A Bugs Life
Judging Water Quality Based on Macroinvertebrates

There is a whole world of life in rivers and lakes. Some of the tiny animals living in the water are *benthic*, meaning they live in the bottom of the body of water. Some are called *macroinvertebrates* because they are large and have no backbone. The most common of macroinvertebrates include insects, clams, snails, crayfish, and worms. Some live their whole lives in the water, others leave the water as adults to feed and reproduce.

Macroinvertebrates are important as food to all the creatures living in the water. Some are considered by scientists to be *indicator species* and are a way of telling whether or not a river or lake is polluted. In rivers, macroinvertebrates live attached to rocks and plants where there is fast flowing water. They are good indicators of water quality because they do not move around and are easy to collect. The moving water gives them food and oxygen. If the water is polluted, there is less food and oxygen for the aquatic macroinvertebrates. Some types of macroinvertebrates are harmed and even killed by the presence of pollutants in the water. Those that are killed by the pollutants are said to be pollution sensitive. Those that can survive in polluted water are said to be pollution tolerant. If the water contains *pollution sensitive* macroinvertebrates in it, then it is a good indication that the water is clean enough and of high enough quality for these sensitive individuals to survive. If there are mostly *pollution tolerant* macroinvertebrates, in the water this may indicate that the water is polluted because those types of species are able to survive the water conditions.

Water pollution can occur in two different ways, as point source pollution and as non-point source pollution. *Point source pollution* occurs at a specific place such as a leaky barrel of pesticide or a pipe discharging sewage. *Nonpoint source pollution* occurs over a large area and its cause cannot be pin pointed to a specific or easily identified place. Pollution such as runoff from a parking or pesticides on a lawn washed into a sewer system would be considered nonpoint source pollution. The severity of both point source and nonpoint pollution can be judged by determining the types of macroinvertebrates that are found in the body of water.

PURPOSE
In this activity you will explore how macroinvertebrates are used to determine the quality of water in lakes, streams, creeks, and any body of freshwater.

MATERIALS
    Map of Aquaville with sites identified
    7 pre-prepared bags containing organisms plates

PROCEDURE

In this activity your team of water quality specialists has been chosen by Mayor Sam "Pops" Waterson to analyze macroinvertebrate specimens taken from the James River in the nearby town of Aquaville. Seven different sites have been chosen and specimens were collected from each site. Using the "specimens" provided, the map of the James River and the town of Aquaville, and the Bug Picking data sheet attached, determine the water quality of the James River at your specific area.

1. Obtain the first sample bag from your teacher.

2. Organize the macroorganisms according to species.

3. Use the provided identification sheets to identify each species and count the number of each organism present at your site.

4. Record your site data on the appropriate data sheet provided in your student answer pages.

5. Calculate the water quality of the site by multiplying the number of species found by the species value, as given on your organism ID sheets.

6. When your teacher indicates that time is up, rotate your packet to the next group.

7. After collecting data for all seven sites, record your results on the James River data table and answer the conclusion questions.

