BIOLOGY 4000 SYLLABUS

COURSE: Bio4000, Developmental Biology, Spring 2021 (3 units lecture + 1 unit lab)

INSTRUCTOR: Dr. Mike Dorrell Rohr Science 158, x2962, mdorrell@pointloma.edu
Office Hours: M,W 10:00 – 12:40. I love to meet with (and help) students. If the "office hour" appointment times don't work for you, please contact me and I am more than happy to find a time that will work. I have an open door policy so if I am in my office, feel free to stop by.

LECTURE: MWF 8:30 – 9:35 AM. Sator 120
LABORATORY SCHEDULE: Thursdays 1:30 – 4:30. Sator 120

Catalog description: An analysis of mechanisms of early development of invertebrates and vertebrates. Includes a study of the cellular, molecular, and genetic factors that influence cell differentiation and the determination of the body plan, as well as a study of the morphogenesis of selected organ systems. The laboratory uses a variety of model organisms to study normal and abnormal development. Lecture and lab. Offered every year.

Full Description: Developmental Biology is a course about how living organisms in all of their complexity come into being from two single cells. Developmental biology has also emerged as the key factor in determining the mechanism of evolution (Evo-Devo). Studying the emergence of life and coming to know it at quite a sophisticated level is awe-inspiring. The remarkable events that must occur in perfect sequence so that we become functional human beings are extremely complex. It is no less than a miracle that we each began as a single fertilized cell. That is the primary objective in this course. As we study the process of development, we are studying that which has been put in place by our Creator, so perhaps the highest objective of all is that we are drawn into worship, not only because of what God has done, but because of who the Creator is. The same Creator whose work we are studying is also our Father who looks at each of our lives with love and, at times, a sense of pride in us, his greatest creation. So being the finest of the fine, studying the majesty of development reminds us of our very significant place in the universe. It reminds us to not take it lightly.

Learning Outcomes;

- Prepare lab reports demonstrating in-depth observations and analysis of the process of development after performing experiments using various model organisms.
- Understand and describe the specifics of fertilization, gene expression, cell signaling, and tissue differentiation, and how these events relate to our development from a single fertilized cell into a fully developed organism. [PLO #1]
- Summarize the events that occur during development of higher level organs, including neuronal development, cardiovascular systems, and limb development. [PLO #1]
- Design and conduct an independent investigation testing the effects of a teratogen on development using a model organism. [PLO #1]
- Critically evaluate and present primary research literature identifying the research purpose, the important methodology, results and conclusions to an audience relatively knowledgeable in biology.
- Articulate and defend a position on how 'endless forms most beautiful' have evolved from a basis of understanding of the importance of development, developmental switches, and genetic mutations (Evo/Devo). [PLO #3]

REQUIRED AND RECOMMENDED BOOKS:

1. **Lab Manual (<u>required</u>):** *Reader from University Reader*
2. **Related text (<u>required</u>);** *Endless Forms Most Beautiful.* Sean B. Carroll. Norton Pub.
3. **Text (required)**: *Developmental Biology*. 12th Edition. Scott F. Gilbert. Sinaur Associates, 2020. ISBN: 9781605358222. **(the course follows this text closely so this is a great resource for learning and studying. I recommend renting unless you want to go into Developmental Biology in which case this is a great resource to own and keep)**

PLNU MISSION: To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service becomes an expression of faith. Being of Wesleyan heritage, we aspire to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Policies

ATTENDANCE:

Attendance at lectures and lab sessions is required. Role will be taken as part of the participation grade. PLNU's official policy regarding attendance states that if the student is absent from more than 10 percent of class meetings (This generally equates to 4 absences), the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See Academic Policies in the Undergraduate Academic Catalog.

Most labs require the use of various model organisms and require extensive preparation and advance setup in order to observe various developmental events. Thus, they cannot be made up. Unexcused absences from a lab will result in a zero for any work done on that day. If you know that you must miss a lab, please come talk to me well in advance of the absence.

CLASS PARTICIPATION:

In addition to attendance, you are expected to participate in class discussions. I lecture in a semi-discussion style manner and I expect you to be willing to participate by volunteering to answer questions as we go, asking questions whenever you are confused, and participating in group work. 5% of your grade will be based on your active participation in class.

