

Virginia Association of Soil and Water Conservation Districts

Watershed Health

A Patch Program for Girl and Boy Scouts

Grade 6 and Up

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This Patch Program was developed by
the Virginia Association of Soil and Water Conservation Districts and
the Henricopolis Soil and Water Conservation District. *Program content was adapted from The Chesapeake Bay Foundation W.A.V.E. Testing the Waters Lesson.*

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Soil and Water Conservation Districts

The VASWCD Educational Foundation Mission

The Virginia Association of Soil and Water Conservation Districts Educational Foundation is nonprofit and classified as a 501(c)(3) organization that was established in 1990. The VASWCD Educational Foundation provides and promotes leadership in the conservation of natural resources through stewardship and education programs. Funding for activities such as Envirothon, Youth Conservation Camp, Youth Conservation Leadership Institute and the Conservation Poster Contest are provided through donations made by individuals, corporations, organizations and other foundations as well as fundraising efforts. Contributions to the VASWCD Educational Foundation are used to support educational efforts within the Commonwealth.

There are 47 Soil and Water Conservation Districts serving localities throughout the Commonwealth of Virginia. Governed by a board of directors of local citizens, districts work hand-in hand with state, federal and county agencies, other conservation organizations, schools, and many community partners to achieve their conservation objectives.

Districts offer many educational programs which target a variety of audiences. Emphasis is on education programs based on the VA Standards of Learning. Resources include activities, games, models, videos, skits, and more. Many districts also have a variety of resources available to teachers and scout leaders.

Contact information for the Soil and Water Conservation District serving each county in Virginia can be found on pages 4 and 5.

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Soil and Water Conservation Districts

County/City	SWCD
Accomack Co.	Eastern Shore SWCD
Albemarle Co.	Thomas Jefferson SWCD
Alleghany Co.	Mountain SWCD
Amelia Co.	Piedmont SWCD
Amherst Co.	Robert E. Lee SWCD
Appomattox Co.	Robert E. Lee SWCD
Augusta Co.	Headwaters SWCD
Bath Co.	Mountain SWCD
Bedford Co.	Peaks of Otter SWCD
Bedford, City of	Peaks of Otter SWCD
Bland Co.	Big Walker SWCD
Botetourt Co.	Mountain Castles SWCD
Brunswick Co.	Lake Country SWCD
Buchanan Co.	Big Sandy SWCD
Buckingham Co.	Peter Francisco SWCD
Buena Vista, City of	Natural Bridge SWCD
Campbell Co.	Robert E. Lee SWCD
Caroline Co.	Hanover-Caroline SWCD
Carroll Co.	New River SWCD
Charles City Co.	Colonial SWCD
Charlotte Co.	Southside SWCD
Chesapeake, City of	Virginia Dare SWCD
Chesterfield Co.	James River SWCD
Clarke Co.	Lord Fairfax SWCD
Covington, City of	Mountain SWCD
Craig Co.	Mountain Castles SWCD
Culpeper Co.	Culpeper SWCD
Cumberland Co.	Peter Francisco SWCD
Dickenson Co.	Lonesome Pine SWCD
Dinwiddie Co.	Appomattox SWCD

County/City	SWCD
Essex Co.	Three Rivers SWCD
Fairfax Co.	Northern Virginia SWCD
Fauquier Co.	John Marshall SWCD
Floyd Co.	Skyline SWCD
Fluvanna Co.	Thomas Jefferson SWCD
Franklin Co.	Blue Ridge SWCD
Frederick Co.	Lord Fairfax SWCD
Fredericksburg, City of	Tri-County/City SWCD
Galax, City of	New River SWCD
Giles Co.	Skyline SWCD
Gloucester Co.	Tidewater SWCD
Goochland Co.	Monacan SWCD
Grayson Co.	New River SWCD
Greene Co.	Culpeper SWCD
Greenville Co.	Chowan Basin SWCD
Halifax Co.	Halifax SWCD
Hanover Co.	Hanover-Caroline SWCD
Harrisonburg, City of	Shenandoah Valley SWCD
Henrico Co.	Henricopolis SWCD
Henry CO.	Blue Ridge SWCD
Highland Co.	Mountain SWCD
Isle of Wight Co.	Peanut SWCD
James City Co.	Colonial SWCD
King George Co.	Tri-County City SWCD
King & Queen Co.	Three Rivers SWCD
King Williams Co.	Three Rivers SWCD
Lancaster Co.	Northern Neck SWCD
Lee Co.	Daniel Boone SWCD
Lexington, City of	Natural Bridge SWCD

