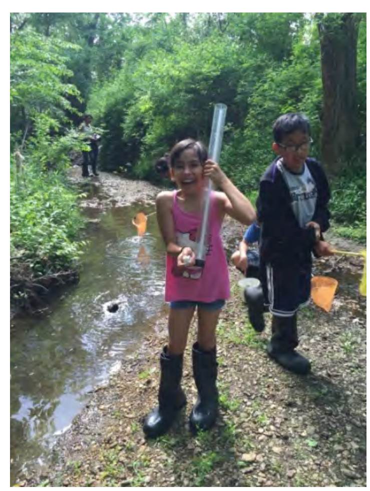
Creek Freaks Curriculum



Updated June 2015

About Creek Freaks

Creek Freaks are children ages 10-14 (grades 4-8) making a splash to help the environment. Students conduct hands-on experiments and venture outside to explore local streams and learn how healthy trees, shrubs, and grasses protect clean water and wildlife. Students are then empowered as local stream experts and are encouraged to continue advocating for and working to improve water quality. Creek Freaks blends hands-on stream projects with online data sharing and social networking. Participants bring their streams to life for others by posting their own data, stories, photos and videos on the Creek Freaks website. Learn more, including how to set up a unique page for your school or program, by visiting www.creekfreaks.net.

About the Izaak Walton League of America

Founded in 1922, the Izaak Walton League is one of the nation's oldest and most respected conservation organizations. With a powerful grassroots network of more than 240 local chapters nationwide, the League takes a common-sense approach toward protecting our country's natural heritage and improving outdoor recreation opportunities for all Americans. We invite to join us in supporting important conservation initiatives in your community. Learn more at www.iwla.org.

About the Creek Freaks Curriculum

The Creek Freaks Curriculum is based on the Holding onto the Green Zone Guide by the U.S. Bureau of Land Management and University of Wisconsin Cooperative Extension. The Creek Freaks Curriculum also includes activities from the Izaak Walton League of America's Youth Manual and Hands-on Save Our Streams: the Save Our Streams Teacher's Manual. This curriculum is aligned to Next Generation Science Standards and the Common Core. For more information on how specific activities support standards of learning, please visit www.creekfreaks.net.

Share Your Ideas

We are continually updating this curriculum based on feedback from educators. Please share your tips on our Facebook page (www.facebook.com/creekfreaks) or send your ideas by email to sos@iwla.org. You can also share tips and best practices with other Creek Freaks program leaders using our website www.creekfreaks.net.

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Watersheds and Water Pollution

Watershed Hands

Watersheds are an abstract concept for students and adults to grasp. In this activity we use a simple demonstration to explain how a watershed functions.

Background

As defined by the EPA; A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place.

Watershed Hands

Description: Learners will understand and demonstrate the features of a watershed using their hands

Duration: 5-10 minutes

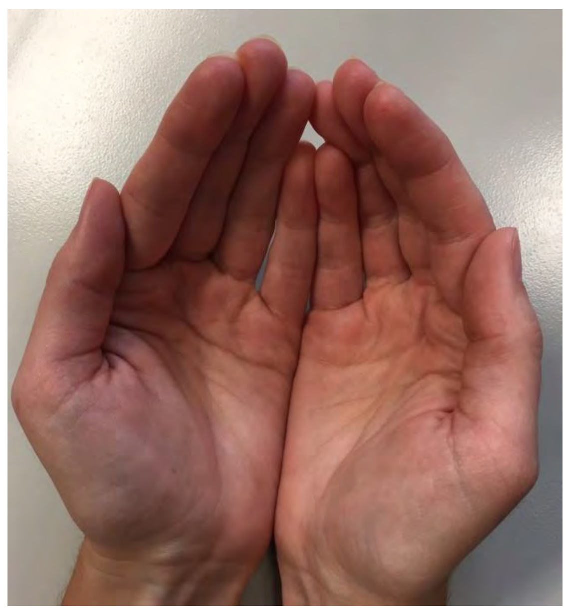
Setting: Outdoor or indoor

Skills: Discussing, observing

Objectives: Learners will be able to describe the way a watershed works and be able to demonstrate water flow within a watershed.

Materials:

- Your Hands!
- Water (optional)



Directions:

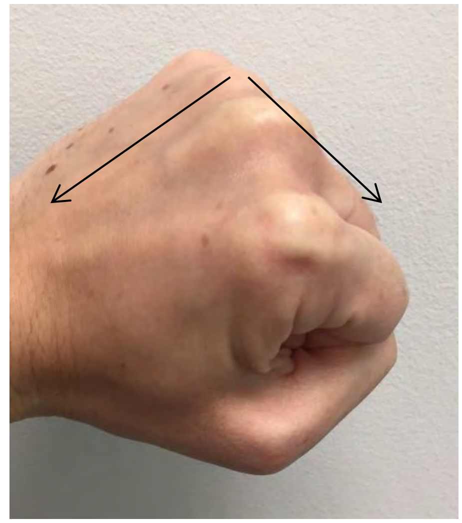
1. Cup your hands as shown in the photo, and instruct students to do the same.
2. Ask them: “If a drop of rain fell on my fingertips, where would it go?” The students should answer “down” or “to your palms”
3. Explain that your hands are demonstrating a watershed, or “An area of land that drains water”
4. Relate different features to types of water bodies.
    - The tips of your fingers are like mountains
    - The cracks between your fingers are like small streams
    - Between your two hands is a larger river
    - Your palms are a large body of water. Usually an ocean, but if there is a large important body of water near you, you can relate it to that (i.e. Chesapeake Bay, Great Lakes, etc)
5. You may also mention that any water that drips between the cracks in your fingers can represent infiltration which recharges groundwater supplies.

Notes: For an active learning session you may drip or spray water on student’s hands and have them observe the water flow.

Extension:

To explain watershed divides place your hand in a fist. Explain that your knuckles represent mountains, or a watershed divide. Rain that falls on one side of your hand will run down to one watershed and rain that falls on the other side will run down to another watershed.

You may likewise spray students hands to reinforce the concept.



Watershed Address

Watersheds are an abstract concept for students and adults to grasp. It is also difficult for students to place themselves within a watershed and understand the impact they may have on it. This activity allows students to develop a sense of place within a larger watershed.

Background

As defined by the EPA; A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place.

Watershed Address

Description: Learners will describe their watershed address by

Duration: 10-30 minutes

Setting: Indoor

Skills: Problem solving, Map reading, Discussing

Objectives: Learners will be able to describe where they live, not based off of their street address but based on what streams they live closest to.

Materials:

- Maps of the local area. (These may need to be large to accommodate large watersheds.) Alternatively use a web based map with zoom functions to observe the water bodies.

Directions:

1. Give an example address to the students and explain how each piece of an address narrows down the location. For example, the Izaak Walton League National office is located at 707 Conservation Lane, Gaithersburg, MD 20878
2. Explain the MD code denotes that our location is in the state of Maryland. The zip code (20878) tells you what area of Maryland. The town name (Gaithersburg) narrows it down even further. The Street (Conservation Lane) gets you almost to our location and finally the number (707) tells you exactly where you can find us!
3. Explain to students that you can also have a watershed address. To create this address you will start with the most specific information- the closest stream to you- and follow that until it reaches a large body of water (usually ocean but can be related to other important bodies of water- i.e. Chesapeake Bay, Great Lakes etc.)
4. Students can either create this for their home address or your current location (school, camp, nature center)
5. Use maps (or preferably Google maps) and follow the closest stream to the next body of water it flows into, and so on, recording them as you go.
6. The Watershed Address for the Izaak Walton League National office is: Muddy Branch, Potomac River, Chesapeake Bay, Atlantic Ocean. Some watershed addresses can be shorter or much longer than the example. It depends on where you are!
7. Have students share their watershed address and explain how they might affect the greater watershed in which they live.

Model Watershed

Build model watersheds for a clear visual demonstration of how water picks up sediment and pollutants as it flows and how to prevent pollution from reaching waterways.

Background

As defined by the EPA; A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place.

Model Watershed

Description: Learners will learn about watersheds, pollution sources, and pollution prevention through demonstrations using a model watershed and/or through building their own model watersheds.

Duration: 30-90 minutes

Setting: Indoor or Outdoor

Skills: Problem solving, Discussing, Design and experimentation

Objectives: Learners will be able to define watersheds, identify sources of pollution, and describe pollution prevention techniques.

Materials:

- See How To Build a Model Watershed on next page

Directions:

- See How to Build a Model Watershed on next page

Extension Activities:

Provide students materials to build their own watershed models in teams. Each team can think about the community included in their watershed, its geography, economy and society, and pollution produced as a result of these factors. Students also can use the model to showcase a variety of pollution prevention techniques appropriate for their watershed's geographic, economic, and social factors. Have each group present their watershed, its characteristics, pollution problems, and pollution prevention techniques.

As an alternative, you can give each team a plastic container for their watershed base and send them outdoors to use natural materials such as soil, rocks, twigs, grass, moss, acorns, etc. to build their watershed models.

HOW TO: BUILD A MODEL WATERSHED

SIMPLE PROJECTS FOR CONSERVATION

It's a simple matter of gravity: Water runs downhill. This model watershed offers a clear visual demonstration of how water picks up sediment and pollutants as it flows — and that simple measures can reduce the amount of polluted runoff that ends up in your watershed.

This is a good project for talking with school children about water pollution and what they can do to prevent it. It's also a great indoor conservation project and travels well to expos and county fairs.

Materials

- Disposable aluminum cake pan or a plastic bin
- Florist foam
- Aluminum foil
- Model farm animals (cows, pigs)
- Small models of barns, houses, industrial buildings
- Permanent markers (e.g., a Sharpie®)
- Watering can or spray bottle
- Chocolate pudding/hot chocolate mix
- Lime gelatin mix
- Orange gelatin mix
- Straw
- Small pieces of artificial turf
- Craft glue
- Plain modeling clay (colored clay will run when wet)
- Sponges
- Bucket

REQUEST TO READERS

If you build a project based on this or other Outdoor America *articles, or if you have an idea for a good conservation project, please e-mail us at* oa@iwla.org.

Three-step landscaping: Sculpt foam inside a cake pan, cover it with foil, and outline a river and lake.

1. Develop Land: Create your landscape inside the cake pan using green florist foam (available at craft stores). Buy blocks and round pieces of foam and arrange them to represent two tall mountains on the outer edges of the pan. A river should run between the mountains down to a lake. Make a shallow depression for the lake to hold water.

2. Cover Ground: Cover the entire landscape with a large piece of aluminum foil. Start from the middle and gently press the foil into the hills, valleys, and waterways. Fold the foil over the edge of the pan to help hold everything in place. You may need multiple sheets of foil.

3. Run a River Through: With a permanent marker, draw the outline of the river running through the middle of the mountains and the lake at the bottom.

4. Build: Put in land-use areas by placing model homes, barns, factories, and animals around the watershed, from the hills to the lakeside. You may need craft glue to hold these in place. Draw roads, fields, and other landscapes to tie the community together.

5. Pollute: Sprinkle chocolate pudding/hot chocolate mix near animals to show manure and/or near construction sites to show exposed

ILLUSTRATIONS BY BOB DRY/WWW.DRYSPOND.COM

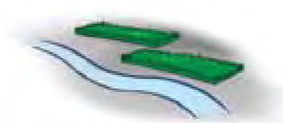
Hot chocolate and gelatin mixes give kids the "dirt" on non-point source pollution.

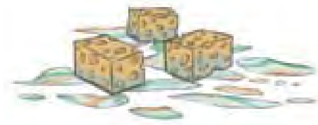
dirt. Sprinkle lime gelatin mix near houses to represent lawn-care chemicals. Sprinkle orange gelatin mix on farm fields to represent agricultural chemicals (pesticides, fertilizers).

6. Rain! Use the spray bottle or watering can to start a rain shower in the mountains. The chocolate, lime, and orange mixes will color the water to show how water pollution can wash down through the watershed, ending with very dirty water in the lake that demonstrates a high level of pollution.

7. Remediate: Dump the water into a bucket and rinse off any residue. Sprinkle the chocolate, lime, and orange mixes in the same spots, taking additional steps to prevent water pollution before the next rainfall.

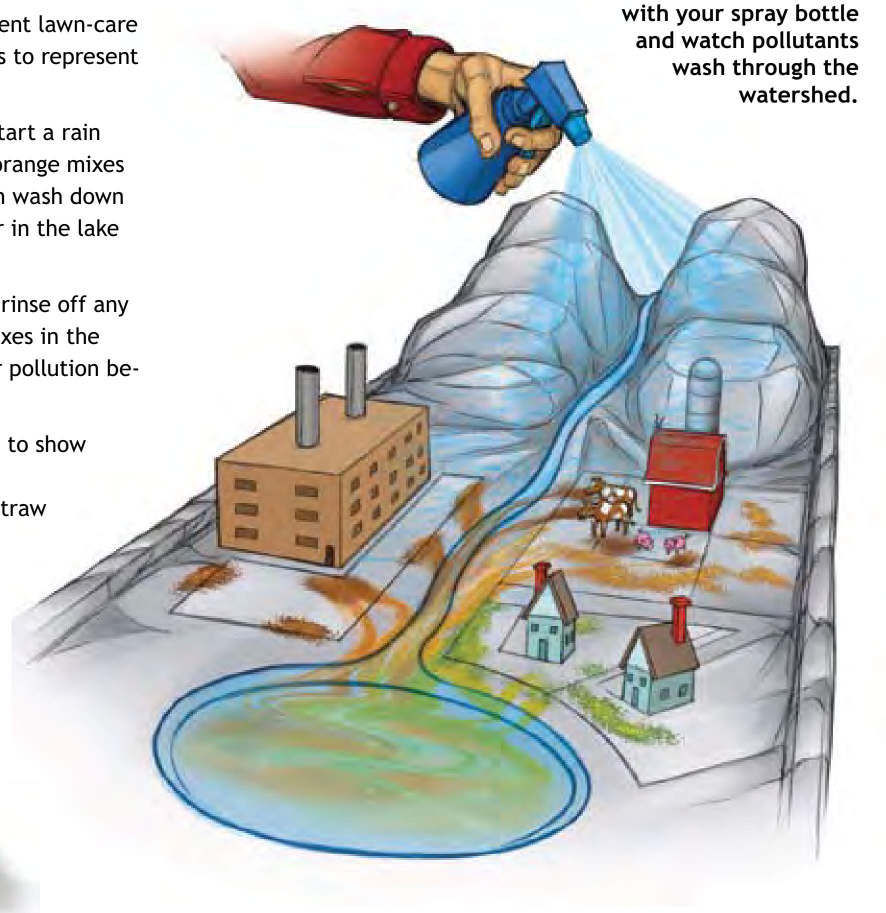
- Use smaller amounts of the lime and orange mixes to show more careful use of chemicals.
- Cover chocolate mix near construction sites with straw to prevent rain from washing away exposed soil.
- Use clay to build barriers around the areas of manure, which will hold runoff water until it can be cleaned.
- Cut small pieces of artificial turf and glue them down between the river and the orange and lime mixes on the farm. These turf pieces represent contour plantings and grass buffer strips, which help filter pesticides and fertilizers from agricultural runoff.





- Cut small pieces of sponge to place near pollution areas and in low spots where water may gather. These serve as wetlands, which filter runoff by trapping and breaking down pollutants.
- Cut small pieces of artificial turf to place along the banks of the river to represent a buffer of stream-side trees and shrubs to slow runoff and trap pollutants.

8. Rain Again: Use the spray bottle or watering can to create a second rainfall. The water that ends up in the lake should be much less colorful because you took multiple steps to keep pollutants out of the runoff.



Create a "rain storm" with your spray bottle and watch pollutants wash through the watershed.

A Few Talking Points

• A watershed is an area of land that drains water, sediment, and pollutants into a common body of water. For example, the Chesapeake Bay watershed is thousands of square miles of land and waterways that all eventually drain into the Chesapeake Bay. A watershed can also be a very small area that drains into a local pond or stream.

• Pollution on land in the watershed eventually ends up in the water. Fertilizer, pesticide, and manure run-off from farms and yards can put potentially harmful chemicals and pathogens in rivers and lakes. Incorrect disposal of household and industrial chemicals can lead to deadly chemicals in waterways. Excess sediment from construction sites can wash into streams, smothering fish eggs and the bottom-dwelling bugs fish eat.

• Healthy watersheds and clean water are important to protect the rivers, streams, and lakes we use for drinking water, recreation, and fishing.

Creek Freaks Curriculum

Introduction to the Riparian Zone

On the Edge

This activity encourages thought and exploration about the unique characteristics of riparian areas.

Background

The areas adjacent to rivers and streams are called riparian zones. Riparian zones host plants and animals adapted to wet conditions, including flooding. Even in arid lands such as those found in the western United States, riparian zones tend to be green and lush. Riparian zones are on the edge between streams and drier upland areas. Because of this, they tend to host a wide variety of plants and animals that come from both ecosystems.

On the Edge

Description: Learners will understand and demonstrate the features of a riparian zone by examining and discussing photographs and/or making observations in the field.

Duration: 5-10 minutes

Setting: Outdoor or indoor

Skills: Discussing, observing

Objectives: Learners will be able to describe the unique features of a riparian zone and the way it differs from upland areas.

Materials:

- One or more photographs of streamside areas (from your own collection or from the Internet)
- Index cards (optional)

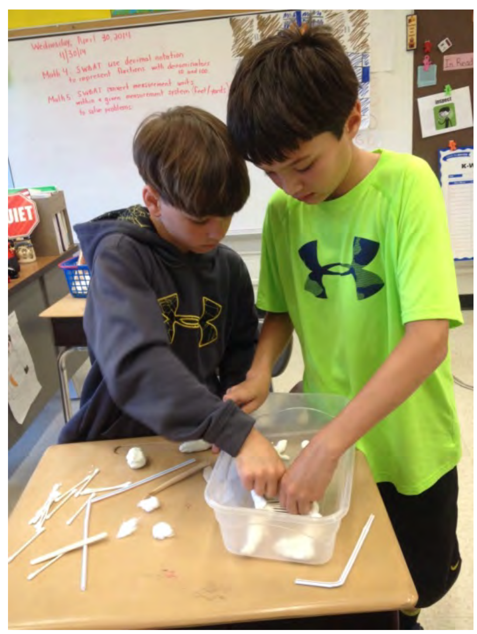
Directions:

1. Show photographs of several different riparian areas. You can print pictures and laminate them or project them on a screen.
2. Ask them: "Have you ever been to an place like this? If so, what was it like? What did you do there? How was this area very close to a stream different than the areas further away from the water?" Discuss answers. You may need to prompt students by asking what was different about the temperature, the types of plants or animals, smells, sights and sounds, and how it felt beneath their feet.
3. Explain the unique features of a riparian area and why it is a good place for many types of plants and animals to make a home.

Extension:

Ask students to walk outside toward a stream and to observe and write down three or more things that are different between the riparian zone along the water's edge and the upland area away from the water. Remind them to look, listen, smell, feel, and touch to explore the differences. Bring students back together to share what they learned.

Creek Freaks Curriculum



Stream Dynamics

Putting on the Brakes

Through the natural processes of erosion and deposition of sediment, rivers take their shape. This shape is critical in determining the speed of the water. The meandering of a river slows the water down, and in times of flood, water rises and spreads out along the floodplain. Plants, roots, and streamside vegetation help to make the stream channel rough and further slow the flow of water, preventing erosion.

Background

To assist youth with this unit, it will help to be familiar with several key concepts. Scientists need a gauge or measuring system to assess the condition of riparian or wetland areas. Natural resource specialists use an assessment method called "proper functioning condition" (PFC) to determine the health of a riparian ecosystem. The PFC is a qualitative method for assessing the condition of riparian-wetland areas, using a consistent approach for evaluating water, vegetation, and soils. More specifically, scientists investigate:

- Water quality and quantity
- Soil qualities
- Plant characteristics
- Stream shape, slope, and speed
- Stream erosion and deposition
- Land uses – human, livestock, and wildlife

A riparian area is considered to be in proper functioning condition (healthy) when the water, vegetation, soils, landforms, and land uses are working together to:

- slow the speed of high, fast-moving water, which helps to reduce erosion;
- trap sediment, keeping it out of the water and adding to the soil in the surrounding floodplain;
- store flood water and recharge groundwater;
- support root masses that strengthen stream banks;
- create areas in the water that are calm and deep, providing habitat for fish, waterfowl, and other aquatic animals; and
- support greater numbers and varieties of plants and animals (biodiversity).

A PFC evaluation assesses whether the physical processes are functioning in a riparian area to provide services for the community such as a clean, abundant water supply; wildlife habitat; forage for livestock; and recreational opportunities. A PFC evaluation also takes into account the particular riparian area's potential.

Putting on the Brakes

Description: Learners will make a shoe-box model of a stream and will devise ways to slow down water (a marble) in their shoe-box stream to demonstrate the relationship between water speed and stream shape in the riparian zone. This activity works best if learners can work in teams of two.

Duration: 45 minutes

Setting: Indoor or outdoor

Skills: Cooperating, describing, designing, calculating, labeling, constructing with media, recording data, working in small groups, testing, timing, visualizing

Objectives: Learners will be able to demonstrate how the shape of a stream affects the velocity of the water.

Materials:

- A shoe box or plastic container with a **flat** bottom for each team
- Ruler (cm)
- Marbles (one for each team)
- Stopwatch (must go to hundredths of a second)
- Paper and pencils with eraser for calculations, or calculator
- Modeling clay to make stream channel [Stick craft supplies to clay to simulate plants, roots, etc.]
- Scissors
- Books or blocks to raise one end of each shoe box approximately 1 inch high
- Miscellaneous craft materials such as toothpicks, cotton balls and swabs, pipe cleaners Scraps of cardboard and various types of paper (optional) Straws (optional)

Directions:

1) Distribute a box, marble and stopwatch to each set of students and allow them to calculate the velocity of the marble with no additional materials. This will serve at the baseline for how fast the marble (water) is able to travel.
2) Distribute craft materials and encourage students to design stream channels that will slow marbles down—but not let them stop!
3) Have students calculate the velocity of the marble for each trial run. It is fun to run this activity as a contest, the team with the SLOWEST velocity wins!
4) Discuss with students the importance of curvy stream in slowing down water and preventing erosion. Refer to the background information for more discussion topics.

WATCH this Activity!

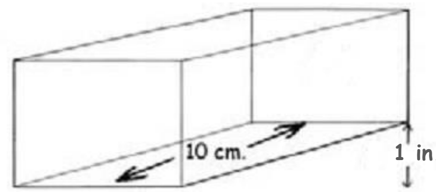
IWLA staff filmed a training video of this activity to assist educators! Watch the demonstration by clicking this link www.youtube.com/watch?v=X5OdDsaoWbM or find it on our Creek Freaks website at www.creekfreaks.net/training

Putting on the Brakes!

In this activity, your team will explore ways in which the flow of water in a stream can be slowed by the shape of the stream. A marble will represent the water and a shoe box will represent the channel and banks of your stream. If possible, work in teams of two.

Directions

1) Construct your stream model by elevating one end of the box by approximately 1 inch using a wooden block or textbook, as seen in the diagram at to the right.
2) Measure and record the inside length of the box, as shown. Record your data in the chart below. If you need more room, recreate this chart on a separate sheet of paper.



3) One team member will be the timer, who operates the stopwatch, while the other will release the marble. After counting down "3-2-1-GO," the timer starts the stopwatch and the second team member releases the marble from the top of the box. When the marble reaches the end of the box, the timer should stop the stopwatch and note the number of seconds in the chart. Calculate the velocity.
4) Your challenge is to slow your marble down by at least half its original speed, using the materials supplied to create a winding path. Chart your marble's velocity each time you test a different idea. Keep track of what you used, keeping in mind that your challenge is to slow the marble down—not stop it completely.

Trial Number	**1**	**2**	**3**	**4**
Materials Used	None			
Length of Box (Distance)				
Number of seconds marble took to roll from one end to the other (Time)				
Velocity of the Marble (Velocity=Distance/Time)	(This is your Baseline)			

In nature, what slows down the water in a stream? Think of as many ideas as you can and list them.

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Adaptations and Suggestions

We are constantly looking for ways to improve our activities. Here are a few suggestions from educators like you! (And a few cool ideas from us too!)

1) For velocity calculations (Velocity=Distance/Time) take a baseline measurement with no materials in the box. Once the stream channel is constructed use a string to measure the curvy path of the stream. This will allow for a more accurate velocity calculation than using the straight ruler. For younger students or informal classes, use the same size containers to avoid the need to do velocity calculations—the distance may vary slightly, but for simplicity sake--whoever has the slowest marble wins!

2) Try propping the boxes up at different heights and examine the effect on the velocity of the marble.

3) Save $$$$! Instead of using craft supplies, bring students outside and let them create stream channels using natural materials. Dirt, sticks, leaves, rocks, grass, and mud make excellent stream construction materials. Use plastic containers for this activity and you can simply wash them out and re-use them. **Helpful hint; Encourage students to not put dirt on the bottom of the channel as this will stop the marble before it reaches the end of the container.

4) For a quick visual lesson about why rivers curve, show students this 3 minute video from Minute Earth. Great visual explanation reinforces concepts and may help them design their model in the Putting on the Brakes Activity. https://www.youtube.com/watch?v=8a3r-cG8Wic

5) Try this great adaptation that NEEF (National Environmental Education Foundation) thought of! Painted plywood is propped up outside. This allows multiple students to work on one project, and uses inexpensive outdoor materials.

6) Sometimes the concept behind Putting on the Brakes is a difficult for students to grasp. Prep them by laying a rope out on the floor in a straight line. Have them walk heel-toe from one end to the other and time them, using a stopwatch. Next, make the rope very curvy and repeat the process. The students should observe that they move slower when the stream is curvy. Tell the students that they represent water droplets and have them make observations about why they slowed down when moving on a curvy path. You can also add in obstacles that can represent vegetation, woody debris, and other things that can make the roughness on the "banks." Explain to students that this also has a great contribution to slowing down water.

Creek Freaks Curriculum

The Role of Streamside Soils

Soil Texture Test

Soils are an important component of the riparian zone. Students can look up local soil surveys and compare results with what they find at a nearby riparian zone or even in their own schoolyard.

