
Environmental Scientist

Overview:

This lesson and activity are designed to give students hands-on experience collecting, identifying and evaluating the quality of water based on macroinvertebrate specimens.

Grade: 5

TEKS

Scientific processes

5.2(B, C, E)

5.4 (A)

Science Concept

5.5 (A)

Math

5.14(B)

Literature

Peach and Blue

A Million Fish More Or

Less

Vocabulary

Macroinvertebrate

Benthic

Materials

Discovery Book

Thermometer

Field Guides

Fish Net

Meter Stick

Plastic Peanut Butter Jars

Hand Lens

Macroinvertebrates Count Too

Classroom Activity

1. Prior to using this lesson collect live macroinvertebrates from a creek, pond or lake. The use of live macroinvertebrates with this activity will increase your students' attention and engagement. *Instead of using live specimens make copies of the "Macroinvertebrates" page and cut out each aquatic bug.*
2. A fish net with a long handle makes a great macroinvertebrate collection tool. Use a net with small (<1/4 inch) holes. Locate aquatic vegetation and or an accumulation of leaves on the bottom of your water source. Take the net and sweep through the vegetation. Continue sweeping until you have an accumulation of aquatic plants or leaves in the net. Pour the contents of the net into a container filled with water.
3. Remove macroinvertebrates from the vegetation. Usually, a gentle swish of the vegetation in the water will remove most critters. Continue this process until you have approximately 100 macroinvertebrates.
4. A plastic peanut butter jar makes an excellent container for your macroinvertebrates. Divide your collection of aquatic bugs equally into 4 or 5 jars. For a permanent class collection substitute rubbing alcohol for the water.

5. In the classroom, write the word "Macroinvertebrate" on the overhead and ask your students to make a concept map about macroinvertebrates. Collect concept maps and file for documentation and evaluation of student achievement.
6. The students are to determine the quality of water based on the macroinvertebrate collected. Aquatic Scientists call this method of water evaluation Rapid Bio-Assessment (RBA). A RBA is a very accurate and inexpensive method of determining the quality of water. Plus, macroinvertebrates are invertebrates large enough to see without the aid of a microscope. Divide your class into 4 or 5 groups.
8. If using the "paper" method, make several copies of the macroinvertebrate page and cut into individual macroinvertebrates. Put all the paper macroinvertebrates in a container and mix. Give each group a container filled with paper macroinvertebrates and a copy of the "Macroinvertebrate Identification" page.
9. Tell your students they are Aquatic Scientists and their job is to determine the quality of water based on their macroinvertebrate sample. Give each group a blank transparency to create their bar graph and pie charts.
10. Have your students complete the following tasks.
 - Identify and count all macroinvertebrates
 - Create a bar graph representing the identification and abundance of macroinvertebrate.
 - Write each macroinvertebrate as a fraction and convert into a percentage.
 - Produce a pie chart that represents all macroinvertebrates in sample.
 - Complete the "Macroinvertebrate Count" and determine the quality of the water.
11. Each group presents and defends their scientific conclusions. Each member of the group presents one of the sections listed above. Encourage the rest of your class to ask "general" and "specific" questions of each group's data.
12. Explain to your students they will soon apply their knowledge of macroinvertebrates in the field at the Eastman Nature and Wildlife Habitat Center. As young aquatic scientists they will have to follow a scientific process.
 - Question (Is the water in _____ creek polluted?)
 - Gather Information (Observations and collecting macroinvertebrates.)
 - Hypothesis (Make an educated guess about the question.)
 - Results (Specifically, what were the results of your field work?)
 - Conclusion (Answer the original question with specific details.)
13. Close the activity by reading *A Million Fish more or Less*. Discuss with students the importance of macroinvertebrates and their role in the food web.

