Pittsburg State University
BIOL 113 - Environmental Life Science
Syllabus – Spring Semester 2019

Instructor: Dr. Christine Brodsky, Dept. of Biology
Office: 330 Heckert-Wells
Office Hours: TTh 11:30 – 2:00 PM; W 9:00 – 11:00 AM & by appointment
Email & Office Phone cbrodsky@pittstate.edu; (620) 235-4947

Credit Hours: 4

Location and Times of Lecture and Lab:

Your Section	*Lecture Location*	*Lecture Time*	*Lab Location*	*Lab Time*
113-01	102 Yates	TTh 8:00 – 9:15 AM	214 Hartman	M 9:00 – 10:50 AM
113-02	102 Yates	TTh 8:00 – 9:15 AM	214 Hartman	W 11:00 – 12:50 PM
113-03	102 Yates	TTh 8:00 – 9:15 AM	214 Hartman	M 3:00 – 4:50 PM
113-04	102 Yates	TTh 9:30 – 10:45 AM	214 Hartman	M 11:00 – 12:50 PM
113-05	102 Yates	TTh 9:30 – 10:45 AM	214 Hartman	W 9:00 – 10:50 AM
113-06	102 Yates	TTh 9:30 – 10:45 AM	214 Hartman	W 1:00 – 2:50 PM

PITT STATE PATHWAY

Mission Statement

The Pitt State Pathway curriculum serves as the heart of the university education by fostering interdisciplinary competencies that typify the educated person. It is designed to facilitate the development of key proficiencies including communication and information literacy. The Pitt State Pathway curriculum provides a transformational experience that challenges students to think creatively and critically, and to immerse themselves in the productive examination of humans in their global setting. By encouraging the development of skills that promote life-long learning, the Pitt State Pathway fosters a sense of personal responsibility, an appreciation of diversity, and an understanding of interconnectedness in our truly global society.

Pitt State Pathway Pillars to Be Covered in This Course

Global Understanding and Civic Engagement

As global citizens, students need a comprehensive understanding of where they live and of the larger, interconnected global system of which they are part, and on which they depend. While identifying commonalities among people and places is important, it is crucial that students understand and appreciate the diverse cultural, social, political, economic, and environmental contexts that create differences. Understanding the role of responsible citizens in their own community and beyond ensures effective and ethical participation at all levels. Students also need to understand how biological, physical, and chemical systems work, how they change naturally, and how they can change due to human involvement. Understanding the implications of the interaction between humans and non-human systems is essential for long-term decision-making.

Learning Outcome: Students will explore global systems conscientiously.

Pitt State Pathway Core Element to Be Covered in This Course

Natural World within a Global Context

Biological, physical, and chemical systems form the context for life. Students need to understand how these systems work, how these change naturally, and how these can change as a result of human activities. The implications of these changes are essential for long-term decision-making. Competency in this element means:

- Analyzing biological, physical, and/or chemical systems;

- Evaluating the implications of changes that result from interactions between natural and human systems.

Pitt State Companion Element to Be Covered in This Course

Scientific Inquiry

The scientific method is the systematic approach to understanding the world around us. Through experimentation and hypothesis testing, students will apply analytical skills and appropriate methods of scientific inquiry (i.e. qualitative and quantitative) to solve a variety of research questions.

Learning Outcome: Students will analyze data logically.

Competency in this companion element means:

- Composing appropriate research questions and hypotheses, drawing from experts, reliable sources, or previously collected data;
- Collecting, synthesizing, and analyzing data from multiple sources;
- Drawing logical conclusions, assessing for gaps or weaknesses, and addressing potential consequences and implications;
- Communicating results using appropriate delivery methods or formats.

COURSE DESCRIPTION

This course covers a basic ecological approach to the principles and processes of life with emphasis placed on human pressures and technology, and the effect of these on the organism-environment complex. Laboratory exercises accompany lecture. Not applicable toward a biology major.