Background

Because of the presence of water, riparian and other wetland areas have soil properties that differ from those of upland areas. Soils that are seasonally saturated with water during some part of the growing season can, when combined with microbial activity, become anaerobic, which means they lack oxygen. Spots of rusty red or orange in the soil form during anaerobic conditions. This happens because microbes will take the oxygen molecules from iron oxides in the soil leaving the iron in solution. When that iron hits an air pocket in the soil, it drops out of solution as iron oxide – or rust – again, causing the red or orange spots.

In upland areas, most soils are derived from in-place weathering processes. Relatively little soil material comes from off-site sources. In contrast, riparian-wetland soils are constantly changing because of the influx of new soils being deposited by storm events and overland flow. Great variability in soil types can occur over short distances in riparian areas. This variation in soils has an effect on the water and vegetation, as well as on the processes of erosion and deposition. The soil along stream banks, in floodplains, and in the substrate under the channel, acts as a sponge to retain water. This stored water is released over time as subsurface water or groundwater, extending the availability of water in the watershed for a longer period during dry seasons or recharging the underground aquifer. Water-restricting soil types such as clay or hardpans often have impermeable layers that cause standing water on the surface of wetland areas, such as a marsh or pond.

Vegetative composition of riparian-wetland areas is also strongly influenced by the amount of moisture and oxygen levels in the soil. For example, the type of riparian-wetland soil, the amount of soil organic matter, the depth to which the water table will rise, the climate, and the season and duration of high water will determine the kinds of plants that will grow in riparian-wetland areas. In this station, learners will experiment with various types of soils, including sand, clay, and a local soil. Soils they find in the riparian zone during field trips to a local stream will most likely be different from the soils used in these activities. But these experiments will help point out the different qualities soils may have depending on their composition. Learners should realize that although proportions may vary, all soils have the same components—mineral and organic matter, water, and air.

Soil Texture Test

Description: Learners will explore basic soil characteristics.

Duration: 20 minutes

Setting: Indoor or outdoor

Skills: Analyzing, describing, observing, predicting, recording

Objectives: Learners will be able to describe basic soil characteristics and explain how to determine if local soil is more similar to sand or to clay soils.

Materials:

- Enough samples of sand, clay, and a local soil so that each learner is able to use approximately a tablespoon of each type
- A spray bottle, or a container that has a lid that will drip water, such as a plastic sports water bottle (1 for every 4-5 learners).
- Copies of the "Texture Test" chart-one for each member of the group

Advance preparation: Collect the three different soil types. We suggest purchasing sand and potting soil at a home improvement or garden store, and purchasing craft modeling clay to represent the three different soil types. You may also collect local soil and see which of the three types (or combination) your local soil matches most closely.

Directions:

1. Each team member should take a sample of soil about the size of a large marble. Put the sample on your palm and add a few drops of water.
2. Try to form a ball.
3. Try to make the other shapes listed in the Texture Test chart to determine some of the characteristics of each soil type.

Notes: Use craft store modeling clay to represent clay soil for this activity. It will help students get a better idea of what true clay should feel like.

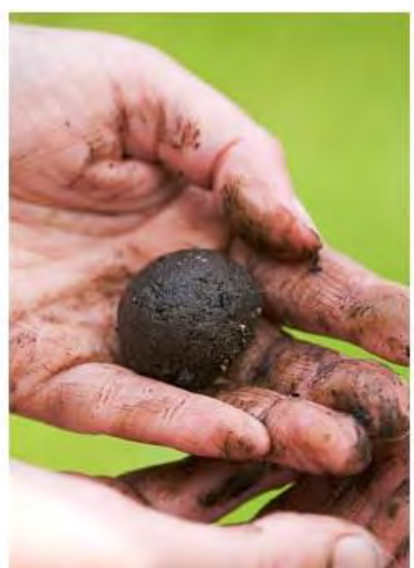


Photo Credit Suzie Gibbons, other credits DESIGN HELEN RICHES

Soil Percolation Test

Description: Learners will time the flow of water through different soils; measure the amount of water held in these soils; observe the ability of soils to filter water.

Duration: 40 minutes

Setting: Indoor

Skills: Explanation, measuring, observation, prediction, timing, comparing and contrasting

Objectives: Learners will be able to predict how long it takes for water to percolate through different soils to recharge groundwater resources in a riparian area and compare percolation rates among different soils.

Materials (one set is needed for each team of students):

- Three clear 2-liter bottles with the bottoms cut off
- Three 500-ml beakers or similar clear containers
- One clear 500-ml measuring container
- Soil samples (sand, clay, potting soil, and a local soil) **PLEASE SEE NOTES SECTION for more information**
- Extra container of sand
- 3 pieces of window screen or other fine mesh cut into circles, each approx. 10 cm in diameter
- Duct tape
- Water
- Stopwatch
- One color of food dye
- Copies of the “Percolation Test” chart - one for each student

Advance preparation:

- Ask students to bring in clean, 2-literplastic bottles. Each team will need 3 bottles.
- Cut the bottoms off the plastic bottles.
- Collect soil samples.
- Collect and cut pieces of window screen into circles approx. 10 cm in diameter.

Directions:

1. Hold each of the soda bottles upside down and tape a circle of screen around each bottle neck so the screen completely covers the opening. (See photo)
2. Pour ½ cup of sand into each bottle. The sand will keep the screen from becoming clogged.
3. Balance each bottle, mesh side down, in a measuring cup, beaker, or clear container.
4. Pour 2 cups of soil into the bottle over the sand, using a different type of soil in each bottle (Potting soil, sand, clay, and local soil (optional)).
5. Fill a measuring up or other clear container with 2 cups of water. Add 2 drops of food dye. Notice what the water looks like at this time.
6. Predict what will happen when you pour the water onto each type of soil. Using the Percolation Test chart, write down your predictions and explain them.
7. Now get ready to take notes about what happens when water percolates through the soil. Pour the water onto the soil and begin timing. As you pour the water, use the questions in the unshaded areas of the chart to help you record your observations. (Be sure to pour slowly!)

8. Once the water has stopped dripping from the bottom of the bottle, remove the soil bottle and hold up the beaker (or measuring cup) of water that has passed through the soil. How does the water look?
9. Pour the water back into the original container. How much water did you start with? How much water is missing? Enter your data in the chart.
10. REPEAT STEPS 5 THROUGH 9 FOR EACH SOIL BOTTLE.

Discussion Questions:

1. Which of the soil types allowed water to move through most quickly—sand, clay, or local soil? How did you decide?
2. Which of the soil types absorbed the most water—sand, clay, or local soil? How could you tell?
3. Which soil type absorbed the most food dye? Which soil type might filter more pollutants in the GREEN Zone? Explain your answer.
4. Predict what would happen to an aquifer after a flood in the GREEN Zone if the soil is: a) sand; or b) clay. What would happen if the soil included a mixture of sand, clay, and decayed plant material, which is good at absorbing water?
5. Animals and people can compact (squeeze or press down) the soil in a riparian zone. If you compacted the soils before performing the percolation tests, do you think your actions would change the results? Why or why not? How might compacted soils affect water movement and plants in the GREEN Zone?

Notes: Using three "control" soils will help students compare their local soil to one of the three soil types. We generally use play sand, purchased at a hardware store, potting soil, and plain clay cat litter ***ground up in a blender.*** We have tried many different methods to represent clay for this activity and have found that the ground up cat litter visually behaves the most like the clay soil we are trying to represent. Once students are able to see how these three soil types behave, they can compare their local soil to one of the three, or a mixture. Window screen pieces should be placed around the opening of the bottle and taped in place. Make sure the window screen is secure before starting the activity.

WATCH this Activity! IWLA staff filmed a training video of this activity to assist educators! Watch the demonstration by clicking this link www.youtube.com/watch?v=h3s_LNla_aI or find it on our Creek Freaks website at www.creekfreaks.net/training

Unit 2, Station 2, Activity 2 – Texture Test

The Scoop on Soil –Texture Test			
	Sand	**Clay**	**Local Soil**
Can you form a ball?			
Can you form a ball and then roll the ball into a snake?			
Can you form a ring with the snake shape you made?			
Does your sample feel gritty or sandy?			
Does your sample feel smooth, like flour?			
Does the sample feel neither gritty nor smooth?			
What color is the soil?			

Unit 2, Station 2, Activity 3 – Percolation Test

(Note: Your prediction should go in shaded areas; your observations go in unshaded sections. Use the right-hand column to explain your predictions and observations.)

Prediction/Observation	Sand	Clay	Local Soil	Explanation
Will the water run out through the bottom of the bottle? Yes/No				
The water ran out of the bottom of the bottle. Yes/No				
How much water will run out?				
How many mL of water percolated through?				
How many seconds will it take for the water to pass through the soil?				
The time it took for the water to pass through the soil was…				
What will the water look like when it comes through? Clear, murky, very dirty, etc.				
The water was… (Describe its appearance.)				
Will the water still have food dye in it? Yes/No				
It looks like the water had…(same amount of dye, less dye, no dye)				
Will the soil look different where the water has gone? Yes/No				
The soil looked…(Same/Different)				

Creek Freaks Curriculum

The Role of Streamside Plants

Filter Plants

Plants in the riparian zone have the ability to take up and use nutrients in the water. Nutrients are essential to plant life, but they can be harmful in excess. This can lead to algae blooms, decreased oxygen levels, and poor light penetration.

Background

Riparian vegetation maintains or improves the quality of water in a stream by trapping sediment and other pollutants from runoff and keeping them out of the stream. Plants play critical roles in the ability of the riparian area to function properly. Each stream or river bank must develop and maintain adequate numbers and varieties of these plant species to create, over time, a balance between the eroding and rebuilding forces of water. In some cases, anchored logs or rocks will perform this function. When the erosion and deposition forces are out of balance, sediments and soils will accumulate in the stream channel, degrading the quality of water, harming fish and other aquatic organisms, and clogging waterways. Through complex microbial processes, plants can also break down, remove, and assimilate a variety of chemical pollutants that are present in the soils and subsurface water of riparian areas, keeping many of these harmful substances out of rivers and streams.

Filter Plants

Description: Learners will demonstrate that plants can filter some pollutants from a riparian area.

Duration: 5-10 minute set-up one day; next day 20 minutes

Setting: Outdoor or indoor

Skills: Comparing, discussing, observing, predicting, recording

Objectives: Learners will be able to describe one way that riparian vegetation can remove pollutants from water and will be able to suggest one reason why the capability of the GREEN Zone to absorb contaminants is limited.

Materials:

- 2 fresh celery bunches
- 2 plastic water cups
- Masking tape
- Red food coloring
- White vinegar
- 2 measuring cups
- Paring knife or plastic knife
- Ruler (cm)
- Paper towel
- Piece of notebook paper for each team

Advance preparation:

- Buy red food coloring and white vinegar.
- Set this up 4-24 hours before running the activity or have students set it up one day and complete it the next day.
- Be sure to cut the bottom of the celery immediately before placing into cups, if the celery is cut from the base too long before you start the experiment the dye does not travel up the stalk.

Directions:

1. Rinse off the celery and trim the bottom end off each stalk. No stalk should be longer than 25 cm.
2. Use masking tape to label the cups “A” and “B.”
3. In cup A put: ¾ cup water, 3-4 drops red food coloring, and ¼ cup vinegar. Add a trimmed celery stalk.
4. In cup B put: 1 cup water, 3-4 drops red food coloring, and a trimmed celery stalk.
5. Let the cups sit for at least 4 hours—overnight, if possible.
6. What do you think will happen to the celery’s color, taste, smell, and texture? Will results in the two cups differ? Write down your predictions.
7. Once the celery has soaked for at least 4 hours, begin your observations, starting with cup B. First, make a chart like the one below in your notes.
   a. Remove the celery from cup B and dry it with a paper towel. This will be Celery B.
   b. Place the stalk lengthwise on a piece of notebook paper, lining up the bottom end of the stalk with the bottom of the paper. Use the ruler to measure along the celery stalk, making a mark on the paper next to the stalk at every 1 cm.
   c. Beginning at the bottom end, slice the celery stalk at every 1 cm mark until the red color is no longer visible in the stalk. Mark this spot on the paper. Measure the distance from the bottom of the paper to the spot. This is how far the color traveled. Record the distance in your chart.
   d. Have one volunteer from your team smell the celery. (Optionally students may also taste it where there is no red color in the stalk.) Take note of the celery stalk’s texture. Record these observations in your chart.

Filter Plants- Observations	**Celery A**	**Celery B**
How far up the stalk did the color travel?		
How does the celery smell?		
How does the celery taste? (optional)		
What is the celery stalks texture? Firm and crisp? Limp?		

8. Repeat steps a-d for the celery in cup A, which will be known as Celery A.
9. Discuss the following questions with your group: In the activity, what does the red food coloring represent? What does the vinegar represent? What happened to the food coloring in each stalk? What happened to the vinegar in Celery A? How can you tell? Compare Celery A and Celery B. How are they alike and how are they different?
10. Summarize what you’ve observed using the following questions.
    - Is clear water always clean or unpolluted? Explain your answer.
    - How can the presence of vegetation in a riparian zone affect the quality of drinking water in a community?

- Riparian vegetation can remove some, but not all, pollutants. List ways your community might prevent pollution in riparian zones before they become contaminated. Share your list with your group.

Notes: You may choose to cut one piece of the celery vertically down its length. This will also show how far the dye has traveled up the stalk

The following can help with answering the discussion questions used in the activity.

What does the red food coloring represent? Pollution – especially excess nutrients, sediments and other pollutants that end up in the water that runs over the land and into streams.

What does the vinegar represent? Toxic pollution.

What happened to the food coloring in each stalk? It was taken up by the celery, which is what plant along streams do with pollution.

What happened to the vinegar? It was also taken up by the celery.

Compare Celery A and B? How are they alike and how are they different? Celery A and B both have red food coloring that has traveled up the stalk. Celery A (with vinegar) also has vinegar that has travelled up the stalk, making the celery sour. Celery A may not allow the food coloring to travel up as high and may also be wilted compared to Celery B. This happens because the acid in the vinegar is breaking down the cell walls in the celery. This helps show that when plants are forced to take up too much pollution, they can suffer and not be as healthy. These less healthy plants are not able to protect the stream water as well as healthier plants that are only filtering a moderate amount of pollution.

Is clear water always clean or unpolluted? No. Some pollution doesn't have a color, so you can't tell if water is clean by just looking at it. Also, natural stream water may not be clear and clean looking because there is life growing in it – plants, animals, algae. Sometimes clear water can mean that toxic pollution killed all life in a stream and that is why it is so clear.

How can the presence of vegetation in a riparian zone affect the quality of drinking water in a community? Vegetation in the riparian zone filters pollutants from the water and can help improve the quality of drinking water.

Riparian vegetation can remove some, but not all pollutants. List ways your community might prevent pollution in riparian zones before they become contaminated. There are many ways to reduce pollution. Some examples include: reduce the amount of pesticides and fertilizers on farmland and lawns; pick up after pets; reduce the amount of hard surfaces like roads and roofs in a community; reduce the amount of lawn and replace it with native shrubs, grasses and trees that better soak up water and absorb pollutants before they get to the stream; drive less often; maintain cars properly to avoid oil and transmission fluid leaks; properly dispose of toxic household chemicals; etc.

WATCH this Activity!

IWLA staff filmed a training video of this activity to assist educators! Watch the demonstration by clicking this link www.youtube.com/watch?v=-1IuSc16Ffg or find it on our Creek Freaks website at www.creekfreaks.net/training

Erosion in the Zone

Erosion along streams riverbanks can be a major problem for the health of streams and the organisms that use them. Eroding stream banks are unstable and result in the destruction of streamside habitat. The sediment eroding from the banks can affect organisms such as fish living in the stream. In sediment choked waters, fish have trouble breathing through their gills and seeing their food. Sediment can also coat the bottom of streams, destroying spawning habitat for species like salmon and decreasing habitat for macroinvertebrates, on which fish feed. Healthy riparian zones are able to prevent erosion by holding onto soil with plant roots from streamside vegetation.

Background

Land uses in the riparian zone by wildlife, livestock, and people can have profound effects on the ability of the riparian area to function properly. Among the major human land use activities that cause disturbance, like erosion, in riparian areas are:

- Agriculture—vegetative clearing, in-stream modifications, soil exposure and compaction, irrigation and drainage, sediment and contaminants
- Forestry—removal of trees, transportation of products, site preparation
- Domestic livestock grazing—loss of vegetative cover, physical impacts from livestock
- Mining—vegetative clearing, soil disturbance, altered hydrology, contaminants, spoils deposition
- Recreation—vegetative clearing, physical impacts from facilities, equipment, and people
- Urbanization—altered hydrology, altered channels, sedimentation and contaminants, road construction, surface runoff, wastewater disposal
- Dams—altered hydrology, altered channels

Erosion in the Zone

Description: Learners will compare and contrast the effects of rainfall on bare soil and on land protected by vegetation.

Duration: 30 minutes (Some preparation time may be needed several weeks in advance.)

Skills: Modeling, measuring, recording, calculating, observing, describing, discussing, comparing and contrasting

Setting: Indoor

Objectives: Learners will be able to define the term "sediment" and explain how plants can capture sediment, improving the quality of water in a stream.

Materials:

- Two large plastic trays (such as kitty litter boxes)
- A portable hand drill with 3/8" drill bit
- A watering can with sieve-style head
- Potting Soil
- Rapid-growth grass seed, OR piece of sod from a garden shop, OR grass dug from a lawn
- Two coffee filters
- Two fine strainers
- Two large empty coffee cans
- Duct tape
- Two plastic cups-cut in half
- Wooden blocks to support the trays (2x4 will work)
- Water

Advance preparation: If you choose to plant grass seed in one of the trays, you should do so several weeks in advance. Otherwise, prepare trays in advance with soil and sod, and assemble other materials needed.

Directions:

1. Drill a small hole at the end of each tray at the center just above a line ~ 1 inch up from the bottom.
2. Cut a plastic cup in half and duct tape it just below the drilled hold on the outside of the tray. This will serve as a funnel during the experiment (See photo)
3. Fill one tray with potting soil up to the bottom of the drilled hole.
4. For the second tray, cut or dig up a piece of sod/grass to fill the container. The bottom top of the soil should come to just below the drilled hole. If the sod is too shallow, fill in soil below the sod to reach the appropriate level. Alternately, fill up to the drilled hole with potting soil and then spread evenly a thin layer of rapid-growth grass seed over the entire area. Gently press the seed into the soil; then place the seeded tray on a sunny windowsill. Using the watering can,

gently water the grass seed daily. When the grass is firmly rooted, you are ready to conduct the experiment.

5. Place both trays side-by-side on a table with the ends with the holes lined up near the table edge. Place a wooden block under each tray at the end opposite the one with the hole. This should prop up the tray enough to create and angle that will allow the water to flow out the hole in the tray.
6. Place a bench (or buckets) at the end of the table to serve as a platform for two coffee cans, which will serve as water catchments for water draining from the two trays. (See Photo)
7. Rest a strainer on top of each coffee can and place 1 coffee filter in each strainer. This will help you assess the amount of sediment being washed off your two different experiments.
8. Using the watering can, gently pour about 500ml of water over the tray containing just the soil. When the water stops draining through the coffee filter, scrape the soil from the filter into the measuring cup. Measure the amount of soil that was lost due to runoff. (You may need to use more water (1500-2000ml), depending on how dry your soil is.) You may find that the dirt cogs the hole when you pour in the water- be prepared to periodically clear it out.
9. Next, pour the same quantity of water over the tray with grass. Measure the amount of soil runoff from this tray and record these results. Compare results from the two trays. Which one lost more soil?
10. As a group, discuss how rivers and other bodies of water can be affected by surrounding areas with and without plant cover.


Notes: You may not need a measuring cup to determine the amount of dirt that was washed off. You can see which tray had more dirt runoff by looking at the filters. However, if you want to be more scientific with the experiment, you can certainly measure the dirt.

WATCH this Activity!

IWLA staff filmed a training video of this activity to assist educators! Watch the demonstration by clicking this link www.youtube.com/watch?v=eTrvrZ9YIok or find it on our Creek Freaks website at www.creekfreaks.net/training

Let It Rain

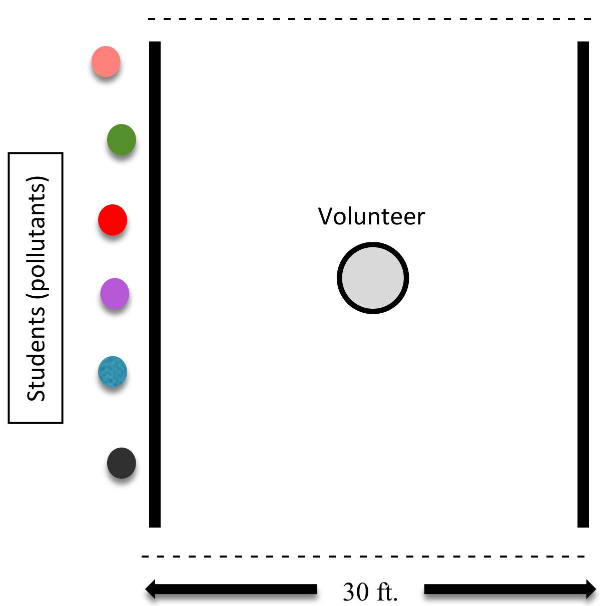
(Environmental Education version of freeze tag)

Suggested use: This activity can be used on its own, or paired with lessons from the Creek Freaks Curriculum downloadable at www.creekfreaks.net/library Use with Filter Plants activity, Erosion in the Zone, or in conjunction with stream monitoring activities to explain how plants in the riparian zone filter pollutants out of rain runoff before that water gets to the stream. This is also an excellent activity to pair with a planting project.

Time: 20 – 30 minutes

Objective: Through this running game students will learn about how riparian buffers (trees, shrubs and native grasses growing along the stream bank) work, and the importance of restoring them to protect and improve water quality.

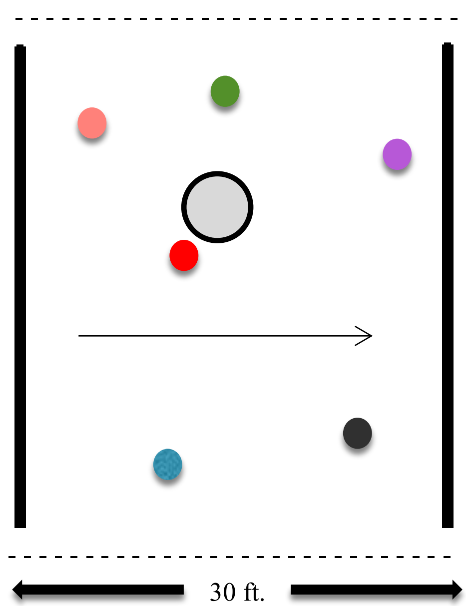
Materials: Tape, rope, or cones should designate two safe lines on the ground opposite each other about 30-40 feet (shorter or longer depending on how active the students are and space available)



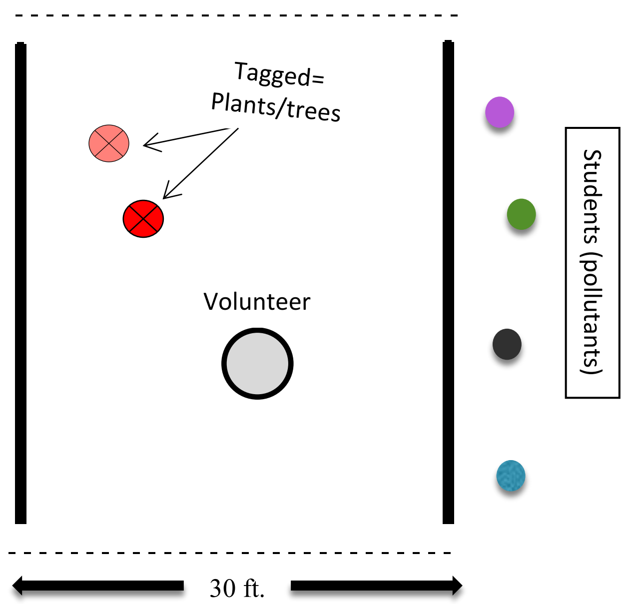
Directions:

1. Line all of the students up behind one of the safe lines, next to each other facing the other safe line (they will be running back and forth). Also define the boundaries on either side so students don't run out-of-bounds to avoid being tagged.

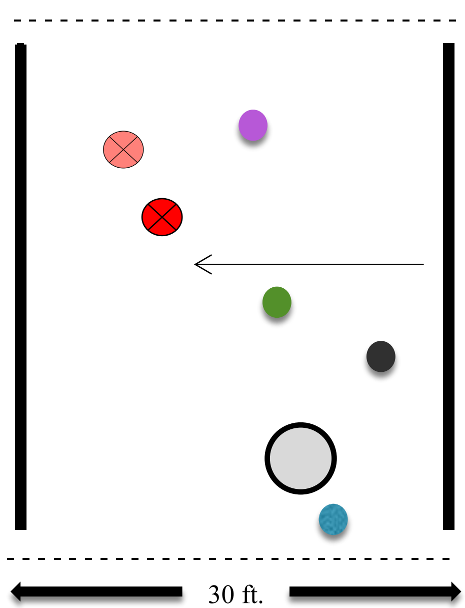
2. Talk to the students about riparian buffer functions (food, filter, flood control, habitat). Refer to **Background** section for information to share with students. Explain to them that they are now going to experience how the riparian buffer works as a filter.
3. Ask for one volunteer.
4. Explain to the students remaining behind the safe line that they are now pollutants such as sediment, nutrients, and toxins. Depending upon time available, you can use this as an opportunity to review types of pollution by having them choose what types of pollution they want to be. Ask them where these things go when it rains. (Downhill, into the stream).
5. Tell everyone that your volunteer is actually a local Izaak Walton League volunteer and is embarking on a stream-side buffer planting project.
6. When the "volunteer" says "Let is Rain", all of the sediment, nutrients, and toxins must run to the other side of the playing field. They are safe when they cross over the safe line. Remind them that they cannot go outside of the boundaries to the left and right of the playing field (imagine the boundaries are a box). While running, the "volunteer" tries to tag as many people as s/he can. If someone is tagged they must stop and remain where they are.



