Edition 3

4 H20 Curriculum Guide

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Lesson 1: *The Water Cycle*

Guiding Questions	What is a watershed? What is the water cycle?
Time	1 hour
Student Learning Objectives	• Students will learn about the Lake Champlain basin watershed. • Students will understand the process of the water cycle.
Lesson Outline	1. Introduction + Create Name Tags (8 min) 2. Watch videos (15 min) a. Water Cycle https://www.youtube.com/watch?v=auvGBmIxG08 b. Abenaki Chief Don Stevens Video in production Abenaki Chief Don Stevens 3. Read: ***The Water Cycle at Work*** (15 min) 4. Water Cycle Relay (20 min) 5. Closing (2 min)
Materials	✓ **Butcher Block Paper & Folder** (for name tags) ✓ **Example: Name Tag** ✓ Markers** Students can use their own or classroom supply. ✓ **Lake Champlain Basin Poster** ✓ **The Water Cycle Poster (2-sided)** ✓ **Book: *The Water Cycle at Work*** ✓ **Milk Gallon Photo** ✓ **Football Field Photo** ✓ **Water Cycle Relay Cards (2 sets)** ✓ **Water Cycle Relay Terms and Definitions Key** ✓ **Ice Cube Gems** ✓ **Spoons** ✓ **Cups** (save cup for Lessons 2, 3 & 6) ✓ **Flash Drive with Videos** ✓ **Take Home Notices for Families and Students** *Throughout the lesson, lesson materials are **underlined and bolded**.

Step 1: Prepare for Your Lesson

- Review and practice the lesson before arriving to teach.
- Reach out to the teacher to check in to see if there is the opportunity for Google Drive access. If not, use the **flash drive** provided in the kit. Make sure the classroom is set up for video projection and speakers for sound!
- Review background information and glossary with specific terms for this lesson.
- Arrive early to set up the **Lake Champlain Basin Poster** on the board. On this watershed map, locate the town with which you are working ahead of time so you can easily point it out to the class.
- Ask the teacher to identify the best place for students to gather for reading aloud and also to split the class into two teams.
- Ask teachers if there is a specific student attention getter they use – this will be easier to use with the class if it is already a part of their classroom culture.
- Review the lesson with the teacher.

Note: Words in *italics* in the lesson plan are designed as a "script" to help you prepare what to say. Try to use your own words, when possible. It will seem more authentic.

Step 2: Introduce Yourself

Begin by introducing yourself, UVM Extension, and the TRY program. Let your students know that you will be visiting them six times to teach them about watershed science. Share a little bit about yourself and why you are interested in watershed science (e.g., you love kayaking and swimming and value protecting Vermont waterways).

UVM Extension takes the research happening at the University of Vermont and makes it available to communities throughout the state. What does this mean? For example, we are teen teachers who are part of a UVM Extension 4-H program called TRY for the Environment that teaches younger students, like you, about the environment. Our group is focusing on water quality.

Explain: *As a class, we will be exploring water and aquatic ecosystems over the next few classes.*

Aquatic = relating to water

Step 3: Create Name Tags (2-3 minutes)

Show the students the **example: name tag**. Then pass out **butcher block paper** and **markers**. Have the students write their names on BOTH sides of the folded paper so that when you move around the room you can see their names. If they have extra time, then they can decorate them. Have the students set them in front of their work stations.

*You will set out these names tags each time you work with these students.

Step 4: Introduce Today's Lesson

Write the guiding questions on the board:

- What is the water cycle?
- What is a watershed?

Explain: *Today we are going to watch two videos, read a book and play a fun game. We are going to explore how water moves through the hydrologic cycle.*

Ask: *Have you heard of these words: hydrologic or hydrology before?*

Explain: *The hydrologic cycle is the scientific way of saying the water cycle.*

Next, tell the students *we are going to explore the water cycle a bit more carefully – asking ourselves what story can water tell? Our goal is to understand how we use water every day and to think like scientists to ensure the water we drink, and use for cooking, washing, and for playing in, remains healthy and clean!*

Teaching Tips!

