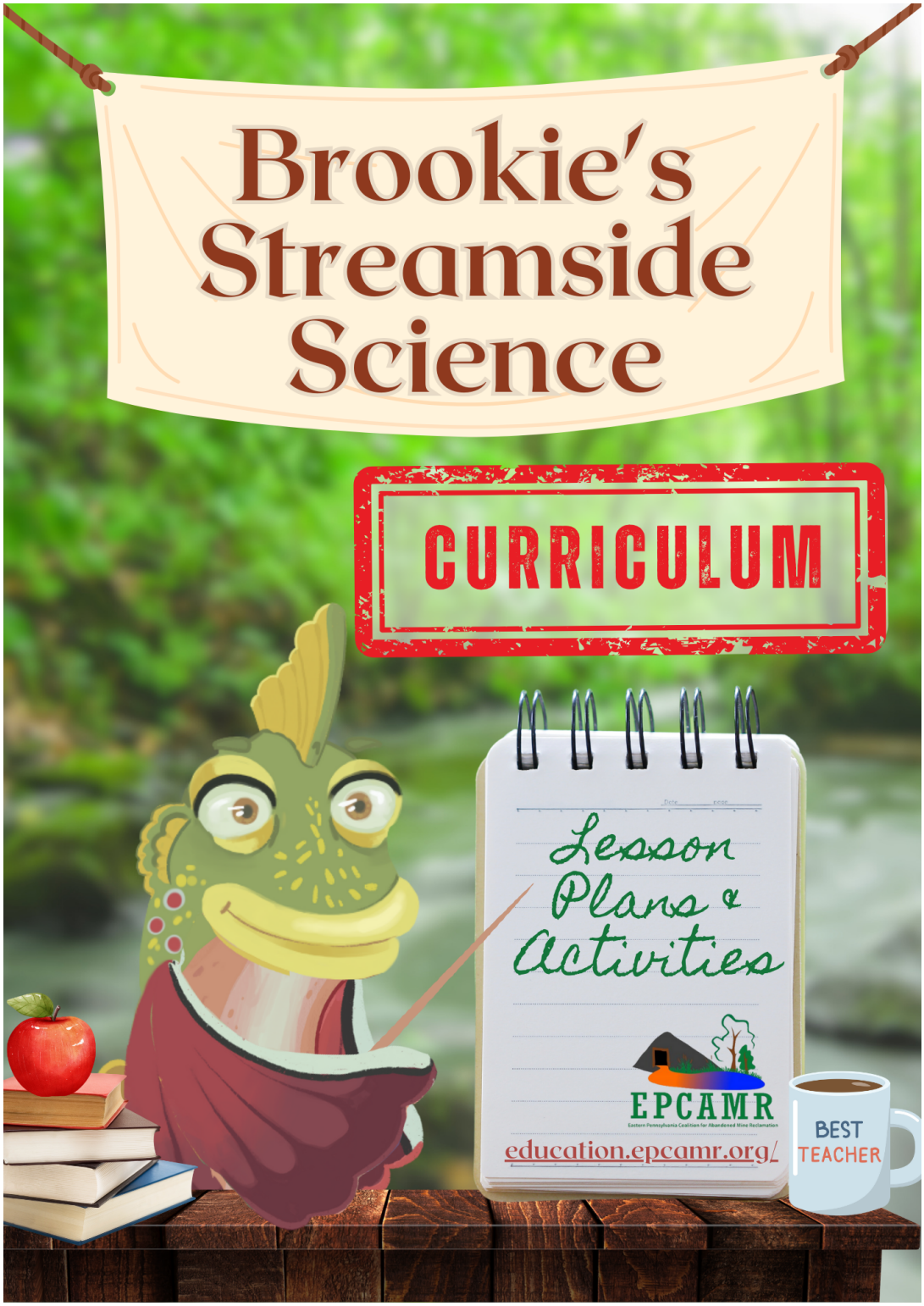


Streamside Scholars Unit

Introduction:

This unit is meant to accompany the *Brookie Braves a Storm* and *Brookie Saves a Stream* videos, supported by Inquiring Systems Inc. with partners: Trout Unlimited, Earth Conservancy, and Ignite Business Services Inc. ©. It was compiled by Laura Rinehimer, Environmental Education Coordinator at Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR).

We hope this curriculum is helpful, fun and empowering for you and your students to help make a difference in your communities.