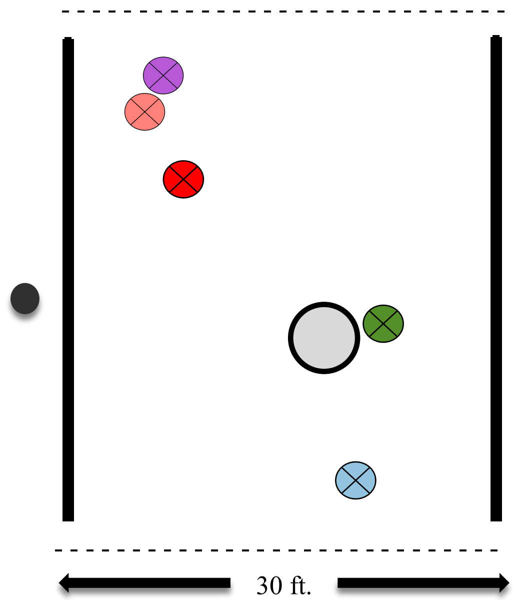
7. After the first round, explain to all of the students that those who were tagged and remain in the field are now streamside plants and trees. Ask the students if plants and trees can move, explain that because of their roots, they must remain where they are.



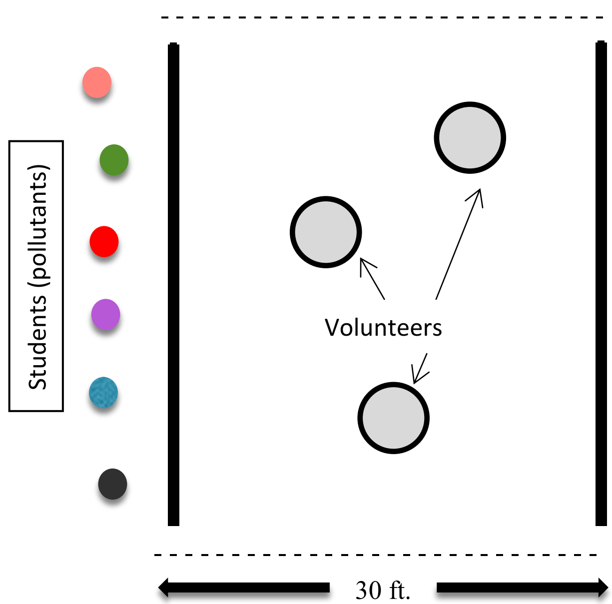
8. In the second round, and thereafter, when the "volunteer" says "Let it Rain" s/he can continue to run and tag the other players as they run to the other base line. The plants/trees cannot move their feet, but they can help the volunteer by tagging anything that gets close enough to them for them to reach with arms outstretched. This helps to demonstrate that the plants/trees help to trap things such as sediment, nutrients, and toxics, thus keeping them from running off into the waterways.



9. Anyone tagged on the second round stops where they are tagged and becomes a plant/tree.
10. Continue going back and forth until only 1 piece of run-off remains.



11. This remaining person now becomes the volunteer. Ask the original volunteer if it was hard restoring the riparian buffer by him/herself (they should say it was a bit tiring). Ask them if they think it would have been easier if they had had some help from their friends and other volunteers.
12. Let the new volunteer choose 2 other volunteers to help him/her. Play again with all 3 volunteers being able to run and tag.



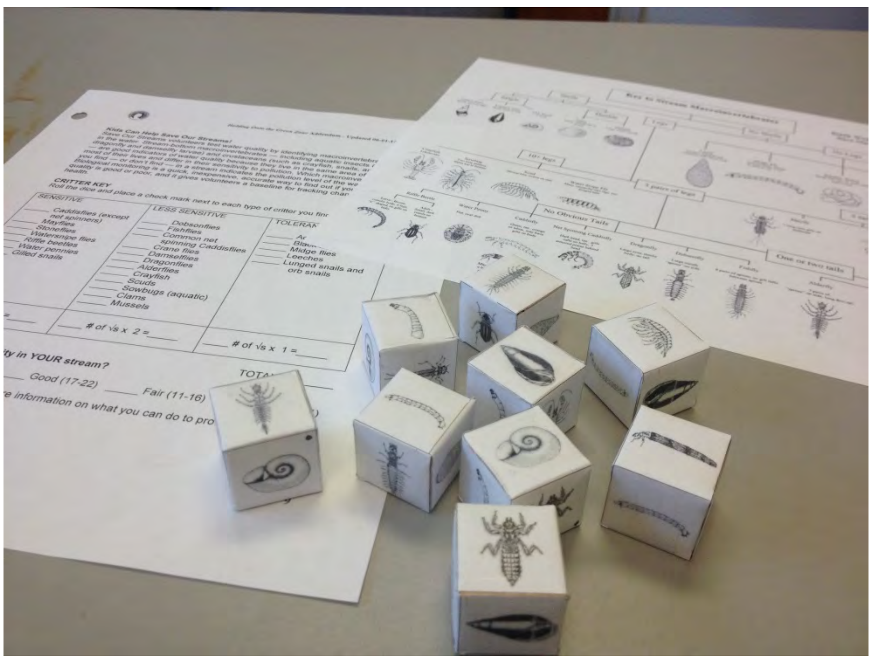
13. Discuss observation with students. Students should observe that starting with 3 volunteers reduces the amount of time and effort needed to reduce the pollutants.
14. If time permits, and depending on the number of students, try again with 5 volunteers.

Background: Riparian vegetation protects water quality, for example, by serving as a buffer. Plants trap some of the sediments and other pollutants that are in runoff and keep them out of the stream. Healthy riparian soils that are filled with plant roots and enriched with humus absorb and store moisture. Plants stabilize stream banks and improve stream habitat for fish and other water creatures. Grasses, shrubs, trees, and other plants provide food and cover for domestic animals and wildlife.

Follow up Question:
Ask the students why stream buffer/riparian zone protection and restoration are important.

Don't Forget:
This game also encourages students to take action in restoration and planting projects…give them direction on how they can help, what they can do…call their local Izaak Walton League chapter and see if there are any projects they can help volunteer with, etc.

Creek Freaks Curriculum



Water Quality Monitoring - Preparation

CATEGORY: WATERS

CAN YOU SEE WATER POLLUTION?

Learning Objectives

To learn about water pollution and how to detect it.

Materials

Five clear glasses, sample of stream water (taken within 24 hours of the activity), isopropyl (rubbing) alcohol, food coloring, tap water (preferably from a municipal system), bottled spring water, tape/labels and a permanent marker (to label glasses with water samples), paper (either pads of paper, a sheet of paper on a clipboard, or note cards), and pens/pencils.

Activity Description

Before this activity begins, prepare five glasses with water samples. Label each glass with a capital letter and fill the glasses with the following samples:

- Glass A: Tap water
- Glass B: Bottled spring water
- Glass C: Tap water with a few drops of food coloring (enough to distinctly color the water)
- Glass D: Tap water with a capful of rubbing alcohol
- Glass E: Stream water

Ask the children to look at the glasses and decide which ones contain polluted water. Depending on the number of participants, you can have the children work in teams of 5 to 6 (which means you will need one set of samples for each group) or this can be done as a demonstration for the entire group. Tell the children that they should use their senses of smell and sight to judge the water quality.

Caution: Tell them **not** to taste any of the samples (they could get sick).

Have the children record their observations about each glass of water. Ask them to write down why they believe certain glasses of water are polluted and others are not. Then discuss the answers.

Discussion Questions

Which water samples do you think are polluted and why?

Answer(s): *Responses will vary.*

Is using sight and smell the best way to determine if water is polluted?

Answer(s): *No. Although smell and sight give you clues about potential pollution problems, they don't provide all the answers — and can even be misleading.*

That's why the Izaak Walton League developed the Save Our Streams program and Creek Freaks project for kids — to test water quality using science.

For example, finding out which insects and other underwater creatures can survive in the water will tell you a lot about the water quality. The water is not "polluted" because it has bugs in it. Some insects can only live in clean water! An unusual color may or may not mean there's a problem — perhaps an odd-colored soil washed into the water that day. You can use simple tools to measure chemicals and oxygen in the water to find out if the water is healthy for fish and wildlife — and you!

Before you jump into a creek, you can use your sense of sight and smell to look for clues to water pollution. If you do find a stream with an unusual color or a bad smell, tell an adult about it and ask them to call the county or city authorities to check it out — it could be a sign of pollution and may not be safe to play in. But to be sure about the quality of your water, you need to use scientific experiments, like the ones in League programs.

Following are specific talking points for each of the five samples.

Glass A: **Tap water** can be considered "polluted" because it contains chlorine, which is added to tap water in most parts of the country to make it safe to drink. Although chlorine is needed to kill bacteria in the water that could make you sick, chlorine is extremely toxic to fish and other aquatic life — if a pipe leaked chlorinated tap water into a stream, the chlorine would kill many of the fish and other aquatic animals living there.

Glass B: Some companies get their **bottled water** directly from mountain springs that are generally free from pollution — at least as far as fish and wildlife are concerned. However, these companies do not have to test spring water to make sure it is safe for drinking, so it may be safe for fish but not for you!

Many bottled water companies are now selling treated tap water — and even untreated tap water — in plastic bottles. If this tap water contains chlorine, it would be considered "polluted" for wildlife.

Glass C: **Tap water with food coloring** may "look" polluted because it has an odd color, but unusual colors are not always a sign of pollution problems. The color could be caused by dirt that washed into the stream — or by chemicals dumped there. The only way to know is to test the water.

Glass D: **Tap water with rubbing alcohol** looks clean but smells terrible. It obviously is polluted, even though it looks perfectly clear. Smells like this could be caused by sewage, chemicals, or natural gases. However, this is just a first clue in finding out whether the water is polluted.

Glass E: **Stream water** should look a little dirty and have plenty of life in it — plants, insects, other aquatic animals. If the water is very muddy or dark, it probably has too much dirt (also called sediment) for fish and other aquatic animals to survive. This sediment can clog fish gills, smother fish eggs, and block the sunlight that water plants need to grow.

What did you learn about detecting water pollution? Name some types of pollution that could harm your stream.

Answer(s): *Just because water looks clean does not mean that it is clean and healthy — and just because water has dirt or bugs does not mean it is polluted.*

There are two basic types of pollution. The first kind of pollution comes from factories or industrial plants. This is usually easy to find and fix. The second kind comes from many sources and can be hard to identify, such as oil leaking from cars, dirt that washes away from construction sites, trash, and pet waste. Some of these we can see (like an oil slick on the water or a plastic bottle floating downstream) and some we can't see (such as chemicals that wash into the stream from someone's lawn).

How do these pollutants get in the water?

Answer(s): *Pollutants get into water by accidental spills, illegal dumping, or rainfall runoff that collects pollutants from the air and ground surfaces such as streets or farm fields and carries them into local waters.*

Are any of these pollutants in your (this) stream? Can you guess which of these might be a threat to the stream?

Answer(s): *Responses will vary.*

Estimated Time

15 to 30 minutes. Preparation time may vary, but allow for another 30 minutes to gather materials and organize samples.

Ages

Recommended for ages 5 to 8.

No adjustments needed for ages 9 to 11, although you can discuss potential pollutants and their impact in more detail.

For youth 9 to 11 and older, you can introduce the terms "point source pollution" for pollution from factories and "non-point source pollution" for pollution from farms, yards, and streets.

Credits

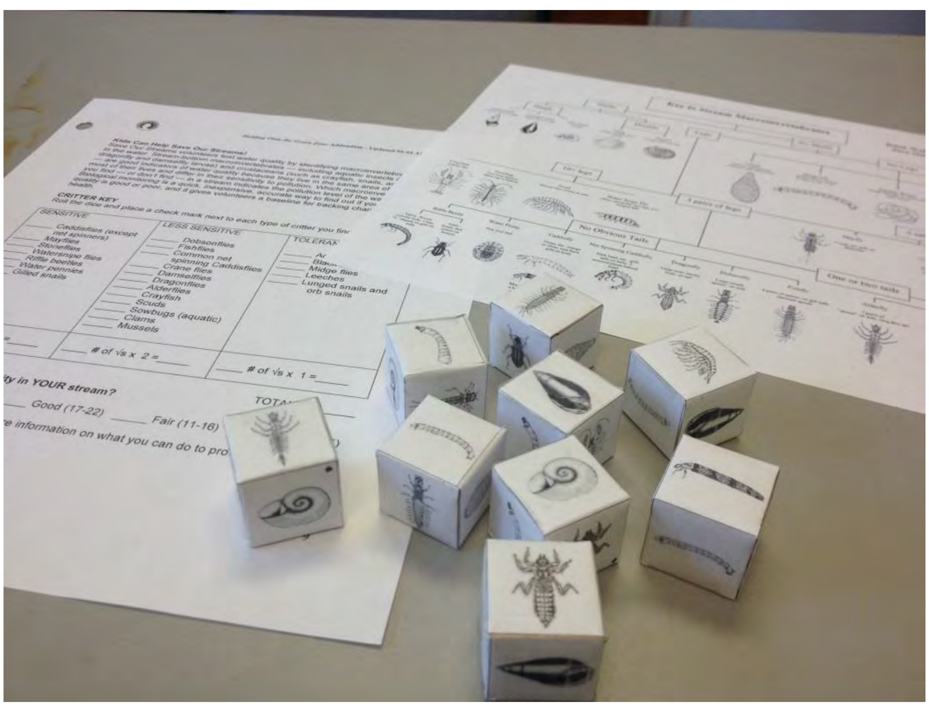
Adapted from "Measuring Stream Health Activities" from the *Hands On Save Our Streams — The Save Our Streams Teacher's Manual,* by the Izaak Walton League of America, 1994.

Critter Cubes

Macroinvertebrates, commonly defined as aquatic insects and crustaceans are indicators of water quality. Macroinvertebrates have different sensitivity to pollution and therefore can indicate good or poor water quality. By sampling them, scientists are able to determine the "health" of a stream. The macroinvertebrates live in the same place in a stream for a few months, and can therefore give an accurate picture of the water quality over a longer period of time, compared to a chemical test which simply gives a snapshot of the water quality at the moment you took the sample.

Background

Riparian specialists use a variety of methods to test the quality of surface water in a riparian area, including water clarity testing, chemical testing, and biological testing. Biological testing usually involves a macroinvertebrate survey. Some macroinvertebrates (water insects, worms, clams, crayfish, and snails) are more sensitive to water pollutants than others. Finding a number of the sensitive organisms in field-testing would indicate that the local aquatic ecosystem is healthy and, therefore, the riparian zone is functioning well.



Critter Cube Count

The object of the Critter Cube Count is to determine a water quality score for an imaginary stream. This version, modified from the GREEN Zone guide, uses the same water quality rating system as the Izaak Walton League's Save Our Streams biological monitoring method. The Save Our Streams monitoring method allows students to determine the water quality of a local stream using macroinvertebrates (insects and crustaceans that live under the water). To actually use this method, you would go to a stream, collect macroinvetebrates in a net, and then identify them. You would record the types of critters found. The results can help you predict if your stream is healthy or polluted. This game simulates the process of identifying and recording the macroinvertebrates caught in the net. Each pair of students will get a set of 9 critter cubes in a bucket or other small container. Students shake up the bucket and dump it onto a table or the floor. The pictures on the cubes that face up, simulate the bugs found that would be found in their net if they had collected the critters from a stream. Students identify the critters using the identification key and record what they found on the tally form. They then use the tally form to calculate the numeric and descriptive water quality rating. Students can play the game several times to see the different water quality ratings that can occur depending upon the pollution tolerance and diversity of the critters in their sample.

Description: Learners will determine a water quality score for an imaginary stream by counting macroinvertebrates in a cube game. This activity gives learners a chance to practice gathering and using information to make judgments about the quality of water.

Duration: 15-30 minutes

Skills: Calculating, describing, identifying, interpreting, recording

Objectives: Learners will be able to use macroinvertebrate data to evaluate stream health.

Materials:

- Critter Key- 1 copy per student/group
- Key to Stream Macroinvertebrates- 1 copy per student
- Nine critter cubes (see instructions in "Advance preparation")
- An ice cream bucket or similar container (to shake up cubes-think Yahtzee)
- A clear, flat surface like a card table or a clear area on the floor
- Scissors and tape or glue
- Pencils for data forms

Advance preparation:

- Make copies of the Critter Key (below) and *Key to Stream Macroinvertebrates* for each team/student
- Make, or have students make, the critter cubes. Use 9 wooden blocks, 1in square. (Can be ordered from www.craftparts.com) Make copies of the Critter Cube templates below. You can have students make sets that vary in their pollution sensitivities by using the three different sets provide. Cut out each of the T shaped templates and tape or glue them around the wooden cube.

Critter Key

Kids Can Help Save Our Streams!
Save Our Streams volunteers test water quality by identifying macroinvertebrates living in the water. Stream-bottom macroinvertebrates — including aquatic insects (such as dragonfly and damselfly larvae) and crustaceans (such as crayfish, snails, and clams) — are good indicators of water quality because they live in the same area of a stream most of their lives and differ in their sensitivity to pollution. Which macroinvertebrates you find — or don't find — in a stream indicates the pollution level of the water. Biological monitoring is a quick, inexpensive, accurate way to find out if your water quality is good or poor, and it gives volunteers a baseline for tracking changes in stream health.

CRITTER KEY
Roll the dice and place a check mark next to each type of critter you find.

SENSITIVE	LESS SENSITIVE	TOLERANT
_____ Caddisflies (except net spinners) _____ Mayflies _____ Stoneflies _____ Watersnipe flies _____ Riffle beetles _____ Water pennies _____ Gilled snails	_____ Dobsonflies _____ Fishflies _____ Common net spinning Caddisflies _____ Crane flies _____ Damselflies _____ Dragonflies _____ Alderflies _____ Crayfish _____ Scuds _____ Sowbugs (aquatic) _____ Clams _____ Mussels	_____ Aquatic worms _____ Black flies _____ Midge flies _____ Leeches _____ Lunged snails and orb snails
____ # of √s x 3 =_____	____ # of √s x 2 =_____	____ # of √s x 1 =_____

TOTAL: ________

What's the water quality in YOUR stream?

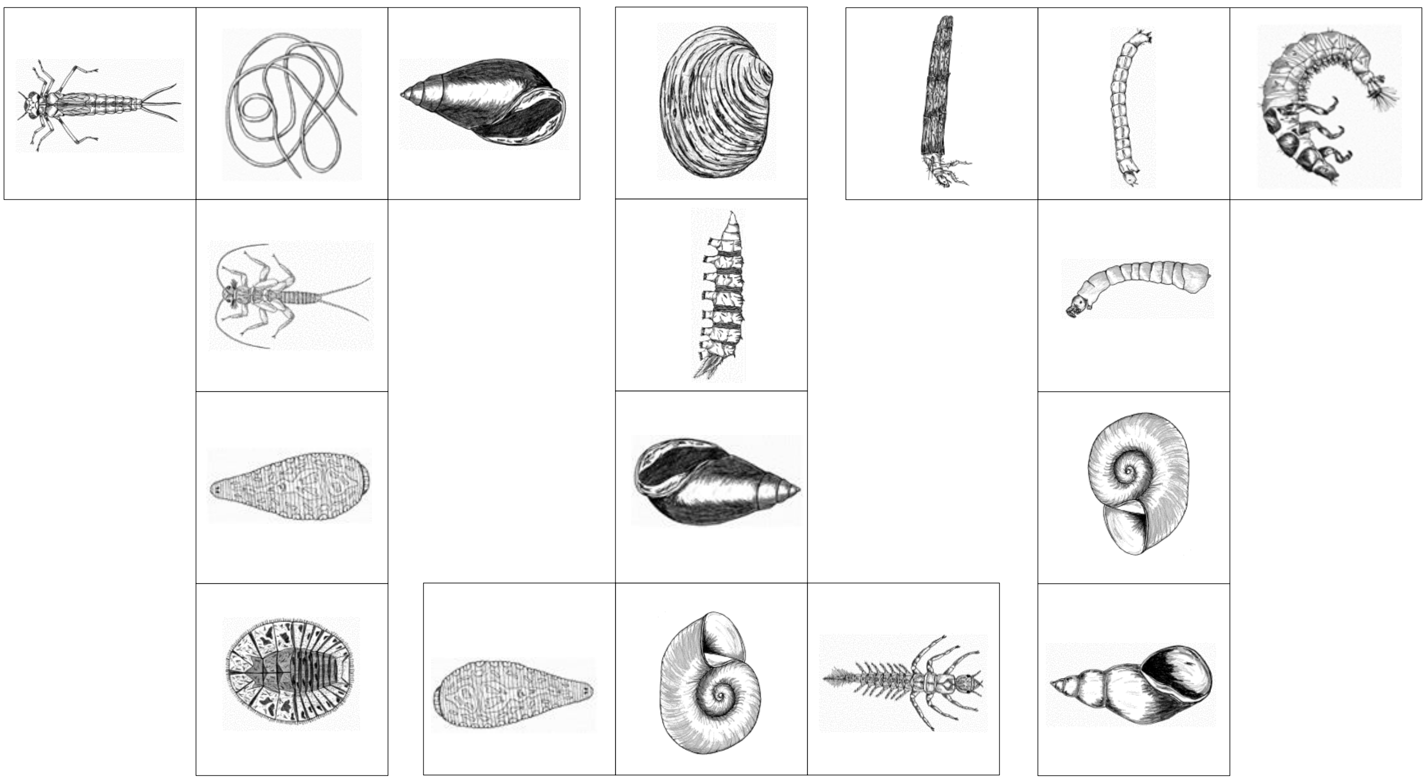
_____ Excellent (> 22) _____ Good (17-22) _____ Fair (11-16) _____ Poor (< 11)

Visit *www.iwla.org/sos* for more information on what you can do to protect streams in *your* neighborhood!

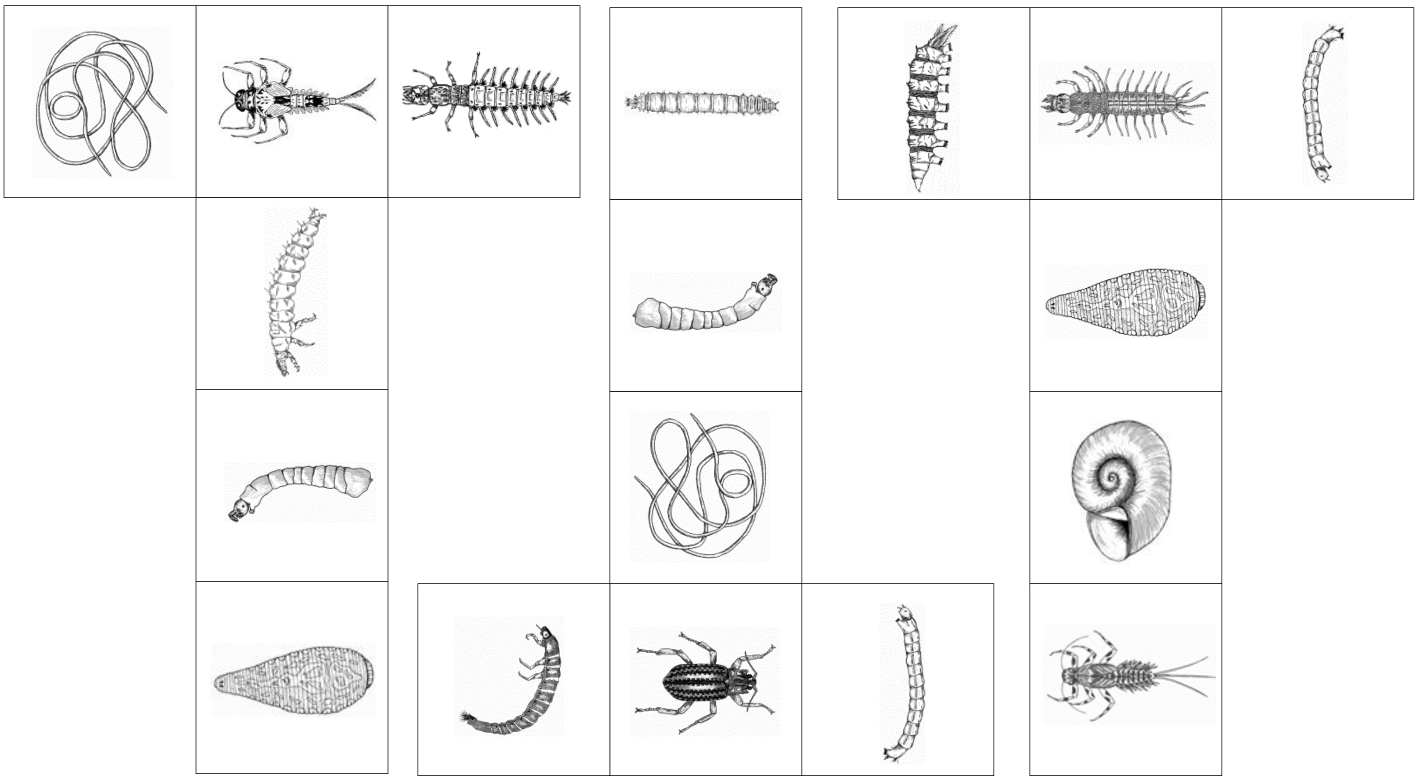
Critter Cubes Set 1

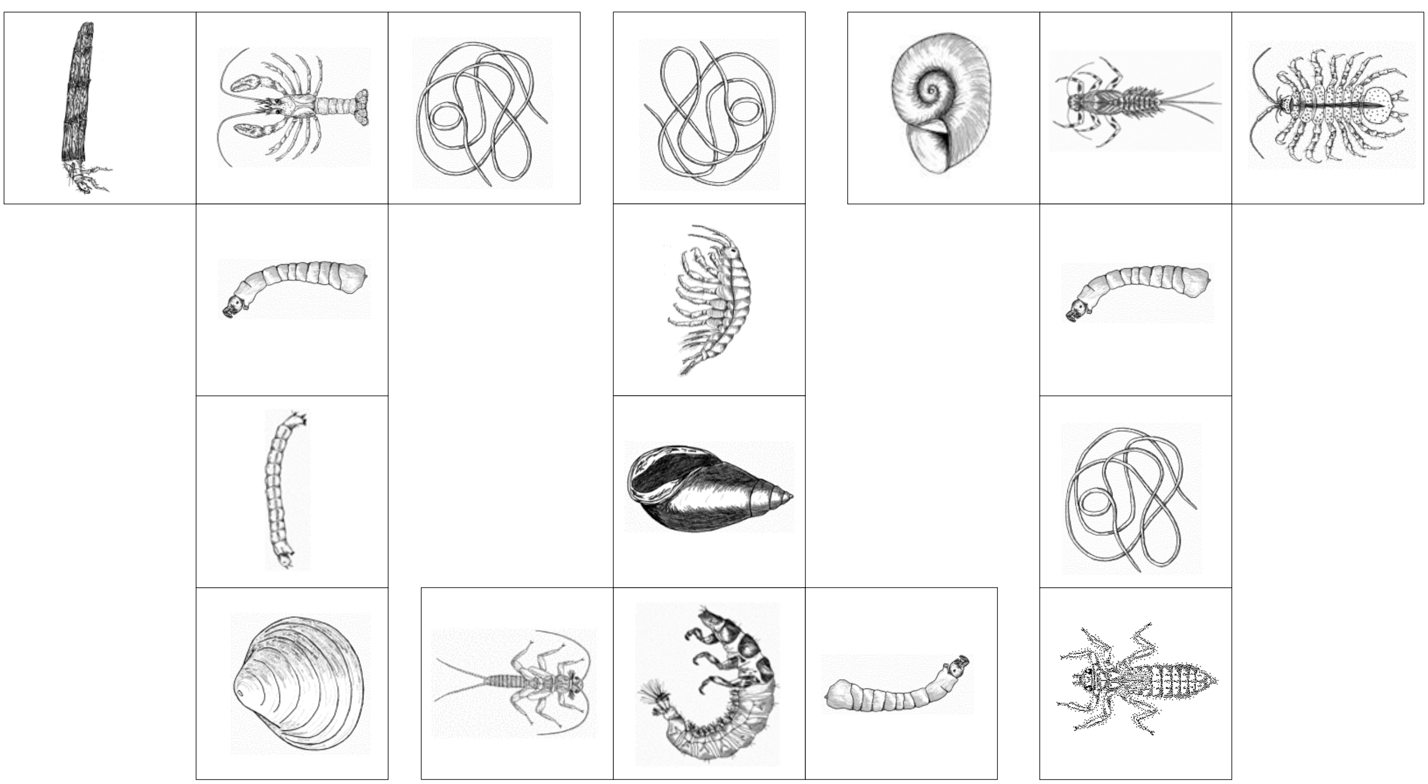
Fair/Good-This set of Critter Cubes generally gets a Fair to Good water quality score. Use this to represent an average stream.

