HOOSIER RIVERWATCH Junior

Activity Guide

Indiana Department of Environmental Management

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Each grade level is identified by its assigned color as you see in this graphic.

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Hoosier Riverwatch is a volunteer stream monitoring program managed by the Indiana Department of Environmental Management. Through educational workshops, adults can explore concepts surrounding watershed management and pollution prevention while learning hands-on monitoring skills. However, there is the need and demand for similar education geared toward youth in grades K-12.

Introducing Hoosier Riverwatch Junior!

This activity guide utilizes low or no cost exercises that explore the world of water. With core concepts that tie directly into Indiana State Education Standards, this curriculum is a valuable tool for any educator. Topics mirror those covered in the Hoosier Riverwatch training manual used in adult workshops. Activities are organized into modules that are color-coded for an appropriate grade level. ***Note: Students learn at different paces. Educators should use whichever modules align best with their students' understanding.***

SAFETY FIRST should be a focus when working around water. Students should always be supervised by an adult during Hoosier Riverwatch Junior activities. Never wade in high or swift water, be aware of weather reports, and have a first aid kit on hand. Refer to pages 9-10 in the Hoosier Riverwatch manual for important safety measures.

Students that participate in Hoosier Riverwatch Junior activities are eligible to receive a program sticker. Teachers, parents, or other group leaders can request stickers by completing the program survey.

Email Riverwatch@IDEM.IN.gov to request a program survey or with any other questions.

HOOSIER RIVERWATCH Junior

WA-2145-BT 09/2025

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Importance of Water

Duration: < *1 hour* | State Standard: *K-LS1-1*

Summary:
Students will recognize that water is needed to grow all types of food.

Ask the students to share what they ate as a recent meal. Go around the room and make a connection to water for each student's breakfast. Use visual aids to illustrate the ingredients in their meals.

Examples:
Oatmeal/Cereal — made with grains which need water to grow.
Eggs & Bacon — both chickens and pigs need water to survive.
Apples & Almonds — both come from trees that require water to grow.
Chocolate Chip Pancakes — pancake batter is mostly made of flour which comes from wheat, a plant that needs water to grow. Even chocolate comes from cocoa trees which require water.

Students will conclude that almost everything in our diet requires water in some way. Without water, we would not be able to survive on this planet.

Possible Extension:

1. Have the students draw their breakfast, dinner or favorite meal with crayons or colored pencils. Ask them to draw how water is used for producing their meal, i.e. a pig drinking water or rain falling on an apple tree.
2. Provide a snack (i.e. candy) to students and have a discussion or watch a video showing the water consumption required to make that snack.

Walking for Water

Duration: *1-2 hours* | State Standard: *K-LS1-1, 2-ESS2-2, 2-ESS2-3, MS-ESS2-4*

FACT:

Water covers 71% of the Earth's surface, according to the Bureau of Reclamation.

Summary:
Students will identify and illustrate where water is within their environment.

Materials: Watercolors/Art Supplies
Take the students to a safe outdoor location. Ask them to point out water as they walk through the environment. Ask them how the water got there. Discuss the water cycle. Ask them to point out things that need water to survive.

Return to the classroom for an art activity. Using watercolor paint (or alternative art supplies), have the students illustrate the observations they made outside. Allow students to add their own imaginative water features. Discuss where water is found on the planet and why it's important to keep our water clean.

Possible Extension:
Take a spray bottle or water pitcher on the walk. Ask the students where the water goes when poured on different surfaces, i.e. asphalt vs grass. Demonstrate by spraying or pouring water on these surfaces.

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Who Polluted the Creek?

Duration: < *1 hour* | State Standard: *K-ESS3-3, 2-ESS2-2, MS-ESS3-3, HS-LS2-7, 1.RC.1, 1.RC.6*

Summary:
Students will visualize sources of pollution and gain awareness of its effect on water.

Materials:
Jar of clean water, at least 12 containers (i.e. clear condiment cups, film canisters, etc.) labeled and containing the following materials:

1. "Construction Site" – Gravel, sand, or dirt
2. "Trees" – Leaves and sticks
3. "Wrappers" – Candy wrappers
4. "Livestock" – Water with mixed food coloring (brown)
5. "Farms" – Sugar or salt with blue or green food coloring
6. "Parking Lots" – Water with blue food coloring
7. "Electricity" – Hand sanitizer or cooking oil
8. "Wash the Car" – Water with dish soap
9. "Fishing Pole" – Fishing line
10. "Picnic" – Straws, napkins, etc
11. "Gardeners" – Water with yellow food coloring
12. "Mysterious Liquid" – Water with red food coloring

Explain to the students that you are going to tell a story about our watershed. Explain to students that the jar of water sitting in the middle of the group represents [local waterbody].

Students will play a part in the story. Pass out the 12 containers labeled with the parts. (Consider pairing students together or providing a container for each student so everyone can participate.) Tell them they may NOT open the canisters yet. When they hear the name of their canister read in the story (bolded words), they are to open it and dump the contents into the jar of water.

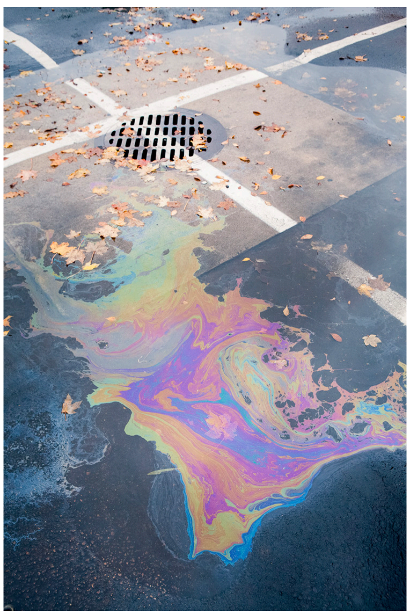
Before starting the story, ask students: "This water looks clean, doesn't it? Would you boat in it? Swim in it? Eat the fish from it? Do you think it is safe for wildlife?"

Read the story:

A girl named Riley is riding the school bus early one morning. From the bus, Riley watches as it begins to rain. The bus passes a ***CON-***

Who Polluted the Creek? (Continued)

Duration: < *1 hour* | State Standard: *K-ESS3-3, 2-ESS2-2, MS-ESS3-3, HS-LS2-7, 1.RC.1, 1.RC.6*



__STRUCTION SITE__ where a new shopping center is being built. There are muddy streams of water flowing over the ground and into a nearby creek. The winds pick up and whip through the __TREES__ blowing leaves into the water. The bus drops the students off at school and some of the kids throw their __WRAPPERS__ onto the sidewalk. The rainwater washes the wrappers into a storm drain.

Ask students: Is the water safe to drink? (If the response is "no" ask if the creek had leaves or soil in it naturally.) Would you swim in it? Boat on it? Safe for wildlife?

During school, Riley's teacher reads the class a news article about local __LIVESTOCK__. The chickens are raised for their eggs and the cows are raised for milk and meat. Manure (animal poop) from these and other animals is washed off the pastures into streams, which lead into [local waterbody]. During lunch, Riley eats an apple. Her mom buys fruits and vegetables from a local store. This food is grown on the many __FARMS__ in the area. In the spring, many farmers spread fertilizer on their fields and when it rains some of the fertilizer from the fields washes off the land and into the water.

Ask students: "Would you want to swim in the water now? Do you think it is safe for wildlife? Why or why not?"

