakeholder. Additional instructions will be provided separately.

In-class activities: There will be multiple in-class activities designed to reinforce and extend concepts discussed in lecture. These activities include problem-solving, examination of data from the primary scientific literature, quizzes, and discussion of reading assignments. Some of these activities may be graded.

Exams: There will be three exams, two during the quarter and 1 final exam. These exams will assess your mastery of the concepts presented in class, and will include questions from reading assignments, lecture, in-class activities, and lab. Each exam is iterative – knowledge from previous units will be assumed as you answer questions from the new units. For the final exam, about 75% of the points will be specific to the material covered after the 2nd exam, and about 25% of the points will based on cumulative questions.

Lab notebook: You are required to keep an electronic lab notebook. Because you will be participating in a real research project, with the potential for publication, it is critical that your notebook is (1) accurate, (2) up-to-date, and (3) detailed. Instructions on setting up and maintaining your notebook will be included in the lab manual posted on Canvas.

Lab participation: Attendance in lab each week is essential. In some weeks, you will also need to come in outside of lab to monitor experiments and maintain your nematode cultures. Absence from scheduled lab, or failure to come in outside of lab as needed, will result in loss of participation points.

Lab assignments: Each week, you will be responsible for completing a pre-lab assignment to ensure that you are prepared for the lab's activities. These assignments will be detailed in the lab manual.

Lab report: At the end of the quarter, you will write a research paper that describes the results of your group's research project. Guidelines will be included in the lab manual on Canvas.

Lab oral presentation: During the last lab session, each lab group will present their findings to the class, as research groups would during lab meetings. The class data will be compiled into a final summary that will help guide decisions about the next steps in the research project.

Grading

Note: Point values and assignments may be altered during the course depending on available time and other course constraints.

Category	Points Possible
Tests (3 x 100 pts ea.)	300
Problem sets (5 x 15 pts ea.)	75
Position papers (2 x 15 pts ea.)	30
Class activities	var.
Lab prelab assignments	75
Lab notebook	66
Lab oral presentation	15
Lab report	100
total	**≥ 661**

Percentage	Letter
93-100	A
90-92.9	A-
87-89.9	B+
83-86.9	B
80-82.9	B-
77-79.9	C+
73-76.9	C
70-72.9	C-
67-69.9	D+
60-66.9	D
0-59.9	E

Course Policies

Disabilities statement: All students have the right to learn, and I care very deeply that students feel supported and engaged in class. In accordance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, I encourage students with specific disabilities that qualify for academic accommodations to contact Disabled Student Services (DSS) in the Center for Learning (http://www.spu.edu/depts/cfl/dss/index.asp). DSS in turn will send a Disability Verification Letter to the course instructor indicating what accommodations have been approved.

E-mail/Canvas: Course announcements will be posted on Canvas, and other information may be disseminated by email, so please check both regularly for any updates - you are responsible for knowing course deadlines. I am happy to respond to emails. However, I generally do not check email in the evening (after 8pm) – please plan ahead if you have questions about the next day's class or lab (especially if there is a test scheduled, or an assignment due!)

Lab Safety: Participation in the laboratory section is mandatory for this class. Final point totals for the course are a combination of those from both laboratory and lecture. The laboratory component of this course includes an original research project. **Time will be required outside of the laboratory to prepare or complete laboratory experiments**. Students working in the lab outside of normal hours must be with a partner at all times. Food, drinks, gum, etc. are NOT permitted inside the lab.

Lab safety training is required of all students. We will work with a variety of microorganisms during this course. While these organisms are not considered human pathogens in healthy adults, precautions are still necessary when working with them. Your instructor will inform you of safety issues and procedures on a daily basis. Please adhere to these guidelines and report any accident, no matter how small, to the instructor or TA immediately for evaluation

You must wear goggles, gloves and appropriate attire when working on your experimental protocols. Gloves must be worn at all times. You will not be permitted to use lab equipment until you have been trained by the instructor or TA, and have demonstrated your ability to use the equipment appropriately.

Academic Integrity and Plagiarism: Any instance of cheating or interfering with another student's ability to learn will not be tolerated. In either case, the guidelines from the Academic Integrity section of the Undergraduate Catalog will be followed (http://spu.edu/catalog/undergraduate/20190/academic-policies-procedures/integrity).