Directions: Cut out the T shaped blocks and tape or glue them around a 1x1in wooden block. **Print this out on colored paper to make sure this set of 9 cubes stays together.** Wooden blocks can be ordered at www.craftparts.com



Critter Cubes Set 1 (Fair/Good) Continued…

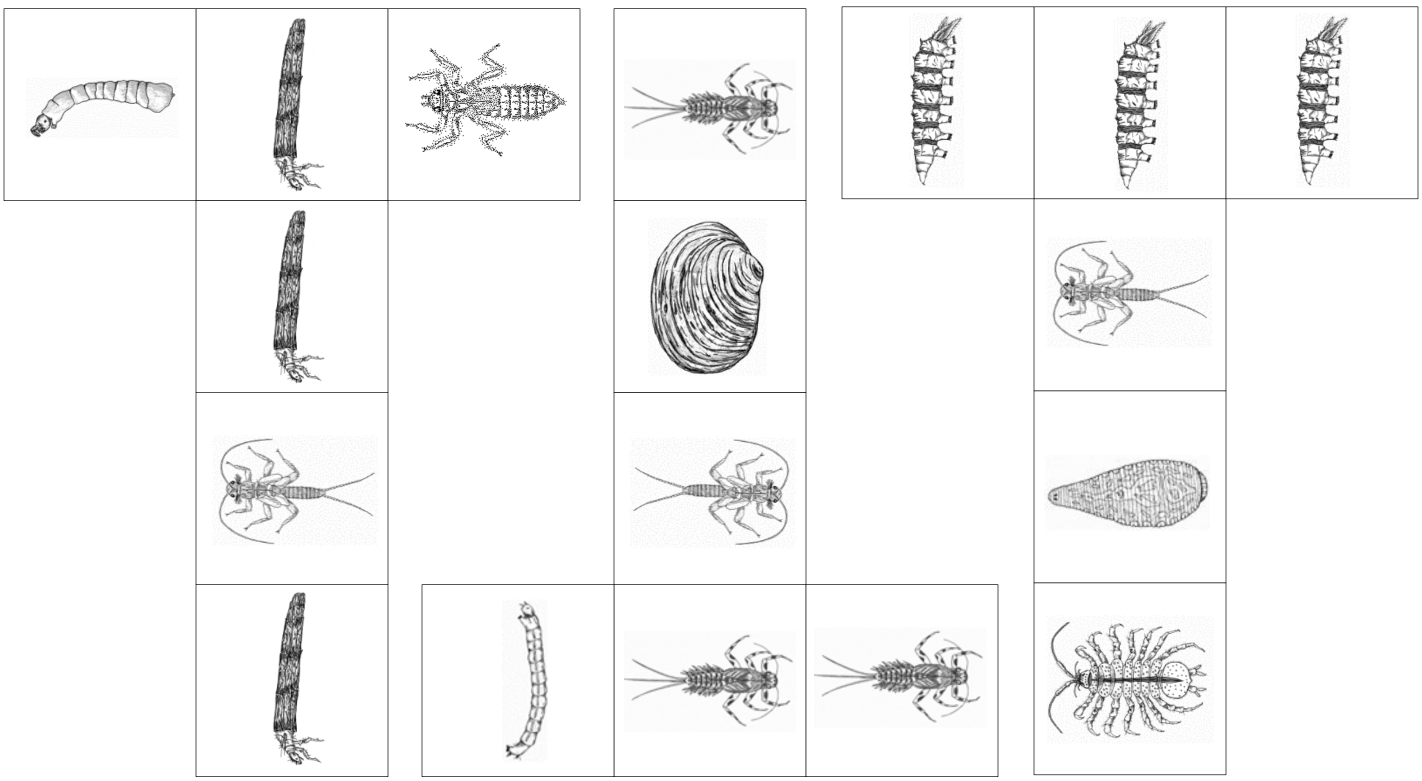




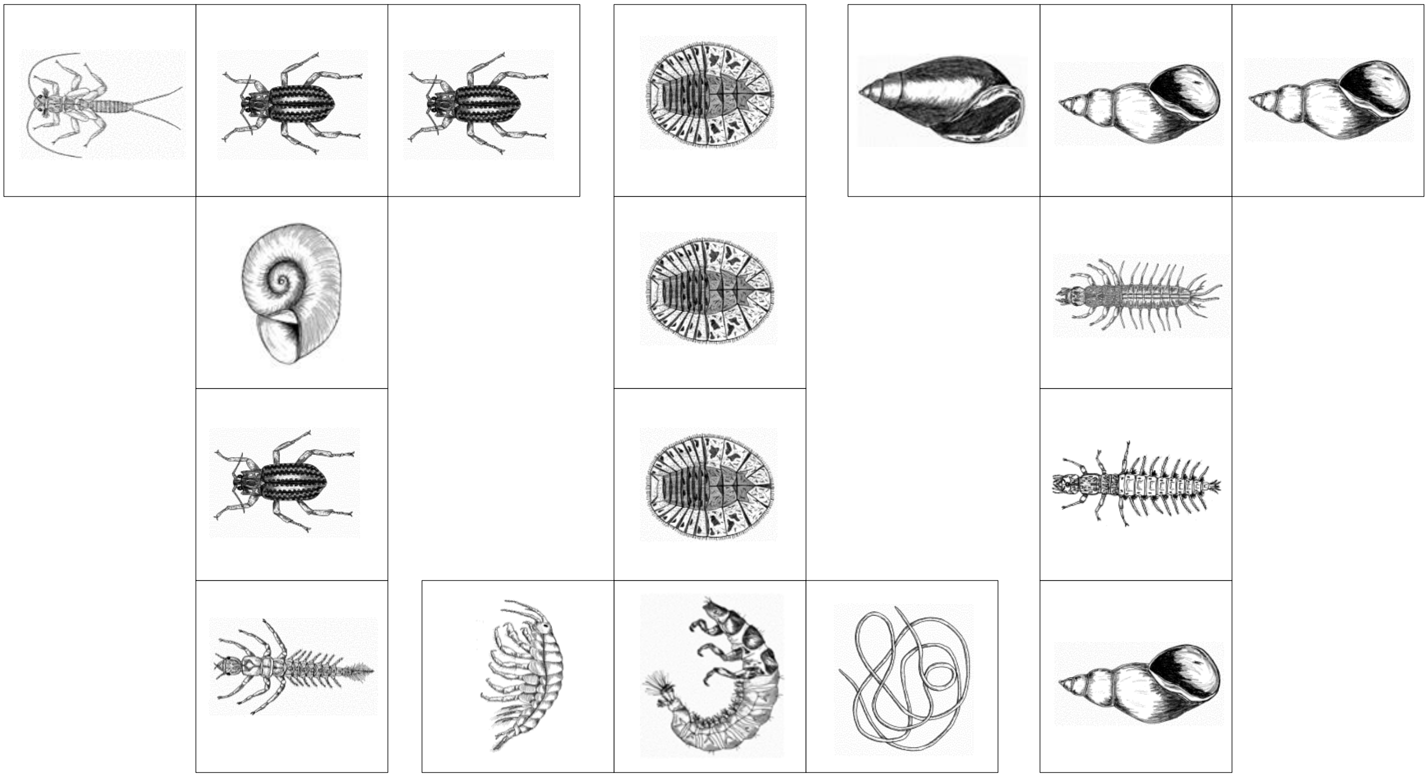
Critter Cubes Set 2

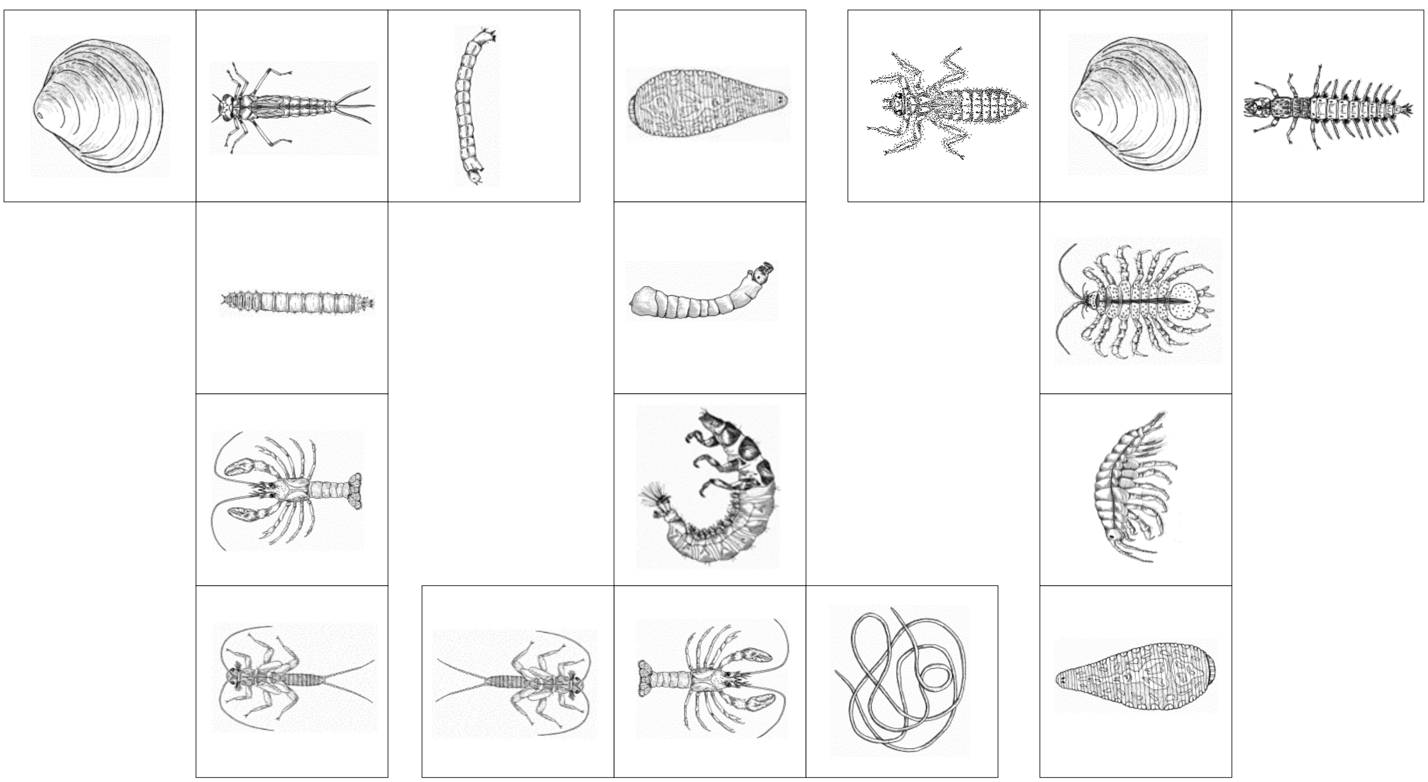
Good/Excellent-This set of Critter Cubes generally gets a Good to Excellent water quality score. Use this to represent a stream with very good water quality.

Directions: Cut out the T shaped blocks and tape or glue them around a 1x1in wooden block. **Print this out on colored paper to make sure this set of 9 cubes stays together.** Wooden blocks can be ordered at www.craftparts.com



Critter Cubes Set 2 (Good/Excellent) Continued…

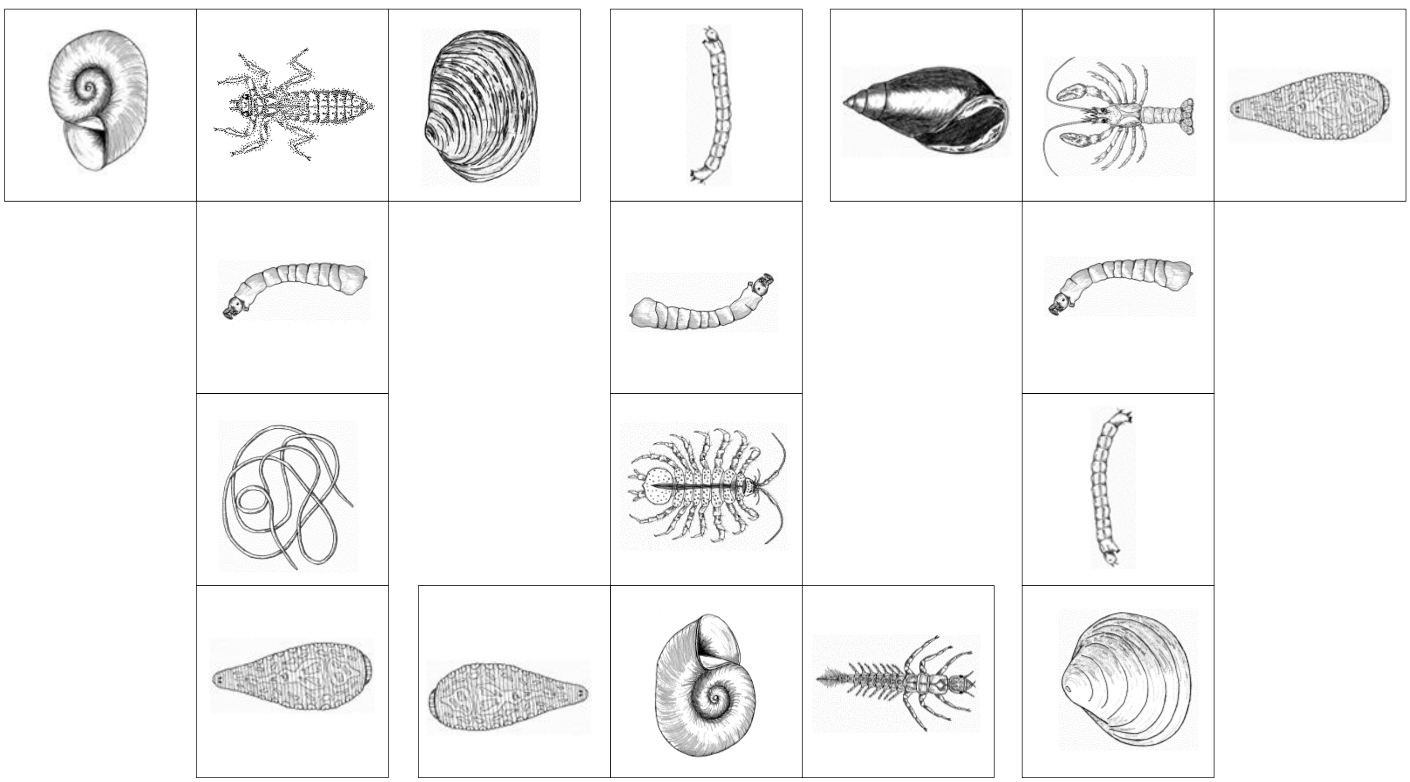




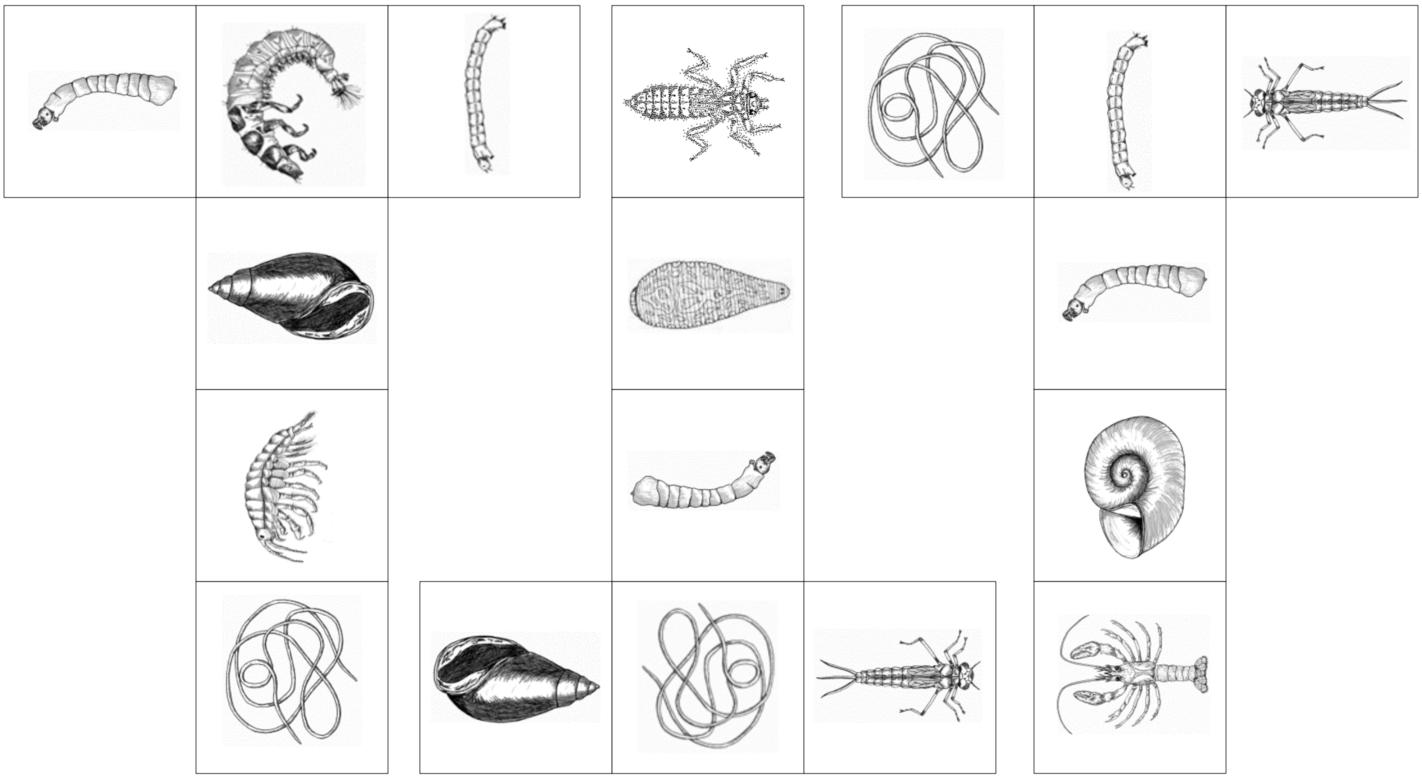
Critter Cubes Set 3

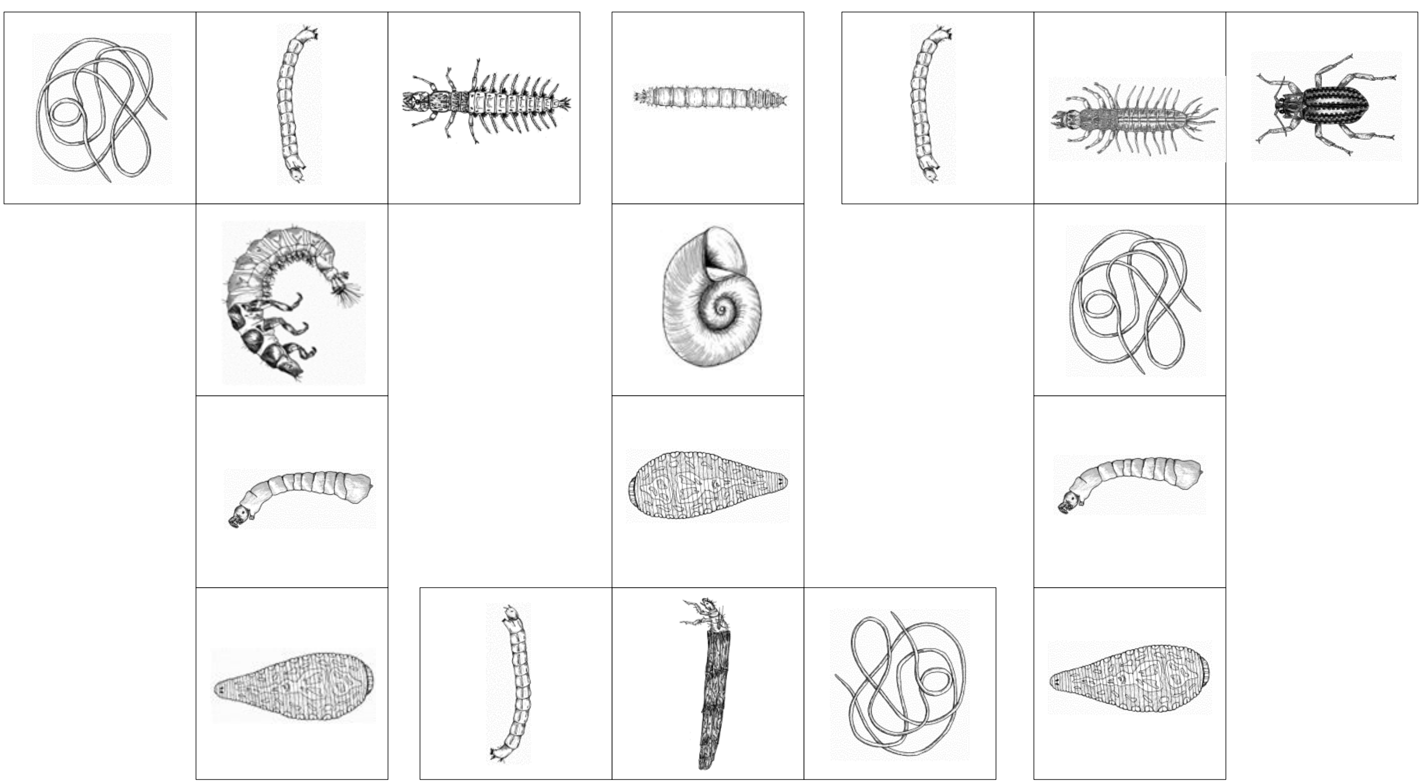
Poor/Fair-This set of Critter Cubes generally gets a Poor to Fair water quality score. Use this to represent a stream with poor water quality due to pollution.

Directions: Cut out the T shaped blocks and tape or glue them around a 1x1in wooden block. **Print this out on colored paper to make sure this set of 9 cubes stays together.** Wooden blocks can be ordered at www.craftparts.com



Critter Cubes Set 3 (Poor/Fair) Continued…





Extension Activity

1) **Stream Creature Construction: IWLA Youth Activities**
   Students are able dress a classmate (or teacher!) up as a macroinvertebrate. They use everyday materials to give their classmate adaptations to catch food, move around on the stream bottom, camouflage or protect themselves, lay eggs, and keep from getting washed away. Alternately, students can create a macroinvertebrate from a toilet paper, or paper towel roll and add craft supplies to give it adaptations. See instructional material in the following pages.

Youth Activity

STREAM CREATURE CONSTRUCTION

Riffle Beetle Larva

A "macroinvertebrate" is an animal with no backbone that you can see without using a microscope. Stream-bottom macroinvertebrates — including aquatic insects (such as dragonfly and damselfly larvae) and crustaceans (such as crayfish, snails, and clams) — are good indicators of water quality because they live in the same area of a stream most of their lives and differ in their sensitivity to pollution. Which macroinvertebrates you find — or don't find — in a stream indicates the pollution level of the water.

How do these creatures survive and stay in one place when swift-flowing water is moving all around them? That's what the children will find out.

Learning Objectives

To learn how stream-bottom macroinvertebrates are adapted to their swift-water habitat.

Materials

Craft materials and tools for making stream creatures. For example: Construction paper, tape, yarn, scissors, pipe cleaners, balloons, straws, crayons, egg cartons, cardboard tubes.

Activity Description

Organize the youth into teams of three or more and ask a member of each team to volunteer to be a stream creature. (Alternatively, each team can decide together who should be the "creature.") Ask the rest of the team members to make the volunteer into a critter that can do the following in moving water:

- Catch food.
- Move around on the stream bottom.
- Camouflage or protect itself.
- Lay eggs.
- Keep from getting washed away.

Now the fun begins! Teams should use the materials at hand to create and attach body parts and construct their critters. Provide a time limit for the construction phase, depending on the age group (approximately 10 to 15 minutes). Once all the teams are done, ask each team to name their creature and explain its adaptations — changes that allow it to survive and thrive in fast-flowing streams. Depending on your groups, you could consider having a critter "fashion show," with the children walking down a pretend runway to show off their designs.

