

**BIO 3320: Principles of Development  
Seattle Pacific University  
Spring Quarter, 2019**

**Instructor:** Jenny Tenlen, Ph.D.

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*Office hours:*

MWF, 10:00 am – 11:30 am, or by appointment, or feel free to stop in any time my door is open.

**Course Information:**

*Lecture:* MWF, 1:30 – 2:50 pm, OMH 136

*Lab:* Tues., 8:00 am – 10:50 am, Eaton 232

Lab TA: Shun-Je Bhark

*“Seattle Pacific University seeks to change the world and engage the culture by graduating students of competence and character, cultivating people of wisdom, and modeling a grace-filled community.”  
[SPU Mission Statement]*

### **Textbooks and other materials**

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*Required textbook:*

Gilbert, Scott (2014) *Developmental Biology*, 10<sup>th</sup> edition. Sunderland, MA: Sinauer Associates, Inc.

(Note: if you cannot afford the cost of the textbook, the 9th edition of this book is available on reserve in Ames Library. URL: <https://tinyurl.com/y7d8l6kc> )

*Other materials:*

I will post other class readings, assignments and lab materials on the course Canvas page.

For lab each week, please bring a lab notebook or bound composition book (preferably with grid pattern), goggles, and a Sharpie pen (either extra-fine or ultra-fine tip). There may be times when you will need your dissection kit.

### **Course Description**

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Welcome to Principles of Development! Development (historically called “Embryology”) examines how organisms progress from single-celled zygotes to complex, multicellular beings. Development is probably my favorite biological discipline (although I love Genetics, too) – I am fascinated by how carefully orchestrated embryogenesis appears to be, and the field integrates multiple levels of biology (genetics, cell & molecular biology, biochemistry, anatomy and physiology). In particular, we will focus on several broad themes: Polarity (how do cells and embryos tell which end is which?), Cell Fate (what distinguishes a nerve cell from a muscle cell?), Morphogenesis (how does a simple ball of cells become a recognizable organism?), Organogenesis (how do complex structures form, such as limbs or the central nervous system?), and Stem cells and regeneration (how are stem cells maintained, and why can some organisms regenerate body parts, but others can’t?). The course is divided into three sections:

- I. Fundamental Concepts in Developmental Biology: historical overview of developmental biology, and the role of gene expression and cell-cell communication in development
- II. Comparative early development: fertilization, cleavage and gastrulation in representative invertebrate and vertebrate model systems
- III. Specification of germ layers in vertebrates: conversion of ectoderm, mesoderm and endoderm into specific tissues and organs

Class sessions will emphasize both fundamental concepts of development, and experimental evidence for these concepts. In addition to lectures and in-class activities, we will discuss the primary literature in regular journal clubs. You will have the opportunity to explore a particular topic in-depth by writing a literature review paper. We will also take time to examine issues that relate to bioethics and human health.

Labs will focus on descriptive and experimental studies in development, including projects related to the instructor's area of research.

## Course Learning Objectives

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### Course

1. Describe fundamental principles of development, and explain how perturbations of developmental processes affect human health.
2. Explain how key experiments in development contributed to our understanding of the field.
3. Learn to read and analyze primary scientific literature, both classic and contemporary.
4. Connect principles of development to moral and faith-based values in resolving ethical dilemmas in developmental biology.
5. Apply the scientific method of acquiring data and presenting information to a specific research question.
6. Acquire, synthesize and present new information, through lab experiments and the review paper.

**Biology Department:** The Biology Department mission statement can be found online at: <http://spu.edu/academics/college-of-arts-sciences/biology/about/mission-goals-and-objectives>. We will specifically address the following Student Learning Outcomes in BIO 3320:

1. Students learn the major themes and core concepts of cell biology, molecular biology, genetics, organismal biology, ecology, and evolution by natural selection.
3. Students use appropriate supporting data and analyses to effectively communicate in oral and written forms.
5. 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>.

## Grading

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<b>Category</b>	<b>Points Possible</b>
Journal clubs (5 x 10 pts)	50
Quizzes (5 x 10 pts)	50
Tests (3 x 100 pts)	300
Literature review proposal	10
Literature review analyses	30
Literature review (final draft)	100
Prelabs (8 x 5 pts)	40
Lab notebook	40
Lab reports (2 x 25 pts)	50
<b>total</b>	<b>670</b>

Scale:

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

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

## Assignments and Assessments

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*Note:* Principles of Development is a “W” course. Writing is an important aspect of this course, and will allow you to practice applying ideas and concepts in a variety of contexts. Please be aware of assignment deadlines and plan accordingly.

