Standing Stone Creek: Our Place in the Bay

Essential Question: How does the health of Standing Stone Creek impact our community?

Enduring Understanding: Stone Creek, like many waterways in our region, has excellent water quality that the Huntingdon community relies on for drinking water, recreation, and tourism; and the conservation of this resource is in the hands of the community residents.

1. Introductory Lesson – Watershed Address: Students will explore what a watershed is, what components make up a watershed, and use maps to identify each student's watershed address. Students will use their own location and watershed address activity to introduce the concept of watersheds – the land that contributes water to a particular waterway – and trace the path from their backyard to the Chesapeake Bay.

2. Enviroscape Watershed Model: Students will explore a model watershed with various land uses represented to demonstrate sources of pollution along with potential solutions to environmental problems. Watershed concepts to be explored include how water flows over land, land and water connections, and learning how small streams can impact a larger water body, demonstrating why we care about Chesapeake Bay. Solutions to environmental problems, called Best Management Practices, will be introduced and demonstrated.

3. Forested Riparian Buffers: Students walk along the riparian area of Stone Creek at Detwiler Park, evaluating the connection between canopy cover, stream temperature, and dissolved oxygen as they discover the benefits of a forested riparian buffer. As they walk, students will take notice of the impacts of Emerald Ash Borer, learn how this invasive species is threatening this area and what can be done to resolve this problem.

4. Water Quality: Students will learn how to conduct chemical tests relating to the water quality of Stone Creek and practice those methods in the classroom and in the field. What does each of the parameters tell us about the water in Stone Creek? How does the land use in the watershed impact the water quality results?

5. Macroinvertebrates: Students will learn how to identify benthic macroinvertebrates using a dichotomous key both in the classroom and in the field. Students will identify how macroinvertebrates are indicators of water quality and explore the connection between water quality and dissolved oxygen and temperature. The Macromania game will be used in the classroom as a warm up to this activity where students learn how to sample in the field.

6. Fish Printing: Students will explore several species of Pennsylvania fishes, their coloration adaptations, and their habitat preferences. What are the places (within Huntingdon County) where these different fish live? Students create a print of one of these fish with a fish model and paints.

7. Physical Parameters: Students will identify and measure the physical parameters within Stone Creek and how the flow regime and pebble size distribution may impact aquatic life. How does the physical structure of the stream bottom relate to macroinvertebrate and fish habitat? How can conservation practices within a watershed improve the physical stream habitat for aquatic life?

8. Local Outdoor Recreation: Students will explore the local outdoor recreation opportunities that exist in our area as a result of the natural resources found here. What are the recreational features of Stone Creek and the natural areas in Huntingdon County? Does a fun activity involving the river, trails, or parks make you feel more connected to it? How does tourism impact our community?

9. Best Management Practices (BMPs): The people occupying a watershed have needs: shelter, food, drinking water, jobs, and recreation. Often, the human activity on land can negatively impact the water resources that people also depend on for those activities. Students will identify possible threats to Stone Creek and inquire about solutions to those threats using the activity "Watershed Decisions." How can human activity occur alongside waterway conservation? How can tools in the conservation kit be used to address existing water pollution issues?

10. Culminating Activity: Summative Assessment to the Essential Question

    Task: Students create posters focusing on some aspect of the unit, incorporating what they have learned and some research of their own. Each student's poster may focus on a particular aspect of the unit or summarize the unit as a whole. The topic may be informative, such as a drawing of macroinvertebrates or which fish can be found in a particular local creek, or may be persuasive, such as how to plant a tree (and use live stakes for shrubs) or how to implement backyard conservation methods at home.

    Event: The teachers will host a gallery walk in school, and the best posters in each topic area will be selected for public view. These posters will be copied and hung in coffee and gift shops around town.

    Also, during the field experience, students will participate in a planting project as an action project to help improve the environment at the park. Students will use live stakes from native shrubs to help prevent erosion along the stream and to encourage native plant growth instead of the prevalent invasive species in the park. Students will also plant seedlings to replace the dead and dying ash trees that are prevalent in the Detwiler Park area.

    Outcome: Some students may also present their posters to a local government agency, based upon availability of students to leave school to attend a public meeting. The possible forums for this presentation include Huntingdon Borough Council, the Huntingdon Co. Conservation District Board of Directors, or their school board.

Introductory Lesson: Watershed Address

<u>Essential Question</u>: How does the health of Standing Stone Creek impact our community?

Secondary Question: What are the watersheds that connect our community to the world?

<u>Context</u>: The introduction to the watersheds unit and study of Stone Creek begins with learning what a watershed is and what components made up a watershed and connecting these concepts to our local watershed, Stone Creek, and the Huntingdon Community. Students will explore maps of the many watersheds to which they belong. Watershed address will be used as the first lesson so that the students are connected with the unit by visualizing where they live in relation to the rest of the watershed (and various sub watersheds).

<u>Standards</u>: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- 4.2.6.A. Identify the six major watersheds of Pennsylvania.
- 4.2.4.A. Describe the physical characteristics of a watershed.
    - Identify and explain what determines the boundaries of a watershed.
    - Identify water systems and their components as either lotic or lentic.
- 4.2.6.C: Identify natural and human-made factors that affect water quality.
- 4.2.8.A: Describe factors that affect the quality of ground and surface waters.
- 4.5.4.C. Describe how human activities affect the environment.

<u>Lesson</u>:

Pre-visit: Students should be able to approximately locate their home on a map of Huntingdon County. Students may be asked ahead of time to find out the name of the nearest stream to their house by asking parents, looking on maps, or researching some other way. Some of them may be quite small and officially unnamed. In that case, or if a student can't find the name of the nearest small stream, a larger tributary can be used.

On-Site: In the classroom, students will view large format maps (if available) or zoomed in online maps of the Huntingdon area to locate their stream. A projector and computer or smartboard will be used for students to take turns locating the stream nearest their house. The activity as described will assume using online maps such as Google maps but can easily be modified to use paper maps if they are available.

To start, students will take turns locating their approximate home location or home stream by zooming in on a map. Pins will be dropped on the map to represent each student's location and the stream name (if known) will be recorded. Once all the student locations are recorded with pins and stream names, the map will be zoomed to a larger scale to view which larger stream the small streams connect to. The instructor may have to focus on separate areas at a time. For example, all the students who posted their location in the Crooked Creek watershed can be considered at one time. The instructor can note how all the pins in a particular area on along Crooked Creek or small streams that lead to Crooked Creek. From there, the instructor can scroll downstream to see where Crooked Creek leads. Once each section of student locations reaches the Juniata River (the common point for everyone in the county), the instructor can lead the class as a whole down the Juniata River by scrolling on the map. As the instructor follows the Juniata downstream, locations of the towns should be noted so that the students can possibly have some familiarity with where the river goes. Once the Juniata River reaches the Susquehanna River, the map should be zoomed out so that the original pins can be viewed. A map outlining just the Juniata River watershed is useful at this point (see below for exemplars). The instructor can then follow the Susquehanna River to the Chesapeake Bay, showing the students how far away we are located from the Bay, how many other rivers and streams connect to the bay, and also that we are indeed connected to the bay by means of this watershed address. A map showing the major river systems in the Chesapeake Bay besides the Susquehanna River can also be used to show the large watershed of the Bay (see below for exemplars).

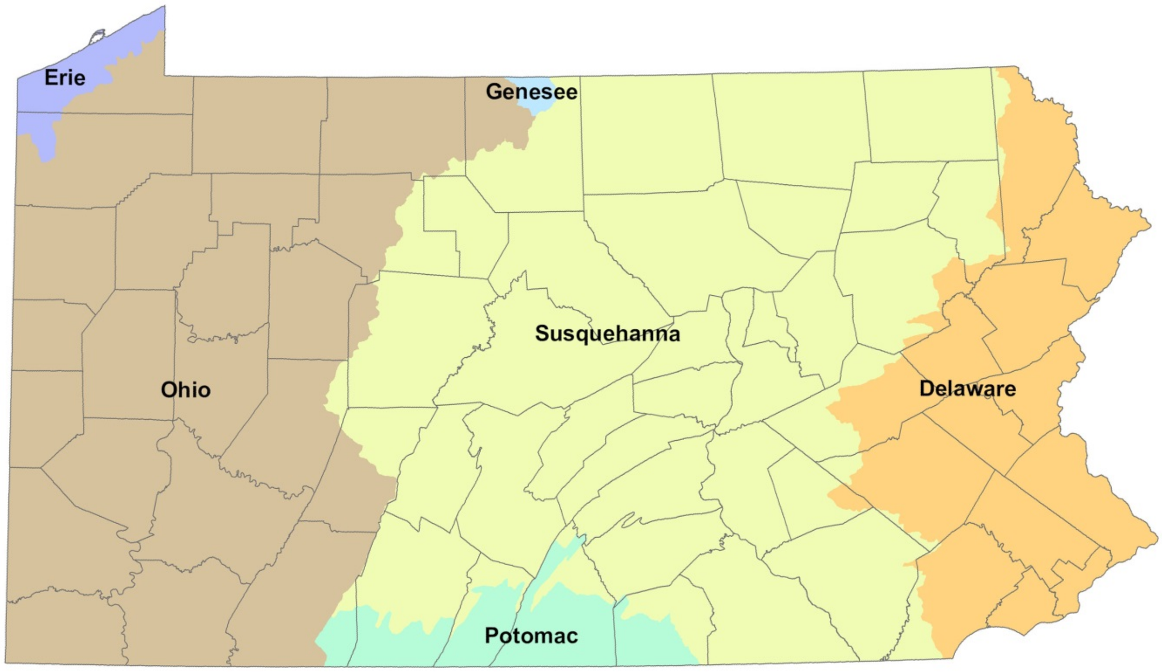
Then, each student should draw their own watershed address, starting with the smallest named stream to their house, connecting with a medium sized stream such as Standing Stone Creek or Crooked Creek, and ending with the Juniata and Susquehanna Rivers and the Chesapeake Bay.

