Water Quality Tests: pH, Dissolved Oxygen, Temperature, Sediments

FYI

The pH, temperature, dissolved oxygen, and sediment in water have a direct effect on the aquatic animals, invertebrates, and plants that can live there. In an artificial pond, these factors may be changed by changing how the pond is managed. For instance, fountains and waterfalls mix (**aerate**) water, which might increase the dissolved oxygen content; they also can cause the water to become warmer, which can decrease water's ability to hold dissolved oxygen. The relationships among the factors and their effects on aquatic life are complicated. It is not necessary for adult leaders and learners to understand all these interrelationships. What is important is to understand that they each must be within a tolerable range for aquatic life to thrive.

pH

In the chart "pH Ranges that Support Aquatic Animal and Plant Life", you can see that animals we might consider "desirable" —such as trout and the aquatic insects they feed upon— find acceptable a narrow pH range between pH 6 to 8. The pH scale ranges from 0, which is **acid**, to 14, which is called **basic**. Both very high and very low pH readings are detrimental to aquatic life. A pH of 7 is called **neutral**. Rain in the western United States averages pH 6.5. In the eastern United States, rain can have a lower pH reading (thus, it is called "acid rain").

Dissolved oxygen (DO)

All aquatic animals need oxygen to survive. The amount of oxygen dissolved in water can be affected by altitude, temperature, plants, light exposure, aeration, and sediments suspended in the water. Temperature has a direct effect on the amount of oxygen in water. Colder water can hold more oxygen.

In the LaMotte Water Monitoring Kit, there is a chart for determining the percent saturation of oxygen. The chart is based on the combined temperature and DO reading. DO is measured in parts per million, written "ppm" (milligrams per liter of water = mg/l). A DO range of 5 to 6 ppm is acceptable for most aquatic life.

Temperature

Temperature is very important to water quality. As we learned above, temperature has a direct effect on dissolved oxygen in water. In addition, temperature can affect the rate of photosynthesis by aquatic plants and the sensitivity of organisms to parasites and

Oregon benchmarks

Benchmark 1
- Describe the basic needs of living things.
- Describe a habitat and the organisms that live there.

Benchmark 2
- Describe the relationship between characteristics of specific habitats and the organisms that live there.

National Science Education Content Standards

Grades K–4
- Properties of objects and materials
- Organisms and environments
- Changes in environments
- Understanding about scientific inquiry

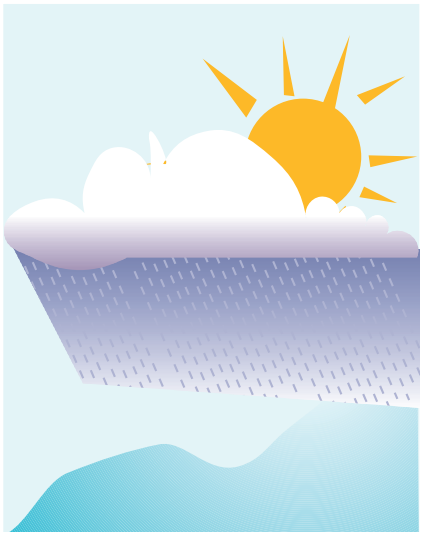
Grades 5–8
- Properties of objects and materials
- Populations and ecosystems
- Populations, resources, and environments
- Understanding about scientific inquiry

Content objectives

Learners will be able to do the following:
- Name two to four water quality factors that can be tested.
- Demonstrate how to test for water quality.
- Explain why water quality factors can affect aquatic animals, invertebrates, and plants.
- Understand that each water quality measurement must be within a tolerable range for aquatic life to thrive.

Process objectives

Learners will be able to do the following:
- Ask questions that can be answered through a scientific investigation.
- Design an investigation to answer a question.
- Collect, organize, and summarize data from an investigation.
- Analyze and interpret data from an investigation.



disease. Salmon and trout generally prefer water temperatures between 40 to 65°F.

Sediments

The measurement of sediments in water is called **turbidity**. It is an indication of the clarity of the water. Sediments are suspended in water; they are not dissolved in the water. Sediments occur naturally as products of weathering. Like the other factors we have learned about, they can be both beneficial and harmful to aquatic life.

In a properly constructed artificial pond, sediments are of minimal importance. It may not be informative to measure turbidity there. However, if there is a natural water system nearby, learners might measure its turbidity over a period of time and record their results. If these measurements change, can learners suggest what is causing the change?

Materials

Part 1 and Part 2

- ⬭ Quick Reference Guide to Aquatic Invertebrates cards, one set per team
- ⬭ Looseleaf binder rings, one for each set of Aquatic Invertebrates cards
- ⬭ Chart: pH Ranges that Support Aquatic Animal and Plant Life, one per team
- ⬭ Water Quality Test Kit
  This kit contains tests for pH, DO, temperature, and turbidity. In addition, it contains tests for coliform bacteria, biochemical oxygen demand (BOD), nitrate, phosphate, and a chart for interpreting the test results.
  If you do not wish to buy the complete kit, you can buy the following individual tests:
  - ◆ pH (pH test paper)
  - ◆ DO
  - ◆ Temperature (standard thermometers)
  - ◆ Sediments/turbidity (Secci disk)

Part 1 only

- ⬭ Gathering Water Quality Data sheet, one for each learner or team of learners
- ⬭ Lemon juice
- ⬭ Baking soda
- ⬭ Pond or stream water

Part 2 only

- ⬭ 4-H Water Data Sheet, one for each learner or team of learners
- ⬭ Aquatic invertebrate collection materials: aquarium nets, plastic collection bowls, hand lenses
- ⬭ Quick Reference Guide to Aquatic Invertebrates cards, one set per team

Preparation

Leaders should review the following:

- ● Background section
- ● FYI section
- ● 4-H Science Inquiry Model
- ● Learner evaluation criteria in the ODE Scientific Inquiry Scoring Guide for Benchmark 2. Keep the evaluation criteria from each each of the four dimensions of the scoring guide in mind as you coach learners.

