MARS 3550: Life In Fluids

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Office Hours: By appointment or drop by
Office: 291A Marine Sciences Building
Semester: Fall semester, odd years
Class Times: Tuesday & Thursday 9:30 –10:45
Classroom: Marine Sciences, 239

Course Description

Organisms live out their lives surrounded by water or air, and the nature of those fluids affect the way organisms move, eat, find food, sense their surroundings, and are able to regulate internal properties such as their temperature. In this course we will address questions such as, how does the fluid environment affect the way a bacteria locates food? What allows an albatross to circumnavigate the globe in under 50 days and yet use only a small amount of energy to do so? How does a *Basiliscus* run on water? How does having a wet nose help the kangaroo rat keep hydrated? Why do some electric fish swim in unusual ways?

Course Learning Objectives

After completing this course students will be able to identify the features of the fluid environment that affect a given feature of an organism's behavior, and describe both qualitatively and quantitatively how this happens. Students will also be able to contrast the effect that different types of fluid environment have on organism movement and life style.

Topical Outline

The following contains a schedule of topics that we will cover in the course. Please note that this schedule is preliminary, and details may change throughout the semester.

The Fluid Environment Understanding the properties of fluids that are important for organisms. A brief introduction into the motion of fluids and how they affect organisms.

Fluid Density the effects of buoyancy (e.g. swim bladders in fish) and density on locomotion (e.g. jet propulsion in squids), lift and drag (e.g. soaring and porpoising), the energy requirements of different ways of moving in a fluid.

Fluid Viscosity Drag and flagella, the problems moving about when you are small, how to stick to something (e.g. limpets sticking to a rock).

Diffusion Using diffusion to find and obtain food (e.g. chemotaxis), breathing by diffusion (e.g. insect trachea, bird eggs), finding a partner.

Boundary Layers Encountering one another in a turbulent environment, hiding from predators, listening and smelling your environment (how do fish smell?), feeding using the boundary layer (e.g. suspension feeding in copepods).

Heat Heat from metabolism (the temperature of bees in flight), losing heat by breathing, heat exchangers (how do penguins keep warm without shoes and socks?), evaporation (the advantage of having a cold nose).

Sound How does sound move in air and water? How small an object can you detect by sound? Using sound (dolphins, bats, and owls), the evolution of hearing structures (whale and dolphin evolution).

Light Using light for food (photosynthesis in air and water), the art and science of being invisible, seeing underwater.

Surface Tension Capillarity (the dangers of getting wet), walking on water.

Electricity Electricity in air and water (do electric eels shock themselves?), sensing your prey's electric field (how sharks use electricity).

Waves How is a duck like a boat? How do ocean waves keep the albatross aloft?

Textbooks & Readings

There are no required textbooks for this course, all required information will be conveyed through the lectures and online readings. However, the course will stick most closely to the book by Mark Denny (listed below). I will also draw on the other books listed below from time to time during the course.

- *Air and Water: The Biology and Physics of Life's Media* by Mark Denny (Princeton University Press, ISBN 0-691-08734-2).
- *Dynamics of Dinosaurs and Other Extinct Giants* by R. McNeill Alexander (Columbia University Press, ISBN 0-231-06666-X).
- *Glimpses of Creatures in their Physical Worlds* by Steven Vogel (Princeton University Press, ISBN 978-0-691-13807-7).
- *Living at Micro Scale: The Unexpected Physics of Being Small* by David B. Dusenbery (Harvard University Press, ISBN 978-0-674-03116-6)

There will be regularly posted readings on ELC. When they are assigned, these should be read **before** the next class.

Coursework

There will be no exams for this course. Instead, there will be a mixture of in-class and out-of-class assignments that will include simple calculations, essay summaries, group work, and individual projects. The individual project will be form a major part of the coursework, and students will give both a presentation on their project as well as hand in a written report.

Course Grading

The breakdown of the course grades into individual categories will be: Homework assignments (30%), in-class work (30%, including class participation), individual project (40% divided into 10% for the presentation and 30% for the report). A final letter grade will be posted for the course. The correspondence between percentages and letter grades is given below The interpretation of

A : 93 – 100%	B+: 87 – 90%	C+: 77 – 80%	D: 60 – 65%
A-: 90 – 93%	B : 83 – 87%	C : 70 – 77 %	F : 59% and below
	B- : 80 – 83%	C- : 65 – 70%	

Table 1: Table of the correspondence between final letter grades and total percentages.

the major letter grades is:

A This grade is used to recognize work that is excellent and of the highest calibre and that stands out from that of other students. Students who achieve this grade have demonstrated a mastery of the content of the course, as well as shown excellence in the presentation and written portions of the course.

B This letter grade is used to signify competent work. A student who achieves this grade has demonstrated proficient understanding of the concepts and content of the course sufficient for effective use of these concepts and techniques.

C This letter grade signifies adequate work. A student who has achieved this grade has demonstrated a general understanding of the concepts covered in the course but with significant flaws in either their understanding or execution of techniques.

D This letter grade indicates that the work is inadequate, and that the student has not demonstrated the requisite skills and understanding to use these techniques.

F This letter grade signifies work that is unacceptable.

Special Accommodations

If you need special accommodations for classwork or other class activities because of a disability, please make an appointment to see the instructor as soon as possible or before the end of the first full week of classes.

Important Dates

Wednesday, August 14, 2019	First day of classes
Thursday, August 15, 2019	First class of the course
Monday, October 21, 2019	Withdrawl deadline
November 27 – 29, 2019	Thanksgiving (no classes)
Tuesday, December 3, 2019	Last class of the course

Table 2: A table of important dates for the Fall 2019 semester.

Academic Honesty

As a University of Georgia student, you have agreed to abide by the University's academic honesty policy, "A Culture of Honesty," and the Student Honor Code. All academic work must meet the standards described in "A Culture of Honesty" found at:

`https://ovpi.uga.edu/academic-honesty/academic-honesty-policy`

Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor.

All students are expected to hand in work that is their own — discussion of homework assignments among students is permitted (and encouraged), but the work you hand in **must be your own**. Any student found cheating or plagiarizing will be disciplined according to the University's rules and policies. Examples of plagiarism include, but are not restricted to: copying someone else's words, calculations, graphics, or presentation without attribution.

The course syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.