When viewing the watersheds at the level of the Susquehanna River and Chesapeake Bay, the instructor can also introduce the six major watersheds of Pennsylvania and identify which of those drain to the Chesapeake Bay (and where the others ultimately drain).

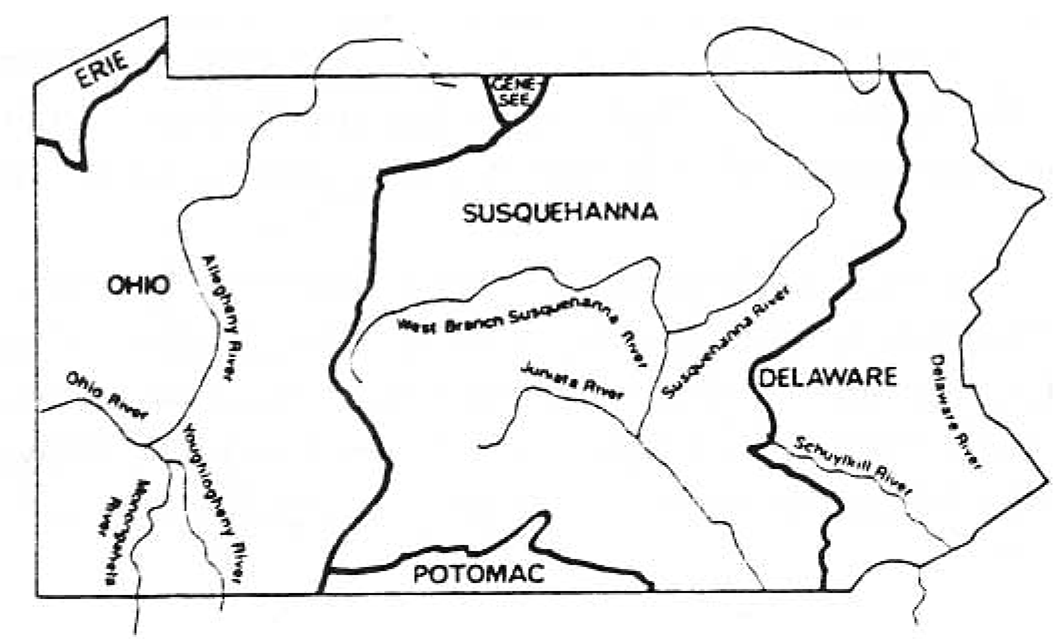
Post-visit: Students should create a colorful and creative watershed address to take home and share with their parents.

Outcome: Students (and their parents!) will realize how we are connected to a place as far away as the Chesapeake Bay and how pollution created here in our small streams (and small streams across the entire Bay watershed) can travel and impact downstream waters.

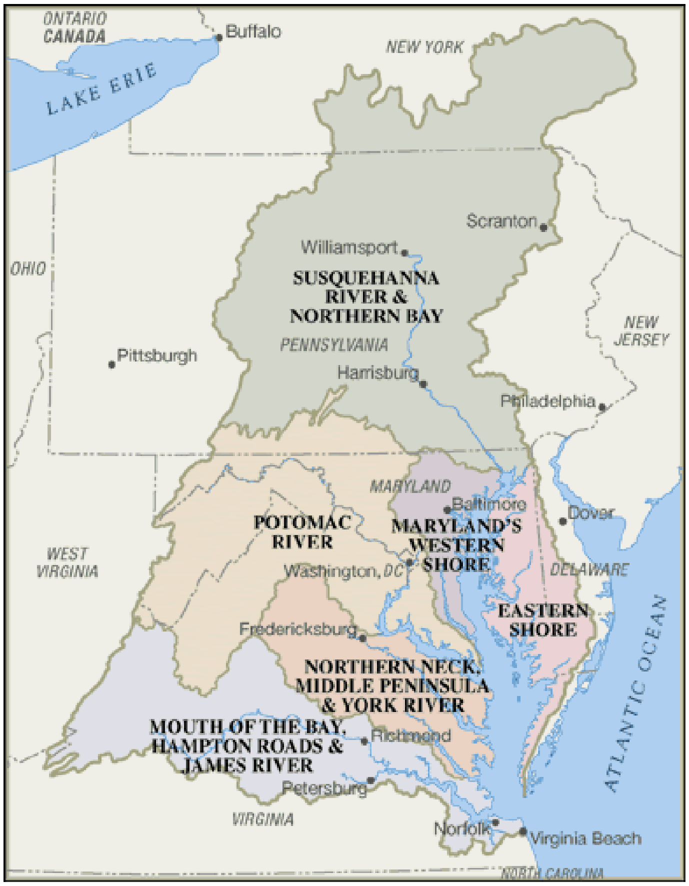
Resources Needed: A computer and projector, paper maps (optional). The following watershed views are provided as useful illustrations to the watershed levels explored in this lesson. These or others (found easily online) are encouraged for use along with an online map showing the students' locations and tracing the rivers downstream to the Bay.



The Six Major Watersheds of Pennsylvania (shown with counties)



The Six Major Watersheds of Pennsylvania (shown with major rivers)



The Major River Systems of the Chesapeake Bay

The Juniata River Watershed

Lesson Plan #2: Enviroscape Watershed Model

Essential Question: How does the health of Standing Stone Creek impact our community?

Secondary Question: What is a watershed? How does land use in a watershed impact a stream or waterbody?

Context: Students will explore a model watershed with various land uses represented to demonstrate sources of pollution along with potential solutions to environmental problems. Watershed concepts to be explored include how water flows over land, land and water connections, and learning how small streams can impact a larger water body, demonstrating why we care about Chesapeake Bay. The model will demonstrate how water can become polluted and also how water sources can be protected.

Standards: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- 4.2.4.A. Describe the physical characteristics of a watershed.
    - Identify and explain what determines the boundaries of a watershed.
    - Identify water systems and their components as either lotic or lentic.
- 4.2.6.C: Identify natural and human-made factors that affect water quality.
- 4.2.8.A: Describe factors that affect the quality of ground and surface waters.
- 4.4.7.A. Describe how agricultural practices, the environment, and the availability of natural resources are related.
- 4.4.4.D. Identify how technology affects the development of civilizations through agricultural production.
- 4.5.3.C. Identify different types of pollution and their sources.
- 4.5.4.C. Describe how human activities affect the environment.
- 4.5.5.C. Explain the difference between point and non-point source pollution.

Lesson:

Pre-visit: This activity serves well as an introduction to watersheds, so there is no lesson that is required or necessarily recommended prior to this activity. It is useful to have done the watershed address activity so that students are connected personally to the concept of watershed and their location in it.

On-Site: In the classroom, students will learn about watersheds using an Enviroscape watershed model. The model depicts various land uses, contains several streams and a lake, and incorporates food coloring to show the flow of water and pollutants in a watershed.

The activity is designed to be inquiry-based, where students are first asked what natural elements are found in the watershed (i.e. the forests, rivers, a lake, fish and wildlife). As a student names one of these elements, they can place the object on the model. Next, the students are asked what human elements are found in the watershed (i.e. homes, roads, farms, and an industrial site). Again, as a student answers a question, they get to place that element on the model. Students are then asked what types of pollution could come from each of those sources, and the students who answer get to place dye on the model accordingly. Next, the station leader or instruction informs the group that Pennsylvania's climate averages about 40" of rain each year, so each student gets a turn spraying the model to simulate rain. As it rains on the model, students are asked to observe the movement of the water over land, water mixing with the pollution they added to the model, and observing plumes in the lake. The students can also be asked to note which tributaries make the biggest contributions of pollution to the lake. The impacts to the natural elements present on the model before the human elements are considered, as well as the impacts to the human elements (i.e. how does this impact the fish in the lake? The nearby fishermen?). Other questions are posed, such as "is all pollution visible?" and "how can we do things differently?"