In the Field

Macroinvertebrates Count Too

1. Prior to leaving your school make sure you have the following items.
 - Discovery Books
 - Ziploc Baggies (1 gallon size)
 - Pencils (inexpensive mechanical pencils are excellent)
 - Thermometer
 - Drinking Water
 - First Aid Kit
 - Sack Lunch or light snack
 - Camera
 - Backpack
 - Fish Nets
 - Hand Lens
 - 5 gallon bucket bottoms or egg cartons
2. Before getting on the trail, remind students their observations/data will be used back in the classroom to create charts and graphs.
3. Set your behavior expectations before leaving the parking lot. Explain how students are to behave along the trail and in small groups. State specifically what behaviors you want to see along the trail and working in the creek.
4. Distribute Discovery Books to students and record weather data observations. Teachers a gallon size ziploc baggie make an excellent container for pencils and Discovery Books during lunch or at the end of the day. They also make great containers for viewing live macroinvertebrates.
5. Walk through the gate and follow the trail. Remember to go slow and listen to your student's observations along the trail. As you approach the creek remind your students to go slow and watch for wildlife.
6. If you have enough adult supervision, divide your class into two or three groups. Have each group survey a different section of the creek. This will help reduce the noise level and also give your students an opportunity to share their observations/discoveries when the class

comes together at the end of the day. This is a good opportunity reinforce the idea that scientists share data too.








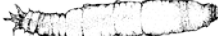





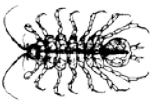
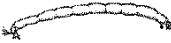




7. At the creek, begin by making your observations and taking measurements. Record the data in your "Discovery Book". Once all general observations are complete, then your students can move into the macroinvertebrate collection phase of the activity.
8. Macroinvertebrates are usually found in the organic matter along the bottom of the creek. A log, leaves, sticks, and in the substrate are usually good places to look for macroinvertebrates. Also, look under rocks in the creek too. Use a fish net to collect the organic material from the bottom of the creek. Pour the contents of the net on the ground. Spread the contents on the ground and wait a few seconds for the macroinvertebrates to start moving. A small stick makes an excellent "tool" for picking up the delicate aquatic bugs.
9. Fill your plastic peanut butter jar with some of the creek's water and place each macroinvertebrate in the peanut butter jar. Students really enjoy this part of the activity, but usually they tend to rush the process. Encourage your students to slow down and look thoroughly through the organic material. Many of the aquatic invertebrates, especially the mayflies, tend to hide on leaves and sticks and are easy to overlook.
10. For an excellent container, cut the bottom (approximately 2 or 3 inches from the bottom) off a 5 gallon white plastic bucket. Pour about an inch of water in the container and add the macroinvertebrates. The container is large enough and the white background makes an excellent container for viewing your macroinvertebrates. Another option is to use egg cartons. Egg carton's compartments are a good way to sort the different orders of aquatic bugs.
11. Complete the activities in the Discovery Book. The activity pages are designed to record basic aquatic data. Wait until you get in the classroom to do any real number crunching. The main idea in the field is to collect, identify and count the macroinvertebrates. Too much "classroom" type work in the field will spoil the outdoor experience.