Soil and Water Conservation Districts

County/City	SWCD
Loudoun Co.	Loudoun SWCD
Louisa Co.	Thomas Jefferson SWD
Lunenburg Co.	Southside SWCD
Lynchburg, City of	Robert E. Lee SWCD
Madison Co.	Culpeper SWCD
Mathews Co.	Tidewater SWCD
Mecklenburg Co.	Lake Country SWCD
Middlesex Co.	Tidewater SWCD
Montgomery Co.	Skyline SWCD
Nelson Co.	Thomas Jefferson SWCD
New Kent Co.	Colonial SWCD
Northampton Co.	Eastern Shore SWCD
Northumberland Co.	Northern Neck SWCD
Nottoway Co.	Piedmont SWCD
Orange Co.	Culpeper SWCD
Page Co.	Shenandoah Valley SWCD
Patrick Co.	Patrick SWCD
Petersburg, City of	Appomattox River SWCD
Pittsylvania Co.	Pittsylvania SWCD
Powhatan Co.	Monacan SWCD
Prince Edward Co.	Piedmont SWCD
Prince George Co.	James River SWCD
Prince William Co.	Prince William SWCD
Pulaski Co.	Skyline SWCD
Rappahannock Co.	Culpeper SWCD
Richmond Co.	Northern Neck SWCD
Roanoke, City of	Blue Ridge SWCD
Roanoke Co.	Blue Ridge SWCD
Rockbridge Co.	Natural Bridge SWCD

County/City	SWCD
Rockingham Co.	Shenandoah Valley SWCD
Russell Co.	Clinch Valley SWCD
Scott Co.	Scott County SWCD
Shenandoah Co.	Lord Fairfax SWCD
Smyth Co.	Evergreen SWCD
Southampton Co.	Chowan Basin SWCD
Spotsylvania Co.	Tri-County/City SWCD
Stafford Co.	Tri-County/City SWCD
Staunton, City of	Headwaters SWCD
Suffolk, City of	Peanut SWCD
Surry Co.	Peanut SWCD
Sussex Co.	Chowan Basin SWCD
Tazewell Co.	Tazewell SWCD
Virginia Beach, City of	Virginia Dare SWCD
Warren Co.	Lord Fairfax SWCD
Washington Co.	Holston River SWCD
Waynesboro, City of	Headwaters SWCD
Westmoreland Co.	Northern Neck SWCD
Williamsburg, City of	Colonial SWCD
Winchester, City of	Lord Fairfax SWCD
Wise Co.	Lonesome Pine SWCD
Wythe Co.	Big Walker SWCD
York Co.	Colonial SWCD

The Importance of Healthy Streams

From ***My Healthy Steam by Trout Unlimited***: "Often, the best joys in life are the simple kind, like sitting next to a steam under the shade of a tall tree on a hot summer day, helping a child catch a fish or maybe just looking out the window at a doe drinking from a nearby brook. Healthy streams can provide these kinds of joys every day.

Healthy streams promote aquatic life and nurture surrounding lands. Healthy stream systems also do much more. They help control high energy floods, they hold water even during drought, and they help recharge groundwater.

In the past, we valued water only when we extracted it from streams and used it on our fields, lawns, or in our homes. Now, we realize that some of the most important value of water occur when the water is left in the stream.

Streams are living systems. They have he ability to clean themselves up. If we damage a stream too much, it will not be able to recover.

Testing the Waters

In this patch, you will assess the water quality, land use, biology and habitat of your local stream. At each of the four stations (land use, water quality, habitat and biology) and complete a Stream Investigation sheet. As you work through the sheets, record all your data on the Data Sheets on pages 18-20. Also feel free to write any observations about the stream or the land around the stream on the Data Sheet. Add the points for each assessment to find the total points for your stream.

Land Use

Aquatic organisms can be hurt by activities outside of their immediate habitat. The way that people use the land around a stream can change the quality of the water, the habitat, and the health of the aquatic species. Aquatic organisms can't do anything to protect their habitat– by we can! In this activity, you'll explore how land is used around your stream. You'll need a tape measure for this activity.

