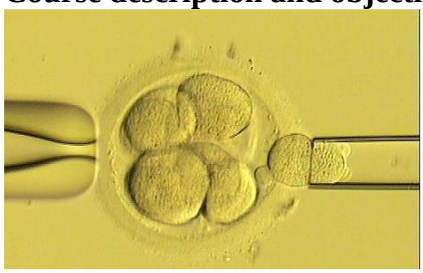
Evolutionary, Developmental and Regenerative Biology
Fall 2016
ZOO 3603C

Lectures: Tuesdays & Thursdays, period 2 (8.30am – 9.20am).
Location: MCCB (McCarthy Hall B) room G086

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 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 laboratory 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 two essays 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. There will be a total of four examinations on the lecture material spaced out during the course and three written assignments.

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Professor
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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.

Additional texts: Principles of Development. L Wolpert, Oxford University Press.

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: MCCB (McCarthy Hall B) room G086

Date	**Lect #**	**Subject**	**Lecturer**	**Textbook chapter**
Tues Aug 23	1	Intro, history, concepts	M.Maden	1
Thurs Aug 25	2	Signaling pathways, model organisms	M.Maden	3
Tues Aug 30	3	Gametes, fertilization	M.Maden	4,17
		Model Organisms		
Thurs Sept 1	4	Invertebrates - C. elegans	B.Harfe	5
Tues Sept 6	5	Invertebrates - Drosophila I	M.Maden	6
Thurs Sept 8	6	Invertebrates – Drosophila II	M.Maden	6
Tues Sept 13	7	Zebrafish, Xenopus	M.Maden	8
Thurs Sept 15	8	Xenopus, chick	M.Maden	8,9
Tues Sept 20		ASSIGNMENT I		
Thurs Sept 22	9	Mouse, how to make a transgenic	E.Scott	9
		Organ systems		
Tues Sept 27	10	Left-right asymmetry	C.Larkins	9
Thurs Sept 29	11	Somitogenesis, clocks	M.Maden	12
Tues Oct 4	12	Development of blood, stem cell concepts	E.Scott	13
Thurs Oct 6	13	CNS development	M.Maden	10
Tues Oct 11	14	Hox genes, development of hindbrain	M.Maden	11
Thurs Oct 13	15	DV patterning of CNS	M.Maden	10
Tues Oct 18	16	Development of axonal guidance, the eye	M.Maden	14
Thurs Oct 20	17	Limb development I	M.Maden	14
Tues Oct 25	18	Limb development II	M.Maden	14,20
Thurs Oct 27	19	Evolution of fins and limbs	M.Maden	
Tues Nov 1	20	Development & evolution of external genitalia	C.Larkins	15
Thurs Nov 3	21	Developmental plasticity and evolution	R.Rajakumar	19,20
Tues Nov 8		ASSIGNMENT II		15
		Regeneration		
Thurs Nov 10	22	Evolution of regeneration	M.Maden	10,11
Tues Nov 15	23	Regeneration in invertebrates I	M.Maden	16
Thurs Nov 17	24	Regeneration in invertebrates II	E.Seaver	16
Tues Nov 22	25	Amphibian limb regeneration I	M.Maden	16
Thurs Nov 24		THANKSGIVING		
Tues Nov 29	26	Amphibian limb regeneration II	M.Maden	16
Thurs Dec 1	27	Stem cells & regenerative medicine	M.Maden	16
Tues Dec 6		ASSIGNMENT III		

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 28 – Sept 2	1	Use of laboratory equipment, C. elegans
Sept 5 - 9		HOLIDAY (Labor day)
Sept 12 – 16	2	Drosophila
Sept 19 – 23	3	Xenopus/Zebrafish
Sept 26 - 30		**Exam I SAQs**
Oct 3 – 7	4	Chick I
Oct 10 – 14	5	Chick II
Oct 17 – 21		**Exam II SAQs**
Oct 24 – 28	6	Regeneration I Hydra and Planarians
Oct 31 – Nov 4	7	Regeneration II Marine inverts
Nov 7 – Nov 11		**Exam III SAQs/ paper discussion**
Nov 14 – 18	8	Regeneration III Salamanders
Nov 21 – 25		THANKSGIVING
Nov 29 – Dec 2		
Dec 5 – 9		**Exam IV SAQs**