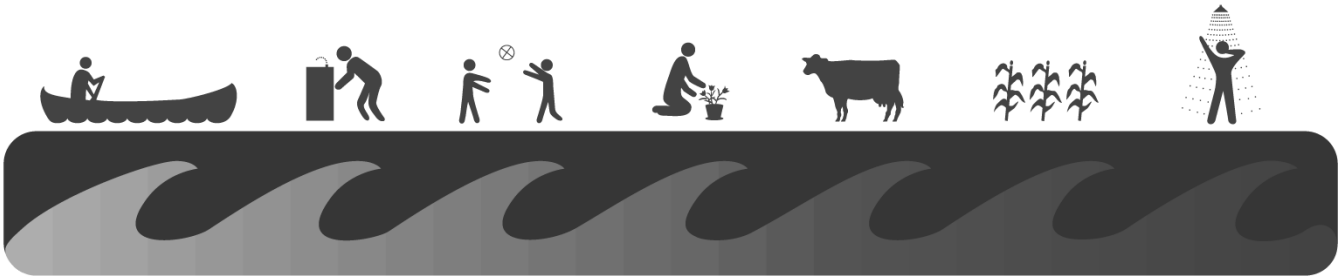
Watershed Connections



Youth Activities Teacher's Guide

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Draft

Note: this is the working draft of the Teacher's Guide. Contact Natalie Carroll (ncarroll@purdue.edu) for a paper copy of the final version.

Note to teachers:

The youth activities in this publication are intended to be used with your county Watershed Connections publication so youth can study their local water resources. The Teacher's Guide give activity objectives, a brief introduction, and the answer keys for the youth activity sheets (provided separately – teacher will need to copy).

The activities are intended for Middle School and High School students, although younger students can also learn from these activities with appropriate assistance. The order of activities follows the order of topics in the county Watershed Connections publication.

SPECIAL THANKS
to teachers Barb Richardson and Bill Laufman of Pine Village Elementary School and Fred Whitford of the Purdue Department Pesticide Programs
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Notes about using the Watershed Connections publications:

- The youth activities are intended to be used in conjunction with your county Watershed Connections publication. While some of the activities can be completed by students without the publication many of the activities depend on the information found in your county publication.
- You will find teacher reference pages which give objectives and an introduction for each activity followed by a listing of materials needed and, in some cases, follow-up questions.
- After the teacher reference page for each activity a copy of the student worksheet is included. Student worksheets have a border to distinguish it from information intended just for teachers. Specific answers are given in Comic Sans MS type font and suggested answers (when multiple answers might be given or county specific information applies) are given in *italic Times font type*.
- Student worksheets are provided as loose leaf pages for ease of copying.

Activity 1:
Watersheds of Indiana

Objective: Students will learn what watersheds are and why watersheds are important.

Introduction: A watershed is the land area that feeds into a particular lake, river, or stream. Watersheds can be studied on a small scale (i.e. the land around a small stream or creek) or on a very large scale (i.e. all the land that feeds water into the Mississippi).

Policy makers and citizens are becoming increasingly aware of the importance of considering *watersheds* when making decisions that will affect water quality. Understanding and using a watershed approach helps people understand the interconnections between people's actions, communities, and the environment.

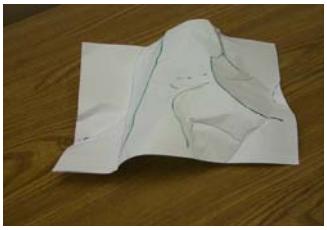
Three parts to this activity are included. The first part will help students visualize what a watershed is, the second part requires students to look at Indiana watersheds and the Watershed Connections publication to answer questions, and the third part describes an activity that older students can do with younger students to show how citizens may affect the water quality of other people.

Activity 1, Part 1: Picture a watershed (teacher led)

Materials Needed: paper, markers (blue, brown, green)

Ask each student to take a piece of paper and crumble it up. Open it up again, unfold it, flatten it slightly, and lay it on a desk or table. The sheet of paper becomes a relief map showing "topography," including hills and valleys. Youth can imagine where water would flow in this landscape.

1. Trace the path of the major rivers in your landscape. These will be the low points of the "valleys," where water would flow to if you sprayed water on your paper. (Note: the picture shows the watershed boundaries.)



2. With a different colored pen, trace the "watershed boundaries." These are the high points in the landscape that define the areas that flow into each river.

There is no fixed number of watersheds into which your landscape should be divided. Often one 8.5 by 11 sheet of paper is split into 3 or 4 major watersheds with several "subwatersheds." Subwatersheds are smaller areas of flow that feed the major watersheds. Each student's landscape will be different. As a check on the accuracy of the lines traced, you can spray water lightly onto the landscape and see if it follows the path the student estimated (less absorbent paper works better for this).

Activity 1, Part 2: Where is my watershed?

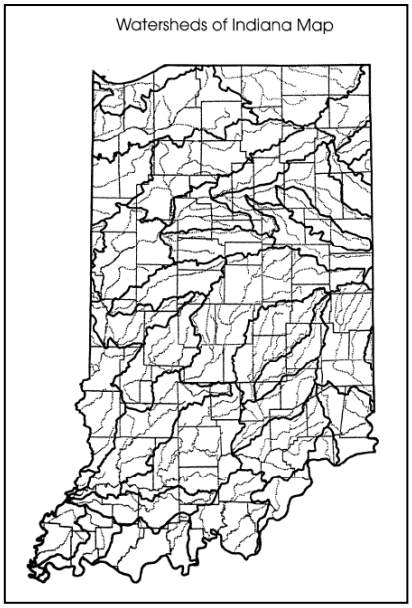
Materials Needed: student worksheet, Watershed Connections publication

Have the students complete the Watersheds of Indiana Activity Sheet. Students may need to refer a map of Indiana (enclosed) to complete some of the questions. Note that watersheds may be drawn at many different scales: from a small watershed that includes only an intermittently running creek to all the land feeding into the Mississippi River, covering almost half of the United States. The modeling scale determines the extent of the watershed.

Follow Up Questions: You may want to hold a general discussion with their students after they have completed the watershed activity. The following questions may be used, if desired:

1) Rain often infiltrates the soil it falls on. However when rain falls on impermeable surfaces it usually runs off into rivers and streams, taking pollutants with it. What types of places often have impermeable surfaces?

Possible sources include houses, schools, parking lots, livestock confinement areas, streets, shopping malls… (places that are paved, concrete, or packed clay)



2) What kinds of pollutants could rain water pick up from each of these places?

Road salt, pet wastes, automobile oil, gasoline, antifreeze, etc.

3) Where does your river go after it leaves Indiana?

Most of the water that leaves Indiana in rivers and streams ends up in the Mississippi via the Wabash and Ohio Rivers. So Illinois, Kentucky, and other states along the Mississippi, all the way down to the Gulf of Mexico, receive our water after it leaves Indiana. But the water from the three north watersheds (Lake Michigan, St. Joseph, and Maumee watersheds) travels to the Great Lakes. The Great Lakes flow east, eventually ending up in the Atlantic Ocean.

Name _____KEY_____

Activity 1:
Watersheds of Indiana

Watersheds are defined by the high point that separates surface water runoff between two adjoining regions. A watershed is like a bathtub. If you turn on the shower, all the water that falls in the tub eventually goes down the drain. Water falling on the edge of the bathtub is like water falling on the high point, or boundary, of two watersheds. If you were to point the showerhead so that some spills out of the tub onto the bathroom floor you are showing two watersheds: the tub and outside of the tub.

1) Locate your county on the Watersheds of Indiana map. Outline your county in red.

Students should be able to locate their county and outline it.

2) List other counties that are in your watershed. (Students are given a map of Indiana with counties shown.)

Students should be able to list other counties that are in their watershed. It can some times be difficult to see all the counties that a watershed touches. Furthermore many counties have more than one watershed in them. You may want to specify which watershed your students should look at.

Example: Marion county is in the Upper White watershed. Other counties in this watershed include: Boone, Delaware, Hamilton, Hancock, Hendricks, Henry, Johnson, Madison, Morgan, Owen, Randolph, and Tipton.

3) List major cities and towns that are in your watershed.

Example: The Upper White watershed includes Anderson, Indianapolis, and Muncie.

4) How can pollutants introduced upstream in a watershed affect people living downstream?

Pollutants are carried downstream with water flow. Most pollutants that enter a river will remain in the river as it flows downstream, since there are few means for removing pollutants from natural waterways.

5) Land use affects the pollutants that you can find in a stream or river. Try to think of some pollutants that the following land uses might cause:

[Teacher note: The land use generally determines the type of pollutants you can expect in the river downstream.]

residential areas – road salt, oil, home waste products such as fertilizers, discharge from family septic systems, and pet wastes

industrial areas – chemical solvents and other pollutants, and trash. Industrial water use may heat the water, which also impacts the natural ecosystem.

