

Department of Bioengineering
BENG 140B Bioengineering Physiology, Sprint 2023

Classes:

Lectures: To be define (TBD) **(IN PERSON ONLY)**

Discussions: TBD **(IN PERSON ONLY)**
TBD **(IN PERSON ONLY)**
TBD **(IN PERSON ONLY)**

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Office hours: Friday 11:00am to 12:50pm, and additional times TBD via email.

TA: TBD

Required Textbook:

BENG140B Course Reader. *Available at UCSD bookstore.*
Vander's Human Physiology (10th, 11th, 12th, 13th or 14th edition) Eric Widmaier, Hershel Raff,
and Kevin T. Strang McGraw-Hill, McGraw-Hill, Inc., New York, 2004 ISBN 0077216091

Additional Resources:

Physiology (5th edition) Robert M. Berne, Matthew N. Levy, Bruce M. Koeppen, Bruce A. Stanton
Mosby, Elsevier, Inc. San Diego, 2004 ISBN 0323033903
Mathematical Physiology (1st edition) James Keener and James Sneyd
Springer Science (ISBN 0387983813)

Course Grading: 30% Homeworks and Case Analysis (5 HWs and 3 CA)
40% Tests (two tests, each worth 20%)
30% Final exam

Final Exam: TBD (location to be confirmed)

Note regarding homework, case analysis, and examinations: **We will require students to follow, write out and sign an honor pledge on all homework and examinations.**

"I affirm that I will not give or receive any unauthorized help on this exam, and that all work will be my own."

Your course grade will be determined by your cumulative average at the end of the term and will be based on the following scale:

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|----|----|----|----|----|----|----|----|----|----|
| A+ | A | A- | B+ | B | B- | C+ | C | C- | D |
| 97 | 93 | 90 | 87 | 83 | 80 | 77 | 73 | 70 | 60 |

The scale may be adjusted to be more lenient, but I guarantee that the grade corresponding to a given percentage will not be lower than specified by the above scale. In addition, you must pass the final examination in order to pass the course. There will be no makeup exams.

Homework and Exam Policies:

ALL parts of the homework must be turned in and will be graded. All parts of exams must be answered unless otherwise stated. Both the exams and homework must be legible, show good use of English, and be organized. Points will be given or deducted for these qualities accordingly. Late homework will not be accepted unless pre-arranged (and only for extenuating circumstances, e.g. medical or family emergency; an exam in another class is not an acceptable excuse). Any requests for a re-grade must be made in writing to the TAs and will result in a re-grade of the entire homework or exam, not just a specific problem, first by the TAs themselves and, if following this a dispute remains, by the course instructor. Such re-grading could result in a higher or lower overall grade.

The Department of Bioengineering adheres to the UCSD Policy on Integrity of Scholarship. An excerpt of this Policy states that "Integrity of scholarship is essential for an academic community. The University expects that both faculty and students will honor this principle and in so doing protect the validity of the University's intellectual work. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind."

All suspicion of academic misconduct will be reported to the Academic Integrity Office according to university policy. Academic misconduct is not just blatant cheating (e.g., copying off another student during an exam), but what you might have thought of as "minor cheating" in high school, for example: copying other students' papers or homework; copying or using old papers/reports; working with others on individual assignments; forgetting to cite material you took from an outside resource; turning in work completed in total or part by another. The Policy on Integrity of Scholarship (academicintegrity.ucsd.edu) and this syllabus list some of the standards by which you are expected to complete your academic work, but your good ethical judgment (or asking me for advice) is also expected as we cannot list every behavior that is unethical or not in the spirit of academic integrity.

Those students found to have committed academic misconduct will face administrative sanctions imposed by their college Dean of Student Affairs and academic sanctions imposed by me. The standard administrative sanctions include: the creation of a disciplinary record (which will be checked by graduate and professional schools); disciplinary probation; and attendance at an Academic Integrity Seminar (at a cost of \$75). Students can also face suspension and dismissal from the University; those sanctions are not at my discretion. Academic sanctions can range from an F on the assignment to an F in the class. The appropriate sanctions are determined by the egregiousness of the Policy violation. Students who assist in or are complicit with cheating could also be in violation of the Policy. Thus, students who become aware of their peers either facilitating academic misconduct or committing it should report their suspicions to me for investigation.