After school, Riley passes many __PARKING LOTS__ on her way home. Some of the cars have leaks and anti-freeze drips onto the paved lot and runs off with the rain. When she gets home, Riley watches TV until her mother comes to give her a chore to do. She gets up and leaves the room with the TV on. The __ELECTRICITY__ that runs the television comes from a power plant. In the process of making electricity some smoke gets into the air, which pollutes the rain.

The storm had finally passed, and Riley's chore is to __WASH THE CAR__. The soapy water rushes down the driveway into the storm drain which empties into the river. Riley then decides she and her dog will take a walk down to the creek. Riley brought along her __FISHING POLE__. She finds a good place to sit on the shore and casts her line. She soon realizes that her line is caught on some logs in the water. She pulls and pulls and finally the line breaks off in the water. That was her only hook,

Who Polluted the Creek? (Continued)

Duration: < *1 hour* | State Standard: *K-ESS3-3, 2-ESS2-2, MS-ESS3-3, HS-LS2-7, 1.RC.1, 1.RC.6*

FACT:

Water is vital for all living organisms, supporting various biological processes.

so she decides to leave. On her way back, Riley sees a family packing up from a ***PICNIC****. They leave behind litter that washes into the creek during the next rainfall.*

Back home, Riley sees her next-door neighbors tending their flower-beds. The ***GARDENERS*** *are using weed-killer and bug sprays to keep the pests away, but with the next rain most of these chemicals will be washed off the plants and into the little creek behind the house and into [local waterbody]. A few doors down, some people are cleaning out their garage. They find some rusty, old cans filled with a* ***MYSTERIOUS LIQUID****. They aren't sure what it is, but they want to get rid of it. Someone decides to pour it down the drain by the curb. The liquid disappears down the drain. It is out of sight but headed for [local waterbody].*

Riley continues home, remembering everything she saw, heard, and did today. She notices that she's thirsty, so she rushes home to pour herself a tall glass of water. As she drinks, she thinks about where her water came from and everything she learned today.

Discuss with the students:

1. Who polluted the creek? Could any of the pollution have been prevented?
2. Why does pollution in our watershed matter? How can it affect us? How can it affect the plants and animals within the watershed?
3. If you were Riley, what might you say to the other kids who dropped their wrappers on the ground when they got off the bus?
4. How can we work to keep our watershed healthy? What are ways that YOU can help the health of the watershed?

Possible Extension:

Have the students design a pollution poster or diorama. They should illustrate the harm of water pollution and include a call to action encouraging others to prevent pollution. Alternatively, have the students act out how they would take action.

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Colors of Water Wheel

Duration: < *1 hour* | State Standard: *K-ESS3-3, 2-ESS2-1, 5-ESS3-1, HS-LS2-7*

Summary:
Students will compare different colors of water and discover potential pollutants responsible.

Materials:
Color copies of water wheel for each student, scissors, brass fasteners (Alternative Materials: Use digital wheel by customizing option at www.pickerwheel.com with text in the color wheel below.)

Water pollution happens when harmful substances enter water bodies such as lakes, rivers, and oceans. This degrades the quality of water. Sometimes, pollutants will affect the color of the water. Provide color copies of the water wheel graphic to each of the students (alternatively, display the customized digital option). Have the students cut out and assemble the water wheel with a brass fastener.

Using the water wheel, have the students name three examples of pollutants that may worsen our water quality.

1. ________________________ Point Source OR Non-Point Source
2. ________________________ Point Source OR Non-Point Source
3. ________________________ Point Source OR Non-Point Source

Pollution can be split into two categories- point source and non-point source. Point source pollution is easy to identify because it is clear where it comes from, like the end of a pipe. Non-point source originates primarily from runoff and is more difficult to identify. It is a product of land use throughout the entire watershed and makes up about 75% of water pollution. Have students circle their examples above as either Point Source or Non-Point Source. Discuss potential solutions to reducing the listed types of pollution and what steps students can take if they observe pollution sources in their communities.

Possible Extension:

1. Have students research different types of pollution and create their own water wheel. Provide a blank wheel which includes the color and name of the type of pollution. Have students fill in details such as possible sources and/or draw a picture of what the pollution looks like.
2. Have students compare and contrast regulation of point source vs non-point source pollution. Discuss IDEM's permit program (https://www.in.gov/idem/cleanwater/wastewater-permitting/national-pollutant-discharge-elimination-system-npdes/) and Total Maximum Daily Load (TMDL) program (https://storymaps.arcgis.com/stories/c19586108c304c779509e3ccbeff4709).

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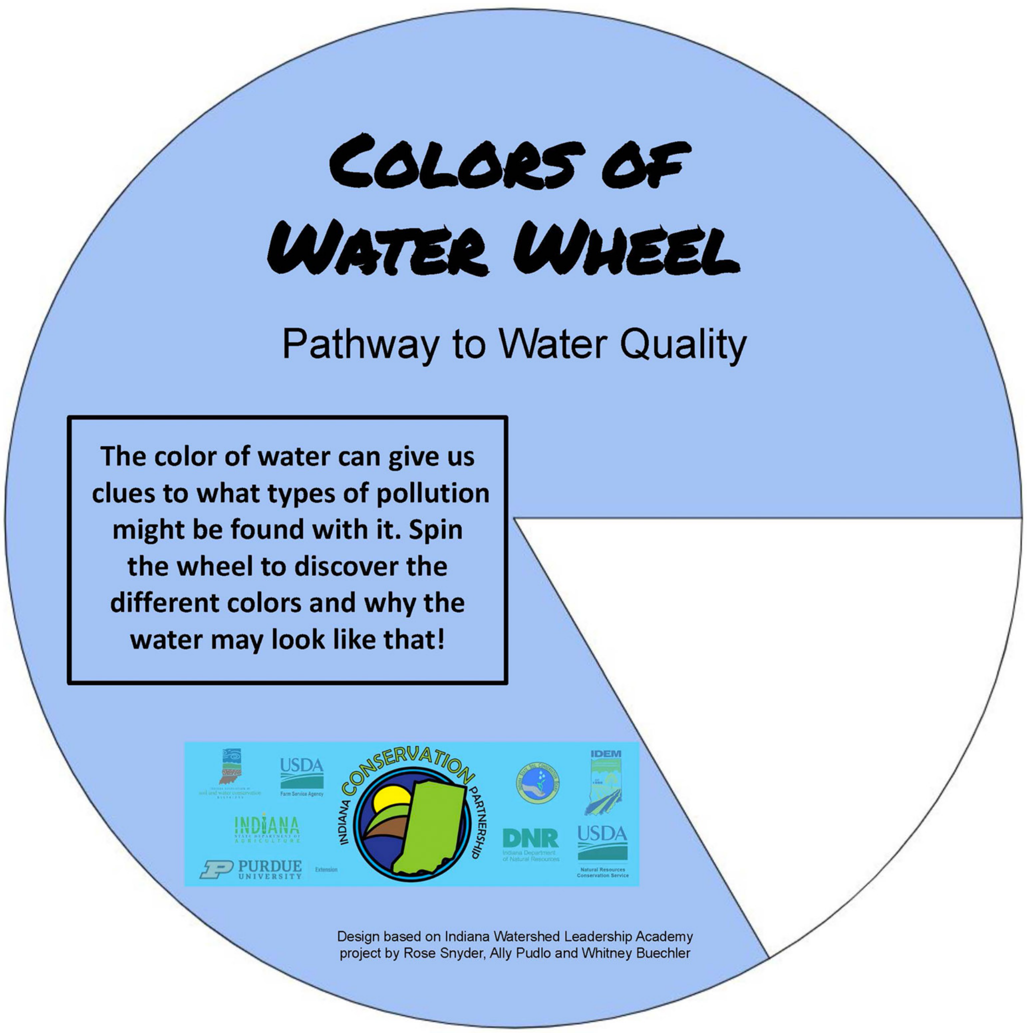
Colors of Water Wheel (Continued)

