

BME 6501/VTBMS 6501: NATURAL ENGINEERING

Location: Bradfield Hall 110
Meeting Time: T, R 11:40 – 12:55
Designation: 1/3 Credits, Letter grade
Instructor: Jonathan Butcher (jtb47@cornell.edu)
Office: Weill Hall 304, Tel. 255-3575
Office Hours: TBD in class
Blackboard Site: www.blackboard.cornell.edu (BME6501-Butcher-Spring2009)

Description: This class focuses on highlighting engineering paradigms that help shape embryonic development, how they are reactivated in adult diseases, and explore ways they can be capitalized to enable new medical therapies. We'll cover stem cell self renewal and differentiation, gastrulation, body patterning, and the morphogenesis of several key organ systems with an emphasis of the critical biophysical/mechanical mechanisms at play. We'll then use this information to look at several adult diseases, such as heart attacks, cancer, and bone healing from this new perspective.

Prerequisites: Graduate Standing unless permission from instructor. Concepts from undergraduate cell biology (i.e. BIOBM4320) and undergraduate engineering analysis (i.e. ENGR2020) will be relied upon.

Text: Peer reviewed primary literature articles (via blackboard)

Reference Text: Developmental Biology – Scott. F. Gilbert, 8th Edition, 2006.

Honor Code: Students are expected to abide by the Cornell Code of Academic Integrity (<http://www.cuinfo.cornell.edu/Academic/AIC.html>). No unfair advantage will be afforded any student in the conduct of this class.

Grades: 30% Class discussion
30% 1-2 pg. "Hypothesis papers"
20% Exams (2)
20% Group project

Grading Policy: In the event you feel I misgraded a problem, I will gladly revisit the question, but I will regrade every problem to make sure I didn't make any other mistakes. Choose wisely.

Exams: Exams are IN CLASS and CLOSED BOOK/NOTES. Programmable calculators, PDAs, etc. may not be used. **No makeup exams** (except for documented medical/family emergencies).

Tentative Lecture Outline*

Date	Day	#	Topic	Reference	Paper	Hypothesis Papers
------	-----	---	-------	-----------	-------	-------------------

20-Jan	T	1	Overview			
				292-294, 327-329, 336-337, 348-349	Grill 2001	
22-Jan	R	2	Cleavage			
27-Jan	T	3	Cell specification	p55-62	Engler Cell 2006	
			Embryonic stem cells and cloning	p684-687	Schenkye-Layalnd 2008	Stem cells: friend or foe?
29-Jan	R	4				
3-Feb	T	5	Somatic stem cells	p157, 687-688	Ebihara 2006	
5-Feb	R	6	Experimental Methods	Ch 3-5	Utomo 1999	
10-Feb	T		NO CLASS			
			Gastrulation/Axis Patterning	297-302, 322-333, 329-366	Zamir 2006	
12-Feb	R	7				
17-Feb	T	8	Morphogens and Fields	p63-67	Lo 2004	
			Biomathematical Patterning	p19-24	Meinhardt website	Chicken or the Egg?
19-Feb	R	9				
24-Feb	T	10	Cell Adhesion	p67-74	Jakab 2004	
			Morphogenesis I - Creation	Ch 6	Ninomiya 2007	
26-Feb	R	11				
			Morphogenesis II - Destruction	p158-160	Toyama 2008	
3-Mar	T	12				
5-Mar	R	13	Systems Biology			
10-Mar	T		Exam I			
			Ectoderm Derivatives	Ch 12, 13	Lamoreux 2002	Patterning the patterns?
12-Mar	R	14				
17-Mar	T		NO CLASS			
19-Mar	R		NO CLASS			
24-Mar	T	15	Neural Crest			
26-Mar	R	16	Mesoderm Derivatives	Ch14	Moore 2006	
31-Mar	T	17	Limb Development	Ch 16	Carter 1998	
2-Apr	R	18	Growth Plates			
7-Apr	T	19	Heart Development I	Ch 15	Butcher 2007	Flow or Beating?
9-Apr	R	20	Heart Development II	Ch 15	Bones and Valves	
14-Apr	T	21	Vasculogenesis	480-493	Gentile 2008	
16-Apr	R	22	Angiogenesis	485-488	Sieminski 2004	
			Evolution and Regeneration			Why can't we regenerate?
21-Apr	T	23				
23-Apr	R	24	Cancer		Beachy 2004	
28-Apr	T	25	Tissue Engineering			
30-Apr	R	26	Exam II			

*NOTE: Subject to change based on student interest.