PREREQUISITES: None

COURSE OBJECTIVES

At the completion of this course, student will be able to…

1. Explain biological, physical and/or chemical processes and human activities that alter them
2. Apply the scientific method to a problem
3. Explain how the environment and natural sciences contribute to the general welfare of civilization
4. Justify the need for sustainable practices in the management of the earth's natural resources

METHODS OF ASSESSMENT

The students' ability to meet the Pitt Pathway Milestone 1 and course objectives will be assessed through:

1. Exams (50%): Five exams on the units of study + final exam. The lowest exam grade will be dropped **prior** to the final exam (i.e. one exam score is dropped from exams 1 – 5). The mandatory final exam will consist of the 1) Last unit of study and 2) Comprehensive section. **NO Makeup Exams!**
2. Assignments (25%): Weekly assignments will be given either in-class (e.g. quizzes, group projects, etc.) or for homework. In-class assignments will not be announced and cannot be made up if you are absent. The two lowest assignment grades will be dropped.
3. Lab Score (25%): Weekly lab quizzes and assignments. Please see the lab syllabus for more information.
4. Bonus points may be given throughout the semester. You must be present to benefit. No exceptions.

GRADING SCALE

Grades will be based on your points earned as the percentage of the total available points. Final grades are **not** rounded or curved.

A = 100% - 90% B = 89.9% - 80% C = 79.9% - 70% D = 69.9% - 60% F = 59.9% and Below

TEXTBOOKS

- **Required:** Environmental Life Science Laboratory Manual – Fall 2018
- **Optional:** *What is Life? A Guide to Biology* 3rd or 4th Edition, by J. Phelan

ATTENDANCE & PARTICIPATION

Attendance and participation is essential for exemplary performance in this class. By attending lecture and lab, you will learn essential information not discussed in the readings, as well as participate in discussions to help you think critically about topics. Please notify me immediately about any issues that may arise, causing you to miss multiple classes (e.g. death in the family, illnesses, etc.). **Laboratory attendance and participation is mandatory**.

EXAMS

Scantron sheets are required for each exam - we will not have extras. The Student Government Association in the Student Center provides free Scantrons. Please come prepared to each exam date with a Scantron sheet and a #2 pencil with a good eraser. **If you miss two or more exams, you will be dropped from the course.**

DEAD WEEK

There may be in-class assignments during Dead Week.

NOTE TAKING

Effective note taking is an essential skill to learn at college and for your future. New research is showing that you learn and retain much more when you write class notes and draw diagrams by hand. This semester, I highly recommend you download the fill-in lecture notes and write your notes by hand. If you feel as though you must use a laptop in class, please avoid distracting your fellow classmates by not checking email, Facebook, etc.

E-MAIL POLICY

I will be using the messaging system on Canvas to contact you outside of class. Please be aware that I check my email sparingly during nights and weekends, so if you send an email after Friday afternoon, please do not expect an answer until Monday morning.

STUDENT ACCOMMODATIONS

All students are expected to meet the standards for this course as set by the instructor. However, students with learning disabilities who may need accommodations should discuss options with the Center for Student Accommodations (CSA) during the first two weeks of class. The CSA will contact professors with suggested classroom needs and accommodations. Approved documentation needs to be on file in the CSA prior to the start of the semester.

ACADEMIC INTEGRITY POLICY

Academic integrity is expected. If you are caught cheating, you will be automatically dropped from the class. Please review the policy on the university's webpage: http://catalog.pittstate.edu/contentm/blueprints/blueprint_display.php?bp_listing_id=162&blueprint_id=124&sid=1&menu_id=7980 For additional information and requirements, see the Syllabus Supplement at: https://www.pittstate.edu/registrar/syllabus-supplement.html