1. Vegetation that separates a stream from human activities helps filter out pollution that might be carried into the water by rain. This area of vegetation is called a "buffer zone". Use a tape measure to measure the width of your stream's buffer zone in three places. Then take the average of the three measurements to find the stream's buffer zone. The stream's buffer zone averages:

At least 17 meters wide	5 points
Between 11-16 meters wide	3 points
Between 6-10 meters wide	2 points
Less than 6 meters wide	0 points

2. What sort of ground surfaces make up most the buffer zone surrounding your stream?

Trees or wetlands	5 points
Shrubs, unmowed grass or pastureland	3 points
Mowed lawns or agricultural crops	2 points
Pavement	0 points

3. A good way to tell if the land use is affecting the stream is to look at the stream itself. Heavy erosion on the banks usually means that development directly around your stream or in upstream areas is channeling lots of water directly into your stream each time it rains. This stream shows

Little to no erosion: boulders shrubs, trees and vegetation present	5 points
Small area of erosion: 10%-30% of the bank shows signs of erosion	3 points
Eroded soil: 30%-60% of the bank is bare; banks are steep	1 points
Eroded soil: more than 60% of the bank looks raw and has no vegetation; banks are very steep	0 points

Land Use

4. Streams need ways to maintain stable water temperatures as the temperature of the air changes from day to day. Trees and shrubs covering the stream provide shade, which helps to keep the stream cool in the summer. What percent of the stream is shaded?

Greater than 80%	5 points
Between 50% and 80%	3 points
Between 30% and 50%	2 points
Less than 30%; mostly direct sunlight	0 points

5. If you've walked barefoot on a how summer day, you know that pavement can absorb a lot of heat. During hot weather, when rain falls on pavement and runs into a stream, the water temperature can be high enough to kill fish and other stream inhabitants. If instead, rainwater falls on soil or vegetated areas, it soaks into the ground and travels to the stream through the cool underground. What land type makes of the stream's watershed:

Largely undeveloped and rural, few houses	5 points
Rural, but with some suburban development	4 points
Largely developed, with a few undeveloped areas	2 points
Fully suburban and/or urban; almost no undeveloped areas	0 points

Water Quality

Stream organism have conditions that they can and cannot tolerate. They are sensitive to changes in their stream, especially poor water quality caused by high temperatures, sediment, acidity, toxics and low dissolved oxygen. In this activity you'll determine if your stream has water quality problems that may affect the health of stream organisms. You'll need a pH test kit, a dissolved oxygen test kit, a thermometer and a calculator.

1. Test the water temperature on the surface and at the bottom of your stream. Calculate the average temperature. The temperature of your stream is:

Under 32° Celsius—temperature ifs fine today	0 points
At or over 32° Celsius—too hot for most organisms	-5 points

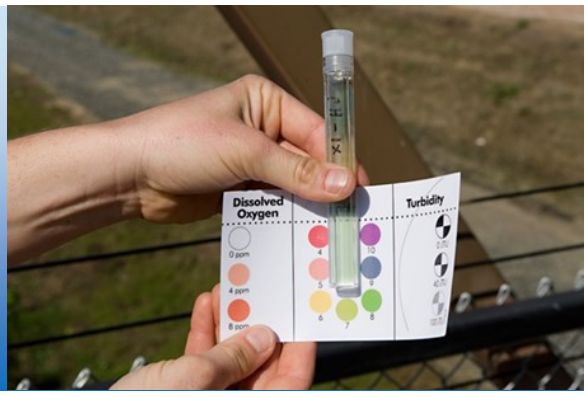
2. Fish and other aquatic species need to breathe. The amount of dissolved oxygen in the water of your stream is an important indication of what can leave there. Using the kit provided, find the DO level of the stream. The dissolved oxygen level is:

More than 5ppm– good for growth and activity	5 points
3-5ppm—stressful for many aquatic organisms	3 points
2-3ppm– stressful for most aquatic organisms	1 point
Less than 2ppm—will not support most fish	0 points

3. Your stream may be too acidic if it is clear but you see very little life in it and there seems to be no other problems. Acidity is measure by pH level. Using the kit provided, find the pH of the water. The pH is:

6.5-8.2: perfect for most organisms	5 points
5.0-6.5 or 8.2-9.0; not directly harmful to fish but may harm delicate species	2 points
4.5-5.0 or 9.0-10.5: harmful to some fish; most eggs won't hatch, most insects absent	1 point
Below 4.5 or above 10.5: lethal to most fish	0 points

Water Quality



4. Now calculate the "percent saturation" of DO in your stream to see how much oxygen it has compared to how much it should have. The chart below tells you how much oxygen your stream could have at different temperatures. Notice that the hotter the water, the less oxygen it can hold.