In other words, cheating of any kind whatsoever will not be tolerated in any form in this course and will be punishable to the maximum extent possible as per university rules and policies. The full policy is available in the Academic Integrity Office (at <http://senate.ucsd.edu/manual/appendices/app2.htm>). Group study and discussion of homework assignments is allowed, but the contributions of others should be clearly documented in writing in the homework. Students are allowed to discuss approaches to problem-solving and design but are not allowed to obtain or provide written solutions. In cases of suspected academic dishonesty, the case will be referred to the appropriate Dean.

Students agree that by taking this course all required papers will be subject to submission for textual similarity review for the detection of plagiarism.

How to Do Well:

This course covers a great deal of complex and interrelated material. You must understand topics covered early in the course to be able to comprehend information presented later in the course, and you will have to be able to integrate material that you learn throughout the course. Therefore, it is imperative that you do not fall behind. You can take several steps to increase your ability to comprehend and remember material.

- 1) Do the assigned reading for a topic before the lecture covering that topic; being familiar with topics beforehand will allow you to get the most out of lecture. In addition, I will occasionally ask questions of class members to motivate you to do the reading before class.
- 2) Exam material will include diagrams and illustrations, and it will be to your advantage to work through the book diagrams.
- 3) Students who attend class regularly get the most out of the course and perform the best on the exams. Students have found it best to jot down supplemental notes on the lecture, including any illustrations/diagrams, and then use these notes to review the material while fresh in their minds. This approach will allow you to listen in lecture and ask questions rather than furiously scribble down everything said in class.
- 4) Be aware that the topics in this course build on each other. So make sure that when you study a topic, you understand it well enough to be able to remember it and use it later in the course. Do NOT fall behind in your reading and studying; you will find it difficult to catch up once you fall behind.
- 5) There is a LOT of material covered and to learn this material, you WILL have to spend hours outside of class reading and studying. Make sure you set aside regular times outside of class to work on the course reading material.
- 6) Attend the discussion sessions. This is your best opportunity to get help understanding the material, and my best opportunity to see if there are major problems with a particular subject. Even if you don't think you have a question for the discussion Session, you should attend anyway; your comrades may have noticed a problem that you haven't yet.
- 7) I recommend as study guides: lecture notes, supplemented with your diagrams, and concepts in each chapter of the textbook.

Miscellaneous: If you have a learning disability and require special teaching or testing conditions, please see me during the first week of class so that we can make the needed arrangements. If you are an observant member of a religion that has a holiday that conflicts with a lecture sometime during the semester, please see me during the first week of class so that we can ensure that you do not miss any assignments or class notes. Also, please do not be late. We will begin class promptly.

IF YOU SEND AN E-MAIL MESSAGE: Please put "BENG 140B" in your subject line. Otherwise my SPAM filter may block your message from my Inbox, or I may delete it without reading it as I routinely delete messages with ambiguous subject lines.

Organization of Course Material: This course is built around two themes: Levels of Organization in the Body, and Homeostasis. For each system covered, we will discuss basic structures and functions of that system, and then examine how the component parts work together to produce a fully functional

system. We also will consider how that particular system contributes to maintaining homeostasis. In order to understand how a system works, it is frequently useful to know what happens when that system fails to work properly. Therefore, in the class, a period will be spent discussing the consequences of failure of some component of a system, a failure that results in human disease. There will always be a few questions on the exams that cover this discussion.

The material in this course is organized in 3 parts:

1. Molecular and Cellular Systems; Control Systems; and Organ and Body Systems. In the first part, Molecular and Cellular Systems, we will discuss explicitly the two major themes: essential chemical and quantitative information, and basic cell physiology and metabolism. You will need to know this information before you can successfully study anything else in the course.
2. Control Systems, we will talk about the two major control systems of the body: the nervous system, and the endocrine system. You will need to know this information in order to understand how each of the organ systems is controlled and regulated.
3. Organ and Body Systems, we will study each of the major systems of the body, and the manner in which they are regulated: Tissues; Autonomic; Endocrine; Cardiovascular; Respiratory; and Renal. Since many students have not taken a course in Human Anatomy or Physiology, the course will be taught with the assumption that students have not had any previous exposure to college-level physiology.