Table of Contents

1	**Title Page**
2	**Introduction**
3	**Table of Contents**
4	**How to Use**
5 - 14	**Watershed Warriors**
15 - 20	**Macro Mayhem**

How to Use:

1. Have students fill out the **KWL Chart** about one of the topics from the video that you plan to do a lesson on.

2. Watch the videos: ***Brookie Braves a Storm*** & ***Brookie Saves a Stream***

3. Have students fill out the **Guided Notes** to accompany the video (we recommend playing once without having students take notes and once with the Guided Notes).

4. Pick a topic to dive deeper: conduct the accompanying **lessons** from the unit.

Title: *Watershed Warriors*

Grade Level:

Upper Elementary

Duration:

- Lesson 1: Background
    - 2 class periods
- Lesson 2: MWEE
    - No less than 3 class periods

Objectives:

At the culmination of these lessons, students will be able to:

- Define a watershed
- Identify smaller watersheds within a larger watershed.
- Delineate a watershed using a topographic map.
- Delineate a watershed using online tools such as Modelmywatershed.org
- Determine some characteristics of a watershed.
- Determine their HCU.
- Determine the direction of streamflow using a topographic map.
- List 5-10 characteristics of streams in their area.
- Recognize natural physical features that define watersheds.
- Understand that the Upper Susquehanna - Lackawanna is a part of the Chesapeake Bay Watershed. (Change to fit your own watershed – which can be found on modelmywatershed.org)

Materials:

- Paper topographic map of the area they live in with a creek or stream flowing through it. (Pre-print or allow students to print their own at https://apps.nationalmap.gov/viewer/)
- Colored pencils
- Device with internet access
- Tarp or plastic tablecloth
- Blue paint (nontoxic)
- Water spray bottles
- Iron oxide pigment (found at epcamr.org/store) or orange paint (nontoxic)
- Journals/paper
- Writing utensils
- Water quality testing equipment (can be borrowed from local Intermediate Unit)
- Map of their Water Basin
- *Reach Into Your Reservoir* Water Conservation Game (printed)
- Gems/beads/jewels
- Bowls

Standards:

NGSS Science Standard: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. (Grades 9 - 12)

Standard 1.2 Reading Informational Text -Students read, understand, and respond to informational text—with an emphasis on comprehension, vocabulary acquisition, and making connections among ideas and between texts with a focus on textual evidence

Standard: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. (Grades 9 - 12)

STEELS:

3.1.K.A Use observations to describe patterns of what plants and animals (including humans) need to survive

3.1.6-8.J Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

3.1.3.G Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

3.1.2.C Make observations of plants and animals to compare the diversity of life in different habitats

Environmental Literacy Goal:

Enable students in the region to graduate with the knowledge and skills needed to act responsibly to protect and restore their local watershed.

21st Century Skills:

Environment & Ecology Standards: Watersheds & Wetlands 4.2.10.A, 4.2.10.B and 4.2.10.C (10th grade) • Examine the interactions between abiotic and biotic factors within a watershed. • Examine how human interactions impact wetlands and their surrounding environments. • Explain the relationship between water quality and the diversity of life in a freshwater ecosystem.

Environment & Ecology Standards: Natural Resources 4.3.10.A. and 4.3.10.B • Evaluate factors affecting the use of natural resources. • Analyze how humans manage and distribute natural resources.

Lesson 1: Background

Introduction:

- **Tarp Activity** – Have a tarp/ plastic tablecloth set up outside with newspaper or foil underneath, representing the topography of the watershed. Add blue paint to certain points on the tarp. This can represent the path water will travel during precipitation events. Have students gather around the tarp with water bottles. As students spray the tarp, have them observe how the water flows down slopes to a common point, or water body. All the surface area of the tarp that leads to the same water body represents the watershed.
- **Non-point Pollution Extension** – Extend this activity by adding iron oxide pigment in spots on the tarp, representing mine impacted areas with abandoned mine drainage non-point pollution. Have students observe how this AMD pollution collects and travels downstream, affecting stream life.
- **Discussion** – Have students define what a watershed and discuss their answers as a class