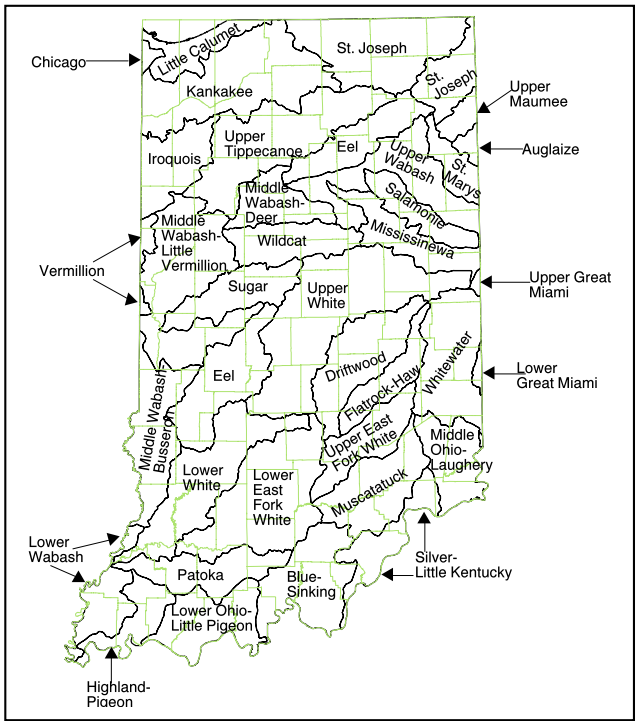
agricultural crop lands – fertilizers, herbicides, fungicides, and eroded soil

agricultural livestock facilities – nitrates and animal waste which includes phosphorus and *E. coli* (bacteria)

construction sites – sediment

Can you think of other potential polluters?

Students may be able to think of other sources of water pollution from things they have seen or read in local papers.



6) What counties downstream would be affected by land use in your county?

Indiana rivers generally flow to the Southwest, with the exception of rivers in the north and northwest which flow to Lake Michigan. Water from the three north watersheds (Lake Michigan, St. Joseph, and Maumee watersheds) travels to the Great Lakes. The Great Lakes flow east, eventually ending up in the Atlantic Ocean.

Example – Marion County affects all the counties to the south and west that the White River runs through.

Activity 1, Part 3: Everything Flows Downstream

(Note: This activity is intended for elementary students. You may want to use it if your high school students have any opportunity to work with elementary students.)

adapted from "Sum of the Parts," Project WET Curriculum and Activity Guide

Materials Needed: paper, common household objects

1. Give each student a sheet of paper. Ask them to mark the paper at 3 inches from the bottom and draw a wavy line from one mark to the other. The paper represents riverfront property that they own. Have them color the "river" below this line blue.

2. Tell the students that they each have one million dollars to use to develop this property as they wish. They can farm or ranch; build resorts, homes, factories, or parks; plant forests, log, mine: whatever they can think of.

3. Ask your students to think about how they developed their property and what kind of impact their development could have on the river. They should identify any of their actions that polluted or added materials to the waterway. Ask each student to think of objects that could represent the pollutants from their property. (This could be a homework assignment, objects available in your classroom, or objects that you bring for them to use. Some suggestions might include: pencils (logging), tissues & empty food or beverage containers (household wastes), toilet paper (septic system), sand paper or container of soil (soil erosion), etc.

4. Ask the students to place their pictures on the floor, side by side in two rows so a river is formed in the middle (bottoms touching). Each student should explain what they chose to do with their land and place the objects that represent pollution on their picture.

5. Tell the students to line up in the same order as their pictures, standing just behind their picture (there should be two rows of students). The first students pick up their pollution items, tell what they represent, and passes them downstream to the next student. That student holds the first students items, picks up their own, tells what their items represent, and passes on all the items. Students continue passing the items, while telling what they are adding (and why) until the last students hold <u>all</u> the items.

After all the items have reached the final student you can discuss this activity. How did those students toward the middle and at the end of the river feel? How can people downstream be affected by the actions of a people upstream? How can upstream citizens alter the water quality of a river downstream?

We	**need a picture**	**here**		
XXXXXXXXX	**XXXXXXXXX**	**XXXXXXXXX**	**XXXXXXXXX**	**XXXXXXXXX**
XXXXXXXXX	**XXXXXXXXX**	**XXXXXXXXX**	**XXXXXXXXX**	**XXXXXXXXX**

Activity 2:
River Discharge

Objective: Students will understand what river discharge is. They will also be able to better comprehend the figure in the Watershed Connections which shows the average yearly discharge from one or more rivers in your county.

Introduction: The amount of water flowing at a particular point in any river at any given time is called *discharge*. Discharge is the volume of water measured (in cubic feet) passing through a known point in one second. The units generally used are cubic feet per second. The discharge is measured at gauging stations. A gauging station is a place along the river where equipment is set up to measure the volume of water flow. The River Discharge activity involves a simple graphing exercise and math conversions as students study the amount of water that flows in rivers in their counties.

Materials needed: Graph paper, two different colored markers, and a ruler, Watershed Connections publication for your county, student worksheet

Perhaps a picture of a gauging station

Follow-up Activity: If your students can access the Internet they can find additional information about the watershed your county is in and rivers in your county at: http://waterdata.usgs.gov/nwis-w/IN/

This is a great site which gives the following information:

- Historical streamflow daily values
- Peak flow rates for rivers in your county
- A map of the region around the rivers in your county
- A link to the EPA "Surf Your Watershed" so you can see the entire watershed your county is in.

Activity 2:
River Discharge

Name ____Key_____

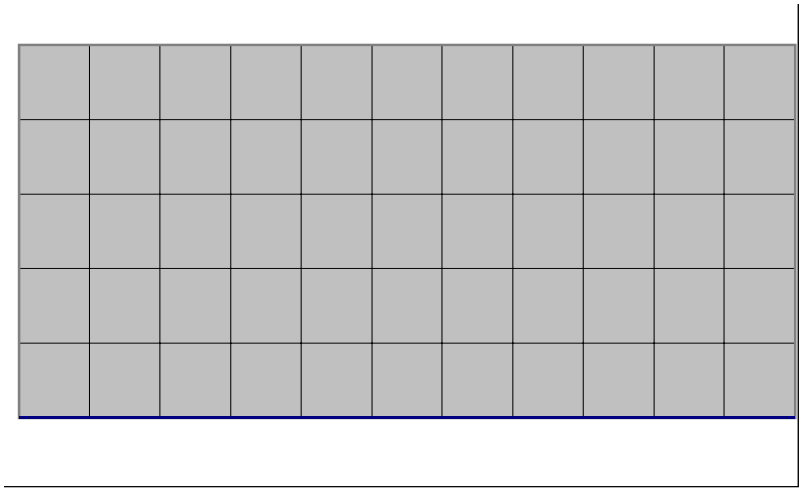
Introduction: There are several major rivers that flow through Indiana. Monitoring the amount of water within rivers is important for proper water management, (flood control, city, urban, rural, and agricultural needs). The volume of water flowing at a particular point in any river at any given time is called discharge. Discharge is measured at gauging stations. A gauging station is a place along the river where equipment is set up to measure the volume of water flowing past the gauging station.

Reference: Watershed Connections figure showing average discharge

Materials Needed:
Graph paper, two different colored markers, ruler

Activity: Using the graph shown below label the x axis January – December. To label the y axis units use the same values as shown in the figure showing river in Watershed Connections. Mark the highest and lowest discharge for a river in your county on the appropriate month (if more than one river discharge is shown use the river with the highest discharge). Connect the high and low for the river and label it and write the name of the river above the line. Next connect the high and low point for a second river with a different colored pencil or marker and label that. You have made a simplified version of the discharge figure from the Watershed Connections publication. Use this graph and the publication to help answer the questions. Optional - use the discharge values for every other month to see how that graph compares to the one given in the publication.

Example graph (Flatrock River in Shelby County):



1. Calculate how much water would flow in the river at the highest discharge rate in one minute, one hour, and one day if it continued to flow at the given rate. Then estimate what this value is in gallons. Note: a cubic foot of water is a volume measurement of water in a one foot x one foot x one foot space. In the United States, however, most people are more familiar with the gallon as a volume measurement. A cubic foot container would hold approximately 7 ½ gallons of water. (Show your work.)

ρ

a) Water flow in one minute (discharge) (from graph) = *800 cfs (cubic feet/second)*

b) Cubic feet of water in one minute = *(a) x 60*

800 x 60 = 48,000 cubic feet

c) Cubic feet of water in one hour = *(b) x 60*

48,000 x 60 = 2,880,000 cubic feet

d) Cubic feet of water in a day = *(c) x 24*

2,880,000 x 24 = 69,120,000 cubic feet

e) Gallons of water per day = *(d) x 7.5*

69,120,000 x 7.5 = *518,400,000 gallons*

This is a lot of water!

2. Why might one river have a higher discharge than another river?

Rivers generally have a higher discharge when they drain more land area (because they have a larger watershed area).

3. Why is the discharge highest during the spring months and lowest during the late summer months?

Discharge levels are related to both rainfall amounts and plant growth. During the spring months there is generally more rain and fewer plants growing to take up and use the water and whereas in the late summer all the fields and gardens are actively growing. Plant cover slows the flow rate of water and plants take up water so there is less drainage into the rivers. *(See the Watershed Connections publication for more information).*

4. How well did your graph match the figure in the Watershed Connections publication?

   The student's graph should roughly approximate the figure shown in Watershed Connections which shows an average discharge based on many years of data.

5. Why is it helpful to use averages and other simplifying methods?

   The simplifications that the students made gives a rough idea of the discharge in your county rivers over the year. Graphing the highs and lows works pretty well here but in other instances using only the high and low values might over-simplify the information to such a degree nothing can be learned from the graph. For example, if students were to chart the daily high temperatures for a month and then simplify that by graphing the highest and lowest temperatures they would probably miss a great deal of useful information. This is less likely to happen with the monthly average data because it is an average from a number of years, and many of the natural fluctuations are averaged out. Furthermore, the general trend is consistent. (Similarly a more realistic graph could be made using average weekly or monthly temperatures.)

Gauging station (same as in teacher's info, page 9).

Activity 3:
Floods, Floodplains, and Flood Probabilities

Objective: Students will learn what the significance of "a 100-year flood" is and how the flood is labeled.

