Comparative Biomechanics - BIOB 391 (3 credits)
Autumn Semester 2017
Mon, Wed, Fri 10:00-10:50, Jeanette Rankin Hall 205

Instructor: Dr. Bret Tobalske Phone: 243-6631
Office: Health Sciences 208 E-mail: bret.tobalske@mso.umt.edu

Office Hours: 9-10 Mon, Wed, Fri or by appointment

Textbook
Vogel, S. (2013) Comparative Biomechanics, 2nd ed. Princeton Univ. Press. Princeton, NJ
Course Handouts: http//umonline.umt.edu

Course Description
We will explore physical principles as related to the form and function of organisms. Topics will include muscle function, locomotion, feeding, skeletal design, blood flow dynamics, material properties and other design features of the living world. This course will help you to integrate anatomy and physiology with physics.

Course and University Policy
All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and /or a disciplinary sanction by the University

All students need to be familiar with the Student Conduct Code.

The University of Montana provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Disability Services for Students at 243-2243. This document has been fixed with heading structure and self-describing links for use with screen readers.

Learning Outcomes
Students will be able to:

1. Recognize or recall information about how the form and function of organisms and how these features relate to their ecology, life-history strategy and evolution.
2. Solve or explain problems using graphing, mathematical equations
3. Discuss and critique articles in the primary literature, use original, creative thinking to propose novel tests of hypotheses.

Teaching Philosophy
Most of the basic knowledge required for this course may be obtained by reading the text. Thus, the lectures will not be a simple regurgitation of the text material. For exam purposes, you are responsible for the material brought up in the text, even if that material is not fully explored in class. The lectures will seek to accomplish the following:

Explain, clarify, and organize difficult concepts
Provide additional examples and illustrations.
Summarize material from a variety of sources
Help you analyze information
Help you integrate and retrieve information

Active Learning
You can learn more about a subject if you are actively involved in learning as opposed to passively absorbing a deluge of information.

To facilitate active learning, before each lecture you should read the assigned material. Doing this will provide you with questions that we can explore as a group, and it will prepare you to interact in a productive manner. I will periodically pose questions or problems that may be solved and discussed in small groups and then shared with the class as a whole, and we shall have in-class demonstrations, videos, and simulations that will be associated with group discussion.

You should complete the assigned homework problems before class, as we will discuss the correct answers in the form of a brief review at the beginning of class.

Grading and Exam Policy

1. Grading: The final grade is based on a percentage of total points accumulated from four exams during the semester (100 points each, including the final exam). The final exam covers the last section of the class (i.e., not "comprehensive"). Half the final exam covers the last section of the class, and half is comprehensive. Final percentages may be adjusted evenly to provide a frequency distribution with a mean of 78%, but only if this represents raising grades, not lowering grades. Borderline grades may be elevated pending performance trends and participation during the semester. Letter grades are assigned:

94-100	=	A
90-93	=	A-
87-89	=	B+
84-86	=	B
80-83	=	B-
77-79	=	C+
70-76	=	C
65-69	=	D+
60-64	=	D
<60	=	F

Test questions will include multiple choice, short answer, and problem solving including graphing. Approximately 50% of the test questions will examine basic knowledge/comprehension, the other 50% will require application or analysis of information as well as integration and synthesis. During each test, you may bring a sheet (or sheets) of paper with any formulae that you consider necessary. A handheld calculator will be needed for all tests. You can use a smartphone or other handheld electronic device, but it must be in airplane mode (no active internet connection).

Sample questions
Knowledge/Comprehension
Q1. As a person inhales air into their lungs, the pressure inside their alveoli is:
a. greater than atmospheric pressure
b. less than atmospheric pressure
c. the same as atmospheric pressure

Q2. Reynolds number (Re) describes is the ratio of:
a. viscosity to density
b. viscous forces to inertial forces
c. inertial forces to viscous forces
d. height to weight

Application/Analysis

A person has a leg length (ground to hip) of 1 meter. At what velocity would they most likely switch from a walk to a run?

