



Water Wonders

Purpose

- To introduce students to hydrology and the study of macroinvertebrates.
- To understand how macroinvertebrates help scientists understand water quality.

Overview

Students will be introduced to different species of macroinvertebrates. They will hypothesize why each insect looks the way it does. Then students will make observations of macroinvertebrates in an aquarium in their classroom. For an optional extension, teachers can take students to a local stream or pond to conduct field observations.

Student Outcomes

After completing this activity, students will have an understanding of what macroinvertebrates are and why scientists study them.

Science Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry

Science Content Standard B: Physical Science

- Properties of objects and materials

Science Content Standard C: Life Science

- The characteristics of organisms
- The life cycles of organisms
- Organisms and their environments

Mathematics Standard: Number and Operations

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems

Mathematics Standard: Measurement

- Apply a variety of techniques, tools, and formulas for determining measurements

Time

- Part 1: One 30-45 minute class period
- Part 2: One 30-45 minute class period, repeated over two weeks
- Part 3: See the "What To Do and How To Do It" section on page 4

Level

Primary (most appropriate for grades K-4)

Materials

Part 1:

- Elementary GLOBE book: *The Discoveries at Willow Creek*
- Overhead transparencies of the *Water Wonders Field Cards*
- Extra photocopies of the *Water Wonders Field Cards*
- Copies of the *Water Wonders Student Activity Sheet 1*

Part 2:

- Tank for an aquarium (including a top)
- Sand
- Water
- Aquatic plants
- Aquatic insects
- Copies of the *Wonders Student Activity Sheet 2*

Part 3 (optional):

- Field trip: see the "What To Do and How To Do It, Part 3" section of this activity for suggested materials and tools



Preparation

- Read the Elementary GLOBE book *Discoveries at Willow Creek* – either read it to the class or have students read it to themselves. The book can be downloaded from www.globe.gov/elementaryglobe.

Part 1:

- Prepare overhead transparencies of illustrations/photographs of several different macroinvertebrates. You can either copy the illustrations provided at the end of this activity (*Water Wonders Field Cards*), or make copies from the following Web sites: www.people.virginia.edu/~7Esos-iwla/Stream-Study/Key/MacroKeyIntro.HTML or www.dec.state.ny.us/website/dow/stream.
- Make extra photocopies of the *Water Wonders Field Cards* for the students to look at on their own.
- Make one copy of the *Water Wonders Student Activity Sheet 1* for each student.

Part 2:

- Create a classroom aquarium with aquatic macroinvertebrates. To set up the aquarium, put about five centimeters of sand in the bottom of a tank. Use water from a pond or stream to fill the aquarium. If you use tap water instead, let it stand for a few days in the aquarium before adding insects. Plant some small aquatic plants or put some algae (green pond scum plants) in the tank. Cover the aquarium with a glass or screen top to keep flying aquatic insects from escaping.
- Add a thermometer to the water of the aquarium. Make sure the temperature graduations on the thermometer are clear enough for young students to read. Students might need assistance reading the thermometer at first.
- Make one copy of the *Water Wonders Student Activity Sheet 2* for each student for each time they will be making observations of the aquarium.
- One supplier of aquatic macroinvertebrates is Carolina Biological Supply (www.carolina.com).

They sell a water insect collection, as well as individual species of aquatic insects. Also, some suppliers sell crustaceans like crayfish, shrimp, etc. and these would be interesting for students to observe as well. (Macroinvertebrates are not just insects, though aquatic insects are the focus of this activity. See the *Teacher's Notes* section for more information.)

- Note: If you decide to collect macroinvertebrates in a stream or pond on your own, make sure you comply with regulations in your local area about plant and animal collections. Some guidelines for this can be found in the *Field Collection of Living Organisms* article on the following Web site: www.carolina.com/tips/95jan/fcolo.asp
- Note: if you have a large enough budget, the ready-made *River Tank Ecosystem* is a great way to set up a classroom aquarium to study macroinvertebrates. For more information about this product, go to www.rivertank.com.
- Note: some of the macroinvertebrates and their larvae may be predaceous (they feed on other insects), so you may have to keep restocking the aquarium. Pollywogs are food for some predaceous insects. Also, a word of warning: when macroinvertebrates are kept happy and healthy, they will morph into adults that live out of the water. Be aware of this when adding black fly or biting midge larvae to your tank!
- For more information about maintaining a classroom aquarium, see the *Project WILD Aquatic K-12 Curriculum & Activity Guide* (www.projectwild.org).

