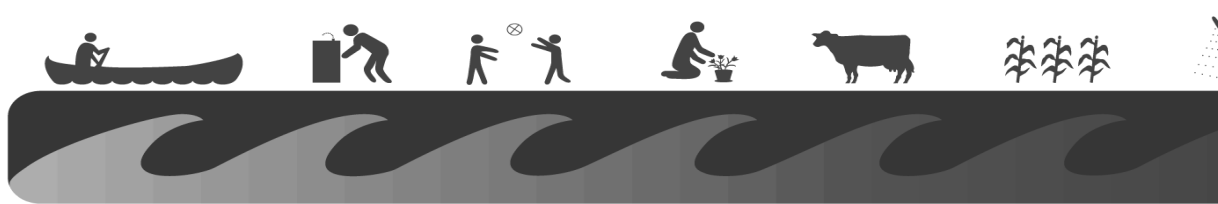


Watershed Connections



Youth Activities



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Contact Natalie Carroll (ncarroll@purdue.edu) for a paper copy of this resource.

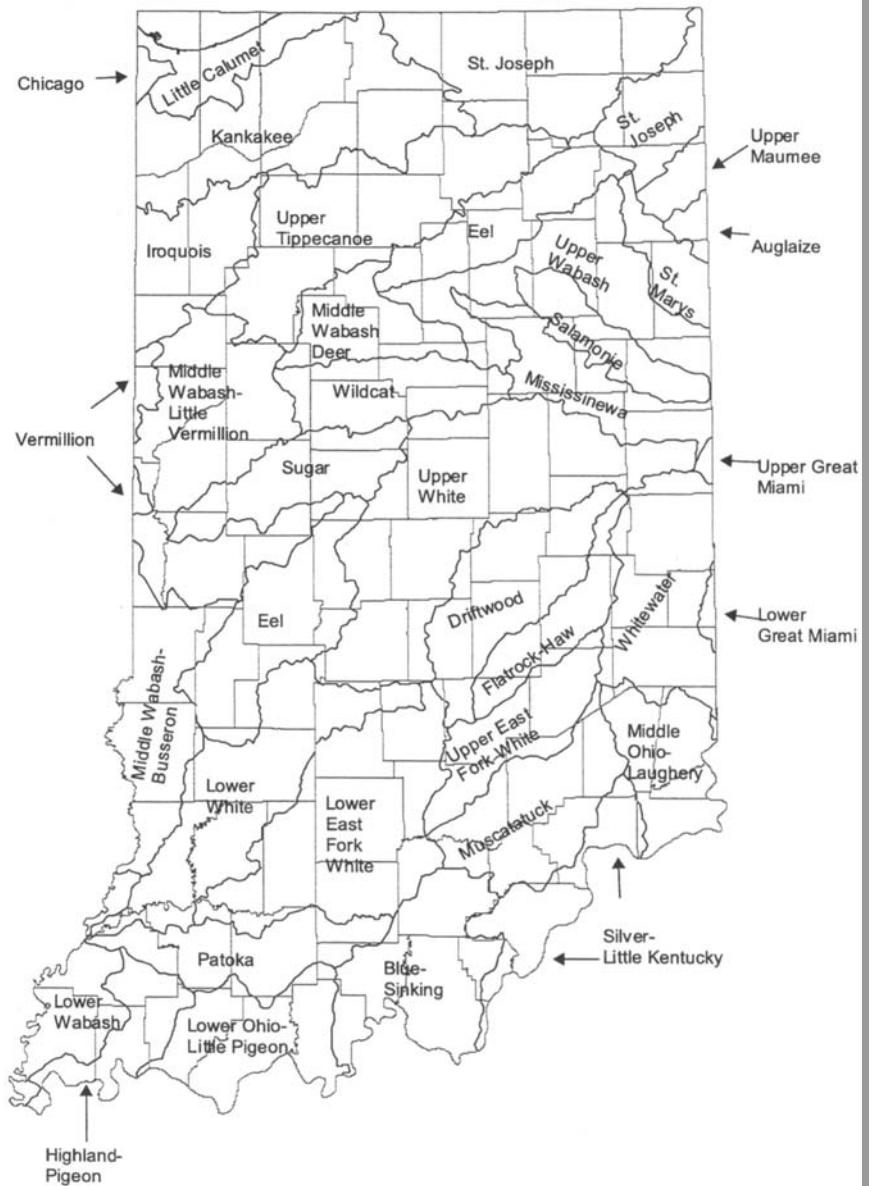
Student Activity 1:

Name _____

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.
- 2) List other counties that are in your watershed (Students are given a map of Indiana with counties shown).
- 3) List major cities and towns that are in your watershed.



Watershed Connections

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

- 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:
 - Residential lands –
 - Industrial areas –
 - Agricultural crop lands –
 - Agricultural livestock facilities –
 - Construction sites -
 - Can you think of other potential polluters?

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

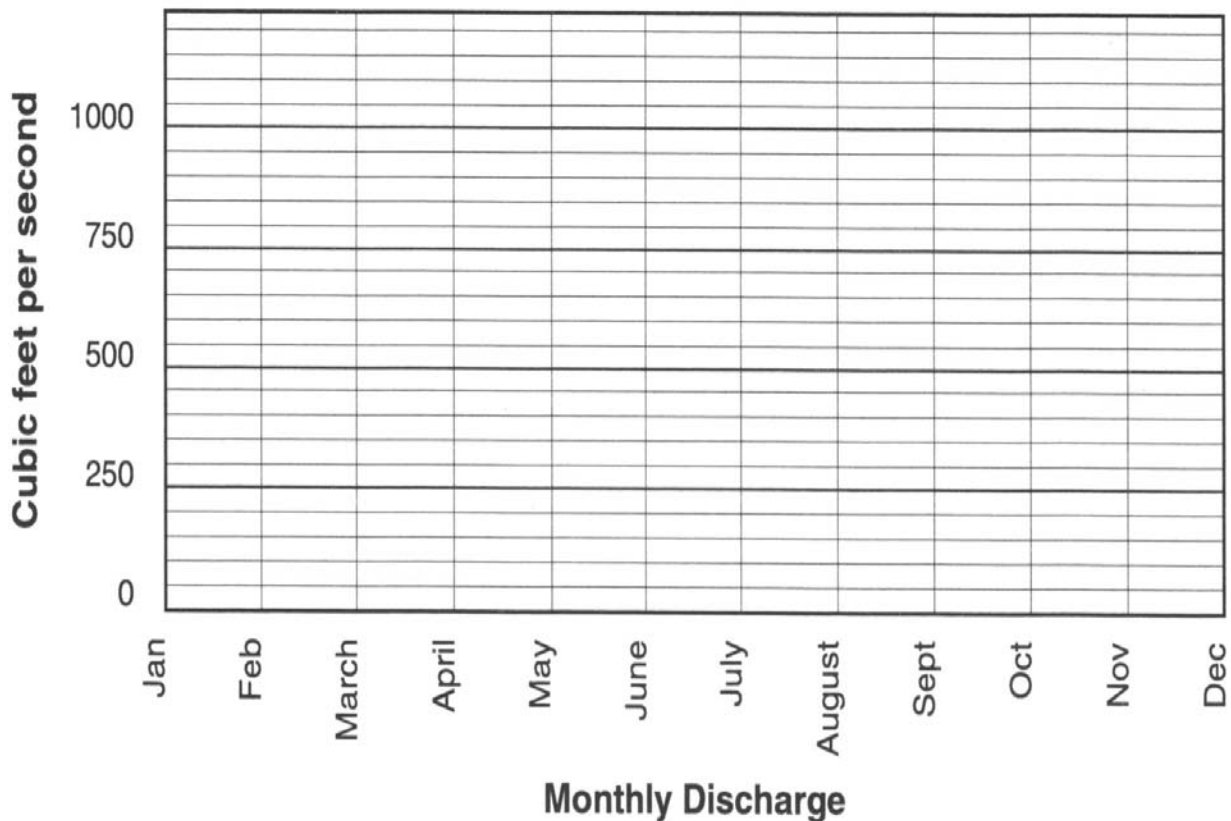
Student Activity 2:

Name _____

River Discharge

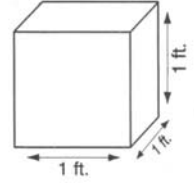
There are several major rivers that flow through Indiana. Monitoring the amount of water within rivers is important for proper water management, (flood control, city, urban, rural, and agricultural needs). The volume of water flowing at a particular point in any river at any given time is called discharge. 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.

1. 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.



Watershed Connections

2. 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 $7\frac{1}{2}$ gallons of water. (Show your work.)



- a) Maximum water flow (or discharge) (from graph) =
- b) Cubic feet of water in one minute =
- c) Cubic feet of water in one hour =
- d) Cubic feet of water in a day =
- e) Gallons of water per day =
3. Why might one river have a higher discharge than another river?
4. Why is the discharge highest during the spring months and lowest during the late summer months? (*See the Watershed Connections publication for more information*).

**Student Activity 3:
(Part one)**

Floods, Floodplains, and Flood Probabilities

Read the following explanation of floodplains and flood probabilities, and answer the questions.

Rivers flood: they always have and always will. When heavy rains come, rivers cannot 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.

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>



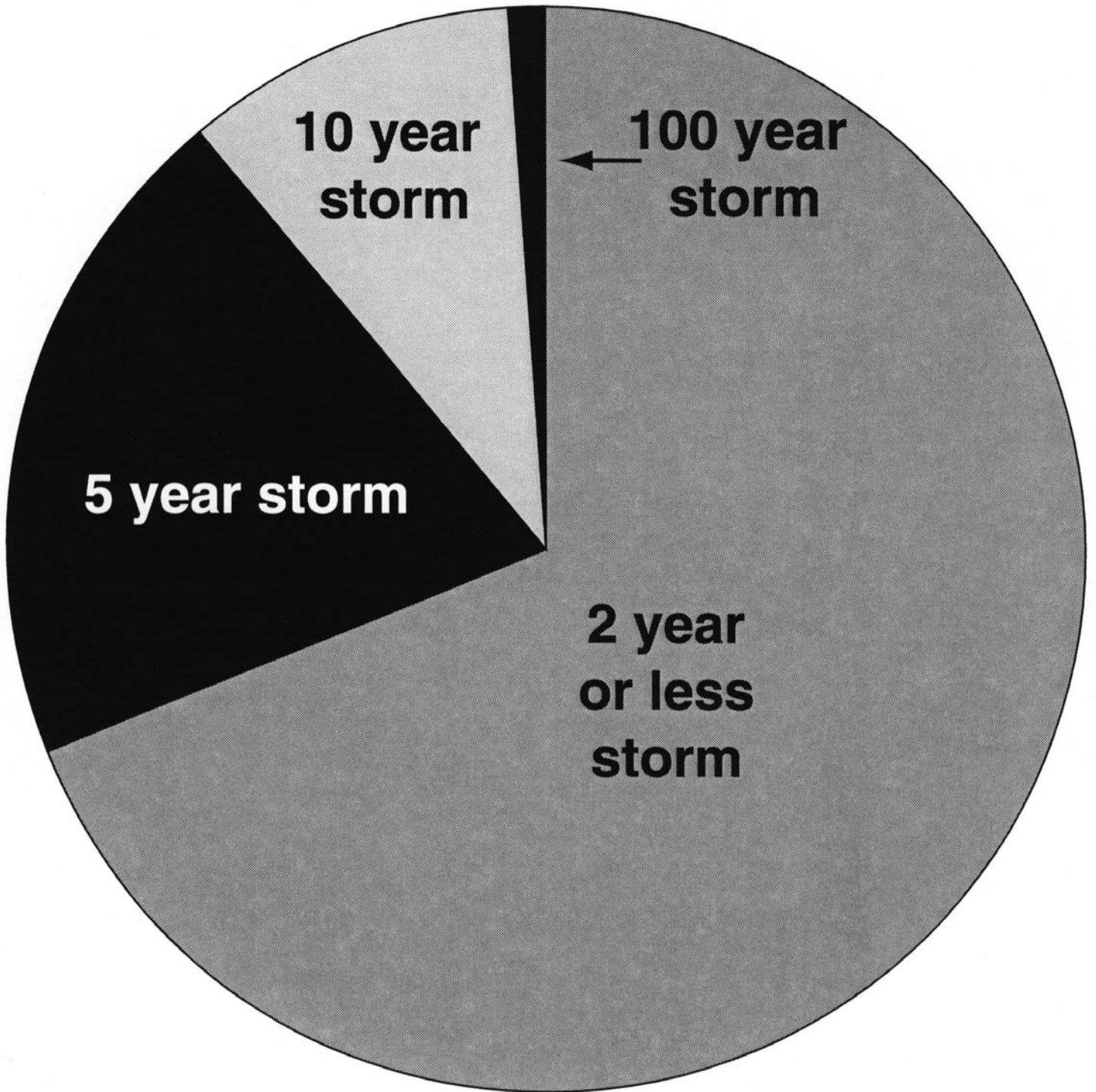
Watershed Connections

Name _____

Flood Questions:

1. Look at the figure entitled “Floodplain of _____ County” in the Watershed Connections publication. Identify the rivers, streams, or lakes that would be the source of flooding in the various areas of the floodplain map for your county.
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?)
3. Study the average monthly discharge graph in Watershed Connections. When is flooding most likely?
4. Why do many people like to live near rivers?
5. What should people consider when buying or building a house near a river?

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Part 2: Tracer 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 | ▪ paper napkins |
| ▪ cup of water | ▪ plastic tubing |
| ▪ sugar | ▪ green food coloring |
| ▪ salt | |

Steps

1. Roll up a coffee filter or tear a napkin in half and roll it up. Gently push the paper 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.
2. Add sugar to the top of the napkin to a depth of about 1/2 inch.
3. Prepare a second tube by packing it with a napkin and adding about 1/4 - 1/2 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.

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.



Roll filter and push into the plastic tube

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Questions

1. What happened when you first added the drop of green food coloring?
2. What happened when you added the water?
3. What differences did you see in the two tubes?
4. How might rain affect chemical transport, for example, the movement of fertilizer to groundwater?



Student Activity 5:

Name _____

Your Drinking Water

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.

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).

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.)

2. What does MCL mean?

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)

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

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Contaminant	Level found in your water	Standard	Typical source

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.)

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

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?

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

Student Activity 6:

Name _____

Comparative Ground Water Vulnerability

Read this information on this and the following page, and then answer the questions.