Since we all need to eat, a place to live, and we need and like products from factories like clothing and computers, the human elements cannot be simply removed from the watershed in order to stop the pollution to the land, streams, and lake. Conservation practices are suggested and placed on the model. Students often suggest moving the cows further from the stream, and can generally be led to suggest keeping the cows out of the stream. The instructor can present this student with a piece of stream bank fencing to place on the model. Additional practices like planting streamside buffers are sometimes suggested by the instructor (depending on the background knowledge of the students in the group). Sponges of various sizes and types are used on the model to represent conservation practices including streamside buffers, rain gardens, and silt fences. Students also discuss the idea of using less of a pollutant (especially residential sources like pesticides and lawn fertilizer), and subsequently less of that dye is used on the model the second time around. After a second rain shower where students get another turn to spray the model, the students observe the impacts of the conservation practices, noting how producing less pollution in addition to implementing conservation has the biggest impact. Students also observe that some pollution can still enter the lake because conservation practices are not perfect, but that the environment is very much better off with them in place.

Post-visit: Immediately after the lesson, the instructor leads the students in an oral review of the types of pollution that can enter a watershed, their source, and what conservation practices can help reduce that type of pollution. The list can be compiled on the class white board or the student's individual unit/field notebooks. Each student should be able to name one type of pollution that enters a stream, where it comes from, and one way to reduce or prevent that pollution from entering the stream.

Outcome: Each student should be able to name one type of pollution that enters a stream, where it comes from, and one way to reduce or prevent that pollution from entering the stream.   For example, the student could list manure from a farm as a source of pollution and streambank fencing as one possible solution. This could be a great topic for some of the student posters.

Resources needed: The Enviroscape model is available for loan from the Huntingdon County Conservation District. It can be loaned out to teachers or brought to the school with a station leader to perform the activity.

The Enviroscape model includes multiple land uses, such as residential, industrial, and agricultural lands, to demonstrate watershed concepts and conservation measures.

Lesson Plan #3: Forested Riparian Buffers

<u>Essential Question:</u> How does the health of Standing Stone Creek impact our community?

Secondary Question: How does the riparian area around Standing Stone Creek impact the health of the creek?

<u>Context</u>: The students have been learning about watersheds – how land and water are connected. They will travel to Detwiler Park, where a forested riparian area along Stone Creek has been impacted by Emerald Ash Borer, to explore the benefits of the buffer along with the impacts of invasive species.

This lesson will demonstrate the connection between many stations in this unit. The students will learn that he benefits of a forested riparian buffer are many: cooler stream temperatures that lead to more dissolved oxygen for fish to breathe, less soil erosion into a stream, and a more beautiful streamside to visit. Detwiler Park is an example of a riparian forest that needs management help, and the more riparian forests along the stream the healthier the stream ecology will be.

<u>Standards</u>: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- 4.2.6.C: Identify natural and human-made factors that affect water quality.
- 4.2.7.C: Use appropriate tools and techniques to analyze a freshwater environment.
- 4.2.8.A: Describe factors that affect the quality of ground and surface waters.
- 4.1.4.E: Explain that ecosystems change overtime due to natural and/ or human influences.
- 4.5.8.A: Explain how Best Management Practices (BMP)can be used to mitigate environmental problems.
- 4.5.4.B: Determine the circumstances that cause humans to identify an organism as a pest.

<u>Lesson</u>:

Pre-visit: Students should be introduced to the term riparian, the land alongside a stream or waterbody. Student should have completed the Enviroscape lesson to learn how land use impacts the water quality and health of the stream.

On-site: The students will engage in a guided walk along the riparian trail, noting several things during the walk. First, several jars of stream water will be present along the trail. Part of the walk is a scavenger hunt to find these jars and record the water temperature, dissolved oxygen, and conditions under which they were found (i.e. was the jar in the shade or partial shade? Were there dead trees above this jar?). Next, students would observe the canopy cover along the trail – noting the number of dead trees. What caused the tree deaths? What species are they?

These observations would lead into a discussion of the conditions that led to cooler water in the jars, the connection between water temperatures and dissolved oxygen levels, and the canopy cover of the area. The cause of the dead trees would also be revealed - the Emerald Ash Borer, an invasive species that has caused widespread damage in PA forests. The station leader will discuss the implications of dead trees (loss of riparian forest, reduced shade, increased erosion, safety, aesthetics) and some possible solutions (treat infected trees, remove dead trees, replant, remove invasive shrubs, increase diversity).

Post-visit: Students will be encouraged to revisit the park in the future to view how the forest is changing as a result of the dying trees and new management plans.

Outcome: Students will fill out the attached handout for the scavenger hunt. A discussion of their findings, connections to their forestry study, and implications for aquatic life will conclude the station. Through this lesson, students will witness the relationship of water temperature and dissolved oxygen, learn how trees shading the stream and increase oxygen levels, and know that aquatic life depends on dissolved oxygen to live.

Setup/instructor's tip: Grab stream samples for the "sunny" or "partial sun" locations the day before to allow them to sufficiently warm up prior to the activity or set these jars in their sunny locations as early as possible on the day of the activity to let the sunny location do its work of demonstrating the difference in water temperatures.

RIPARIAN STATION SCAVENGER HUNT

Name:____ Date: _______________________

Stream name: ______________________________________Location: _______________________

Instructions: Find the jars of stream water located along the trail. Test the water for temperature and dissolved oxygen levels. Fill in the chart to document your findings and discuss as a group at the end of the station.

Jar #	Site Conditions (Please list one: Shade, Partial Shade, Sun, Partial Sun)	Temperature (°F)	Dissolved Oxygen (mg/L)	Notes (Are the nearby trees dead or alive?)
1				
2				
3				
4				
5				
6				
7				

Questions for discussion:

Which site conditions led to cooler water temperatures?

What is the relationship between water temperature and dissolved oxygen?

What do these findings mean for the stream at this location? Why is dissolved oxygen important?

What is the canopy cover here at the park? How does it compare with other sites?

What is the impact of the Emerald Ash Borer at this site?

How can planting seedlings and live stakes improve the environment at this park?

Lesson Plan #4: Water Quality

***Essential Question**: How does the health of Standing Stone Creek impact our community?*

Secondary Question: What is the water quality in Standing Stone Creek?

Context: Students will learn how to conduct chemical tests relating to the water quality of Stone Creek and practice those methods in the classroom and in the field. The students will learn what each of the parameters reveal about the water in Stone Creek. In this activity, students will learn how land use can impact the water quality results and how the water quality results are related to the macroinvertebrate and physical assessment scores.

Standards: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- 4.2.5.C. Identify physical, chemical, and biological factors that affect water quality.
- **4.2.6.C:** Identify natural and human-made factors that affect water quality.
- 4.2.7.C: Use appropriate tools and techniques to analyze a freshwater environment.
- **4.2.8.A:** Describe factors that affect the quality of ground and surface waters.

Lesson:

Pre-visit: Teachers may have students practice one or more of the water quality tests kits prior to going to the stream. Familiarity with some of the kits or general procedures greatly aids the lessons in the field. Students should have also completed the Enviroscape model to learn about watersheds and land use impacts to water quality.

On-site: The students will start by first observing the stream to see if any qualitative conclusions can be made about water quality by noting any odors or colors detected in the water and filling in their datasheets with their observations. The station leader will then introduce each of the test kits to be used during the stream study to obtain quantitative data and demonstrate how to use each. The instructions for each particular kit should be brought to the field for reference (especially since different name brands of kits will vary). Students will work in small groups to complete each of the following tests:

Dissolved oxygen: Students will complete this test, and teachers should be advised that the kits for this test can take up to a half hour (including the time to get in the stream to collect the sample and run the entire test). The station leader will discuss with the group what dissolved oxygen is, why it is important for aquatic life like macroinvertebrates and fish, how the physical habitat can contribute dissolved oxygen to the stream, and how pollutants (such as nitrates and phosphates) can contribute to lower dissolved oxygen levels in the stream).

pH: Students may use a meter is used for this test. Students should turn on this meter, place it in the stream or in a collection jar containing stream water, and wait for the reading to stabilize.

Students may also use a test strip for measuring pH. The instructions on the package should be followed and the test result matched to a color bar to determine the pH of the stream. The station leader should review the pH scale and discuss how low readings indicate acidity in the stream, potentially due to the natural geology or acidified rain. High readings can indicate limestone geology. Normal stream pH levels are between 6.5 and 8.5.

Temperature: Students will use a meter is used for this test. Students should turn on this meter, place it in the stream or in a collection jar containing stream water, and wait for the reading to stabilize. The station leader should discuss how the physical assessment results relate to the temperature of the stream. Cooler stream temperatures are needed for certain species of fish (usually trout) and also contain higher dissolved oxygen levels. Higher stream temperatures indicate a lack of shading along the stream, and warmer water is able to retain lower amounts of dissolved oxygen.