Teacher's Notes

In the Elementary GLOBE book *Discoveries at Willow Creek*, the GLOBE students discuss how they found aquatic insects in the stream when they visited it for the first time. They learn that they can't see any on the second visit because it was too early in the spring and the water levels were too high and the water temperature was too cold. Studying macroinvertebrates is something younger elementary students enjoy and



is a way to introduce them to hydrology concepts, including the idea that macroinvertebrates indicate water quality.

Macroinvertebrates are small animals without a backbone that can be seen without a microscope. They live around living or dead vegetation, on the surface or in the sediments of water bodies. They include many larvae of insects such as mosquitoes, dragonflies and caddis flies that begin their lives in the water before becoming land dwelling insects when they mature. Other examples of common macroinvertebrates include crustaceans (such as crayfish), snails, worms and leeches. Macroinvertebrates can populate ponds or streams in amazing numbers – some of them up to thousands in a square meter. They are an important part of the food chain.

Macroinvertebrates can tell us a lot about the conditions within a water body. Many macroinvertebrates are sensitive to changes in pH, dissolved oxygen, temperature, salinity, transparency and other fluctuations in their habitat. A habitat is a place that includes everything that an animal needs to live and grow. It includes food resources and the physical characteristics of the environment, as well as places and materials to build nests, raise young and keep them safe from predators. Habitats include rocks, sticks, dead and decaying vegetation and other living organisms such as plants.

Macroinvertebrate samples allow us to estimate biodiversity, examine the ecology of the water body and explore relationships among water chemistry measurements and organisms at a stream or pond.

For more information on hydrology and aquatic macroinvertebrates, here are some resources you can use:

- The Hydrology section of the *GLOBE Teacher's Guide* (www.globe.gov)
- *Project WILD Aquatic K-12 Curriculum & Activity Guide* (www.projectwild.org)
- *WOW! The Wonders of Wetlands*, by Environmental Concern, Inc. and The Watercourse (www.projectwet.org)

What To Do and How To Do It

Part 1: Introduction to Macroinvertebrates

1. After reading the Elementary GLOBE book *Discoveries at Willow Creek* with your students, talk to them about the macroinvertebrates mentioned in the book. Gather the students together and tell them that they will be studying macroinvertebrates, or water critters, that live in ponds and streams. Then show them enlarged versions of the *Water Wonders Field Cards*.
2. Tell the students that they will see some of these macroinvertebrates in the classroom aquarium, and that they might also be able to see them in a local stream.
3. As you show the different illustrations to the students, ask them to think about why each critter looks the way it does. Have them look at the critter's shape, presence or absence of gills, number and placement of legs, antennae, tails, etc.
4. Pass out copies of the *Water Wonders Student Activity Sheet 1*. Have the students select a water insect illustration to look at more closely so they can fill out their activity sheet. You might want to pass out extra photocopies of the *Water Wonders Field Cards* for the students to use at this point.

Part 2: Classroom Aquarium

1. Show the students the classroom aquarium. Note that the aquarium may look different to them because it has macroinvertebrates in it instead of fish.
2. Tell the students that they will make observations of the different water insects over the next few weeks. Each time they make observations, they can also record the water temperature in the aquarium.
3. Divide the students into groups of 3-4 students and have them spend some time making observations about the macroinvertebrates in the aquarium. Encourage the students to watch the different critters' behavior. They can use the questions listed



in the box at the end of this section to guide their observations.

4. Have each student fill out the *Water Wonders Student Activity Sheet 2*.
5. Repeat this activity every day, or every few days, for a few weeks so the students can notice changes in the macroinvertebrates' behavior.
6. At the end of this observation period, gather the students for a class discussion. Ask them to share what they learned about the macroinvertebrates and record their responses on chart paper. They can use the *Water Wonders Student Activity Sheet 1* they filled out at the beginning of this lesson to help them make conclusions about what they have learned.
7. See the "Adaptations for Younger and Older Students" section of this activity for ideas of water quality activities you can do with the aquarium.

Questions to ask when observing the aquatic insects:

1. How does the insect move?
2. What shape is it?
3. What color is it?
4. What does the insect eat?
5. Does anything prey upon it?
6. Is it a larva, or an adult?

Part 3: Optional Field Trip

Note: if there is an accessible stream or pond near your school, it is a wonderful experience to take students to the stream/pond to investigate macroinvertebrates in the wild. You can combine this trip with other hydrology investigations. Below are some ideas of what to do with your students at the stream/pond.