Introduction: Floods can cause a great deal of damage. The most frequent cause of flooding is heavy rain. Flooding can also be caused by rapidly melting snow, or if the channel has been blocked by debris, sediment, or overgrown vegetation. Flooding is also affected by human activity such as development. Impermeable surfaces such as houses, sidewalks, roads, and parking lots also increase surface runoff which usually increases flooding.

Two activities are included. The first activity includes some information for the students to read and questions to answer. The second activity, "Wheel of Flooding" is intended to show how probability affects flooding prediction.

Materials Needed: Watershed Connections publication for your county, student worksheet, "wheel of flooding" (in student activity sheets), and peas or a method to make the "wheel" spin.

Follow-up Activity: Invite a local official responsible for floodplain management to speak to your class. It might be someone from the Area Plan Commission, or Soil and Water Conservation District. Ask them to bring floodplain maps for an area you know. Discuss what actually exists in the floodplains. You can purchase the floodplain maps from the Federal Emergency Management Agency, 1-800-358-9616 (ask for the current price).

Activity 1: Student information sheet & worksheet

A watershed acts as a funnel, bringing all runoff water (water that does not infiltrate the soil) to a single outlet. River and stream channels are generally only large enough to carry the flow expected in "average" storms. So rivers flood: they always have and always will. When heavy rains come, rivers can not hold all the water and they flow outside their banks onto normally dry lands adjacent to the stream, known as floodplains. Approximately 7% of the total land area of Indiana is in floodplains. Wherever you are, chances are good that you live within a few miles of a floodplain.

The most frequent cause of flooding is heavy rain. Flooding can also be caused by rapidly melting snow, or if the channel has been blocked by debris, sediment, or overgrown vegetation. The worst floods usually occur when it rains on ground that is already saturated from previous rain or snowmelt. Flooding has also been affected by human activity such as development. Impermeable

surfaces such as houses, sidewalks, roads, and parking lots also increase surface runoff which usually increases flooding. Inadequate bridges and culverts may restrict natural streamflow capacity and cause increased flood stages. Draining or filling wetlands where flood waters are often stored also increases flood damage.

The *intensity* of a storm determines how much rain falls in a given time period. The greater the intensity of a storm the more likely flooding is to occur, because rain may fall faster than it can be taken up by the soil. In urban areas much of the rain will fall on roof tops, roads, and parking lots, then travel to street drains and on to rivers, streams, lakes, or oceans.

While floods in Indiana may occur at any time of the year, the majority of floods occur during the period from January through June. There's no way to predict when the next flood will happen, or how severe it will be. However, we can use statistical data (what has happened in the past) to estimate the *probability* or chance that floods of a certain size will occur in the future. For example:

- A fairly common small flood might occur on the average 50 times over a 100-year period. This flood would be expected to occur on an average of once every 2 years, or have a 50% chance of happening in a particular year. A flood of this magnitude is called the 2-year flood, and the area that is flooded is called the 2-year floodplain. In most cases the river or stream channel itself can contain the 2-year flood.
- A larger (more unusual) flood might occur on the average 10 times in 100 years. This is called the 10-year flood, and the area that is flooded is the 10-year floodplain.
- Occasionally a flood so large and unusual that it only occurs on the average 1 time in 100 years. These floods are called a 100-year flood. It has a 1% chance of occurring in any year, and it floods a much larger area called the 100-year floodplain.

The chance of a flood of a certain size occurring and then re-occurring is like flipping a coin or spinning a wheel. Just because heads comes up doesn't mean the next try has to be tails. One 100-year flood doesn't reduce the chance (which is always 1%) of a 100-year flood occurring during the next 365 days.

Because flooding is such a common and expensive natural disaster, floodplain maps have been developed for most communities in Indiana. The map in *Watershed Connections* shows the floodplain delineated for your county. People who live within this area should have flood insurance to protect their property from this risk. More information on the National Flood Insurance program is available on the Internet at http://www.fema.gov/nfip

Activity 3:
Floods, Floodplains, and Flood Probabilities

Name _____KEY_____

1. Look at the Figure entitled "Floodplain of xxx County" shown in the Watershed Connections publication. Identify the rivers, streams, or lakes that are the source of flooding in the various areas of the floodplain map for your county.

   Example - Tippecanoe County: The Wabash River is a major source of flooding during, and after, heavy rains.

2. Identify the land use of this area for any areas you know (i.e. is the floodplain used for agriculture, urban development, parkland, forest, etc?)

   Example - Tippecanoe County: Much of the land in the Wabash River floodplain is agricultural fields (corn, soybeans, or alfalfa). Some of the land is developed, although homes and buildings are set back from the river. Roads near the river often flood, however.

3. Study the average monthly discharge graph in Watershed Connections. When is flooding most likely?

   Flooding across Indiana generally occurs between January and June.

   You, or your students, can check long-term flow records for streams in your area at the web site http://waterdata.usgs.gov/nwis-w/IN/

4. Why do many people like to live near rivers?

   Cities were usually built near rivers for transportation and access to water for industry. Today many people like to live near the river for aesthetic reasons and for recreation.

5. What should people consider when buying or building a house near a river?

   If people want to build or buy near the river they should check the official floodplain maps to see if their land lies within the floodplain. If it does, they need to think about how they would feel if their house was flooded. Does the chance (even though it may be small) of losing their possessions or even their house equal the value they see in living in that location? If they decide to live there, they should purchase flood insurance. Flood damage is almost never covered by typical homeowners insurance, but is available through the National Flood Insurance Program in most communities.

Activity 2: Wheel of Flooding

Activity: Students will begin to understand how data from past years helps to predict flood probabilities by playing "Wheel of Flooding." Students will randomly select a certain size storm. Any of the following methods may be used to randomly select areas of the pie chart to give a probability tally.

1. Use a twist-tie (i.e. from a bread bag) and a strait pin as a spinner. Push the strait pin through the tie (not at the center) and into the center portion of the pie chart. The larger portion of the tie acts as the point. A cardboard or Styrofoam backing for the pie chart would be helpful to hold the pin.

- OR -

2. Use peas to toss onto the pie chart from an appropriate distance. Disregard peas that fall outside the chart or use two pieces of paper to form a barrier around the pie chart (8 ½ inches high). Students then drop the peas from waist high into the tube.

- OR -

3. Cut the pie chart and paste it on to a circular piece of construction paper. Use a strait pin to attach the pie chart to another piece of cardboard with an 'x' or a pin to indicate the storm. Students spin their wheel and tally the number of times they get each storm.

Activity 3:
Wheel of Flooding

Name _____KEY_____

Directions: Use the pie chart to study why events with higher probabilities occur more frequently. The values shown on the pie chart are roughly equivalent to the chances of having a 2, 5, 10, and 100-year storm. Spin the chart 100 times and tally your results.

1. Tally the number of times each area of the wheel was selected.

Teacher Note: These values will vary each time the students do the exercise.

2 year, or less	5 year	10 year	100 year
A	*B*	*C*	*D*

Where:

A – total tally for the 2-year, or less, storm
B – total tally for the 5-year storm
C – total tally for the 10-year storm
D – total tally for the 100-year storm
E – total tally for all storms (A + B + C + D)

Example (50 throws):

2 year, or less	*5 year*	*10 year*	*100 year*
1111 1111 1111 1111 1111 111	*1111 1111 11*	*1111*	*1*
33	*12*	*4*	*1*

Question: Calculate the percentage you got for each storm.

2 year, or less	5 year	10 year	100 year
A/E x 100	B/E x 100	C/E x 100	D/E x 100
Example:			
66%	*24%*	*8%*	*2%*

Note: Students will probably get <u>about</u> the same results if they try 100 times. If students only take 10 tries, however, the results will probably vary widely. The percentages that you would <u>expect</u> (based on the percentages used to make the chart) are:

STORM	*%*
2 year, or less	*69*
5 year	*20*
10 year	*10*
100	*1*

Note: Each selection represents the biggest storm for any given year. The expected value (69%) given for the 2 year-or-less storm was chosen to give a 100% sum. A two year storm would actually have a 50% chance of occurring in any given year and a 1 year storm would be <u>expected</u> every year.

More spins increases the probability that the results your class gets will agree with the expected results (above). Three points should be made here:

- *More data generally gives "better" results (closer to what is expected).*
- *Probability only tells us what to expect, not what will actually happen. (You may want to point out the diversity of results by different teams. This diversity will likely be larger if each team has only 10 tries, rather than 100 or more).*

More "tries" (spins, peas dropped, or other data collection) increases the likelihood of getting the expected results.

2. Would you expect to get the same results the next time you play?

It is unlikely that students would get the same results twice in a row. They might expect to get very similar results, particularly if they tried a number of times.

3. If your local news reporter said that flooding in your area was caused by a 50-year storm, how old would you be when you would <u>expect</u> to see such a flood again?

Students could expect to see a similar flood in 50 years, but such a flood could occur much sooner, or later.

Could this size flood occur the next year?

Yes, this size flood could occur next year or even later the same year.

Activity 4:
Understanding Ground Water Flow

Objective: Students will understand how soil helps filter water and how water soluble nutrients and contaminants are transported. They will also begin to understand that there are many variables that affect nutrient and contaminant movement.

Introduction: Water is stored as surface water or ground water. Surface water includes water in puddles, streams, rivers, ponds, lakes and oceans. Ground water is any water that moves into the soil and percolates below plant roots. This water may be taken up by plants, held in the soil, or move down to the water table.