Map of Aquaville
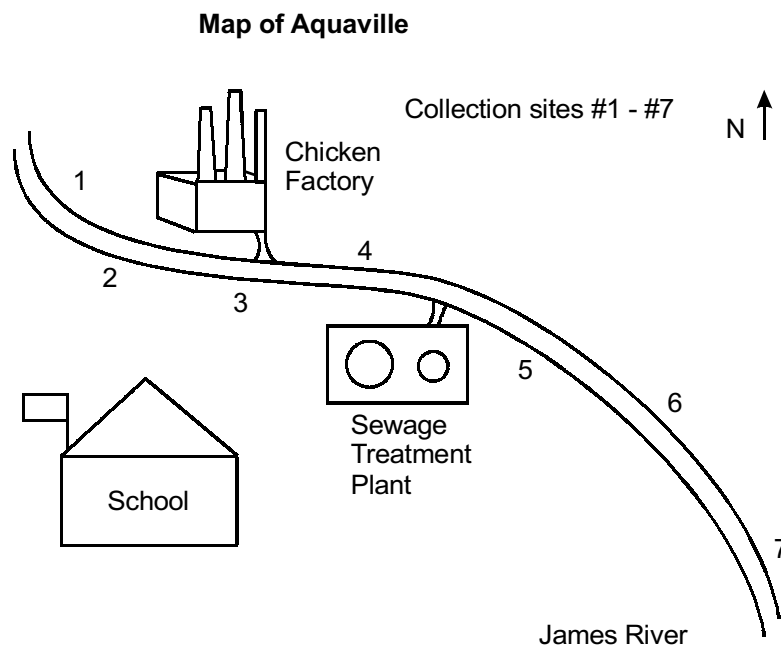
Name _____

Period _____

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ANALYSIS

Site 1 Data Sheet

Sensitive	Somewhat Sensitive	Tolerant
___ **caddisfly larvae**	___ **beetle larvae**	___ **aquatic worms**
___ **hellgrammite**	___ **clams**	___ **blackfly larvae**
___ **mayfly larvae**	___ **crane fly larvae**	___ **leeches**
___ **gilled snails**	___ **crayfish**	___ **midge fly larvae**
___ **riffle beetle adult**	___ **damselfly larvae**	___ **lunged snails**
___ **Stonefly larvae**	___ **dragonfly larvae**	
___ **water penny larvae**	___ **scuds**	
	___ **sowbugs**	
	___ **fishfly larvae**	
	___ **alderfly larvae**	
	___ **watersnipe larvae**	
	___ **whirligig beetle larvae**	
Boxes checked x 3 = _____ index value	Boxes checked x 2 = _____ index value	Boxes checked x 1 = _____ index value
TOTAL INDEX VALUE (SUM OF ALL CATAGORIES) _____	**Excellent (>22)** **X Good (17-22)**	**Fair (11-16)** **Poor (<11)**

Site 2 Data Sheet

Sensitive	Somewhat Sensitive	Tolerant
___ caddisfly larvae	___ beetle larvae	___ aquatic worms
___ hellgrammite	___ clams	___ blackfly larvae
___ mayfly larvae	___ crane fly larvae	___ leeches
___ gilled snails	___ crayfish	___ midge fly larvae
___ riffle beetle adult	___ damselfly larvae	___ lunged snails
___ Stonefly larvae	___ dragonfly larvae	
___ water penny larvae	___ scuds	
	___ sowbugs	
	___ fishfly larvae	
	___ alderfly larvae	
	___ watersnipe larvae	
	___ whirligig beetle larvae	
Boxes checked x 3 = _____ index value	Boxes checked x 2 = _____ index value	Boxes checked x 1 = _____ index value
TOTAL INDEX VALUE (SUM OF ALL CATAGORIES) _____	**Excellent (>22)** **X Good (17-22)**	**Fair (11-16)** **Poor (<11)**

Site 3 Data Sheet

Sensitive	Somewhat Sensitive	Tolerant
___ **caddisfly larvae**	___ **beetle larvae**	___ **aquatic worms**
___ **hellgrammite**	___ **clams**	___ **blackfly larvae**
___ **mayfly larvae**	___ **crane fly larvae**	___ **leeches**
___ **gilled snails**	___ **crayfish**	___ **midge fly larvae**
___ **riffle beetle adult**	___ **damselfly larvae**	___ **lunged snails**
___ **Stonefly larvae**	___ **dragonfly larvae**	
___ **water penny larvae**	___ **scuds**	
	___ **sowbugs**	
	___ **fishfly larvae**	
	___ **alderfly larvae**	
	___ **watersnipe larvae**	
	___ **whirligig beetle larvae**	
Boxes checked x 3 = _____ index value	Boxes checked x 2 = _____ index value	Boxes checked x 1 = _____ index value
TOTAL INDEX VALUE (SUM OF ALL CATAGORIES) _____	**Excellent (>22)** **X Good (17-22)**	**Fair (11-16)** **Poor (<11)**

Site 4 Data Sheet

Sensitive	Somewhat Sensitive	Tolerant
___ **caddisfly larvae**	___ **beetle larvae**	___ **aquatic worms**
___ **hellgrammite**	___ **clams**	___ **blackfly larvae**
___ **mayfly larvae**	___ **crane fly larvae**	___ **leeches**
___ **gilled snails**	___ **crayfish**	___ **midge fly larvae**
___ **riffle beetle adult**	___ **damselfly larvae**	___ **lunged snails**
___ **Stonefly larvae**	___ **dragonfly larvae**	
___ **water penny larvae**	___ **scuds**	
	___ **sowbugs**	
	___ **fishfly larvae**	
	___ **alderfly larvae**	
	___ **watersnipe larvae**	
	___ **whirligig beetle larvae**	
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TOTAL INDEX VALUE (SUM OF ALL CATAGORIES) _____	**Excellent (>22)** **X Good (17-22)**	**Fair (11-16)** **Poor (<11)**