Duration: < *1 hour* | State Standard: *K-ESS3-3, 2-ESS2-1, 5-ESS3-1, HS-LS2-7*



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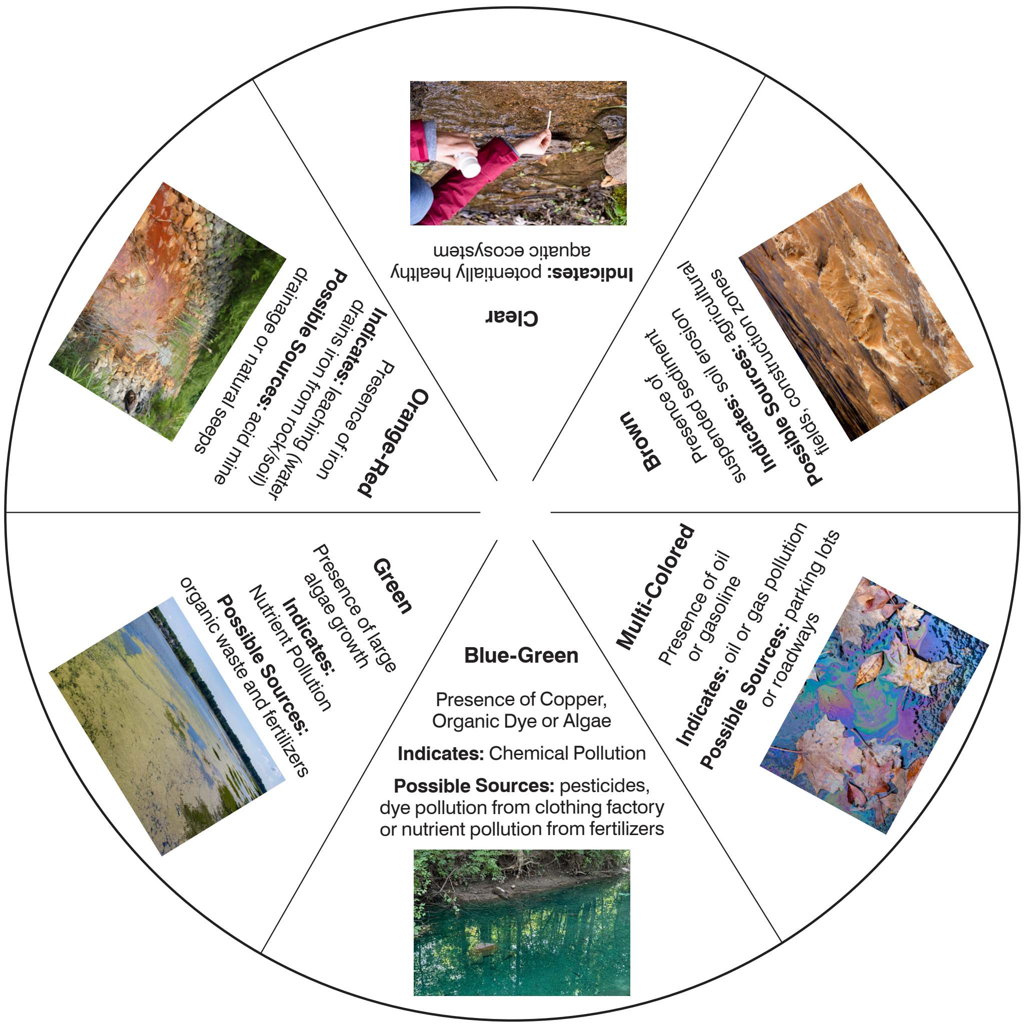
Colors of Water Wheel (Continued)

Duration: < *1 hour* | State Standard: *K-ESS3-3, 2-ESS2-1, 5-ESS3-1, HS-LS2-7*



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Watershed Tarp

Duration: < *1 hour* | State Standard: *2-ESS2-1, 2-ESS2-2, 2-ESS2-3, MS-ESS2-4, MS-ESS3-3, HS-ESS2-5, HS-ESS3-4, HS-LS2-7, HS-LS4-6*

FACT:

Water is the only substance found naturally in three states: solid (ice), liquid, and gas (water vapor, steam).

Summary:
Students will visually delineate watersheds and their features while becoming aware of how pollutants accumulate within watershed boundaries.

Materials:
2 tarps/plastic tablecloths/other water-resistant covers, spray bottle with water, newspaper/plastic bags/assorted items to create topography, toy animals/cars/buildings, household items to represent pollutants.

Examples:
Brown sprinkles (dog waste), cocoa powder (dirt), green food coloring (fertilizer), red food coloring (toxic waste), vegetable oil or honey (motor oil), dish soap (laundry detergents), etc.

Directions:
Lay the first tarp on the ground with students standing around the outside. Have students throw crumpled-up newspaper/plastic bags/ etc. onto the tarp. (Tip: Place most of these items toward the center of the tarp away from the edges.) Place the second tarp on top resulting in a "landscape" of hills and valleys.

Watershed Tarp (Continued)

Duration: < *1 hour* | State Standard: *2-ESS2-1, 2-ESS2-2, 2-ESS2-3, MS-ESS2-4, MS-ESS3-3, HS-ESS2-5, HS-ESS3-4, HS-LS2-7, HS-LS4-6*

Possible Extension:

1. Place a sponge in an area where the polluted water collects. Describe to students that wetlands work similar to sponges. Wetlands can reduce flooding, capture soil erosion, recharge groundwater, and filter contaminants. Unfortunately, about 85% of Indiana's wetlands have been lost since European settlement.
2. Using yarn, delineate different county or municipal boundaries across the landscape. Place pollutants in some counties but leave others pollution-free. Spray the landscape to observe the water and pollutants flow across these yarn boundaries. Discuss with the students how we are interconnected by watersheds. Pollution from one area can easily flow into another and working with other communities can help reduce pollution for everyone.

Ask the students to define a watershed. (A watershed is an area of land that water flows over on its way to a common waterbody.) Watersheds are separated by areas of high elevation. Ask the students to identify potential watersheds within your tarp landscape. Using the spray bottle, simulate rain by spraying water across the tarp. Observe the droplets flow through the landscape and collect in different "watersheds".

Discuss with the students how land use is linked to water quality. Different uses of the land, i.e. agriculture vs industrial vs residential, can introduce different pollutants into the waterways. For example, a cattle pasture may lead to high *E. coli* counts due to the runoff of livestock waste. Have the students brainstorm how other land uses affect the watershed.