A great deal of interest and concern is currently being focused on the movement of various chemicals into ground water. Pollutants come from many sources (industrial, agricultural, runoff from roads and parking lots, homeowners, etc.) and many scientists and citizens are concerned about the potential for pollutants to reach their water supplies. However, the issues are complex and a good understanding of water movement will help youth understand the importance of following instructions and regulations when using fertilizers, pesticides, or other substances that could be detrimental if they were to get into our water supplies. Much of the research regarding pollutants has focused on the break-down of the pollutants by various factors which may include: temperature, time, sunlight, moisture conditions, or microbe activity. Understanding that different substances react differently to the same conditions helps youth understand the complexity of soil water/chemical interactions. Students can observe how two substances have different reactions due to different chemical makeup.

The first part of this activity, "Filtering," shows how filtering helps clean water as it moves through the soil. A second part, "Contaminant Movement in Soil," shows youth how different substances move through soils differently. These activities can be done by the instructor as a demonstration (utilizing student help as desired) or as a "station activity" where small groups of students complete the activity.

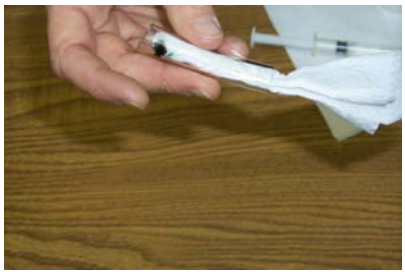
Materials Needed: Student worksheets; Activity 1: Filtering - cup measure, water, garden soil, coffee filter; Activity 2– eye dropper, cup of water, food coloring, white paper napkins (basic, not fancy), and plastic tubing (diameter about ½ inch and approximately 3 inches long – often available at hardware stores).

Notes:

Activity 1 Filtering: The directions for this activity suggest using a coffee filter to separate soil particles from water. You may choose to have your students use cloth instead. The weave in cloth will determine both the speed that the water flows through the cloth and the degree of cleansing. A loose weave will allow water to filter through quickly with minimal filtering whereas a fine weave (i.e. silk) will reduce the rate of water flow but will result in a cleaner product. The different weaves of cloth show how different soil types (loose weave ~ sandy and tighter weaves ~ clay) filter soil differently.

Activity 2: Contaminant Movement in Soil - uses chromatography (separation of materials by absorption of a liquid to a solid) to show how different substances may react differently in

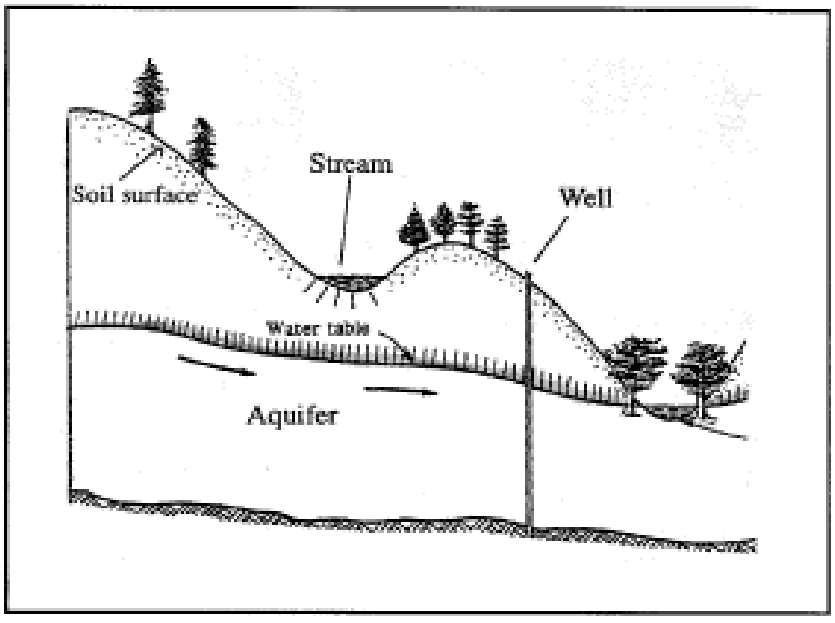
the soil. Contaminants may be affected by many variables including light, temperature, and bonding to electrically charged soil particles. When the coffee filter (or napkin) is removed students should see that the sugar did not cause a color separation but the salt did.



Roll filter and push into the plastic tube.

Add sugar (or salt) and dye.

Pull filter out of tube and open to observe extend of dye.



Activity 4:
Understanding Ground Water Flow

Name _____Key_____

Part 1: Filtering Contaminants

You can observe the filtering process by using common household products. Soil does not dissolve in the water so it can be filtered out of water fairly easily. To show how this is done use the following methods:

Materials needed

- cup measure
- water
- garden soil
- coffee filter

Mix 1/2 cup of soil with 1/2 cup water. Place the coffee filter in a colander and pour the mixture through it. The coffee filter traps the larger soil particles just as the soil particles hold each other while water moves through the voids (spaces between particles) as gravitational forces act on the water. The water will not be crystal clear since some fine particles will get through the coffee filter but most soil particles will be removed. A second filtering will make the water clearer.

Questions

1. Why was the water cleaner after moving through the coffee filter?

The fibers in the coffee filter trapped the soil particles resulting in cleaner water.

1. Name some contaminants that might be filtered out of water.

Sediment, algae, microorganisms such as bacteria, some pesticides, and phosphorous are things that attach to sediment and can be filtered out.

3. Where might the filtering techniques observed in the activity be useful in cleaning the water we use?

- Water is filtered as it passes through soil before being pumped from a well (natural filtration).
- In a drinking water treatment plant, water passes through a sand filter to eliminate pollutants before the water is piped to our houses
- Pools have filtering devices to remove bugs and other contaminants from the water.
- Some cities use sand or wetland filters to treat urban runoff.
- Industries that utilize water in their production processes are required to remove specific contaminants before they discharge the water. Filtration is sometimes used for this.

Name _____KEY_____

Part 2: Contaminant Movement in the Soil

A great deal of interest and concern is currently being focused on the movement of various chemicals into ground water. Pollutants come from many sources and scientists and citizens alike are concerned about the potential for pollutants to reach their water supplies. However, the issues are complex and a good understanding of water movement will help you understand how complex these processes can be. The break-down of pollutants depends on temperature, time, sunlight, moisture conditions, or microbe activity. Pollutants may also act differently depending on what other chemicals are in the soil. Understanding that different substances react differently to the same conditions helps us understand the complexity of soil water/chemical interactions. The following activity will show how two substances have different reactions due to different chemical makeup.

Materials needed	
▪ eye dropper or syringe	▪ salt
▪ cup of water	▪ paper napkins or coffee filter
▪ sugar	▪ plastic tubing
	▪ green food coloring

Steps

1. Roll up a coffee filter or tear a napkin in half and roll it up. Gently push the paper napkin into the plastic tube (coffee filters will have the center at the top, napkins should be folded to have the fold at the top.) Leave about 1/2 - 1 inch open at the top of the tube. The napkin should be packed into the tube and may extend out of the bottom of the tube.

   Note: if the paper is too loosely packed, the water will run through too fast. If it is too tightly packed, it will not move fast enough. You may need to experiment with this.

2. Add sugar to the top of the napkin to a depth of about ½ inch.
3. Prepare a second tube by packing it with a napkin and adding about ¼ - ½ teaspoon of salt.
4. Add one drop of green food coloring on top of the salt and sugar.
5. Add water, a drop at a time, to the top of the tube. You should be able to observe the movement of the dye down the tube. (If the napkin was too loosely packed it will pour right through.)
6. Gently pull the paper out of the plastic tube and open it up.

Questions

1. What happened when you first added the drop of green food coloring?

   The dye did not move much, just dispersed in the salt or sugar.

2. What happened when you added the water?

   The water moved the dye down the tube.

3. What differences did you see in the two tubes?

The salt caused the green dye to decompose into its primary colors. The sugar did not.

4. How might rain affect chemical transport, for example, the movement of fertilizer to groundwater?

Rain is necessary to move fertilizer to the root zone where it can be used by plants. Excessive rain can move the fertilizer past the root zone, however, where the plants can no longer utilize it. Fertilizer that moves past the root zone may potentially pollute ground water. Rain can also wash chemicals that were intended to be left on plants for protection from insect pests (pesticides) into the ground.

Activity 5:
Your Drinking Water

Objective: The students will learn where their drinking water comes from and if any contaminants have been measured in their drinking water.

Introduction: Public water suppliers are required to publish information about drinking water on a yearly basis, beginning in 1999. The reports must provide consumers with the fundamental information that the student activity sheet requests. Students, and their parents, should be aware of this information about their drinking water. Teachers may request these reports and make copies or students may request the reports by contacting their water supplier.

Students who get their home drinking water from a private well would be unlikely to have access to this information, unless the well has been tested recently. (It is recommended that private wells be tested yearly. The cost of testing is the responsibility of the homeowner.) In any event, you may ask these students to obtain a drinking water report and fill out the activity sheet for the school or their parent's place of work so that they can answer all the questions.

More information is available in "Water on Tap: A Consumer's Guide to the Nation's Drinking Water" (EPA 815-K-97-002). To request a copy call (800) 426-4791.

Materials Needed: County Watershed Connections publication, Student Activity Sheet and the water quality report from the local water supplier. If youth have well water at home they can use the report from the school water supplier or a report from the water supplier of their parent's place of work.

Activity: Students are to read the water quality report from their supplier (home, school, parent's place of work, etc.) and fill out the Student Activity Sheet.

Answers to Questions on the Student Activity Sheet are found on your local Water Quality Report. Contact your local water supplier if you have any questions. Example answers are provided, below.

Follow-up Discussion: Holding a follow-up discussion about the reports can be beneficial for the students. A public water supply official might be willing to attend this discussion to discuss the report and clear up any questions that your students may have. Public water supply personnel have a very difficult job. They must take the water that is available to the community, filter and clean it, and make sure it is safe for public use, and yet they have no control over the wastes that are introduced into the surface and ground water supplies.

