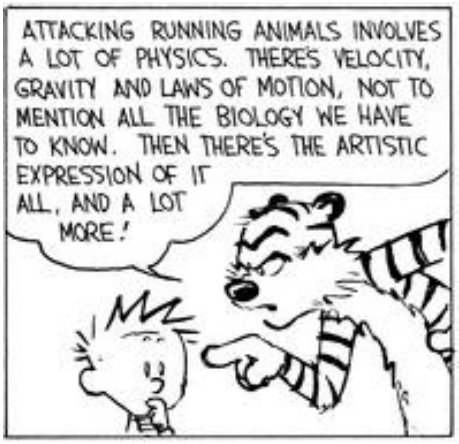

Comparative Biomechanics

BIOL-462/698 Spring 2024
Tuesday, Thursday: 11:30AM - 12:50PM

Instructor:
Dr. Brooke Flammang (flammang@njit.edu)
Office hours by appointment

Course Description: The objective of this course is to integrate physiology, morphology, and physics to help students understand the scientific principles regulating life. Students will gain a basic understanding of the mechanics of biological systems that translates to further understanding research topics in biology, biomedical engineering, and health sciences.

Prerequisites: 120:101, 120:102, 120:201, 120:202, PHYS 111&121

Week of	Topics	Problems	1st ed.	2nd ed.
16 Jan	**Entrance Exam**			
18 Jan	The Physics of Biology (Setting the Stage)		1,2	1,2
23 Jan	The Physics of Biology (More Tools)	1	4	3
25 Jan	Gases & Liquids: Fluids at Rest	2	5	4
30 Jan	Viscosity & Patterns of Flow		6	6
1 Feb	The Forces of Flow	3	7	7
6 Feb	Fluid Events Near Surfaces		8	8
8 Feb	Where Flows are Inside; Circulatory Systems	4	9,10	9,10
13 Feb	Flows in Small Worlds		11	11
15 Feb	About Lift	5	12	12
20 Feb	*no class – BEF at conference*			
22 Feb	*no class – BEF at conference*			
27 Feb	Thrust for Flying & Swimming		13	13
29 Feb	Gases meet Liquids: The Interface, Motion at the Air-Water Interface	6	14	5,14
5 Mar	*no class – BEF at conference*			
7 Mar	**EXAM 1**			
12&14 Mar	***spring break***			
19 Mar	A Matter of Materials		15	15
21 Mar	Biological Materials: Tuning Properties Properly, Cracks & Composites	7	16	16,17
26 Mar	More about Complex Materials: Viscoelasticity		17	18
28 Mar	Simple Structures: Beams, Columns, Shells; Less Simple Structural Matters	8	18,19	19,20
2 Apr	Hydrostatic Structures, Hydraulic Devices		20	21
4 Apr	Structural Systems	9	21	22
9 Apr	Motility and Mobility		22	23
11 Apr	Tuning and Transmissions	10	23	24
16 Apr	Getting Around on Land		24	25
18 Apr	**Student Presentations**			
23 Apr	**Student Presentations**			
25 Apr	**EXAM 2**			

Course outline:

Text: Vogel, Steven. (2003 (1st ed.) or 2013 (2nd ed.)) Comparative Biomechanics: Life's Physical World. Princeton University Press. ISBN: 9780691155661

- Unit problem sets will be made available at the beginning of the unit and due at the end of the unit. Students may work together if desired. I am just as interested in seeing how you figure out the problem as the answer itself, so please include your train of thought in your answer.
- You will choose from a list of scientific papers in the middle of the semester and be required to put together a 15 minute long talk in which you discuss the paper as if you were the scientist who did the work and were presenting it at a scientific conference. Be sure to bring in the biomechanics concepts you learned in class as a tool to explain "your" findings.

Grading: 30% problem sets
25% Exam 1
25% Exam 2
20% final presentation

Grade Scale

A= 100-90
B+=89-85
B=84-80
C+=79-75
C=74-70
D=69-65
F=64 and lower

Learning Outcomes:
In this course, students will learn to:

1. Demonstrate the role of physics in the life of biological organisms
2. Use basic algebraic formulas to solve for limits of biological mechanisms
3. Identify parameters important to the function of physiological systems
4. Diagram the forces acting to generate motion of an organism
5. Explain the factors that influence stability of a physiological structure
6. Describe the physical factors influencing life in a fluid environment
7. Describe the physical factors affecting terrestrial locomotion

Class Policies:

Academic Integrity: Students are reminded of the Honor Code each one has agreed to abide by (at Rutgers or NJIT). Violations of Academic Integrity will be dealt with according to the guidelines indicated in the NJIT Academic Honor Code (http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf). This document describes conducts that are considered unacceptable (cheating, violating the US Copyright law, etc). Rutgers has similar rules (http://www.ncas.rutgers.edu/oas/ai).