

**BIO-378 DEVELOPMENTAL BIOLOGY
COURSE SYLLABUS**

Tuesday & Thursday, 10:00 AM – 11:45 AM; Friday, 9:00 AM – 10:45 AM; Science Center 308

Instructor:

Dr. Jason Pellettieri
Science Center 330
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603-358-2380

Office Hours:

Tuesdays, 12:00 PM – 1:00 PM
Wednesdays, 12:00 PM – 1:00 PM
Thursdays, 2:00 PM – 3:00 PM
or by appointment

Catalog Description:

An integrated lecture-lab course examining fundamental developmental phenomena, such as the differentiation and patterning of tissues and organs. Classic experiments in the field using a variety of model organisms will be discussed and students will complete original laboratory research projects investigating the genetic basis of animal development. Prerequisites: BIO 311 and BIO 312.

Course Outcomes:

In successfully completing this course, students are expected to gain an understanding of key concepts in the field of developmental biology as well as the discoveries upon which those concepts are based. Additionally, students will learn how to design, carry out, and present an original laboratory research project. Specific learning outcomes are outlined below.

Content-Based Learning Outcomes – students will be able to demonstrate:

- Knowledge of cellular mechanisms of gametogenesis and fertilization
- Knowledge of embryonic stem cells and how they are cultured in the laboratory
- Knowledge of autonomous and non-autonomous mechanisms of cell fate specification
- Knowledge of molecular mechanisms regulating developmental gene expression
- Knowledge of how major body axes are established and how embryos are patterned
- Knowledge of cell movements and their role in establishing tissue and organ morphology
- Knowledge of vertebrate limb formation and patterning
- Knowledge of the basis for evolutionary changes in development
- Knowledge of how environmental factors impact development
- Knowledge of basic cellular and molecular mechanisms of regeneration
- Knowledge of single-cell sequencing and its application to the study of development
- Familiarity with key discoveries in the field

Skill-Based Learning Outcomes – students will be able to demonstrate:

- Ability to search and analyze the peer-reviewed scientific literature
- Ability to identify and analyze gene sequences using bioinformatics approaches
- Ability to clone genes using basic molecular biology protocols
- Ability to silence gene expression using RNA interference

- Ability to screen for phenotypes in a model organism
- Ability to present and discuss research articles from the primary literature
- Ability to create and deliver effective oral presentations
- Ability to write in the style of a primary research article

Students will reach these outcomes by attending lectures and studying the material presented therein, participating in group discussions of published research papers, and completing original research projects.

Course Materials:

The textbook for this course is *Essential Developmental Biology (3^d ed.)* by Jonathan Slack, available at the college bookstore. While exams will focus almost entirely on material covered in class, reading the text will help you to attain a deeper level of understanding than you will get from attending lectures alone. Therefore, you are strongly encouraged to complete all assigned readings. You should also note that other developmental biology texts (including slightly older editions) will contain the same general information. One of these is freely available online:

<http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=dbio>

Please be sure to comply with the NCBI terms of use:

<https://www.ncbi.nlm.nih.gov/home/about/policies.shtml>

Additionally, the following research articles will be posted to Canvas:

Paper 1 – Adult Oogenesis? (Zou et al., 2009)

Paper 2 – Myostatin Knockout “Supermice” (McPherron et al., 1997)

Paper 3 – MicroRNAs (Lee et al., 1993)

Paper 4 – RNAi (Fire et al., 1998)

Paper 5 – Embryonic Patterning (Nüsslein-Volhard & Wieschaus, 1980)

Paper 6 – Two-Headed Worms (Gurley et al., 2008)

Paper 7 – Polydactyly in Hemingway’s Cats (Lettice et al., 2008)

Paper 8 – Stickleback Evolution (Shapiro et al., 2004)

Paper 9 – Non-Mendelian Inheritance in Plants? (Lolle et al., 2005)

Evaluation and Grading:

Quizzes – 5 X 15 points each	75 points
Paper Presentation	75 points
Research Project	
Oral Presentation	75 points
Written Report	75 points
Midterm Exam	100 points
Final Exam	100 points
<i>Total</i>	<i>500 points</i>

A 465-500 (93%)

AB 440-464 (88%)

B 415-439 (83%)

BC 390-414 (78%)

C 365-389 (73%)

CD 340-364 (68%)

D 315-339 (63%)

F 0-314 (<63%)

Monitoring Your Performance

Note that your grades will be viewable (password-protected) throughout the semester on Canvas. You are responsible for monitoring your own performance. Please see me during office hours if you have questions/concerns about your grades. Final grades for the course will not be changed after they are entered, except in the event of a grading error.

