

Evolutionary Developmental Biology

Fall 2018

ZOO 3603C

Lectures: Tuesdays & Thursdays, period 2 (8.30am – 9.20am).

Location: MCCA (McCarthy Hall A) room 2196

Laboratories: Mondays, Tuesdays, Wednesdays.

Section 16D1 – Mondays, periods 7-9 (1.55 – 4.55)

Section 16C6 – Tuesdays, periods 7-9 (1.55 – 4.55)

Section 16C9 – Wednesdays, periods 4-6 (10.40 – 1.40)

Location: Carr Hall 109 (Biology Department)

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.

Course requirements: 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.

Instructor: Malcolm Maden

Professor

Department of Biology

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Office Hours: Wednesdays, 9.30 -10.40am

Teaching Assistants:

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Required text:

‘Developmental Biology’ by Scott Gilbert, 11th edn. Sinauer Associates. This is an excellent textbook with multiple websites for more information, videos etc. 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

Lecture schedule. Lectures period 2 Tuesdays & Thursdays (**8.30am – 9.20am**)

LOCATION: MCCA (McCarthy Hall A) room 2196

Date	Lect #	Subject	Lecturer	Textbook cha (11th ed.)
Tues Aug 28	1	Intro, history, concepts	M.Maden	1
Thurs Aug 30	2	Signaling pathways, model organisms	M.Maden	4
Tues Sept 4	3	Gametes, fertilization	M.Maden	6,7
		Model Organisms		
Thurs Sept 6	4	Invertebrates - C. elegans I	B.Harfe	8

Tues Sept 11	5	Invertebrates - C. elegans II	B.Harfe	8
Thurs Sept 12	6	Invertebrates - Drosophila I	M.Maden	9
Tues Sept 18	7	Invertebrates – Drosophila II	M.Maden	9
Thurs Sept 20	8	Zebrafish, Xenopus	M.Maden	11
Tues Sept 25		Xenopus, chick	M.Maden	11,12
Thurs Sept 27	9	Mouse, how to make a transgenic	E.Scott	
		Organ systems		
Tues Oct 2	10	Somitogenesis, clocks	M.Maden	17
Thurs Oct 4	11	Limb development I	M.Maden	19
Tues Oct 9	12	Limb development II	M.Maden	19
Thurs Oct 11	13	Evolution of fins and limbs CNS development	M.Maden	19
Tues Oct 16	14	Development of blood, stem cell concepts	E.Scott	18,5
Thurs Oct 18	15	CNS development	M.Maden	13
Tues Oct 23	16	Hox genes, development of the hindbrain	M.Maden	13
Thurs Oct 25	17	DV patterning of CNS	M.Maden	13
Tues Oct 30	18	Development of axonal guidance, the eye	M.Maden	15
Thurs Nov 1	19	Development & evolution of the U-G system	B.Armfield	6
Tues Nov 6	20	Epigenetics and development	J. Brant	24,26
Thurs Nov 8		Assignment II		
		Regeneration		
Tues Nov 13	21	Evolution of regeneration	M.Maden	22
Thurs Nov 15	22	Regeneration in Hydra	M.Maden	22
Tues Nov 20	23	Regeneration in Planarians	M.Maden	22
Thurs Nov 22	24	THANKSGIVING		
Tues Nov 27	25	Amphibian limb regeneration I	M.Maden	16
Thurs Nov 29		Amphibian limb regeneration II	M.Maden	16
Tues Dec 4	26	Stem cells & regenerative medicine	M.Maden	5
Thurs Dec 6	27	READING DAY		
Wed Dec 12		FINAL EXAM 7.30 – 9.30		

LAB SCHEDULE

Location: Carr 109 (Biology Department)

Timings: Section 16D1 Monday, periods 7-9 1.55pm – 4.55pm

Section 16C6 Tuesday, periods 7-9 1.55pm – 4.55pm

Section 16C9 Wednesday, periods 4-6 10.40am – 1.40pm

Date	Lab #	Topic
Aug 27 – Aug 31		NO LABS
Sept 3 - 7		HOLIDAY (Labor day)
Sept 10 – 14	1	embryonic forms/Drosophila
Sept 17 – 21	2	xenopus/zebrafish
Sept 24 - 28		exam I SAQs
Oct 1 – 5	3	chick I
Oct 8 – 12	4	chick II
Oct 15 – 19		exam II SAQs
Oct 22 – 26	5	regeneration I Hydra and Planarians
Oct 29 – Nov 2	6	regeneration II marine inverts
Nov 5 – Nov 9		exam III SAQs
Nov 12 – 16		presentations
Nov 19 – 23		THANKSGIVING
Nov 26 – 30	7	C. elegans virtual lab
Dec 3 – 7		exam IV SAQs