Science Objectives

- Students will simulate adjusting the pH of a lake and draw conclusions about the relationship between pH and biodiversity.
- Students will learn the difference between biotic and abiotic factors and how abiotic factors affect biotic factors.
- Students will simulate adjusting the temperature of a lake and draw conclusions about the relationship between water temperature and dissolved oxygen levels in the lake.

Vocabulary

- pH
- biotic
- acid
- base
- abiotic
- biodiversity
- dissolved oxygen

About the Lesson

In this activity, students will observe model environments, adjust abiotic variables in those environments, observe the results of those adjustments, and then draw conclusions about the effects of the abiotic world on the biotic world.

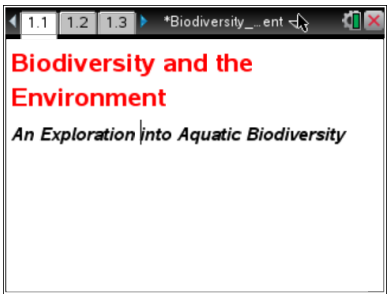
- As a result, students will:
  - Learn the fundamental meaning of "biotic" and "abiotic" factors, and how each impacts the other to determine biodiversity.
  - Form a basic understanding of pH and how it affects biodiversity of an aquatic ecosystem.
  - Develop an understanding of the relationship between water temperature and dissolved oxygen levels.

TI-Nspire™ Navigator™

- Send out the .tns file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to have students demonstrate how to negotiate the simulations and to spotlight student answers.
- Collect student responses from assessment items that are embedded throughout the document.

Activity Materials

- *Biodiversity_and_the_Environment.tns* document
- TI-Nspire™ Technology



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Manipulate sliders to adjust variables
- Answer assessment questions within a document

Tech Tips:

Make sure that students know how to move between pages by pressing ctrl ◀ (left arrow) and ctrl ▶ (right arrow).

Lesson Materials:

Student Activity

- Biodiversity_and_the_Environment_Student.doc
- Biodiversity_and_the_Environment _Student.pdf

TI-Nspire document

- Biodiversity_and_the_Environment.tns

Discussion Points and Possible Answers

Move to page 1.2.

1. After opening the document, students should read the background information on page 1.2.

Move to pages 1.3 – 1.5.

Have students answer questions 1–3 on either the handheld, on the activity sheet, or both.
These three questions assess the students' background knowledge of biotic factors, abiotic factors and biodiversity. It is recommended that these questions be used for discussion purposes after the students answer them.

Q1. Give two examples of abiotic factors in an environment.

Suggested Answers: water, air, climate, rain, snow, rocks, oxygen, carbon dioxide, etc.

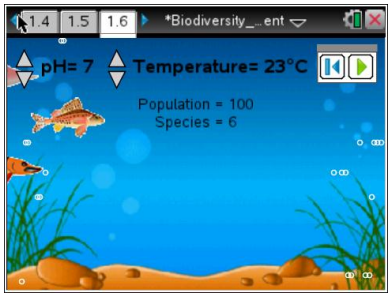
Q2. Which of the following ecosystems is likely to support the highest biodiversity?

Answer: C. Forest with three soil types, varied land features, and a small stream (This ecosystem has the greatest diversity of physical characteristics so it is likely to harbor more species uniquely adapted to each environmental condition).

Q3. Which of the following is an example of a biotic factor influencing another biotic factor?

Answer: B. Higher plant diversity increases animal diversity. (Plant diversity is a biotic factor that influences animal diversity-- another biotic factor. Hippopotamuses and wood debris are also biotic factors, but they are influencing abiotic factors in those examples.)

Move to page 1.6.



2. On page 1.6 are some instructions for the student about the simulation of the aquatic ecosystem. After reading the directions on the page that overlays the lake, the students should close the instruction window by clicking ☒. If needed at any time during the simulation, students can press menu if they would like to view the directions again.
   In order to see the impact of changing pH and temperature on the biodiversity of the lake, students should only adjust ONE variable at a time. For example, guide the students to work through the entire range of the pH scale, making observations of the effects of changing the pH. Then, the pH should be reset to 7 and the temperature should be changed. Remind students that if both variables are changed at the same time, it's difficult to determine which is impacting the ecosystem.

Move to pages 1.7 – 1.8.

Have students answer questions 4 and 5 on the handheld, the activity sheet, or both.

Q4. What are the variables that you can regulate in the simulation? (Select all that apply.)

Answers: A. pH and D. Temperature

Q5. Which of the following represent "biotic" factor(s) in the simulation? (Select all that apply.)

Answers: A. fish biomass and C. plant diversity

Move to pages 1.9 – 1.10.