Quizzes

Short quizzes will be administered for each of the assigned papers. The quiz for the first paper will not be scored and is intended to give you an idea of what these will be like. Your three lowest scores for the remaining eight quizzes will be dropped. All quizzes will be administered at the start of class and cannot be made up for any reason (the three dropped scores are intended to accommodate any excused absences).

Paper Presentation

Together with a classmate, you will be presenting an original research article in developmental biology. These presentations constitute a key part of the course and you are expected to demonstrate a thorough knowledge of your assigned subject matter. Further information on how to prepare your presentations and how they will be graded will be provided in class. I will present the first paper to give you an idea of how you should approach this assignment. Please meet see me outside of class if you have questions about your paper.

Research Project

The laboratory work in this course will involve a single, semester-long project, divided into weekly activities. Specifically, each of you will be identifying, cloning, and silencing a novel planarian gene using a technique called RNA interference (RNAi). Because each lab activity will build upon previous work, it is important not to miss labs and fall behind. The oral presentations will involve a brief summary of your experimental design, results, and conclusions. Each of you will also complete a written report that will follow the format of a peer-reviewed scientific research article. Further information on the research project, oral presentation, and written report will be provided in class.

Exams

Both the midterm and final will be based on lecture and lab content and may also address concepts covered in the paper presentations. You are advised to take careful notes in class. The final examination will cover primarily material from the second half of the semester but may also include comprehensive questions pertaining to topics covered in the first part of the course.

Course Requirements and Policies:

You are responsible for making sure that you understand and adhere to all of the course requirements and policies outlined below. These policies are not subject to negotiation.

Attendance

Students are expected to attend all class sessions and to take part in all course activities. Given the unique nature of the research project, *any student missing more than two lab exercises due to unexcused absences will receive a zero for both research project assignments (deduction of*

150 points, or 30%, from the final course grade). You will also receive a zero for any other coursework (e.g., exams or presentations) missed because of an unexcused absence. My previous experience teaching this course suggests attendance is critical to doing well on exams. Please note that College policy stipulates a student who misses in excess of three weeks of classes prior to the eleventh week of the semester, for any reason whatsoever, must withdraw from the course.

Absences due to illness, serious accident, death in the family, or participation in a scheduled athletic event will be excused. Except in unusual circumstances (e.g., a car accident shortly before the start of class), you must notify me of your absence *in advance* for your absence to qualify as excused. Written documentation, such as a doctor's note, may also be required. If you are late for class, the policies for excused and unexcused absences outlined above will be applied to the time you miss.

Make-Up Coursework

Coursework missed because of an excused absence can be made up if you contact me as soon as possible to make alternative arrangements. The content and/or format of the make-up coursework may differ from that of the original. Exams, assignments, or lab work missed because of unexcused absences *cannot* be made up.

Cell Phone Policy

Please do not use your cell phones or wireless devices during class and lab (with the exception noted below). The first time you violate this policy, you will receive a verbal warning. A second violation will result in dismissal from class. A third violation will result in mandatory withdrawal from the course. I will make an exception to this policy if you have a serious personal issue that requires use of your phone and you notify me prior to the start of class.

Late Assignments

Late assignments will incur a penalty, the amount of which will be determined at my discretion.

Academic Honesty

Please read and make sure you fully understand the College's Policy on Academic Honesty (<http://www.keene.edu/administration/policy/detail/academic-honesty>). Any incidents of plagiarism, cheating, or other violations of this policy will be reported to the administration.

You should be aware that plagiarism includes both paraphrasing another person's work without providing a citation, as well as directly copying another person's work without putting the copied material in quotation marks (or italicizing extended passages) and providing a citation. The College's Policy on Academic Honesty includes further guidelines on this subject and I will provide additional guidance in class as well.

Course Website and E-mails

You are required to check your KSC e-mail at least once between each class period. You should also visit the course website on Canvas at least once each week. Updates to course content, including changes to instructions for completing assignments, may be e-mailed and posted throughout the semester. PowerPoint slides for lectures will be posted to Canvas, usually prior to the start of class.

Weather Policy

I will notify you of any class cancellations due to inclement weather by campus e-mail. If the College declares curtailed operations, class will automatically be cancelled.

Getting Extra Help:

Being a college student can be a stressful experience. If you need extra assistance with any aspect of this course or in dealing with problems outside of this course, please don't hesitate to ask for help. You can meet with me and/or seek support from the following campus offices:

Student Disabilities

It is College policy to provide reasonable accommodations to students with disabilities. If you would like to request such accommodations, please contact the Office of Disability Services (ODS) located on the first floor of the Elliot Center (phone: 603-358-2353).

Aspire Program

Any student interested in obtaining academic assistance (tutoring, advice on study or time management skills, etc.) should contact the Aspire Program located on the first floor of the Elliot Center (phone: 603-358-2325).