Follow-up Questions:

1. Who is more vulnerable to problems with Cryptosporidium in the water?

   Populations that are at higher risk and need to avoid Cryptosporidium are immuno-compromised people. Cryptosporidium is a protozoan that can be transmitted through drinking water, person-to-person contact, or other exposure routes. The disease this protozoan causes in humans is cryptosporidiosis and may cause acute diarrhea, abdominal pain, vomiting, and fever that lasts 1-2 weeks in healthy adults. Immuno-compromised people may develop a chronic or fatal disease.

2. What can citizens do to ensure clean drinking water?

3. What questions or concerns do you have about the safety of your drinking water? (If students have questions and a water supply official was unable to join your class discussion these questions should be written by the class and sent to the water system contact listed on the water quality report.)

There are no right, or wrong, answers to questions . Answers will be based on student opinion, but, hopefully they will remember the three suggestions given in the Watershed Connections publication: Be Informed – Be Responsible – Be Involved. The last question (what concerns do you have) will depend on individual situations and the media information that the students are exposed to.

Additional Activity:

If your water supplier has had a source water assessment completed they will have information about your drinking water's susceptibility to contamination (based on the findings of the source water assessment). This document can help students understand what they can do to reduce negative impacts on water quality.

More information about private drinking water supplies (maintenance and testing) is available at the EPA website: http://www.epa.gov/OGWDW/wot/whatdo.html

If you have access to the Internet students can find answers to the following questions at the US Geological Survey web site: http://water.usgs.gov/public/watuse/ [To get the answers they should choose water questions and answers and then Water Use in the U.S.]

1. What is most of the freshwater in the U.S. used for? 39% for irrigation and 39% for thermoelectric plants
2. Which states use the most water? California
3. What is the primary use of the water in the state you named above? Crop irrigation

4. Is saline water used for anything? Yes –thermoelectric power plant cooling and some industrial and mining uses
5. How important is ground water? Ground water is one of our Nation's most important resources. Ground water is the source of 38% of public water supplies and over 97% of rural water supplies. Ground water supplies approximately 37% of the water used for irrigation of crops.

Activity 5:
Your Drinking Water

Name _____KEY_____

Introduction: All citizens should understand fundamental information about their drinking water: where it comes from; any contaminants that might be in it; where potential contaminants come from; what to do about drinking water contamination; and where to go for more information. Public water suppliers are required to publish information about drinking water on a yearly basis, beginning in 1999. Students, and their parents, should be aware of this information about their drinking water.

Activity: Answer the following questions about your drinking water. Your teacher will tell you if you should answer them for your home or at school and where to go for help with the questions (use the back of this sheet if necessary).

*[**Note to teachers** – the answers given here are examples, only --- <u>not</u> based on an actual report. We recommend that you fill out a blank (student sheet) for your key, using the water quality report that you have obtained for your students.]*

1. a) What percentage of people in your county use ground water for drinking?

   b) What percentage of people in Indiana use ground water for drinking?

   c) Name the source of your drinking water (ground water, surface water, or a mix.)

   Example answer: Our drinking water comes from ground water.

2. What does MCL mean?

   MCL is the highest level of a contaminant that is allowed in drinking water. MCL stands for "maximum contaminant level."

3. If any contaminants are found in your local drinking water, list the level (or range of levels) found and the Environmental Protection Agency's (EPA) health-based standard. Note that the level listed will usually be the annual average.

Contaminant	Level found in your water	Standard (MCL)
Nitrate	*8 ppm**	*10 ppm**
Mercury	*1 ppb**	*2 ppb**

   **ppm – parts per million*
   **ppb – parts per billion*

4. List the likely source of any contaminants found to be <u>in violation</u> of the EPA standards and the typical source.

Contaminant	Level found	Standard (MCL)	Typical source
asbestos	*10*	*7*	*Decay of asbestos cement pipes in water systems*

5. Is your water supplier in compliance with monitoring, record keeping, treatment, and reporting rules? (Note – suppliers are only required to report any infractions to these rules, so if no information is listed in the water quality report they are in compliance.)

   Our water supplier is in compliance with all water-related rules.

6. What groups of people are more vulnerable to contaminants in drinking water?

   - *Immuno-compromised persons (people undergoing chemotherapy, people who have undergone organ transplants, people with HIV/AIDS or other immune system disorders)*
   - *Some elderly people*
   - *Infants*

7. If nitrate, arsenic, or lead levels are detected above 50% of EPA's standard what information is given to help you understand these contaminants?

   Nitrate – Nitrate in drinking water at levels above 10 ppm is a health risk for infants of less than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods of time because of rainfall or agricultural activity. If you are caring for an infant, you should ask for advice from your health care provider.

   Arsenic – EPA is reviewing the drinking water standard for arsenic because of special concerns that it may not be stringent enough. Arsenic is a naturally-occurring mineral known to cause cancer in humans at high concentrations.

   Lead – Infants and young children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have

your water tested and flush your tape for 30 seconds to 2 minutes before using tap water. Additional information is available from the Sate Drinking Water Hotline (800-426-4791).

8. Where can you get additional information about your drinking water supply?

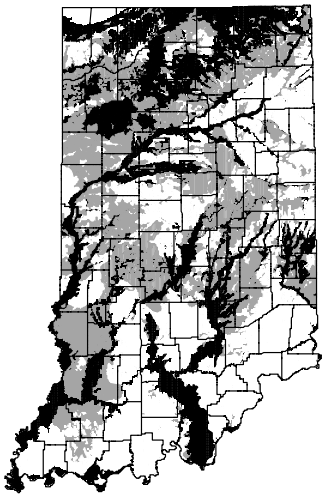
Water suppliers are required to provide the name and phone number of a contact person. Example answer: Contact Joe Smith, (111) 123.4568

Activity 6:

Comparative Ground Water Vulnerability

Objective: Students will learn what the term *comparative ground water vulnerability* means. Students will learn how natural conditions have different effects on ground water vulnerability. Students will understand that it is often necessary to consider many factors in decision making.

Introduction: Geologic areas that are highly vulnerable to ground water contamination tend to occur in north central and northwest Indiana, where soil is often sandy or gravely. Another area of high vulnerability is in valleys of Indiana's major rivers. An area of concern in south central Indiana is known as "karst" where sinkholes provide access for potential contaminants to ground water. Karst areas have limestone bedrock which has channels or even caverns through which water can flow so the soil does not filter the water much.



Geological features that decrease the risk of ground water pollution are heavy clay soils, glacial till, and bedrock. Sloping areas also have a decreased risk of ground water pollution because rain tends to run off the land into streets and rivers, rather than leaking into the ground. Runoff is primarily a concern with surface waters (rivers and lakes) rather than ground water.

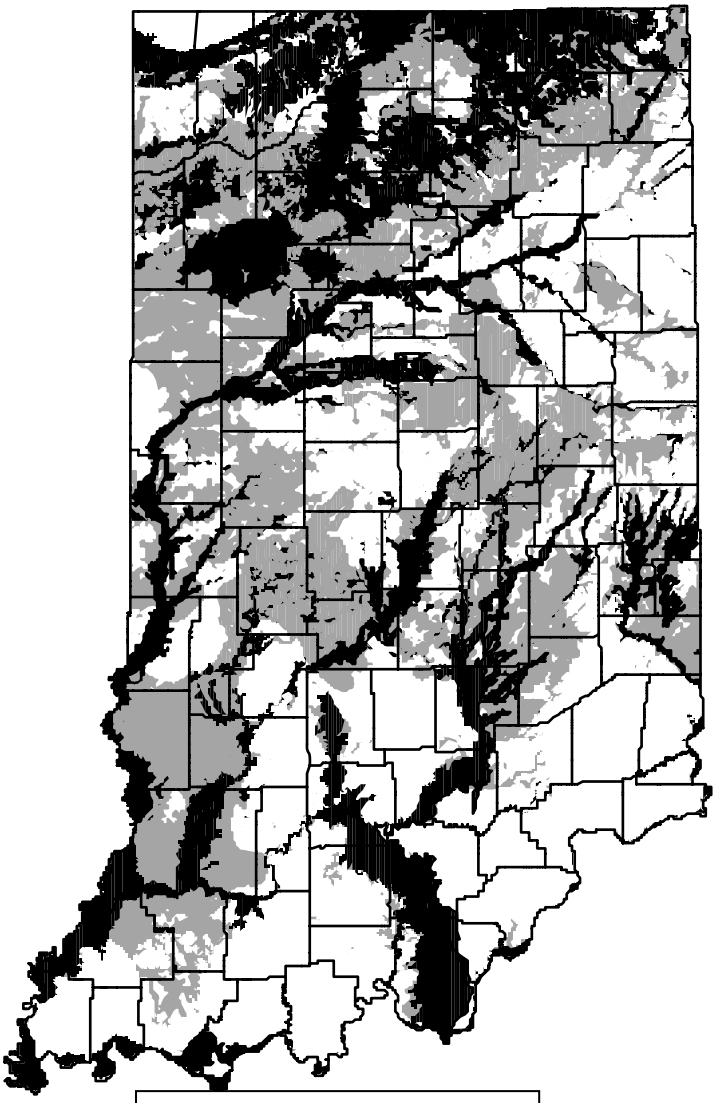
Materials Needed: Student information and work sheets and Watershed Connection publication (Ground Water Quality and Protecting the Water sections)

Activity 6:
Comparative Ground Water Vulnerability

The map shown on this page is called a Comparative Ground Water Vulnerability map. It shows the areas that are at the greatest, and least, risk of contamination from pollutants. To understand how to read the map you need to understand what the words "comparative" and "vulnerability" mean.