Nitrate: Students will use a kit or a test strip for measuring this parameter. The instructions should be followed and results obtained. The station leader will discuss how nitrates get into streams and waterways, which land use activities can contribute nitrates, and how nitrates are a nutrient that increases algal blooms in water (and increase plant growth on land). The nitrates are a resource on land and can be a pollutant in water. If excessive algal blooms occur in water, the bacteria that feed on the decaying algal blooms use up a lot of the dissolved oxygen that is needed for other aquatic life, such as macros and fish. This disruption of the stream ecology can lead to fewer of the macroinvertebrates that indicate good water quality and also fewer fish that feed on the macroinvertebrates.

Total Hardness: Students will use a kit for this test that measures the mineral content of the water. The station leader will discuss how the geology of the area will impact the stream water's total hardness, or the measure of certain ions. Hardness does not impact human health, but can cause corrosion or limescale buildup in certain uses of water. Drinking water is often treated for hardness, including at the water treatment plant just a mile downstream from the sampling location which supplies the entire community with drinking water.

Post-visit: Students should complete their water quality worksheets with the test results obtained during the field visit. If a student group is unable to complete all of the tests, students may share results with each other within a few days of the trip so that each student has a complete set of data for their field journals. Also, the worksheet has space for up to three test results for each parameter so that groups may combine their data and an average reading used as the final result. This will demonstrate the variability that can exist in the testing parameters and that obtaining more than one result will improve the accuracy of the tests (and also help to rule out a potential test that went awry during the field day). The results may be submitted to a Penn State University citizen science program (their water quality data sheet is used for this reason).

<u>Outcome</u>: Students will gain a picture of the water quality of Stone Creek, how to perform various water quality tests, and also the meanings of the results that they found. The water quality, physical habitat assessment, and macroinvertebrate collection will together provide a story of the stream and how these three factors combine to create a healthy stream ecosystem for larger aquatic life, like fish, to survive and thrive in the stream.

Resources needed: DO kit, pH meter or strips, thermometers, nitrate kit or strips, total hardness kit, rain boots or waders (depending on stream levels). Waders may be loaned from the Science in Motion program.

Watershed Education
Chemical Data Sheet

Grade:

Group:

Phone #:

Contact Person:

Basin: Watershed: Stream:

Location:

Date: Time: # of Participants:

Weather:

ODOR

Place an "x" next to the odor you detect:

_______ chemical	_______ chlorine	_______ oily / gasoline
_______ medicinal	_______ rotten eggs	_______ fishy
_____ septic / sewage	_______ other: _____________	

COLOR

Describe the water's color and its intensity:

Color:

clear	gray	milky	brown
black	blue	green	red
rust	straw	yellow	cloudy
clear w/ particles	tan	muddy	other

Intensity:

slight moderate very

Color: _______________________________

example: slightly green, moderately green

2.30

Chemical Tests:

* Parts per million, (ppm) is synonymous with milligrams per liter, (mg/l)

Test	1st result	2nd result	3rd result if needed
Dissolved Oxygen:	__________ ppm	__________ ppm	__________ ppm
pH:	__________	__________	__________
Turbidity:	__________ jtu's	__________ jtu's	__________ jtu's
Nitrate:	__________ ppm	__________ ppm	__________ ppm
Total Hardness:	__________ ppm	__________ ppm	__________ ppm
Alkalinity:	__________ ppm	__________ ppm	__________ ppm
Iron:	__________ ppm	__________ ppm	__________ ppm

If you choose to perform additional tests, please list results below.

Comments:

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Lesson Plan #5: Macroinvertebrates

<u>Essential Question:</u> How does the health of Standing Stone Creek impact our community?

<u>Secondary Question</u>: What do the things that live in the river tell us about the health of the river?

<u>Context</u>: In this unit, students are learning how to determine the health of the stream and macroinvertebrates are one measure of stream health. The macro invertebrate community that is present in a stream relates to the water quality and the physical habitat quality. It is important that the stream at Detwiler Park is healthy because it is located in a prominent community park and is also less than one mile from the water intake and water treatment plant for the entire Huntingdon community.

<u>Standards</u>: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- 4.2.6.C: Identify natural and human-made factors that affect water quality.
- 4.2.7.C: Use appropriate tools and techniques to analyze a freshwater environment.
- 4.2.8.A: Describe factors that affect the quality of ground and surface waters.
- 4.1.4.E: Explain that ecosystems change overtime due to natural and/ or human influences.
- 4.2.4.C. Explain how freshwater organisms are adapted to their environment
    - Explain the life cycles of organisms in a freshwater environment
- 4.2.8.C. Describe how a diversity index is used to assess water quality.

<u>Lesson</u>:

Pre-visit: Teachers should utilize the LaMotte Macro Mania game as an introduction to macroinvertebrates (it is available on loan from the Conservation District). In the game, flash cards of macros are used in a simulation of sampling macroinvertebrates from different land use areas. Student teams are given a deck of macroinvertebrate flash cards representing a sample of macroinvertebrates from one of three sites – one with a forested watershed, one with an agricultural watershed, and one with an urban watershed. Students sort and identify the macros in their set and practice using the water quality assessment that they will be using in the field to determine water quality. Students will identify which land use their sampled site likely represented based on their findings on the water quality assessment.

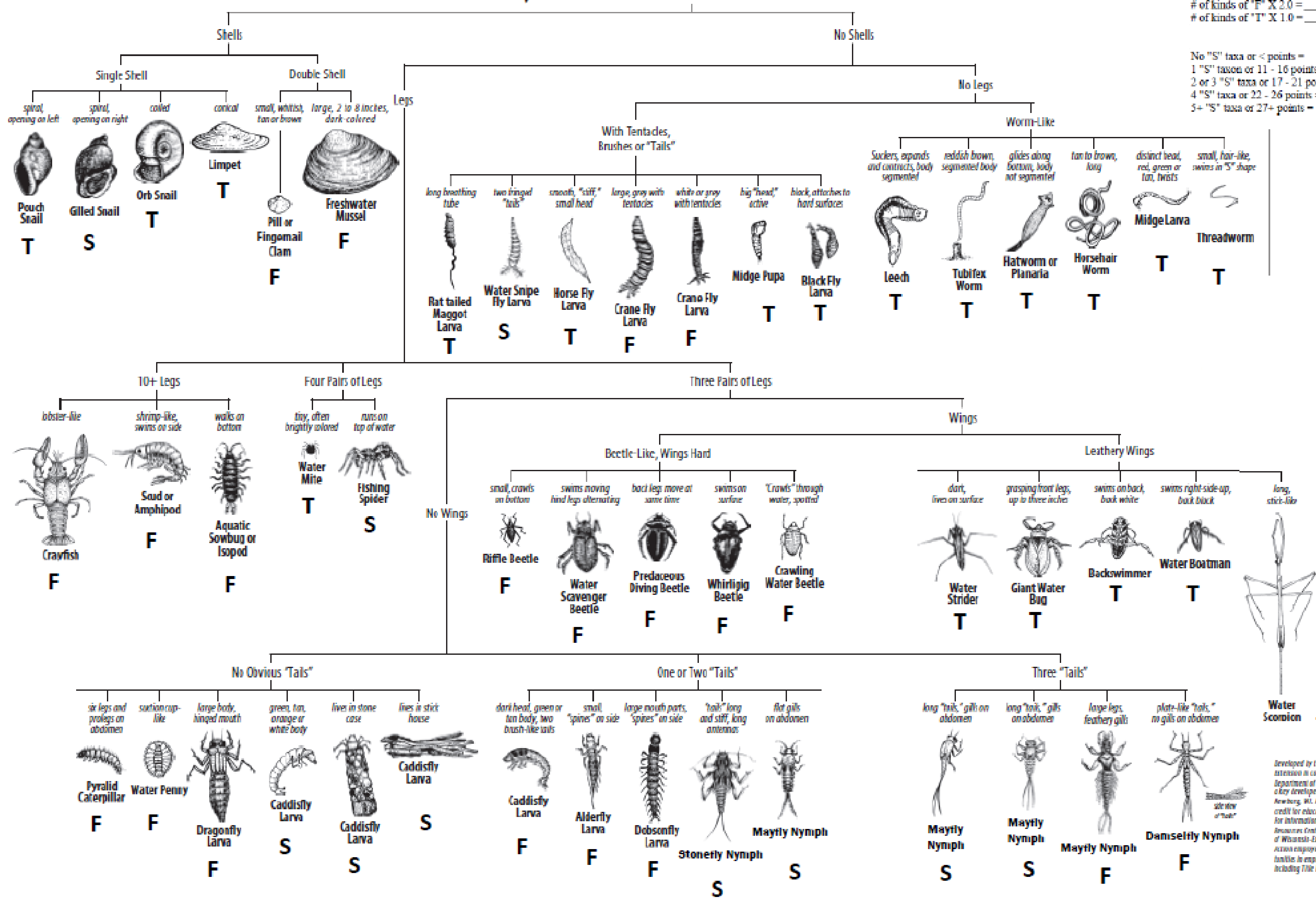
On-site: At the stream, students will be given hip waders and instructions on their proper use before entering the stream. The instructor will demonstrate how to sample macroinvertebrates by carefully placing the net on the stream bottom and digging in the heels of their boots to disturb the rocks upstream, allowing dirt and macroinvertebrates to wash downstream and into the net. Next, groups of students will be allowed to do the same, returning to land to inspect what they've collected. Each group will collect the macros they find in their own net and place them in sorting trays in order to be identified. Instructions on how to use the identification key will be given and students will be allowed to identify their own macros. Students will be asked to confirm their identifications before moving on to another specimen and the instructor will either confirm that it is correct (and why) or suggest looking back at the key or specimen for something they have missed. Students will fill out a water quality assessment as a group for the macros they found, assigning a number to the water quality based on the type and diversity of macroinvertebrates found.   Macros from the sensitive group are unable to survive in polluted waters, while macros in the tolerant group will live almost anywhere.   A higher score will result from more types of macros found in the sensitive and fair groups than if macros from only the tolerant group were found. The instructor will discuss how these scores can be compared to scores from previous years' field studies, other groups within the same day, and even other streams.

