

BIOL 3103: PRINCIPLES OF PHYSIOLOGY

Instructor: Dr. Katie Willis

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Class Meetings: T/R 9:00-10:15 AM; Dale Hall 206

Final exam: 8:00-10:00 AM, Wednesday May 8

Course Materials

The course textbook is Principles of Animal Physiology (Moyes & Schulte). The 3rd edition will be used for giving sections for readings, but you can also use the 2nd edition. There is also an online course book for principles of physiology written by Dr. Bridge and Dr. Knapp (<http://coursebook.thebridgelab.oucreate.com/blog/>). This course book makes extensive use of information on the internet in the public domain, and I encourage students to use this and other sources as they work to understand the course material. Some other excellent free resources include Physiology Web (www.physiologyweb.com) and Khan Academy (primarily under biology and health & medicine). I recommend the "Anatomy and Physiology" app from Visible Body (<https://support.visiblebody.com/hc/en-us>), which typically runs ~\$30. It is compatible with most smart phones, tablets, and laptops. The course will make extensive use of Canvas. Lecture slides and study materials will be posted on Canvas in advance of each class period. **You will also need an iClicker for this course.**

About the Course

Physiology is a blend of chemistry, biology, physics, and mathematics. Doing well in this course will require not just memorization, but integration of information. The subject matter of the course will focus on the function of vertebrate bodies and how their various components are adapted to help keep an organism alive and fit to reproduce. But more generally, the course will require an ability to absorb and synthesize information. You will be expected not only to know the material but also to apply general knowledge to particular cases and new situations. After completing this course, you should be able to:

- 1) Identify the important structures in the various animal organ systems (e.g., nervous, endocrine, respiratory, digestive) and describe their functions.
- 2) Explain how the components of each organ system work together to maintain homeostasis or carry out the system's function
- 3) Predict how each organ system will alter its function in response to a specific perturbation of the internal or external environment.
- 4) Explain how specific interactions between systems can a) increase/decrease the probability of survival and/or reproduction or b) cause health problems.
- 5) Understand that physiological principles underlie animal responses to a wide variety of environmental challenges, both natural and human-made.

The course will follow a molecules-to-organisms progression. The first few weeks will concentrate on the molecular machinery that allows organisms to use energy, replicate their DNA, generate new biological molecules, conduct nerve impulses, and orchestrate processes via chemical messengers. We will then progress through the major organ systems that sustain a complex organism (e.g., sensory systems, muscular movement, cardiovascular, immune systems, digestion, excretion).

Course organization

The course material will be offered as a combination of lectures, classroom activities, and homework assignments. Class periods will typically be divided into several sessions that may entail lectures on specific topics, demonstrations, or other classroom activities. **Most class periods will require preparation** on the part of each student, which will include readings, on-line lectures, or short assignments. I assume that all students have done these assignments, and in-class lectures and activities will typically build upon the preparatory materials. The class schedule lists the preparatory materials assigned for each class period, and these materials will be organized by class period on Canvas. Canvas will be used to post course materials (readings, online lectures, lecture slides, study materials, and interesting stuff I come across that intersects with the course material), manage grades, and make important announcements. All students should make it a habit to check email and Canvas regularly. Both in-class and online lectures will be based in PowerPoint and will generally cover a lot of material. To help students keep up I will post lecture slides on Canvas. The lectures will not be scripted, so **downloading the slides and reading them is no substitute for attending class. The lecture slides are not designed to be a substitute for taking notes during lecture.** I post slides in both PowerPoint and PDF format on Canvas.

Exam schedule, missed exams, and make up exams

Exams will cover all course material (online lectures, classroom lectures, assignments, and class activities). A list of all relevant exam material is provided in the schedule below and will be updated for each exam if necessary. The exams will generally include multiple choice and short answer questions. Exams are spaced out more or less evenly over the semester. The midterms are not comprehensive and will cover only the four or so weeks that precede them. During the final exam period there will be two separately graded exams, one to cover only the most recent course material and one comprehensive. See the course schedule for exam dates. If you will be unable to take a midterm exam because of a religious holiday or an official university event, or legally required activities (ex: emergency military service, jury duty), you must let me know at least one week before the missed exam to arrange for accommodation. I will also allow make up exams for professional development activities (ex: interviews, conferences), but you must make me aware of these activities at least one week before the exam. In the event of a documented illness, you must provide me with a written note from a physician by the class period after you are released to return to class in order to be eligible for a make up exam. In all other cases, the missed exam will be the dropped grade.