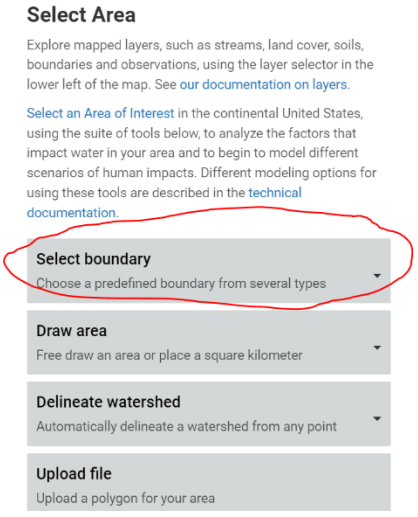
Background Information:

1. **What is a Watershed?**
    1. Read the following passage: https://www.mbgnet.net/fresh/rivers/index.htm
    2. Identify the main idea of the passage: Main Idea Worksheet
    3. Watch the following video: https://www.youtube.com/watch?v=2pwW2rlGIa8
    4. Fill in the guided notes: Watershed Notes
    5. Use the Water Basin Map to have students identify which Water Basin they live in.
    6. Have students play the Watershed Game

2. **HCU:**

    Find your watershed: Use the features on the *Model My Watershed* site to visually see your watershed and discover other information about it. Go to modelmywatershed.org enter the address you want to use and click “Get Started”.

    It is best to become familiar with the site until you feel comfortable using the many features. To easily find the watershed, look to the left of your screen and choose “Select boundary”.



Choose: USGS Subbasin Unti (HUC8) and hover over your location to see your watershed. To get more specific, click on HUC12.

Find your watershed address (HCU):

Enter your zip code in the box at this site to find your HCU *(see glossary)* and other information about your watershed. Guide students to explore their watershed by clicking on the tabs and the waterbodies on the map. Prompt students find "identified issues" and the "health score."
https://www.epa.gov/waterdata/hows-my-waterway

***Take it further: Give students a different city in Pennsylvania (or let them choose) to compare and contrast to their watershed using the same site.

3. Watershed Issues

1. Engage students in a discussion about environmental issues in our watershed using both data collected from the previous websites as well as first-hand experiences and knowledge from previous research. Lead them to understand that what happens in a watershed affects the water downstream.
2. Divide students into groups. Give each group a set of environmental watershed issues cards. Have each group decide on what they feel is the most important issue to address within their watershed based on what they have researched. Have them brainstorm ways they can help.

4. Watershed Delineation:

1. ***Delineating*** a watershed means: finding a boundary of a watershed (also known as catchment, drainage basin or river basin).
2. First, become familiar with **Delineating watersheds** using a topographic map.
3. Give students a topographic map from https://apps.nationalmap.gov/viewer/ (or better yet- show them how to use the site and have them print their own).
4. Have students explore the maps and give them a basic overview of the features of a topographic map, such as:
    a. Explain that contour lines going up by a fixed amount from a set starting point.
    b. Have students find the fixed amount the contour lines are increasing by.
    c. Have them find the highest elevation level on the map.
    d. Explain that you can use the elevation levels to figure out where water will flow.
5. Present the Watershed Delineation PowerPoint.
6. Have students act as civil engineers by using topographic maps to delineate watersheds using their colored pencils.
    a. Step 1: Draw a circle at the outlet or downstream point of the wetland in question.

b. Step 2. Put small "X's" at the high points along both sides of the watercourse, working your way upstream towards the headwaters *(see glossary)* of the watershed.
c. Step 3. Starting at the circle that was made in step one, draw a line connecting the "X's" along one side of the watercourse. This line should always cross the contours at right angles (i.e. it should be perpendicular to each contour line it crosses).
d. Step 4. Continue the line until it passes around the head of the watershed and down the opposite side of the watercourse. Eventually, it will connect with the circle from which you started.

The following resources will help:

- https://www.youtube.com/watch?v=f7aVNyVMO5g
- https://www.teachengineering.org/activities/view/vpi-2594-watershed-delineation-activity
- https://www.epa.gov/waterdata/waters-geoviewer-tutorial
- Example: https://www.youtube.com/watch?v=ajF0DsuuY4k

5. Connections:

- Compare the topographic map to the online delineation tool at **modelmywatershed.org**
    - Click on “Get started” and scroll down to “Delineate watershed”.
    - By clicking on areas on the map, it will show the boundary of the watershed.