Post- visit: An optional assessment for this lesson includes a student made poster or a thank-you card for the helpers on their field experience. Teachers can encourage students to sketch a macro of their choice on the cover of the card and review the cards before sending them to the people who helped with their classes. Again, an example of mastery of the station would include a student sketching in sufficient detail so that the macroinvertebrate could be identified by their sketch. An elongated insect body with six legs and two tails would suffice for a stonefly.

Outcome: In an oral review of the on-site station, the students will be asked to demonstrate to the station leader that they can successfully navigate the key to identify a macro of their choice. If they select the wrong identification but use the key correctly and are then able to find the correct identification, they are still deemed proficient at using the tool. Mastery of the station is measured by students being able to correctly identify a given macro, defend their identification, and state it's relation to water quality. For example, a student correctly identifies a stonefly, defends their identification by stating it has six legs and two tails, and that it's a sensitive organism, so its presence indicates good or excellent water quality in the stream.

Resources needed: Kick net or D-net, waders (at least 4 pairs), trays for sorting (ice cube trays work well), plastic spoons and/or forceps, Key to Life in the River identification key (large format, laminated versions available from HCCD), Stream Water Quality Worksheet.

Key to Macroinvertebrate Life in the River



Presence / Absence rating base on 1 M² sampled

# of kinds of "S" X 3.0 = ____________
# of kinds of "F" X 2.0 = ____________
# of kinds of "T" X 1.0 = ____________
____________ Total

No "S" taxa or < points =	Poor
1 "S" taxon or 11 - 16 points =	Fair
2 or 3 "S" taxa or 17 - 21 points =	Good
4 "S" taxa or 22 - 26 points =	V. Good
5+ "S" taxa or 27+ points =	Excellent

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Stream Water Quality Worksheet

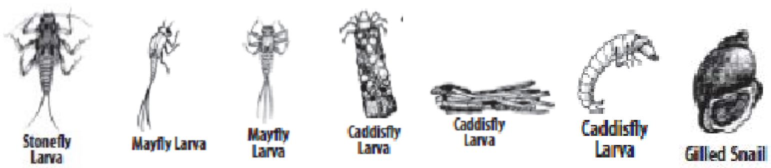
Name: ____ Date: ______________________________

Stream name: ___________________________________Weather over past day: ________________

Instructions:

1. Place a check next to each macroinvertebrate that you find in the stream.
2. If you find something that is not pictured, draw it in the group that it belongs to.
3. Total the number of checkmarks for each group and multiply as directed.
4. Add the three columns to the far right to reach the final stream score.
5. Compare the score with the stream rating results listed below.

Group 1: Sensitive



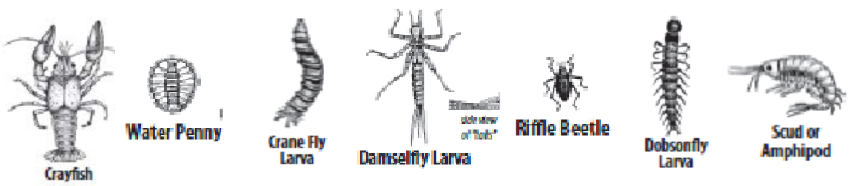
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ X 3 = ☐

Number of boxes checked

\+

Group 2: Fair



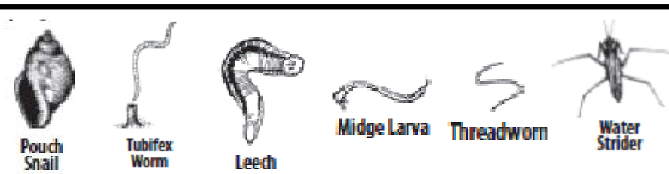
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ X 2 = ☐

Number of boxes checked

\+

Group 3: Tolerant



☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ X 1 = ☐

Number of boxes checked

Stream Score Result: ☐

Stream Rating: (circle one)

Greater than 22 "**Excellent**"	17-21 "**Good**"
11-16 "**Fair**"	Less than 11 "**Poor**"

Lesson Plan #6: Fish Printing

***Essential Question**: How does the health of Standing Stone Creek impact our community?*

Secondary Question: How are fish connected to the health of Stone Creek and our community? Where in our region do different fish live?

Context: The fish that live in Stone Creek and other local waterways tell an important story for our community – the quality of the water here, and the attraction of tourists to our area. The fish have different habitat and food requirements that are related to the human impacts on our streams.

Standards: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- **4.2.6.C:** Identify natural and human-made factors that affect water quality.
- 4.2.7.C: Use appropriate tools and techniques to analyze a freshwater environment.
- **4.2.8.A:** Describe factors that affect the quality of ground and surface waters.

Lesson:

Pre-visit: Teachers may have students do the Enviroscape and macroinvertebrates lessons prior to this activity.

On-site: The station leader will show the students 6 different fish models, asking the students to try to identify them, and confirming the correct identification for each fish. The station leader will discuss a few unique attributes and a local location to find each particular fish (i.e. name of a local creek, river, or lake). Students will learn about the coloration and camouflage adaptations of the fish in general during the lesson, and also study more specifically the fish they have chosen to print by studying the illustrations from the PA Fish and Boat Commission's "Pennsylvania Fishes" book. Using these lifelike, colored illustrations and models that were cast from real fish, the students will explore the colorations of the fish species they choose and recreate them on the fish models with the paints and brushes provided. A cloth is stamped on the model to record each student's print that they may then take home to share with parents. Students will record the fish species along with their own names on the prints using a marker.

Post-visit: Students may undertake their own research to find out a few facts about their fish, such as food or habitat preference, and write them on the print with the fish (or find a creative way to attach or display the information with the artwork).

Teachers can display all or select fish print projects in their school. A gallery walk of the display is encouraged so students can present their fish project to their peers. Students will then have the opportunity to learn about other fish species than the one they chose to research.

Outcome: Students will come to understand that Pennsylvania's fish resources are part of our ecosystem, economy, and recreational opportunities in the state and especially locally and that these fish resources are connected to clean water and environmental conservation efforts in our area.

Resources needed: Fish models, washable paint, fabric, paint brushes, paint trays, and illustrations from the PA Fish and Boat Commission's "Pennsylvania Fishes" book. Fish models are available from the Huntingdon County Conservation District. They can be loaned out to teachers or brought to the school with a station leader to perform the activity.

Suggested Learning Topics for students: (Teacher Use)

- Learn about some of the fish that live in Pennsylvania (freshwater)
  - What is their habitat preference? Lentic or lotic? Cool or warm water?
  - What are some of their different food preferences?
  - Where do these fish live within in Huntingdon county? Which of these waterways are closest to where you live?
- Fish adaptations and coloration
  - Adipose fin (ventricular structure)
  - Lateral line – sensory organ
  - Light belly, dark top – general camouflage
  - Stripes/spots/ markings as additional camouflage
- Fish in the environment
  - Indicators (brook trout)
  - Native/stocked/introduced/wild
  - Human dependence/uses of fish (food, recreation, tourism)

Fish Details:

Blue Gill

- Blue markings on gill, flattened shape
- Habitat: lakes, slow parts of warmwater rivers
  - Sunny coves of Raystown Lake, slow parts of the Juniata River
- Food: generalized feeders (macros, crustaceans, minnows, plants)
- Related to: Largemouth bass, rock bass, crappie, pumpkinseed
  - Sunfish family: Centrarchidae, aka panfish

Yellow Perch

- Stripes for camouflage
- Habitat: cool lakes, sluggish streams, shallow water (<30 feet)
  - Shady coves of Raystown Lake
- Food: zooplankton/small macros as young; small fish as adults (also serve as food for other fish)
- Related to: darters, walleye
  - Percidae family (elongated fish, 2 dorsal fins separate or narrowly connected)

Largemouth Bass

- Largest member of sunfish family
- Habitat: Warm water lakes and larger rivers
  - Raystown Lake and Juniata River