ELS Lecture Schedule

Week	Dates	Topic	***What is Life?*** Suggested Reading
1	Tu, Jan 15	Introduction to Scientific Thinking	Chapter 1
	Th, Jan 17	Waste Management	--
2	Tu, Jan 22	Chemistry	Chapter 2.1 – 2.7 (4th ed: Ch 2)
	Th, Jan 24	Human Use of Water Resources	--
3	Tu, Jan 29	Human Use of Land Resources	--
	Th, Jan 31	**Exam 1**	--
4	Tu, Feb 5	Chemistry	Chapter 2.8 – 2.22 (4th ed: Ch 3)
	Th, Feb 7	Cells	Chapter 3 (4th ed: Ch 4)
5	Tu, Feb 12	Energy	Chapter 4 (4th ed: Ch 5)
	Th, Feb 14	Human Energy Sources	--
6	Tu, Feb 19	**Exam 2**	--
	Th, Feb 21	DNA, Gene Expression, & Biotechnology	Chapter 5 (4th ed: Ch 6 & 7)
7	Tu, Feb 26	Chromosomes & Cell Division	Chapter 6 (4th ed: Ch 8)
	Th, Feb 28	Mendelian Inheritance	Chapter 7 (4th ed: Ch 9)
8	Tu, Mar 5	**Exam 3**	--
	Th, Mar 7	Evolution & Natural Selection	Chapter 8 (4th ed: Ch 10)
9	Mar 12/14	**Spring Break** – No Class	
10	Tu, Mar 19	Evolution & Behavior	Chapter 9 (4th ed: Ch 11)
	Th, Mar 21	Origin & Diversification of Life on Earth	Chapter 10 (4th ed: Ch 12)
11	Tu, Mar 26	Economics and Sustainability	--
	Th, Mar 28	**Exam 4**	--
12	Tu, Apr 2	Animal Diversification: Invertebrates	Chapter 11.1 – 11.12 (4th ed: Ch 13.1 – 13.12)
	Th, Apr 4	Animal Diversification: Vertebrates	Chapter 11.13 – 11.20 (4th ed: Ch 13.13 – 13.20)
13	Tu, Apr 9	Plant & Fungi Diversification	Chapter 12 (4th ed: Ch 14)
	Th, Apr 11	Evolution & Diversity Among the Microbes	Chapter 13 (4th ed: Ch 15)
14	Tu, Apr 16	Human Health & Environmental Risks	--
	Th, Apr 18	**Exam 5**	--
15	Tu, Apr 23	Population Ecology	Chapter 14 (4th ed: Ch 16)
	Th, Apr 25	Ecological Communities	Chapter 15.9 – 15.17 (4th ed: Ch 17.9 – 17.17)
16	Tu, Apr 30	Ecosystems	Chapter 15.1 – 15.8 (4th ed: Ch 17.1 – 17.8)
	Th, May 2	Conservation Biology	Chapter 16 (4th ed: Ch 18)
17		**FINAL Sections 1, 2, & 3 (TTh 8:00AM): Tuesday, May 7 @ 8:00AM** **FINAL Sections 4, 5 & 6 (TTh 9:30AM): Thursday, May 9 @ 9:30AM**	

Unit 2
Water: Chemical and Biological Applications

Learning Objectives

When you have completed this unit, you should be able to…

1. Describe key physical properties of water and types of available water sources
2. Test for the chemical and biological properties of pond water
3. Use a water chemistry test kit
4. Identify common macroinvertebrates

Key Vocabulary Terms

Dissolve, surface water, watershed, groundwater, water table, aquifer, carbon dioxide, dissolved oxygen, turbidity, nitrate, macroinvertebrate

Background & Tasks

Water makes up a significant part of the earth's surface (71%) and is essential for life.

Physical Properties of Water

Water has unique properties. Its high boiling point and low freezing point mean that water remains a liquid in most climates on earth. It can store a large amount of heat without a large change in temperature. This helps protect living organisms from the shock of abrupt temperature changes, it moderates the earth's climate, and it makes water an excellent coolant. Water's ability to absorb large amounts of heat as it changes into water vapor, and to release this heat as the vapor condenses back to liquid water, is a primary factor in distributing heat throughout the world.

Water can also **dissolve** a variety of compounds. This enables it to carry dissolved nutrients throughout the tissues of living organisms, to flush waste products out of those tissues, to serve as an all-purpose cleanser, and to help remove and dilute water-soluble waste. Because of its excellent solubility, water can become polluted easily.

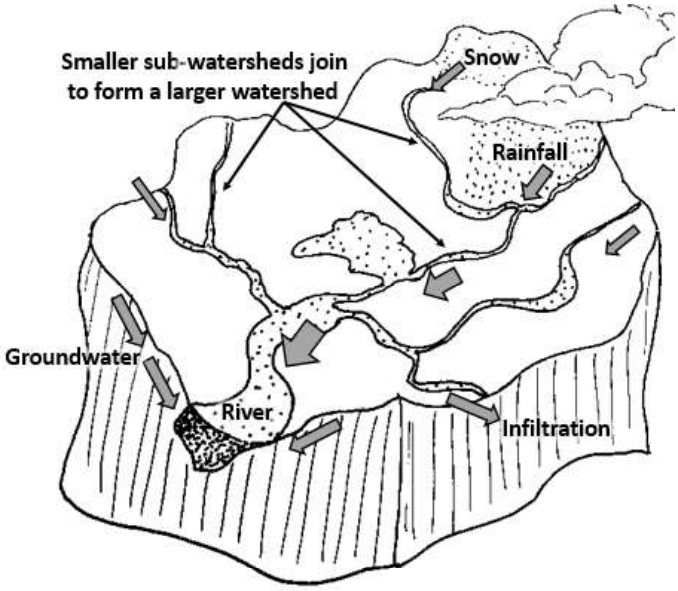
Most substances shrink when they freeze, but liquid water expands when it becomes ice. Consequently, ice has a lower density than liquid water and will float on the surface of liquid water. Without this property, lakes and streams in cold climates would freeze solid, and most current forms of aquatic life would not exist.