6. Conclusion:

- Review the definition of watershed, the watershed that the students live in, and the watershed it drains into (the larger watershed). Also review the issues that they found in their watershed from the data and have students draw conclusions why these issues might be happening in their watershed. Finally, tell students that they will get to complete a **Meaningful Watershed Educational Experience (MWEE**) to learn more about their local watersheds in the next lesson.

  Extra:
  Create a watershed model.

Lesson 2: MWEE

Introduction:

Teacher Source: What is a MWEE
MWEE Guide

- **Using the Senses Meditation:**
  Have students quietly close their eyes and observe the sounds they **hear**. Have them focus on the furthest sound they could hear. Next, ask students to observe what they **smell** and how they would describe it. Then, ring a bell, singing bowl or anything else that makes a resounding sound. Have students open their eyes once they hear the sound stop.

  Discuss what the students observed. Tell students that just like animals must use their senses to survive, humans also use our senses to **survive** as well as to **solve problems**.

  Discuss ways that using their senses could help humans survive such as hearing warnings, seeing smoke, or smelling gasoline. Next, discuss how using their senses can help them identify problems by explaining that we must first notice our environment before we can know a problem exists.

  Finally, discuss how it's not **safe** for students to always use all 5 senses for instance: touching a wild animal, tasting an unknown plant or staring directly at the sun would all be examples of unsafe ways to use your senses. Have students list more.

- **Field Experience**

  Bring students on a field study to a location of your choice to examine the watershed. Review safety precautions with students and give parameters for them to stay in. Introduce the definition of *phenomena* with students. Allow students at least 10 minutes to explore, make observations and record phenomena in journals/notebooks.

Phenomena - observable events that occur in the universe and that we can use our science knowledge to explain or predict.

- **Issue Definition**

As a class or in small groups, have students discuss the phenomenon they observed. Create a class list on the board of the observations that they noticed. Next, introduce the term "environmental problem". Have students pair up to identify environmental problems from the

list. Then, discuss as a class to narrow it down to one environmental problem that may lead to an environmental issue. Define “environmental issue”.

Environmental Problem - an interaction between humans and the environment that threatens or puts something of value to humans at risk; it often includes cause-and-effects relationships

Environmental Issue - An environmental problem about which individuals may take varying perspectives. The disagreement may be over how the problem is to be solved or it may be over whether or not the problem is, in fact, a problem. People disagree because of differing beliefs or values.

- **Land-use Planning Activity (Looking through different perspectives)**:

Explain that people come up with different solutions to problems (or even whether or not they think something is a problem) based on their own perspective and beliefs. Have students split into 4 groups and give each a map of their watershed. Assign each group a different identity, such as “business owner”, “mother”, “investor” and “environmentalist”. Then have them decide what to use the newly reclaimed land for based on the interest of their identity. Have groups debate what the land should be used for and take a vote.

Examine the Watershed Issue cards to choose a category that their Problem might fall into.

- **Driving Question**

Help guide students to create a Driving Question about the Environmental Issue. Review what a Driving Question is. Focus on making sure it can lead to action.

Criteria for Effective Driving Questions:

- Supports learning objectives (i.e., knowledge, skills, and attitudes)
- Serves as a context for both increasing content knowledge and practicing inquiry and methodological skills
- Open-ended (i.e., arguable, with no single, final, or correct answer)
- Relevant and related to students’ lived experiences
- Anchored in real-world environmental and social problems
- Affords the opportunity for continuity and coherence across the MWEE
- Provides the opportunity for students to develop and explore supporting questions as knowledge and understanding evolve
- Provides opportunities for environmental action
- Allows students to design and enact investigations that yield answers
- Calls for higher-order thinking, including analysis, inference, prediction, and evaluation
- Allows for the exploration of both natural and social systems

Examples of driving questions include:

- How is my community impacted by climate change?
- How does the way the land is used surrounding my school affect the Little Conestoga Creek?
- How do human activities impact the local bird population?

- How do local and state policies impact polluted runoff and, should more be done?
- How do trees at our school and in the community impact human health?

- **Research**

Have students research and brainstorm ways to investigate the driving questions. Gather any materials they need such as water quality measurement tools (Contact your local Intermediate Unit to borrow a streamside kit).

- **Field Experience**

Return with students to the field to gather data to support the driving question. Have students record their findings in their journals and take pictures if applicable. *(See following lessons on measuring water quality).*

- **Synthesis & Conclusion**

Help each group examine the data they collected. Guide them towards making decisions about the level of human management necessary and what that might look like.