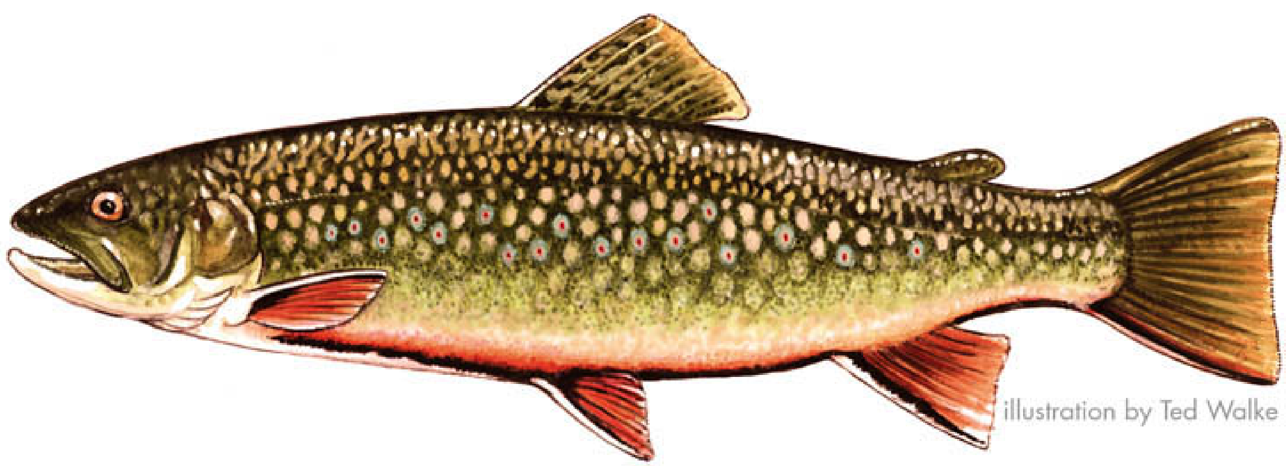
    - Raystown Lake is one of PA's prime areas for Largemouth Bass
- Food:
- Related to: Bluegill and sunfish family

Brook Trout

- Pennsylvania State Fish, adipose fin, Native species, indicator species
- Habitat: small, cool, clean streams
    - Locations: Spruce Creek, Stone Creek, and possibly Shaver's Creek in Huntingdon County
- Food: macros, terrestrial insects, crustaceans, small fish
- Related to: Trout and salmon family (it's a very large family)

Walleye

- Luminous eye adaption for feeding at night
- Sharp teeth (predator), large size (up to 3')
- Habitat: large lakes, big rivers/streams (lentic and lotic systems)
    - Raystown Lake, maybe the Juniata River further downstream than Huntingdon
- Food: other fish (top predator), frogs, crayfish, large insect larvae
- Related to: perch (walleye is the largest and toothiest member of the family)



Brook Trout Illustration available from the PA Fish and Boat Commission's "Pennsylvania Fishes" book

Lesson Plan #7: Physical Habitat Assessment

Essential Question: **How does the health of Standing Stone Creek impact our community?**

Secondary Question: **How much water is in Stone Creek? What are the rocks like along the stream bottom?**

Context: In this unit, students are learning how to determine the health of Stone Creek and about the role this stream (and the environment of our region) plays in their community. In this lesson, the students will visualize the stream as a home for the macroinvertebrates and fish that they have been studying in this unit. By looking at the physical makeup of the stream, this station will demonstrate how the concepts of sedimentation and erosion learned in the Enviroscape lesson impact the macro invertebrates they have learned about. Specifically, this station will assess how much sedimentation has occurred in the stream and correlate to the health of the macro invertebrates found here. Other factors the students will observe in the assessment completed will relate to fish habitat. This assessment will also look qualitatively at the amount of water, with the instructor noting its importance as a water supply for the Huntingdon area.

Standards: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- 4.2.6.C: Identify natural and human-made factors that affect water quality.
- 4.2.7.C: Use appropriate tools and techniques to analyze a freshwater environment.
- 4.2.8.A: Describe factors that affect the quality of ground and surface waters.
- 4.1.4.E: Explain that ecosystems change overtime due to natural and/ or human influences.
- 4.5.8.A: Explain how Best Management Practices (BMP)can be used to mitigate environmental problems.

Lesson:

Pre-visit: Students should complete the macro-mania game to introduce students to the concept of macro invertebrates, land use, and stream health and how they interrelate. Also, students should have already completed the Enviroscape lesson to learn how land use impacts stream health.

On-site: Students will assess the physical makeup of the stream by categorizing the particle sizes on the stream bottom, looking for erosion on the stream banks, and observing the flow in the stream. An assessment of the stream habitat will be completed by the students:

Streambed composition: Students will enter the stream to look at the bottom of the stream to rate how diverse the rock and particle sizes are. The station leader will demonstrate the difference between silt, sand, gravel, pebble, cobble, (large cobble), and boulder with examples brought in or found on site. Upon review of this parameter, the leader will point out how a mix of cobbles and gravels allow more space between themselves which is where many macroinvertebrates live.

Streambank Stability: Students will turn their attention to the stream banks to look for areas of erosion and note the amount observed on their assessment. Widespread erosion will degrade the streambed habitat, resulting in more sand and silt than cobbles and gravels present over time.

Depth and Velocity: Students will observe the stream for pools and riffles, noting the presence and approximate depth of pools and the relative speed of the riffles. The station leader will note that areas of high velocity create higher dissolved oxygen and ask students what they predict (or have already found from the water quality station) the dissolved oxygen results will be for the stream. This is also a qualitative look at the amount of water in the stream, which is important for both aquatic life and for the community water supply.

Streambed cover: Students will look for places that fish can hide from predators and/or fast currents. The students will look for rock ledges, submerged logs and roots, and large rocks that can provide these hiding places. These habitats also help support reproduction.

Riparian Vegetation: Students will observe the types of vegetation growing in the riparian area of the stream. The station leader will lead a discussion of the importance of diversity in plant types along the stream. For example, the leader may pose questions such as: How long are the roots of grasses and how much soil can they hold? How long are the roots of trees and how much soil can they hold? What happens if there are no shrubs or grasses in the large spaces between mature trees?

Riparian Vegetation Zone Width: The students will measure or estimate the width of the vegetated area beside the stream. Estimates can be given by using a number of paces or comparisons to familiar lengths (i.e. the length of a person compared to the length of a basketball court). The importance of width of the riparian zone can be related back to their Enviroscape lesson (How well did those sponges hold back pollution? Would a larger sponge hold more?).

Post-visit: Students will complete their habitat assessments and generate a total score. Upon review of their physical habitat assessment results, the context of fish and macros will be used when discussing each parameter assessed in this station. For example, the station leader may pose some review questions in order to evaluate the students' understanding. Why are diverse rock and particle sizes important for a good habitat score? How does the habitat score relate to the riparian area? to the macro score? How is the streamed score impacted by erosion along the stream bank? Also, how can land use upstream in the watershed cause a poor result for streambed composition?

Outcome: Students will be able to quantify the habitat quality of the stream during their field trip and relate it to the other parameters measured. The concept of a high quality habitat relating to health riparian areas, land use within the watershed, and a health macro invertebrate population will be discussed. By filling out an assessment of the habitat, the students will be able to quantify what makes a good habitat for aquatic life and also learn about the factors that contribute to poor habitat and result in poor health for aquatic life.

Resources needed: Intermediate Stream Habitat Assessment worksheet, waders or rain boots (depending on stream level).

Intermediate Stream Habitat Assessment — Tier 2

(Adapted from Vermont Project WET)

Name:	Date:
Stream or River:	Town:

Streambed Composition. Large sediment types (cobbles and gravels) support a wider variety of organisms than smaller sediment types (sands and silts).

Check one of the following and write its points in the shaded column.	Point Values	Points Given
❐ mixture of cobbles, gravels, and sand	3	
❐ mixture of gravel and sand	2	
❐ mostly sand and silt	1	
❐ mostly silt	0	

Streambank Stability. Stream banks that are actively eroding generally have degraded habitats when compared to stable streams.

Check one of the following and write its points in the shaded column.	Point Values	Points Given
❐ banks appear stable (no signs of erosion)	2	
❐ moderately stable banks (some areas of erosion visible)	1	
❐ unstable banks (lots of erosion present)	0	

Depth and Velocity. High dissolved oxygen (DO) levels support a healthy, diverse aquatic community. Shallow streams have warmer water, which results in lower DO levels. Fast streams mix air into the water, which results in higher DO levels.

