



Time:
(1) 45 minute classroom session

Level:
Secondary Science -- Biology

Goals:
This lab will give students an opportunity to use hands-on exploration as they learn about 'abiotic' and 'biotic' factors, and how these factors apply to real life. At the end of this lesson, students will have a clearer understanding of how they can help their environment by making just a few minor changes.

Objectives:
Students will be able to –

1. Analyze how ecosystems differ from each other due to abiotic and biotic factors, mentioning at least 3 ways that they differ from each other.
2. Observe and list 3 abiotic factors (temperature, water, nutrients, pH,) in specific ecosystems.
3. Observe and list 3 biotic factors (plants, animals, organic matter) that affect a specific ecosystem.
4. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.

Materials listed with each individual activity.

Examine a Pond Ecosystem

by Matthew Southam, Neicca Butts, and Mark Larese-Casanova

Correlations to Core Curriculum:

Secondary Science -- Biology

- Standard 1: Students will understand that living organisms interact with one another and their environment.
 - Objective 3: Describe how interactions among organisms and their environment help shape ecosystems.
 - Indicator c: Use data to interpret interactions among biotic and abiotic factors (e.g., pH, temperature, precipitation, populations, diversity) within an ecosystem.
 - Indicator d: Investigate an ecosystem using methods of science to gather quantitative and qualitative data that describe the ecosystem in detail.

Background Information:

Abiotic Factors

Abiotic factors are those non-living physical and chemical factors that affect the ability of organisms to survive and reproduce. Abiotic factors vary in the environment and determining the types and numbers of organisms that exist in that environment. Factors which determine the types and numbers of organisms of a species in an ecosystem are called limiting factors. Many limiting factors restrict the growth of populations in nature. An example of this would include low annual average temperature average common to the Arctic restricts the growth of trees, as the subsoil is permanently frozen.

Examples of Abiotic factors:

- Light intensity
- Temperature range
- Type of soil or rock
- pH Level
- Water availability
- Dissolved Gases
- Level of pollutants

<http://regentsprep.org/regents/biology/units/ecology/biotic.cfm>

Biotic Factors

Biotic factors are all the living things or their materials that directly or indirectly affect an organism in its environment. This would include organisms, their presence, parts, interaction, and wastes. Factors such as parasitism, disease, and predation (one animal eating another) would also be classified as biotic factors.

<http://regentsprep.org/regents/biology/units/ecology/biotic.cfm>

Lessons and Activities:

Prior to teaching the following activities, students should have had lessons introducing the topics of abiotic and biotic factors, as well as ecosystems.

Day 1 --

Engage (12 minutes) – Review with students the definitions of the words ‘abiotic factors,’ ‘biotic factors,’ ‘pH,’ ‘dissolved oxygen levels,’ and ‘ecosystem.’ Discuss the effects of pH, temperature, and dissolved oxygen levels on water ecosystems.

To introduce the topic of pond water, watch the short video clip, “Organisms in Pond Water,” found at <https://www.youtube.com/watch?v=mXqyCNAYrH4>. The time is 2:30. Although the students in the video are young, the information given in this video is applicable to both young and old learners.

Explore (22 minutes) – The following activities should be done in small groups of about 4 students each:

Have 6-8 jars or containers of pond water set throughout the room. Each jar should have enough space around it that small groups of students can easily access it. Near each jar, a microscope and microscope slides should be placed (or, alternatively, petri dishes and magnifying glasses). If possible, chose a microscope with different options for magnification. This will give students a chance to see the pond water organisms at different levels of magnification, which can help enhance learning and create further interest in the subject.

Students should be divided into groups of 4 people. Each student should have their ‘Examine an Ecosystem’ worksheet. Although they will be working together on the lab, each student should fill this paper out independently while working so that they can later put it in their science journal.

Materials:

Supplies:

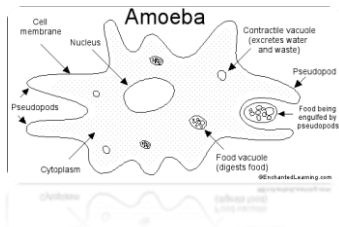
- 6-8 clear jars/buckets
- Pond water (enough to fill each jar/bucket)
- Lab worksheet (included at the bottom of the lesson)
- Science journals
- Pencils

Equipment:

- 16-20 pipettes
- 6-8 microscopes (1 per jar of pond water)
- Microscope slides (At least 4 per station)
- Cover slips (Enough for each microscope slide)
- *Petri Dishes and magnifying glasses (optional, can be used as an alternative to using microscope and slides)*

Did you know?

Amoeba move by pseudopods, or 'false feet.' This means the cell can extend temporarily in any direction.



Did you know?