*Journal club:* There will be 5 journal clubs this quarter, with a set of questions to answer for each assigned paper. These journal clubs will allow us to examine in-depth the research that contributed to the topics we’re studying in class. Written answers are due at the start of class on the designated day.

*Quizzes:* There will be 6 quizzes to assess your understanding of reading assignments and lectures. Please check the syllabus for scheduled dates. Quizzes will take place during the last 20 minutes of class. If you are absent from class on the day of a quiz, you may not make it up, unless you are an athlete or musician on a school-sanctioned trip (in which case, your quiz will be proctored). **Your lowest quiz score will be dropped from your final grade.**

*Literature review:* You will research a specific topic in developmental biology, and write a literature review on this topic. You will receive feedback on a rough draft before submitting the final version. Please see the separate assignment guidelines for more information.

*Exams:* There will be three exams. While each test will focus on a specific set of course materials, concepts will be iterative - that is, concepts from preceding units will be important in answering questions on subsequent tests. Check the syllabus for dates.

*Lab notebook:* You are required to keep a lab notebook. Instructions on setting up and maintaining your notebook are posted on the lab Canvas site.

*Lab assignments:* For each lab, you will complete a prelab assignment, due at the start of lab. You will write two research reports, in the format of a journal article. Additional information will be provided separately.

*Participation:* You are expected to attend all class and lab sessions. Participation in class includes being attentive, asking and answering questions, contributing to journal club discussions, and participating in other in-class activities. In lab, participation includes working with your lab partner, observing lab safety rules, and handling and maintaining research organisms in a safe and respectful manner. At times, you will also need to come in outside of lab to monitor experiments and maintain animal cultures. Absence from scheduled lab, or failure to come in outside of lab as needed, will result in loss of participation points.

## Course Policies

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**Lab Safety:** Participation in the laboratory section is mandatory for this course. Final point totals for the course are a combination of those from both laboratory and lecture. Lab safety training is required, and will be conducted during the first full week of the quarter as needed. If you signed the Lab Safety Training form in Fall or Winter quarter, you do not need to sign a new form.

You must wear goggles, gloves and appropriate attire when working on your experimental protocols. 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 and drinks are NOT permitted inside the lab.

We will work with a variety of live animals (primarily invertebrates). Dr. Tenlen will inform you of safety issues and procedures regularly. Please adhere to these guidelines and report any accident, no matter how small, to Dr. Tenlen immediately for evaluation

The use of all lab equipment is subject to the following guidelines.

1. The first time you use ANY equipment in lab you must be instructed on its use and safety by the instructor.
2. The second time you use the equipment you must be directly observed by the instructor.

Once approved, you may use the equipment on your own.

**Plagiarism and Academic 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 or copying another student's work) 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. 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.* Since a significant part of your grade in this course will involve written research assignments it is a critical that you fully understand this policy.

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 simply copy your lab partner's methods section and paste it into your own 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.

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. See the SPU undergraduate catalog for more information on academic integrity (<http://spu.edu/catalog/undergraduate/20189/academic-policies-procedures/integrity>).

**Attendance and participation:** Students are expected to attend all class and lab sessions. Attendance will be taken by the instructor. The class will require everyone's active participation. If you are not in class, you cannot participate. For this reason, chronic *unexcused* absences from the class will result in significant grade reductions (1-2 letter grades deducted at the instructor's discretion for four or more unexcused absences). If you plan to be absent due to a university-sanctioned event (e.g., 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.

**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.

**Coursework:** All coursework must be completed and turned in by the stated deadline. As stated above, you are responsible for completing all of your own work. If you will be absent on the day an assignment is due, it is your responsibility to turn in the assignment on time. Grades for late work, when accepted, will be reduced by 10% of the possible points for each 24-hr period the assignment is late. Exceptions may be made for documented illness and emergencies when the instructor has been notified and concurs. Be sure to mark the date of the final exam - makeup exams will not be given unless under extreme circumstances.

**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. I am happy to respond to emails.

**Disabilities statement:** All students have the right to learn, and Dr. Tenlen cares 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, students with specific disabilities that qualify for academic accommodations are strongly encouraged 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.