Grading policies

Regrading examinations will be considered as an unusual rather than a routine request. A request for regrading of an examination must be submitted to Dr. Willis **in writing** (on a separate sheet of paper with a brief explanation for the request), along with the original exam. A regrade request *must* be submitted by the end the next class meeting after a semester examination was returned to the class (not after you pick up an exam if you did not attend the lecture when the exam was available to all students), which is usually the first or second class period after the examination date. Only one cycle of regrading will be considered per examination. By submitting an exam for regrading, you agree to accept the score of the entire regraded examination, not the original score. In other words, I can read and grade the exam again, and any errors detected that are in your favor or not in your favor would be corrected and included in determining your new score. If you think you have grounds for a grade review request, you must construct an argument for any modifications in your score based on the specifics of your work compared to the instructions and the criteria for grading. For example, "The instructions state X, the criteria states Y, I did Z, therefore, I deserve to get credit (x number of points) for my work." The more specific you are the better. Due to time constraints, the final examination will not be considered for regrading. If you are concerned about your grade, be proactive about it and talk to me about your performance while there is still time in the semester to effect a change in your trajectory. There will likely be opportunities for bonus assignments throughout the semester, but I do

not give out special assignments to individuals who want to improve their grade. Grades will be based on five exams (four exams and a final), each worth 100 points, as well as a variety of quizzes, in-class activities, and homework assignments throughout the year. Point values of these assignments will vary but will typically not exceed 20 points per assignment. There will also be an optional group project that students can execute around the end of the semester to improve their grade. There will also be occasional opportunities for students to earn extra credit by helping with class demonstrations or through outstanding work on in-class assignments. In calculating grades, I will drop the lowest regular exam grade. Letter grades will be assigned based on the percentage as follows:

A = 90% and above (540-600 points); B = 80-89.9% (480-539 points); C = 70-79.9% (420-479 points); D = 60-69.9% (360-419 points); F = 59.9% and below (0-359 points).

Do not under any circumstances ask the undergraduate TA about your grade.

Point Allotment

Exams: 4 semester exams, 100 points each, drop lowest:	300 points
Final exam:	100 points
iClicker points:	60 points
Online quizzes (10):	75 points
Homework (worksheets/other assignments):	65 points
Total points:	600 points

Cell Phones & Electronic Devices

As a courtesy to the rest of the class, please silence all cell phones and other noisy electronic devices and refrain from using them except for true emergencies. In the case of an emergency that you must deal with, please leave the classroom as unobtrusively as you can. You can use of laptops during the class period, but they should only be for accessing relevant information or taking notes. Activities like web surfing, emailing, and movie watching can distract and annoy your classmates, so I ask students to help me in keeping everyone on task.

Policies

This is an upper division class. You are expected to attend class, participate in class discussions, and work outside of class to understand and master the material that we will cover. As you can see from the schedule, we will cover a massive amount of material and move quickly. In order for you to get the most out of class time, you will need to prepare before class. It is very important that you arrive to class on time, especially because iClicker questions will be often given at the beginning of class. If the iClicker questions have all been completed by the time you arrive, you will not have the opportunity to answer the questions. iClicker questions cannot be made up even due to an excused absence. There is a substantial buffer in place to allow you to miss some classes without any penalty for iClicker points. Make up exams and revised due dates for assignments are allowed for verified medical reasons, death in the immediate family, religious observances, and university activities, all in accordance with university policy. Without proper documentation, you will not be allowed to make up the work.

Assignments turned in late will be reduced in grade by 20% per day. The 20% reduction starts immediately after the deadline and increases by 20% every 24 hours after the deadline.

Any behavior or conduct that interferes with other students' ability to learn or my ability to teach will not be tolerated. One polite request to cease and desist will be followed by removal from the classroom if the problem persists.

Submitting materials on time through Canvas is your responsibility, as is dealing with any technical issues. You are responsible for the correct functioning of your iClicker as well.

Statement for Students with Disabilities

The University of Oklahoma will reasonably accommodate otherwise qualified individuals with a disability unless such accommodation would pose an undue hardship or would result in a fundamental alteration in the nature of the service, program, or activity or in undue financial or administrative burdens. The Disability Resource Center (DRC) provides support services to students with disabilities and is committed to the goal of achieving equal educational opportunity and full participation for students with disabilities. Any student in this course who has a disability that may prevent them from fully demonstrating his or her abilities should contact me personally as soon as possible so we can arrange accommodations necessary to ensure full participation and facilitate your educational opportunities. You may reach the DRC by email at drc@ou.edu or by phone at (405) 325-3852. You may contact the DRC without notifying me if you prefer to keep your disability confidential.

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability.