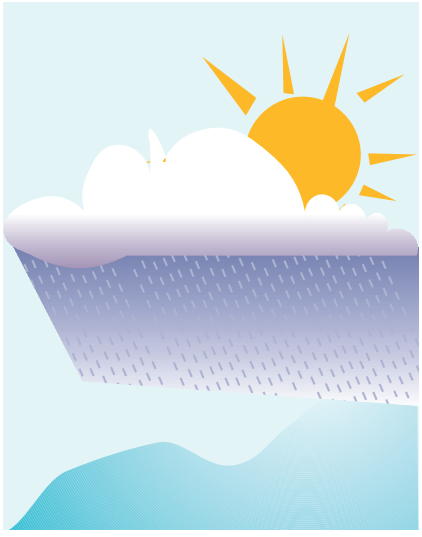
Order the water quality testing materials of your choice. Practice using them before demonstrating them to learners.

Make photocopies of the Gathering Water Quality Data sheet, 4-H Water Data Sheet, and the pH Ranges that Support Aquatic Plant and Animal Life chart.

Make photocopies of the Quick Reference Guide to Aquatic Invertebrates cards onto card stock, one set per team. Punch a hole in one corner of each card and insert a looseleaf binder ring through each set to keep them together. (These also are used in Lessons 4A and 6A.)

The day before the lesson, ask learners to bring in water samples from neighborhood streams or ponds in clean plastic bottles. Collect a water sample from the habitat area pond.

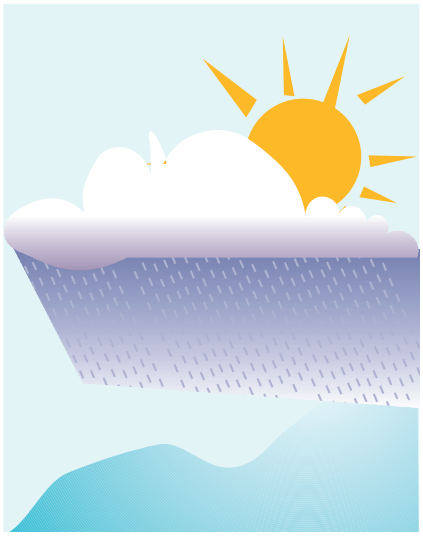
Procedure



Part 1

Lead a discussion with learners to determine what they know about water pollution and water quality. Share information with learners based on the "Background" and "FYI" sections. Adapt the information to the age and interests of the learners. If learners have questions that are not answered by the information provided, have them do some library research to find an answer.

One objective of this lesson is for learners to know how to use water quality test kits. Demonstrate how to take the pH test. For older learners, pass out the Gathering Water Quality Data sheet and ask them to work numbers 1 through 3. Demonstrate the test for DO and ask the older learners to complete number 4. For younger learners, the leader may do the tests outlined on the



Gathering Water Quality Data sheet and ask the learners to observe and explain the results.

Ask the group to pause before beginning number 5. Ask them to list some methods they might use to change the level of DO in the sample. If there are several good methods suggested, assign a different method to each team of learners. Ask the teams to complete number 5.

When all the teams have completed number 5, ask them to report their method and results to the whole group.

Lead a discussion to answer question 6 with the group.

- How are the tests we have learned today applicable to the pond in our habitat area?
- How does what we learned today apply to your world beyond the school?
- Where in the neighborhood was the water for the tests collected?
- Is there more we could learn about the habitat area pond or the neighborhood by doing more tests? or by doing the tests over a longer period of time (several months)? or at different seasons of the year?

Part 2

For younger learners

Simply go to the habitat area pond to demonstrate the use of the water quality tests they learned in Part 1.

For older learners

Lead a discussion about water quality monitoring programs. Pass out the 4-H Water Data Sheet. (Note: The 4-H Water Data Sheet calls aquatic invertebrates "macro-invertebrates.") Using the knowledge they now have about water quality tests, ask learners to design a plan for monitoring the quality of the water and numbers and types of invertebrates in the habitat area pond. Ask, "If we do not monitor the quality of our pond's water, how would we know if the pond water was becoming polluted?" "Should a water quality program also be conducted on a local pond or stream?"

Coach learners to ask a question or form a hypothesis that they can investigate and test over time using the water quality monitoring tests they have learned. Follow the steps outlined in the 4-H Science Inquiry Model. Create a timeline for the project. This could be a week, a month, or the entire year.

At the end of the investigation phase, learners should organize and summarize their data. They then should provide some analysis or interpretation of the data. They can use the Quick Reference Guide to Aquatic Invertebrates cards and the pH Ranges That Support Aquatic Life chart to interpret the data.

Extend the learning

4-H Wildlife Stewards Project Handbook grades K–3 curriculum:
A Drop in the Bucket; Making a Terrarium

4-H Wildlife Stewards Project Handbook grades 4–6 curriculum:
Energy for Tree Growth

A Palette of Fun (4-H 713L): Mural Madness

Project WILD Aquatic Education Activity Guide: Designing A Habitat; Where Does Water Run?; Water Canaries; Aqua Words