SAVE THE POND: TEACHER GUIDE

Subject: Life Science
Grade Level: Middle School
Last Updated: March 7, 2008

Case Summary

Your class has been chosen to lead the 'save the pond campaign.' Devise safety guidelines, a detailed description of the pond's ecology and an improvement plan; the county is counting on you!

Credits

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Learning Objectives

At the end of the case, students will be able to:

1. Apply and demonstrate lab safety rules and practices.
2. Evaluate the current status of the pond using a variety of laboratory techniques and observation skills.
3. Analyze data gathered in the field and in laboratory exercises and use their analyses to summarize the critical problems of the pond.
4. Research various aspects of pond ecology using a variety of print and nonprint references.
5. Compare and contrast healthy and unhealthy pond systems.
6. Design a healthy pond.
7. Propose a plan for restoring the pond within a given budget.
8. Use a transect line in field research.
9. Identify organisms in and around a local pond.
10. Explain the role of sunlight in the pond environment.
11. Determine the difference between a systematic observation and a biased observation.
12. Estimate the size, area, and volume of a pond.
13. Identify the sources of nitrate and nitrogen in a pond, and explain the functions they perform.
14. Explain the significance of pH in a pond and the effects of a pH that is too high and too low.
15. Explain the relationship between temperature and dissolved oxygen.
16. Explain the importance of dissolved oxygen in a pond.
17. Define coliform bacteria and explain their importance.

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Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A, G).

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations

SCSh6. Students will communicate scientific investigations and information clearly. (NSES Content Standard G)

d. Participate in group discussions of scientific investigation and current scientific issues

SCSh8. Students will understand important features of the process of scientific inquiry. (NSES Content Standard A, G)

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9. Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas

c. Building vocabulary knowledge

d. Establishing context.

S7L1. Students will investigate the diversity of living organisms and how they can be compared scientifically. (NSES Content Standard C)

a. Demonstrate the process for the development of a dichotomous key.

b. Classify organisms based on physical characteristics using a dichotomous key of the six kingdom system (archaebacteria, eubacteria, protists, fungi, plants, and animals).

S7L4. Students will examine the dependence of organisms on one another and their environments. (NSES Content Standard C)

a. Demonstrate in a food web that matter is transferred from one organism to another and can recycle between organisms and their environments.

b. Explain in a food web that sunlight is the source of energy and that this energy moves from organism to organism.

c. Recognize that changes in environmental conditions can affect the survival of both individuals and entire species.

d. Categorize relationships between organisms that are competitive or mutually beneficial.

e. Describe the characteristics of Earth's major terrestrial biomes (i.e. tropical rain forest, savannah, temperate, desert, taiga, tundra, and mountain) and aquatic communities (i.e. freshwater, estuaries, and marine).

Assessment

Students were assessed based on the following case products:

1. *Lab notebooks*: Students will keep their data sheets from each station in a group lab notebook. The lab notebooks will be checked periodically for accuracy and completeness. A final assessment will come from the list of pond problems and the

response letter to the PTA. A pond assessment guide is provided in the ***Student Materials***. Classroom data will be coded into the grid and students will use the classroom data to answer the questions.

2. *Webquest*: The webquest will be an individual assessment though students will work in pairs on the computer to work through the webquest.
3. The pond proposal will be a group assessment. Specifics for what are required in the pond proposal are listed above in scene 3. An assessment rubric is being created.
4. Individually, students will have general quizzes on material that relates to the pond and to the current topic in their classroom.

Refurbishment of the pond on the afternoons and weekends will be voluntary and may be used as a source of extra credit or to replace a homework grade.

Implementation Strategy

We dedicated one day a week to pond during September, October, and November.

