

Physiology for Bioengineers BIM 204

Time: T - Th 8:00 – 9:50 am

Room: 1007 Giedt Hall

Instructor: Craig Benham (cjbenham@ucdavis.edu)

Offices: 2144 Math-Statistics Bldg and 4331 GBSF

Office Phone: 754-8159 (Math) or 754-9647 (Genome Center)

Office Hours: Tu 10 - 11 am (catch me right after class), and W 3 - 4 in GBSF 4331. Other times on request; email for appointment

Text: *Medical Physiology* Second Edition, W.F Boron and E.L. Boulpaep, Elsevier Saunders Press

There is extensive reading available in the text for each physiological system covered. However, not all topics presented in the course are covered in the book, and many topics that are found in the book will not be treated in the course at the same depth. **The students are expected to master the material in this course at the level it is presented in the classes.**

There is a course SmartSite, on which important course materials will be posted. The instructor will either email or post on the Resources section of the SmartSite a handout version of the slides for each lecture. Where possible, this will be done by 11 am each class day for the lecture to be given that day. Students are strongly encouraged to download these handouts, print them out, take them to class and take notes on them.

There will be two midterms and a final exam. The first midterm will be a take home exam. It will be given out on Tuesday, Oct 12, to be returned Tuesday, October 19. The second midterm will be given during class on November 9. The final exam is 3:30 – 5:30 pm on Tuesday, December 7. The second midterm and the final exams are both given in the classroom, Giedt 1007.

Grading:	Midterm 1	20%
	Midterm 2	30%
	Final	50%

Course Syllabus

BIM 204 F'08

This course will treat eight physiological systems, with brief introductions to other areas as time permits. Each system will be described, and a selection of topics will be treated at greater depth. Emphasis will be placed on engineering principles in physiology. Possible examples may include control systems, continuum mechanics, electrochemistry, fluid dynamics, transport processes, countercurrent exchange, signal transduction, compartmental models and/or dimensional analysis.

0. Physical chemistry; transport processes

1. Neuronal and Sensory Systems

Electrochemical Equilibrium

Action potentials and their transmission; Hodgkin-Huxley; excitability

Synapses – transmission of action potentials between cells

Components of the nervous system

- Peripheral and central nervous systems
- The autonomous nervous system and its control
- Some sensory systems

2. Muscle

Contractility and energy use in muscles

Muscle structure

Skeletal and smooth muscle

3. Cardiovascular System

Properties of blood and the structure of the circulatory system

Hemodynamics in pipes and in compliant vessels

The cardiac pump

Electrophysiology of the heart

Regulation of the heartbeat: Control of cardiac output

4. Introduction to the Lymphatic System

5. Respiratory System

Structure and function of the respiratory system

Mechanics of breathing

Ventilation, perfusion, transport of O₂ and CO₂

Control of breathing

6. Endocrine System

7. Renal System (Kidneys)

Countercurrent exchangers and renal function

Control of osmolality and volume: electrolyte homeostasis, acid-base balance

8. Gastrointestinal System

Daily Syllabus (approximate) and Chapters Covered

<u>Date</u>	<u>Topics</u>	<u>Chapters</u>
9/23 Th	Orientation; Physical Chemistry, Transport Processes	2, 3, 5
9/28 Tu	Membrane Equilibria; Electrochemistry and Action Potentials	6, 7
9/30 Th	Synapses, Neurons and the Nervous System	8, 10, 11, 12
10/5 Tu	The Brain, Peripheral and Sensory Systems	10, 13, 14
10/7 Th	The Senses; The Autonomic Nervous System; Efferents	13, 14, 15
10/12 Tu	Somatic Systems, Skeletal Muscle	16, 9
10/14 Th	Muscle Mechanics; Smooth Muscle	9
10/19 Tu	Cardiovascular system overview; The Heart as a Pump	17, 22
10/21 Th	The Cardiac Cycle; Cardiac Function	22, 23
10/26 Tu	Hemodynamics	17
10/28 Th	Circulatory System I	17, 18, 19
11/2 Tu	Circulatory System; gas transport; control systems	22, 23, 24
11/4 Th	The Pulmonary System	25, 26
11/9 Tu	Midterm exam	
11/11 Th	Veteran's Day Holiday	
11/16 Tu	Pulmonary functions	27, 31, 32
11/18 Th	Pulmonary System, Endocrine System, Renal System	29, 30, 47
11/23 Tu	Renal System	33 – 39
11/25 Th	Thanksgiving holiday	
11/30 Tu	Renal System; Gastrointestinal System	36, 38, 39, 41
12/2 Th	Gastrointestinal System	42 - 46

The instructor will email to the students handout version of the slides for each lecture. Whenever possible this will be done by 3 pm for a class the following day. These handouts also will be posted to the Resources section of the course SmartSite. **Students are strongly encouraged to download these handouts and use them to take additional notes on in class.**

Students also are strongly encouraged to read ahead of the lectures in the book.