Water is one of the most poorly managed resources on the earth. We waste it and pollute it. We also charge too little for making it available, thus encouraging even greater waste and pollution of this vital and potentially renewable resource.

Types of Water

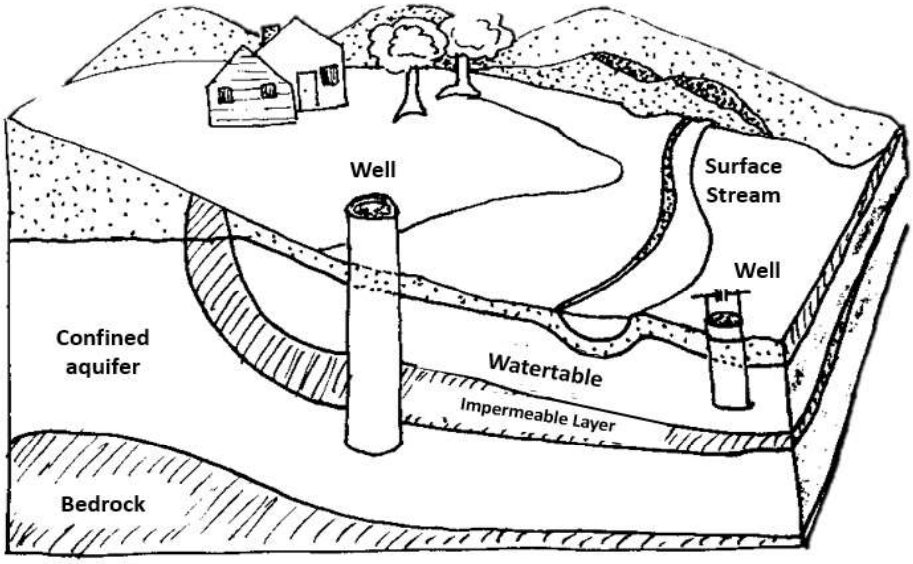
Surface Water

Precipitation in the form of rain does not all soak into the ground. Much of the excess runs across the land surface and settles in low areas or channels. If there is enough water present, **surface water** forms lakes, wetlands, streams, and artificial reservoirs. The **watershed** is the area of land that drains into the lowest part of the topography within a designated region.



Groundwater

Some precipitation infiltrates the ground and fills the pores in soil and rock. The water in these pores is called **groundwater**. The **water table** is the upper surface of an underground zone of saturated soil and rock. The water table falls in dry weather and rises in wet weather. **Aquifers** are porous, water-saturated layers of sand, gravel, or bedrock through which groundwater flows. Aquifers can yield an economically significant amount of water; thus we often drill wells.



Water Distribution in the World

The Earth is called "the water planet." Between 2/3 and 3/4 of the surface is covered with water. The types of water found on the planet include: oceans, icecaps/glaciers, groundwater, freshwater lakes, inland seas/salt lakes, rivers, and atmosphere.

Water is not distributed evenly. The following percentages show the distribution.

Oceans	97.2%	Some water is also tied up in organisms.
All icecaps/glaciers	2.0%	
Groundwater	0.62%	
Freshwater lakes	0.009%	
Inland seas/salt lakes	0.008%	
Atmosphere	0.001%	
All rivers	0.0001%	
Total	99.8381%	

Out of this water distribution, even less is available to use for drinking water!

TASK 2.1: Please read the sections above and answer the following questions:

1. Why does ice float?

2. Aquifers sit (ABOVE / BELOW) the water table.

3. Which statement about watersheds is FALSE?
   a. A watershed is an area of land which surface water drains to only one location.
   b. Watersheds only contain flat land leading to rivers and lakes, not mountains.
   c. Watersheds are defined by boundaries, and adjacent watersheds can share boundaries.
   d. The size of watersheds can range in size from a few states to only a few counties.

