

Spring 2024

BIOL 340-008, 010, 012: Mammalian Physiology

Dirk Bucher

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BIO 340-008/010/012: Mammalian Physiology

Section	Time	Instructor	email	Office hours
Lecture	M, W: 10 – 11:20, CKB 204	Dr. Dirk Bucher	bucher@njit.edu	Zoom (by appointment only): T, R: 11-12
Lab 008	T: 10-12:50, CKB 302	Smita More-Potdar	sm2573@njit.edu	TBA
Lab 010	T: 02:30 - 05:20, CKB 302			
Lab 012	F: 08:30 - 10:20, CKB 302	Anthony Sena	ats29@njit.edu	TBA

Lab Coordinator: Prof. Yarotsky yarotsky@njit.edu

COURSE WEBSITE: NJIT Canvas (<https://canvas.njit.edu/>)

COURSE SUMMARY

In this course we will examine basic concepts of mammalian physiology, including membrane biology, protein structure as applied to the structure of transmembrane transport proteins, cellular excitability and neuronal signaling, mechanisms of muscle physiology, sensory-motor integration, blood and fluid mechanics, cardiovascular physiology and regulation, gas transport and control of respiration, digestive system function, renal physiology and electrolyte homeostasis, endocrine function, growth and metabolism. We will examine the physico-chemical basis of how each system operates and build from this an understanding of the function of each system as a whole. This knowledge will be applied to the understanding of everyday activities of the human body.

LEARNING GOALS

At the end of the course students will be able...

- to understand general principles of function of the human body as a mammal.
- to understand the basic integrative principles of how their own bodies operate through coordination of different organ systems.
- to understand the application of basic physico-chemical principles to biological problems.
- to understand how biological and physiological function arises from interaction between different levels of organization from cell to organism.

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- to understand biological functions and structures as dynamical processes and systems that can be studied with quantitative approaches.
- to understand in some detail the function and regulation of the nervous, neuromuscular, cardiovascular, respiratory, endocrine, digestive, urinary, and immune systems.

PREQUISITES

Foundations of Biology (R120: 201, 202)

TEXTBOOKS

- **Lecture Textbook:**

Human Anatomy & Physiology
Marieb, & Hoehn
10th edition

ISBN-13: 9780133995190

A physical used copy can be found for a reasonable price (Usually less than \$30) and an online version can be purchased for \$54 from a number of online retailers.

- **Lab Textbook:**

Human Anatomy & Physiology Laboratory Manual, Main Version
Marieb, & Hoehn
11th Edition

ISBN-13: 978-0133873214

- **Virtual Lab Exercises:**

PhysioEx

Access can to be purchased from here:

https://media.pearsoncmg.com/bc/bc_0media_ap/physioex/10/login/sign-in.php?dest=https://media.pearsoncmg.com/bc/bc_0media_ap/physioex/10/index.php

All 3 items are NOT OPTIONAL!

Both the lab textbook and access to PhysioEx are essential for the lab component. The lectures stay close to the textbook and this is a reading intensive course! Due the volume of material that is to be covered, students are expected to know topics in the text book that could not be covered during lectures. **It is highly recommended that students read the chapters before class.**