Comparative - how do two things differ. Think about your best friend, and compare your heights: Are you taller or shorter? Suppose that you are taller than your best friend. That gives information about you and how your height compares to that of your best friend but not how your height compares to the rest of your class, or to the rest of students your age in Indiana. It is important to remember that when we make comparisons we are just comparing two things. We do not know how those two things compare to fixed values. For example, knowing that you are taller than your friend does not give any information about how you compare to the class average or to any other person in your class. Similarly, the ground water vulnerability map shows what sections of the state are at greater risk of contamination, but does not tell us anything about the actual levels of contamination.

Vulnerability - open to attack or damage. People are more vulnerable to colds and the flu when they do not take good care of themselves by getting enough sleep and nutritious food. That means that you are more likely to get sick if you are run down but it doesn't necessarily mean that you will get sick. Ground water vulnerability is like that - there are certain conditions that make it more likely that it will become polluted.



Ground Water Contamination:

Anything we apply or spill on the land has potential to reach ground water. Oil spilled on the ground, fertilizer and pesticides applied to crops, and waste discarded in landfills can contaminate ground water if they reach it before breaking down into by-products. Furthermore, contaminant by-products can contaminate ground water. The Comparative Ground Water Vulnerability map was developed to study ground water vulnerability to pesticides and fertilizer.

Because of the differences in soil and depth to ground water various areas are at different risk levels to potential contaminants that may be spilled or applied to crops. This difference is referred to as "ground water vulnerability." The vulnerability of the geologic area is an important factor in determining risk of ground water contamination. Much of the water that Indiana citizens drink comes from ground water (nearly all wells and much of the water that is supplied by public suppliers) so the purity of the water is of special importance to citizens.

There are many conditions that affect the amount of contaminants that reach ground water. Three variables that affect ground water vulnerability are explained below:

- **Soil filtration.** Soil can filter out many substances from water. Some dissolved contaminants are physically filtered and some chemicals bond to the soil as water passes through. Clay particles generally retain more contaminants than sand. Organic matter filters best of all.
- **Depth of ground water.** Most chemicals eventually break down into harmless by-products. The farther the distance from the ground surface to the water table the more likely chemicals will have broken down before reaching ground water. Therefore, shallow aquifers are much more vulnerable to pollution than deeper aquifers.
- **Barriers to water movement.** Some soils are very difficult for water to move through so chemicals dissolved and transported by water do not move to ground water. Clay and glacial till are examples of soils that can form a barrier to water movement. Areas with an aquifer under glacial till or solid bed-rock including are, in general, less vulnerable to contamination. Much of central and southern Indiana has this geological formation. It must be noted, however, that no barrier has been found to be totally impermeable to contaminant transfer so vigilance is required in every area to keep ground water pure. Ground water underlying sandy soil is more vulnerable than ground water under clay soils. Sand and gravel allow water and the pollutants it carries to pass through relatively easily.

Note: To actually know what pollutants have reached a certain depth you would need to test the soil and water at various points a given distance beneath the surface. Contaminant levels can vary greatly at different depths or with different positions at a given depth.

Note: The Comparative Ground Water Vulnerability map *does not tell us anything about how clean, or polluted, our ground water is. It shows places that are more vulnerable to pollution. How contaminated the surface and ground water is depends on human practices, the geology of an area, weather factors, and other variables.*

Name _____KEY_____

Activity 6:
Comparative Ground Water Vulnerability

1. Locate your county on the Comparative Ground Water Vulnerability map. Outline your county in red.

   Students should be able to locate their county on the map.

2. Counties generally have more than one vulnerability level at different places in the county. What is the most common vulnerability level in your county?

   Example answer: Most areas in our county are moderately vulnerable.

   What is the least common vulnerability level in your county?

   Example answer: A small portion of the county is at low vulnerability.

   Where are the areas of high vulnerability in your county?

   Example answer: Land near the rivers, in the northwest part of the county, and the southern tip are highly vulnerable.

3. Look at the entire state of Indiana. Where are the most vulnerable areas in Indiana for ground water pollution?

   Generally, the northern part of Indiana, along all major rivers, and an area in south central Indiana (the Hoosier National Forest) are the most vulnerable areas.

   [To answer question 4 think about the geological features of Indiana, such as rivers, flatlands, hills, etc. A map of Indiana might help you answer these questions.]

4. What types of geological features seem to <u>increase</u> the risk of ground water pollution?

   - Northern Indian has many areas with sandy soils and high water tables
   - River valleys typically have sandy or gravelly soil. The water table is also usually near the surface in river valleys.
   - The area in south central Indiana is known as "karst" or limestone where there are many caverns. Contaminants can easily flow through the caverns to ground water.

Use your county Watershed Connections publication to help you answer questions 5 and 6.

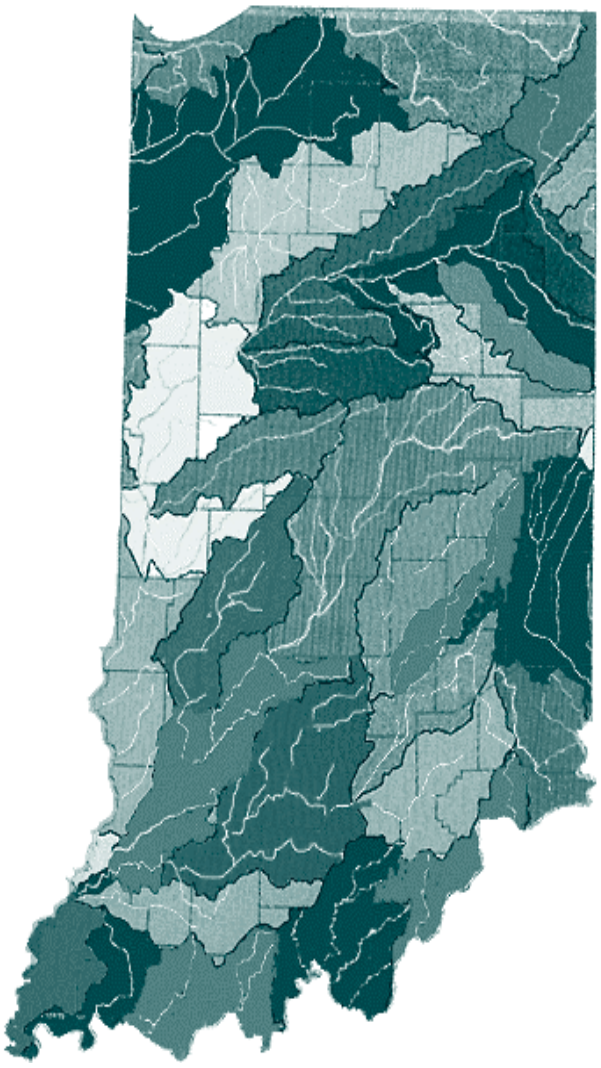
5. Can you think of any pollutants that might contaminant ground water?
   Example answers:
   - Volatile organic compounds (gasoline, solvents, and other petroleum products)
   - Nitrate
   - Pesticides

Activity 7:
Pollution Sources

Objective: Students will learn the difference between point and non-point source pollution and how to differentiate between the two pollution sources. Students will learn that they can become more aware of various pollution sources.

Introduction: Students should read the information about pollution sources in their county Watershed Connections publication.

Materials Needed: Watershed Connections publication, Student activity sheet



Follow Up Activity:

- Invite a guest speaker from your local Solid Waste District Office or the local Soil Conservation District to discuss how to safely dispose of the old cleaners and other toxins (your county Extension Educator can help you locate a speaker). They could also discuss options to toxic products and some of the recycling challenges in your county. Some common problems for recycling districts are improperly sorted materials and dirty (not rinsed) products. They may also be able to discuss point and non-point source pollution.

- Have a group brainstorming activity to discuss reuse and recycling options that reduce pollutants by reducing the manufacturing of new items. Ask the students why they think more people don't recycle. (This can be a very involved discussion involving societal expectations, morals and beliefs if you wish to let it develop.) This discussion should occur both before and after the guest speaker. The students could also discuss ways to solve any problems that the speaker mentions. Each group should share their results with the class (perhaps using overheads).

Name _____KEY_____

Activity 7:

Pollution Sources

The quality of our water depends on the care that humans give it. The type and amount of pollutants that are disposed of impact both surface and ground waters. There are two basic categories of pollutants: point and non-point source.

Read "Potential Sources of Water Pollution" in your county Watershed Connections publication to learn more about these pollution sources and potential contaminates in your county.

Answer the following questions in the space provided beneath the questions.

Part 1 – Pollution Sources

1. Consider the types of pollution shown below and check the appropriate box, indicating if it is primarily a point source or non-point source of contamination.

Example	Type of pollution	Point source	Nonpoint source
1	*Pet wastes*		X
2	Factories	X	
3	Schools (kitchen & bathroom waste)	X	
4	Sewage treatment plants	X	
5	Household cleaners		X
6	Lawn pesticides		X
7	Oil and/or gas leaks on driveways		X
8	Excess fertilizer runoff		X
9	Bacteria & nutrients livestock waste		X
10	Illegal dumping of hazardous liquids	X	
11	Landfills	X	
12	Soil Erosion		X

. 2. What are the substances that are permitted to be discharged in your county?