4. The majority of water on earth is freshwater: True / False

Importance of Water Quality

Aquatic life (e.g. fish, insect larvae, and frogs) have unique ranges of water temperature, pH, and oxygen that they can tolerate. If there is too little oxygen, for instance, some species may die. If environmental conditions are extremely poor, the aquatic area will have little or no life.

EXERCISE #1. Quantitative Analysis by Chemical Assessment of a Pond

We will be testing the difference in water chemistry and quality between tap water and water collected from University Lake. To determine chemical health of a pond, several tests may be made using the HACH Water Test Kit. Below are some general tests we use to test for water quality via chemical assessments. We will only test for temperature, pH, and dissolved oxygen.

Common Water Chemical Tests:

pH - The standard measure of acidity. The pH scale ranges from 1 - 14 with 1 most acidic and 14 most basic (alkaline). Optimum pH levels for fish are 6.5 - 9.0.

Carbon Dioxide (CO_2) - When fish breathe, they take in oxygen (O_2) and give off CO_2. When plants photosynthesize (daytime), they take in CO_2 and give off oxygen. At night, plants use oxygen and give off CO_2. High levels of CO_2 can interfere with oxygen uptake by fish. Optimum levels for fish are < 10 mg/l.

Dissolved Oxygen (DO) – Oxygen is added to water by plants in the daytime, wave action, and turbulence. Removed by plants (at night), fish, and bacterial action (decomposition). Optimum levels are > 5 mg/l.

Turbidity - A measure of the suspended particles in the water affecting clarity. May be from microscopic plants or soil sediments. Restricts light penetration and photosynthesis. Some fish that feed by sight must have clear water (largemouth bass); other fish can feed by smell and will live in murky water (channel catfish).

Nitrite - A form of nitrogen produced during the bacterial decomposition of animal wastes. Highly toxic to fishes. Levels should remain <0.2 mg/l.

TASK 2.2: Circle the appropriate word for your predictions regarding differences between tap water and lake water for:

1. Tap water will have a **MORE ACIDIC** / **MORE BASIC** / **EQUAL** pH than lake water.
    a. Why?

2. Tap water will have a **LOWER** / **HIGHER** / **EQUAL** dissolved oxygen concentration than lake water.
    a. Why?

3. Tap water will have **GREATER** / **LESS** / **EQUAL** turbidity than lake water.
    a. Why?

You will work in groups to sample two sources of water. For each test, follow instructions in the HACH Water Test Kit and record your data. You will then need to share your information with the class.

TASK 2.3: Data Collection.

	Tap Water	University Lake
Date:		
Time:		
Water Temperature (°C or °F → Indicate which!):		
pH (1 – 14):		
Dissolved Oxygen (mg/l):		
Turbidity (What depth?):	(Assume 10+ meters)	

Interpretation of Results

Chemical Test	Good	Moderate	Poor
pH	6.5-7.5	>7.5	<6.5
Dissolved Oxygen (mg/liter)	>5.0	3.0-2.0	<2.0

TASK 2.4: Revisit your predictions.

1. Were you able to accept them all? Reject some? Explain.

2. How is the overall health of University Lake? Back up your position with data.

3. **Clean up:** Give your trash from the HACH kits to your instructor to throw away. Wash out any used test tubes.

EXERCISE #2. Using Aquatic Organisms to Monitor Water Quality

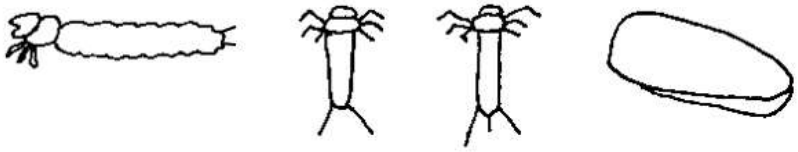
Many organisms that live in the stream, pond, or marsh bottoms are small, but are numerous. Most of the organisms are insect forms (either larvae or nymphs) that are entirely aquatic, after which they will become terrestrial adult forms. These bottom-dwelling organisms, whether insects or not, are called benthic **macroinvertebrates** or benthos. These benthic macroinvertebrates often go unnoticed because of their size and habitat, but they are an extremely important part of aquatic ecosystems.

