

ZOO3603C - Evolutionary Developmental Biology

Evolution, Development and Regenerative Biology

Fall 2022

ZOO 3603C

Lectures: Tuesdays & Thursdays, period 3 (9.35am – 10.25am).

Location: Bartram Hall 0211 (Biology Department)

Laboratories: Mondays

: **Class 18060 Monday, periods 4-6 (10.40am – 1.40pm)**

Class 18062 Monday, periods 7-9 (1.55pm – 4.55pm)

Location: Carr Hall 0120 (Biology Department)

Instructor: Dr Malcolm Maden

Professor, Department of Biology

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Office Hours: Thursdays, 10.30 -11.30am

Teaching Assistant:

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Course description and objectives

Surely the most amazing process in biology is the development of a complex adult organism such as a human from a single cell, the fertilized egg. The egg divides to give many millions of cells and these form structures as complex and varied as eyes, arms, heart and brain. How does it do this unbelievable feat of organization? How do

the cells arising from early division become different from each other? What controls the behavior of individual cells so that highly organized patterns emerge? How are the organizing principles of development embedded in the DNA of our cells and how is this translated into pattern formation?

This course is designed to answer these exciting questions by studying the developmental principles we see in various organisms – invertebrates such as the fruit fly *Drosophila*, lower vertebrates such as fish and frogs and higher vertebrates such as birds and mammals. The development of individual organ systems such as the brain, the eye and the limbs will also be studied to draw together principles of organization. Amazingly we find that the same signaling pathways are used time and again to turn an apparently homogeneous group of cells into a structure such as a limb or a brain.

By studying the development of these different animal systems we can also draw together principles of development which have stood the test of evolutionary time. Evolution acts on the developing embryo, not on the adult organism which is why the study of development is so important for understanding how evolution works. As an example of this process we will consider how fish came onto land, turned their fins into limbs and became the first land tetrapods.

In addition the course also includes a consideration of the regeneration of complex organ systems such as the limb and the principles involved in this process. Questions such as what is the role of stem cells in complex regeneration, can cells lose their differentiated state and begin development again will be asked. This will lead us into the medical world of the role that stem cells play in regenerative medicine.

The course consists of two lectures per week and one lab session per week where students can both observe and experiment on embryos. There will be four exams of short answer questions throughout the course and three assignments which will consist of one essay, one scientific presentation and the writing of a scientific paper based on the result obtained in one of the laboratory experiments.

Recommended texts:

'Developmental Biology' by Baressi & Gilbert, 12th edn. Sinauer Associates. This is an excellent textbook containing more information than you will ever need with multiple websites for more information, videos etc. Older editions are perfectly acceptable.

'Principles of Development' Wolpert & Tickle, 4th edn. Oxford University Press. A less detailed textbook than above, but with all the necessary information there. Older editions are perfectly acceptable.

Lectures, handouts and supplemental readings:

Lectures will be posted on the course website on Canvas at least the day before class and it is expected that you will either print the appropriate handouts and bring them to class with you or follow them on Canvas. Laboratory worksheets will also be available on the course website. Additional reading papers will be posted the previous week.

Examinations and grading:

Final grades will be determined by a combination of exams, written assignments, attendance at lectures and labs and participation in the course.

Exams 1, 2, 3 & 4 @ 120 points each	480
Assignments 1, 2 & 3 @ 120 each	360
Laboratory write-ups	100
Participation	60
Total	1000

Students Requiring Accommodations. Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at gatorevals.ua.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at gatorevals.ua.ufl.edu/public-results/.

Class Demeanor. Students are expected to arrive to class on time and behave in a manner that is respectful to the instructor and to fellow students. Please avoid the use of cell phones and restrict eating to outside of the classroom. Opinions held by other students should be respected in discussion, and conversations that do not contribute to the discussion should be held at minimum, if at all. Consistent and punctual attendance to all parts of the course is expected and required and a component of the marks is specifically laid aside for this.

University Honesty Policy. UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following

pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conducthonor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

COVID. In response to COVID-19, the following recommendations are in place to maintain your learning environment, to enhance the safety of our in-classroom interactions, and to further the health and safety of ourselves, our neighbors, and our loved ones.

