Mighty Macroinvertebrates

Based on "Benthic Bugs and Bio assessment", from Healthy Water, Healthy People

Albuquerque Bernalillo County Water Utility Authority

"The most direct and effective measure of the integrity of a body of water is the status of its living systems." Karr

Summary: Students will sample water for macroinvertebrates (represented by beads of various colors) to determine the relative quality of water at different locations by conducting a simulated bio assessment.

Grade: Seven

Subject Areas: Science, Math

Common Core

Mathematics (4) Students will draw inferences about populations based on samples.

Reading (3) Students will follow precisely a multistep procedure when carrying out experiments

Next Gen Science Standards

LS2.A: Interdependent Relationships in Ecosystems…students will understand that ecosystems are ever changing because of the interdependence of organisms and the nonliving elements of the environment.

LS2.C: Ecosystem Dynamics, Functioning, and Resilience…Disruptions to any biological or physical component of an ecosystem can lead to shifts in all of its populations.

LS2.C: Biodiversity describes the variety of species found in Earth's ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.

NM Science Standards

I.I.5-8 Benchmark I: Use scientific methods to…conduct experiments, analyze and evaluate results, and communicate findings

I.II.5-8 Benchmark II: Understand the process of scientific investigation and how scientific inquiry results in scientific knowledge

II.II.5-8 Benchmark I: Explain the diverse structures and functions of living things and the complex relationships between living things and their environments

II.II.5-8 Benchmark II: Explain the effect of mankind's use of energy and other activities on living systems (e.g. water quality) their environments.

Objectives: Students will

- Learn the important role that aquatic macroinvertebrates play in determining water quality.
- Simulate the process of a bioassessment of macroinvertebrates.
- Collect, sort, classify, identify, analyze, and evaluate a sample of materials representing aquatic macroinvertebrates.
- Determine a river's water quality using a pollution tolerance index based on a sample of macroinvertebrates.
- Compare the differences between the relative water qualities of different samples.

Supplies:

- Large, laminated poster showing some of the more common macroinvertebrates found in the Rio Grande
- 3 each of 3 different student kits (9 total) representing 3 different sample locations -to include a plastic tub, an ice cube tray for sorting, beads precounted in a ziploc bag, and a net scoop
- Laminated copy of "Macroinvertebrate Identification Chart"
- Copy of two sided student worksheet, "Data Sheet" and "Pollution Tolerance Index" - one per student

Introduction – 10 minutes

1. Ask: Where does our drinking water come from in Albuquerque? Discuss how we rely on water from both the aquifer and the Rio Grande to meet our needs. Therefore, the health of the Rio Grande is important to the citizens of Albuquerque who drink this water.

2. Explain: How do scientists determine the relative health of a river? One way is to perform a bioassessment in which they take samples of macroinvertebrates from different locations along the river. Define "Bioassessment" (the process of evaluating the biological condition of a body of water using biological surveys) and "Aquatic Macroinvertebrates" (animals without backbones that live in aquatic environments that are large enough to be seen without a microscope) on the board. Explain that this is what they will be doing today. Show poster with large, colorful photographs of a few of the most commonly found macroinvertebrates in the Rio Grande.

3. Pass Out "Laminated Macroinvertebrate Charts". Explain that each macroinvertebrate will be represented by a bead of a different color, as outlined in the chart. Explain that healthy water systems typically contain mainly macroinvertebrates that are intolerant of environmental stressors (pollution, warm temperatures due to low flow, low dissolved oxygen due to algal blooms…), like mayflies, stoneflies, and caddisflies. A body of water that has undergone environmental stress would contain more organisms that are tolerant of these conditions like leeches, tubifex worms, or pouch snails. Elicit from students: What are some possible environmental stressors that may affect the health of an aquatic habitat?

Activity – 30 minutes

1. Divide students into six to nine groups at six to nine stations, depending on class size (three sets each of stream samples 1, 2, 3), each containing a plastic tub, bag of beads representing macroinvertebrates according to chart below, ice cube tray for sorting, and a net to use as a scoop. Pass out a worksheet for each student. (Or have one student act as the recorder, in which case only one data sheet would be necessary per group).

2. Explain to students that they will collect samples of the macroinvertebrates in their "stream" using the small net scoop. Each student will collect one sample/ scoop. Specify that they should each sample from different places in the river, and that to collect a sample, they will scoop straight down and up (rather than dragging the net back and forth along the entire length of the river.)

3. After the samples have been collected, have them sort and count the different colors of beads using the ice cube trays.

4. Record the number of each type of macroinvertebrate on the Data sheet and tabulate the percent composition of each (Number of organisms in each group /Total number of organisms x 100).