*Check one of the following **for each category** (Deepest Pool and Flow Types) and write its points in the shaded column.*	Point Values	Points Given
Deepest Pool is at least:		
❐ chest deep	3	
❐ waist deep	2	
❐ knee deep	1	
❐ ankle deep	0	
Velocity		
❐ very fast (hard to stand)	3	
❐ fast (quickly takes objects downstream)	2	
❐ moderately fast (slowly takes objects downstream)	1	
❐ slow (hardly any flow)	0	

Subtotal for Page 1	

Streambed Cover. A wide variety and/or abundance of submerged structures in the stream supports good aquatic habitat.		
Check ***as many as you see*** *and write a point for each checked item in the shaded column. Example: If you check all items, give 5 total points.*	**Point Values**	**Points Given**
❐ rock ledges	1	
❐ submerged logs, stumps, or tree roots	1	
❐ large rocks	1	
❐ artificial objects	1	
❐ other ______________________________	1	

Riparian Vegetation. The root systems of plants growing along streambanks help hold soil in place and reduce the amount of erosion that is likely to occur.		
Check ***one*** *of the following and write its points in the shaded column.*	**Point Values**	**Points Given**
❐ mixture of trees, shrubs, and grasses	3	
❐ mixture of shrubs and grasses	2	
❐ mostly grasses	1	
❐ no vegetation	0	

Riparian Vegetative Zone Width. A vegetative zone serves as a buffer to pollutants entering the stream from runoff and helps to control erosion.		
Check ***one*** *of the following and write its points in the shaded column.*	**Point Values**	**Points Given**
❐ buffer zone is greater than 100 feet	3	
❐ buffer zone is between 50 and 100 feet	2	
❐ buffer zone is between 25 and 50 feet	1	
❐ no buffer zone	0	

Subtotal for Page 2	

Total Score: Subtotal for Page 1 ________ + Subtotal for Page 2 _________ =	

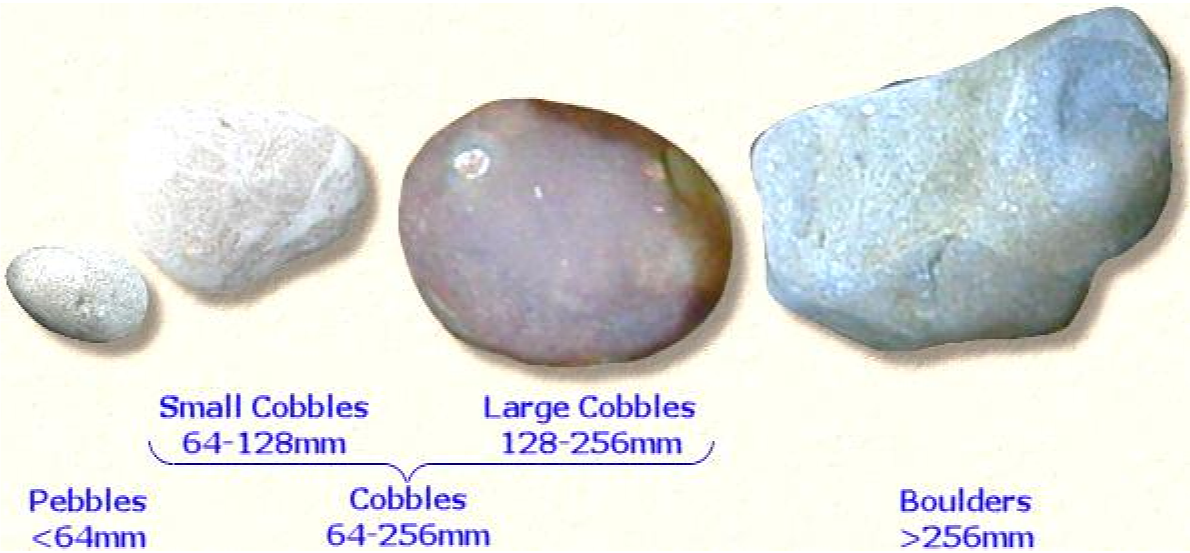
Stream Habitat Assessment Rating. Check the rating that applies to your total score.			
❐ Excellent	22 to 18 total points	❐ Fair	10 to 6 total points
❐ Good	17 to 11 total points	❐ Poor	5 to 0 total points

Gravel

Sand

Silt

Clay



Small Cobbles
64-128mm
Large Cobbles
128-256mm
Pebbles
<64mm
Cobbles
64-256mm
Boulders
>256mm

Lesson Plan #8: Local Outdoor Recreation and FUN!

***Essential Question**: How does the health of Standing Stone Creek impact our community?*

Secondary Question: What opportunities are there for outdoor fun in the Stone Creek watershed?

Context: In this unit, students are learning about the health of Stone Creek, how to determine how the stream is doing, and what sources of pollution pose threats to the health of the stream. This lesson looks at why these things matter to the community and to those who use the river and the watershed for fun. By looking at some of the recreational opportunities available in our area, the students will have the opportunity to connect with the stream on a different level. Helping the students to connect with and love the natural resources in their community can help with motivation in learning about the academic portions of this unit. Outside of school, they can enjoy the river, park, or state forest for personal use. Further, in this lesson, the students will gain an appreciation for what these natural resources can do for our community. Is this town, often seen by residents as "boring," "sleepy," "hillbilly," or "backwards," offering more than can be seen? What kind of energy are the new bike trail system, clean water for fishing and kayaking, and/or the emerging activities like geocaching and stand up paddleboarding bringing to our community?

Standards: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- **4.2.6.C:** Identify natural and human-made factors that affect water quality.
- 4.1.4.E: Explain that ecosystems change overtime due to natural and/ or human influences.

Lesson:

Pre-visit: Students will fill out the predictions section of the Fun in Huntingdon handout to establish what they already know about local outdoor recreation and set the stage for learning more.

On-site: A guest speaker who is active in the community and local outdoor recreation will lead a discussion and demonstration with the students about the opportunities present in our community. The importance of conserving our natural resources so that these opportunities continue to exist will be emphasized. Demonstrations of mountain bikes, kayaks, nature journaling, and/or geocaching will be offered. A display table of local maps to state parks and recreational trails will be included. The site of the field experience is Detwiler Field – a public park that contains a nature trail along Standing Stone Creek. Detwiler contains a geocache, interpretive tree identification area, a bicycle and walking track, and is a popular spot for fishermen. Stone Creek is seasonally available for kayaking, and nearby locations such as the Juniata River and Raystown Branch of the Juniata River are the most popular spots for kayaking, canoeing, and fishing nearby.

Post-visit: Students will complete the second half of the Fun in Huntingdon handout to show what they've learned from the field visit to a local park. The assessment can also be done orally.

Outcome: Students will write down two goals for exploring outdoor recreation: one that is free and one that might have some cost. By experiencing a sampling of outdoor recreation activities and learning about the local places to take part in these activities, students may pursue the goals they write down in this activity. A sampling of trail maps, water trail information, state park handouts, and other information will be available for students to take home and share with their families.

Resources needed: It is highly recommended that this station be led by a community leader who is active in local outdoor recreation efforts. Contact the Huntingdon County Conservation District for assistance.

Fun in Huntingdon

<u>Predictions: What does this town have to offer?</u>

Name 3 outdoor recreation activities for the Huntingdon Area: (possible answers given in red)

Hiking road biking mountain biking kayaking canoeing fishing hunting camping boating geocaching picnicking swimming backpacking birding running horseback riding orienteering photography writing

Name 2 local and 3 state parks in Huntingdon County.

Local – Detwiler Field, Portstown Park, Weis Park, Riverside Park, Blair Field, Peace Chapel, Flagpole Hill, Shaver's Creek, Camp Blue Diamond,

State – Whipple Dam, Greenwood Furnace, Penn Roosevelt, Trough Creek, Alan Seeger Natural Area, Bear Meadows Natural Area, Rothrock State Forest, Raystown Lake (federal)

Guess the number of people that visit Raystown Lake each year:

The Raystown Lake Recreation Area welcomes nearly 2 million visitors per year to the lake and the public land surrounding it for world-class fishing, hiking, hunting, mountain biking, boating, picnics and more (source: Raystown Visitors Bureau)

<u>After the recreation activity: What did you learn? What did you like?</u>

Name 3 more outdoor recreation activities (circle any that you didn't know about before today):

Can you name 3 local and 3 state parks now?

Set 1 goal for trying a FREE outdoor recreation activity (include an activity, a place, and any anyone you may take with you).

Make a wishlist of 1 outdoor recreation activity you would like to try that is not free (requires some equipment or an access fee). Include a place, activity, and equipment needed.

Lesson Plan #9: Best Management Practices (BMP's)

***Essential Question*: How does the health of Standing Stone Creek impact our community?**

Secondary Question: What are the tools that people can use to minimize the impact of human activities on our water resources?

Context: Human activities and watershed protection coexist in the same landscape. The land within a watershed has many uses, including agriculture, forest space, homes for people, and factories to create products for human use. Often, human activities within a watershed impact the streams that run through them. Conservation tools, called Best Management Practices or BMPs, allow humans to produce food and products, build shelters and roads most efficiently, while preserving the quality of our water resources.

Students have already explored land use, water quality, and how both impact aquatic life. They have learned how Stone Creek, their local stream, is important and connected to the well-being of their community. As the final lesson in their unit, this activity serves to pull together all of the facets they have learned about in order for them to make decisions about how to protect this resource. They know how it has been polluted, what impacts that has had on the fish and macros and their drinking water, but what can be done about it? More importantly, what is being done about it? This lesson serves as an important introduction to what conservation districts and other environmental agencies actually do in order to conserve our natural resources.