FERPA POLICY

In compliance with federal law, neither PLNU student ID nor social security number should be used in publicly posted grades or returned sets of assignments without student written permission. This class will meet the federal requirements by (Note: each faculty member should choose one strategy to use: distributing all grades and papers individually; requesting and filing written student permission; or assigning each student a unique class ID number not identifiable on the alphabetic roster.). Also in compliance with FERPA, you will be the only person given information about your progress in this class unless you have designated others to receive it in the "Information Release" section of the student portal. See Policy Statements in the (undergrad/ graduate as appropriate) academic catalog.

Major projects and assignments:

JOURNAL CLUB:
A major aspect of keeping up to date with current scientific findings entails reading current primary literature and discussing the findings with colleagues. During 6 labs over the course of the semester, you will be given an article to read. We will be discussing these articles together in lab. Each person will be assigned two articles to present in groups of 3 – 4. This group will be in charge of presenting the major findings of the article in a journal club style format on the assigned week. In this manner, everyone will participate in leading two discussions throughout the semester. How you divide the material within your group is up to you. You will be evaluating the other members of your group for participation and their input. I will be evaluating the group on your understanding and presentation of the material. **All students who are not presenting are expected to have read the article.** A significant portion of this evaluation will be based on participation in the discussion, questions asked, etc., even when you are not presenting.

REFLECTION ON EVOLUTION AND DEVELOPMENT
Over the course of the semester, we will be relating development to the mechanisms of evolution. During this time, we will also discuss the theological implications of these topics. As part of this section, we will be reading the book "Endless Forms Most Beautiful" ('*EFMB*'), by Sean Carroll. This is an excellent book which I feel ties together the concepts of developmental biology and does a great job of relating them to our current understanding of evolution. As part of this section, you will be expected to write a ~1500 word reflection of development and evolution that incorporates aspects of your learned knowledge of developmental biology, our reading of EFMB, and our discussions throughout the course. These discussions are designed to present the evidence from developmental biology in support of evolution, and to discuss how science and religion can tie together rather than conflict, they are not designed to force any particular stance on this topic. Your stance can shine through in this reflection, regardless of what your viewpoint may be (in fact, I encourage that), as long as your ideas are clearly stated and supported, and a clear understanding of what we've learned in developmental biology is apparent.

BRIEF SUMMARIES OF SCIENTIFIC AMERICAN AND NAUTILUS ARTICLES
Periodically throughout the semester, I will be distributing some relatively simple overviews that relate to particular topics (6 total are planned). These are designed give you an overview of what we are discussing, even while we are diving into some of the more intimate details. They are also designed to give you some extra historical background information, or make you think about the context of the information we are learning as it applies to human life and our beliefs. You will be expected to write and turn in a short summary of each of these (~500 words) that summarizes the article, its main points, and how it fits into our topics.

LAB
See the accompanying lab syllabus and lab schedule for information on the various lab projects, grading, and due dates.

EVALUATION AND GRADING:

Exams: Exam II, III, and IV will be cumulative, and thereby will include questions from the previous section of the course. Exam II and III will consist of approximately 15% from the previous section(s), and the final exam (Exam IV) will be about 65% cumulative.

Summary: The activities described above will contribute to your total course grade based on the following percentages (these are subject to change slightly):

Exams I, II, III, IV(Final)	~55%
Lab	~15%
Journal club	~10%
Reflection on *EFMB* evo / devo	~9 %
Scientific American and Nautilus article summaries (homework)	~7 %
class participation	~4 %
Total	**100%**

Letter grades will be assigned at the end of the course based on your percentage of total possible points, according to the following APPROXIMATE scale:

A	93 – 100%	A-	90 – 93%	B+	87 - 90%	B-	83 - 87%
C+	77 – 80%C	C	73 – 77%	C-	70 – 73%	D	60 – 70%
	NC/F < 60%						

Plusses and minuses (*e.g.*, B+/A-) will be determined partially at the instructor's discretion. A major factor in this decision will be *class participation and general effort*.
(As a general rule +/- 2-3% from the cutoff grades will usually be given +/- grades). I reserve the right to assign anyone within the 2-3% range with the letter grade I feel appropriate. For example, someone with a 92.4% could receive an 'A' or an 'A-' depending on the level of participation and effort exhibited throughout the course.

FINAL EXAMINATION POLICY - Successful completion of this class requires taking the final examination on its scheduled day. The final examination schedule is posted on the Class Schedules site. NO requests for early examinations or alternative days will be approved.