Plagiarism is the representation of someone else's work as your own. Neglecting to properly cite references is the most common example of this. Plagiarism and other breaches of academic integrity (e.g. cheating) will not be tolerated and will be dealt with severely. The first offense will result in a failing grade for the assignment or exam in question. The second offense will result in a failing grade for the course and your actions will be reported to the University registrar. While you will be working with a partner in lab, and will often work on in-class activities in groups, all work must be your own. As one example, you may not copy your lab partner's methods section and paste it into your own lab report. One of the learning objectives of this course is to develop skills to communicate in writing to a broad community of scientists. Simply copying from others cheats you of this opportunity to develop these skills. Please ask questions IN ADVANCE if you are not sure about what constitutes plagiarism, at this stage it is simply a learning exercise (i.e., not a breach of academic integrity) and you will be able to rectify the situation. *Once a paper is submitted, however, you will be held to the above guidelines*.

Attendance and participation: Students are expected to attend all class sessions. Due to the unusual nature of this course, it is essential that we all work together as a team and participate on a daily basis to ensure that effective progress is made. If you are not in class, you cannot participate. For this reason, chronic *unexcused* absences from the class will result in significant grade reductions (at the instructor's discretion, four or more unexcused absences could result in the loss of at least one letter grade). If you plan to be absent due to a university-sanctioned event (e.g., grad-school interview, choir performance or athletic competition), please alert the instructor in advance. If you are unable to attend class due to a severe illness or other emergency, you must notify the instructor *before* class if possible. If you miss a graded in-class activity for an *unexcused* absence, you will not be able to make it up. If you miss a graded in-class activity for an *excused* absence, you may be asked to do a makeup assignment, at the instructor's discretion.

Religious holidays: Students who would like to request an accommodation for a religious holiday (e.g. request that an exam scheduled for a religious holiday be rescheduled) should make a written request within the first two weeks of the course pursuant to SPU's Academic Schedule Religious Accommodation Policy. The policy is posted in the Undergraduate Student Handbook at https://spu.edu/administration/office-of-student-life/handbook/behavioral-community-expectations/university-policies.

Classroom conduct: You are expected to help maintain a classroom environment that is conducive to learning by arriving on time, by minimizing distractions (texting, cellphones, laptops, food), and by respecting the rights of other students to ask questions and express their views.

Late work policy: All coursework (both lecture and lab) must be completed and turned in by the stated deadline. You are responsible for completing all of your own work. Points for late work, when accepted, will be reduced by 10% for each calendar day the assignment is late. Exceptions may be made for illness and emergencies when the instructor has been notified and agrees in writing.

Note the date and time of all exams, including the final exam, and make your travel plans accordingly. Make-up exams will be considered only for extraordinary circumstances and only if the instructor has been notified in writing in advance (leaving early for vacation does not count as an extraordinary circumstance). The format of a makeup exam is the instructor's choice. No late work will be accepted after the start of the final exam.

Report an Emergency or Suspicious Activity
Call the Office of Safety and Security (OSS) at 206-281-2911 to report an emergency or suspicious activity. SPU Security Officers are trained first responders and will be dispatched to your location. If needed, the OSS Dispatcher will contact the police and/or fire department with the exact address of the location of the emergency.

SPU-Alert System
The SPU-Alert System is SPU's emergency notification system. It can send information via text messages, emails, electronic reader boards, computer pop-ups (for SPU computers), loudspeakers, and recorded cell phone messages. In order to receive text messages from SPU-Alert, your cell phone number must be entered in the Banner Information System on the web, https://www.spu.edu/banweb/. To check if your number is entered, select the Personal Menu then choose the Emergency Alert System tab. Contact the CIS Help Desk (206-281-2982) if you have questions about entering your personal contact information into the Banner Information System. Emergency announcements may also be made by SPU staff members serving as Building Emergency Coordinators ("BECs").

Lockdown / Shelter in Place – General Guidance
The University will lock down in response to threats of violence such as a bank robbery or armed intruder on campus. You can assume that all remaining classes and events will be temporarily suspended until the incident is over. Lockdown notifications are sent using the SPU-Alert System.

If you are in a building at the time of a lockdown and you are NOT in immediate visible danger:

- Stay inside and await instruction.
- Move to a securable area (such as an office or classroom) and lock the doors and silence your phone.
- Close the window coverings then move away from the windows and get low on the floor.
- Remain in your secure area until further direction or the all clear is given (this notification will be sent via the SPU-Alert System).

If you are in a building at the time of a lockdown and you ARE in immediate visible danger: Run to escape or hide in a securable area, and plan to defend yourself if necessary.

If you are outside at the time of a lockdown: Leave the area and seek safe shelter off campus. Return to campus after the all clear is given (this notification will be sent via the SPU-Alert System).