Temperature	Potential Dissolved Oxygen in PPM
0	14.6
5	12.8
10	11.3
15	9.1
25	8.2
30	7.5
25	6.9

With you calculator, use the following formula to calculate your stream's percent saturation.

$$\frac{\text{Measured dissolved oxygen}}{\text{Potential dissolved oxygen}} \times 100 = \text{Percent saturation of dissolved oxygen}$$

The percent saturation of DO is

80%-100% of the potential dissolved oxygen	5
60%-79% of the potential dissolved oxygen	3
40%-59% of the potential dissolved oxygen	1
Below 40% of the potential dissolved oxygen	0

Water Quality

5. Nutrients like nitrates or phosphates enter the water from human and animal waste, decomposing organic matter (like leaves) and fertilizer. Too many nutrients in the water cause algae to grow rapidly. As the algae grow and die, they block sunlight and use up the oxygen in the water. Use the nitrate kit to measure the nitrate level in the water. The nitrate level is:

Below 1ppm: unpolluted	5 points
Between 5 and 1pmm	3 points
Between 9 and 5.1ppm	1 point
Greater than 9pmm: not safe to drink	0 points

Habitat

Aquatic species require specific habitats to lead healthy lives. With access to a habitat, it is very difficult for aquatic species to survive. This activity will help you determine if your stream offers the right habitat for aquatic species to live. You'll need a yard stick, ping pong ball and a stopwatch.

1. Eroded streambanks are a sign that runoff enters the stream quickly and in large, uncontrolled amounts. Vegetation, boulders and tree roots help hold soil in place and prevent erosion. Signs of streambank erosion include steep, crumbling banks with exposed soil. The streambank shows:

Little or no erosion: boulders, shrubs, trees and vegetation present	5
10%-30% is eroded; small areas of erosion	3
30%-60% eroded; banks are quite steep	1
60%-100% eroded; banks are steep with no vegetation	0

2. Streams naturally curve. When streams are straightened or the streambanks are hardened by man-made ditches, culverts and channels, the water moves more quickly, often increasing erosion down-stream and destroying habitiat.

Shows little or no evidence of being straightened or widened by man. It's a curving stream with natural streambanks	5
10%-40% of it is straightened or changes from its natural state	3
Over 80% straightened; 40%-60% of the streambanks are concrete	1
Over 80% straightened; over 60% concrete; there are few places where aquatic animals could hide or feed	0

3. When water in a stream dries up or covers very little of the streambed, there are fewer places for aquatics organisms to live. How much of he stream bed is full of water? Water fills:

The banks of the stream on both sides; bottom is under water	5
75% of the stream; less than 25% of the bottom is exposed	3
25-75% of the streambed; much of the bottom is exposed	1
Very little of the streambed; mostly in still pools	0

Habitat

For a diversity of organisms to survive in a stream, there must be a diversity of habitats, including several depths and speeds of water. Complete the activities below to find out if the stream has diverse habitats.

4. Determine the depth of the water. Place the yard stick vertically into the water until it touches the stream bottom. Measure in several places until you find the deepest and shallowest spots (Deep = .5 meter or more, Shallow is less that .5 meters).

5. Determine is the stream has both slow and fast moving areas. Hold the yardstick horizontally just above the water. Drop a ping pong ball along one end of the stick. Time how long it take the ball to travel down to the other end of the stick. Repeat in several areas. Calculate the rate that the ball traveled at each site (Fast =.3 meters per second, slow = less that .3 meters per second)

All types of water can be seen—deep , shallow, slow and fast	5
Only 3 or the 4 types are seen	3
Mostly shallow and slow pools	1
Slow and Shallow water only	0

Biology

A healthy stream will have many different types of macroinvertebrates– the larvae and bugs that live at the bottom of the stream. Because some macroinvertibrates are extremely sensitive to water quality, they can tell you whether your stream is healthy or not. For this activity, you will need a shallow pan, ice cube trays, metal strainer, small pain brushes, magnifying glass, and the *Izaak Walton League Key to Stream Macroinvertebrates* on page 17.