- Help students break apart "hydrologic"

Hydro means water

-logic means the science of

Ask them what comes out of a fire hydrant? **Water!**

Step 5: Watch Videos

Tell the students: *We are going to watch two different videos to show how water moves through the hydrologic cycle and the importance of water to the Abenaki peoples. The Abenaki are one of the Wabanaki (Wa-ba-nak-i), the first nations of Native Americans of northeastern North America. The people in this area were called "People of the Dawn" or "People of the First Light." This is in part because the sun rises in the east and is first visable on the northeast coast.*

Before you start the first video –

Ask: *By a show of hands, who has learned about the water cycle or hydrologic cycle before? What is the water cycle describing?*

Answer: The water cycle is how water moves and changes form over time as it moves across and within the Earth and through its atmosphere. Remind them that hydrologic cycle means water cycle. You can ask students who raise their hand to share a little bit about what they learned or know about the hydrologic cycle.

Play the first video: The Water Cycle
https://www.youtube.com/watch?v=auvGBmIxG08

After the first video

Ask: *Who can share 4 "stages" or "phases" of the water cycle?*

Answer: precipitation, condensation, evaporation, collection). Encourage them to use the scientific names (e.g., precipitation instead of rain).

Ask: *Does anyone know how water moves from ponds to clouds? What is the name of that process?*

Answer: Evaporation – younger students may respond with something like: water goes up through "air." That's okay – just help them learn that process is evaporation.

Ask: *During the hydrologic cycle is there ever "new" water?*

Answer: No, there is the same amount of water on the planet as when the dinosaurs roamed – it simply changes form as it moves through the hydrologic cycle.

Tell the students: *This next video will show the connection between water and people here in the Lake Champlain Basin, focusing on the Abenaki peoples. The Abenaki were the first people to settle in this area. They still live among us.*

Play second video: Abenaki in the Lake Champlain Basin (https://vimeo.com/326359780)

After the video

Ask: *What are some of the ways water was tradionally used by the Abenaki peoples?*

Answer: *transportation, drinking water, to cook*

Ask: *When you use water, do you think of it as a scarce and important resource?*

Answer: It is the web of life that connects all living things together.

Step 6: Facts about water in Vermont:

Share a couple of facts from the list below that you think are interesting!

- All water is recycled, meaning some of the same water from millions of years ago that dinosaurs drank might be the same water we drink today!
- The largest lake in Vermont is Lake Champlain. It is 120 miles long and 12 miles wide at its widest point. It can reach depths of 400 ft!
- Looking at the **Lake Champlain Basin Poster**
  - **Ask:** *Is there more land or water on the map? There is a lot more land!* Emphasize that we have to make wise choices in caring for the land as things that are put on the land will eventually make their way to the streams that drain into the lake.
- 20 million gallons of water is pumped out of Lake Champlain each day for drinking water. (Encourage students to visualize this by showing them the **milk gallon photo** and the **football field** photo.

- **Explain:** *What if this entire football field was covered in milk cartons filled with water? That's how much water we take out of Lake Champlain each day for drinking water!*

- The water we drink is treated through public water treatment facilities in our towns. We are lucky to have a drinking water system that helps to keep our water clean and safe.

Step 7: Introduce the book

Gather the students. Show the cover of the book: **The Water Cycle at Work**.

Explain: *Let's review what we've learned about the water cycle by reading this book. This story will help us understand places water is found in our everyday lives and where it moves all around us. As a class, we will begin to think about the things we do every day and how they impact water quality and quantity and also think about how we can be better stewards; someone who takes care, of water.*

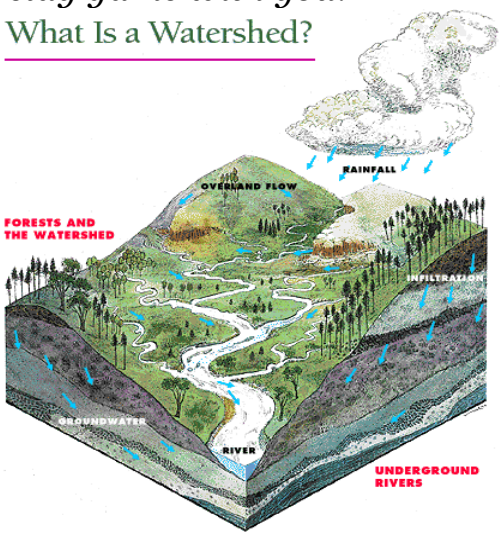
Now read The Water Cycle at Work

Teaching Tips!

- If the students are sitting on the ground it may be helpful if you kneel or sit in a chair so you are off the ground and students in the back can see you and the book.
- After each page pause and let the students look at the pictures and/or ask questions.
- Read **slowly** and clearly.

