

# BIO 1037: The Four Seasons

## Plant and Animal Adaptations to Life in a Changing Environment

*Spring 2009; 4 credits*

*Lecture: Terrace 124, M W F 10:00 - 10:50*

*Lab: Ackley 106, alternating Tu 1:00 - 5:00*

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or by appointment

### Course Description

Have you ever wondered why maple trees lose their leaves in the fall? Or why a cold-blooded animal like a frog doesn't freeze solid in the winter? Or how rodents that live in deserts can withstand such extremes in temperature? Plants and animals have developed an astonishing range of adaptations to the variable conditions they experience throughout the year. In this course we will study the mechanisms underlying these adaptations by examining a variety of biological topics, including biochemistry, cell structure, cell interactions, physiology, genetics, anatomy, reproduction, and development.

### Course Objectives

By taking this course, you will ...

- ... develop and refine your understanding of the standards of scientific research.
- ... gain experience communicating about science through written and oral means.
- ... understand biological principles from the molecular to the organismal levels.
- ... better appreciate the fundamental roles that ecological conditions and evolutionary history play in shaping the natural world around us.
- ... develop an appreciation for the dynamic nature of the natural world and the ways that organisms adapt to these varying conditions.

### Course website

We will be using a course website on Epsilon for communication this semester. Every Friday afternoon, I will post a schedule of the following week's lectures, reading, labs, and assignments. It is your responsibility to check this and stay on top of what is due. I will be handing out more detailed instructions for how to access the course website shortly after the beginning of the class.

### Textbooks

Main text: Campbell & Reece, *Biology*, 8<sup>th</sup> ed.

On reserve: Bernd Heinrich, *Winter World*.

I will also periodically assign articles and book sections that you will download from the course website.

## Grading (points out of 1000)

Quizzes	100
Exams (100 points each)	300
Lab quizzes and reports	150
Research project	250
Cumulative final exam	100
Participation	100

**Attendance:** Attendance and participation are critical to your ability to understand and apply the material you are learning, so part of your grade is based on your active participation during class and labs. I expect you to come to class having read the assigned reading and prepared to ask questions. Lab meetings are mandatory and cannot be made up.

**Late/missed work:** Any late work will be docked 10% per day down to 50%. Any assignment can be turned in by the last day of class (May 6) to still receive half credit. All assignments need to be turned in by 5:00 PM the day they are due to be considered on time. No make up exams will be given without a medically valid excuse.

**Electronic submission of work:** I expect you to make every effort to turn in your written work in hard copy unless I specify otherwise. If you must turn in an assignment in electronic format, please turn it in to the course website. I will not accept assignments submitted as email attachments.

**Academic honesty:** You must cite sources for any work or ideas that are not your own. Any student who submits deliberately plagiarized work will receive a 0 for that assignment. If you do it again, you will fail the class.

## Quizzes

There will be a quiz every Monday during weeks that we don't have an exam. These are worth ten points each, and you will be able to drop your lowest quiz grade. There will also be quizzes at the beginning of each lab session. These are worth 5 points and are designed to verify that you have read the lab handout in preparation for that day's lab.

## Research project

You will work in groups of 4-5 on a research project related to sap flow in sugar maple trees (*Acer saccharum*) on campus. Each group will develop its own research question and study design. You will collect data during sap flow season (roughly during the month of March) then give an oral presentation and write these results in a formal scientific research paper. More details on this assignment will follow.

## Policy on group work

For some assignments, you will work in small groups to give you the experience of working in a collaborative setting. You will be asked to describe the relative contribution of each group member for these assignments. Although in general, each group member will receive the same grade, if there is an egregious example of someone not pulling his/her weight, that person will not receive as much credit as the other group members. If you are having trouble getting along with fellow group members and are unable to work things out amongst yourselves, please contact me so that we can work on the problem sooner rather than later.

## Students with disabilities

If you have a specific learning, physical, or psychiatric disability and require accommodations, please let me know early in the semester so that your learning needs may be appropriately met. I cannot provide an accommodation for you unless you have one on file with the Calhoun Learning Center, the office responsible for coordinating accommodations for students with disabilities. If you have not already done

so, please register with them. The Calhoun Learning Center is located on the 3<sup>rd</sup> floor of Griswold Library. If you have questions, please contact Joey Blane, Learning Specialist, at x8234.

## Athletes

I support Eagle athletics, and I understand that student-athletes will occasionally have conflicts between their athletic schedule and the course schedule. Please come to me early in the semester with an official schedule so that we can develop a plan for makeup work.

## Important dates

Exam 1	2/16
Exam 2	3/23
Exam 3	4/24
Oral presentation	4/28
Final report	5/4
Final exam	5/8

## Course Outline

We will begin the course with a discussion of general scientific principles. We will then progress through the different levels of biological organization from the smallest biological molecules to the structure and function of whole organisms. Each unit will include an adaptation focus where we will use a specific example or two from the natural world to illustrate the relationship between the points covered in the unit and more general principles of ecology and evolution.

### I. Introduction

This section will introduce the course and provide an overview of the scientific method. We will also review the concept of evolutionary adaptations.

During this section you will ...

- ... apply the scientific method to observations you make of the world around you.
- ... develop an understanding of an “adaptation” that you will apply to different aspects of plant and animal biology throughout the course.

### II. The biochemical basis of life

In this unit, we cover the chemical basics underlying all biological life.

During this section you will ...

- ... learn the importance of water to life.
- ... understand the role and composition of biological molecules like proteins and DNA.

### III. Plants

We will briefly overview plant form and function and introduce our study organism, the sugar maple.