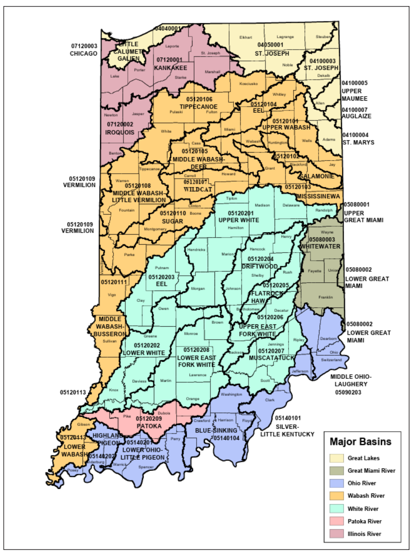
Invite the students to place the toy cars, animals, and buildings around the landscape. Next, have students distribute the "pollutants" near their associated land use. For example, vegetable oil can be poured near the toy car to represent motor oil. Once the landscape is set, have the students predict what will happen when it rains again. Spray the water onto the tarp again to observe the pollutants washing away and collecting in the rivers and lakes. These types of pollutants are what is referred to as non-point source pollution or run-off. They are introduced to a waterway from a wide area, and it is difficult to identify and regulate the original source . Ask the students what they think can be done to reduce or eliminate pollution within the landscape.

Clean up the activity by pouring the water down the sink or waste container. Clean the toys for later use and properly dispose of the newspaper or plastic bags. Wipe off the tarp for later use.

*Adapted from *Earth Force Watershed Model Activity*. Example video at https://vimeo.com/16661153.

Hydrologic Unit Codes

Duration: < *1 hour* | State Standard: *2-ESS2-2, 2.W.6, 3.W.6*



IDEMs HUC Finder

Summary:
Students will discover how watersheds are organized and how to identify the watershed they live in.

Materials: Computer with internet access.
A watershed is the total area of land that drains into a particular waterbody (wetland, stream, river, lake, or sea). Just as everyone in Indiana lives within the boundaries of a county, everyone also lives within a watershed. Each watershed in Indiana is assigned a number called the Hydrologic Unit Code, or HUC. These HUCs are comparable to zip codes and can be thought of as the “stream address”.

Demonstrate IDEM’s “HUC Finder” tool (https://www.in.gov/idem/cleanwater/resources/indiana-huc-finder/). Have the students find the name and 8-digit HUC for the watershed their school or home is within.

Watershed Name: ______________________________________

Watershed HUC #: _____________________________________

Note: Without internet access, print the HUC map on our resource page link (https://www.in.gov/idem/riverwatch/junior) or from the training manual in the Hoosier Riverwatch training manual (page 15, https://www.in.gov/idem/riverwatch/training-manual/) beforehand and distribute copies to students.

Possible Extension:
Have students conduct research on one of the HUC units on the map. Have them share their findings with the class. For example, what are the largest cities/towns in the HUC? What is the primary land use? What are the largest bodies of water in the HUC? What is the topography like within the HUC? Etc.

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Habitats

Duration: *1–2 hours* | State Standard: *2-LS4-1, MS-LS2-4, MS-LS2-5, HS-ESS2-5*

Summary:

Students will explore physical features of stream ecosystems that contribute to higher habitat scores.

A healthy stream must have certain characteristics to support a biodiverse ecosystem. Have students define the following terms regarding stream habitats. For help, refer to the Hoosier Riverwatch Manual, Chapter 3: Habitat Assessment at https://www.in.gov/idem/riverwatch/training-manual/.

Riparian –

Meander –

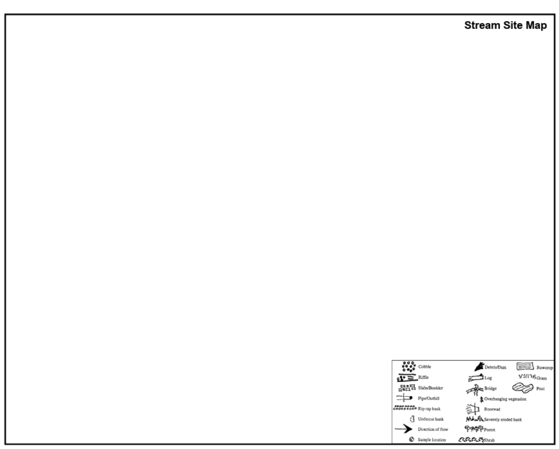
Riffle –

Run –

Pool –

Oxbow –

With adult supervision, have the students complete the Citizens Qualitative Habitat Evaluation Index (see resource page link https://www.in.gov/idem/riverwatch/junior or page 26 of the Hoosier Riverwatch manual, https://www.in.gov/idem/riverwatch/training-manual/) at a creek site of your choosing. Draw a sketch of your site and label landmarks, vegetation, and features of the creek (example below) by going to the resource page link https://www.in.gov/idem/riverwatch/junior.



Habitats (Continued)

Duration: *1–2 hours* | State Standard: *2-LS4-1, MS-LS2-4, MS-LS2-5, HS-ESS2-5*

Citizens Qualitative Habitat Evaluation Index (CQHEI)

Date: __/__/__ Volunteer ID: __________ Site ID: __________

Stream Name: ____ CQHEI Total

I. SUBSTRATE (bottom type) Score:

a) Size

- ☐ 14 pt — Mostly Large (Fist Size or Bigger)
- ☐ 10 pt — Mostly Medium (Smaller than Fist, larger than Fingernail)
- ☐ 6 pt — Mostly Small (Smaller Than Fingernail, but Coarse, or Bedrock)
- ☐ 0 pt — Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky)

b) "Smothering"

Are Fist Size and Larger Pieces Smothered By Sands/Silts?

- ☐ 5 pt — No
- ☐ 0 pt — Yes

Symptoms: Hard to move pieces, often black on bottom.

c) "Silting"

Are Silts and Clays Distributed Throughout Stream?

- ☐ 5 pt — No
- ☐ 0 pt — Yes

Symptoms: Light kicking results in substantial clouding for more than a minute.

II. FISH COVER (hiding places) - Add 2 Points For Each One Present Score:

- ☐ 2 pt — Underwater Tree Roots (Large)
- ☐ 2 pt — Underwater Tree Rootlets (Small)
- ☐ 2 pt — Shrubs/Small Trees Hang Over the Bank
- ☐ 2 pt — Backwaters, Oxbows or Side Channels
- ☐ 2 pt — Downed Trees, Logs, or Branches
- ☐ 2 pt — Shallow, Slow Areas for Small Fish
- ☐ 2 pt — Water Plants
- ☐ 2 pt — Deep Areas (Chest Deep)
- ☐ 2 pt — Undercut Banks
- ☐ 2 pt — Boulders

III. STREAM SHAPE and HUMAN ALTERATIONS Score:

a) "Curviness" or "Sinuousity" of Channel

- ☐ 8 pt — 2 or More Good Bends
- ☐ 6 pt — 1 or 2 Good Bends
- ☐ 3 pt — Mostly Straight Some Wiggle"
- ☐ 0 pt — Very Straight

b) How Natural Is The Site?