Please see www.ou.edu/content/eoo/faqs/pregnancy-faqs.html for any questions.

Title IX

Title IX makes it clear that violence and harassment based on sex and gender is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support that are applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources from the Equal Opportunity Office (<https://www.ou.edu/eoo.html>). For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24-7, counseling services, mutual no contact orders, scheduling adjustments, and disciplinary sanctions against the perpetrator. You can contact the Sexual Misconduct Office 405-325-2215 (8-5, M-F) or OU Advocates 405-615-0013 (24-7) to learn more or to report an incident. One resource for sexual assault and domestic violence outside the university is the Women's Resource Center <http://wrcnormanok.org/contact-us/>. Online, you can consult <https://www.rainn.org/> or call 1-800-656-HOPE confidentially 24-7.

Equal Opportunity Office

The University of Oklahoma, in compliance with all applicable federal and state laws and regulations does not discriminate on the basis of race, color, national origin, sex, sexual orientation, genetic information, gender identity, gender expression, age, religion, disability, political beliefs, or status as a veteran in any of its policies, practices, or procedures. This includes, but is not limited to: admissions, employment, financial aid, housing, services in educational programs or activities, or health care services that the University operates or provides. Inquiries regarding non-discrimination policies may be directed to: Bobby J. Mason, University Equal Opportunity Officer and Title IX Coordinator, 405-325-3546, bjm@ou.edu, or visit <http://www.ou.edu/eoo.html>

Mental Health & Other Resources

Your mental health is important. Professional services are available at low cost through the university counseling center (<https://www.ou.edu/ucc>). Other resources outside of campus can be found at <https://findtreatment.samhsa.gov/> and <https://www.psychologytoday.com/us/therapists/oklahoma>. If you or someone you know is contemplating suicide, you can call the National Suicide Prevention Lifeline 24-7 at 1-800-273-8255 or <https://suicidepreventionlifeline.org/talk-to-someone-now/>

Sooners Helping Sooners (shs.ou.edu) provides emergency grant funding to current Norman and Tulsa campus students affected by unforeseen financial strain. They provide assistance to students who face natural disasters, theft of personal property, death in the family, and a variety of other circumstances. Students can apply for an emergency grant on their website.

Religious Observance Policy

It is the policy of the University of Oklahoma to excuse the absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required classwork that may fall on religious holidays. If you will miss class work for religious observance, please notify me in as far in advance as possible, so we can more easily make arrangements to accommodate your absence.

University Activity Absences

Documentation for absence due to a sponsored university activity (such as intercollegiate athletics or other competitions) must be provided in advance and in accordance with university policies.

Academic Integrity

The University of Oklahoma seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. Work from other classes should not be reused. All students are expected to understand and abide by these principles. If you are at all unclear about any aspect of academic integrity, detailed information on the definitions and consequences of academic dishonesty can be found at http://integrity.ou.edu/files/Academic_Misconduct_Code.pdf and <https://www.ou.edu/integrity/students>

Cheating and plagiarism are against University rules. Academic dishonesty will not be tolerated. Any student engaging in any form of academic misconduct will be reported to the Office of Academic Integrity and any form of academic misconduct will result in a grade of "F" for the course.

Withdrawal Policy

If a grade of W (withdraw) or I (incomplete) is requested, university policy will be followed. <https://www.ou.edu/advising/enrollment>

Communication

The easiest way to contact me is via email (kwillis@ou.edu). I do my best to respond to emails the same working day. Please use your OU email; otherwise it will probably get marked as spam. If I don't respond to your email within 24 hours, feel free to resend it. Emails regarding exam *content* must be sent by 8pm the day before the exam in order to guarantee my response.

Miscellaneous Items

- If you are ill for an extended period of time or have another circumstance that will cause you to miss a substantial amount of class, please contact me as soon as possible to discuss options
- Some of the research we discuss describes animal experiments in detail that might make you uncomfortable. You are not required to understand the minutiae of these experiments
- **Contact me about any problems sooner rather than later so we can work together to find a good solution**

BIOL 3103 TENTATIVE COURSE SCHEDULE SPRING 2018

Jan 15: Class period 1: Introduction

Jan 17: Class period 2: Why is everything so complicated? Big themes in physiology

Preparation: M&S: chapters 1 & 2 (should be a review)

Course book chapter 1

Session 1: Scaling and metabolism

Main topics: body size and complexity;

Body size and metabolic rate

Session 2: Homeostasis

Main topics: Strategies for homeostasis, Positive and negative feedback, Time-dependent setpoints for feedback regulation.