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 –

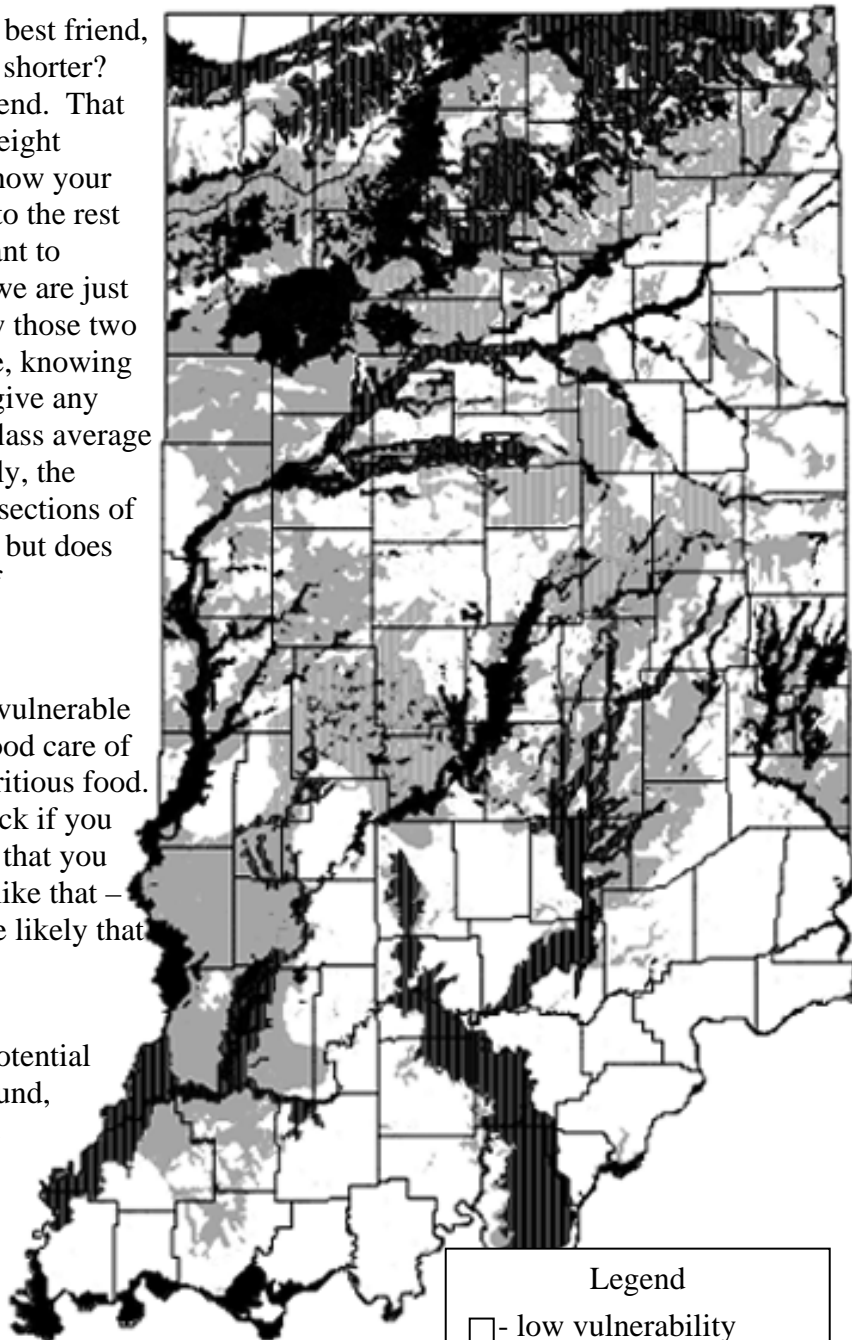
How do two things differ. Think about your best friend, and compare your heights: Are you taller or shorter? Suppose that you are taller than your best friend. That gives information about you and how your height compares to that of your best friend but not how your height compares to the rest of your 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.

**Legend**

- low vulnerability
- moderate vulnerability
- high vulnerability

Watershed Connections

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.

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

What is the least common vulnerability level in your county?

Where are the areas of high vulnerability in your county?

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

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 increase the risk of ground water pollution?

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?

Student Activity 7:

Name _____

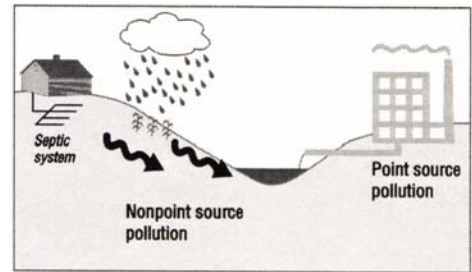
Watershed Connections

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 contaminants 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.