ILLUSTRATIONS BY PETER GROSSHAUSER

Net-winged Midge Larvae

Whirligig Beetle Larva

Net-spinning Caddisfly Larva

Black Fly Larva

Water Penny

You can then show the youth a few examples of interesting stream adaptations from sources such as IWLA's *The Guide to Aquatic Insects and Crustaceans* or *Pond Life, A Golden Guide*. Examples might include

- Caddisfly larvae, which live in little houses made of sand, pebbles, and tiny twigs to hide from fish and other predators.
- Net-spinning caddisfly larvae, which construct underwater webs to catch their food.
- Black fly larvae, which attach to rocks and sticks using little suckers on their abdomens and move by drifting downstream on silken threads that come out from tips of their abdomens.
- Water penny beetles, which have flat bodies that allow them to move around on rocks without washing away.

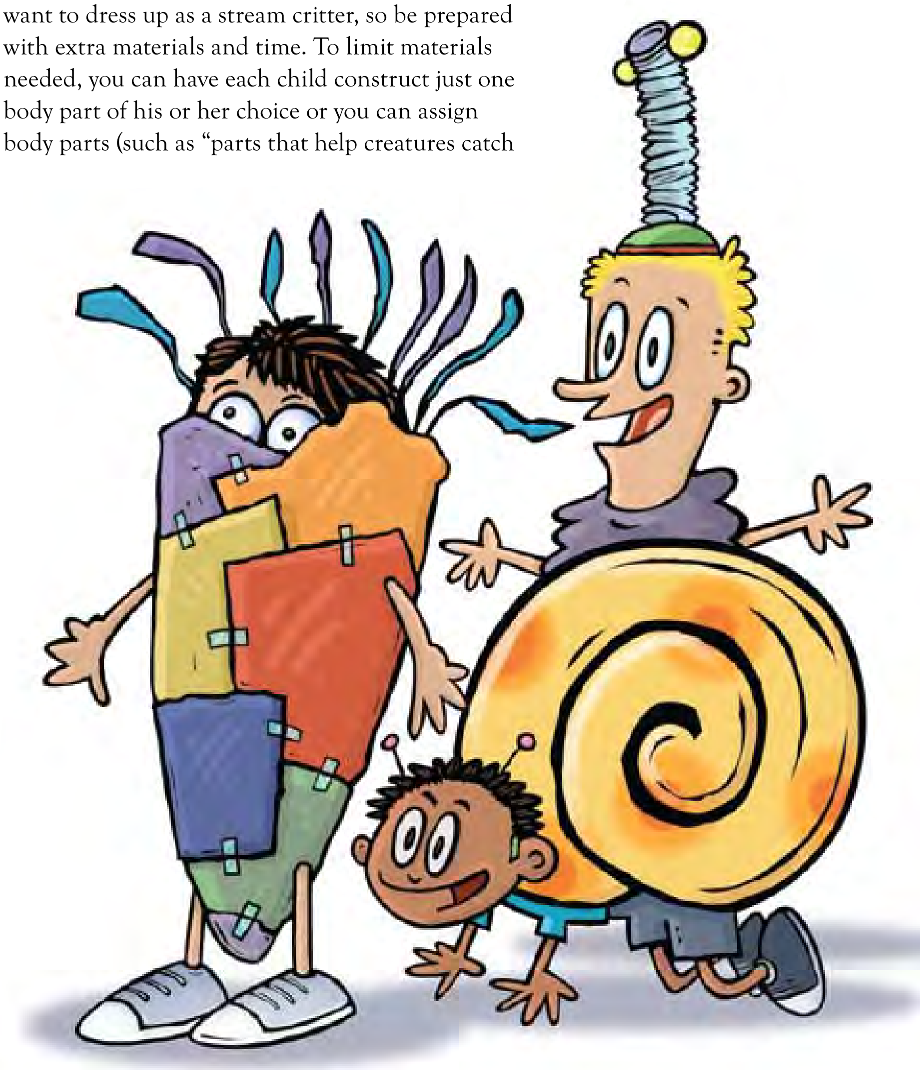
RELATED SOURCES

A Volunteer Monitor's Field Guide to Aquatic Macroinvertebrates Field Charts, by the Izaak Walton League of America, 2002.

Pond Life (A Golden Guide), by George Reid, St. Martins Press, 2001.

The Guide to Aquatic Insects and Crustaceans, by the Izaak Walton League of America, Stackpole Books, 2006.

Options: Depending on their ages, every child may want to dress up as a stream critter, so be prepared with extra materials and time. To limit materials needed, you can have each child construct just one body part of his or her choice or you can assign body parts (such as "parts that help creatures catch



food under water”). You can also have the children construct mini-macroinvertebrates — small critters that they can show and share.

Discussion Questions

If you have a guide and the children were able to look through it, ask: Did the creature that you invented look like any aquatic creature that you saw in a book? If so, which one(s)?

Answer(s): *Will vary depending on what aquatic creatures are invented. Discuss not just the appearance of creatures in the book but what survival techniques they use that are similar to ideas the youth had (such as different ways to cling to rocks in the water).*

Want more great youth activities like this one? Check out the IWLA *Engaging Youth in the Outdoors* manual!

Point to the pictures of some aquatic creatures and ask: How is this creature adapted to its aquatic lifestyle?

Answer(s): *Will vary and might include:*

- *Long legs covered with hairs that trap air bubbles and enable water striders to float on top of the water.*
- *Bifocal eyes for whirligig beetles, so they can look above and below the water’s surface.*
- *Long legs for swimming used by water boatmen and backswimmer insects.*
- *Camouflaged houses made by caddisfly larvae.*
- *Extendable mouthparts that dragonfly larvae use to snag their insect prey.*

Estimated Time

30 minutes.

Ages

Recommended for ages 5 to 8. Equally applicable for ages 9 to 11. In addition, with this age group you can spend more time looking at illustrations of stream-bottom macroinvertebrates and start talking about which ones can only live in clean water and which thrive in polluted waters.

Credits

Adapted from *Hands-On Nature*, edited by Jenepher Lingelbach, Vermont Institute of Natural Science, 1986.

Creek Freaks Curriculum

Water Quality Monitoring – In the Field

Safety and Fun in Your Watershed

There are several important things to remember when you are working outside. If you follow these safety tips, you will have a fun and enjoyable experience.

BEFORE YOU GO

Remember to tell a friend or relative the date, time, and location of your watershed activity. Work with a partner so if you are injured, someone can go for help.

Find the phone number and location of the nearest medical center to your work site. Carry a cellular phone with you and note the location of a pay phone. Remember that cell phones do not always work in rural areas, so do not rely on them at all times.

Bring a first aid kit that includes these items:

- Adhesive and cloth bandages
- Antiseptic spray or ointments
- Surgical tape
- Hydrogen peroxide
- Tweezers
- Cotton balls
- Aspirin or non-aspirin pain reliever
- Bee-sting neutralizers

Review safety rules and tips with everyone in your work group before each outdoor project.

SAFETY RULES

The League recommends that groups never get into a stream when the water is at flood stage or is flowing much more swiftly than normal. It is better to delay monitoring or cleanup projects than to risk personal harm. Water should always be below the knee level of the people who will be in the water. Remember that the knee level of children may be much lower than the knee level of adults. Avoid steep and slippery banks.

When in contact with water, keep your hands away from your eyes and mouth, as not all pollution can be seen or smelled, and waterborne diseases are often transferred by way of eyes or mouth. Always wash your hands thoroughly with soap and water after being in contact with stream or river water. You may also want to bring antibacterial hand gel to the field site for use immediately after water contact.

"THE ULTIMATE TEST OF A MORAL SOCIETY IS THE KIND OF WORLD IT LEAVES TO ITS CHILDREN"

– Dietrick Bonhoeffer

For more information, contact:
Izaak Walton League of America Watershed Programs
707 Conservation Lane
Gaithersburg, MD 20878-2983
Phone: (301) 548-0150
(800) BUG-IWLA
E-mail: sos@iwla.org
Website: www.iwla.org

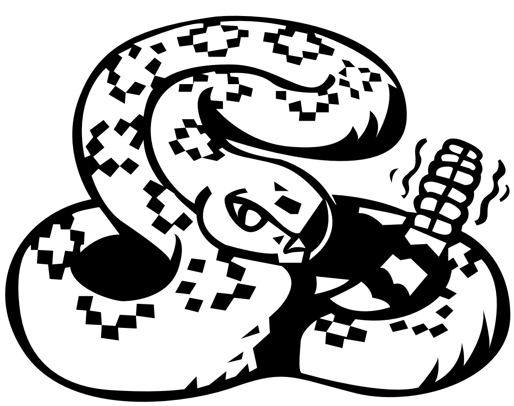
If the water is posted as unsafe for human contact or appears to be severely polluted, (strong smell of sewage or chemicals, unusual colors, lots of dead fish) do not touch the water. If these signs of severe pollution are not present, but you are unsure of conditions or would like additional protection, take the following precautions:

- Wear rubber boots high enough to keep water from coming in contact with your skin.
- Wear heavy rubber gloves that go up to your shoulders (available at most automotive supply stores). Surgical gloves will not work. They can be punctured easily by snags or sharp objects, and they are not long enough to protect your arms.
- Wear a protective covering for your mouth such as a painter's mask (available at most drugstores or hardware stores). You can get sick if you breathe in vapors from sewage-contaminated water.
- Report any pollution problems to your state's water regulatory agency.

OTHER AREAS OF CONCERN

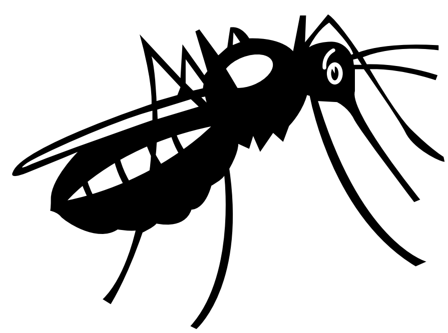
Snakes: Snakes can be a concern when you are in an aquatic environment, especially slow-moving waters with overhanging vegetation. To avoid an encounter with a snake, observe the following rules:

- Check rocks, logs, and stubs for snakes. Snakes must get out of the water to dry their skin and will lie on flat surfaces exposed to sunlight.
- If you have to approach the water through high grass, thump the ground in front of you with a stick. Snakes will feel the vibrations and move away. Snakes are deaf and respond only to vibrations.
- If you come upon a snake at close range, simply move away. The snake probably will leave the area when it no longer perceives you as a threat. Remember, you are much bigger than the snake, and it is more afraid of you than you are of it. Allow the snake a chance to back off, and it usually will.



Most snakes associated with aquatic environments are not poisonous. However, because it's difficult to distinguish between poisonous and non-poisonous snakes without getting too close, the best advice is to stay away from them all. If a snake bite does occur, follow these simple steps:

- Elevate the bitten area. Do not apply ice or a tourniquet to the wound. Do not cut the wound open or attempt to suck out the venom.
- Remain calm. Take a few deep breaths and keep movement to a minimum. Walk calmly to your vehicle and have your partner carry your equipment.
- Remove all watches and jewelry if bitten on the hand or arm. Snake venom will cause the bitten area to swell.
- Seek immediate medical attention.



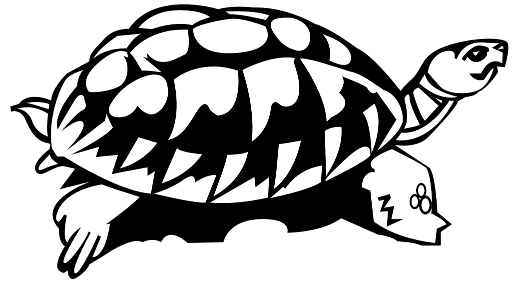
Insects: If you are allergic to any type of insects, bring your antidotes or medicines. Ask other members of your group about their allergies before you go to the site. If a volunteer gets an insect bite that swells up to an unusual size or has severe redness, seek medical attention immediately.

Many people have concerns about West Nile virus. Female mosquitoes transmit the virus primarily among birds. Occasionally, mosquitoes transfer the virus from birds to humans, most of whom experience no symptoms. About one in five infected people develop West Nile fever, which resembles the flu. Infections can be fatal in people with weak immune systems, but this is rare. To avoid mosquito bites, wear long sleeves and pants. Avoid areas of standing water during dawn and dusk, when mosquito activity is at its peak. Consider using mosquito repellants that contain DEET. Do not spray DEET underneath clothes. For more information on West Nile virus, see the U.S. Environmental Protection Agency factsheet "Wetlands and West Nile Virus" online at www.epa.gov/owow/wetlands/facts/WestNile.pdf, or contact the Izaak Walton League.

Ticks: Ticks are prevalent in grassy or woody areas. It is important for volunteers to check their bodies for ticks. Feel along the scalp for any loosely attached bumps. If it is a tick, do not pull it out. Yanking the tick may cause an infection if its head remains in the scalp. Grasp the tick with tweezers and gently twist it counterclockwise for several rotations until the tick is free. Swab the area with hydrogen peroxide to clean the area. If you want to kill the tick, burn it with a match or suffocate it with nail polish or petroleum jelly after it has been removed from the skin.

One type of tick, called a deer tick, can carry a serious illness called Lyme disease. Deer ticks resemble common ticks except they are much smaller (only a few millimeters across.) Symptoms of Lyme disease include chills, malaise, and fever. Often the first sign of Lyme disease is a bull's-eye shaped mark on the skin, but this is not always present. Treatment requires a shot of prescribed antibiotics. If not treated, this disease can remain in your body for a lifetime. If you exhibit any of the symptoms, it is recommended that you see your doctor and ask for a Lyme disease test.

Alligators and turtles: In southern states, you may encounter alligators and large aquatic turtles. These animals are not dangerous if left alone. Alligators under 18 inches in length are juveniles and may be near their mothers. Female alligators are very protective and may be dangerous. If you see alligators, leave the area immediately. Snapping turtles and soft-shelled turtles usually will move out of an area if the water is disturbed. Although turtles are not poisonous, treat a turtle bite with the same care as a snake bite.



Bears: Black bears and grizzly bears live in forested areas around the United States. Black bear encounters are more prevalent in the eastern United States, while grizzlies may be encountered in the Northwest.

- When in an area with the potential for bear encounters, make sure you stay with a group of people and make noise to alert the bear of your presence. It is also a good idea to carry bear pepper spray, just in case.
- If you see a bear and it does not see you, quickly leave the area while keeping your distance from the bear, giving it plenty of room to escape should you startle it.
- If you encounter a bear and it sees you, do not run. You cannot outrun a bear. Stay calm and slowly back away from the bear. Look for an escape route that gives the bear plenty of space; try to stay out of its "comfort zone" and avoid direct eye contact.
- Climbing trees to escape is a common suggestion, but be aware that bears can follow you up a tree.
- If a bear should charge you, do not run. Drop to the ground and cover your head, face, and neck with your arms for protection. If you are wearing a backpack, make sure it faces the direction of the bear so it can absorb punishment from any attack. Bear attacks are often "hit and run" and don't last very long. Lay motionless and give the bear time to leave the area. Seek medical treatment as soon as possible for any injuries.
- If you feel an attack is predatory, disregard the above strategy and fight back with everything you have. This also applies to mountain lion attacks. Seek medical treatment immediately and report the attack to wildlife authorities.
- Never go near a cub because the mother bear is always nearby and will become very aggressive in trying to protect her young.

Physical Observations and Measurements Procedures

Materials

- Boots
- Rope
- Tape Measure
- Yard stick
- Clothes pins
- Timer
- Data sheet on clip board with pencil
- GPS unit
- Calculator
- Whiffle balls with string – tie one end of string to the ball, measure out 3 feet, cut the other end so the string is 3 feet long

- **Before students arrive**, pick a representative location on the stream, paying attention to access knowing that students must walk across the stream to collect measurements. Limit group size to 10.

- **When students arrive,** briefly explain what they are going to do and why.

1. We will be recording information about what the stream looks and feels like, and even how it smells. Also, we will record information relating to the stream corridor (the adjoining banks/buffer zone/riparian zone).
2. We will be taking **measurements**, including stream width, depth and flow rate to determine the volume of water flow. This tells us, over time, if upstream activities are having an affect on the volume of water in the stream – which could contribute to erosion and associated problems.
3. We will record our coordinates using a GPS unit so that we and other groups can find this exact spot again in the field or on a map.

Enter General data, weather, and GPS coordinates

- You may want to record some of this information, including the GPS coordinates, on your own before the group arrives.
- For Creek Freaks program leader trainings, have the group complete this general information together. Show the group how to turn on GPS units, how to make sure they are using the correct coordinate system, and how to read/record the coordinates. Use decimal degrees, not minutes/seconds.
- For Creek Freaks students, discuss weather. Explain that weather is important to know because weather conditions today and over the longer term can greatly affect streams. [IE: Floods and droughts can change the shape of the stream channel and affect stream life. Recent rains may cause more pollution like fertilizers or oil to run off the land and the roads into streams. Colder air temperature may lower water temperature and allow more dissolved oxygen needed by stream life.] Read off weather choices and ask the group to pick the ones that apply.

Physical Measurements

An important physical parameter that is measured is stream flow, or discharge. The flow rate is first estimated through measurements and calculations, while the actual flow rate is measured using the float method. The stream flow will be calculated by multiplying the transect area and average velocity. The average stream depth and width of the stream are needed to determine the transect area of the stream in order to calculate the flow rate. The students, through what we call the "float technique" will collect the average velocity. Flow rates are recorded in units of cubic feet per second (ft^3/s or cfs). Stream flow (discharge) is expressed in the following equation:

Stream flow = area x velocity = cubic feet per second (cfs)

In advance of the students' arrival, two transects are prepared across stream sites where the data will be collected. The transects are selected with an eye toward average visual representation of the stream, and by accessibility. The transect provides the cross-sectional area of the stream. The students record the width (measured in feet) and depth (measured in feet) of the stream at this selected site, using a measuring tape and a straight-edge measuring stick (yard stick). The width is marked across the stream along the previously placed rope (secured at a 90 degree angle to the stream's current). Five evenly distributed locations across the stream transect are marked using clothespins. The depth is measured at the five marked locations with a straight edge measuring stick. The average of the depth measurements is recorded on the field data survey form.

The velocity of the stream at the monitoring site is measured using the "float technique." The float technique involves volunteers timing how long it takes for a float (a whiffle ball works well because it tends to run below the surface yet above the bottom, thus moving at an average speed within the water column) to travel a specified distance from upstream to downstream. In this case, we will use whiffle balls with a 3-foot string attached. One person releases the float in the main current at the point on the transect with each clothespin while holding securely onto the end of the string. The end of the string should be held close to the water surface at the transect point. Another individual uses a stopwatch to determine the amount of time it takes the float to travel the specified distance. The five float trails are released at the five evenly distributed points (where the stream depth was also measured). Velocity is then calculated by first adding all the times of the five runs together and then dividing by five to get the average time, then dividing the distance the float traveled by the average amount of time it took the float to go that distance. Average velocity is recorded in a unit of feet per second (ft/s). The average velocity is calculated and recorded on the field data survey form.

*******English units are used for physical measurements since this system is what is most commonly used in the field of hydrology.*

Begin physical measurement with students.

1. Have students put on waders (if you are rotating students through different stations, including physical monitoring, have them put on waders as a larger group and keep the same waders for the entire field session).
2. <u>Select an on-land data recorder</u> and give her/him paperwork on clipboard.

Width (width can be done in advance and explain what was done to students to save time)

1. Student <u>carries</u> one end of the <u>rope across the stream</u> where it is <u>secured around a tree</u>, shrub or boulder, <u>1 to 2 feet above water level</u>. **[Note – program leaders may want to set up the transect rope and/or measuring tape and clothespins ahead of time, depending upon the amount of time students will be at the physical monitoring station.]**

2. On the near bank, directly across, a student secures rope in a shrub/tree at same height, <u>making rope taut</u>.
3. Student carries the end of the <u>tape measure across stream</u> and holds it where water meets the bank.
4. Near-bank student holds tape measure <u>taut</u> and calls out width of stream for recording.
5. <u>Stream Width is divided by 6 to establish 5 equidistant points</u> across the stream from shore to shore. Use the calculator if needed, or have students do the division.
6. Students then <u>clip clothespins</u> to the rope at measured <u>equidistant points</u>.

Depth

1. Measuring depth - Ask if anyone has ever walked across a stream thinking it was shallow and then hit a deep spot. Streams are not the same depth all the way across. We are going to measure the depth at various points across the stream.
2. In-stream students, using a yardstick, <u>measure steam depth</u> (in inches) below each clothespin. Measurements are called out to recorder to <u>place in data sheet</u>.
3. (At some point, these measurements in inches need to be converted to fractions in feet, and than decimal equivalents. (Example: 6" = 1/2 of a foot. 1/2 foot converts to .5 feet. Another example: 20" = 1 2/3 feet. 1 2/3 feet converts to 1.66 feet.) This is necessary in order to simplify the math calculations in determining stream flow later. This can be done using a calculator at the stream site or back at the office by the program leader.

Velocity

1. Explain that stream velocity is how fast the water is moving (distance over time or meters per second). We will measure velocity using a whiffle ball and stopwatch. The ball has a string attached that is one meter long. Demonstrate how the students should hold the string and ball under the measuring tape at the transect and release the ball, but not the string, when the timer says "GO."
2. Choose a student to release the ball, a student to be the timer, and a student to record. Walk the students through these steps:
    a. Hold the ball (with three-foot string attached) with one hand and the end of the string in the other. Hold both of these directly below the one-meter mark on the tape measure.
    b. Have someone with a stopwatch say "GO," while you release the ball, but continue to hold the string at the one-meter mark.
    c. When the ball floats to the end of the string (3 feet), stop timing. Record in seconds the time it took the tennis ball to travel the one meter.
    d. Repeat the procedure at each of the five equidistant points along the transect (at each clothespin).
3. Ask the group to note that velocity is not the same at each point along the transect. That is why we take velocity measurements at different points across the transect. Then we can add our five velocities together and divide by three to get average velocity.
4. This information, along with the stream's water depth and width, is needed to calculate the flow rate, which is measured in cubic meters per second. This is a measure of how much volume of water the stream moves each second. If we have time, we can use the white board to show the calculation of stream flow.
5. Calculate average float time by adding results for trials 1-5 and dividing by 5. Use calculator as needed.

6. Find average velocity by dividing 3 (because each ball traveled three feet, which is the length of the string attached to the whiffle ball) by the average float time in seconds to get velocity in feet per second.
7. Calculate area of stream transect by multiplying average stream depth by stream width.
8. Calculate flow rate by multiplying Area of Stream Transect by Average Velocity.

Visual Observations

- In recording the **general characteristics/observations** of the stream and the stream corridor for the data sheet, the recorder calls out options to look for (and smell) in the stream (this is asked of students in the stream) and along the stream corridor – and checks appropriate boxes that reflect responses. There can be more than one box checked for each observation. Include Riparian Zone width with these visual observations.

Water Color

1. Read off water color choices and ask the group to pick the ones that apply.
2. Discuss what those color choices could mean using the information below:
   - **Clear –** Clear water doesn't necessarily mean clean water, but it could indicate low levels of dissolved or suspended substances.
   - **Brown –** Brown water is usually due to heavy sediment loads.
   - **Blackish –** Blackish water is usually is caused by a natural processes of leaf decomposition.
   - **Foamy –** Foam can indicate detergent in the water, or can be a result of natural causes like water bubbling over rocks and picking up oxygen.
   - **Oily Sheen –** Oily sheens can be caused by petroleum or chemical pollution, or they may also occur naturally as byproducts of decomposition. To tell the difference between petroleum spills and natural oil sheens, poke the sheen with a stick. If the sheen swirls back together immediately, it's petroleum. If the sheen breaks apart and does not flow back together, it is from bacteria or plant or animal decomposition.
   - **Milky –** A milky appearance may be caused by salts in the water.
   - **Muddy –** Muddy water is due to excess sediments in the water. This sediment can clog fish gills or smother fish eggs.
   - **Scummy –** Can indicate a variety of natural causes or pollution sources.

Stream Bottom Appearance

Similar to water color, colors on the stream bottom may have natural or human-induced causes.

Water Odor

1. Read off water odor choices and ask the group to pick the ones that apply.
2. Discuss what those odor choices could mean using the information below:
   - **None –** The water has no odor.
   - **Musky –** Musky odors may result from natural or human-induced activities.
   - **Rotten Egg –** This odor can be caused by hydrogen sulfide gas, a by-product of **anaerobic decomposition** (rotting without oxygen). This is a natural process that occurs in areas that have large quantities of organic matter and low dissolved oxygen. It may be caused by excessive organic pollution.
   - **Oil/Petroleum –** Petroleum or chemical smells can indicate serious pollution problems from a direct source, such as industry or storm sewer runoff.

- **Sewage/Manure –** These smells can be common in air (especially near farmland) but should NOT be what our water smells like. It is important to differentiate whether the odor is coming from the water or the air.

Algae Color and Texture
Algae feels slimy. A great deal of algae may indicate too many nutrients in the water. Sometimes more algae will appear in the spring after snowmelt releases extra nutrients into the stream. However, take note of the percent and type of algae present in the stream to make sure it is not increasing over time.

Algae Amount
See above.

Stream Bed Stability
An unstable stream bed can mean that soil is eroding from the bottom of the stream and may indicate water quality problems. When standing in the stream, determine how frequently the bed sinks beneath your feet.

Riparian Zone Width

1. Have the group face upstream and estimate width of the riparian zone [area along the stream with trees, shrubs, or grasses] on first the left bank and then the right bank.
2. Discuss why this riparian zone is important. [Tree roots hold the bank together during floods and provide habitat for stream life. Shrubs, grasses, and other plants slow and filter runoff water before it enters the stream. While a zone as little as 10 feet may help keep banks from eroding, 30-50 feet is needed for nutrient removal and more than 100 feet is needed for wildlife habitat.]

Stream Channel Shade

1. At the stream transect looking upstream, have the group estimate what percent of stream is shaded by trees and overhanging vegetation for as far upstream as you can see when standing at the stream transect.
2. Ask the group which is better for the stream – more canopy cover or less. [More]. Ask why. [Shade means the water will be cooler, which means more dissolved oxygen for stream life.]