Step 8: The Water Cycle – Comprehension Check

Say: *Wow! We have learned many new words from this book and two videos! I would like to ask two questions about some of the water concepts and words we have learned. Then, I would like to play a water cycle relay game with you.*



Ask: *What is a watershed?*

Answer: Imagine that a watershed is like a giant bathtub, where the drain is the river, lake, or stream. All of the land that drains into the river, lake or stream makes up the watershed. The edge of a watershed can be defined by a ridge of land that separates waters flowing to different rivers, basins, or seas.

Ask: *What do you think happens to a drop of water that starts at the top of the mountain?* (Point to this on the **Lake Champlain Basin Poster**).

Answer*:* When it rains, say on the top of the mountain, the water droplets flow downhill. The water that flows down the mountain will flow into a stream, a river and maybe even into another body of water, eventually reaching the ocean. In Lake Champlain, Vermont's largest lake, the water drains first to the Richelieu (rish-eh-loo) River, and then to the St. Lawrence River, which flows to the ocean through Canada.

Ask for a volunteer and have the student trace where a water droplet might travel if it fell on different points of the Lake Champlain Watershed. Do this two more times with different volunteers.

Step 9: Introduce the Water Cycle Relay Game

This next game will help us learn how water moves through the watershed so that we can become water cycle experts.

Teaching Tips!

- Take time to wait for answers during the review at the start of the game, many quiet students take the longest to respond.
- If the students are VERY unfamiliar with the water cycle concepts, give them the terms first and then match the riddles on the board.
- **Split the group into two teams:** Ask the teacher to do this ahead of time!

Start by setting the expectations for the **Water Cycle Relay Game**.

Explain: *For this activity, we will need to use our inside voices and keep our minds focused on the water cycle ideas we have been learning.*

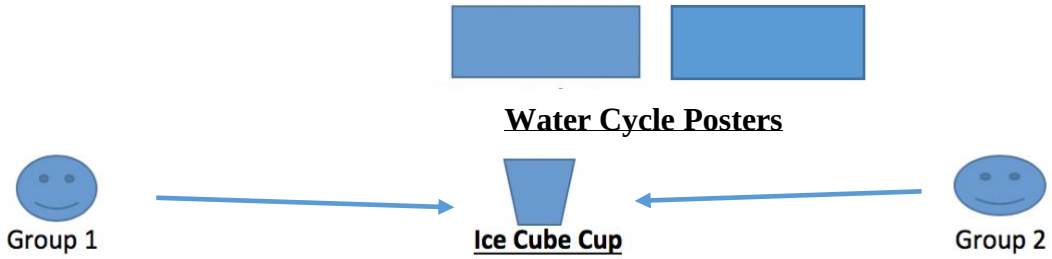
It is incredibly important that we are respectful of other learning that is going on in the building. If I raise both hands, then I want you to raise both your hands, and close your mouth, and look to me for the next direction. Ok? The faster this happens, the faster we can get back to the game!

Demonstrate quiet practice for the students. Show them your quiet hands up in the air so they recall the signal for quiet attention.

Step 10: Water Cycle Relay Game Directions

Explain the activity and say: *You will be playing a water cycle relay game. This game will help you remember the stages in the water cycle and how all water is recycled. You will be working in 2 teams to try to move an "ice cube" (simulating a rain drop) through the water cycle.*

Figure 1: Water Cycle Relay Game Classroom Setup



Say: First we are going to review the **water cycle relay card** terms

1. Hang the two **Water Cycle Poster** on the wall next to each other so they are set up for the actual activity.
   Note: However, for this review portion of the activity only use ONE poster/set of water cycle relay cards.
2. As a group, review each **water cycle relay card** and place them in the correct spot on the **water cycle poster**. Give students a moment to ask questions about any of the words they do not understand.
   Note: definitions can be found in the "water cycle relay terms and definitions" table at the end of this lesson.
3. Once you have reviewed each term, you can pull them off of the poster.