Post Eastman Activities

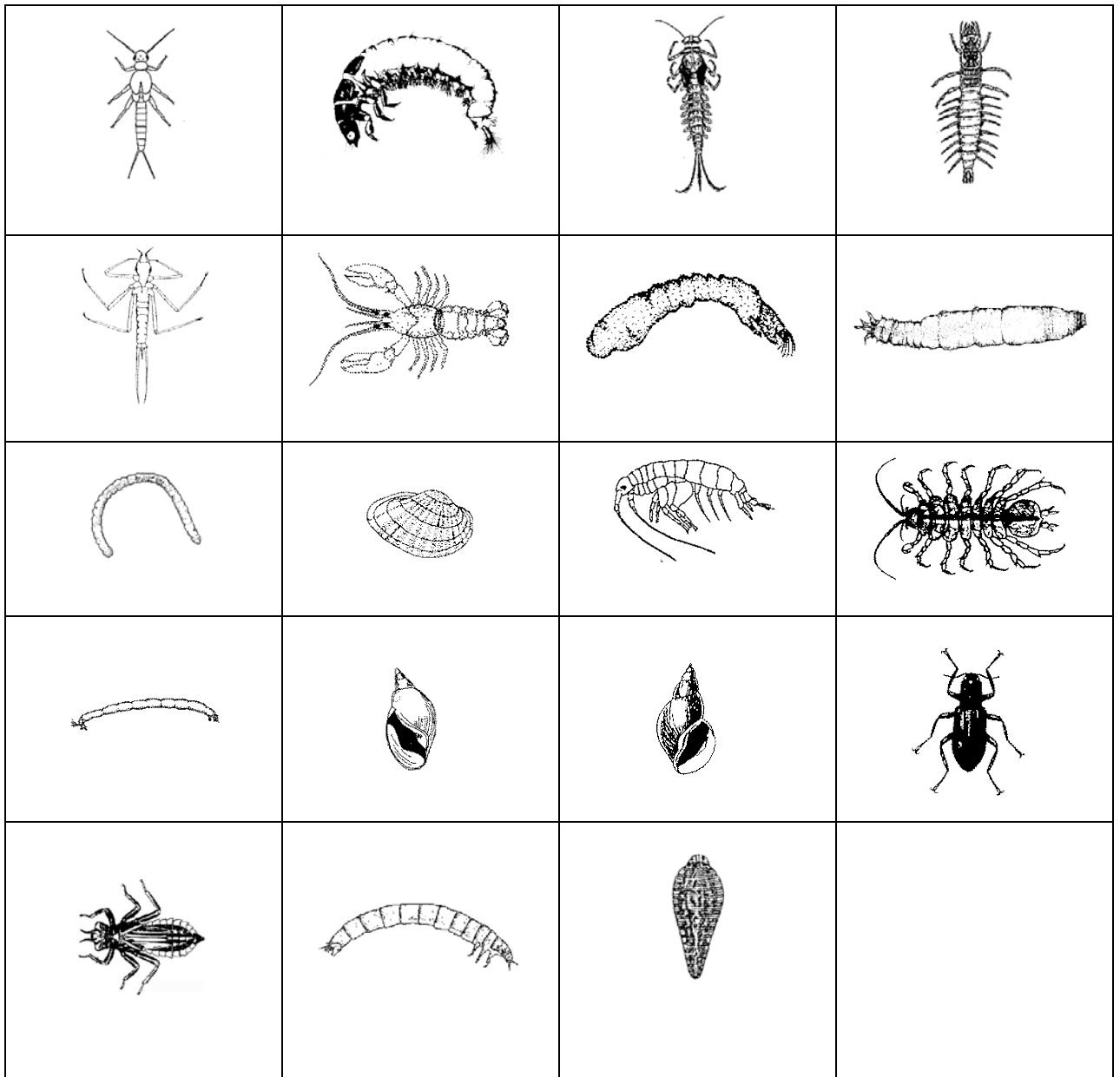
Macroinvertebrates Count Too

- Write the word "Macroinvertebrate" on the overhead and have your students produce another concept map.
- Write each macroinvertebrate collected in the field as a fraction and convert into a percentage.
- Produce a pie chart that represents all macroinvertebrates in sample.
- Complete the "Macroinvertebrate Count" and determine the quality of the water.
- Create a bar graph representing the identification and abundance of macroinvertebrate.
- Write a narrative about their experiences looking for macroinvertebrates.
- Using the computer, have your students create charts and graphs of the data they collected while at the Eastman Nature and Wildlife Habitat Center.
- Have your students write a narrative about their experience at the Eastman Nature and Wildlife Habitat Center.
- Contact your local Texas Commission on Environmental Quality (TECQ) (formerly the Texas Natural Resource Conservation Commission or TNRCC) office and invite an Aquatic Biologist to visit your classroom to discuss biological assessment procedures.
- Students create an "Environmental Report" based on their Discovery Book observations.
- Write a Haiku about "Life in a Creek."
- Conduct a biological survey of a creek near your school and compare the data to the Eastman creek.
- Research and report on the life cycle of a macroinvertebrate.