Day 1	(full class period) Students will receive their first letter from the PTA at the beginning of class. A student or the teacher may read the letter to the class. If the class has not already done so, they will visit the pond to see its layout and potential hazards. Students will then be placed into groups of 4-5 students and will take 10-15 minutes to come up with safety rules – they can do this outside at the site of the pond or they can do it in the classroom. Students will discuss their rules with the class and a general list of pond safety rules will be created with penalties for rule violations for each rule.
Day 2	(full class period) Students will work on the healthy pond webquest in pairs.
Day 3	(30 minutes) Students will receive their second letter from the PTA and will work in their groups to come up with different types of tests that they should do based on what they learned are important tests during the webquest.
Days 4-8	(full class period for each one): Students will rotate through the station labs and finish webquests (rotate through webquest work as if it is a station lab). We used the Pond Water Tour Kit available through Carolina Biological Supply for supplies and supplementary materials. Facilitators will need to be on hand to supervise students at the pond for the measurement lab and the temperature / DO lab. Lab results of each group should be recorded in their data sheets and on the classroom data sheet / grid (we used a large piece of paper taped to the wipe-board in the front of the class).

Day 9	(full period) Students will use their classroom data to answer the questions on the final pond assessment. This is an individual activity.
Day 10	(We did this the day after the final pond assessment -- 30 minutes): Each group will draft a letter to the PTA describing their findings and the class will vote on the best letter to send to the PTA.
Day 11	(30 minutes) Scene 3: Students receive a letter from the PTA stating how much money they will be given and asking for a detailed proposal for the refurbishment. The PTA will then choose the refurbishment plan to be followed (or this can be voted on by students). The refurbishment plan will be due one month after students receive this letter. Students will then begin to brainstorm about how they want to refurbish the pond. They will delegate responsibilities to research various aspects of pond refurbishment (prices, supplies, & necessary components for a healthy pond). They will be given one research day and one or two more in-class days to work on the details of the refurbishment plan, the rest will need to be completed outside of class. Refurbishment of the pond will take place in the spring when the weather is warm enough on weekends & afternoons after school.

Facilitator Guide: Pond Plan Specifics

** Facilitators will help students address each of the following. Students can use their textbooks, internet, garden supply catalogs, etc as references.

Specifics

1. Colored sketch of what new pond will look like and general written description
2. How will you address the following problems (include problems generated during observation and measurement lab)
3. List of organisms you need, cost of each organism, how many of each organism, and why you chose the type and number of organisms that you did.
4. Other supplies needed and pricing
5. Strategic plan – Detailed steps for restoring the pond
6. Plan for maintaining pond throughout the year and during the summer

** To implement the plan, some in-class time can be used to involve all the students in the refurbishing, also time after school and weekend workdays can be held that will give students extra credit.

Specific Activities

1. Station Labs for assessing the current situation of the pond (see ***Student Materials***)
2. Webquest investigating the aspects of a healthy pond (see ***Student Materials***)
3. Creation of a proposal for the refurbishment of the pond
4. Activities around refurbishment that are specific to the students' proposal

The following is a list of pond lab stations that every group will participate in; additionally, a webquest will be a station that students will rotate through. Each group will complete one station per day – students will then rotate to the next lab on the next day. No two groups are doing the same lab at the same time. There will be tasks "assigned" to each student when there is a lab and students cannot have the same task twice. Lab instructions and data sheets can be found in ***Student Materials***. We had five groups with no more than 5 students so the arrangement of the labs worked fine. If you have more or lesss students labs can be combined (the pH and dissolved ions can be done in the same day by the same group with some modifications) or add the webquest as a lab instead of as a separate day.

Supplies List for Pond Station Labs:

Computers for research and webquests
Tape Measure
Yard stick (maybe)
String
Masking Tape
3 thermometers suitable for measuring water temp
3 dissecting scopes
3 regular scopes (optional – depends on depth of lab)
calculators (2-3)
3 clipboards
colored pencils
blank / lineless paper
classroom data chart (made from poster board or banner paper)
Chemical analysis color comparison chart (2 is best—from pondwater tour kit)
pH testabs (pondwater tour)
ammonia 1 and 2 testabs (pondwater tour)
nitrate 1 and 2 testabs (pondwater tour)
dissolved oxygen testabs (pondwater tour)
guide to aquatic animals
folders (1 for each group to keep data sheets)
containers to gather or hold samples
plastic bags for doing tests (pond water tour)
small glass bottles for DO test (pondwater tour)
tap water samples
pond water samples
plastic pipettes
gloves
paper towels
timers / watches with minute hand
felt tip marker
soap or waterfree hand cleaner