Evacuation – General Guidance
Everyone should evacuate a building if the fire alarm sounds or if a faculty member, a staff member, or the SPU-Alert System instructs building occupants to evacuate. In an evacuation, gather your personal belongings quickly and safely proceed to the nearest exit. Most classrooms contain a wall plaque or poster on or next to the classroom door showing the evacuation route and the assembly site for the building. Do not use an elevator.

Once you have evacuated the building, proceed to the nearest evacuation assembly location. The "*Stop. Think. Act.*" booklet posted in each classroom contains a list of assembly sites for each building. The assembly sites are also listed online at: https://emergency.spu.edu/campus-emergency-procedures/evacuation-and-assembly-areas/. Check in with your instructor or a BEC (they will be recognizable by their bright orange vests). During emergencies, give each BEC your full cooperation whenever they issue directions.

Additional Information
Additional information about emergency preparedness can be found on the SPU website at https://emergency.spu.edu/.

Emergencies (continued): If an emergency requiring evacuation occurs during lecture, please exit the classroom in a calm and orderly fashion and meet as a group in the Ross parking lot. If an emergency occurs during lab, please meet in Tiffany Loop. Please do not leave this area, as the instructor needs to account for all students immediately following the evacuation. If possible, pair up with your nearest neighbor in an emergency and keep track of each other until the situation has been resolved. In the unlikely event of a lockdown, please stay in the classroom and follow the instructor's directions.

Inclement weather: The University maintains an Emergency Closure Hotline (206-281-2800). In the event of inclement weather or an emergency that might close the university, please call the Hotline for the most up-to-date closure information or check the SPU website. Both will be updated before 6:00 a.m. In the event that class is cancelled unexpectedly, please check the course Canvas site for makeup information.

Succeeding in Genetics

Genetics is an intense subject, in part because it is so focused on problem-solving. On the course Canvas site, I created a "Helpful Resources" tab with links to useful websites and articles that you may find helpful as you move through the course. Here are a few general tips that I encourage you to follow:

1. Attend all class sessions and labs! Classes will include different types of activities, including lecture, discussion, problem-solving, brainstorming, etc. These activities are designed to help you practice applying concepts introduced in lecture to real-world genetic problems. When you miss class, you miss out on these learning opportunities.

2. Check Canvas! For each lecture, I will create a page of resources, including the study guide for the associated textbook reading assignments, lecture handouts to facilitate note-taking, links to lecture recordings, and links to helpful tutorials, animations and other aides to help you practice applying the material.

3. Ask for help! I want all of you to succeed. If you have questions about something we covered in class or lab, or are unsure of how to approach a genetics problem, please come talk to me, so I can help you.

4. Form a study group with your classmates to share notes, pick each other's brains, and review concepts. The study area on the main floor of Eaton includes a white board that students are free to use during their studies.

5. The 3Rs: Read, Review, Re-write

    a. Read the assigned chapters or articles before class, and identify the key concepts. Note any questions you have about the material.
    b. Review class materials and lectures. I will try to make lectures available after class through Panopto.
    c. Re-write your lecture notes after each class – the sooner, the better, since it will still be fresh in your mind. Re-writing your notes will not only allow you to reorganize them, but there is extensive research demonstrating the "hand-brain connection" – writing and re-writing help you to process concepts and information, and move it from short-term to long-term memory.

Syllabus

- *Please note: all textbook readings are from the 6th ed. (5th ed. equivalents are posted on Canvas). Additional readings not listed here may be assigned. The syllabus is subject to change. Any changes will be communicated verbally and on Canvas.*