If you have access to the Internet ask your students to look at the allowable discharges that are permitted in your county at: www.epa.gov/enviro *Click on the arrow by 'overview of available data' and select 'water discharge permits.' Then choose 'PCS quires,' and the 'Water discharge permits query form' will come up. You will probably want to do a 'Geography search.' Fill in your zip code, or city (note - Indiana is in EPA Region 5), go to the bottom of the page and click on 'search.' You will see a summary of the permits that the EPA has allowed in your area.*

Potential Point Source Pollution

Typical point source discharges include suspended solids, ammonia, cadmium, copper, lead, and chlorine. See Watershed Connections for specifics for your county.

Urban and Residential Nonpoint Sources –

Improperly functioning septic systems household hazardous wastes, salt, oil, fertilizers for lawns, and antifreeze can be nonpoint sources of water contamination if not handled properly. (Note - the percent of homes in your county on a septic system is given in the Watershed Connections publication.)

Agricultural Nonpoint Sources -

Sediment, nutrients, and pesticides, manure from livestock may contribute nutrients to ground and surface water.

Part 2 – What we can do

3. What are some ways you can reduce water pollution?

Be Informed – Be Responsible – Be Involved

To protect our water citizens should do the following:

- keep liter, pet waste, leaves, and grass clippings out of gutters and storm drains
- never dispose of any household, automotive, or gardening waste in a storm drain
- keep septic systems in good working order
- follow directions on labels for use and disposal of household chemicals
- take used motor oil, paints, and other hazardous household materials to proper disposal sites
- if you have a stream on your property protect the banks by planting buffer strips of native vegetation

(See the last section, "Protecting the Water" in Watershed Connections for more information.)

4. Examine the products you have in your home. Make a list of the potential contaminants you have at home, garage, or on your property (for example: cleaning products; insecticides). Note any special disposal warnings on the product label.

Potential Contaminant	Place Found	Disposal Warning
Examples of possible student responses:		
Counter cleaners	*Kitchen*	*Wrap empty container in newspaper ant throw in trash.*
Tub and commode cleaners	*Bathroom*	
Sink and plumbing cleaners	*Kitchen and bathroom*	
Bleach	*Laundry room*	
Insect sprays (mosquito and flea)	*May be kept in the kitchen, laundry room, etc.*	*Wrap empty container in newspapers and throw in trash.*
Gasoline & motor oil	*Garage*	*Recycle used motor oil. Contact your solid waste district for help with disposing of gasoline.*
Fertilizers & pesticides	*Garage*	*Wrap empty container in newspapers and throw in trash.*

You may want to discuss the types of products that students found in their homes. Some students will be aware of options for non toxic cleaners or other "green" alternatives. Items that require special care and disposal include many cleaning supplies for the kitchen, bath, carpets; flea sprays; mosquito repellents; cigarettes and wood burners; batteries; paints; lawn care products; and automotive products.

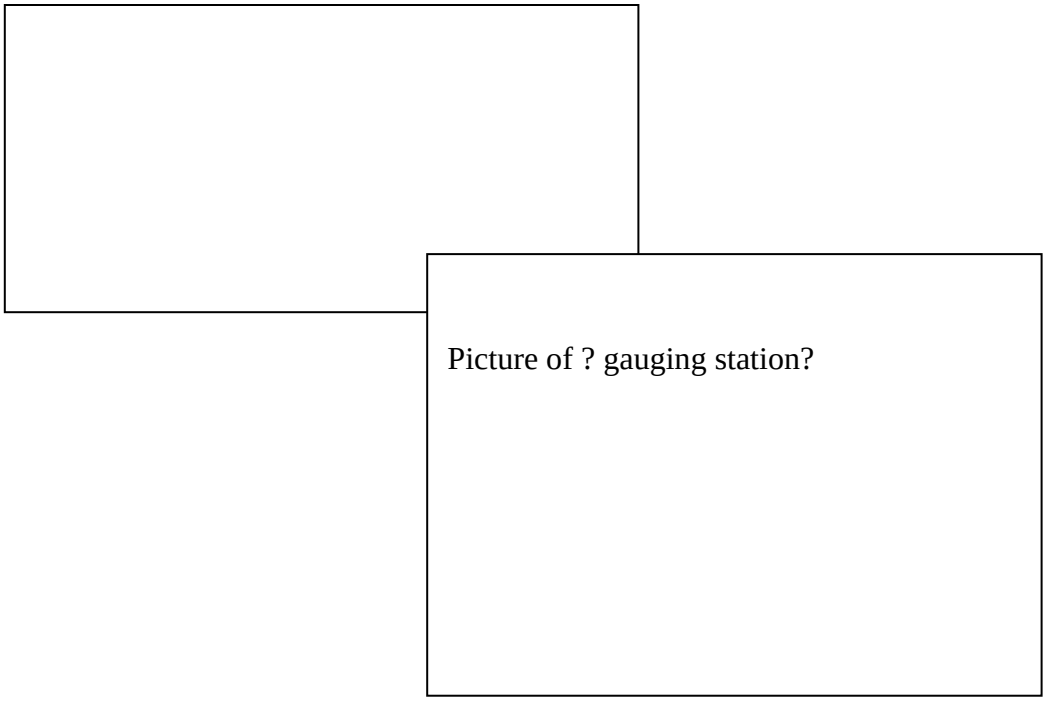
Activity 8:
Water Resource Terms

Objective: The students will use the Watershed Connections to learn definitions of words related to water resource issues.

Introduction: Clean water is necessary to support all forms of life. In order to understand water quality it is necessary to understand that everything that water touches and everything that enters water effects the quality of the water. Understanding the terms used to discuss water quality helps you discuss water quality issues and understand what you read about the subject.

Materials Needed: Watershed Connections publication, student activity sheet

Activity: Two activities are included to help students become familiar with water quality terms. 'Understanding Water Quality Terms' is intended for middle school students, or when there is insufficient time to complete the 'Defining Water Quality Terms' activity. This worksheet allows students to match the terms and definitions. For high school students you may prefer to use the 'Defining Water Quality Terms' activity sheet. Students will likely find the Watershed Connections publication helpful in completing this activity sheet.



Activity 8:

Understanding Water Resource Terms

Name _____KEY_____

Introduction: Clean water is necessary to support all forms of life. In order to discuss water quality it is necessary to understand that everything that water touches and everything that enters the water effects the quality of the water. It is important to understand the meanings of terms used to discuss water quality so that you can discuss water quality issues.

Activity: Match the water related terms with the correct definition. Each definition may only be used to match one term. Put the letter of the correct definition by the appropriate term in the space provided. The Watershed Connections publication may help you.

Terms	**Definitions**
1. Watershed - F	A. Volume of water flowing per unit of time
2. Discharge – A	B. Expected number of years between storms of a given size
3. Gauging station - E	C. Low area adjacent to rivers, lakes, or stream channels that may be submerged by floods
4. Floodplains – C	D. Rain, snow, sleet, hail
5. Precipitation – D	E. Equipment that measures the discharge of water in a river
6. Return period – B	F. Region of land that drains into a lake, stream, or river
7. Point source pollution - G	G. Contaminants that enter the water directly, usually through a pipe
8. Nonpoint source pollution – H	H. Contaminants that enter the water at areas that are not easily seen or identified

Activity 8:
Defining Water Resource Terms

Name _____KEY_____

Introduction: Clean water is necessary to support all forms of life. In order to understand water quality it is necessary to understand that everything that water touches and everything that enters water effects the quality of the water. Understanding the terms used to discuss water quality helps youth understand and discuss water quality issues.

Activity: Define the water related terms below. The Watershed Connections publication may help you.

1. Watershed – Region of land that drains into a lake, stream, or river

2. Discharge – Amount of water flowing past a given point per unit of time

3. Gauging station – Equipment that measures the discharge water in a river

4. Floodplains – Low area adjacent to rivers, lakes, or stream channels that may be submerged by floods

5. Precipitation – Rain, snow, sleet, hail

6. Return period – Expected number of years between storms of a given size

7. Point source pollution – Contaminants that enter the water directly, usually through a pipe

8. Non-point source pollution – Contaminants that enter the water at areas that are not easily seen or identified

Activity 9:
Web Search

Objective: Students will become familiar with some of the Internet sites that were used to write your county Watershed Connections publication.

Introduction: A great deal of information is easily accessible to all citizens who can access the World Wide Web. This information includes all kinds of resources, entertainment, general information, newspapers, directions, and even a translator program. Many government agencies have put much of their statistical information on the web and, consequently, available to the general public. This information can be very useful to students looking for information about their own county, state, or the nation. Some of the information they will find was used to write the Watershed Connections publication and some is additional information that may be of interest to you and your students.

Materials Needed: Computer with Internet access, Student Activity Sheet, Watershed Connections publication

Activity: Students will access the Internet sites listed on their activity sheet to answer questions about their county, Indiana, and the United States. The sites that they will visit were used to create the Watershed Connections publication. Students will learn how the publication was put together and how much information about their county, state, and nation is available on the Internet.

Picture relating to the Internet????

Activity 9:
Water Quality WWW Search

Name _____KEY_____

Introduction:

Lots of water-related information can be found on the Internet. In fact, much of the information used in the Watershed Connections publication was obtained from the World Wide Web sites such as those listed below:

1. **http://govinfo.kerr.orst.edu/ag-stateis.html**
2. **http://govinfo.kerr.orst.edu/usaco-stateis.html (suggestion - click on your state & county)**
3. **http://shadow.agry.purdue.edu/sc.norm-geog.html**
4. **http://water.usgs.gov/public/watuse/ (suggestion - use water questions and answers)**
5. **http://sasquatch.kerr.orst.edu/stateis.html (suggestion - use summary and housing)**
6. **http://www.ctic.purdue.edu/CRM/TillDefine.html**
7. **http://www.agry.purdue.edu/agronomy/ext/environment.htm**
8. **http://www.epa.gov/OGWDW/wot/whatdo.html**

Use these sites to answer the questions:

County Questions (1 – 5)

[Note to Teachers: Warren County is used as an example for county specific information in this key.]