- ☐ 12 pt — Mostly Natural
- ☐ 9 pt — Few Minor Man-Made Changes (e.g., a bridge)
- ☐ 6 pt — Many Man-Made Changes, but Some Natural Conditions left (e.g., trees, meanders)
- ☐ 0 pt — Heavy, Man-made Changes (e.g., leveed or channelized)

IV. STREAM FORESTS & WETLANDS (riparian area) & EROSION Score:

a) Riparian Width Mostly:

- ☐ 8 pt — Wide (Can't throw a rock through it)
- ☐ 5 pt — Narrow (can throw a rock through it)
- ☐ 0 pt — None

b) Land Use - Mostly:

- ☐ 5 pt — Forest/Wetland
- ☐ 4 pt — Shrubs
- ☐ 3 pt — Overgrown Fields
- ☐ 2 pt — Fenced Pasture
- ☐ 2 pt — Park (Grass)
- ☐ 2 pt — Conservation Tillage
- ☐ 1 pt — Suburban
- ☐ 1 pt — Row Crop
- ☐ 0 pt — Open Pasture
- ☐ 0 pt — Urban/ Industrial

c) Bank Erosion

- ☐ 4 pt — Stable Hard or Well-Vegetated Banks
- ☐ 2 pt — Combination of Stable and Eroding Banks
- ☐ 0 pt — Raw, Collapsing Banks

d) Stream Shading

- ☐ 3 pt — Mostly
- ☐ 2 pt — Partly
- ☐ 0 pt — None

V. DEPTH & VELOCITY Score:

a) Deepest Pool is At Least:

- ☐ 8 pt — Chest Deep
- ☐ 6 pt — Waist Deep
- ☐ 4 pt — Knee Deep
- ☐ 0 pt — Do Not Exist

b) Check ALL The Flow Types That You See (Add Points):

- ☐ 2 pt — Very Fast: Hard to Stand in Current
- ☐ 3 pt — Fast: Quickly Takes Object Downstream
- ☐ 1 pt — Moderate: Slowly Takes Object Downstream
- ☐ 1 pt — Slow: Flow Nearly Absent
- ☐ 0 pt — None

VI. RIFFLES/RUNS (areas where current is fast/turbulent, surface may be broken) Score:

a) Riffles/Runs Are:

- ☐ 8 pt — Knee Deep or Deeper and Fast
- ☐ 6 pt — Ankle/Calf Deep and Fast
- ☐ 4 pt — Ankle Deep or Less and Slow
- ☐ 0 pt — Do Not Exist

b) Riffle/Run Substrates Are:

- ☐ 7 pt — Fist Size or Larger
- ☐ 4 pt — Smaller Than Fist Size, but Larger Than Fingernail
- ☐ 0 pt — Smaller Than Your Fingernails or Do Not Exist

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Stream Flow

Duration: *1–2 hours* | State Standard: *2.M.2, 2.M.3, 3.M.2, 5.DA.2, 6.NS.4*

Summary:
Students will calculate the amount water moving through a site by taking physical measurements.

Materials:
Yardstick, tape measure, stopwatch, floating object (Easter egg, fishing bobber, etc.)

Flow, or discharge, is the volume of water moving in a stream per second. Hoosier Riverwatch records flow in cubic feet per second. Flow can vary day to day, or even hour by hour, depending on the weather conditions. The discharge rate is obtained by multiplying the average width, depth, and velocity of the stream. All measurements are taken (or converted) into feet.

Average Width (W) — width of the stream (flowing area itself) taken from where it touches the stream bank on one side to where it touches the stream bank on the other side – take three width measurements

Average Depth (Z) — three depth measurements are taken (using a yardstick) across the stream on three transects – nine total measurements

Average Velocity (V) — how fast the water is moving – measure a distance and time how long it takes a floating object to travel that distance – repeat three times (Hoosier Riverwatch uses floating objects like Easter eggs or fishing bobbers.)

Roughness Coefficient (n) — select 0.8 for a gravel or rocky bottom; select 0.9 for sandy, muddy or bedrock

Flow = W x Z x V x n

With adult supervision, have the students complete the Stream Flow Data Sheet on page 17 and on the resource page link https://www.in-.gov/idem/riverwatch/junior or from (page 30 of the Hoosier Riverwatch manual, https://www.in.gov/idem/riverwatch/training-manual/) at your creek site. Use a tape measure, yard stick, and floating object as detailed on page 28 in the manual.

Stream Flow (Continued)

Duration: *1–2 hours* | State Standard: *2.M.2, 2.M.3, 3.M.2, 5.DA.2, 6.NS.4*

With the students, explore the USGS Stream Stats website (https://streamstats.usgs.gov/ss). This site provides a map of stream gauges throughout the country with real-time flow data. Choose a stream gauge near you to examine. Compare the 7-day, 30-day, and 1-year data. What was the lowest flow? Highest? Ask the students why this data may be valuable to have.

Alternative Procedures:

Without a safe sampling location, provide a set of measurements for students to plug into the equation. Organize the class into several groups and provide different measurements to each group. Have the students determine which group has the highest and lowest flow value.

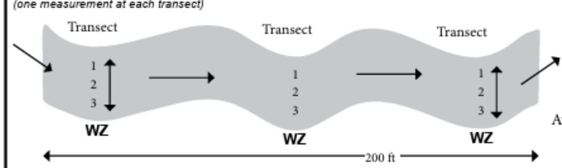
Solving the equation:

FLOW (D) = W x Z x V x n

Where:
W = Average Width
Z = Average Depth
V = Average Velocity
n = Coefficient - 0.8 for gravel/rocky bottom streams
0.9 for muddy or bedrock bottom streams
D = Flow/Discharge

Convert measurements of feet + inches to 10ths of feet. **1 inch = 0.0833 feet**

W
River Width
(one measurement at each transect)



Transect	Width (ft)
1	
2	
3	
Average	

Z
River Depth
(three measurement along each transect)

Transect	Transect 1 (ft)	Transect 2 (ft)	Transect 3 (ft)
1			
2			
3			
Average of Transects			

Average of Averages:

V
Surface Velocity = Length/Time
(allow the object to attain velocity before timing)

Transect	Length (ft)	Time (seconds)	Velocity (ft/sec)
1			
2			
3			
Average			

D
Stream Flow or Discharge

W	x	Z	x	V	x	n*	=	D (cfs)

**Coeffecient (0.8 for gravel/rocky bottom streams, 0.9 for muddy or bedrock bottom streams*

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Moving for Macros

Duration: < *1 hour* | State Standard: *K-LS1-1, K-ESS3-1, 2-LS4-1, 3-LS1-1, 3-LS2-1, 3-LS4-3, 5-LS2-1, MS-ESS2-1, HS-LS2-6, HS-LS4-5*

FACT:

Water is vital for all living organisms, supporting various biological processes.

Summary:
Students will complete a relay race to simulate the sampling of macroinvertebrates while discovering the importance of their pollution tolerances.

Materials:
4 dip nets, balloons of various colors (around 2-3 times number of students), trash bag for each team.

Discuss with the students what benthic macroinvertebrates ("macros") are and why they are used in water monitoring. Benthic macroinvertebrates are animals that are big enough to be seen with the naked eye. They lack backbones and live at least part of their lives in or on the bottom (benthos) of a body of water. While some prefer to live in shallow, turbulent waters (riffles), others can be found in standing water.

Many macroinvertebrates display a life cycle that includes metamorphosis. Mayflies, for example, lay eggs in water which hatch into larvae, also known as nymphs. The larvae grow and molt their exoskeleton many times during their time in the water. The following year, the larvae will molt into a winged adult that will survive for approximately 48 hours in search of a mate for reproducing.

Macroinvertebrates include aquatic insects, snails, worms, freshwater clams, mussels, and crayfish. Some benthic macroinvertebrates, such as midges, are small and grow no larger than 1/2 inch in length. Others, like the three-ridge mussel, can be more than ten inches long.

Macros are an important part of the food chain, especially for fish. Many feed on algae, leaves and organic matter while others will prey upon smaller species. Because of their abundance and position as "middleman" in the aquatic food chain, macros play a critical role in the balance of their ecosystem. Additionally, each species of macro has a different tolerance for pollution. This means we can use the presence or absence of macros as an indicator of water quality.