Tentative lecture schedule:

	Date	Topic	Textbook Ref.
Week 1	**1-11 (Tues)**	Intro to Dev Bio;	
	1-12	Questions of Dev. Bio, History, Stages of Development, and Fate Mapping	Chapter 1 (Pgs. 1 – 30)
	1-14	***Asynchronous:*** Paradigm of differential gene expression	Chapter 3
Week 2	**1-17**	No Class; MLK Jr. Day	
	1-19	Paradigm of differential gene expression ***(Be reading Scientific American article; "Developmental Switches")***	Chapter 3
	1-21	***No Class (1st Friday off)***	
Week 3	**1-24**	Paradigm of differential gene expression ***Due: "Developmental Switches" by 8:30 on Mon***	Chapter 3
	1-26	Specification	Chapter 2
	1-28	***Asynchronous:*** Cell-cell communication - cell adhesion, juxtacrine signals, and paracrine signals ***(Be reading Nautilus Article #1)***	Chapter 4 (Pgs 99 – 108, 116 - 127)
Week 4	**1-31**	Cell-cell communication in development	Ch. 4 (109–115)
	2-2	***DUE: Nautilus Article #1 due by 8:30 (2-2)*** Cell-cell communication in development ***(make sure you are finishing EFMB intro – Ch. 3)***	Chapter 4 (Pgs 137 – 141)
	2-4	***No class (2nd Friday off)***	
Exam #1		**2-10 Lab Period; Exam I (covers Ch. 1 - 4)**	
Week 5	**2-7**	Catch up day for Chapters 3 and 4 / Review ***(make sure you are finishing EFMB intro – Ch. 3)***	Chapter 4
	2-9	**EFMB discussion (Intro and chapters 1 – 3).** *Quiz on these sections at the beginning of class*	EFMB; Intro – Chapter 3
	2-11	***Asynchronous:*** *Fertilization part 1 – egg and sperm, and species specificity*	Chapter 7 (Pgs. 213 – 224)
On your own		Independent study: "The Stem Cell Concept"	Ch. 5: Pgs 143 – 148, 167 – 177 (canvas)
Week 6	**2-14**	Fertilization (prevention of polyspermy)	Chapter 7 (Pgs. 225 - 240)
	2-16	Early development; autonomous specification. Snails, C-elegans, and tunicates	Chapter 8 (Pgs 251 – 254, 260 – 266). Ch. 10 (318-322)
	2-18	**No Class (3rd Friday off)**	
Week 7	**2-21**	Drosophila	Chapter 9
	2-23	Drosophila ***(Be reading Nautilus article #2)***	Chapter 9
	2-25	***Asynchronous:*** Early development; Sea Urchins	Ch. 10 (303 – 317)

Week 8	**2-28**	Drosophila (cont.) ***Nautilus article #2: sex and gender; (due by 8:30)***	Chapter 9
	3-2	Drosophila (cont.)	Chapter 9
	3-4	***Asynchronous:*** zebrafish development (short) ***(Be reading EFMB and Nautilus article #3)***	Ch. 11 (pgs. 325 – 328, 339 – 351))
March 7 - 11		**No Class (Spring break)**	
Exam #2		**3-17 Lab Period; Exam 2 (covers Ch. 7 - 11)**	
Week 9	**3-14**	***EFMB discussion. Chapters 4 – 8*** ***Quiz at beginning of class:***	Chapter 11 (pgs. 340 – 356)
	3-16	Catch-up day / review (chapters 7 – 11) ***(Nautilus article #3 due by 8:30)***	
	3-18	***Asynchronous:*** Early development in birds and early mammalian development	Ch. 12 (pgs. 369 – 385, 394 - 396)
Week 10	**3-21**	Early development in mammals	Ch. 12 (385 – 390)
	3-23	Early development in mammals	Chapter 12 (pgs. 390 – 398)
	3-25	**No Class (4th Friday off)**	
Week 11	**3-28**	Ectoderm; Neurulation and brain growth	Ch. 13 (p 401 - 414)
	3-30	Ectoderm; Neural tube development **Be reading Sci. Am. article; *"What makes us human"***	Ch. 13 and Ch. 14 (pgs 414 - 433)
	4-1	***Asynchronous*:** Creativity and cooperation: roles in human evolution ***Evo/Devo reflections due coming up; 4-13)*** ***(Be reading EFMB Ch. 9 – 11)***	
Week 12	**4-4**	Ectoderm; CNS dev. cont.: The human brain ***Due: Sci. Am. Article "What Makes Us Human"***	Chapter 14 (pgs 434 – 440)
	4-6	**Catch up day and EFMB discussion (Chapters 9 – 11) and quiz**	
	4-8	**No Class (5th Friday off)**	
Week 13	**4-11**	Neural Crest	Ch. 15 (441–447)
	4-13	Neural Crest ***(Evo/Devo reflections due by end of Wed; 4-13)***	Chapter 15 (Pgs. 457 – 464)
	4-15	**No Class; Easter**	
Exam #3		**4-21 Lab Period; Exam 3 (covers Ch. 11 - 15)**	
Week 14	**4-18**	**No Class; Easter**	
	4-20	Neural Crest	Ch. 15 (464 – 482)
	4-22	***Asynchronous:*** Heart & blood vessel development	Ch. 18 (550 – 562)
Week 15	**4-25**	Tetrapod limbs ***(Due: Self-designed teratogen write-up)***	Chapter 19 (pgs. 574 – 596)
	4-27	Making tetrapod limbs ***(Be reading "How limbs develop")***	Chapter 19 (pgs. 574 – 596)
	4-29	***Asynchronous (short):*** Making tetrapod limbs ***(Due; Sci. Am. Article: "How Limbs Develop")***	Chapter 19 (pgs, 600 – 604)
Final Exam; Friday, May 6th; 7:30 – 10:00 AM (Must be taken at this time)			