1. How many farms are in your county (most recent data). Is the number increasing, decreasing, or about the same?

   There were 435 farms in Warren county in 1992. This number is decreasing. (There were 486 farms in the county in 1987 and 530 farms in 1982). *[site # 1]*

2. How many acres are in farms are in your county (most recent data). Is the number increasing, decreasing, or about the same?

   In 1992 Warren county had 201,739 acres in farm land. The amount of land in farm land is also decreasing. (In 1987 there were 204,827 acres and in 1982 there were 210,488 acres in Warren county.) *[site # 1]*

3. What was the total resident population of your county (most recent data)? Is the number increasing, decreasing, or about the same? (note: to get this information use the arrow by "summary report" and then choose "get the above selected report")

The population of Warren county in 1992 was 8,394 people. This number is increasing and decreasing, depending on when you compare it. (There were 8,171 people in 1990 but more, 8,976 people in 1980.) *[site # 2]*

4. What percent of high school graduates does your county have (25 years of age, and older)? (note: to get this information use the arrow by "summary report" and then choose "get the above selected report")

   In 1990 71.9% of Warren county residents were high school graduates. *[site #2]*

5. What percent of college graduates does your county have (25 years of age, and older)?

   In 1990 9.4% of the Warren county residents held a college degree. *[site # 2]*

Indiana Questions (6 – 9)

6. Fill in the chart for the monthly mean temperatures your region of Indiana.

   [*site # 3, choose your region, then 'monthly,' and 'mean temperature,' then click on 'search' You may be able to get county information, but at the time of publication many counties have not yet been entered.]*

   [example: East Central Indiana]

Month	Mean Temperature (degrees F)		Month	Mean Temperature (degrees F)
January	23.9		July	73.2
February	27.1		August	71.0
March	38.6		September	64.6
April	49.7		October	52.7
May	60.4		November	41.6
June	69.6		December	29.6

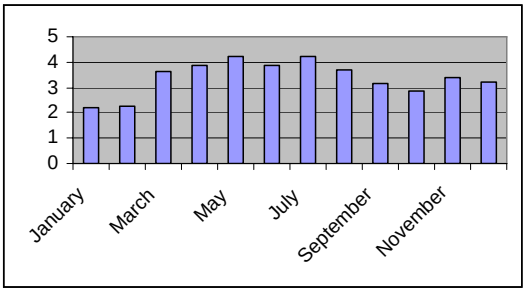
7. Fill in the chart for the normal monthly precipitation for Indiana.
   [site # 3, choose the entire state, then 'monthly,' then 'precipitation,' then click on 'search']

Month	Monthly Precipitation	Month	Monthly Precipitation
January	2.21	July	4.22
February	2.24	August	3.72
March	3.62	September	3.17
April	3.88	October	2.85

May	4.21	November	3.38
June	3.84	December	3.20

Plot the average monthly precipitation for Indiana and your county (in Watershed Connections) on the same graph.

[*Indiana precipitation is given to the right – county precipitation is given in the Watershed Connections publication.]*



8. What is the predominant source of water for Indiana residents, public systems or individual drilled wells?

   Most Indiana citizens get their water from public and private companies. [site # 5]

   Compare this information with the percent of your county population that get their drinking water from ground water (See 'County Ground Water' in the Watershed Connections publication). (Note that "public water supplies" includes public systems and private companies. Private wells are almost always drilled, although some older wells were dug.)

   Example answer: In our county more people get their drinking water from public systems.

9. What is the predominant type of sewage disposal in Indiana, public or private septic tank? What percent of citizens in your county use a private septic tank (see Watershed Connections publication)?

   Most people are connected to a public sewer system. [site # 5]

United States Questions (10 – 18)

10. What is most of the freshwater in the U.S. used for? How does this water use compare to the water use in your county (see the "Water Use" section in Watershed Connections)?

    The largest categories for freshwater use in the U.S. are irrigation and thermoelectirc power, both at 39%. A great deal of water is used to irrigate agricultural crops. If the category 'agriculture' including livestock needs and irrigation use, it become the largest category of freshwater use in the U.S. [site # 4]

    Water use in Indiana depends on the county. The primary use of water in Shelby County is for domestic purposes (57%) but in LaPorte County 77% of the water is used for thermoelectric power generation.

11. Which states use the most water?

California, followed by Texas, Illinois, and Idaho, use the most water, accounting for over ¼ of all the freshwater used. *Most of this water was used for crop irrigation.* [site # 4]

12. Is saline water used for anything?

About 8% of all the water used in the U.S. is saline (salt) water. The main use was for thermoelectric power-plant cooling. Some saline water is used for industrial purposes and some for mining. Desalination (removing the salt) is possible, but very expensive. [site # 4]

13. How important is ground water? What percent of your county population relies on ground water for drinking?

Ground water is one of the Nation's most important natural resources. Ground water is the source of about 38% of the water used by public suppliers. It provides drinking water for more than 97% of the rural population who do not get water from a public or private supplier. About 37% of the water used for irrigation comes from ground water. In Indiana 60% of all citizens get their water from ground water supplies. [site # 4]

In Indiana as a whole, 60% of citizens use ground water for drinking. The value will vary for different counties (see Watershed Connections).

14. What is conservation tillage?

Conservation tillage is any tillage and planting system that covers 30% or more of the soil surface with crop residue, after planting, to reduce soil erosion by water. Where soil erosion by wind is the primary concern, any system that maintains at least 1,000 pounds per acre of flat, small grain residue equivalent on the surface throughout the critical wind erosion period. [site # 6]

16. What is no-till?

No-till leaves the soil undisturbed from harvest to planting except for nutrient injection. Planting or drilling is accomplished in a narrow seedbed or slot created by special equipment. Weed control is accomplished primarily with herbicides. Cultivation may be used for emergency weed control. [site # 6]

17. Is bottled water safer than tap water?

No, health standards are no stricter for bottled water than for tap water. In fact, until 1995 bottled water was not subject even to the same standards as tap water. [site # 7]

18. How often should private drinking water supplies be tested for nitrates and coliform bacteria?

Private Drinking Water supplies should be tested yearly for nitrates and coliform bacteria. If a problem is suspected they should b tested more often. [site # 8]

Additional Resources

The 4-H Soil & Water Conservation manuals have many activities that may be of interest. There are 4 youth manuals and an adult (Leader) guide. These manuals are available from Purdue University at the address given below (Media Distribution Center).

4-H 795, Level A, for 3rd - 4th graders ($2.50 each)
4-H 796, Level B, for 5th - 6th graders ($2.50 each)
4-H 797, Level C, for 7th - 9th graders ($2.50 each)
4-H 798, Level D for 10th - 12th graders ($2.50 each)
4-H 830 Leaders/Helpers manual ($6.00 each)

each manual (A - D) contains activities in the following areas:

• Soil & Water - Useful Resources	• Conservation Can Help
• Soils are Different	• Water Properties
• Looking at Life in the Soil	• The Water Cycle
• Plants & Animals Need Soil & Water	• Water Quality
• Erosion by Wind & Water Harms Soil	• Conservation Careers

Indiana's Water Riches, 4-H 779, is a curriculum written for upper elementary students intended to teach youth specifically about Indiana's water resources.

Healthy Indoor Air for America's Homes is an excellent resource for information about many air pollutants (asbestos, lead, tobacco smoke, formaldehyde, moisture and biologicals, combustion products, radon, and particulates). This resource contains a notebook with lesson plans, background information, and sheets for transparencies. Video tapes are also available. Contact your local CES Educator for availability or more information.

Project WET (Water Education for Teachers) is a program offered through the Indiana Association of Soil and Water Conservation Districts, Division of Soil Conservation, and the Indiana Department of Natural Resources. The program provides learning activities that integrate water quality knowledge and ethics into K - 12 school curricula. Contact the Project WET office for more information about their materials.

6013 Lakeside Blvd.
Indianapolis, IN 46278-2933
Tel 317.290.3200 ext. 321
Fax 317.290.3225

Riverwatch and CRAWDAD are programs coordinated by the Indiana Department of Natural Resources. Riverwatch is a state-wide program which focuses on increasing public awareness of water quality issues and concerns by training volunteers to monitor and care for stream and river quality. Citizens may adopt a river through this program. The CRAWDAD (Collaborative Resource Alliance for Water Quality Data And Development) committee is composed of representatives from existing surface water quality monitoring programs and environmental agencies. You may get more information at the web site: http://www.dnr.state.in.us/soilcons/riverwat/index.htm or by contacting:

Riverwatch Coordinator
402 W. Washington W265
Indianapolis, IN 46204
Phone: 317.232.0108

Other Environmental Resources:

The Purdue Cooperative Extension Service has many resources that offer information related to the environment. The Departments of Agriculture and Biological Engineering, Agronomy, Animal Sciences, Botany and Plant Pathology, Entomology, Forestry and Natural Resources, and Horticulture all have numerous publications that relate to different environmental concerns. Some of these publications are listed in the back of the county Watershed Connections publication (with order information). You can also request a catalog from the Purdue University Agricultural Communication Service.

Order these or other publications from:

Purdue University Agricultural
Communication Service
Media Distribution Center
301 South 2nd Street
Lafayette, IN 47901-1232
Hours 8-12 & 1-5, M - F

Phone: 1-888-EXT-INFO
(1-888-398-4636)
Fax: (765) 496 - 1540
E-mail: Media_Order@mdc.ces.purdue.edu

Internet:
http://www.agcom.purdue.edu/agcom/Pubs/menu.htm