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COURSE SCHEDULE

WEEK		LECTURE (M,W 10-11.20)	BOOK CHAPTER	LAB (T: 340-008, 340-010; F: 340-012)
Week 1 Jan 15-19		MLK day, no lecture		<i>Week of MLK day - no labs</i>
		Introduction, Organ Systems, Homeostasis	1,2,3	
Week 2 Jan 22-26		Cell Signaling	1,2,3	Lab Manual: Exercise 17: Gross Anatomy of the Brain and Cranial Nerves- All activities
		Fundamentals of the Nervous System I	11	
Week 3 Jan 29 – Feb 2		Fundamentals of the Nervous System II	11	Lab Manual: Exercise 19: Spinal Cord and Spinal Nerves- All Activities
		Central Nervous System I	12	
Week 4 Feb 5-9		Central Nervous System II	12	Lab Manual: Exercise 14: Skeletal Muscle Physiology- Activities 1 & 3
		Muscles I	9	
Week 5 Feb 12-16		Muscles II	9	Lab Manual: Exercise 21: Human Reflex Physiology-Activities- 1,2,3,6,7
		Review		
Week 6 Feb 19-23		Midterm I		Lab Manual: Exercise 29: Blood-Activities- 2,3,4,6,7
		Blood	17	
Week 7 Feb 26 – Mar 1		Blood vessels and circulation	19	Lab Exam 1
		Heart I	18	
Week 8 Mar 4-8		Heart II	18	Lab Manual: Exercise 30: Anatomy of the Heart-Activities 1-4
		Respiratory System I	22	
Week 9 Mar 11-15		<i>Spring Break</i>		<i>No labs</i>
Week 10 Mar 18-22		Respiratory System II	22	Lab Manual: Exercise 33: Human Cardiovascular Physiology BP and Pulse- Activities-1,2,5,6,7,8
		Review		
Week 11 Mar 25-29		Midterm II		<i>Week of Good Friday - no labs</i>
		Digestive System I	23	
Week 12 Apr 1-5		Digestive System II	23	Lab Manual: Exercise 38: Anatomy of the Digestive System
		Endocrine System I	16	
Week 13 Apr 8-12		Endocrine System II	16	Lab Manual: Exercise 27: Endocrine Glands-Activities 1&2
		Urinary System I	25	
Week 14 Apr 15-19		Urinary System II	25	Lab Manual: Exercise 40: Anatomy of the Urinary System- Activities 1&2
		Review		
Week 15 Apr 22-26		Midterm III		Lab Exam 2
		Immune System I	21	
April 29		Immune System II	21	<i>End of classes: April 30 - no labs</i>
May 3-9 (TBA)		Final Exam		

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VIRTUAL LAB EXERCISES (PhysioEx, click links)

Exercise 3: Neurophysiology of Nerve Impulses

- [Activity 1: The Resting Membrane Potential \(opens new window\)](#)
- [Activity 2: Receptor Potential \(opens new window\)](#)
- [Activity 3: The Action Potential: Threshold \(opens new window\)](#)
- [Activity 4: The Action Potential: Importance of Voltage-Gated Na⁺ Channels](#)

Exercise 3: Neurophysiology of Nerve Impulses

- [Activity 5: The Action Potential: Measuring Its Absolute and Relative Refractory Periods \(opens new window\)](#)
- [Activity 6: The Action Potential: Coding for Stimulus Intensity \(opens new window\)](#)
- [Activity 7: The Action Potential: Conduction Velocity \(opens new window\)](#)
- [Activity 8: Chemical Synaptic Transmission and Neurotransmitter Release \(opens new window\)](#)
- [Activity 9: The Action Potential: Putting It All Together](#)

Exercise 2: Skeletal Muscle Physiology

- [Activity 1: The Muscle Twitch and the Latent Period \(opens new window\)](#)
- [Activity 2: the Effect of Stimulus Voltage on Skeletal Muscle Contraction \(opens new window\)](#)
- [Activity 3: The Effect of Stimulus Frequency on Skeletal Muscle Contraction \(opens new window\)](#)
- [Activity 4: Tetanus in Isolated Skeletal Muscle \(opens new window\)](#)
- [Activity 5: Fatigue in Isolated Skeletal Muscle \(opens new window\)](#)
- [Activity 6: The Skeletal Muscle Length-Tension Relationship \(opens new window\)](#)
- [Activity 7: Isotonic Contractions and the Load-Velocity Relationship](#)

Exercise 11: Blood Analysis

- [Activity 1: Hematocrit Determination \(opens new window\)](#)
- [Activity 2: Erythrocyte Sedimentation Rate \(opens new window\)](#)
- [Activity 3: Hemoglobin Determination \(opens new window\)](#)
- [Activity 4: Blood Typing](#)