Introduction/Syllabus quiz due

Jan 22: Class period 3: Biomolecules

Preparation M&S: Chapter 3

Course book chapters 2 and 3.

Session 1: Synthesis of enzymes:

Main topics: DNA transcription and translation; regulation of gene products, transcriptome research, transgenic research.

Session 2: Cell structural elements:

Main topics: Membrane elements, Cytoskeleton, Cellular junctions, Vesicles and Proteasomes.

Session 3: Class activity: Narrate the translation dance

Groups of 3 or 4 students: View the 1971 DNA translation dance by students at Stanford.

<https://tinyurl.com/bp5y993> Write out a narrative explaining what's going on.

Assignment: Type up your group's narrative (due Jan 24 via Canvas) 10 points

We will start using iClickers today, so have those registered

Jan 24: Class period 4: Deriving Energy

Preparation: M&S: Chapter 3

Course book Chapter 4; Optional: watch glycolysis and citric-acid-cycle video on Canvas

Session 1: Glucose

Main topics: Digestion of glucose; Membrane transport of glucose; Storage of Glucose; Blood sugar regulation, Glycolysis; Citric acid cycle; Oxidative Phosphorylation, OxPhos biproducts.

Session 2: Other sources of chemical energy (fats, proteins, nucleic acids)

Translation dance narrative due via Canvas

Assignment: KEGG biochemical pathways worksheet (due Jan 29) 20 points

Canvas quiz (1) over biomolecules and energy

Jan 29: Class period 5: Membranes and transport proteins

Preparation: M&S: Chapter 3

Course book chapter 5

Session 1: Membranes in extreme cold.

Session 2: Barriers and conduits: Fick's law of diffusion; chemical and electrical gradients;
Osmosis and tonicity; Membrane transport modes, Membrane transport molecules.

Session 3: Imaging proteins: DNA sequencing, X-ray crystallography

**KEGG biochemical pathways worksheet due via Canvas
Assignment – Membrane worksheet (due Feb 5) 20 points**

Jan 31: Class period 6: Membranes and transport proteins continued.

Preparation: M&S: Chapter 3

Do what you can with the membrane worksheet. Bring it to class

Session 1: Membrane equilibrium and cellular signaling

Main topics: Membrane equilibrium,

Nernst equation, GHK equation

Session 2: Membrane worksheet review

Session 3: Fundamental cell-signaling pathways

Main topics: Types of signaling; Hydrophobic and hydrophilic messengers; Ligands and receptors; Saturation and regulation; Signal amplification; Gated ion channels, Receptor enzymes, G-protein coupled receptors, Types of second messengers

Canvas quiz (2) over membranes and transport proteins

Feb 5: Class period 7: Neurons and Action Potentials

Preparation: M&S: Chapter 5

Course book chapter 6.

Neuron structure and function

Main topics: types of neurons, roles of neurons, action potentials, refractory period, graded potential

**In-class work – Apply the GHK equation to an action potential
Membrane worksheet due via Canvas**

Feb 7: Class period 8: Neurons and Action Potentials Continued

Preparation: M&S: Chapter 5

Course book Chapter 7

Session 1: Types of receptors and neurotransmitters.

Main topics: Neurotransmitter systems, Signaling pathways, Agonists and antagonists,

Session 3: Neuron interactions and clinical neurology

Main topics: Synaptic transmission; examples of the effects of drugs.

Canvas quiz (3) over neurons and action potentials

Feb 12: Class period 9: **EXAM 1** (Covers all previous material)

Feb 14: Class period 10: Nervous System - Autonomic Nervous System

Preparation: M&S: chapter 8
Course book chapter 8 (Introduction and Autonomic Nervous System)
Session 1: Overview of Nervous System
Session 2: Autonomic Nervous System
Session 3: Enteric Nervous System
Session 4: Somatic Nervous System

Feb 19: Class period 11: Nervous system – Central Nervous System

Preparation: M&S: chapter 8
Course book chapter 8
Session 1: Somatic Nervous System (cont.)
Session 2: Central Nervous System
Session 3: Learning and Memory

Feb 21: Class period 12: Sensory systems

Preparation: M&S: chapter 7
Course book chapter 9
Session 1: Sensory transduction
Session 2: Receptor types
Session 3: Sensory demonstrations
Session 4: Sense of taste

Feb 26: Class period 13: Sensory systems

Preparation: M&S: chapter 7
Session 1: Electoreception
Session 2: Vision
Main topics: Center-surround and on- and off-center fields: limits to visual acuity; detection of edges.
Session 3: Hearing

Canvas quiz (4) over nervous system and sensory systems

Feb 28: Class period 14: Muscle contraction

Preparation: M&S chapter 6
Course book chapter 14

Mar 5: Class period 15: Muscle Control

Preparation: M&S: chapter 6; supplemental information in the first part of chapter 12 (pp 499-515)

Course book chapter 14

Session 1: Proprioceptors and muscle control

Main topics: Spindle fibers, Golgi organs, reflexes.