Writing and Math Centers

Students interested in improving their writing or math skills are encouraged to schedule an appointment with a tutor at the Center for Writing at 81 Blake Street (phone: 603-358-2412) or the Math Center at 88 Winchester Street (phone: 603-358-2387).

The Hungry Owl

If you are facing challenges securing food, you are encouraged to make use of the free food provided by The Hungry Owl food resource at a variety of locations on campus including the main location behind Randall Hall and at Mason Library. You can follow The Hungry Owl on Twitter (@KSCTheHungryOwl), Instagram (@kschungryowl), or Facebook (@TheHungryOwlKSC) to learn more.

Counseling Center

The Counseling Center offers a full range of mental health services to all students. The Center is located on the third floor of the Elliot Center (phone: 603-358-2437 or call 603-358-2436 to speak with a crisis counselor during non-business hours).

BIO-378 Schedule
(Subject to Change)

Date	Topic(s)	Reading
Tuesday, 1/22	Course Introduction; History of Developmental Biology	Chapters 1&2
Thursday, 1/24	Germline and Fertilization	Chapters 7-12 (selected sections)
Friday, 1/25	Lab Overview; Gene Selection	
Tuesday, 1/29	Paper 1: Adult Oogenesis?	Zou et al., 2009
Thursday, 1/31	Embryonic Cleavage	Chapters 7-12 (selected sections)
Friday, 2/1	BLAST Searches; Primer Design	
Tuesday, 2/5	Embryonic Stem Cells; Gene Knockouts	Chapter 21
Thursday, 2/7	Autonomous Specification	Chapters 7-12 (selected sections)
Friday, 2/8	RT-PCR; Gel Electrophoresis	
Tuesday, 2/12	Cell-Cell Signaling	Chapters 7-12 (selected sections)
Thursday, 2/14	Paper 2: Myostatin Knockout "Supermice"; PCR Cleanup	McPherron et al., 1997
Friday, 2/15	Cloning Reactions; Transformations	
Tuesday, 2/19	Regulation of Gene Expression I	Chapters 7-12 (selected sections)
Thursday, 2/21	Regulation of Gene Expression II	Chapters 7-12 (selected sections)
Friday, 2/22	Paper 3: MicroRNAs	Lee et al., 1993
Tuesday, 2/26	Diagnostic PCRs	
Thursday, 2/28	HT115 Transformations	
Friday, 3/1	No Class	
Tuesday, 3/5	Paper 4: RNAi	Fire et al., 1998
Thursday, 3/7	Axis Specification; RNAi Food Preparation	Chapters 7-12 (selected sections)
Friday, 3/8	Paper 5: Embryonic Patterning; RNAi Food Preparation	Nüsslein-Volhard & Wieschaus, 1980
Tuesday, 3/12	No Class: Spring Break	
Thursday, 3/14	No Class: Spring Break	
Friday, 3/15	No Class: Spring Break	
Tuesday, 3/19	Midterm Exam Review; RNAi Feeding 1	
Thursday, 3/21	Midterm Exam; RNAi Feeding 2	
Friday, 3/22	Planarian Regeneration; RNAi Feeding 3	Chapters 7-12 (selected sections)
Tuesday, 3/26	Gastrulation; RNAi Feeding 4	Newmark & Sánchez Alvarado, 2002
Thursday, 3/28	Planarian Disease Models; RNAi Feeding 5	Stubنهاus et al., 2016
Friday, 3/29	Paper 6: Two-Headed Worms; RNAi Feeding 6	Gurley et al., 2008
Tuesday, 4/2	The CNS; RNAi Feeding 7	Chapter 14
Thursday, 4/4	Limb Development; RNAi Feeding 8	Chapter 15 (pp. 274-284)

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(Subject to Change)

Date	Topic(s)	Reading
Friday, 4/5	No Class	
Tuesday, 4/9	Paper 7: Polydactyly in Hemingway's Cats; Amputations	Lettice et al., 2008
Thursday, 4/11	Evolution and Development; Phenotypic Analysis	Chapter 22
Friday, 4/12	Paper 8: Stickleback Evolution; Phenotypic Analysis	Shapiro et al., 2004
Tuesday, 4/16	Environmental Effects on Development; Phenotypic Analysis	
Thursday, 4/18	Paper 9: Non-Mendelian Inheritance in Plants?; Phenotypic Analysis	Lolle et al., 2005
Friday, 4/19	Prepare Project Presentations and Written Reports	
Tuesday, 4/23	Aging	Chapter 19
Thursday, 4/25	Project Presentations	
Friday, 4/26	Project Presentations	
Tuesday, 4/30	Project Presentations	
Thursday, 5/2	Single-Cell Sequencing	Fincher et al., 2018
Friday, 5/3	Exam Review; Written Project Reports Due (5:00 PM)	
Tuesday, 5/7	Final Exam, 10:30 AM – 12:30 PM	