Moving for Macros (Continued)

Duration: < *1 hour* | State Standard: *K-LS1-1, K-ESS3-1, 2-LS4-1, 3-LS1-1, 3-LS2-1, 3-LS4-3, 5-LS2-1, MS-ESS2-1, HS-LS2-6, HS-LS4-5*

Count off by 4 to organize into four teams, one for each net. Spread the balloons out in the open space ahead of the students. Explain the rules:

1. Spin 3 times around the net before running to pick up a balloon
2. Only use the net to pick up balloons - NO hands
3. Only pick up ONE balloon per trip
4. Return balloon to teammates and place in trash bag
5. Trade net to the next in line and go to the back of the line
6. Repeat the steps

You can race until all the balloons are gone OR until a time limit is reached. Students gather with their teams to count the balloons. DESCRIBE THE POINT SYSTEM AFTER COLLECTING BALLOONS. Some macroinvertebrates are scored higher because of their low tolerance to pollution and indication of clean water. Describe a point system that fits the colors you have. Below is an example:

- Blue & Purple = +3 points each (least pollution tolerant species)
- Green & Yellow = +2 points each
- Red & Orange = +1 point each
- White = -1 point each (most pollution tolerant species)

Have the teams tally their totals and share to announce a winning team. Collect and dispose of any balloons that may have popped during the exercise.

Alternative Procedures: To be more environmentally friendly, use an alternative to balloons if budget allows. Dodge balls, tennis balls, or any item small enough to fit into the dip nets can be labeled or painted to represent the different tolerance groups.

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ID With The Key

Duration: < *1 hour* | State Standard: *K-ESS3-1, 1-LS1-1, 2-LS4-1, 3-LS4-3, 4-LS1-1, HS-LS2-6, K.CA.1*

Summary:
Students will use dichotomous keys to identify macroinvertebrates and score their species with the pollution tolerance form.

Materials:
Folders #1-4 with printed photos and resource pages (see resource page link https://www.in.gov/idem/riverwatch/junior).

Organize the students into four groups. Assign a folder to each group. Each folder contains four photographs, an identification key, and a pollution tolerance scoring sheet. (Feel free to make more copies of these pages for larger groups.)

Detail how to use the key (moving top to bottom, answer one question at a time regarding your species- does it have a shell? Does it have legs? If so, how many? Does it have tails?). Point out the pollution scoring sheet (+4 points for 'Group 1' species that requires clean water through +1 for 'Group 4' species that can live in polluted water.

ID with The Key (Continued)

Duration: < *1 hour* | State Standard: *K-ESS3-1, 1-LS1-1, 2-LS4-1, 3-LS4-3, 4-LS1-1, HS-LS2-6, K.CA.1*

FACT:

Water helps regulate both the Earth's temperature and the temperature of living organisms.

The folders have the following species and subsequent scores:

Folder #1:
Left-Handed (Pouch) Snail, Dobsonfly, Riffle Beetle, Damselfly = 12 points

Folder #2:
Dragonfly, Leech, Caddisfly, Mayfly = 13 points

Folder #3:
Rat-tailed Maggot, Leech, Crayfish, Scud = 9 points

Folder #4:
Leech, Midge, Flatworm, Stonefly = 10 points

Have the students identify macros and calculate scores for their folders. Following this format, Folder #2 will have the "cleanest stream" with the highest score (lowest pollution). This is similar to the procedure that Hoosier Riverwatch volunteers follow to score a stream's biological health.

Note: You can change content of the folders using photos of different macroinvertebrates from the pollution scoring page. Remember to update the scores for the folders.

Possible Extension: Conduct in-person sampling at a safe stream site. Using D-nets or kick nets, have students collect macroinvertebrates. Transfer the organisms to a white dish pan to allow for better viewing. Use the dichotomous key to identify collected specimens. Complete the Biological Monitoring Data Sheet (see resource page link https://www.in.gov/idem/riverwatch/junior or page 75 of the Hoosier Riverwatch manual, https://www.in.gov/idem/riverwatch/training-manual/) to determine the Pollution Tolerance Index (PTI) rating.

Without a safe sampling site available, complete a virtual macroinvertebrate survey at https://leafpacknetwork.org/virtual-stream-study/, published by Stroud Water Research Center.

Creekside Chemistry

Duration: *2+ hours* | State Standard: *MS-ESS3-3, HS-ESS3-4, HS-LS2-7, HS-LS4-6, K.NS.6, K.M.1, 3.M.2, 4.DA.1, 5.DA.2, 6.NS.4, 6.DS.3*

Summary:
Students will discover common measurables of water chemistry and how they are related to each other.

Numerous chemical parameters can be measured while monitoring water quality. Name at least four chemical tests that can be completed during monitoring. For help, refer to the ***Hoosier Riverwatch manual, Chapter 4: Chemical Monitoring***.

Many of the chemical parameters in water monitoring are interconnected. For example, the temperature of water is inversely correlated with dissolved oxygen. Colder water is able to hold more dissolved oxygen (DO) than warmer water. As water temperature rises, the amount of oxygen in the water decreases. It is natural, however, for the temperature of water and DO levels to fluctuate throughout the seasons.

Ideally, the saturation of dissolved oxygen in water should remain stable around 100%. Percent saturation expresses the current amount (in milligrams) of oxygen gas dissolved in one liter of water at a given temperature compared with the maximum milligrams of oxygen gas that can remain dissolved in one liter of water at the same temperature and pressure. The table below shows the mg/L of DO that represents 100% saturation at each given temperature.

Approximate amount of Dissolved Oxygen (mg/L) needed for your water sample to be 100% Saturated at the given temperature.*

Temp °C	Dissolved Oxygen (mg/L)	Temp °C	Dissolved Oxygen (mg/L)
0	14.6	15	10.1
1	14.2	16	9.9
2	13.8	17	9.7
3	13.5	18	9.6
4	13.1	19	9.3
5	12.8	20	9.1
6	12.5	21	8.9
7	12.1	22	8.7
8	11.8	23	8.6
9	11.6	24	8.4
10	11.3	25	8.3
11	11.0	26	8.1
12	10.8	27	8.0
13	10.5	28	7.8
14	10.3	29	7.7

Calculating Percent Saturation:

$$\frac{\text{DO mg/L (your sample)}}{\text{Max DO mg/L (from chart at left determined by water temperature)}} \times 100\%$$

Example at 16 °C:

$$\frac{8.0 \text{ mg/L}}{9.9 \text{ mg/L}} \times 100\% = 81\%$$

*for fresh water at sea level

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Creekside Chemistry (Continued)

Duration: *2+ hours* | State Standard: *MS-ESS3-3, HS-ESS3-4, HS-LS2-7, HS-LS4-6, K.NS.6, K.M.1, 3.M.2, 4.DA.1, 5.DA.2, 6.NS.4, 6.DS.3*

FACT:

Water is a molecule composed of two hydrogen atoms and one oxygen atom (H2O).

A. Using the table on page 23. Have the students find the percent saturation for the following examples:

1. At 20°C, your sample reads 7ppm O_2 ⟶ _______% saturation
   (7ppm/9.1ppm x 100% = 76.9%)
2. At 15°C your sample reads 10ppm O_2 ⟶ _______% saturation
   (10ppm/10.1ppm x 100% = 99%)
3. At 17°C your sample reads 12ppm O_2 ⟶ _______% saturation
   (12ppm/9.7ppm x 100% = 123.7%)

It is possible for water to be supersaturated, or retain more than 100% oxygen, for a short period of time. Ask the students why they think this might happen. Typically, this occurs when there is large amounts of photosynthesizing plants or algae in the water. In this situation, the oxygen levels may decrease at night because these organisms cannot photosynthesize without light.