Lab Descriptions

1. Measurement:
    a. Location: pond
    b. Estimated time: 45 minutes
    c. Supplies: String, Tape Measure, Pencil, Data Sheet, calculator, yard stick
    d. General Description: Students will measure the length, width, and depth of the pond. They will take three measures from three different locations to get the average depth. They will use formulas to estimate the simple area and volume of the pond. The will use string and measure the circumference of the pond and use the circumference to more accurately estimate the area of the pond and compare how the two area measurements differ and how the shape of an object can alter its area. More advanced students may do the same for volume
    e. Student jobs to fill
        i. Reader of instructions
        ii. Recorder of results
        iii. Measuring person (may require two people)
        iv. Person to read the measurement
        v. Overseer -- calculator
2. Temperature and Dissolved Oxygen
    a. Location: pond and classroom
    b. Estimated time: 50 minutes: 30 minutes at pond, 20 minutes in classroom (travel time included)
    c. Supplies: Thermometer, pencils, "Pond Water Tour" kit for dissolved oxygen lab and reading materials provided with the kit, lab instructions and data sheets.
    d. General Description: Students will take the temperature of the pond in three different locations and calculate an average temperature. They will also record the date, time of day, and outside air temperature as well. Students will take a sample of water from the pond to the classroom and complete a test for dissolved oxygen on the sample.
    e. Student jobs to fill:
        i. Reader of instructions
        ii. Recorder of data
        iii. Data gathering (3 students b/c three sites and three measurements –will also do dissolved oxygen)
        iv. Handler / gatherer of samples and supplies

3. Biological Characteristics of the Pond:
    a. Location: classroom
    b. Estimated time: 45 minutes
    c. Supplies: 3 light and 3 dissecting scopes, (students will work in pairs within their groups). 3 taxonomic key / aquatic organisms guide, a book about the significance of specific indicator species, colored pencils, data sheet
    d. General Description: In pairs students will sketch and identify the various organisms they see and indicate the kingdom to which they belong. Students

will research the significance of the organisms they find and indicate that significance on their worksheet

4. pH:
    a. Location: classroom
    b. Estimated time: 45 minutes
    c. Supplies: "Pond Water Tour" kit for pH lab and reading materials provided with the kit, lab instructions and data sheets.
    d. General description: Students will analyze pre-collected samples of pond water for pH. They will compare the pH of the pond water to various other liquids. Students will discuss the significance of their findings
    e. Student jobs:
        i. Reader
        ii. Recorder
        iii. Sample and handler for pH
        iv. All investigate significance
        v. overseer

5. Dissolved ions
    a. Location: classroom
    b. Estimated time: 45 minutes
    c. Supplies: "Pond Water Tour" kit for dissolved ions lab and reading materials provided with the kit, lab instructions and data sheets.
    d. General description: Students will analyze precollected samples of pond water for dissolved ions and investigate the significance of their findings
    e. Student jobs
        i. Reader
        ii. Recorder
        iii. Sample and handler for ions test (several different tests so a student will be assigned to handle a specific test)
        iv. All investigate significance
        v. overseer

Students will keep all data sheets and lab notes in a group binder. When all lab stations are completed, students will work in their groups to review their lab notes and data sheets and come up with a list of pond problems that need to be addressed in order to create a healthy pond (the pond assessment guide located in the ***Student Materials*** can help students organize data). They will then draft a letter to the PTA about the problems associated with the pond.
**We used the Pond Water Tour Kit offered by Carolina Biological Supply Company.

Resources

Microscopy UK (2007) Virtual pond dip. Accessed December 22, 2007 from http://www.microscopy-uk.org.uk/ponddip/index.html

1728 Software Systems (2000) Circle formulas. Accessed December 22, 2007 from

http://www.1728.com/diamform.htm

Friends of the Rouge (2007) Chemical monitoring. Accessed December 22, 2007 from http://www.therouge.org/Programs/REP/chemical_monitoring.htm#pHtest

Cleveland, April J. for Science Junction, NC State University (1998) Water what-ifs: Water quality and dissolved oxygen. Accessed December 22, 2007 from http://www.ncsu.edu/sciencejunction/depot/experiments/water/lessons/do/

Microscopy UK (2007) Pond life identification kit: A simple guide to small and microscopic pond life. Accessed December 22, 2007 from http://www.microscopy-uk.org.uk/index.html?http://www.microscopy-uk.org.uk/pond/