Sampling for Macroinvertibrates

1. Fill your ice cube tray with clear stream water.
2. Select a fast moving area
3. Place the strainer at the downstream edge of the water.
4. Dip the strainer into the bottom sediment using a jabbing motion to loosen organisms.
5. Also try dipping up against the stream bank edges and around any fallen tree limbs or tree roots that are in the water
6. Scoop up the bottom sediment and dump the contents into a shallow pan to examine. Always lift the strainer from the bottom of the water upstream so you samples do not escape.
7. Separate the macroinvertibrates from the silt and debris found
8. Scoop the strainer into the bottom sediment several times to get a good sampling
9. Using the magnifying glass, tweezers or paint brushes to carefully pick up any samples and place them in the ice cube trays. Be sure the group similar samples in the same section of the tray.
10. Use the *the Izaak Walton League Key to Stream Macroinvertebrates* to determine the types of macroinvertibrates you've collected.
11. Record each different type of Macro below. If you find more than one of a species, write it down but count it only once.

Biology

12. Refer to the chart on the following page to determine how many points to give each macro. Record the points for each different macro found.

13. Release the macros back into the stream.

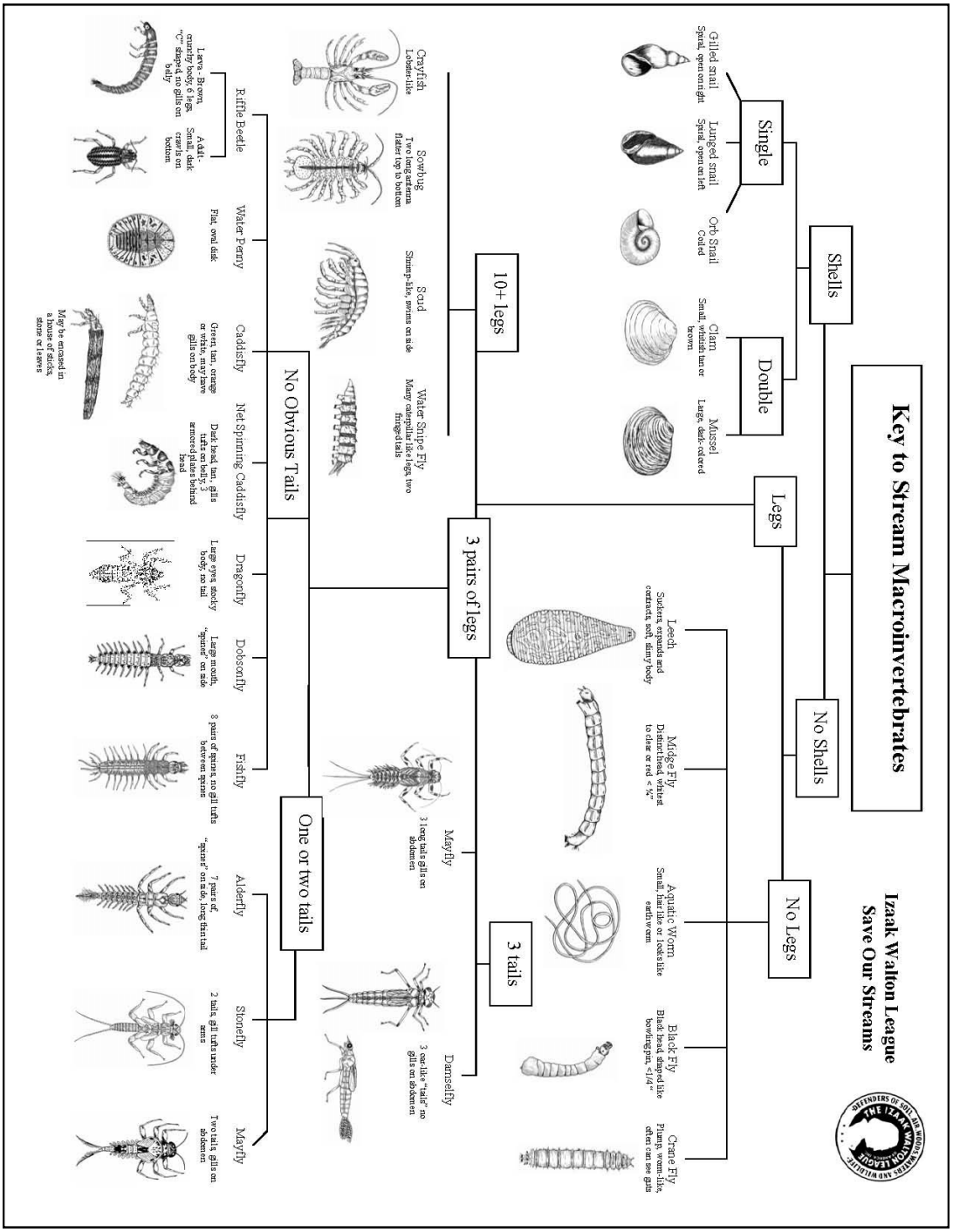
Macroinvertebrate Point Value

Sensitive to Pollution *3 Points*	Somewhat Sensitive to Pollution *2 Points*	Tolerant of Pollution *1 Point*
Mayfly	Scud	Leeches
Stonefly	Clam	Midge Fly
Riffle beetle	Crayfish	Aquatic Worms
Water Penny	Sow Bug	
Caddis fly	Damselfly	
	Dragon fly	
	Cranefly	