5. Use the data to complete the Pollution Tolerance Index and determine their water quality assessment score.

6. Have students answer questions about the water quality of their river sample and discuss answers.

Macroinvertebrate	Represented by:	River Sample 1	River Sample 2	River Sample 3	Total Items
Mayflies	Yellow beads	35	15	0	50 beads
Stoneflies	Purple beads	65	35	0	100 beads
Dobsonflies	Orange beads	30	20	0	50 beads
Caddisflies	Pink beads	30	20	0	50 beads
Craneflies	White beads	25	13	12	50 beads
Dragonflies	Green beads	20	20	10	50 beads
Scuds	Brown beads	5	15	30	50 beads
Midges	Blue beads	0	20	30	50 beads
Leeches	Black beads	0	15	35	50 beads
Pouch Snails	Turquoise	0	15	35	50 beads
Tubifex Worms	Red beads	0	15	35	50 beads

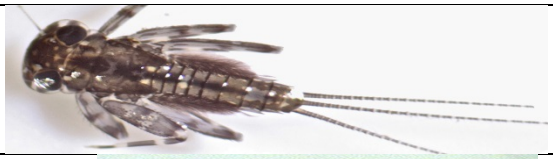
Time permitting –

Have students rotate to another station and repeat the bioassessment procedure, then compare the water quality of the two rivers.

Wrap Up – 5 minutes

Discussion: Now that we know the quality of water in the Rio Grande is important/ directly affects us here in Albuquerque, what can we do to help protect our river/ keep it clean? Discuss things students can do such as clean up dog poop, don't pour chemicals or medicine down the sink, don't litter because trash can get washed down storm drains, etc.

Macroinvertebrate Identification Chart

Macroinvertebrate	Looks Like…
Mayflies (Order Ephemeroptera) Yellow beads	
Stoneflies (Order Plecoptera) Purple beads	
Caddisflies (Order Trichoptera) Pink beads	
Dobsonflies (Order Megaloptera) Orange beads	
Midges (Order Chrinomidae) Blue beads	
Craneflies (Order Diptera) White beads	
Dragonflies (Order Odonata) Green beads	
Scuds (Order Amphipoda) Brown beads	
Pouch Snails (Class Gastropods) Turquoise beads	
Tubifex Worms (Class Oligochaeta) Red Beads	
Leeches (Class Hirudinea) Black beads	

Name:_____

Stream #:_____

Macroinvertebrate Data Sheet

Sort and tabulate the number of organisms for each of the major groups listed below. Then calculate their percent composition. This measure yields the relative abundance of the macroinvertebrates in your sample.

Percent Compostion = Number of Organisms in Each Group x 100

Total Number of Organisms

Macroinvertebrates	**Number of Organisms in Each Group**	**Percent Composition**
Mayflies (Order Ephemeroptera) Yellow Beads		
Stoneflies (Order Plecoptera) Purple Beads		
Caddisflies (Order Trichoptera) Pink Beads		
Dobsonflies (Order Megaloptera) Orange Beads		
Midges (Order Chironomidae) Blue Beads		
Craneflies (Order Diptera) White Beads		
Dragonflies (Order Odonata) Green Beads		
Scuds (Order Aphipoda) Brown Beads		
Pouch Snails (Class Gastropoda) Turqouise Beads		
Tubifex Worms(Class Oligochaeta) Red Beads		
Leeches (Class Hirudinea) Black Beads		
Total Number of Organisms		

If the macroinvertebrates on the top of the list are most sensitive to environmental stressors, and those on the bottom are least sensitive, what can you predict about the water quality of your river?

Pollution Tolerance Index

1. Place a check next to each macroinvertebrate group present in your sample.

2. Complete the chart for all of the macroinvertebrate groups.

3. Calculate the group scores using the multipliers divided.

4. Total all of the group scores for your total score.

5. Compare your total score with the water quality assessment chart scores and record the relative water quality rating for your river sample.

Group 1 Macroinvertebrates Very Intolerant	Group 2 Macroinvertebrates Intolerant	Group 3 Macroinvertebrates Tolerant	Group 4 Macroinvertebrates Very Tolerant
____ Stoneflies ____ Mayflies ____ Caddisflies ____ Dobsonflies ____ Dragonflies	____ Dragonflies ____ Scuds ____ Craneflies	____ Midges ____ Leeches	____ Pouch Snails ____ Tubifex Worms
# of checks =____ x4 Group Score = _____	# of checks = ____x3 Group Score - _____	# of checks = ____x2 Group Score = _____	# of checks = ____x1 Group Score = _____
Total Score = _____ Your Water Quality Assessment:		Water Quality Assessment Chart: ≥23 Potentially Excellent Water Quality 17-22 Good Water Quality 11-16 Fair Water Quality ≤10 Potential Poor Water Quality	

Answer the following questions as a group:

1. Based on the macroinvertebrates found in your sample, what would you conclude about the relative quality of the water in your river?

2. What are some environmental stressors that might negatively impact the quality of water in a river?

3. What can we do to protect the Rio Grande and prevent pollution?