1. Remind your students about safety issues before visiting the stream/pond.
2. Some supplies you should bring to the field site: dip nets, plastic containers for holding water and collected organisms, magnifying lenses, rulers, journals, pencils, towels, paper towels, field guides, and laminated sheets with information on

macroinvertebrates.

3. When you arrive at the stream/pond, have the students first use their senses; they can listen, see, smell, and touch the stream environment and then record these observations in their journals.
4. Next, with adult assistance, have students wade in the stream safely and collect macroinvertebrates using a net. Then sort and identify the indicator species using a pictorial identification key. For more information on indicator species, see the "Further Investigations" section of this activity on page 5.
5. Point out unique characteristics of each species, including their shape, size, movement, and behavior.
6. If it fits in with your students' ability level, perform tests on the pond or stream water. Some things you can test are: dissolved oxygen, nitrates, water pH, water temperature, and stream flow.
7. After the field trip, have the students write a sentence and/or draw a picture about what they saw, smelled, heard, or felt on their trip.
8. For more information on studying macroinvertebrates in streams and ponds, see the GLOBE Freshwater Macroinvertebrates Protocol in the *GLOBE Teacher's Guide* (www.globe.gov).

Adaptations for Younger and Older Students

For younger students: Have each student select a macroinvertebrate and write several descriptive sentences about the characteristics of this "water critter." Some students will need to have an adult help them with this. The students can also draw the macroinvertebrates. Have each student share his or her information with the class.

Older students can conduct various tests on the water in the aquarium, including testing the water pH, dissolved oxygen levels, nutrient levels, etc. Younger students can pair up with middle or secondary school students who are studying hydrology to learn more about water quality tests.



Older students can use a Macroinvertebrate Dichotomous Key to identify unknown macroinvertebrates. The following Web site has a key you can use: www.dec.state.ny.us/website/dow/stream/. You can also find other keys on the World Wide Web or at your local library. Also, have older students look at macroinvertebrates under a microscope to learn more about their anatomy.

- **Hydrology Investigations:** Based on your students' knowledge and ability levels, conduct the different Hydrology Protocols with your students. See the *GLOBE Teacher's Guide* for more information (www.globe.gov).

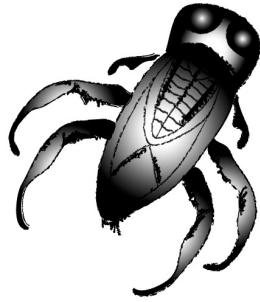
Further Investigations

- **Life Stories of Macroinvertebrates:** Have the students each select a specific macroinvertebrate that they have observed. Based on what they learned about this insect in class, have the students write a story about the life of this organism. If possible, the students can do additional research for their stories.
- **Water Quality Studies:** Explain to the students that macroinvertebrates are what scientists call an indicator species. This means that certain macroinvertebrates can tolerate higher levels of pollutants in the water, while others cannot tolerate pollutants at all. Learn which critters are pollution tolerant, somewhat tolerant, or pollution sensitive. Based on the critters you find in a stream or pond, you can determine if the water quality is good or not; this helps students understand how sampling aquatic macroinvertebrates helps determine whether the water is clean and safe. The following web site provides information: www.epa.gov/bioindicators/html/benthosclean.html.
- **Community History:** Have the students talk to older members of the community who have lived there all their lives. They can talk to family members, residents at a senior center, etc. After asking the community members to describe what the local streams and ponds were like when they were young, the students can learn how the stream/pond has changed over the years.
- **Water Walk Learning Activity:** This activity can be found in the Hydrology chapter of the *GLOBE Teacher's Guide* (www.globe.gov).



Water Wonders Field Cards 1

Water Boatman



2.5cm long
Oval, brown insect
Short front legs
Long, flattened hind legs that help with swimming
Lives in ponds or in still pools of streams
Feeds on algae or decaying plants

Whirligig Beetle



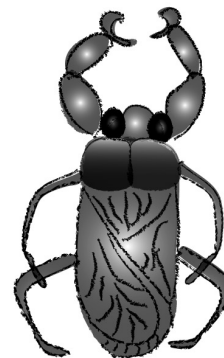
3-15mm long
Oval, black beetle
Lives on the surface of calm water
Long front legs catch food
Four shorter hind legs help it swim
Eats mostly mosquitoes

Diving Beetle Larva



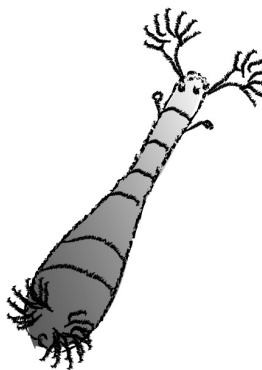
Up to 6 cm long
Hangs below water surface while breathing
Lives in ponds and calm water
Has strong jaws
Attacks prey larger than itself