Session 2: Class demonstration: Tricking the proprioceptors.

Session 3: Muscle cell types and fiber types.

Motor units, oxidative and glycolytic fibers, smooth muscle, cardiac muscle.

Session 4: Superfast muscles

Canvas quiz (5) over muscles

Mar 7: Class period 16: **Exam 2** (Nervous system, sensory systems, and muscles)

Mar 12: Class period 17: Circulatory system

Preparation: M&S: chapter 6 (cardiac portion), chapter 9

Course book Chapter 10

Session 1: Blood constituents

Main topics: plasma proteins; transport proteins

Session 2: Gas exchange

Main topics: Hemoglobin cooperativity; Blood pH; Bohr effect

Session 3: Clotting

Main topics: clotting cascade; thrombin positive feedback; dissolving old clots

Mar 14: Class period 18: Circulatory system cont.

Preparation: M&S: chapter 9

Course book chapter 11

Session 1: Diversity of cardiac pumps, two, three, & four chambered hearts

Session 2: Blood vessels

Session 3: Cardiac output, autonomic control of blood pressure regulation.

Canvas quiz (6) over circulatory system

Mar 19 & 21 Spring Break

Mar 26: Class period 19: Endocrine System

Preparation: M&S: chapter 4

Course book chapter 13

Session 1: Insulin & Glucagon

Session 2: Calcium balance – storage and mobilization

Session 3: Does calcium limit egg laying?

Mar 28: Class period 20: Endocrine System

Preparation: M&S: chapter 4
Course book Chapter 13
Session 1: Stress physiology and the HPA Axis
Session 2: metabolism and the HPT Axis
Session 3: HPGH axis, regulation of growth

Canvas quiz (7) over endocrine system

Apr 2: Class period 21: Immune system

Preparation: M&S: chapter 12
Course book chapter 12
Session 1: Innate immune system – primary layers of protection
Session 2: Acquired immune response
Session 3: Zombies

Apr 4: Class period 22: Respiration and gas exchange

Preparation: M&S: chapter 11
Course book chapter 15
Session 1: Short quiz on endocrine system and muscles
Session 2: Gas exchange in water breathers
Session 3: Gas exchange in air breathers

Apr 9: Class period 23: Respiratory systems

Preparation: M&S: chapter 11
Course book chapter 15
Session 1: Evolution of respiratory systems
Main topics: types of respiratory organs, Scaling and oxygen delivery
Session 2: Mammalian vs Avian respiratory systems.

Canvas quiz (8) over respiration and immune systems

Apr 11: Class period 24: **Exam 3**

Apr 16: Class period 25: Excretory systems

Preparation: M&S: chapter 13
Course book chapter 16
Session 1: Nitrogenous wastes
Main topics: What are nitrogenous wastes? How can they be disposed of?
Session 2: Excretory organs
Main topics: Protonephridia, Malpighian tubules, nephrons and kidneys.
Time permitting: Urinalysis case studies

Apr 18: Class period 26: Excretory systems

Preparation: M&S: chapter 13
Course book chapter 17
Session 1: Kidney/nephron structure and function
Session 2: Water and nutrient resorption
Session 3: Control of water balance

Apr 23 Class period 27: Digestive systems

Preparation: M&S: chapter 14
Course book chapter on digestive systems
Session 1: Digestion, nutrient uptake, regulation of gut length.
Session 2: Appetite control.

Canvas quiz (9) over excretion and digestion

Apr 25: Class period 28: Sex determination and differentiation

Preparation: M&S: chapter 16
Session 1: Why sex?
Session 2: Sex determination across species

Assignment: Hormone Résumé OR Physiologically Possible Super Hero/Villain (due on Canvas April 25, choose ONE, upload under that assignment's dropbox; 15 points)

Apr 30: Class period 29: Reproduction

Preparation: M&S: chapter 16
Session 1: Mammalian/human reproductive cycles.
Session 2: Male and female reproductive systems.

Canvas quiz (10) over sex determination/differentiation and reproduction

May 2: Class period 30: Why is everything still so complicated?

Preparation: none
Sum up and review

May 8: Final exam period

Exam 4 (Excretion, digestive systems, and reproduction)
Final exam (comprehensive)