Standards: The following Pennsylvania Department of Education educational standards are met with this program. The standards may change depending on the grade level to which this program is tailored.

Environment and Ecology Standards being addressed:

- 4.1.7.B. Understand the role of a watershed.
- 4.1.10.A. Describe changes that occur from a streams' origin to its final outflow.
- 4.1.10.E. Identify and describe natural and human events on watersheds and wetlands.
- 4.1.12.E. Evaluate the trade-offs, costs and benefits of conserving watersheds and wetlands.
- 4.3.7.B. Describe how human actions affect the health of the environment.
    - Identify land use practices and their relation to environmental health.
    - Identify residential and industrial sources of pollution and their relation to environmental health.
    - Explain how non-point source pollution can affect the water supply.
- 4.8.7.B. Explain how people use natural resources.

Lesson:

Pre-visit: Students will learn about the types of impacts that human activities have on water and the types of pollution that each activity can create. Through the activity, they will know that

human development and conservation efforts come with a series of choices, trade-offs, and decisions to protect water quality while maintaining vital human activity. Specific types of Best Management Practices and their applications will be learned.
On-site: Students will work in small groups to complete the "Watershed Decisions" activity, a game where they become members of a watershed group that has formed in response to their local stream being designated as "impaired." The instructor will discuss what an impaired status means for a stream and encourage the students to name the stream they will be working on (a real or fictitious name, preferably their local stream). In the activity, each "watershed group" has received a grant to conduct water quality monitoring of the stream in question, investigate the possible sources of pollution, and implement two BMP's to improve water quality.

To begin the activity, students will fill each of the small plastic cups included in the game with water and note the secchi dish printed on the bottom. The secchi disks will be used as a means of visually comparing the water quality at various sites along the stream in question. Each cup corresponds to a sampling location and should be placed on the laminated stream map (see photo). Students should briefly observe the features of this pretend watershed and stream map, noting the different land uses shown along the stream, as well as the different branches of this stream coming together to make larger streams.

Next, students open the "water quality results" envelope and follow the instructions for adding food coloring and water to various cups to show the different water quality test results. Students should observe which sites appear to have the worst water quality based on their ability to view the secchi disk on the bottom of each cup. Students should make predictions about the causes of degraded water quality based on this visual evidence (worksheet attached).

After predictions are recorded, students can open the "investigation results" envelope to reveal how much pollution is actually coming from each site. Sites that appeared to have the worst water quality may not always be the contributing cause of most of the pollution, but rather are a result of being located further downstream within the watershed. Using these results, students will record sites that have the biggest impact on the watershed – either contributing the most pollution, are contributing a pollutant that is more harmful than the others, or are located in the headwaters which impacts a larger area of the stream.

After the sites are identified, students can open the "practices and improvements" envelope to read about the types of conservation tools available to their watershed group. The grant that their group has been awarded has enough funds for students to choose 2 of these tools, known as Best Management Practices or BMPs, in order to improve their watershed (if time permits, an instructor may increase this number to as many as 4). They may use the same BMP twice but in two locations, but each will count toward the total number of BMPs used. Using the information from the "water quality results" and "investigation results," students will have to justify the BMPs and the sites they select.

Post-visit: Students will understand that environmental conservation costs money and that limited funds are available to fix environmental problems. They will learn that some strategies can help that funding to have a bigger impact - such as riparian buffer restoration funds being spent where the most pollution is coming from, but also in the most populated area of the watershed, and that the buffer can be multi-use (for a park or bike trail). Further, students will have the opportunity to discuss the tradeoffs of spending money in headwaters versus downstream in a watershed and of deciding which types of pollution should be priority for cleanup. Students will come away with the understanding of complexities that can arise in environmental problem solving and that there are multiple correct answers to those problems.

Outcome: The student groups will use their worksheets to present the conservation tools that their watershed group decided to use. In their presentations to their peers and their instructors, students will have to explain the benefits of the BMPs they selected and also will be encouraged to think of additional benefits to their choice. Installing any BMP will be an improvement, but why does their choice maximize the benefits for the community? The groups take turns justifying the decisions that were made for BMP implementation and lead into discussion of environmental problem solving. Students will gain experience in speaking to a larger group, presenting their ideas on complex issues, and justifying choices in a situation where there are not necessarily correct or incorrect answers.

The success of each group will be determined by whether each group member took a turn speaking or answering a question and by the group being able to list at least one reason for the BMPs they selected. Exemplary groups will be able to list additional reasons for their choice of BMPs or think of additional benefits of their choice (i.e. a forested riparian buffer that also serves as wildlife habitat or town park).

Resources needed: Watershed Decisions game, food coloring, access to water and a water pitcher. The Watershed Decisions game is available for loan from the Huntingdon County Conservation District. It can be loaned out to teachers or brought to the school with a station leader to perform the activity.

Watershed Decisions

Water Quality Results: Write at least 3 predictions after completing the Water Quality Results portion of the game.

- Sites with worse water quality:
    -
    -
    -
    -
- Causes for degraded water quality:
    -
    -
    -
    -

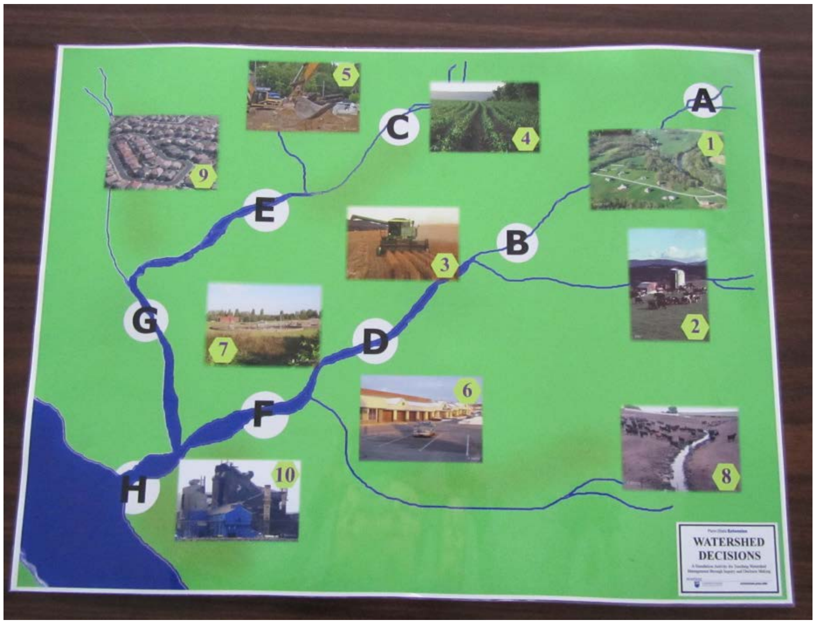
Investigation Results: Write down at least 2 of the sites that seem to have the most impact on the watershed (note: they may not appear to have the worst water quality)

-
-
-
-

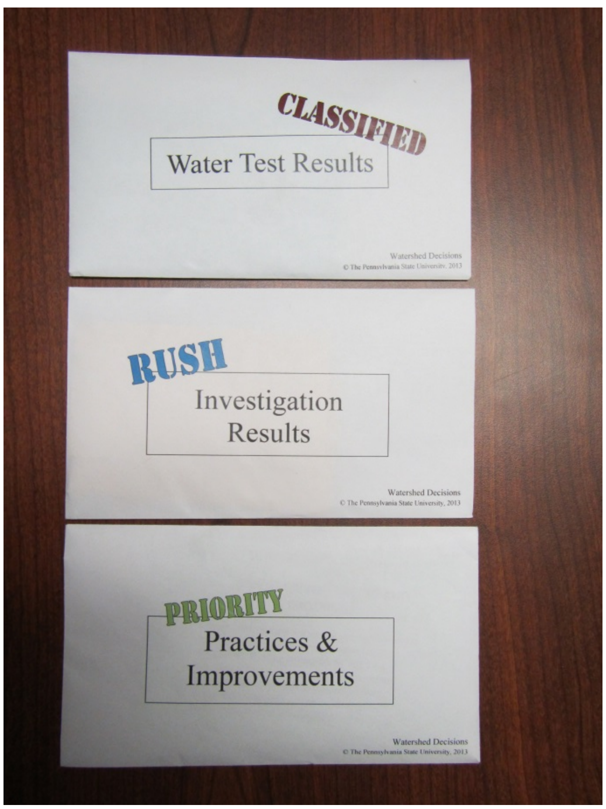
Practices and Improvements: Record the 2 Best Management Practice (BMP), the sites they will be installed on, and at least one reason why you have selected them. You may change your mind from the sites chosen above

- Site:
    - BMP:
    - Reason:
    -
- Site:
    - BMP:
    - Reason:
    -

Images of the Watershed Decisions Game



The watershed map showing the stream, various land uses, and sampling points.



Three envelopes the students will use throughout the course of the game