Have students answer question 6 on the handheld, the activity sheet, or both.

3. Have students read the content information about pH on page 1.9. The concept of pH may be new to students, so it is recommended that the teacher take some time to discuss it.

Q6. A lake with a pH of 6.5 would be considered:

Suggested Answer: C. slightly acidic

Move to pages 1.11 – 1.12.

4. On page 1.11, the students will read about the meaning of biodiversity. After reading the information on this page, they should move to page 1.12. On this page, they will be instructed to return to the simulation on page 1.6 and review what happens when the pH and temperature of the water are changed.

Move to page 1.13 – 1.16.

Have students answer questions 7–11 on the handheld, the activity sheet, or both.

Q7. How do temperature and pH affect each other?

Answer: D. Temperature and pH do not affect each other.

Q8. In general, there is a greater diversity of fish when the water is warmer.

Answer: B. Disagree

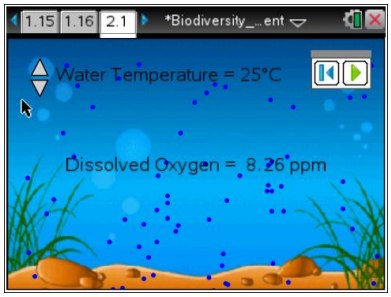
Q9. As the water becomes more acidic, the diversity of fish decreases. Which is the best explanation?

Answer: B. Only a small number of species are adapted to survive in acidic conditions.

Q10. Go back to the simulation and set the temperature at 20°C and the pH at 7. Note the population and species values. Now change the pH to 5 and keep the temperature at 20°C. What do you observe?

Suggested Answer: The number of species and the number of fish has declined.

Move to page 2.1 for the simulation on dissolved oxygen.



5. After finishing the first simulation and all of the questions, the students should move to the second simulation, which deals with the relationship between water temperature and the levels of dissolved oxygen in the water. The process for the students will be the same as in the first simulation.

Move to pages 2.2 – 2.8.

Have students answer questions 11–17 on the handheld, the activity sheet, or both.

Q11. What happened to the amount of dissolved oxygen as you increased the temperature of the water?

Answer: The amount of dissolved oxygen decreased when water temperature was increased.

Q12. Which term do you think best describes the relationship between water temperature and dissolved oxygen levels?

Answer: B. Inverse

Q13. Water has less capacity to hold dissolved oxygen as temperature increases, because gas molecules move faster and spread apart in warmer water.

Answer: A. Agree

Q14. Which of the following factors do NOT contribute to higher dissolved oxygen levels?

Answer: D. Low water temperature

Q15. Fish such as salmon and trout need a lot of oxygen to survive. Which water temperature do you think would be best for these fish?

Answer: D. 10°C

Q16. Catfish have a lower oxygen requirement than many freshwater fish. In which aquatic habitat are they likely to be better adapted than other fish?

Answer: C. shallow tropical lake (this aquatic environment is expected to experience highest temperatures and will not have deeper, cooler water for refuge)

Q17. Oxygen is rarely a limiting abiotic factor in aquatic ecosystems.

Answer: B. Disagree. (Diurnal and seasonal changes in dissolved oxygen often create hypoxic conditions, which severely affects the physiology and overall productivity of many aquatic organisms)

Move to page 2.9.

6. On page 2.9, there is a graph of the data that was collected automatically as the students made changes to the water temperature in the simulation. Spend some time with the students analyzing the graph.

Move to pages 2.10 – 2.11.

Have students answer questions 18 and 19 on the handheld, the activity sheet, or both.

Q18. Which words could be placed in the blanks below to make the statement true? (Select all that apply.)

As water temperature goes _____, the dissolved oxygen level goes _____.

Answers: B. up; down and C. down; up

Q19. Predict what would happen if the water continued to get warmer and warmer.

A. **Answer:** A. The dissolved oxygen levels would continue to drop and level off at 0 ppm.

Move to page 2.12.

7. The final page of the activity shows the student the actual data that was collected as they made changes to the temperature of the water in the dissolved oxygen simulation.

TI-Nspire Navigator Opportunities

Make a student a Live Presenter to demonstrate how to negotiate the cell diagrams. The questions in the activity may be distributed as Quick Polls or used as a formative or summative assessment

Wrap Up

When students are finished with the activity, retrieve the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.

Extension

If a Vernier Dissolved Oxygen Sensor is available, you could experimentally determine that cold water is able to hold more dissolved oxygen than warm water. Half-fill a bottle with warm water and shake it for a few seconds, then test the dissolved oxygen level. Next, do the same with cold water

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