Site 5 Data Sheet

Sensitive	Somewhat Sensitive	Tolerant
___ **caddisfly larvae**	___ **beetle larvae**	___ **aquatic worms**
___ **hellgrammite**	___ **clams**	___ **blackfly larvae**
___ **mayfly larvae**	___ **crane fly larvae**	___ **leeches**
___ **gilled snails**	___ **crayfish**	___ **midge fly larvae**
___ **riffle beetle adult**	___ **damselfly larvae**	___ **lunged snails**
___ **Stonefly larvae**	___ **dragonfly larvae**	
___ **water penny larvae**	___ **scuds**	
	___ **sowbugs**	
	___ **fishfly larvae**	
	___ **alderfly larvae**	
	___ **watersnipe larvae**	
	___ **whirligig beetle larvae**	
Boxes checked x 3 = _____ index value	Boxes checked x 2 = _____ index value	Boxes checked x 1 = _____ index value
TOTAL INDEX VALUE (SUM OF ALL CATAGORIES) _____	**Excellent (>22)** **X Good (17-22)**	**Fair (11-16)** **Poor (<11)**

Site 6 Data Sheet

Sensitive	Somewhat Sensitive	Tolerant
___ caddisfly larvae	___ beetle larvae	___ aquatic worms
___ hellgrammite	___ clams	___ blackfly larvae
___ mayfly larvae	___ crane fly larvae	___ leeches
___ gilled snails	___ crayfish	___ midge fly larvae
___ riffle beetle adult	___ damselfly larvae	___ lunged snails
___ Stonefly larvae	___ dragonfly larvae	
___ water penny larvae	___ scuds	
	___ sowbugs	
	___ fishfly larvae	
	___ alderfly larvae	
	___ watersnipe larvae	
	___ whirligig beetle larvae	
Boxes checked x 3 = _____ index value	Boxes checked x 2 = _____ index value	Boxes checked x 1 = _____ index value
TOTAL INDEX VALUE (SUM OF ALL CATAGORIES) _____	**Excellent (>22)** **X Good (17-22)**	**Fair (11-16)** **Poor (<11)**

Site 7 Data Sheet

Sensitive	Somewhat Sensitive	Tolerant
__ **caddisfly larvae**	__ **beetle larvae**	__ **aquatic worms**
__ **hellgrammite**	__ **clams**	__ **blackfly larvae**
__ **mayfly larvae**	__ **crane fly larvae**	__ **leeches**
__ **gilled snails**	__ **crayfish**	__ **midge fly larvae**
__ **riffle beetle adult**	__ **damselfly larvae**	__ **lunged snails**
__ **Stonefly larvae**	__ **dragonfly larvae**	
__ **water penny larvae**	__ **scuds**	
	__ **sowbugs**	
	__ **fishfly larvae**	
	__ **alderfly larvae**	
	__ **watersnipe larvae**	
	__ **whirligig beetle larvae**	
Boxes checked x 3 = _____ index value	Boxes checked x 2 = _____ index value	Boxes checked x 1 = _____ index value
TOTAL INDEX VALUE (SUM OF ALL 3 INDEXES) _____	**Excellent (>22)** **X Good (17-22)**	**Fair (11-16)** **Poor (<11)**

James River Water Quality Analysis		
Site	**Score (total points)**	**Water Quality**
1		
2		
3		
4		
5		
6		
7		

CONCLUSION QUESTIONS

1. What does it mean for a macroinvertebrate to be pollution sensitive? What does it mean for a macroinvertebrate to be pollution tolerant?

2. Could a pollution tolerant macroinvertebrate live in clean water? Why?

3. Which site (number and location) of the James River is the most polluted?

4. What are some possible causes of the pollution of the James River?

5. Can you be positive that the pollution is coming from this site and not from a location upstream? Why or why not?

6. Why could the Chicken Factory be a source of pollution? Give a point source and nonpoint source example.

7. Which is better indication of the water quality, the number of organisms (for example 12 crayfish are found at one site) or the type of organisms (water pennies are found with lots of pouch snails and leeches) found at a site? Why?

8. In addition to taking macroinvertebrate specimens as a water quality test Mayor Pops has requested chemical analysis of the water. Why is this a good idea?