Why is it that a diving duck finds it easier to remain submerged when it is 10 m below the surface of the water compared with when it is 1 meter below the surface?

If the aorta has a cross-sectional area of 3 cm2 and blood flow rate through the aorta is 10 ml s-1, what is the average velocity of the blood flowing through the aorta?

Synthesis

Briefly describe how quadrupedal and bipedal gaits differ.

Compare the energy saving mechanisms involved in walking and running.

How do "gaits" in animal flight compare with gaits in terrestrial locomotion.

Exam Policy: With the exception of the final exam, early exams may be arranged to accommodate valid time conflicts. The validity of the time conflict will be evaluated on a case by case basis. No exam will be given late unless special arrangements are made beforehand (example: excused absence for ROTC or sporting event) or if there is a confirmed health condition involved in the absence.

Tips on Studying:

Read the assigned reading before coming to lecture. Try to work through (derive a solution for) each equation as it appears in the text. Before coming to the next class, solve the assigned homework problems from the last class. If you have difficulty answering a question, raise the question during the review session at the beginning of lecture. Odds are that the topic is unclear for others as well.

After lecture, integrate lecture notes, in-class discussion, and text information into a single body of material. Revisit the equations in the reading, carefully making sure that you are able to apply them for problem solving. Invent new questions using the equations.

Tentative Course Schedule (v09_01_2017, subject to revision as semester progresses)

Month	Date	Day	Lecture	Topic	Reading Assignment
Sep	1	F	01	Introduction, Syllabus	Ch. 1
	4	M	*	**Labor Day, No Class**	
	6	W	02	Dimensions and Quantities	Ch. 2, App. 1
	8	F	03	Dimensional Analysis, Rates and Sums	Ch. 3, App. 2
	11	M	04	Size and Scale	App. 3
	13	W	05	Size and Scale II	‘
	15	F	06	Fluids at Rest	Ch. 4, 5
	18	M	07	Fluids at Rest II	“
	20	W	08	Velocity and Flow	Ch. 6
	22	F	09	Velocity and Flow II	“
	25	M	*	**Exam I (100 pts)**	
	27	W	10	Momentum and Drag	Ch. 7
	29	F	11	Momentum and Drag II	“
Oct	2	M	12	Boundary Layers	Ch. 8
	4	W	13	Flow within Walls	Ch. 9
	6	F	14	Circulatory Systems	Ch. 10
	9	M	15	Circulatory Systems II	“
	11	W	*	**No Class**	
	13	F	16	Low Reynolds Numbers	Ch. 11
	16	M	17	Lift	Ch. 12
	18	W	18	Lift II	“
	20	F	19	Thrust	Ch. 13
	23	M	20	Thrust II	“
	25	W	*	**Exam II (100 pts)**	
	27	F	21	Solids	Ch. 15
	30	M	22	Solids II	“
Nov	1	W	23	Biomaterials	Ch. 16
	3	F	24	Biomaterials II	Ch. 17
	6	M	25	Viscoelasticity	Ch. 18
	8	W	26	Simple Structures	Ch. 19
	10	F	*	**Veteran’s Day, No Class**	
	13	M	27	Simple Structures II	“
	15	W	28	Complex Structures	Ch. 20
	17	F	*	**Exam III (100 points)**	
	20	M	29	Hydrostatic Structures	Ch. 21
	22	W	*	**Travel Day, No Class**	
	24	F	*	**Thanksgiving Break, No Class**	
	27	M	30	Structural Systems	Ch. 22
	29	W	31	Motility	Ch. 23
Dec	1	F	32	Motility II	“
	4	M	33	Using Muscle	Ch. 24
	6	W	34	Using Muscle II	“
	8	F	35	Terrestrial Locomotion	Ch. 25
	11	M	36	Terrestrial Locomotion II	“
	12	W	*	Study/Reading Day, No Class	
	15	F	*	**Exam IV (Final, 100 pts) 8:00-10:00**	