Tentative lab schedule:

Date	Topic	Text
1-13	Lab 1: Chick embryos	Chick embryonic development (lab manual pgs 1-5).
1-20	Lab 2: (intro; practice de-jellying) Lab techniques - lecture	(2) Axolotls (Lab manual pages 7-11)
	Journal club #1. Science article… DNA methylation in honeybee epigenetics (first part of lab)	
1-27	Lab 2b (perform retinoic acid and cyclopamine mutagenesis). (lab manual Pg. 7-11)	Continue chick observations (euthanize remaining chicks)
2-3	Lab 2c analysis of teratogenic effects on axolotls (manual pgs. 7-11)	*Lab 1 write-up (Intro and results) due* Lab 4; (self-designed exp.) – planning stages (*read pgs 29 – 35 in manual*)
	Journal club #2. Stem Cells and eye regeneration	
2-10	**Exam 1 (Chapters 1 – 4).**	
2-17	Lab 3; Sand dollar Fertilization (lab manual pgs 13-16)	*Lab 2 write-up (results / data analysis and discussion) due*
2-24	zebrafish embryo observations (lab manual pgs 21-28) Lab 4; (self-designed teratogen experiment). *pgs 29 – 35 in manual*	Zebrafish embryo observations Come prepared to work on creating physiological concentrations for your teratogen experiment. *Lab 3 write-up (Intro / methods) due*
	Journal club #3. iPS cells & modeling Spinal Muscular Atrophy (SMA)	
3-3	Self-designed teratogen work	
	Journal club #4. Nature article…Generation of a novel wing pattern by wingless morphogen (during retina staining incubation)	
3-10	***No lab --- Spring break!***	
3-17	**Exam II (Chapter 7-11)**	
3-24	Evo - Devo video / human skulls /	continue to work on teratogen experiment.
3-31	Self-designed teratogen work	Continue to work on self-designed experiment with zebrafish
	Journal club #5. Nature article… Control of ground state pluripotency by allelic regulation of Nanog.	
4-7	Self designed teratogen work	Continue to work on self-designed experiment with zebrafish
4-14	No Lab; Easter!	
4-21	**Exam III (chapters 11-15)**	
4-25 (Mon)	*Self-designed teratogen experiment write-up due*	
4-28	Presentations	Teratogen presentations (by group)

PLNU Undergraduate Syllabus Notification Page

PLNU COPYRIGHT POLICY ★

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PLNU ACADEMIC HONESTY POLICY ★

Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

PLNU ACADEMIC ACCOMMODATIONS POLICY ★

If you have a diagnosed disability, please contact PLNU's Disability Resource Center (DRC) to demonstrate need and to register for accommodation by phone at 619-849-2486 or by e-mail at DRC@pointloma.edu. See Disability Resource Center for additional information.

PLNU ATTENDANCE AND PARTICIPATION POLICY ★

Regular and punctual attendance at all classes is considered essential to optimum academic achievement. If the student is absent from more than 10 percent of class meetings, the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See Academic Policies in the Undergraduate Academic Catalog.