If you are not vaccinated, get vaccinated. Vaccines are readily available and have been demonstrated to be safe and effective against the COVID-19 virus. Visit one.uf for screening / testing and vaccination opportunities.

If you are sick, stay home. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 to be evaluated. Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work.

Masks are optional at UF. However, masks are always acceptable for those who wish to wear them. The CDC recommends that those not fully vaccinated for COVID-19 continue to wear masks, particularly indoors; and even those who are fully vaccinated may choose to wear masks for a variety of reasons. Thank you for supporting your fellow Gators as they balance health, comfort, and other considerations in their decision to wear or not to wear a mask.

Lecture schedule 2022. Lectures period 3 Tuesdays & Thursdays (9.35am – 10.25am)

LOCATION: Bartram Hall (Biology) room 0211

Date	Lect #	Subject	Lecturer	Textbook chapter (11th ed.)
Thurs Aug 25	1	Intro, history, concepts	M.Maden	1,26
Tues Aug 30	2	Signaling pathways, model organisms	M.Maden	4

Thurs Sept 1 3 Gametes, fertilization M.Maden 6,7

Model Organisms

Tues Sept 6 4 Invertebrates - C. elegans I B.Harfe 8

Thurs Sept 8 5 Invertebrates - C. elegans II B.Harfe 8

Tues Sept 13 6 Invertebrates - Drosophila I M.Maden 9

Thur Sept 15 7 Invertebrates – Drosophila II M.Maden 9

Tues Sept 20 8 Zebrafish, Xenopus M.Maden 11

Thur Sept 22 9 Xenopus, chick M.Maden 11,12

Tues Sept 27 10 Mouse, transgenics E.Scott

Organ systems

Thur Sept 29 11 Somitogenesis, clocks M.Maden 17

Tues Oct 4 12 Limb development I M.Maden 19

Thurs Oct 6 13 Limb development II M.Maden 19

Tues Oct 11 14 Evolution of fins and limbs M.Maden 19, 26

Thurs Oct 13 15 Development of blood, stem cell concepts E.Scott 18,5

Tues Oct 18 16 CNS development M.Maden 13,15

Thurs Oct 20 17 Hox genes, development of the hindbrain M.Maden 13

Tues Oct 25	18	DV patterning of CNS	M.Maden	13
Thurs Oct 27	19	Axonal guidance	M.Maden	15
Tues Nov 1	20	Development and regeneration of epithelial structures	G.Fraser	16
Thurs Nov 3		Assignment I		
Tues Nov 8	21	Development & evolution of the U-G system	B.Armfield	6,7
Regeneration				
Thurs Nov 10	22	Evolution of regeneration/Hydra	M.Maden	22
Tues Nov 15	23	Regeneration in Planarians	M.Maden	22
Thurs Nov 17	24	Amphibian limb regeneration I	M.Maden	22
Tues Nov 22	25	Amphibian limb regeneration II	M.Maden	22
Thurs Nov 24		THANKSGIVING		
Tues Nov 29	26	Stem cells & regenerative medicine	M.Maden	5
Thurs Dec 1	27	Course summary	M.Maden	

LAB SCHEDULE

Location: **Carr 0120 (Biology Department)**

Timings: Class 18060 Monday, periods 4-6 10.40am – 1.40pm

Class 18062 Monday, periods 7-9 1.55pm – 4.55pm

Date	Lab #	Topic
Aug 29	1	C. elegans/Drosophila
Sept 5		HOLIDAY (Labor day)
Sept 12	2	C. elegans labster
Sept 19	3	zebrafish/frogs
Sept 26		exam I SAQs
Oct 3	4	chick I & chick Labster
Oct 10	5	chick II
Oct 17		exam II SAQs
Oct 24	6	regeneration I Hydra and Planarians
Oct 31	7	regeneration II marine inverts
Nov 7		exam III SAQs
Nov 14	8	regeneration on-line lab
Nov 21		presentations I
Nov 28		presentations II
Dec 5		exam IV SAQs