Stream Bank Composition

1. Explain that we are going to look at the stream banks because the shape and condition of the banks give important information about the health of the stream and what kind of life it can support. Steep, cut, and eroding banks are not as healthy as gently sloped banks with trees and grasses growing on them. Ask the group why we don't want eroding banks. [Erosion means too much dirt in the stream which clogs fish gills and smothers bugs. It also means there are not a lot of good places in the stream for fish and bugs to live].
2. Ask the group to face upstream and look at the banks. Read off the options and check off the ones the group picks. Make sure they are thinking about both banks together.
3. Ask the group if they think the stream is healthy based on the banks.

Stream Bank Erosion

1. Ask the group to face upstream and look at the banks. Read off the options and check off the ones the group picks. Make sure they are thinking about both banks together.
2. Ask the group if they think the stream is healthy based on the banks.

THE IZAAK WALTON LEAGUE OF AMERICA

Creek Freaks | *Physical Monitoring Data Form*

Name of Stream: ______________________ River or Lake Basin: ______________________________________

County: ____________________ Township: ____________ School or Group Name: __________________________

Field Personnel Involved: ____

____

Survey Date: ____________________ Start Time: ____________________ End Time: _________________________

Location (description): ____

____ GPS Coordinates: ______________________________

Weather Conditions (last 3 days): ____

VISUAL OBSERVATIONS

Water Appearance

- ❑ Clear
- ❑ Brownish
- ❑ Blackish
- ❑ Foamy
- ❑ Oily
- ❑ Milky
- ❑ Muddy
- ❑ Scummy
- ❑ Other _______

Stream Bottom Appearance

- ❑ Grey
- ❑ Orange/red
- ❑ Yellow
- ❑ Black
- ❑ Brown
- ❑ Other ______

Odor

- ❑ None
- ❑ Musky
- ❑ Rotten eggs
- ❑ Oil
- ❑ Sewage
- ❑ Other ______

Algae Color and Texture

- ❑ Light green
- ❑ Dark green
- ❑ Brown
- ❑ Matted
- ❑ Hairy

Algae Amount

- ❑ Scarce
- ❑ Scattered
- ❑ Moderate
- ❑ Dense

Stream Bed Stability

(Bed sinks beneath your feet in)

- ❑ No spots
- ❑ A few spots
- ❑ Many spots

Riparian Zone Width *(looking upstream from transect)*

	0-10'	11-50'	51-100'	100+'
Left Bank	____	____	____	____
Right Bank	____	____	____	____

Stream Channel Shade *(estimate)*

- ❑ >80% (excellent)
- ❑ 50%-80% (high)
- ❑ 20%-49% (moderate)
- ❑ <20% (almost none)

Stream Bank Composition

	High	Medium	Low
Trees	❑	❑	❑
Shrubs	❑	❑	❑
Grass	❑	❑	❑
Bare soil	❑	❑	❑
Rocks	❑	❑	❑
Other ________________	❑	❑	❑

Stream Bank Erosion *(estimate)*

- ❑ >80% (severe)
- ❑ 50%-80% (high)
- ❑ 20%-49% (moderate)
- ❑ <20% (slight)

STREAM FLOW ESTIMATE

Estimated flow rate: ❑ high ❑ moderate ❑ low ❑ negligible

STREAM FLOW MEASUREMENT

Measured flow rate: Flow = Area x Velocity = Cubic Feet Per Second

Area

Measure Stream Depth at Five Equidistant Intervals Across the Stream: *Depth will be measured in inches and needs to be converted into feet. Convert by dividing number of inches measured by 12. For example, 6 inches/12 inches = .5 feet.*

1 ___________ inches /12 = ___________ feet

4 ___________ inches /12 = ___________ feet

2 ___________ inches /12 = ___________ feet

5 ___________ inches /12 = ___________ feet

3 ___________ inches /12 = ___________ feet

Calculate Average Stream Depth: *Calculate average stream depth by adding the results, in feet, of 1through 5 above and dividing by 5.*

Average Stream Depth: ___________ feet

Measure Stream Width: *Measure stream width at a point that visually appears to be the average width of the stream. Measure width rounded to the nearest foot.*

Stream Width: ______________ feet

Calculate Area of Stream Transect: *Average Stream Depth x Stream Width = Area.*

Area of Stream Transect: ____________ square feet

Velocity

Measure and mark a distance along the stream (normally from 20 to 30 feet, depending on the stream) where you will start and end your float trials.

Length of Stream Run: ________________ feet

Float Time Trials: *Time how long it takes for a wiffle ball to travel the length of the stream run.*

1 ____________ seconds

4 ____________seconds

2 ____________seconds

5 ____________seconds

3 ____________seconds

Average Float Time: *Calculate average float time by adding results for trials 1 through 5 and dividing by 5.*

Average Float Time: ____________ seconds

Calculate Average Velocity: *Velocity is a measurement of feet traveled per second. Divide length of stream run by average float time.*

Average Velocity: ___________________ feet/second

Flow Rate: *Calculate the flow rate by multiplying Area of Stream Transect by Average Velocity.*

Flow or discharge = Area x Average Velocity = _______________ cubic feet/second

Izaak Walton League Creek Freaks
Chemical Observations and Measurements Procedures

As you explore your stream's water chemistry, it is important to understand that **water chemistry is very complex**. While some chemicals are absolutely necessary for life (such as nutrients) others can be harmful (such as pesticides). Some chemicals may not directly impact human health, while others (such as nitrate) can have harmful effects in our drinking water.

Examples of how environmental conditions can influence water chemistry:

- **Season of year** – *Spring's* snowmelt and heavy rains greatly increase the volume of water in our streams. *Summer's* dry, hot weather reduces the volume of flow. *Winter* can reduce flow because water is locked up in ice and snow. *Fall* sees more heavy rains and the input of organic matter (fallen leaves).
- **Time of day** – Dissolved oxygen levels rise during sunlight hours due to increased photosynthesis in aquatic plants and algae. They decrease overnight when photosynthesis is not occurring and plants and animals are using up dissolved oxygen.
- **Weather** – Runoff from heavy rains can transport pollutants to streams, thus having a strong impact on nonpoint source pollution. On the other side of the coin, very dry conditions over a long period of time (drought) lower stream flow, raising the concentration of chemicals in the stream.
- **Physical influences** – Decreased canopy cover from riparian zone vegetation removal results in solar warming of the water, which can decrease dissolved oxygen levels.
- **Land use** – What we do on, and to, the land greatly affects the volume of stream water flow and intensity of flooding, along with the quality of our streams' water. *Development* (think of the filling in of wetlands, the runoff from paved areas, roofs, and lawns with their many applied chemicals); *Agriculture* (think of runoff containing crop chemicals and animal waste, tilling of the land, and the filling in of wetlands); *Recreation* (think of the clearing of land, chemical applications, plus the introduction of invasive species).

Note:

A number of our tests are run using **"Chemetrics"** kits. The chemicals in these kits, though not dangerous, could cause mild skin and eye irritation and, so, should be handled with care. Also, the chemical ampules are glass, and sharp. Be careful!

The test strips we use, along with the Chemetrics waste materials, can be disposed of as you would any household items headed for the landfill.

All chemical testing materials:

STORE AT ROOM TEMPERATURE.

STORE Chemetrics DO and Phosphate Kits IN THE DARK.

Pay Attention to the EXPIRATION DATE. Do not use old materials.

pH

pH is a measure of a water's acid/base content and is measured in pH units on a scale of zero to 14. A pH of seven (7) is neutral (distilled water), while a pH greater than seven is basic/alkaline and a pH less than seven is acidic.

The pH level of stream water is influenced by the concentration of acids in rain and the types of soils and bedrock in the state. The typical pH of rainfall in the U.S. is slightly acidic, ranging from 5.0 to 5.6. Rainwater pH is determined by natural atmospheric processes and man's activities (e.g.., industry emissions causing **acid rain**). Low pH levels (acidic) can have a harmful impact on the health of aquatic communities and, because it can leach toxic substances from the soil, those toxins then can be taken up by aquatic plants and animals and passed up the food chain **(bioaccumulation)**.

Most aquatic organisms require habitats with a pH of 6.5 to 9.0.

Reporting Technique: For use with Hach® pH test strips

1. Check the expiration date on the bottom of the bottle. If expired, **DO NOT USE**.
2. Facing upstream, in the area along your *transect* with the greatest flow, dip the test strip in the water and remove immediately. Hold strip level for **15 seconds**. **DO NOT SHAKE** excess water from the test strip.
3. Estimate pH by comparing test pad to color chart on test strip bottle. Remove sunglasses before reading the strip. ***The pad will continue to change color, so make a determination immediately after 15 seconds.***
4. Record results on the Chemical Monitoring Form.

Dissolved Oxygen (DO)

Dissolved oxygen (DO) is necessary for nearly all aquatic life to survive. Certain processes add oxygen to a stream, while others remove or consume oxygen. Oxygen is added to a stream from the atmosphere through mixing in turbulent areas. Plants also contribute oxygen through photosynthesis. DO in streams can be affected by:

- **Water Temperature** – Cold water holds more oxygen than warm water.
- **Time of Day** – On a sunny day, DO levels rise from morning through the afternoon as a result of photosynthesis, reach a maximum in late afternoon, and steadily fall during the night, reaching their lowest point before dawn.
- **Stream Flow** – DO will vary with the volume and **velocity** of water in a stream; faster moving water mixes readily with atmospheric oxygen, thus increasing DO.
- **Aquatic Plants** – Plant and algae growth in a stream will affect the oxygen contributed by photosynthesis during the day and depleted by plant **respiration** at night.
- **Dissolved or Suspended Solids** – Oxygen dissolves more readily in water that does not contain high amounts of salts, minerals, or other solids.
- **Human Impacts** – Lower DO levels may result from human impacts including organic enrichment, urban stormwater runoff, riparian corridor removal, stream channelization, and dams.

Typical range for dissolved oxygen = 8.7 to 12.9 mg/L (rivers); 7.4 to 10.4 mg/L (lakes)

Note: DO less than 3 ppm is too low for fish populations; 3-5ppm supports fish for 12-24 hours; 6ppm supports spawning; greater than 9 supports abundant fish populations.

Reporting Technique: For use with the Chemetrics® dissolved oxygen test kit

1. Remove the 25 ml sample cup from the kit and rinse it **three times** with stream water.
2. Facing upstream, in the area along your *transect* with the greatest flow, fill the sample cup to the 25 ml mark, mixing the water and air as little as possible.
3. Lower the sample cup down to wrist depth while holding it upside down. Turn the opening downstream so that the cup backfills with water, then turn the cup upstream and carefully remove cup and water sample from stream.
4. ***GENTLY*** tip the sample cup to pour off excess water.
5. Place the ampoule in the sample cup, tilting it so the tip is wedged in one of the spaces along the side of the sample cup.
6. Snap off the tip of the ampoule by pressing it against the side of the cup, allowing it to fill with water.
5. Remove the ampoule from the cup and mix the water by inverting the ampoule several times. Be careful not to touch the broken end, as it will be sharp.
6. **Two minutes** after you break off the ampoule tip, compare the ampoule to the color standards provided in the kit. ***Read the ampoule right at two minutes as the ampoule will continue to change color.*** Remove your sunglasses before making a determination.
7. Hold the comparator nearly flat while standing directly beneath a bright source of light. Place your ampoule between the color standards moving it from left to right until the best color match is found. Record your result on the Chemical Monitoring Form.

- **Be careful of the broken glass.** Avoid breaking the ampoule open, as the **contents may be mild skin and/or eye irritants.**

Nitrate-N / Nitrite-N

Nitrogen is an essential plant nutrient, but excess nitrogen can cause water quality problems. Too much nitrogen and phosphorus in surface waters cause nutrient enrichment, increasing aquatic plant growth and changing the types of plants and animals that live in a stream. This process, called **eutrophication,** can also affect other water quality parameters such as temperature and dissolved oxygen.

Nitrate and **nitrite** are two forms of nitrogen.

- *Nitrate* is very easily dissolved in water and is more common in streams. Sources of nitrate include soil organic matter, animal wastes, decomposing plants, sewage, and fertilizers. Nitrate is more soluble in water than phosphorus and can move more readily into streams.
- *Nitrite* is another form of nitrogen that is rare because it is quickly converted to nitrate or returned back to the atmosphere as nitrogen gas. Due to its instability, detectable levels of nitrite in streams and lakes are uncommon. Detectable nitrite levels in streams may indicate a relatively fresh source of ammonia.

The amount of nitrate or nitrite dissolved in water is reported as nitrate-N (nitrate expressed as the element nitrogen) or nitrite-N in milligrams per liter of water (mg/L). Stream water nitrate rates may vary greatly depending on season and rainfall, fertilizer application rates, tillage methods, land use practices, soil types, and drainage systems. Consistently high nitrate readings (over 10 mg/L) may be cause for concern and warrant further investigation.

Typical range for Nitrate + Nitrite-N = 3 to 8.5 mg/L (rivers); 0.05 to 0.94 mg/L (lakes)

Reporting Technique: For use with Hach® nitrate-N / nitrite-N test strips

1. Facing upstream, in the area along your *transect* with the greatest flow, dip the test strip into the water for one second and remove. **DO NOT SHAKE** excess water from the test strip.
2. Hold the strip level, with pad side up, for **30 seconds.**
3. Compare the NITR**I**TE (lower) test pad to the nitrite-nitrogen color chart on the test strip bottle, estimate the nitrite concentration in mg/L, and record your reading on the Chemical Monitoring Form (remove sunglasses before reading the strip). ***The pad will continue to change color, so make a determination immediately after 30 seconds***.
4. At **60 seconds** (or 30 seconds after estimating nitrite concentration), compare the NITR**A**TE (upper) test pad to the nitrate-nitrogen color chart on test strip bottle, estimate the nitrate concentration in mg/L, and record your reading on the Chemical Monitoring Form (remove sunglasses before reading the strip). ***The pad will continue to change color, so make a determination immediately after 60 seconds***.

Phosphate

Phosphorus is an essential nutrient for plants and animals and is usually present in natural waters as dissolved orthophosphate. Plant growth in surface waters is generally limited by the amount of orthophosphate present. It is the simplest form of phosphorus found in natural waters and is most available for plants to use. In most waters, orthophosphate is present in very low concentrations. For our purposes, we will refer to orthophosphate as simply "phosphate."

There are natural sources of phosphorus, such as certain soils and rocks, but most elevated levels of phosphorus are caused by human activities. These include human, animal, and industrial wastes, as well as runoff from fertilized lawns and cropland. Excess phosphorus in water speeds up plant growth, causes algal blooms, and can result in low dissolved oxygen, or **hypoxic**, conditions that can lead to the death of certain fish, invertebrates, and other aquatic animals.

Typical range for total phosphorus = 0.11 to 0.34 mg/L (rivers); 0.05 to 0.13 mg/L (lakes)

Reporting Technique: For use with Chemetrics® phosphate test kit

1. Remove the 25 ml sample cup and black lid from the kit and rinse them **three times** with stream water.
2. Facing upstream, in the area along your *transect* with the greatest flow, fill the sample cup to the 25 ml mark, mixing the water and air as little as possible.
3. Lower the sample cup down to wrist depth while holding it upside down. Turn the opening downstream so that the cup backfills with water, then turn the cup upstream and carefully remove cup and water sample from stream.
4. ***GENTLY*** tip the sample cup to pour off excess water.
5. Add 2 drops of A-8500 Activator Solution, place black cap on sample cup, and shake to mix the contents.
6. Place the ampoule in the sample cup, tilting it so the tip is wedged in one of the spaces along the side of the sample cup.
5. Snap off the tip of the ampoule by pressing it against the side of the cup, allowing it to fill with water.
6. Remove the ampoule from the cup and mix the water in the ampoule by inverting it slowly several times. *Be careful not to touch the broken end, as it will be sharp.*
7. **Two minutes** after you break off the ampoule tip, compare the ampoule to the color standards provided in the kit. ***Read the ampoule right at two minute,s as the ampoule will continue to change color.*** Remove your sunglasses before making a determination.
8. Based on the color of your ampoule, use the appropriate color comparator to estimate the orthophosphate concentration.
   a) The low-range circular comparator measures concentrations ranging from 0 to 1 mg/L. To use the circular comparator, place your ampoule, flat end downward, into the center tube. Direct the top of the comparator up toward a good light source while viewing from the bottom. Rotate the comparator to match your ampoule to the standards and record your results on the Chemical Monitoring Form.

   OR

   b) The high-range comparator in the lid of the kit measures concentrations ranging from 1 to 10 mg/L. Hold the high range comparator nearly flat while standing directly beneath a bright source of light. Place your ampoule between the color standards moving it from left to right until the best color match is found. Record your result on the Chemical Monitoring Form.

Chloride

Chloride is a chemical found in salts, which tend to dissolve easily in water. In natural waters, elevated levels of chloride may indicate inputs of human or animal waste, or inputs from fertilizers, many of which contain salts. During winter months, elevated chloride levels in streams may occur as a result of road salt runoff to nearby streams. Chloride can be used as a "conservative" measure of water contamination since other natural processes, such as breakdown by bacteria, do not affect it.

Typical range for chloride = 16 to 29 mg/L (rivers)

Reporting Technique: For use with Hach® chloride titrators and sample cup from one of the Chemetrics® test kits.

1. Rinse the 25 ml Chemetrics® test kit sample cup **three times** with stream water.
2. Facing upstream, in the area along your *transect* with the greatest flow, fill the sample cup up to the 25 ml mark with stream water.
3. Remove a titrator from bottle and replace cap immediately.
4. Insert the lower end of titrator into sample cup. **Do not allow the yellow completion string located at the top of the titrator to become submerged in the water sample.**
5. Allow water sample to completely saturate the wick of the titrator. There is no time limit for this test – the reaction is complete when yellow string turns dark (this will take a few minutes).
6. Note where the tip of the white chloride peak falls on the numbered Quantab® scale. This represents the Quantab® unit value.
7. Refer to the table on the Quantab® test strip bottle to **convert the Quantab® units into a chloride concentration** and record results on the Chemical Monitoring Form.
8. If the Quantab® unit is below 1.0, report the chloride concentration as < (less than) the lowest concentration listed on the test strip vial (which for data submission purposes is 25 mg/L).

Water Temperature

Many of the chemical, physical, and biological characteristics of a stream are directly affected by water temperature. Some species, such as trout, are quite sensitive to temperature changes. Water temperatures can fluctuate seasonally, daily, and even hourly.

Human activities can adversely raise stream temperatures in a variety of ways. **Thermal pollution** can be caused by:

- releasing warmed water into a stream from industry discharges or runoff from paved surfaces
- removing riparian corridors, which increases solar heating
- soil erosion, resulting in darker water, which can absorb more sunlight

Water temperature impacts:

- The amount of oxygen dissolved in water – cool water holds more oxygen than warm water
- The rate of photosynthesis by algae and aquatic plants – the rate of photosynthesis increases with higher temperatures
- The metabolic rates of aquatic animals, which increase with higher temperatures
- The sensitivity of organisms to diseases, parasites, and toxic wastes

Human impacts are most critical during the summer, when low flows and higher temperatures can cause greater stress on aquatic life. It is important to note that the temperature of some streams is normally higher than others, depending on groundwater flow into the stream, weather, and other factors.

Reporting Technique: At your *stream transect* place an aquatic thermometer directly into the stream, holding it underwater in the main flow of the stream (not in a pool) for at least two minutes so the reading can stabilize. Record the temperature on your Chemical Monitoring Form.

Transparency

Transparency is a measure of water clarity and is affected by the amount of material suspended in water. As more material is suspended, less light can pass through, making it less transparent. Suspended materials may include soil, algae, **plankton**, and microbes. Transparency is measured using a transparency tube and is measured in centimeters. It is important to note that transparency is different from turbidity; transparency is a measure of water clarity measured in centimeters, while turbidity measures how much light is scattered by suspended particles using NTUs (Nephelometric Turbidity Units).

Low transparency (or high number of suspended particles) is a condition that is rarely toxic to aquatic animals, but it indirectly harms them when solids settle out and clog gills, destroy habitat, and reduce the availability of food. Furthermore, suspended materials in streams promote solar heating, which can increase water temperatures (see *Water Temperature*), and reduce light penetration, which reduces photosynthesis, both of which contribute to lower dissolved oxygen. Sediment also can carry chemicals attached to the particles, which can have harmful environmental effects.

Sources of suspended particles include soil erosion, waste discharge, urban runoff, eroding stream banks, disturbance of bottom sediments by bottom-feeding fish (carp), and excess algal growth.

Explain What Transparency Is and Why It is Important

1. Ask if any of your students know what transparency is. Add to or clarify any answers given.
2. Transparency is a measure of how clear the water is or how far down into the water you can see. It shows how much material (dirt, sediment) is suspended or floating in the water.
3. Having lots of dirt in the water means when that dirt settles to the bottom, it can clog fish gills or smother bugs that fish eat. Having a lot of dirt in the water makes the water easier to heat up, which means lower dissolved oxygen, needed for bugs and fish in the stream.

Demonstrate How to Do the Test:

1. We measure transparency with a transparency tube that shows how many centimeters down into the tube you can see the black and white pattern at the bottom.
2. Make sure the finger clamp on the hose is closed. Facing upstream, in the area along your *transect* with the greatest flow, fill the transparency tube.
3. Hold the tube upright and in the shade. Use your body to shade the tube if nothing else is available.
4. With your back to the sun, look directly into the tube from the open top and release water through the small hose, regulating the flow with the finger clamp until you are able to distinguish the black and white pattern (Secchi pattern) on the bottom of the tube. Close the finger clamp.
5. Read the number on the outside of the tube that is closest to the water line. Record your reading in centimeters (cm).
6. Rinse the tube after each use so that the bottom Secchi pattern does not become dirty and clouded.

THE IZAAK WALTON LEAGUE OF AMERICA

Creek Freaks | *Chemical Monitoring Data Form*

Date __________ Time ___________ # of participants ______ Program Leader _________________________________

Site Name ___________________________ GPS Coordinates (decimal degrees): ____

WEATHER CONDITIONS
Check all that apply:

Today:	❑ Sunny	❑ Overcast	❑ Intermittent Rain	❑ Steady Rain	❑ Heavy Rain	❑ Snow
Yesterday:	❑ Sunny	❑ Overcast	❑ Intermittent Rain	❑ Steady Rain	❑ Heavy Rain	❑ Snow
Day Before Yesterday:	❑ Sunny	❑ Overcast	❑ Intermittent Rain	❑ Steady Rain	❑ Heavy Rain	❑ Snow

Nitrate-N ________ (mg/l)

Phosphate _______ (mg/l)

Chloride _________ mg/l (Convert Quantab Units to mg/L using the chart provided on the bottle)

Transparency (record whole numbers only – no tenths) _______ centimeters

Other Stream Assessment Observations and Notes ____
____

Water Quality Summation for Chemical Tests

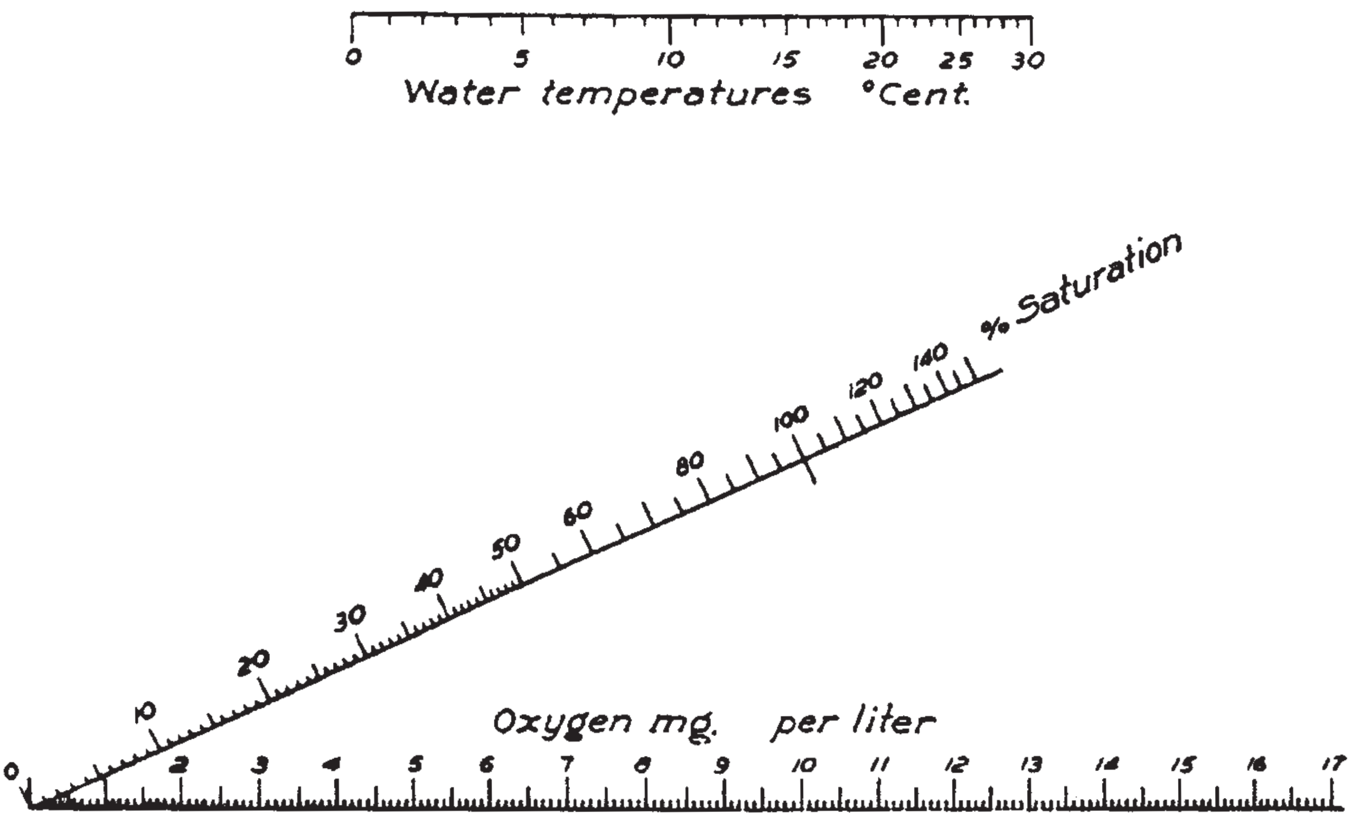
	EXCELLENT	GOOD	FAIR	POOR
Dissolved Oxygen (% Saturation)	80-120	70-80 120-140	50-70 >140	<50
pH (units)	7.0-7.5	6.5-7.0 7.5-8.5	5.5-6.5 8.5-9.0	<5.5 >9.0
Chloride (Cl) ' (mg/L)	0-20	20-50	50-250	>250
Reactive Phosphate ($P0_4X^3$ (mg/L)	0-0.2	0.2-0.5	0.5-2.0	>2.0
Nitrate (NO_3)' (mg/L)	0-3	3-5	5-10	>10
Transparency (cm)	> 65.0	65.0-35.0	35.0-15.5	< 15.5

Source: Izaak Walton League's Project Watershed CNY/SOS, 1999; Milchell and Stapp, 1997; http://watermonitoring.uwex.edu/pdf/level1/datasheets/data-DOTempTrans2010.pdf

STUDENT-COLLECTED DATA

Water Temperature	Dissolved Oxygen	pH
____________ °C	__________mg/L	_______ pH units
	___________ % saturation	

FINDING THE PERCENT SATURATION OF DISSOLVED OXYGEN



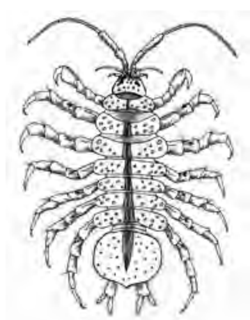
To read this chart, use a straight edge. Place the straight edge on the mg/L of oxygen you have determined for your site, then place the other end of the straight edge on the water temperature you have measured. The point where the straight line passes through the line labeled “% Saturation” is your percent saturation.