Several characteristics of macroinvertebrates make them useful indicators of water quality:

1. Many are sensitive to physical and chemical changes in their habitat.
2. Many live in the water longer than a year.
3. They cannot easily escape pollution as some fish can.
4. They are easily collected in many streams and rivers.

Common Macroinvertebrates & Their Water Quality Classification

Class I (Best Water Quality –Sensitive to Pollutants)



Hellgrammite Stonefly Mayfly Mussel

Class II (Moderate)

Damselfly Nymph Dragonfly Nymph Fingernail Clam Crayfish

Class III (Poor Water Quality – Tolerant to Pollutants)

Conical Snail Leech Bloodworm Mosquito Larva

Particularly note the body shape, the shape of the legs, the number of antennae, and the number of hair-like structures at the back of the organism.

TASK 2.5: Drag your net along the water's edge. Make sure that the flaps are outside of the net. Take the macroinvertebrates that you find and put them in the cube to see them with magnification.

1. Provide a general description of the areas you sampled at University Lake.

2. Sketch and identify the macroinvertebrates you found:

3. What do the macroinvertebrates that you found tell you about the health of University Lake? Which water quality rank should we give University Lake (Class I, II, or III)?

4. **Clean up:** Rinse off your net and magnifying box. Return both to the classroom.

We know that the organisms are present with the following temperature ranges:

Temperature Ranges	**Organisms Present**
Greater than 20 Degrees C	Many plant life forms, bass, crappie, bluegill, carp, catfish, caddis fly
Middle Range (13 - 20 Degrees C)	Some plant life, salmon, trout, stonefly, mayfly, caddis fly, water beetles
Low Range (less than 13 Degrees C)	Trout, caddis fly, stonefly, mayfly

TASK 2.6:

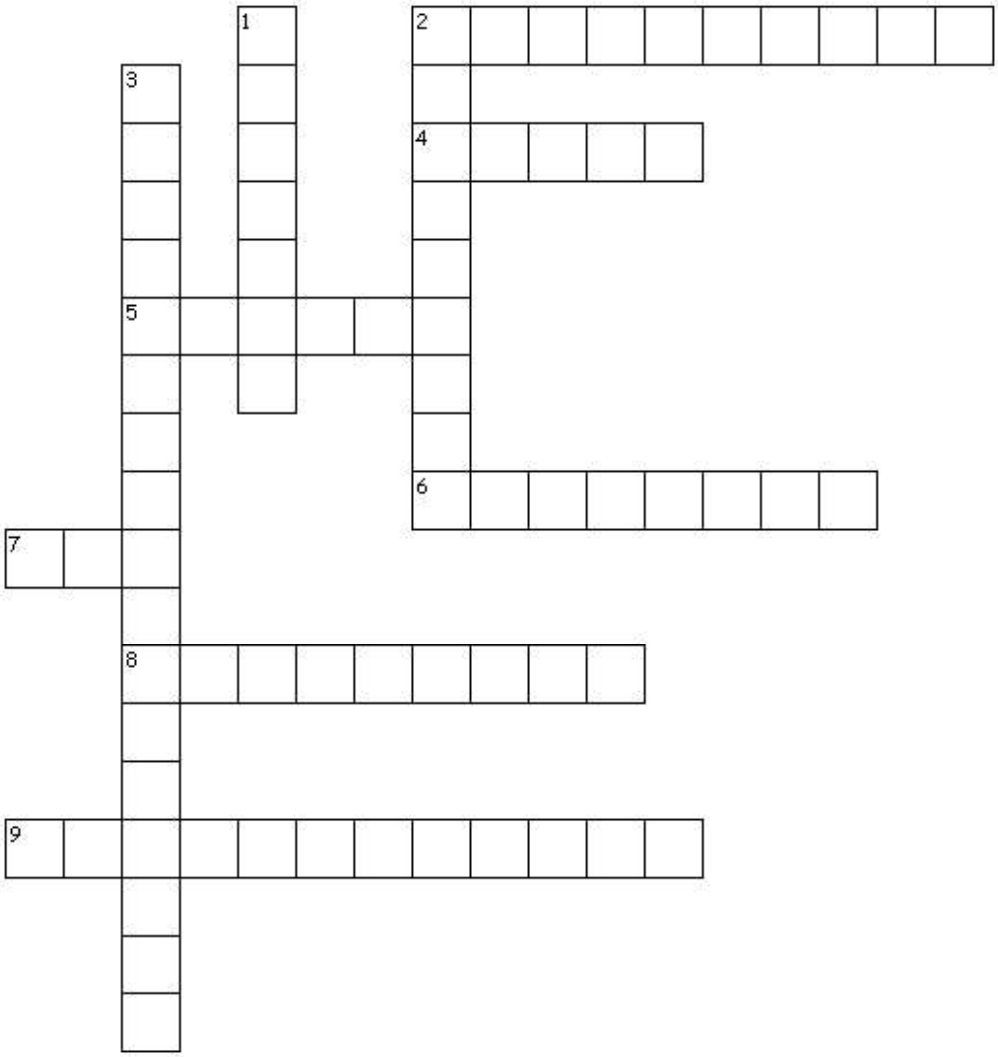
1. Does the water temperature of the lake correspond to the organisms you found? Why?