**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.

**Emergencies:** If there is an emergency during lecture that requires evacuating the building, meet as a group in the Otto Miller parking lot. If an evacuation occurs during lab, meet as a group in Tiffany Loop. Please do not leave this area, as your 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. If there is a lockdown, please stay in the classroom and follow your instructor's directions. Additional information about emergency procedures is provided on the next page.

## Emergency Preparedness Information

### Report an Emergency or Suspicious Activity

Call the Office of Safety & Security (OSS) at 206-281-2922 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 local fire/police 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 message, email, electronic reader board, computer pop-ups (for SPU computers), loudspeaker, and recorded cell phone messages. Text messaging has generally proven to be the quickest way to receive an alert about a campus emergency. In order to receive text messages from SPU-Alert, you must provide SPU with your cell phone number through the Banner Information System on the web, <https://www.spu.edu/banweb/>. Select the Personal Menu then choose the Emergency Alert System tab. Contact the CIS Help Desk 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:

- Stay inside and await instruction, unless you are in immediate visible danger. If you are in immediate danger: run to escape or hide in a securable area, and plan to defend yourself if necessary.
- 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 and if you are with other people spread out around the room.
- 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 outside at the time of a lockdown:

- Leave the area and seek safe shelter off campus. Remaining in the area of the threat may expose you to danger.
- Return to campus after the all clear is given (this notification will be sent via the SPU-Alert System).

### Evacuation – General Guidance

Students 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 the event of 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 the 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 easily 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 web page at <https://emergency.spu.edu/> or by calling the Office of Safety & Security at 206-281-2922.

## Succeeding in Development

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Development is an intense subject, and will require you to integrate different pieces of information or evidence to build a conceptual framework. On the course Canvas site, I created a “Helpful Resources” tab with links to websites and texts that you may find helpful as you progress through the course. Here are a few general tips that I encourage you to follow:

1. Use the syllabus as a schedule for reading the textbook. Check Canvas for upcoming assignments. If you start working on assignments sooner rather than later, you will have more time to seek help if you need it.
2. Prepare for each class and lab session so that you can be a productive member of your team. Before each class, read the relevant page in Canvas (under Modules > Lecture Materials). For each class session, I will post a summary of the topic, a link to the relevant textbook reading assignment & study guides, a PDF containing lecture handouts to help in taking notes, and other resources that I think could be helpful.
3. Attend all class sessions and labs! Classes will include different types of activities, including lecture, problem-solving, etc. These activities are designed to help you practice applying the concepts introduced in lecture. When you miss class, you miss out on these learning opportunities.
4. 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 about an aspect of a reading assignment or journal paper, please come talk to me, so I can help you.
5. 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.
6. 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 TechSmith Relay.
  - 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: additional readings not listed here may be assigned during the quarter. The syllabus is subject to change. Any changes will be communicated to the class verbally and through announcements on Canvas.