Diagram reprinted with permission from M.K. Mitchell and W. B. Stapp, *Field Manual for Water Quality Monitoring*

Stream Quality Survey Instructions

IZAAK WALTON LEAGUE VOLUNTEER STREAM MONITORING PROTOCOL

Surveying stream macroinvertebrates provides information about the health of your stream. Many stream-dwelling organisms are sensitive to changes in water quality. Their presence or absence can serve as an indicator of environmental conditions.



Before selecting a site to monitor, please follow these rules:

- Check with state and county agencies to make sure you are not disturbing a survey area used by government agencies (over-monitoring may harm the stream).
- Review "Safety and Fun in Your Watershed" and carefully prepare for your trip.
- Always contact local landowners before monitoring to make sure you are not trespassing.
- Ask for permission if you need to cross private land. Most landowners will give permission for your study and may even want to help you conduct your survey.

Monitoring should be conducted at the same station (location) each time you sample during the year. If you want to monitor several stations on your stream, make sure the stations are spaced no closer than one quarter-mile apart. If the stations are spaced more closely, the monitoring activity may become the main impact to the water quality. If you want to monitor a one-mile segment of a stream, you can have a maximum of four monitoring locations.

Carefully record the location of your monitoring station on your Stream Quality Survey form. Include roads, bridges, and significant landmarks. If you can locate your station on a topographic map, record your station according to longitude and latitude. By providing this information, you allow your station to be located from anywhere in the world and easily described to government officials and others. A free catalogue of topographic maps is available from the U.S. Geological Survey at (800) USA-MAPS, or online at www.usgs.gov.

THINGS TO CONSIDER

If you are monitoring more than one station, begin monitoring downstream and move upstream. This will prevent macroinvertebrates disturbed by the first test from washing downstream and being captured in your net a second time. Each survey should record only the organisms present at that particular location and time.

Monitoring should be conducted four to six times per year at each station. Monitor once each in the spring, summer, winter, and fall and at two other times during the year. These times may be after floods or other pollution events. The extra surveys, when compared to the regular seasonal surveys, will help to determine water quality

For more information, contact:
Izaak Walton League of America Watershed Programs
707 Conservation Lane
Gaithersburg, MD 20878-2983
Phone: (301) 548-0150
(800) BUG-IWLA
E-mail: sos@iwla.org
Website: www.iwla.org

impacts. Monitoring once each season will accurately record the yearly life cycle in the stream. Less frequent monitoring, while still useful, will not give the complete picture of stream life.

When scheduling monitoring events, remember that excessive monitoring can become the major threat to stream health because each monitoring event disturbs the stream bed and dislodges macroinvertebrates. In general, monitoring stations should have two months to recover from a monitoring event. It is crucial to the integrity of your data that you do not over-monitor your stations. There is some flexibility in this rule. For example, if an oil spill occurs, you might want to monitor your stream, even if you have done your six surveys for the year. The data you collect might be the only data available on the immediate impacts of the spill. Be sure to follow safety precautions from the "Safety and Fun in Your Watershed" factsheet. Do not monitor streams where strong oil or chemical odors are present because they could indicate a health risk.

The methods described in these instructions are for use in wadable streams. To be wadable, the water level in the stream must not exceed the height of your knees. When planning monitoring sessions for younger people, please remember that knee height varies greatly between adults and children.

There are two sampling methods available to collect aquatic macroinvertebrates. Muddy Bottom Sampling is used in streams that do not have riffles, a streambed feature with cobble-sized stones between 2 to10 inches in diameter where the water bubbles over the rocks. If your stream has riffles, please refer to the Rocky Bottom Sampling section.

Muddy Bottom Sampling

The Muddy Bottom Sampling Method is intended for volunteers sampling streams that do not have rocky bottoms or riffles. Muddy bottom streams are composed of muddy or sandy substrate, overhanging bank vegetation, and submerged woody and organic debris. This method enables sampling of streams where kick-seining techniques do not yield the best representative sample of macroinvertebrates or allow easy collection from the most productive aquatic habitats.

Monitoring is conducted using an aquatic D-frame or dip net with 1/32-inch mesh and a four-foot pole. The dip net is used to sample a wide variety of habitats and collect many different kinds of organisms.

Following are simple descriptions of the habitat types and collection techniques for each habitat:

Steep banks/vegetated margins

The area along the bank and the edge of the water body consists of overhanging bank vegetation, plants living along the shoreline, and submerged root mats. Vegetated margins may be home to a diverse assemblage of dragonflies, damselflies, and other organisms. Move the dip net in a bottom-to-surface motion, jabbing at the bank to loosen organisms. Each scoop of the net should cover one foot of submerged area.

Silty bottom with organic matter

Silty substrates with organic matter can be found where the water is slow-moving and where there is overhanging vegetation or other sources of organic matter. The substrates harbor burrowing organisms such as dragonflies or burrowing mayflies. Collect samples by pushing the net upstream with a jabbing motion to dislodge the first few inches of organic layer.

Woody debris with organic matter

Woody debris consists of dead or living trees, roots, limbs, sticks, and other submerged organic matter. It is a very important habitat in slow-moving rivers and streams. The wood traps organic particles that serve as food for the organisms and provides shelter from fish and other predators.

To collect woody debris, approach the area from downstream and hold the net under the section of wood you wish to sample, such as a submerged log. Rub the bottom of the net frame along the surface of the log for a total surface area of one foot. It also is good to dislodge some of the bark, as organisms may be hiding underneath. You also can collect sticks, leaf litter, and rub roots attached to submerged logs. Be sure to thoroughly examine any small sticks you col-

Equipment:

- One D-frame aquatic dip net with mesh of 1/32 inch
- "Field Guide to Aquatic Macroinvertebrates"
- *Monitor's Guide to Aquatic Macroinvertebrates*
- Stream Quality Survey data forms
- Fahrenheit thermometer
- Two small magnifier boxes (optional)
- Magnifying glass (optional)
- Plastic shallow pan
- Specimen jars or ice cube trays for sorting organisms
- One screen-bottom bucket with a mesh of 1/32 inch (optional)
- Tweezers or forceps (optional)
- Clipboard (optional)
- White sheet or plastic trash bag (optional)
- Old sneakers or sandals that secure to your feet. Waders may be preferred in colder weather or for additional leg protection when water is cloudy.

For information on how to obtain monitoring equipment and publications, please visit our Web site at www.iwla.org/sos or call toll free (800) BUG-IWLA.

lect with your net before discarding them. There may be caddisflies, stoneflies, riffle beetles, and midges attached to the bark.

Sand/rock/gravel substrate

In slow-moving streams, bottoms are generally composed of only sand or mud because the water is not fast enough to transport large rocks. Sometimes you may find a gravel bar located at a bend in the river. The bottom can be sampled by pushing the net upstream with a jabbing motion to dislodge the first few inches of gravel, sand, or rocks. You may want to gently wash the gravel in your screen bottom bucket and then discard gravel in the river.

Before you begin monitoring, familiarize yourself with the four main habitats that can exist along muddy bottom streams: steep banks/vegetated margins, silty bottom with organic matter, woody debris with organic matter, and sand/rock/gravel substrate. Search for these habitats along a 50-foot section upstream from the monitoring station.

To provide for accuracy of collection and comparability of data from one station to another, take 20 scoops from the different habitats. Each scoop involves a forward motion of one foot. The D-frame net is one foot wide, so one scoop equals one square foot being monitored.

Ideally, you should identify the location of all four main habitat types, and then collect the following number of scoops from each habitat:

- 10 scoops from steep banks/vegetated margins
- 3 scoops from silty bottom with organic matter
- 4 scoops from woody debris with organic matter
- 3 scoops from sand/rock/gravel substrate

If one of the habitat types is not present, divide the number of assigned scoops from that habitat between the other habitat types that are present. For example, if the stream does not have sand/rock/gravel substrate, take one extra scoop from each of the other three habitat types. The most important thing is to have a total of 20 scoops and to make sure all habitat types that are present are represented.

If you have large rocks (greater than two inches in diameter), it is important to dislodge any burrowing organisms. To do this, hold the net on the downstream side of the rocks. In a one square foot area in front of the net, gently kick up the rocks with your toes or push them free with your fingers. This should dislodge burrowing organisms and allow them to wash into your net.

Each time you sample, sweep the mesh bottom of the D-frame net back and forth through the water (not allowing water to run over the top of the net) to rinse fine silt from the net. This will avoid a large amount of sediment and silt from collecting in the pan and clouding the water.

After collecting some samples, dump the net into a shallow white pan filled with a few inches of water. It is a good idea to do this every few scoops to avoid clogging the net. Clearing the net periodically also prevents having to sort too much debris at once.

Collect organisms from the net or pan and place them in similar groups as you go through the sample. This will make your identification quicker when you are ready to record results on your survey form. Plastic ice cube trays are helpful when sorting the sample. For example, put all organisms with two tails in one section and all organisms with three tails in another section. See "Identification" in this fact-sheet for information on identifying the organisms in your sample.

Rocky Bottom Sampling

The Rocky Bottom Method is intended for volunteers sampling streams that have rocky bottoms or riffles. A kick-seine net, a finely meshed net with supporting poles on each side, is the best tool to use for collecting macroinvertebrates in rocky bottom streams. The League's Rocky Bottom Sampling method uses a kick-seine net that is 3 square with 1/16 or 1/32-inch mesh. While both net mesh sizes are adequate for obtaining accurate results, some state and local government agencies require use of the 1/32-inch mesh. Both sizes capture the full range of macroinvertebrate species included in this monitoring method. However, the 1/32-inch mesh net will provide you with a larger sample because it captures younger, and therefore smaller, organisms of each species.

Select a riffle that is a shallow, fast-moving area of water with a depth of 3 to 12 inches and cobble-sized stones (2 to 10 inches) or larger. Before entering the stream, record observations about riffle composition on the back of the stream quality data form.

Place the kick-seine at the downstream edge of the riffle. Remember to use rocks to secure the net tightly against the streambed so that no organisms escape under the net. Also, don't allow any water to flow over the top of the net; organisms can escape over the net. Also, if water is flowing over the top of the net, the water level is too high for safe monitoring.

Monitor the streambed for a distance of three feet upstream of the kick-seine and across the width of the net. Firmly and thoroughly rub your hands over all rock surfaces to dislodge any attached insects. Carefully place all large rocks outside of your three-foot sampling area after you have rubbed off any macroinvertebrates. Stir up the bed with your hands and feet until the entire area has been searched. All exposed and detached organisms will be carried into the net. Then, for at least 60 seconds, use the toe of your shoe to jab the streambed with a shuffling

Equipment:

- Kick-seine
- "Field Guide to Aquatic Macroinvertebrates"
- *A Guide to Aquatic Insects and Crustaceans*
- Stream Quality Survey data forms
- Fahrenheit thermometer
- Two small magnifier boxes (optional)
- Magnifying glass (optional)
- Shallow plastic pan
- Specimen jars or ice cube trays for sorting organisms
- Tweezers or forceps (optional)
- White sheet or plastic trash bag (optional)
- Clipboard (optional)
- Camera (optional)
- Squirt bottle (optional)
- Glass sample vile for your macroinvertebrate collection and 70-percent alcohol for specimen preservation (optional)
- Old sneakers or sandals that secure to your feet. Waders may be preferred in colder weather or for additional leg protection when water is cloudy.

For information on how to obtain monitoring equipment and publications, please visit our Web site at www.iwla.org/sos or call toll free (800) BUG-IWLA.

motion towards the net. Disturb the first few inches of sediment to dislodge burrowing organisms.

Before removing the net, rub any rocks that you used to anchor the net to the stream bottom and remove the rocks from the bottom. Firmly grab the bottom of the net so that your sample does not fall from the net, and then remove it with a forward-scooping motion. The idea is to remove the net without allowing any insects to be washed under or off it.

Placing a white trash bag or white sheet under the net before separating the sample will catch any tiny organisms that may have crawled through the net. Use a watering can or spray bottle to periodically water your net. The organisms will stop moving as the net dries out. Occasionally wetting the net will cause the organisms to move, making them easier to spot. Watering the net is especially important on hot, dry days.

Place the net on a flat, bright area, out of direct sunlight. Using tweezers or your fingers, separate all the organisms from the net and place them in your collecting container which should be half full of water. Sort organisms into similar groups as you separate your sample. This will make your identification quicker when you are ready to record results on your survey form. Plastic ice cube trays are helpful when sorting the catch. For example, put all organisms with legs in one section and all organisms with no legs in another section. Any organism that moves, even if it looks like a worm, is part of the sample. Look closely, since most aquatic macroinvertebrates are only a fraction of an inch long.

IDENTIFICATION

Once organisms are collected through either the Rocky Bottom or Muddy Bottom methods, they are sorted and identified using IWLA's "Field Guide to Aquatic Macroinvertebrates" and *A Guide to Aquatic Insects and Crustaceans.*

The Izaak Walton League's macroinvertebrate guides provide a general overview of the significance of macroinvertebrate types found across the United States. The composition of macroinvertebrate populations varies depending on local geography and geology. Try contacting your local environmental protection agency or universities for more information about local macroinvertebrates. Local experts might be able to share additional field guides that are specifically designed for your area.

Not all organisms in your stream are listed in the guides. For instance, macroinvertebrates such as whirligig beetles, water striders, and predaceous diving beetles are not included on the survey sheet. They are surface breathers and do not provide any indication of water quality.

When beginning your identification, ask yourself the following questions to identify an organism:

- How large is the organism?
- Is the body long and slender, round, or curved?
- Does the organism have any tails? How many?
- Does the organism have any antennae?
- Does the organism have legs? How many? Where?
- Is the body smooth and all one section, or is it segmented (two or more distinct sections)?
- Does the organism have any gills (fluffy or plate-like appendages)?
- Where are the gills located? Sides, back, underside, under its legs?
- Does it have pinching jaws like a beetle larvae?
- Are any legs or antennae missing because they were broken off in the net?
- What color is the organism?
- Does the organism swim under water or remain on the surface?

When using the macroinvertebrate guides, remember to read the descriptions for each organism. The sizes of the organisms are also noted for reference. However, if you catch a young macroinvertebrate that has just hatched and has not yet reached full size, it may be smaller than indicated in the guides. Specimens can be put into magnifying boxes to ease identification. Volunteers also can call the IWLA toll-free help line at (800) BUG-IWLA.

After identifying the organisms, record your results on the IWLA Stream Quality Survey data form. Return the organisms to the stream after sampling is completed. Also include information relating to habitat and physical parameters of the stream in the survey on the back of the data form. Tabulate your results to determine the water quality using the instructions on the survey sheet. Use letters to indicate the number of each type of organism (A=1–9, B=10–99, C=100 or more). Add the number of letters in a column and multiply by the index value at the bottom. Add the subtotal for each column to arrive at your final stream rating.

You will notice that the letter (A, B, or C) does not affect the final rating score of excellent, good, fair, or poor. This is because the survey is based primarily on diversity, not the number of individual organisms found. However, the letters are valuable because they document changes in populations over time. For instance, your spring survey has only C's in the "pollution sensitive" column and only A's in the "pollution tolerant" category. In your summer survey, you find only A's in the sensitive range and C's in the tolerant range. Although your rating would remain the same, you might conclude that overall water quality was declining because populations of the tolerant organisms are increasing (A to C) while those in the sensitive category are decreasing (C to A). You should monitor for an entire year to get a clear picture of your stream. Consult with local or state biologists to discuss your findings.

The League updates the sensitivity rankings for macroinvertebrates based on the most recent scientific research. To download a copy of the latest stream survey form, please visit our Web site at www.iwla.org/sos/sostools.html.

Survey Data Form Questions

On the back of the survey data form there are a number of questions about the land and vegetation surrounding the stream. These questions help characterize the quality of stream habitat and its ability to support a healthy population of stream organisms. The land-use information also paints a picture of the stream for other people who might review your survey form. Guidelines for correctly answering these questions are given below. Record the answers based on the area that is upstream from your monitoring site; generally, you should record the data for the area that you can see. For land-use information, include uses for one mile upstream from your site or the section of stream you have adopted. If necessary, take a walk or consult a map for this information.

Fish water-quality indicators: The survey form asks if fish are present. Different fish have different tolerances to pollution. The type of fish present may indicate the type of water quality expected. If you collect fish but don't recognize the type, write a description of the fish on the survey form or take a picture to use for later reference. You can find fish identification charts or experts to help with fish identification at local schools, agencies, libraries, or online.

Barriers to fish movement: The question concerning barriers to fish movement is important to consider because the absence of certain fish types in your stream section may be due to a dam or other large obstacle, not because of the water quality. Note on your survey form if the dam is upstream or downstream, and measure its distance from your survey site. Waterfalls should only be recorded if they are large enough that a fish could not reasonably jump over them or swim around them. Usually, waterfalls of a few feet or less are not impediments to upstream movement of fish.

Surface water appearance: Check more than one of the colors listed, but not all of them. Note if strange colors are present throughout the stream or only in one section, such as immediately below a discharge pipe or highway culvert.

Streambed deposit (bottom): Record the general overall appearance of the stream bottom. If the streambed does not have any apparent coating, you may note it as "other" and write in "normal."

Odor: Note any unusual odors. Odors may come from natural processes or may indicate potential water quality problems.

Stability of stream bed: An unstable stream bed can mean that soil is eroding from the bottom of the stream and may indicate water quality problems. When standing in the stream, determine how frequently the bed sinks beneath your feet.

Algae color: Algae feels slimy. You will notice it as you rub rocks during monitoring. A great deal of algae may indicate too many nutrients in the water. Sometimes more algae will appear in the spring after snowmelt releases extra nutrients into the stream. However, take note of the percent and type of algae present in the stream to make sure it is not increasing over time.

Algae located: Estimate the percentage of stream bed that is covered by algae. Algae often is present in small quantities in healthy streams. Excess algae may indicate water quality problems.

Stream channel shade: Over the course of the day, estimate what percentage of the stream channel is shaded by stream-side trees, shrubs, and grasses. Shading helps keep water cool and can be beneficial for aquatic life.

Streambank composition: Remember to look at both sides of the stream's banks. When questions ask for a percentage, use the information for both the left and right bank and combine values. For instance, if one side of the bank is completely bare from erosion while the other side is well vegetated, you should record the percent of bank coverage as 50 percent.

When recording total percentages of shrubs, grasses, and trees, you should also look at both sides of the bank. However, if one side has artificial structures such as rock riprap or concrete, you will have to account for such ground cover. For instance, if the left side of the bank is not vegetated, you cannot have more than 50 percent of shrubs, grasses, and trees total when those values are added together.

Streambank erosion: Again, looking at both sides of the bank, determine the percentage of soil erosion.

Riffle composition: This question refers to the 3x3-foot area of stream sampled for rocky bottom sampling techniques with a kick-seine net. Do not fill out this question when using the muddy bottom sampling technique.

If you used a kick-seine to conduct the Rocky Bottom Sampling Method, answer this question before you disturb the site. The organisms you collect are most abundant in riffles composed of predominantly cobble-sized stones (more than 70 percent cobbles is a good riffle habitat). Start with the largest rocks first when recording bed composition. If you don't have any boulders (rocks larger than 10 inches), record cobble-sized stones and continue until your percentages equal 100 percent. A typical riffle in a medium-gradient stream might be recorded as 5 percent boulders, 65 percent cobbles, 15 percent gravel, 10 percent sand, and 5 percent silt. Ranges are given on the survey form for the rock sizes. For the smaller rock sizes, remember that silt feels like talcum powder and sand feels gritty. If your riffle had 40 percent silt, 10 percent gravel, and no cobbles, you should either find another station to monitor or switch to the Muddy Bottom SamplingMethod.

Land-uses in the watershed: The survey form asks if land-use impacts are high (H), moderate (M), slight (S), or none (N). Although these questions are somewhat subjective, determining the impact is easy and straightforward. Note "H" for a land-use if it comprises the majority of land in the watershed and is polluting the stream, such as a stream traveling through land that is being strip-mined for coal. Mark "H" if the land-use has a severe impact on stream quality even though the land-use does not utilize a great deal of land, such as a construction site that has caused the stream to be full of silt. Note "M" if the land-use is definitely contributing to stream degradation, but is not the major cause for degradation (or is one of many causes). For example, parking lot runoff and trash from a shopping mall may contribute significantly to stream pollution, but they may not be the only causes of stream degradation. Note "S" for a land-use if its impacts only slightly pollute the stream. For example, although a farm may be present, good farming practices and conservation measures may mean the pollution impact is negligible. If the land-use is present but causing no pollution, write "N" for none. If the land-use is not present, do not write anything. Also, you should take the time to drive or walk through your watershed before filling out this section to determine if these land-uses are present and impacting the stream.

When considering land-use as the controlling factor in stream quality, look not just at the area visible from the stream, but at all the land draining to the stream—the watershed. If the stream collects water from an intensely developed or agricultural area, do not be surprised if no organisms are found. Should this be the case, consider visiting a forested stream of the same size in the same watershed for sampling comparison. You might be surprised at the different types of organisms you find.

You can identify a pollution source by sampling the stream at quarter-mile intervals upstream from the initial sampling point (where a pollution impact is suspected) until quality improves. The pollution sources should be identified somewhere between the point where degraded conditions were first found and the point where water quality improves.

Comments: Use this space to record observations that are not noted elsewhere on the data form. This may include current and potential future threats to the stream's health.

Stream Problems and Their Effects on Stream Organisms

1. *Physical Problems* may include excessive sediment from erosion, street runoff, or discharge pipes. Sediment can create poor riffle characteristics, contribute to excessive flooding, reduce flow, change water temperature, and smother aquatic life. The result is usually a reduction in the number of macroinvertebrates in the study area.

2. *Organic Pollution* is from excessive human or livestock wastes or high nutrient enrichment from farm or yard runoff. The result is usually a reduction in the diversity of insects.

3. *Toxic Pollution* includes chemical pollutants such as chlorine, acids, metals, pesticides, and oil. The result is usually a reduction in the number of insects.

Macroinvertebrate Count and Water Quality

Observation:	Analysis:
High diversity, high numbers, many sensitive species such as stoneflies, caddisflies, and mayflies	No problem; good water quality
High diversity, low numbers	Possibly due to poor habitat conditions
Low diversity, high numbers	Organic pollution (nutrient enrichment) or sedimentation; excessive algae growth from nutrient enrichment
Low diversity, low numbers; or no bugs but the stream appears clean	Toxic pollution (e.g., chlorine, acids, heavy metals, oil, herbicides, insecticides)

THE IZAAK WALTON LEAGUE OF AMERICA

Creek Freaks

Stream Quality Survey

Date ______________________________

Time ______________________________

Name ______________________________

Please refer to the Izaak Walton League's volunteer stream monitoring protocol and identification guides to learn how to complete this form. Please use the League's *Field Guide to Aquatic Macroinvertebrates* to complete portions of this stream quality survey form. For assistance, please call (800) BUG-IWLA or send an e-mail to sos@iwla.org.

Stream ______________________ Station # ______________ County/City ______________

Location (GPS coordinates) ____

Weather Conditions (last 72 hours) ______________________________________

________ ________ ________ ____________

Rocky Bottom Sampling

Before sampling, record riffle composition on the back of this form. Take 3 samples in the same riffle area, fill out this form, and keep the highest scoring sample for your records. To help track the number of samples you have collected, check one of the boxes below:

☐ Sample 1 ☐ Sample 2 ☐ Sample 3 ☐ Is this your highest score sample?

Muddy Bottom Sampling

Record the total number scoops taken from each habitat type and provide details to best describe the specific habitat on the lines below.

☐ Steep bank/vegetated margin ______________________________________

☐ Woody debris with organic matter ______________________________________

☐ Rock/gravel/sand substrate ______________________________________

☐ Silty bottom with organic matter ______________________________________

Macroinvertebrate Count

Consult the stream monitoring instructions on how to conduct the macroinvertebrate count. Use letter codes (A = 1-9, B = 10-99, C = 100 or more) to record the numbers of organisms. Add up the number of organism types (or number of letters) found under each category (sensitive, less sensitive, etc.) and multiply by the indicated index value. Although A, B, and C ratings do not contribute to the water quality rating, the letters track the population size in each category to see how the macroinvertebrate community changes over time.