UNIT 2: WATER: CHEMICAL AND BIOLOGICAL APPLICATIONS

Name: _____ Due Next Lab – Please Tear Out Page and Hand In

Directions for Homework: Use the information that you collected in the lab and the week's key vocabulary terms to help you answer the following questions.

1. **Crossword** (2 points)



Across

2. Upper surface of an underground zone of saturated rock (2 words)
4. An example of a fish that prefers warm (13 - 20°C) waters
5. Where most water is stored on earth (plural)
6. To become incorporated into a liquid
7. The solid, less dense, form of water
8. Measurement of water clarity vs. cloudy
9. Precipitation in the form of rain that does not soak into the ground (2 words)

Down

1. Porous, underground areas of water-soaked rock
2. Area of land to where all water drains
3. Organism found in streams and lakes that lack a backbone

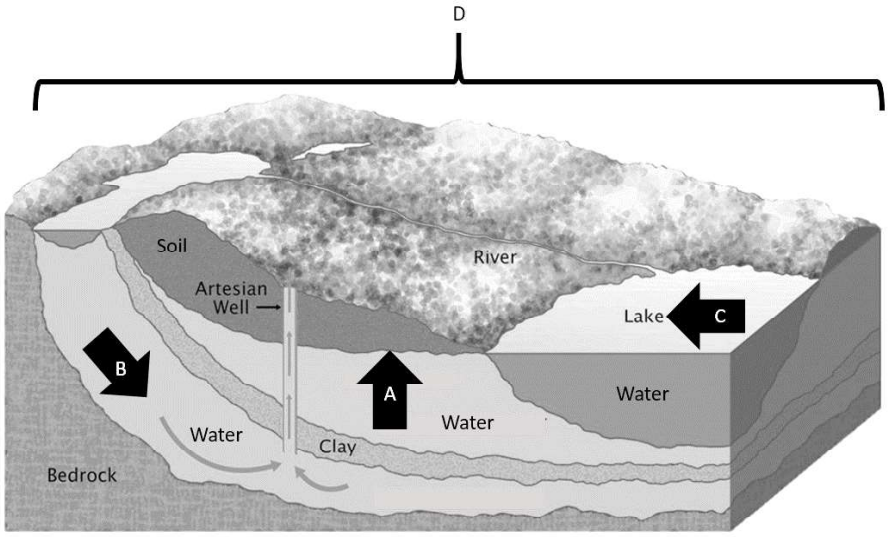
1. Match the following diagram features (A, B, C, D) with their corresponding term. (1 point)