- **Action Project**

Have students use the data and the driving question to create an action project.
Action projects can fall into 4 different categories:

1. Restoration or Protection, such as planning a community cleanup.
2. Community Engagement, such as making a social media campaign.
3. Civic engagement, such as writing elected officials/decisions makers.
4. Everyday Choices such as composting

Have students brainstorm using the Action Project Worksheet and fill out the Environmental Action Planning Worksheet.

- **Closing Activity**

Allow students to play the game: *Reach Into Your Watershed* in order to learn about water conservation.

We would love to see your Action Projects! Please share them with Robert Hughes rhughes@epcamr.org and Laura Rinehimer lrinehimer@epcamr.org .

Title: *Macro Mayhem*

Grade Level:

Upper Elementary

Duration:

- Lesson 1 - Introduction & Application
    - 2-4 Class Periods

Objectives:

At the culmination of this lesson, students will be able to:

- Identify a macroinvertebrate
- Discuss why the presence of pollution intolerant macroinvertebrates indicates clean water
- Calculate the water quality based on the presence of macroinvertebrates
- Examine stream habitats

Materials:

- Proper licensing to handle Macroinvertebrates
- Laminated cutouts of Macro Math card game (Indoor biosurvey)
- Device with Internet access
- Crayons/colored pencils
- Macroinvertebrate Coloring Pages
- What's a Macro info notes
- Macroinvertebrate Report Notes
- Roll A Macro sheet
- Dice
- Paper
- Bins with gems/rock/sand/marbles to hide macro cards (1 bin per group)
- Dichotomous Key (found with Macro Math card game)
- Water Tolerance (found with Macro Math card game)
- Bug viewers
- Waders (optional)
- Nets (D-net and kicknets recommended)
- Ice-cube trays
- Paintbrushes
- Macro memory game

Standards:

NGSS Science Standard: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. (Grades 9 - 12)

Standard 1.2 Reading Informational Text -Students read, understand, and respond to informational text—with an emphasis on comprehension, vocabulary acquisition, and making connections among ideas and between texts with a focus on textual evidence

Standard: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. (Grades 9 - 12)

Lesson 1

Introduction:

- Watch the Video Macro Mayhem and fill out the Info Sheet: "*What's a Macro?*" that goes along with it
- **"Which macro are you?"** – Have students take the personality quiz to find which macroinvertebrate their answers relate to.
- Macroinvertebrate Coloring Pages – Using an identification, have students examine the markings of their macroinvertebrate and color the sheet.
- Macro Report : Have students research their macroinvertebrate (using either guidebooks, printed information, or the Internet). Then have them fill out the Information included in the Report.

Application:

1. **Macro ID**
   Quiz students on their identification of macroinvertebrates with this online game. You may allow them to use resources or try to complete it without any. Macro Identification Game

2. **Macro Memory**
   Partner students and allow them to play the Macro memory game in order to become familiar with the different types of species or macroinvertebrates they might encounter.

3. **Indoor Macro Dig**
   - Print off and laminate the Macro Math card game (Indoor biosurvey)
   - Prepare bins with either sand, rocks, gems, marbles or similar substrate to hide the laminated macroinvertebrates (1 bin per group). Differentiate the macro cards that you add to each bin so that various stream measurements can be done.
   - Split students into groups. Have them work together to dig for macroinvertebrates, identify them using a dichotomous key, and finding their water pollution tolerance using the chart.
   - Have students record their findings and calculate the Water Quality based on what macroinvertebrates they find.
   - Introduce the Macro App as an additional resource: https://play.google.com/store/apps/details?id=org.macroinvertebrates.mobile&hl=en_US&gl=US&pli=1

- Discuss the findings and conclusions that students drew
- If time and interest allow, have the groups switch their bins and do the dig again. (This can easily be turned into stations).

4. **Stream Ecology:**
   Read the Sampling Manual to learn how to sample macroinvertebrates. Take students to a local stream where they can look for macroinvertebrates themselves. If possible, allow students to use waders, kicknets and D-nets to examine the macroinvertebrates they find in the stream. Next, have them sort the macroinvertebrates into ice-cube trays with a paintbrush in order to count how many there are of each species. Allow students to reference their dichotomous keys,

   Other Resources:

   ➔ Macroinvertebrate Mix & Match