SENSITIVE	LESS SENSITIVE	TOLERANT
_____ Caddisflies (except net spinners) _____ Mayflies _____ Stoneflies _____ Watersnipe flies _____ Riffle beetles _____ Water pennies _____ Gilled snails	_____ Dobsonflies _____ Fishflies _____ Common net spinning Caddisflies _____ Crane flies _____ Damselflies _____ Dragonflies _____ Alderflies _____ Crayfish _____ Scuds _____ Aquatic sowbugs _____ Clams _____ Mussels	_____ Aquatic worms _____ Black flies _____ Midge flies _____ Leeches _____ Lunged snails
____ # of letters multiplied by 3 =_____	____ # of letters multiplied by 2 =_____	____ # of letters multiplied by 1 =_____
Now add the three totals from each column for your stream's index value. Total index value = ______________		

Compare the final index value to the following ranges of numbers to determine the water quality of the stream sample site.

Water Quality Rating

_____ Excellent (> 22) _____ Good (17-22) _____ Fair (11-16) _____ Poor (< 11)

THE IZAAK WALTON LEAGUE OF AMERICA

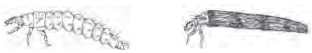
Creek Freaks

Tally Form

Under each type of macroinvertebrate on the tally sheet, write the number found in your net. Use the boxes with your group number. If none are found of that type, leave it blank.

SENSITIVE

Caddisfly larva (except common net spinning caddisfly)



1 2 3

Riffle Beetle (adult and larva)

1 2 3

Mayfly nymph

1 2 3

Water Penny larva

1 2 3

Stonefly nymph

1 2 3

Gilled Snail

1 2 3

Water Snipe Fly larva

1 2 3

SOMEWHAT SENSITIVE

Dobsonfly larva

1 2 3

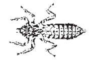
Damselfly nymph

1 2 3

Fishfly larva

1 2 3

Dragonfly nymph



1 2 3

Common Net Spinning Caddisfly larva

1 2 3

Alderfly larva

1 2 3

Crane Fly larva

1 2 3

Crayfish

1 2 3

Scud

1 2 3

Aquatic Sowbug

1 2 3

Clam

1 2 3

Mussel

1 2 3

TOLERANT

Aquatic Worm

1 2 3

Black Fly larva

1 2 3

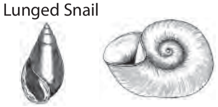
Midge Fly larva

1 2 3

Leech

1 2 3

Lunged Snail



1 2 3

GROUP 1

Add the totals from your group for the stream's index value.

Sensitive: _______ # of boxes filled in X 3 =

Somewhat Sensitive: _______ # of boxes filled in X 2 = +

Tolerant: _______ # of boxes filled in X 1 = +

Total index value Group 1 =

GROUP 2

Add the totals from your group for the stream's index value.

Sensitive: _______ # of boxes filled in X 3 =

Somewhat Sensitive: _______ # of boxes filled in X 2 = +

Tolerant: _______ # of boxes filled in X 1 = +

Total index value Group 2 =

GROUP 3

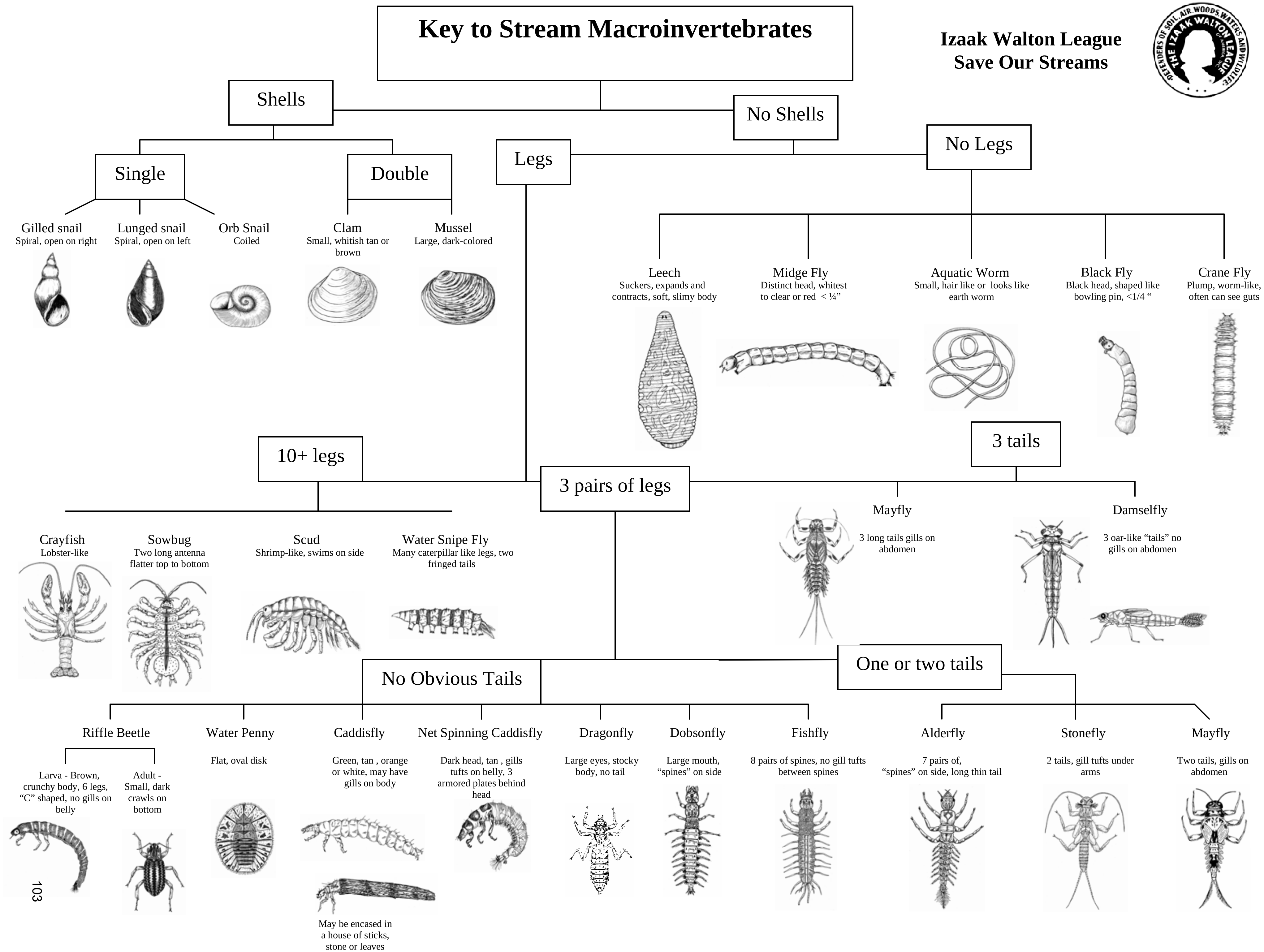
Add the totals from your group for the stream's index value.

Sensitive: _______ # of boxes filled in X 3 =

Somewhat Senstive: _______ # of boxes filled in X 2 = +

Tolerant: _______ # of boxes filled in X 1 = +

Total index value Group 3 =



Key to Stream Macroinvertebrates
Izaak Walton League
Save Our Streams
Shells
No Shells
Single
Double
Legs
No Legs
Gilled snail
Spiral, open on right
Lunged snail
Spiral, open on left
Orb Snail
Coiled
Clam
Small, whitish tan or brown
Mussel
Large, dark-colored
Leech
Suckers, expands and contracts, soft, slimy body
Midge Fly
Distinct head, whitest to clear or red < ¼"
Aquatic Worm
Small, hair like or looks like earth worm
Black Fly
Black head, shaped like bowling pin, <1/4 "
Crane Fly
Plump, worm-like, often can see guts
10+ legs
3 pairs of legs
3 tails
Crayfish
Lobster-like
Sowbug
Two long antenna flatter top to bottom
Scud
Shrimp-like, swims on side
Water Snipe Fly
Many caterpillar like legs, two fringed tails
Mayfly
3 long tails gills on abdomen
Damselfly
3 oar-like "tails" no gills on abdomen
No Obvious Tails
One or two tails
Riffle Beetle
Larva - Brown, crunchy body, 6 legs, "C" shaped, no gills on belly
Adult - Small, dark crawls on bottom
Water Penny
Flat, oval disk
Caddisfly
Green, tan , orange or white, may have gills on body
May be encased in a house of sticks, stone or leaves
Net Spinning Caddisfly
Dark head, tan , gills tufts on belly, 3 armored plates behind head
Dragonfly
Large eyes, stocky body, no tail
Dobsonfly
Large mouth, "spines" on side
Fishfly
8 pairs of spines, no gill tufts between spines
Alderfly
7 pairs of, "spines" on side, long thin tail
Stonefly
2 tails, gill tufts under arms
Mayfly
Two tails, gills on abdomen

Macroinvertebrate Size Chart

Macroinvertebrates may be smaller or larger than the pictures. Actual size ranges are listed.

Very Small


Midge 1/8 to ¼ in

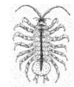

Blackfly 1/8 to ¼ in


Riffle Beetle (Larvae) 1/8 to ½ in


Riffle Beetle (Adult) 1/16 to 1/8 in

Small

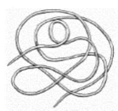

Scud 1/8 to ¼ in


Sowbug ¼ to ¾ in


Water Penny ¼ to ½ in

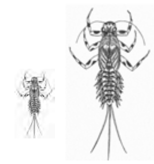

Net-spinning Caddisfly ¼ to 1 in

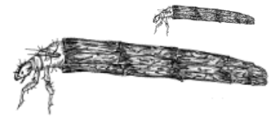

Leech ¼ to 2 in

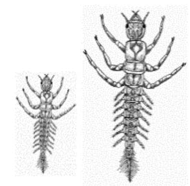

Worm ¼ to 2 in

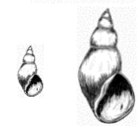

Watersnipe Fly ¼ to 1 in

Size Varies

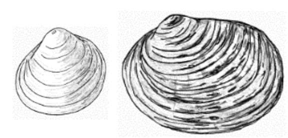

Mayfly ¼ to 1 in

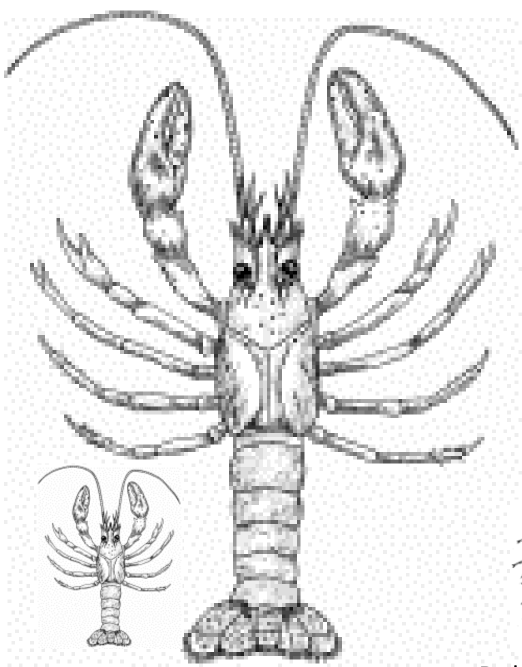

Caddisfly ½ to 1 ½ in

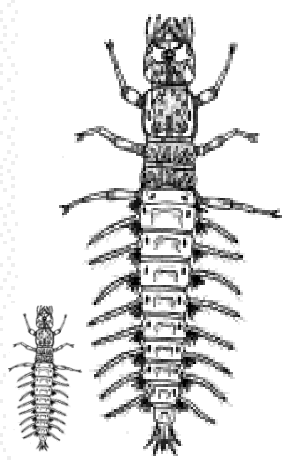

Alderfly ½ to 1 ½ in

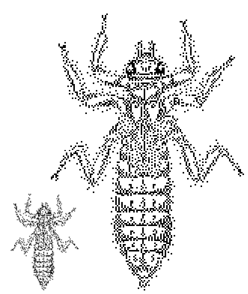

Gilled Snail 1/16 to ¾ in

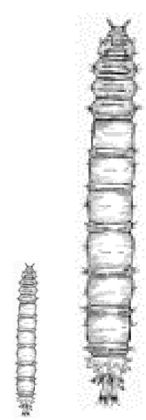

Lunged (orb) Snail 1/8 to 1in

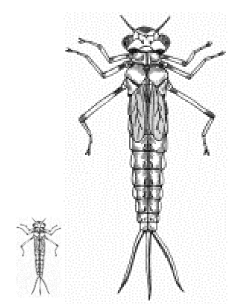

Clams & Mussels 1/8 to 5in

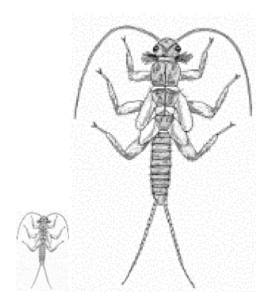

Crayfish
½ to 5 in

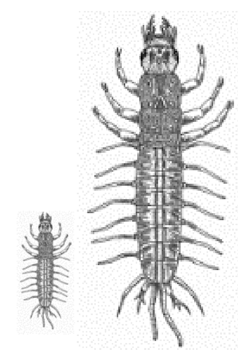

Dobsonfly (Hellgramite)
¾ to 4 in


Dragonfly
½ to 2 in


Crane Fly
1/3 to 2 ½ in


Damselfly
½ to 2 in


Stonefly
½ to 1 ½ in


Fishfly
¾ to 4 in

Identifying Macroinvertebrates

Identifying aquatic macroinvertebrates can be a daunting task, but start out by asking yourself these 5 questions. They will help you notice certain characteristics about the organism that will make it easier to identify.

Ask yourself these 5 questions every time.

1. **Does it have a shell?**
2. **Does it have legs?**
3. **How many pairs of legs does it have?**
4. **Does it have obvious tails?**
5. **How big is it?**

Does it have a shell?

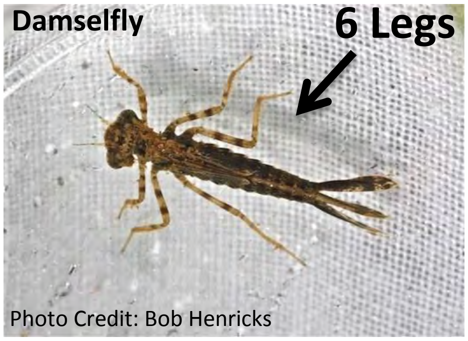
- These organisms are usually easy to identify, and include snails and clams.

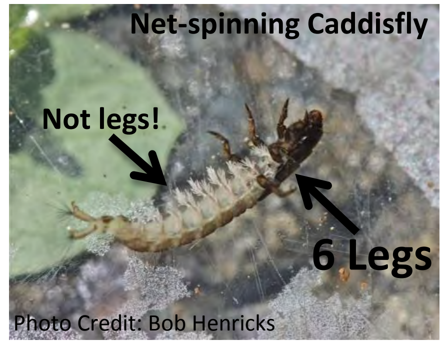
Does it have legs?

- Most do, but if it doesn't you are able to narrow it down to organisms that are wormlike

How many pairs of legs does it have?

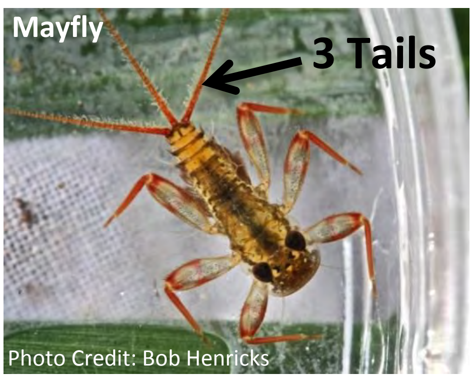
- This may seem hard, but they either have 3 pairs (6 legs) or 10+ legs
- Legs only exist on the thorax (right behind the head) not the abdomen. Leg-like pieces on the abdomen are fleshy appendages.

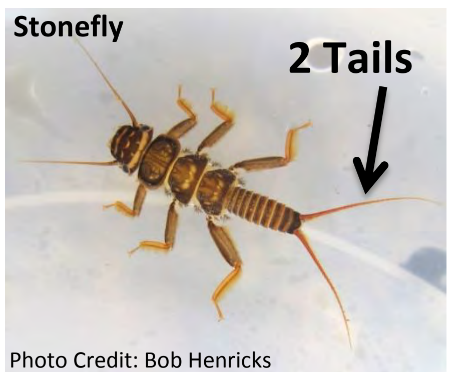




Does it have obvious tails?

- Tails will be obvious, and long. Keep in mind that they may have been broken off during sampling.
- If it has tails, how many?





How big is it?

- This can help distinguish between some of the bugs. They all look the same in drawings but some are generally very small (1/4 in) while others can be very large (3 in). **Check your Identification guides to learn what size is typical for the bug you are observing.**

Creek Freaks Activities-Materials List

This list includes materials needed for most of the Creek Freaks activities and an estimated price for each activity. Try to get as much material donated as possible. Some materials are used for multiple activities and therefore would only need to be purchased once (i.e. stopwatches). They are listed multiple times in case you are only doing selected activities.

The dollar store is your friend! Try to get as many items there as you can! Remember that while some materials will need to be purchased each time (i.e. celery) most of these items can be reused for multiple demonstrations. Ordering items online and buying in bulk can be significantly cheaper, but don't forget to add in shipping and handling charges, which could drive your price per item up. (This is inevitable for some of the chemical and biological monitoring materials.)

If you buy all materials, and share items such as stopwatches/cups/potting soil between the activities, you can expect to spend at most about $750. This does not include the purchase of any boots or waders.

The indoor activities cost about $250
**Dollar stores, donations, borrowing, and resourcefulness could significantly decrease this cost! Get Creative!

The monitoring equipment costs about $500.

Have fun!
Questions please contact Leah Miller, leah@iwla.org or (301) 548-0150 x 219

Watershed Model

Item/Quantity	**Cost**
1 aluminum cake pan 9x13"	$3.00
1 roll aluminum foil	$3.00
2-3 blocks Florist Foam (various shapes) or empty soda cans	$3.00 or Donated
1 package small farm animals	$7.00
1 package Model houses and trees	$10.00
1 empty spray bottle	$2.00
1 packet cocoa powder (pudding or hot chocolate mix fine)	$1.50
1 box red kool-aid mix (packets are fine- 2-3)	$2.50
1 box blue kool-aid mix (packets are fine- 2-3)	$2.50
A few small pieces artificial turf (Ask for scraps from a cut)	Donated or $3.00 sq. ft.
1 sponge	$1.00
1 bottle chocolate sprinkles	$2.50
1 bottle rainbow sprinkles	$2.50
Total	**$43.50**

Putting on the Brakes

Item/Quantity	Cost
1 per student/group- plastic "take out" containers or shoe boxes (with flat bottoms)	Donated or $2.00 each
1 centimeter ruler	$1.00
1 package modeling clay (1-lb)	$10.00
1 marble per student/group	$1.00
1 bag cotton balls (small handful per group)	$1.00
1 package pipe cleaners (small handful per group)	$2.00
Additional craft supplies-q-tips, popsicles, straws, etc.	$5.00
1 stopwatch (needs to go to hundredths of a second) per group	$6.00
1 wooden block, book, or similar (to prop up container) per group	Donated
Total	**$28.00**

Soil Texture and Percolation Tests

Item/Quantity	Cost
1 per student - Texture & Percolation test charts from **Leader** Guide (p. 24)	<$1.00
1 per student - "Key to Soil Texture by Feel" from Green Zone **addendum** (pg. 13)	<$1.00
1 roll paper towels	$1.00
1 blender (cheap)	$20.00
4 cups clay kitty litter **ground up** in blender	$3.00
10 lbs. sand	$5.00
20 lbs. local soil/potting soil	$7.00
3 containers for different soils (Tupperware like)	Donated
3 clear 500-mL wide-mouth beakers/measuring cup	$8.00
3 clear smaller beakers for soda bottles to sit in (2 cup or <4.5 in diameter) Norpro #3036 Plastic 2 Cup Measuring Cup	$6.00
3 stopwatches (need to go to hundredths of a second)	$12.00
1 bottle food dye (any color)	$4.00
1 roll duct tape	$5.00
6 pieces of window screen or other fine mesh to cut into circles, each approximately 10 cm in diameter	$16.00
3 empty 2-litre soda bottles –bottoms cut off, mesh screens taped on with duct tape per Green Zone addendum	Donated
3 small clear plastic cups	$1.00
1 package modeling clay (1-lb)	$10.00
1 set of measuring cups	$4.00
Total	**$104.00**

Filter Plants –*Set up the night before!

Item/Quantity	Cost
1 centimeter ruler	$1.00
1 bunch fresh celery with leaves	$1.50
1 roll masking tape	$1.00
1 bottle red food coloring	$4.00
1 bottle white vinegar	$2.00
2 **sturdy** (glass or hard plastic) cups to stand celery stalks in	$4.00
1 knife to cut celery	Donated or $1.00
1 roll paper towels	$1.00
Cutting board/plate to cut celery on	Donated or $2.00
Total	**$17.50**

Erosion in the Zone

Item/Quantity	
2 large empty coffee cans	Donated
2 fine strainers with handles that fit inside the coffee cans	$18.00
4-6 coffee filters (to have extras)	$2.00
2 large plastic kitty litter trays with a 3/8" hole drilled at the end of each tray at the center about 2 inches up from the bottom. Please measure – both need to be the same. Each of these will be filled with the soil and one will stay bare and the other will be covered with sod. Can be the next size up. Just a fairly small hole is needed.	$6.00
Potting soil to fill kitty litter tray	$7.00
2 wooden blocks to raise up one end of each tray	Donated
1 piece of sod large enough to cover one tray (don't get until a few days before)	Donated
2 large buckets to turn upside down on the floor and place the coffee cans on top of so they aren't too far below the trays that will be set up on a table top/ or boxes/ plastic tubs	$8.00
2 plastic cups	$1.00
1 box cutter/knife/scissors to cut plastic cups in half	Donated
2-3 empty gallon jugs (filled with tap water on site)	Donated
1 watering can with sprinkler head	$12.00
Total	**$54.00**

Can You See Water Pollution?

Item/Quantity	Cost
5 **clear** plastic cups	$1.00
1 bottle of food coloring	$4.00
1 bottle of white vinegar	$2.00
1 cup stream/pond/lake water	N/A
1 bottle of bottled water	$1.00
1 cup tap water	N/A
Total	**$8.00**

Critter Cube Count

Item/Quantity **You will need a full set of this for each group of students**	Cost
1 set of critter cubes	
9 1x1 wooden blocks www.craftparts.com	$4.00
Critter Cube Templates printed from www.creekfreaks.net/library	<$1.00
1 bucket to shake 8 cubes (e.g., ice cream bucket, Tupperware, large cup)	Donated or $1.00
1 macroinvertebrate ID chart in Addendum pg. 10	<$1.00
1 "Critter Key" sheet Addendum pg. 9	<$1.00
1 laminated *Field Guide to Aquatic Macroinvertebrates***	$4.95 (each)
1 *A Guide to Aquatic Insects & Crustaceans***	$8.95 (each)
Total	**$20.00**
**Items can be ordered from http://www.mwpubco.com/conservation.htm Call 1-800-233-8787 to ask for potential educational discounted price	

Other Items

Item/Quantity	**Cost**
Extra (sharpened) pencils for the data forms	$2.00
1 Calculator	$2.00
10 Sheets of blank computer paper for various activities	<$1.00
1 pair Scissors	$2.00
Total	**$7.00**

WATER QUALITY MONITORING FIELD ACTIVITIES

Physical Monitoring

Item/Quantity	
1 Physical Monitoring Form - Green Zone Binder or www.creekfreaks.net/library	<$1.00
1 100-foot measuring tape	$15.00
1 folding yard stick	$4.00
1 stopwatch (need to go to hundredths of a second)	$6.00
1 ball of string or twine	$2.50
1 whiffle ball	$2.00
Total	**$29.50**

Biological Monitoring

Item/Quantity	
Waders, water shoes (closed toed), or old sneakers for kids to get in the water	Donated/bring your own
1 Biological Monitoring Form - Green Zone Binder or www.creekfreaks.net/library	<$1.00

1 SOS kick seine net, 1/32" mesh from Nichols Net&Twine 1-800-878-6387	$41.40
2 wooden dowels (1 ¼ x 48in poplar)	$9.20
1 plastic white tablecloth - 54" x 108"	$3.00
2 white ice cube trays	$4.00
1 F/ C thermometer **(order in set of 12):** Science Kit & Boreal Laboratories (67310M20) www.sciencekit.com	$89.79
5 pairs forceps (Nasco #SB12628M)	$11.50
3 handheld lenses/magnifying glasses	$3.00
2 large magnifying boxes (Nasco #SB10305M)	$5.30
5 small magnifying boxes (Nasco #SB10304M)	$10.75
1 *Field Guide to Aquatic Macroinvertebrates***	$4.95
1 *A Guide to Aquatic Insects & Crustaceans***	$8.95
5 Key to Stream Macroinvertebrates- Addendum pg. 10	<$1.00
1 clipboard	$2.00
****Shipping charges may increase price** Total**	**$106.05**
**Items can be ordered from http://www.mwpubco.com/conservation.htm Call 1-800-233-8787 to ask for potential educational discounted price	

Chemical Monitoring
Item/Quantity

1 Chemical Monitoring Form - Green Zone Binder or www.creekfreaks.net/library	<$1.00
1 Chemetrics Dissolved Oxygen kit: Chemetrics (K-7512) www.chemetrics.com	$50.24
1 Extra dissolved oxygen comparators: Chemetrics (C-7512) www.chemetrics.com	$18.05
1 Chemetrics Phosphate kit (ortho): Chemetrics (K-8510) www.chemetrics.com	$58.82
1 Extra phosphate comparators: Chemetrics (C-8510) www.chemetrics.com	$18.05
1 HACH pH test strip set: Fondriest Environmental (2745650) www.hach.com	$11.25
1 HACH Nitrate/Nitrite test strip set: Fondriest Environmental (2745425) www.hach.com	$19.95
1 HACH Chloride low-range test strip set: Fondriest Environmental (2744940) www.hach.com	$44.95
1 Transparency tubes: Ben Meadows (111360) www.benmeadows.com	$40.00
1 F/ C thermometer **(order in set of 12):** Science Kit & Boreal Laboratories (67310M20) www.sciencekit.com	$89.79
1 stopwatch	$6.00
1 Extra 25ml sleeve of plastic containers (A-0013) www.chemetrics.com	$9.11
****Shipping charges will increase price** Total**	**$366.21**