Type of pollution	Point source	Nonpoint source
Pet wastes	<input type="checkbox"/>	<input type="checkbox"/>
Factories	<input type="checkbox"/>	<input type="checkbox"/>
Sewage treatment plants	<input type="checkbox"/>	<input type="checkbox"/>
Household cleaners not disposed of properly	<input type="checkbox"/>	<input type="checkbox"/>
Pesticides used on lawns and gardens	<input type="checkbox"/>	<input type="checkbox"/>
Oil leaks on driveways	<input type="checkbox"/>	<input type="checkbox"/>
Fertilizer runoff	<input type="checkbox"/>	<input type="checkbox"/>
Livestock waste	<input type="checkbox"/>	<input type="checkbox"/>
Illegal dumping of hazardous liquids (for example down a storm drain)	<input type="checkbox"/>	<input type="checkbox"/>
Landfills	<input type="checkbox"/>	<input type="checkbox"/>
Soil erosion	<input type="checkbox"/>	<input type="checkbox"/>

Watershed Connections

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

Potential Point Source Pollution –

Urban and Residential Nonpoint Sources –

Agricultural Nonpoint Sources –

WHAT WE CAN DO

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

Student Activity 8:

Name _____

Understanding Water Resource Terms**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 resource 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

1. Watershed -
2. Discharge –
3. Gauging station -
4. Floodplains –
5. Precipitation –
6. Return period –
7. Point source pollution -
8. Nonpoint source pollution –

Definitions

- A. Volume of water flowing per unit of time
- B. Expected number of years between storms of a given size
- C. Low area adjacent to rivers, lakes, or stream channels that may be submerged by floods
- D. Rain, snow, sleet, hail
- E. Equipment that measures the discharge of water in a river
- F. Region of land that drains into a lake, stream, or river
- G. Contaminants that enter the water directly, usually through a pipe
- H. Contaminants that enter the water at areas that are not easily seen or identified

Activity 8:

Name _____

Defining Water Resource Terms

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 -

2. Discharge -

3. Gauging station -

4. Floodplains -

5. Precipitation -

6. Return period -

7. Point source pollution -

8. Nonpoint source pollution –

Student Activity 9:

Name _____

Web Search

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> (click on your state & county)
3. <http://shadow.agry.purdue.edu/sc.norm-geog.html>
4. <http://water.usgs.gov/public/watuse/> (use water questions and answers)
5. <http://sasquatch.kerr.orst.edu/stateis.html> (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)

1. How many farms are in your county (most recent data). Is the number increasing, decreasing, or about the same?
2. How many acres are in farms are in your county (most recent data). Is the number increasing, decreasing, or about the same?
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”)
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”)
5. What percent of college graduates does your county have (25 years of age, and older)?

Watershed Connections

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.]

Month	Mean Temperature (degrees F)
January	
February	
March	
April	
May	
June	

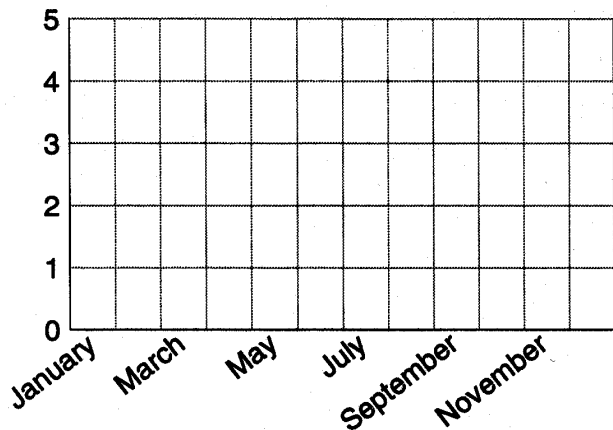
Month	Mean Temperature (degrees F)
July	
August	
September	
October	
November	
December	

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		July	
February		August	
March		September	
April		October	
May		November	
June		December	

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



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

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.)

9. What is the predominant type of sewage disposal in Indiana, public or private septic system?

What percent of citizens in your county use a private septic system (see *Watershed Connections* publication)?

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*)?

11. Which states use the most water?

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12. Is saline water used for anything?

13. How important is ground water?

14. What percent of your county population relies on ground water for drinking?

15. What is conservation tillage?

16. What is no-till?

17. Is bottled water safer than tap water?

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