Course Schedule, Topics and Objectives

| Week | Date | Topic <i>Book chapters</i> | Subtopics | Objectives |
|------|--------|--|---|--|
| 1 | 29-Mar | Homeostasis | Homeostasis | Course overview |
| | 31-Mar | Cell signaling <i>Chapter 5</i> | Process related Receptors Signal transductions | Process of adaptation Regulation Pathways and messengers |
| 2 | 5-Apr | Tissues <i>Chapter 4, 6, 9, 10</i> | Connective | Structure, function and types |
| | 7-Apr | | Epithelial Nervous Muscles | |
| 3 | 12-Apr | Neurons and Autonomic System <i>Chapter 6, 8</i> | Nervous System Brain and Spinal Cord Autonomic System Regulation | General functions, anatomical subdivisions Structure and function Role of Autonomic System on homeostasis Parasympathetic and sympathetic |
| | 14-Apr | Endocrine System <i>Chapter 11</i> | Hormones and their Actions Diseases | General functions of hormones Hormones actions on other systems Hormonal disorders and their symptoms Diabetes |
| 4 | 19-Apr | Regulation of Metabolism and Grow <i>Chapter 18</i> | | Carbohydrates, proteins, and fats metabolism Growth control Regulation of energy storage Regulation of body temperature |
| | 21-Apr | Cardiovascular System <i>Chapter 12</i> | Blood Pressure | Role on homeostasis Pressure, flow, resistance |

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|---|--------|-----------------------------------|---|--|
| 5 | 26-Apr | | <i>Chapter 12</i> The Heart | Major functions Cardiac cycle Myocardium Cardiac mechanoenergetics |
| | | | Cardiac Muscles Conduction System | Explain what an Electrocardiogram (ECG) measures Normal and abnormal ECG results. |
| | 28-Apr | | <i>Chapter 12</i> Cardiac Output | Balance pressure, flow, volume and the cardiac cycle Explain how exercise affects cardiac output |
| | | | System Interconnections | Heart and other systems; Heart sounds Diseases and disorders |
| 6 | 3-May | | Blood Vessels | Structure functions and features Role on homeostasis Diseases and disorders |
| | | | Microcirculation | Structure functions and features Local and extrinsic control |
| | 5-May | | Lymphatic | Capillaries exchange Role on homeostasis Interaction with immune system |
| | | Blood | Cells and purpose <i>Chapter 12</i> | Components and function Transport, protection, and regulation |
| 7 | 10-May | | Hemostasis Blood Types | Clots formation and prevention Preferred and permissible blood type donor Blood diseases and disorders Artificial blood and oxygen carriers |
| | 12-May | Respiratory System | Functions and Components <i>Chapter 13</i> Respiration | Organization airways and blood vessels Major events of respiration (lung mechanics) |
| 8 | 17-May | Oxygen and CO ₂ | Gas exchange Control of respiration | Partial pressures of gases Oxygen exchange Interactions with organ systems Diseases and disorders |
| | 19-May | Hypoxia | High altitude Exercise Regulation | Adaptation to low oxygen Oxygen and lactate |
| 9 | 24-May | Renal System | Functions and Components <i>Chapter 14</i> | Structures and renal process Function of nephrons Nephrons transport process Regulation of water intake and output |
| | | Water, Electrolyte, and Acid-Base | Micturition (Urine formation) | Renal clearance Baroreceptor and osmoreceptor Body fluid homeostasis |
| | 26- | | Water balance | Electrolytes; gain and loses |

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|----|--------|---|--|--|
| | May | | Ion balance Acid-Base Balance | Sodium and Potassium regulation Mechanisms to maintain pH |
| 10 | 31-May | Reproduction <i>Chapter 19</i> | Gametogenesis Male reproductive system Female reproductive system Pregnancy | General principles Reproduction control Spermatogenesis, Testosterone Oogenesis, Estrogen Fertilization, Development, Pregnancy |
| | 2-Jun | Defense Mechanisms <i>Chapter 20</i> | Immune defenses Infection Immune Responses | Inflammation Functions of B Cells and T Cells Acquired Immune Deficiency Syndrome (AIDS) Rejection, Reactions, and Allergies Antibiotics, and Resistance to stress |