Date	Topic	Readings & Assignments
Mon., 1/6	Introduction to course & research project	**Text:** Articles on Canvas
Wed., 1/8	Mendelian genetics & probability	**Text:** Ch. 1; 2.1-2.2
Fri., 1/10	Pedigree analysis	**Text:** Ch. 2.3 **Due:** Syllabus Quiz (Canvas)
Mon., 1/13	Beyond Mendel: single-gene traits	**Text:** Ch. 3.1 **Due:** Problem Set #1
Wed., 1/15	Epistasis	**Text:** Ch. 3.2; article (Canvas)
Fri., 1/17	Epistasis; Variations in gene expression	**Text:** Ch. 3.3
Mon., 1/20	***MARTIN LUTHER KING, JR DAY - NO CLASS***	
Wed., 1/22	Chromosome Theory of Inheritance	**Text:** Ch. 4.1 & 4.6 (review 4.3-4.5) **Due:** Problem Set #2
Fri., 1/24	Genetics and Society: Case Study #1	**Due:** Position Paper #1
Mon., 1/27	Sex-linked traits	**Text:** Ch. 4.2 & 4.7, 13.4
Wed., 1/29	***EXAM 1***	
Fri., 1/31	non-Mendelian inheritance	**Text:** Ch. 15 (all)
Mon., 2/3	non-Mendelian inheritance; Genetic testing	**Text:** Ch. 15 (all); 11.1, 21.3
Wed., 2/5	Gene linkage and recombination	**Text:** Ch. 5.1-5.4
Fri., 2/7	Gene linkage and recombination	**Text:** Ch. 5.1-5.4 **Due:** Problem Set #3
Mon., 2/10	Mutant analysis & complementation	**Text:** Ch. 7.1-7.2, 7.4
Wed., 2/12	Mutant analysis & complementation	**Text:** Ch. 7.1-7.2, 7.4
Fri., 2/14	Prokaryotic genetics	**Text**: Ch. 14.1-14.4 **Due:** Problem Set #4
Mon., 2/17	Prokaryotic genetics	**Text:** Ch. 8.2-8.3, 16.1
Wed., 2/19	Prokaryotic genetics	**Text:** Ch. 8.2-8.3, 16.1
Fri., 2/21	***EXAM 2***	
Mon., 2/24	Eukaryotic gene regulation	**Text:** Ch. 17.1-17.2, 8.4
Wed., 2/26	Eukaryotic gene regulation	**Text:** Ch. 17.1-17.2, 8.4 **Due:** Problem Set #5
Fri., 2/28	Eukaryotic gene regulation	**Text:** Ch. 17.1-17.2, 8.4
Mon., 3/2	Genetic engineering: CRISPR-Cas9	**Text:** Ch. 7.3, 18.3-18.4
Wed., 3/4	Genetics and Society: Case Study #2	**Due:** Position Paper #2
Fri., 3/6	Eukaryotic gene regulation	**Text:** Ch. 17.1-17.2, 8.4
Mon., 3/9	Epigenetics	**Text:** Ch. 12.1-12.3, 17.3
Wed., 3/11	Epigenetics	**Text:** Ch. 12.1-12.3, 17.3
Fri., 3/13	Epigenetics	**Text:** Ch. 12.1-12.3, 17.3
Sun., 3/15	**Lab Report Due (11:59 pm)**	
Wed., 3/18	***FINAL EXAM*** ***8:00 AM - 10:00 AM*** ***BERTONA 3***	
Mon., 3/23	**Due:** Student course evaluation (in Canvas)	

Lab Schedule

Week	Dates	Activities
1	1/7 & 1/9	• Pre-lab assignment: GENI-ACT account and lab notebook setup • Lab safety training and drawer check-in • Practice aseptic technique. • Learn how to pick, manipulate and observe worm strains • Record observations and compare/contrast wild-type (N2) and mutant (*mes-1*) strains • Set up overnight cultures of your assigned RNAi clones
2	1/14 & 1/16	• Pre-lab assignment: DNA minipreps and PCR • Isolate plasmid DNA from bacterial cultures • Characterize DNA concentration/purity using NanoDrop • Set up PCR reactions • Practice picking worms, and maintain strains
3	1/21 & 1/23	• Pre-lab assignment: RNAi article • Lab lecture: discussion of RNAi • PCR clean-up • Characterize DNA concentration/purity using NanoDrop • Gel electrophoresis • Practice picking worms, and maintain strains
4	1/28 & 1/30	• Pre-lab assignment: Bei et al (2002) article • Lab lecture: discussion of Bei et al paper • dsRNA synthesis • Practice picking worms, and maintain strains • Practice scoring progeny
5	2/4 & 2/6	• Pre-lab assignment: BLAST and WormBase search • Finish preparing dsRNA for experiments • Practice setting up soaking experiment • Practice picking worms, and maintain strains • Practice scoring progeny
6	2/10 – 2/14	• Pre-lab assignment: Literature search results • RNAi experiment, Trial 1 • Maintain strains
7	2/17 – 2/21	• Pre-lab assignment: Experimental procedures • RNAi experiment, Trial 2 • Maintain strains
8	2/24 – 2/28	• Pre-lab assignment: Box plot summarizing Trial 1 & 2 results • RNAi experiment, Trial 3
9	3/3 & 3/5	• Pre-lab assignment: Updated box plot; Bei et al questions • Statistical analysis of data • New discussion of Bei et al paper
10	3/10 & 3/12	• Pre-lab assignment: Reflection questions and final lab notebook • Oral presentations
	3/15	• **DUE:** final lab report (11:59 pm)