Giant Water Bug (Adult)



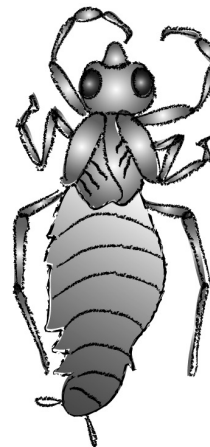
Up to 7cm long
Large, brown, oval insect
Lives in streams and ponds
Uses its front legs like claws to grab its prey
Eats small fishes and tadpoles

Black Fly Larva



Less than 1 cm long
Attach to river rocks. Many together look like a little black carpet
Moves like an inchworm
Lives in cold streams
Has tiny gills by the head that filter food from the water

Dragonfly Nymph

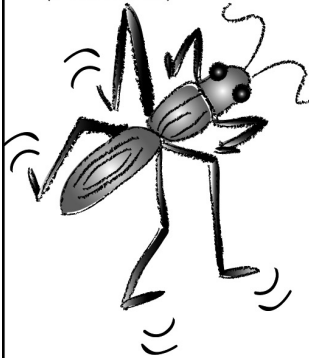


Up to 5 cm long
Golden brown with large eyes and a large, scoop-like lower lip
Lives in cool still water
Eats water insects and small fish



Water Wonders Field Cards 2

Water Strider (Adult)



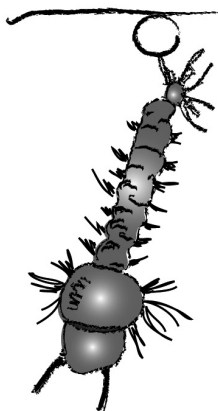
2cm long
 Thin, dark blue or brown insect
 "Skates" along the surface of the water
 Lives in ponds or in still pools of streams
 Eats larvae and insects that live or fall on the surface of the water

Mayfly Nymph



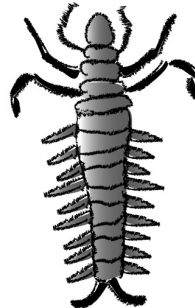
Up to 2 cm long
 Has three long tails, a single claw on each leg, and short antennae
 Lives underwater in streams and ponds
 Eats plants

Mosquito Larva



Up to 8mm long
 In a cocoon that covers half the body
 Called "wigglers" because they squirm below the water surface
 Lives in cool or warm stagnant water
 Eats microorganisms

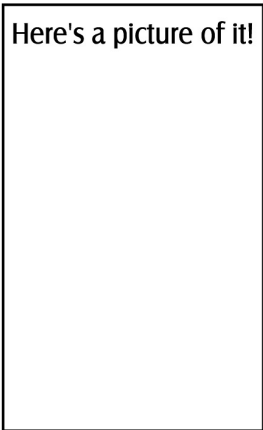
Caddisfly Larva



Up to 4 cm long
 Has a soft body
 One or two claws or hooks near the abdomen
 Six segmented legs on middle of the body
 Often hiding inside a little house of twigs or sand
 Eats plants and small insects

I found a _____

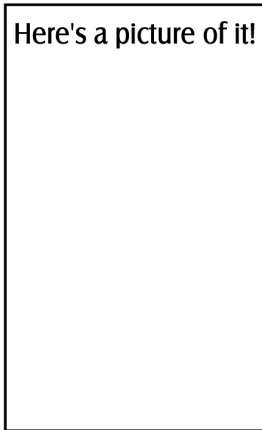
Here's a picture of it!



This is what it is like:

I found a _____

Here's a picture of it!



This is what it is like:



NAME: _____

Water Wonders Student Activity Sheet 1

My First Macroinvertebrate

It's name is _____

Here's a drawing of what it looks like.

This is where I think it lives. _____

This is how I think it moves _____



NAME: _____

Water Wonders Student Activity Sheet 2

What I'm Watching in the Water

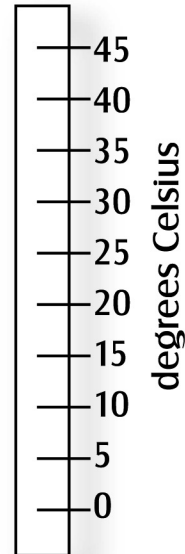
This is what I observed in the aquarium today.

The date is _____.



Draw what you see.

Water temperature
(Fill the thermometer.)



Write about what you see. _____