The more oxygen an ecosystem has is not necessarily a good thing, however. In fact, supersaturation can be harmful to aquatic organisms, causing gas bubble disease, a condition similar to "the bends" which scuba divers may get if they surface too fast.

Hoosier Riverwatch utilizes 'Q-values' to compare the results of chemical tests that are measured in different ways. For example, dissolved oxygen saturation is measured as a percentage while nitrates are measured in ppm and E. coli is measured in CFU/100mL. Conversion tables in the Hoosier Riverwatch training manual allow volunteers to translate results to Q-values.

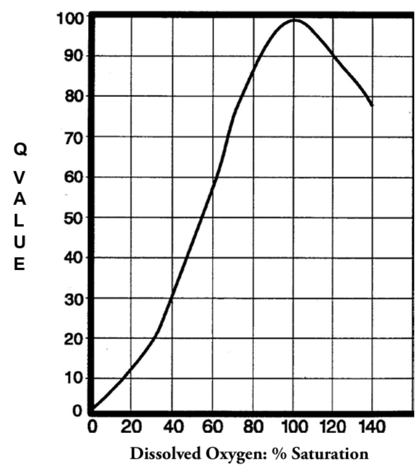
B. Using the conversion chart/graph below, have students convert the % saturation calculations from above to a Q-value.

1. 76.9% ⟶ _______ (approx. 84 Q-value)
2. 99% ⟶ _______ (approx. 98 Q-value)
3. 123.7% ⟶ _______ (approx. 88 Q-value)

Creekside Chemistry (Continued)

Duration: *2+ hours* | State Standard: *MS-ESS3-3, HS-ESS3-4, HS-LS2-7, HS-LS4-6, K.NS.6, K.M.1, 3.M.2, 4.DA.1, 5.DA.2, 6.NS.4, 6.DS.3*

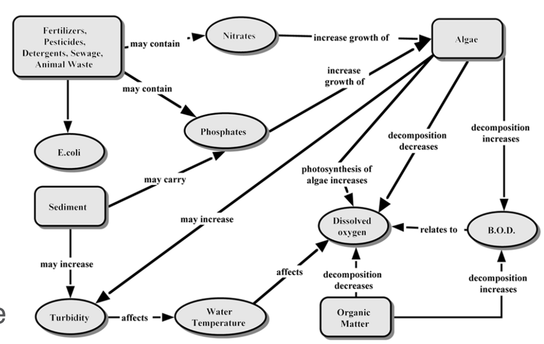
Dissolved Oxygen Q-Values



DO (% Saturation)	Q-Value
0	0
10	8
20	13
30	20
40	30
50	43
60	56
70	77
80	88
85	92
90	95
95	97.5
100	99
105	98
110	95
120	90
130	85
140	78
>140	50

Temperature and oxygen are just two of the many chemical parameters measured within water. Other parameters include pH, nutrients, and turbidity. Many of these measures are interconnected to one another. For example, the introduction of organic waste into an aquatic ecosystem can increase harmful bacteria such as E. coli. In addition, the organic waste can increase nutrient loads which cause increased growth of algae. Algae can increase turbidity, or cloudiness of the water, while decreasing oxygen during decomposition (breakdown of dead organisms by bacteria or other microbes).

C. Have the students complete the *Think, Pair, Share* worksheet on the resource page link https://www.in.gov/idem/riverwatch/junior). First, allow students time to write down answers for themselves. Next, have students gather in pairs to compare answers. Lastly, allow the students to share and discuss the parameters as a class. Compare their answers to those on the backside of the page.



Creekside Chemistry (Continued)

Duration: *2+ hours* | State Standard: *MS-ESS3-3, HS-ESS3-4, HS-LS2-7, HS-LS4-6, K.NS.6, K.M.1, 3.M.2, 4.DA.1, 5.DA.2, 6.NS.4, 6.DS.3*

D. Have students write an essay using the following prompt:

Imagine you are an aquatic ecologist speaking to your state legislators. You want to persuade these lawmakers to support a bill that would reduce nutrient run-off into our waterways and slow the process of eutrophication. Define eutrophication and its primary causes. Explain how eutrophication negatively impacts aquatic ecosystems and human health. Promote specific actions that individuals, communities, and this governing body can take to mitigate nutrient pollution. Provide a call to action addressing the long-term consequences of neglecting to address this issue.

E. Conduct in-person sampling at a safe stream site using a variety of chemical tests. Obtain one or more tests from suppliers, such as those in the table below. Supervise students as they conduct chemical tests following the procedures in Chapter 3 (Chemical Monitoring, pages 32-65) of the Hoosier Riverwatch Manual (https://www.in.gov/idem/riverwatch/training-manual/). Complete the Chemical Monitoring Data Sheet (page 39 of the Hoosier Riverwatch manual, https://www.in.gov/idem/riverwatch/training-manual/) to determine the Water Quality Index (WQI) rating.

Without a safe sampling site available, have students complete a virtual macroinvertebrate survey at https://leafpacknetwork.org/virtual-stream-study/, published by Stroud Water Research Center.

Hoosier Riverwatch Training Manual

Virtual Stream Study

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Creekside Chemistry (Continued)

Duration: 2+ *hours* | State Standard: *MS-ESS3-3, HS-ESS3-4, HS-LS2-7, HS-LS4-6, K.NS.6, K.M.1, 3.M.2, 4.DA.1, 5.DA.2, 6.NS.4, 6.DS.3*

FACT:

Water is heavy, with a cubic foot weighing 62.4 pounds and a gallon weighing 8.34 pounds.

Product	Vendor	Website	Item Number	Price
Chemical Monitoring Supplies				
Dissolved Oxygen Test Kit	CHEMetrics	chemetrics.com	K-7512	$71.01
Dissolved Oxygen Ampoules	CHEMetrics	chemetrics.com	R-7512	$35.50
Dissolved Oxygen Comparator	CHEMetrics	chemetrics.com	C-7512	$25.34
OrthoPhosphate Test Kit	CHEMetrics	chemetrics.com	K-8510	$82.96
OrthoPhosphate Ampoules	CHEMetrics	chemetrics.com	R-8510	$33.72
OrthoPhosphate Color Comparator	CHEMetrics	chemetrics.com	C-8501 (0-1)	$17.53
			C-8510 (1-12)	$25.34
Hach Nitrate/Nitrite strips (bottle of 25)	Hach	hach.com	2745425	$36.89
Hach pH strips (bottle of 50)	Hach	hach.com	2745650	$20.85
BOD Bottle with stopper	Forestry Suppliers	forestry-suppliers.com	53868	$26.50
Thermometer	Forestry Suppliers	forestry-suppliers.com	77141	$16.25
Transparency Tube (120cm)	Forestry Suppliers	forestry-suppliers.com	77292	$65.95

E. coli Supplies				
Coliscan EasyGel/Petri Dishes (10 tests)	Micrology Labs	micrologylabs.com	25001	$39.68
Sterile Pipettes 1 mL (500)	Thomas Scientific	thomassci.com	1216H32	$150.08
Sterile Pipettes 3 mL (500)	Thomas Scientific	thomassci.com	1216H38	$151.34
3M™ Petrifilm™ E. coli/Coliform Count Plates	Carolina Biological	carolina.com	824020	$94.00
Thermal Air Hova-Bator Incubator	G.Q.F. Manufacturing	gqfmfg.com	1602N	$56.70

**Hoosier Riverwatch volunteers affiliated with a school, non-profit, or government agency are eligible to receive a FREE stream monitoring equipment kit for your group. To become a trained volunteer, complete a basic workshop, listed on our event calendar at https://www.hoosierriverwatch.com/#cal. To apply for a grant kit, return the *Hoosier Riverwatch Water Monitoring Equipment Application* (State Form 55220, available on the IDEM Agency Forms page) to Riverwatch@IDEM.IN.gov.