Exercise 6: Cardiovascular Physiology

- [Activity 1: Investigating the Refractory Period of Cardiac Muscle \(opens new window\)](#)
- [Activity 2: Examining the Effect of Vagus Nerve Stimulation \(opens new window\)](#)
- [Activity 3: Examining the Effect of Temperature on Heart Rate \(opens new window\)](#)
- [Activity 4: Examining the Effects of Chemical Modifiers on Heart Rate](#)

Exercise 8: Chemical and Physical Processes of Digestion

- [Activity 1: Assessing Starch Digestion by Salivary Amylase \(opens new window\)](#)
- [Activity 2: Exploring Amylase Substrate Specificity \(opens new window\)](#)
- [Activity 3: Assessing Pepsin Digestion of Protein \(opens new window\)](#)
- [Activity 4: Assessing Lipase Digestion of Fat](#)

Exercise 4: Endocrine System Physiology

- [Activity 1: Metabolism and Thyroid Hormone \(opens new window\)](#)
- [Activity 2: Plasma Glucose, Insulin, and Diabetes Mellitus \(opens new window\)](#)
- [Activity 3: Hormone Replacement Therapy \(opens new window\)](#)
- [Activity 4: Measuring Cortisol and Adrenocorticotrophic Hormone](#)

Exercise 9: Renal Physiology

- [Activity 1: The Effect of Arteriole Radius on Glomerular Filtration \(opens new window\)](#)
- [Activity 2: The Effect of Pressure on Glomerular Filtration \(opens new window\)](#)
- [Activity 3: Renal Response to Altered Blood Pressure \(opens new window\)](#)
- [Activity 4: Solute Gradients and Their Impact on Urine Concentration \(opens new window\)](#)
- [Activity 5: Reabsorption of Glucose via Carrier Proteins \(opens new window\)](#)
- [Activity 6: The Effect of Hormones on Urine Formation](#)

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GRADING POLICY AND SCALE

The final letter grade is based on the assignments in the lecture section (75%) and laboratory section (25%).

Assignment	%
Lecture Section	
3 Midterms ("mini exams")	37.5
Weekly Quizzes	12.5
Final Exam	25
Lab Section	
Attendance & Lab Quizzes	5
2 Lab Exams	20
TOTAL	100

Grading Scale	
A	$\geq 90\%$
B+	$\geq 85\%$
B	$\geq 80\%$
C+	$\geq 75\%$
C	$\geq 70\%$
D	$\geq 65\%$
F	$< 65\%$

- The Lecture Midterm Exams cover the previous section of lectures, as indicated by the color code in the schedule.
- The Lecture Final Exam is cumulative (covers the whole course).
- The Lecture weekly quizzes are short (~10 min), delivered asynchronously online.
- The weakest score out of the total Weekly Quizzes and the Midterms will be dropped.
- The weakest 2 of the individual quiz scores will be dropped.
- The Lab exams are practical (with stations).
- If lab attendance becomes a problem, the lab instructor will begin to administer impromptu quizzes that will later be calculated into the exam grades, valuing at 10% of total semester grade.
- **Extra credit assignments are not an option!**

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IMPORTANT RULES AND POLICIES

- ❖ Attendance is taken in every lab class and is MANDATORY. Two unexcused absences in the lab automatically result in an "F" in the course.
 - ❖ Lab instructors reserve the right to count excessive or repeated tardiness as unexcused absences.
 - ❖ If you miss a lab or an exam due to a valid excuse, medical or other, you need to provide valid and verifiable documentation to the [Dean of Students Office](#).
 - ❖ Missed labs cannot be made up under normal circumstances. Three or more absences in the lab (even if excused) result in an "Incomplete" in the course.
 - ❖ Make-up assignments for missed exams will be determined on a case-by-case basis. Under normal circumstances, excused absences from a Midterm Exam in the lecture section will not be made up, but the exam in question will be dropped from the course grade calculation.
 - ❖ Attendance is also highly recommended to do well in the lecture section of the course.
 - ❖ Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the [academic code of integrity policy](#). Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office.
 - ❖ Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the [Dean of Students Office](#).
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