

Survey: Biological Properties

Applicable TEKS

Science Grade 4	Science Grade 5	Science Grade 6
4.1 A 4.2 A, B, D, F 4.3 A 4.4 A, B 4.10 A	5.1 A 5.2 A, B, C, D, F 5.3 A 5.4 A, B 5.9 A 5.10 A, C	6.1 A 6.2 A, B, E 6.3 A 6.4 A, B 6.12 C, D

Duration

Two to three 40-minute lessons

Objectives

Students will learn what lives in a stream and how these organisms act as indicators of pollution. Rather than arriving at an accurate count, students will understand that it is more important to see how many different species of freshwater benthic macroinvertebrates are present in the body of water.

Prerequisites

Students should complete *Lesson 4—Water Pollution* before starting this lesson.

Teachers should determine the number of supervisors needed (example: one per team) and make sure those supervisors understand their responsibilities before starting this lesson. You do not need a permit for handling insects; if you would like to handle other animals, please visit the Texas Parks and Wildlife Department's Web page at tpwd.texas.gov/business/permits/land/wildlife/research for more information. In addition, you may want to build your own equipment; see the "Additional Resources" section for instructions on building your own dip nets and kicknets.

Materials

- ▶ *Handout 9—Survey: Biological Properties*
- ▶ Rubber boots or waders
- ▶ Magnification lenses
- ▶ Forceps
- ▶ Collection equipment (dip nets, and a hand screen or kicknet)
- ▶ White observation pans (enamel or plastic)

Procedure

1. Discuss the safety procedures. Remind your students to:
 - a. stay only in shallow water;
 - b. wear rubber gloves when they are using their hands to disturb the substrate, aquatic vegetation, roots, or stick piles;
 - c. wear rubber boots or waders if entering the water; and
 - d. wash their hands at the end of the lesson.
2. Discuss information in "Pollution Indicators" about benthic macroinvertebrates, including:
 - a. Benthic macroinvertebrates are small animals without backbones that live on the bottom of water bodies.
 - b. They are used to determine past and present water quality; in addition, continued sampling (over a period of time) can help you tell if the water quality is improving, degrading, or remaining the same.
 - c. We categorize macroinvertebrates by their tolerance to pollution. For this lesson, the categories are intolerant (sensitive to poor stream conditions), intermediate (moderately tolerant to degraded habitat and water quality), and tolerant (most tolerant to degraded habitat and water quality).
 - d. Water quality is not always the limiting factor in the presence or absence of aquatic organisms; physical habitat also plays a key role in whether an organism inhabits a water body.
 - e. As a general rule—a healthy stream contains intolerant species while polluted streams do not. Intermediate and tolerant species can be in both healthy and polluted streams.
3. Review with your students *Handout 9—Survey: Biological Properties* so they understand the handout. Based on the data previously collected, ask your students what results they might expect from this study (healthy or polluted stream).
4. Before your students start, discuss the collection protocols including:
 - a. Do not collect fish, oysters, shrimp, clams, mussels, or crabs; instead, count how many you see and write that number on your handout.
 - b. Return benthic macroinvertebrates slightly downstream of the collection area.
5. Assign student teams to their collection areas:

- a. Teams using a hand screen or kicknet need to collect in habitats with running water, such as a riffle.
 - b. Teams using the dip nets can collect in almost any of the aquatic habitats.
6. Once your students complete the handout, discuss the results with your students. If students found:
- a. Intolerant species and a few intermediate and tolerant species, then the stream is considered healthy.
 - b. No intolerant species, and more tolerant species than intermediate species, then the water quality is considered poor.

Hand-Screen (or Kicknet) Collection

1. One student will enter the water and stand in a location where he or she can disturb the substrate.
2. Two other students (each one holding an end of the screen) will enter the water and firmly place the bottom of the screen into the substrate approximately 0.5 meter downstream from the other student. The screen should be perpendicular to the substrate or slightly angled downstream so it can catch benthic macroinvertebrates and other dislodged material.
3. When ready, the student upstream will disturb the substrate with his or her hands or feet (or both) for at least 5 minutes. The area in front of the net should be thoroughly disturbed.
4. In a scooping action, lift the screen out of the water so that all captured material remains on the screen.

5. Bring the screen to the bank and lay it down on the ground.
6. As a team, use the forceps to collect the benthic macroinvertebrates and put them into the observation pan.
7. Using *Handout 7*, identify the collected organisms and enter the number for each species.

Dip-Net Collection

1. Use the following procedures when collecting benthic macroinvertebrates found on roots, stick piles, or aquatic vegetation:
 - a. Place the dip net slightly downstream on the substrate. If there is little to no water movement, place the net in a manner that would catch the benthic macroinvertebrates.
 - b. Vigorously move the vegetation, etc. for several seconds.
 - c. In a scooping action, bring the dip net to the bank and pour its contents into an observation pan.
 - d. Use the forceps to collect benthic macroinvertebrates and put them into another observation pan.
 - e. Using *Handout 7*, identify the collected organisms and enter the number for each species.
2. To collect benthic macroinvertebrates from the substrate, follow the hand-screen procedures; however, only one student needs to hold the dip net to the substrate.

Fish and Benthic Macroinvertebrates

Biological communities (fish and freshwater macroinvertebrates) can be used to determine past and present water quality. You can also tell if the water quality is improving, degrading, or remaining the same by analyzing any changes to this community over time.

Fish and benthic macroinvertebrates are placed into categories based on their tolerance to pollution and are used as indicator organisms in evaluating the health of streams. The three main categories of pollution tolerance are:

- ▶ **Intolerant:** sensitive to poor stream conditions.
- ▶ **Intermediate:** moderately tolerant of degraded habitat and water quality.
- ▶ **Tolerant:** most tolerant of degraded habitat and water quality.

As a general rule for healthy streams, intolerant organisms will be present along with intermediate and tolerant organisms.

Water quality is not always the limiting factor in the presence or absence of aquatic organisms. Physical habitat also plays a key role in whether an organism inhabits a water body. The lack of physical habitat can be just as limiting as poor water quality.

The type and number of organisms present can tell a lot about a stream. If the aquatic community is made up of more intolerant species and a few intermediate and tolerant forms, the stream can be considered healthy. The presence of intolerant and intermediate species generally means that no significant pollution exists. Poor water quality is indicated when the number of tolerant species exceeds that of intermediate species, and intolerant species are absent. The number of individuals of any one species is also an indicator of quality. A good quality stream will have a larger number of species with fewer individuals per species, increased variety, and a balanced system. An unhealthy community includes a few species with numerous individuals, lacks variety, and is unbalanced.