Invasives Investigation

Duration: *1–2 hours* | State Standard: *3-LS4-3, 3-LS4-4, 4-LS1-1, MS-LS2-1, MS-LS2-4, MS-LS1-4, HS-LS2-2, HS-LS2-7, HS-LS4-5, 3.W.6*

FACT:

While 97% of the Earth's water is saltwater, only 3% is freshwater. A significant portion of this freshwater is locked in glaciers and ice caps.

Summary:

Students will research and share findings regarding an aquatic invasive species (AIS).

An "invasive species" is defined as a species that is non-native to the ecosystem and whose introduction causes or is likely to cause harm to the environment, economy or human health. Invasive species can be plants, animals, or other organisms. Visit Indiana DNR's invasive species website at https://www.in.gov/dnr/rules-and-regulations/invasive-species/. Choose an aquatic invasive species to study. Write a summary or create a visual media (i.e. poster, video, etc.) of your findings on the species. Where is the species native to? How was the species introduced? What are the distinguishing features that help in identification? What are the negative impacts this species is having on the environment? How can we manage this species?

IN DNR
Invasive Species

What Can YOU Do?

Duration: *2+ hours* | State Standard: *K-ESS3-3, 2-ESS2-1, 5-ESS3-1, MS-LS2-5, MS-ESS3-3, HS-ESS3-4, HS-LS4-6, 3.W.6, 3.CC.7, 4.CC.6*

FACT:

Water can dissolve more substances than any other liquid.

Summary:
Students will define and explore best management practices and their benefits on water quality.

Best Management Practices, or BMPs, are activities or actions that individuals or industries can take to reduce their negative impact on the environment. For example, a farmer may plant a border of vegetation along their crops that filter the excess fertilizer running off the fields. A conservation group may plant trees along a creek bank to provide shade and reduce soil erosion. A homeowner may budget for the recommended maintenance of their septic tank to reduce E. coli levels in their local creek. Review the list of BMPs in Appendix C of the Hoosier Riverwatch manual (pages 139-140, https://www.in.gov/idem/riverwatch/training-manual/). Choose one practice and develop a visual presentation (PowerPoint slideshow, presentation with prop, etc.). Conduct a 5-minute presentation to the class highlighting the BMP.

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Data Exploration

Duration: *1–2 hours* | State Standard: *K.DA.1, 1.DA.1, 2.DA.1, 3.DA.1, 4.DA.1, 5.DA.1, 6.DS.3, 4.W.5*

Hoosier Riverwatch Database

Summary:

Students will explore the Hoosier Riverwatch database and learn to analyze water quality data.

Hoosier Riverwatch volunteers have been contributing water quality data for over 25 years. Explore the Hoosier Riverwatch database (https://www.hoosierriverwatch.com/search/) and corresponding graphs (https://www.hoosierriverwatch.com/visualize/).

Write your reaction to the data. Is the database organized and easy to navigate? What locations and parameters did you explore and why? Is there data missing and why might there be gaps in the data? Is the data easy to read and understand? Do you need additional information to fully understand the data? What data would you add to the database and why?

Compare the chemistry data to the state averages and typical ranges from Appendix D (page 141, https://www.in.gov/idem/riverwatch/training-manual/). Explore the Pollution Tolerance Index (PTI) ratings on the Biological Monitoring Data Sheet (page 75 of the Hoosier Riverwatch manual, https://www.in.gov/idem/riverwatch/training-manual/). Remind students that any unit labeled CQHEI is a test involving habitat quality. A set of ranges for Excellent, Medium, Poor, Very Poor has not yet been developed for this index; however, CQHEI scores > 60 have been found to be “generally conducive to the existence of warm water fauna” and 114 is the maximum CQHEI score.

With this knowledge, ask the students to make further inferences and conclusions from the data found online.

Watershed Resources

There are many other sources of data regarding watersheds and water quality. Lead students through the following resources:

IDEM Watershed Management Plans —
https://www.in.gov/idem/nps/resources/watershed-management-plans/

Stroud Water Research Center 'Model My Watershed' —
https://modelmywatershed.org

Stroud Water Research Center 'Runoff Model' —
https://runoff.modelmywatershed.org/

River Runner App —
https://river-runner.samlearner.com/

NOAA Indiana Drought Map —
https://www.drought.gov/states/indiana/

EPA 2018-19 National Rivers & Streams Assessment —
https://riverstreamassessment.epa.gov/dashboard/

National Science Foundation Atlas of Common Freshwater Macroinvertebrates —
www.macroinvertebrates.org

Water Resource Books:

One Well: *The Story of Water on Earth by Rochelle Strauss*

A Drop of Water: *A Book of Science and Wonder by Walter Wick*

We Are Water Protectors *by Carole Lindstrom*

Over and Under the Pond *by Kate Messner*

Water Dance *by Thomas Locker*

Hey, Water! *by Antoinette Portis*

Water is Water *by Miranda Paul*

Watershed Resources (Continued)

Stream Team Jeopardy by Hoosier Riverwatch —
email Riverwatch@IDEM.IN.gov for the game file and instructions

Stream Team Challenge

Identify Me	Habitat	Chemistry	Macro-invertebrates	Watersheds
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

Potential Field Trips

Hoosier Riverwatch Jr. encourages both formal and informal education settings. If resources allow, below are locations for potential field trips for furthering students' understanding on water as a resource.

- ***Local Soil & Water Conservation District:*** Each county in IN has a SWCD office that engages with the community on stewardship efforts.
- ***Wastewater Treatment Plant or Drinking Water Treatment Plant:*** Understand the water treatment process and the importance of clean water for the community.
- ***Nature Preserves/Wetlands/Waterfront Park:*** Explore natural habitats and their biodiversity. (https://www.in.gov/dnr/nature-preserves/nature-preserve/)
- ***River Cleanup Day:*** Participate in or organize a community river cleanup event to experience the direct impact of pollution and the importance of collective action.
- ***State Fish Hatchery:*** Learn the process of raising and releasing fish to ensure healthy populations and support recreation (https://www.in.gov/dnr/fish-and-wildlife/properties/state-fish-hatcheries2/)
- ***Hydroponic Farm/Irrigation System:*** Discover the benefits and challenges of traditional vs non-traditional crop production.
- ***Dam/Reservoir/Hydroelectric Facility:*** Tour a facility managed by the Army Corps of Engineers or other entity to learn its purpose and benefits.

Hoosier Riverwatch Jr. Stickers

As recognition for completing Hoosier Riverwatch Jr. activities, students are eligible to receive a logo sticker once educators complete the program survey. Once the survey is returned to Riverwatch admin, stickers will be mailed to your classroom. Email Riverwatch@IDEM.IN.gov for a program survey.

HOOSIER RIVERWATCH Junior