Date	Topic	Readings & Assignments
Mon., 3/25	Introduction to Development	<b>Text:</b> Ch. 1
Tues., 3/26	<b>LAB:</b> Gametogenesis and early cleavage	* Bring a lab notebook
Wed., 3/27	Introduction to Development	<b>Text:</b> Ch. 1
Fri., 3/29	Differential gene expression	<b>Text:</b> Ch. 2 (pp. 34-58) <b>DUE:</b> Syllabus quiz (Canvas)
Mon., 4/1	Genomic equivalence <i>QUIZ 1</i>	<b>Text:</b> Ch. 2 (pp. 34-58)
Tues., 4/2	<b>LAB:</b> Introduction to Tardigrade Project; Introduction to Literature Review • Library Session with Carrie Fry	<b>DUE:</b> Lab 2 prelab <b>Text:</b> Literature Review Assignment Instructions
Wed., 4/3	Cell sorting and cell adhesion <i>Journal club 1</i>	<b>DUE:</b> journal article responses <b>Text:</b> Ch. 3 (pp. 69-99)
Fri., 4/5	Cell-cell communication	<b>Text:</b> Ch. 3 (pp. 69-99)
Mon., 4/8	Cell-cell communication <i>QUIZ 2</i>	<b>Text:</b> Ch. 3 (pp. 69-99)
Tues., 4/9	<b>LAB:</b> Tardigrade project	<b>DUE:</b> Lab 3 prelab
Wed., 4/10	Cell migration; epithelial and mesenchymal cells	<b>Text:</b> Ch. 3 (pp. 99-104)
Fri., 4/12	<i>C. elegans</i> development <i>Journal club 2</i>	<b>DUE:</b> journal article responses <b>Text:</b> Ch. 5 (pp. 155-161; 170-177)
Mon., 4/15	<i>C. elegans</i> development	<b>DUE:</b> Literature review topic proposal <b>Text:</b> Ch. 5 (pp. 155-161; 170-177)
Tues., 4/16	<b>LAB:</b> Tardigrade project	<b>DUE:</b> Lab 4 prelab
Wed., 4/17	<b>EXAM 1</b>	
Fri., 4/19	<b>NO CLASS - GOOD FRIDAY (SPU closes after 12:00 PM)</b>	
Mon., 4/22	<i>Drosophila</i> development	<b>Text:</b> Ch. 6 (pp. 179-202)
Tues., 4/23	<b>LAB:</b> Tardigrade project	<b>DUE:</b> Lab 5 prelab
Wed., 4/24	<i>Drosophila</i> development <i>Journal club 3</i>	<b>DUE:</b> journal article response <b>Text:</b> Ch. 6 (pp. 179-202)
Fri., 4/26	Gastrulation in invertebrates <i>QUIZ 3</i>	<b>Text:</b> TBD
Mon., 4/29	Amphibian development	<b>DUE:</b> Paper #1 analysis <b>Text:</b> Ch. 8 (pp. 241-252)
Tues., 4/30	<b>LAB:</b> Regeneration project	<b>DUE:</b> Lab Report #1
Wed., 5/1	Amphibian development	<b>Text:</b> Ch. 8 (pp. 252-271)
Fri., 5/3	Mammalian development <i>QUIZ 4</i>	<b>Text:</b> Ch. 9 (pp. 298-315)
Mon., 5/6	Mammalian development	<b>DUE:</b> Paper #2 analysis <b>Text:</b> Ch. 9 (pp. 298-315)
Tues., 5/7	<b>LAB:</b> Regeneration project	<b>DUE:</b> Lab 7 prelab
Wed., 5/8	Gastrulation in mammals	<b>Text:</b> Ch. 9 (pp. 298-315)

Fri., 5/10	Ectoderm: central nervous system	<b>Text:</b> Ch. 10 (pp. 333-355)
Mon., 5/13	<b>EXAM 2</b>	
Tues., 5/14	<b>LAB:</b> <i>C. elegans</i> project	<b>DUE:</b> Lab 8 prelab
Wed., 5/15	Ectoderm: CNS and neural crest cells	<b>DUE:</b> Paper #3 analysis <b>Text:</b> Ch. 11 (pp. 375-393)
Fri., 5/17	Ectoderm: neural crest cells <i>Journal club 4</i>	<b>DUE:</b> journal article response <b>Text:</b> Ch. 11 (pp. 375-393)
Mon., 5/20	Mesoderm: Somitogenesis <b>QUIZ 5</b>	<b>Text:</b> Ch. 12 (pp. 416-434)
Tues., 5/21	<b>LAB:</b> <i>C. elegans</i> project	<b>DUE:</b> Lab Report #2
Wed., 5/22	Mesoderm: Somitogenesis	<b>DUE:</b> Literature review - rough draft <b>Text:</b> Ch. 12 (pp. 416-434)
Fri., 5/24	Mesoderm: Tetrapod limb development	<b>Text:</b> Ch. 14 (pp. 489-516)
Mon., 5/27	<b>NO CLASS - MEMORIAL DAY</b>	
Tues., 5/28	<b>LAB:</b> <i>C. elegans</i> project	<b>DUE:</b> Lab 10 prelab
Wed., 5/29	Mesoderm: Tetrapod limb development <b>QUIZ 6</b>	<b>Text:</b> Ch. 14 (pp. 489-516)
Fri., 5/31	Conclusion: What Does It Mean To Be Human? (When in development is "personhood" established?)	<b>Text:</b> TBD <b>DUE:</b> Literature review - final draft (11:59 pm)
Tues., 6/4	<b>FINAL EXAM</b> <b>OTTO MILLER 136</b> <b>1:00 - 3:00 pm</b>	
Wed., 6/12	<b>DUE:</b> Student Feedback Survey (Canvas)	