Macroinvertebrate Key

Very Sensitive to Pollution			
 Stonefly	 Caddisfly	 Mayfly	 Dobsonfly
 Adult Riffle Beetle	 Gilled Snail		
Somewhat Sensitive to Pollution			
 Damselfly	 Cranefly Larva	 Riffle Beetle Larva	 Clam
 Crayfish	 Dragonfly	 Scud	 Sowbug
Tolerant of Pollution			
 Midge	 Lunged Snail	 Blackfly Larva	 Aquatic Worm
 Leech			

Macroinvertebrates



Macroinvertebrate Count

Sensitive	Somewhat Sensitive	Tolerant
<input type="checkbox"/> Caddisfly Larva	<input type="checkbox"/> Beetle Larva	<input type="checkbox"/> Aquatic Worms
<input type="checkbox"/> Dobsonfly	<input type="checkbox"/> Clams	<input type="checkbox"/> Blackfly Larva
<input type="checkbox"/> Mayfly	<input type="checkbox"/> Crane-fly Larva	<input type="checkbox"/> Leech
<input type="checkbox"/> Stonefly	<input type="checkbox"/> Crayfish	<input type="checkbox"/> Midge Larva
<input type="checkbox"/> Riffle Beetle (Adult)	<input type="checkbox"/> Damselfly	<input type="checkbox"/> Lunged Snails
<input type="checkbox"/> Gilled Snails	<input type="checkbox"/> Dragonfly	
	<input type="checkbox"/> Scud	
	<input type="checkbox"/> Sowbugs	
Number of boxes checked times 3 = _____ index value.	Number of boxes checked times 2 = _____ index value.	Number of boxes checked times 1 = _____ index value.

Add the index value for each column together. Total Index Value = _____

<p>Water Quality</p> <p><input type="checkbox"/> Excellent (>22)</p> <p><input type="checkbox"/> Good (17-22)</p> <p><input type="checkbox"/> Fair (11-16)</p> <p><input type="checkbox"/> Poor (<11)</p>	<p>The quality of my water is</p> <p>_____.</p>
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Resources

Publications

Peach and Blue by Sarah Kilborne

A Million Fish More Or Less by Patricia McKissick. New York: Alfred A. Knopf, 1992.

Sunship Earth by Steve Van Matre

Teaching in the Outdoors by Hammerman

Field Guide for the Eastman Nature Trail by Eric L. Taylor, Ph.D.

A Guide to Freshwater Ecology, Texas Natural Resource Conservation Commission, 1993.

Save Our Streams, The Izaak Walton League of America, 1401 Wilson Blvd., Level B, Arlington, VA 22209.

Wet Instruction Handbook, Texas Natural Resource Conservation Commission, 1990.

Aquatic Entomology by W. P. McCafferty Jones and Bartlett Publishers, Inc., 1983.

Web Pages

Macroinvertebrate Key

<http://www.people.virginia.edu/~sos-iwla/Stream-Study/Key/MacroKeyIntro.HTML>

Water Resource Monitoring

<http://www.state.ky.us/nrepc/water/waterres.htm>

Surf Your Watershed

<http://cfpub.epa.gov/surf/locate/index.cfm>

The Global Water Sampling Project

<http://www.k12science.org/curriculum/waterproj/>

The Volunteer Monitor

http://www.epa.gov/owow/volunteer/vm_index.html

The Stream Study

<http://www.people.virginia.edu/~sos-iwla/Stream-Study/StreamStudyHomePage/StreamStudy.HTML>

The Water's Edge Scientific LLC

<http://www.watersci.com/>

Sabine River Study

<http://www.ansp.org/research/pcer/projects/sabine/index.php>

Society for Fresh Water Science

<http://www.freshwater-science.org/>