The stream's macro sample was

Excellent: 23 species	5 points
Good: 17-22 species	3 points
Fair: 11-16 species	1 point
Poor: 10 species	0 points

Biology


Key to Stream Macroinvertebrates
Izaak Walton League
Save Our Streams
Shells
No Shells
Single
Double
Legs
No Legs
Gilled snail
Spiral, opens on right
Lunged snail
Spiral, opens on left
Orb Snail
Coiled
Clam
Small, whitish tan or brown
Mussel
Large, dark-colored
Leech
Sucking, 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 gills
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
No Obvious Tails
One or two tails
Mayfly
3 long tails gills on abdomen
Damselfly
3 one-like "tails" no gills on abdomen
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, many have gills on body
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, "gunnel" on side
Fishfly
8 pairs of spines, no gill tufts between spines
Alderfly
"gunnel" on side, long thin tail
7 pairs of
Stonefly
2 tails, gill tufts under arms
Mayfly
Two tails, gills on abdomen
May be encased in a house of sticks, stone or leaves

Data Sheets

Land Use	Points	Possible Points
Buffer Zone		5
Ground Cover Vegetation		5
Condition of the Stream Banks		5
Stream Shade Cover		5
Development and Land Use		5
Total for Land Use		25

Water Quality	Points	Possible
Temperature		5
Dissolved Oxygen		5
% Saturation of DO		5
pH		5
Nitrite		5
Total for Water Quality		25

Data Sheets

Habitat	Points	Possible
Signs of Erosion		5
Stream Curve		5
Amount of streambed covered by water		5
Water Depth and Movement		5
Total for Habitat		20

Biology	Points	Possible
Macroinvertebrate Data		5
Total for Biology		25

Data Analysis

Copy the total points from your Data Sheet into the table below and compute the percent of the total scored for each Investigation. To find the percent of total score, total score/possible score x 100)

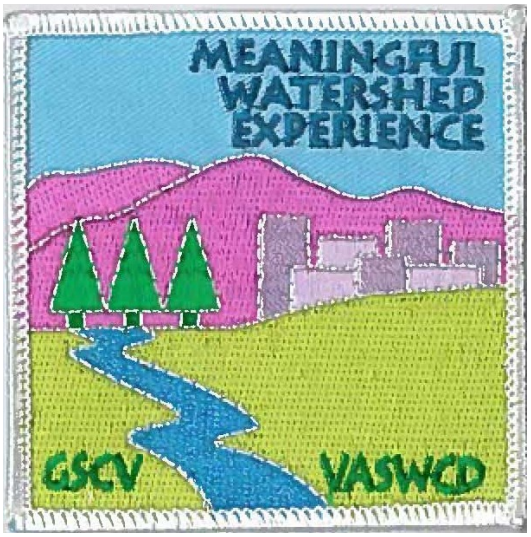
Investigation	Total Score	Possible Score	Percent of Total Score
Land use		25	
Water Quality		25	
Habitat		20	
Biology		5	

The overall health of the stream may be evaluated by looking at all of the factors you have tested and observed at the waterway. Review the results of each of the categories (Land Use, Water Quality, Habitat and Biology) and indicate below whether you feel each is a good score or a bad scors for this waterway. Generally, scores above 80% are considered good whereas scores below 80% are considered poor. But you will need to consider all your observations when making your decision.

Why you think your stream scored well in the areas in which it did? Why do you think your stream scored poorly in the areas in which it did?

The Patch!

The Stream Health patch is available through your local Soil and Water Conservation District. Contact your SWCD to request a workshop or to order patches after completing the activities on your own. A list of SWCDs and the counties they serve are listed on pages 3-5.



WATERSHED HEALTH

Name	*Activity 1* Land Use	*Activity 2* Water Quality	*Activity 3* Habitat	*Activity 4* Biology	Activity 5 Analysis