During this section you will ...

- ... review the methods of scientific study design.
- ... understand the fundamentals of plant structure and reproduction.
- ... apply what you learn about transport in plants to sugar maples.

### IV. Cell structure and function

In this unit we will cover one of the most fundamental units of biological organization: the cell.

During this section you will ...

- ... understand how cells are organized.
- ... learn about different cell types.
- ... learn about energy production in plant and animal cells.

## V. Genetics

Genetics underlie everything about the function of organisms, and the Central Dogma that describes how DNA sequence determines protein structure is one of the most important discoveries of modern biology.

During this section you will ...

- ... learn the mechanisms by which DNA is inherited.
- ... understand the link between DNA and proteins and apply this to the field of gene expression.
- ... learn some basic molecular lab techniques.

## VI. Animals

We will close the course with a discussion of complex organ systems and how they work together for animal form and function, with an emphasis on vertebrate biology. As a class, we will vote on the specific organ systems that we will cover.

During this section you will ...

- ... review different organ systems that make up animal bodies.
- ... apply what you know about these systems to animal adaptations.

## Detailed schedule

	Date	Topic	Assignment due	Reading <sup>1</sup>
Week 1	W 1/21	<b>INTRODUCTION</b>		
	F 1/23	Welcome and introductions		
		What is science?		Understanding science
Week 2	M 1/26	<b>Adaptation focus:</b>	<b>Quiz</b>	WW Ch. 1
		Life history and adaptations		
	T 1/27	LAB 1: Library research		
		<b>THE BIOCHEMICAL BASIS OF LIFE</b>		
	W 1/28	Water, the chemical reactions of life		C&R Ch. 3,4
	F 1/30	Macromolecules		C&R Ch. 4,5

<sup>1</sup>Readings are abbreviated as:

Campbell & Reece (your textbook): **C&R**

Winter World: **WW**

Download from course website: **Handout**

	M 2/2	<b>Adaptation focus:</b> Antifreeze proteins and oily fats	<b>Quiz</b>	WW Ch. 13 Handout
Week 3	W 2/4	<b>PLANTS</b> Plant structure and growth	<b>Lab 1 due</b> <b>Project proposal</b>	C&R Ch. 35
	F 2/6	Plant reproduction		C&R Ch. 38
	M 2/9	Plant transport	<b>Quiz</b>	C&R Ch. 36
Week 4	T 2/10	LAB 2: Data management		
	W 2/11	<b>Adaptation focus:</b> Leaf buds, Maple physiology		WW Ch. 24 Handout
	F 2/13	Review		
	M 2/16	<b>EXAM 1</b>		
Week 5	W 2/18	<b>CELL STRUCTURE AND FUNCTION</b> Introduction to the cell	<b>Lab 2 due</b>	C&R Ch. 6
	F 2/20	Organelles		C&R Ch. 6
	M 2/23	Cellular membranes	<b>Quiz</b> <b>Project methods</b>	C&R Ch. 7
Week 6	T 2/24	LAB 3: Cells		
	W 2/25	Introduction to metabolism		C&R Ch. 8
	F 2/27	Enzymes		C&R Ch. 8
Week 7	M 3/2	<b>Adaptation focus:</b> Leaf color, hibernating turtles	<b>Quiz</b>	Handout WW Ch. 11
	W 3/4	Photosynthesis: Light reactions	<b>Lab 3 due</b>	C&R Ch. 10
	F 3/6	Photosynthesis: Dark reactions		C&R Ch. 10
SPRING BREAK				
Week 8	M 3/16	Respiration I	<b>Quiz</b>	C&R Ch. 9
	T 3/17	LAB 4: Proteins		
	W 3/18	Respiration II		C&R Ch. 9
	F 3/20	Review		
	M 3/23	<b>EXAM 2</b>		
Week 9	W 3/25	<b>GENETICS</b> Meiosis and mitosis	<b>Lab 4 due</b>	C&R Ch. 12, 13
	F 3/27	Mendelian inheritance		C&R Ch. 14

	M 3/30	Chromosomes and DNA	<b>Quiz</b>	C&R Ch. 15
	T 3/31	LAB 5: Mendelian genetics		
Week 10	W 4/1	<b>Adaptation focus:</b> Gene expression and flowering		Handout
	F 4/3	Transcription and translation I		C&R Ch. 17, 18
	M 4/6	Transcription and translation II	<b>Quiz</b>	C&R Ch. 17, 18
		<b>ANIMALS</b>		
Week 11	W 4/8	Homeostasis	<b>Lab 5 due</b>	C&R Ch. 40
	F 4/10	<b>Adaptation focus:</b> Body heat, fat storage	<b>Project introduction &amp; results</b>	Handout
		EASTER BREAK		
	T 4/14	LAB 6: DNA forensics		
Week 12	W 4/15	Choose topic	<b>Quiz</b>	TBD
	F 4/17	Giving presentations		
	M 4/20	<b>EXAM 3</b>		
Week 13	W 4/22	Choose topic	<b>Lab 6 due</b>	TBD
	F 4/24	Choose topic		TBD
	M 4/27	<b>Adaptation focus:</b> Hibernating squirrels and bears	<b>Quiz</b>	WW Ch. 7, 21
Week 14	T 4/28	LAB 7: Presentations		
	W 4/29	Choose topic		TBD
	F 5/1	Choose topic		TBD
	M 5/4	Choose topic	<b>Final report due Quiz</b>	TBD
Week 15	W 5/6	Wrap-up and review		
	F 5/8	<b>CUMULATIVE FINAL EXAM 1:00 PM TERRACE 124</b>		