Watershed Connections

Youth Activities Teacher's Guide

Selected activities adapted for the TEACH Great Lakes CD-ROM

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Note to teachers:

The youth activities (Floods, Drinking Water, Pollution Sources, and Terminology) were adopted from activities written for a county-based publication, Watershed Connections, written to help citizens study their local water resources. The activities are intended for Middle School and High School students, although younger students can also learn from these activities with appropriate assistance.

This publication gives activity objectives, a brief introduction, and the answer keys for the youth activity sheets.

You can see the Watershed Connections publications currently available at www.four-h.purdue.edu/staff.home/natalie/resources.html.

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Notes about using the Watershed Connections publications:

- 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*.

Activity: 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: Internet access for flood date, student worksheet, "wheel of flooding" (in student activity sheets), and pennies or 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 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 www.fema.gov/business/nfip/.

Activity: Floods, Floodplains, and Flood Probabilities

Name _____KEY_____

4. Use the FEMA website (www.fema.gov) to obtain flood information. 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.

5. 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.

6. Talk to your parents or others that live near the floodplain. Ask them, "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/

7. 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.

8. 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: 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: 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 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 given on the following page:

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.

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

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 expect 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: 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/.

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: 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: Obtain a **Drinking Water Quality Report** for the water you drink at school or home. Answer the following questions about your drinking water.

*[**Note to teachers** – the answers given here are examples, only --- not 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. What percentage of people in your county use ground water for drinking?

2. What percentage of people in Indiana use ground water for drinking?

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

   Example answer: Our drinking water comes from ground water.

4. What does MCL mean?

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

5. 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*

6. List the likely source of any contaminants found to be in violation 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*

7. 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.

8. 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*

9. 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).

10. 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: 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: Student activity sheet, Internet or other resource materials

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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: 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 *Enter "discharge" in the search box and then click on "Water Discharge Permits Query form." 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: student activity sheet, resources for definitions (Internet or other)

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