Dissolved oxygen is absolutely essential for the survival of all aquatic organisms (not only fish but also invertebrates such as crabs, clams, zooplankton, etc).

http://www.lenntech.com/why_the_oxygen_dissolved_is_important.htm#ixzz34R9lMePj

Explain to students that they will be examining pond water organisms today, and will be looking for abiotic and biotic factors in the pond water ecosystem. They will also be testing the temperature, level of dissolved oxygen, and pH of the water. For instructions on these procedures, see 'What's in the Water?' in USU Water Quality Extension's Stream Side Science Manual: <https://extension.usu.edu/waterquality/htm/educator-resources/stream-side-science/sss-lesson-manual/>

Show students that a list of pond water organisms and their respective pictures are listed on the back of their worksheet. Explain that they will be given time to examine the pond water organisms from their container and then be able to match them up with the organisms on the back of their worksheet. Ask students to circle each pond water organism that they observe.

You may choose to put different pond water samples at the various stations to create differentiation, or you may choose to have the same pond water sample type in each of the jars. If needed, review how to use microscopes, along with the slide and cover slips before allowing students to do it on their own.

Dismiss groups of students to go to their respective stations. Give students 10 minutes to examine pond water and look for various organisms. Make sure that group members are giving everyone an opportunity for everyone to view the organisms under the microscope.

After this time is up, have group members work together for the next 10-12 minutes to fill out their worksheet. The final question can be done individually or as a group.

Explain (10 minutes) – Have each group go back to their table. Ask each group to assign a spokesperson to talk about their pond water organisms and the overall ecosystem. Allow each group spokesperson 1-2 minutes to discuss what they saw in their pond water ecosystem. Discuss similarities and differences between the various pond water ecosystems and observations as a class.

Elaborate (5 minutes) – Ask students, "After looking at this pond water and knowing that you can have an effect on it personally, what could you do as an individual to raise awareness to your community about our water and how we can improve its quality?"

Did you know?

Pond water health is determined by many different factors; the amount of sunlight the pond receives, the water temperature, and the amount of pollution in the pond all effect how healthy the pond and the organisms inside of it are!

Assessment:

This lab is meant to be part of a larger unit on ecosystems and the factors within them; therefore, no formal assessment has been created for this lesson plan. If desired, you may choose to have the students turn in their worksheets at the end of the lab, so as to inform your future instruction and to learn what student misconceptions are still present. After this informal assessment has been graded, these papers should be returned to the students so that they can glue them into their science notebooks.

When the final unit test is given, you may choose to set up the pond water lab again, and have students identify organisms on their own, as well as test the temperature, pH, and dissolved oxygen levels. This will give students a chance to show what they have learned in a hands-on, interactive way. This activity will help your test parallel what the students actually learned in class.

Extensions:

- Allow students to compare their jar with other jars in the classroom. Ask them, "Which one do you think is the 'healthiest' ecosystem? Why?" Have them write down their answer in their science journal.
- National Geographic has created a lesson plan in which students create an imaginary marine ecosystem. Doing this activity would solidify concepts such as biotic and abiotic factors, food webs, trophic levels, etc. The lesson plan has been created for grades 9-12. All worksheets and information is found on their website.

http://education.nationalgeographic.com/education/activity/marine-ecosystem-invention/?ar_a=1

Resources:

Books

- *Pond and Brook: A Guide to nature in Freshwater Environments* by Michael J. Caduto
- USU Water Quality Extension's Stream Side Science Manual -- <https://extension.usu.edu/waterquality/htm/educator-resources/stream-side-science/sss-lesson-manual/>

Websites

- Learn about the importance of dissolved oxygen -- http://www.lenntech.com/why_the_oxygen_dissolved_is_important.htm#ixzz34R9IMePj

- Abiotic and Biotic factors information --
<http://regentsprep.org/regents/biology/units/ecology/biotic.cfm>
- Additional information and activities --
http://education.nationalgeographic.com/education/activities/marine-ecosystem-invention/?ar_a=1

Name _____

Examine an Ecosystem

Examine your ecosystem (jar of pond water) and record what you see.

Abiotic Factors

What abiotic factors are visible in the ecosystem? _____

What is the temperature of your ecosystem?

What is the pH of your ecosystem? _____

What is the amount of dissolved oxygen?

Biotic Factors

What organisms are visible with the naked eye?

What biotic factors are visible in the ecosystem?

What organisms are visible under a microscope? Use the chart on the back to list the organisms which you see.

If you were to change 1 biotic and abiotic factor in your ecosystem, what would you change and how would that change your ecosystem? (1 paragraph)



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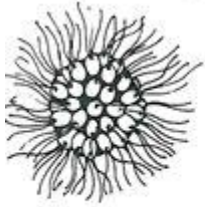
Closterium



Chilomonas



Pediastrum



Synura



Colpidium



Phacus



Stylonychia



Paramecium



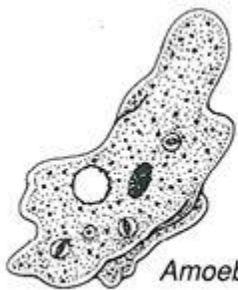
Cosmarium



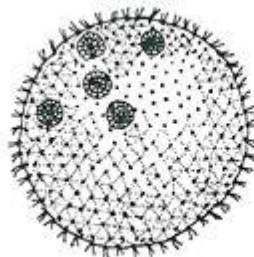
Cyclops



Paramecium



Amoeba



Volvox



Spirogyra



Oscillatoria