_____ Watershed

_____ Surface Water

_____ Water Table

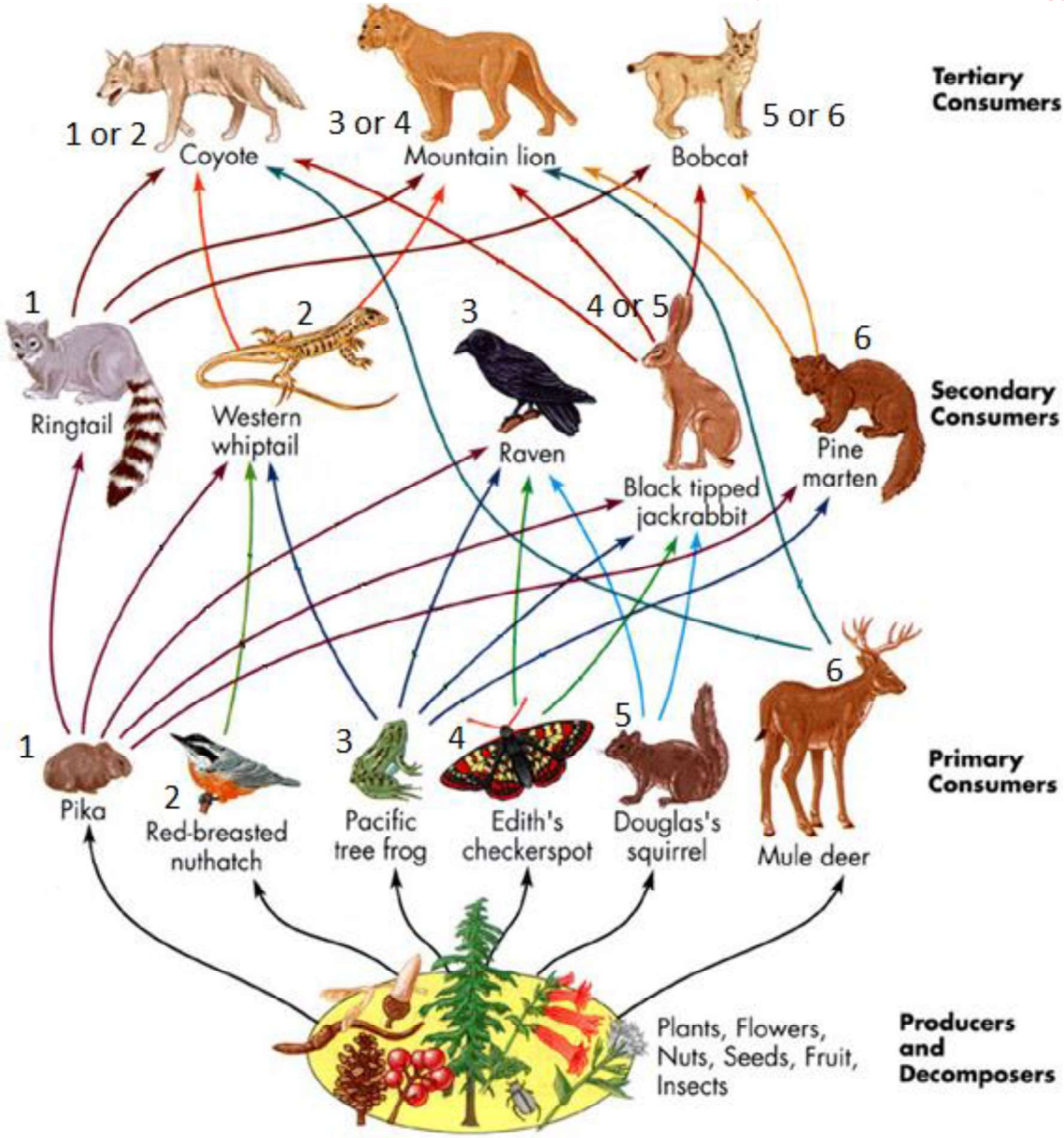
_____ Aquifer



3. You and your labmates sample a new pond and find bloodworms, mosquito larvae, and dragonfly nymphs. Predict the pond's water quality and describe why macroinvertebrates are used to analyze water pollution levels. (2 points)

Grade: _____ / 5 points

Activity: Food Webs and Conservation (In-Class Activity for Conservation Biology Lecture)



In groups of 3-4, read the following instructions and answer the questions on separate sheet of paper.

1. Look at this food web and see what the organisms feed on, and what eats them.
2. Roll your dice. The number that you have corresponds to a **primary consumer**. This represents the randomness of the environment, which ultimately forces that organism to become **extirpated** from the region. Repeat for **one** other primary consumer.
    a. How does this affect the food web? Will other organisms become extirpated? Which species will do well?
3. Roll your dice again. This number responds to a **secondary consumer**, again killing it off.
    a. Again, how does this affect the food web? Will other organisms become extirpated? Which species will do well?
4. Roll again, killing off a **tertiary consumer**.
    a. Redraw your new food web without the extirpated species.
    b. What species should be of conservation concern (important to conserve)?
    c. Why are diverse communities important for ecosystem stability?