Activity set up:

1. Divide the class into two groups and send each to either side of the **Water Cycle Posters** as shown in the diagram above (reference Figure 1).
2. Pass out **1 spoon**, a bag with **10 ice cube gems**, and a set of **Water Cycle Relay Cards.**
3. Set up the ice cube **cup** in the middle of the two groups (reference Figure 1)

Specific instructions:

1. *I am going to read a riddle about the water cycle – each riddle will have a matching vocabulary card.*

2. *After I am done reading you will have a "whisper meeting" with your group about which word you think best fits the riddle.*
3. *Once the group has decided which **card** they think is correct, then they place the **ice cube** on the **spoon.***
4. *The **ice cube**, **spoon** AND **water cycle relay card** are passed from the back of the line up to the first person in line.*
    i. No one may touch the "**ice cube**" after it is placed on the spoon.
    ii. If the "**ice cube**" falls off, you need to send the **spoon**, **ice cube**, and **card** to the back of the line and restart (if the students are having trouble, allow them to simply pick it up and start where it was dropped).
5. *Once the items reachs the front of the line, the first person in line carries the* **Water Cycle Relay Card** *in one hand, and the* **ice cube** *balanced on the* **spoon** *in the other. They deposit the* **ice cube** *in the* **cup** *and take the term to the board.*
6. *The* **Water Cycle Relay Card** *must be placed in the correct spot*
7. **Scoring**: *Two points will be awarded to the first team to place the correct **water cycle relay card** on their **poster** (1 point for finishing first and 1 point for placing the correct term in the correct spot on the poster). The other team also gets 1 point if they place the correct term on their poster.*
    i. **Bonus Points:** *A point will be awarded to the quietest team that can do the MOST silent cheering. Show them the quiet applause! (Wave ten fingers with open palms.)*
8. *Once points are tallied up on the whiteboard, the student that just placed the* **Water Cycle Relay Card** on the poster *then rotates to the back of the line.*
9. *Then another riddle is read.*
10. *The activity is over once all of the **Water Cycle Relay Cards** have been placed on the poster.*

Complete a practice round:

Start by allowing for a "practice round." Read one clue and have students discuss and decide what vocabulary term matches and allow them to complete the relay.

Teaching Tips!

- You might want to vary the difficulty of the activity based on the age group you are working with.
- For example, if the ice cube falls off then you might want to allow them to keep going without restarting.

Step 11: Closing

Have the students return to their desks and wrap up your lesson.

Say: *Thank you! Today we learned about the Lake Champlain Basin and the water cycle – I hope you enjoyed today's lesson! Next time we visit with you we will be building on our understanding of the water cycle and we will get to play more water games!*

Close by answering any questions the students might have.

Reminder: Give the teacher a copy of the **Take Home Notices for Families and Students**. Ask that s/he distribute in his/her weekly newsletter, post online, etc. – however they usually get information home to parents. We want to make sure that parents get this information.

*Collect **student name tags** and place in the **folder** found in Lessons Material Bag (use for each lesson after this). Return markers to teacher.

Water Cycle Relay Terms and Definitions

Term	Riddle
Ground Water	*Below the surface of the Earth in between particles of dirt, that is where water is found.* **Hint:** *Deep below the ground.*
Infiltration	*In between and all around through the soil without a sound. Water seeping down, down, down, slowly moving underground.* **Hint:** *What happens to water in a garden but not a parking lot?*
Evaporation	*Heat from the sun makes water rise up as vapor to the skies.* **Hint:** *What happens to a puddle on a hot summer day?*
Cloud	*Cumulus, stratus, cirrus too, water vapor visible in skies of blue.* ***Hint:*** *What do we see in the sky on a rainy day?*
Precipitation	*Down is the direction this water falls. In the form of crystals, drips or even small balls.* **Hint:** *From the clouds, what falls? What word do we call this that includes the different types that fall in winter and summer?*
Condensation	*Once a gas but then it is changed into liquid to be seen again.* **Hint:** *My, my, its hot out today, what happened on the glass of my lemonade?*
Evapotranspiration	*From the pores of plants water vapor escapes into the air without a trace.* **Hint:** *How does the condensation on plants make it to the clouds?*
River	*I begin as a trickle and then I grow. Picking up speed, down I go! Over the surface from land to the sea. Obeying the laws of gravity.* **Hint:** *What leads to lakes and flows from mountains?*
Hydrologic Cycle (Water Cycle)	*Water going around and round, changing form, but not amount?* **Hint:** *What do we call all of the water forms and processes together, from stream to cloud and back?*

Important Vocabulary for Teen Teachers	
Glossary	
Aquatic	Relating to water.
Cloud	They form when water vapor in the air condenses to form millions of tiny liquid water droplets or ice crystals. They can only form when dust particles and cool air are present.
Condensation	The process where water vapor changes from a gas to liquid water.
Cool Air	Cool air is necessary for condensation to occur in the atmosphere and clouds to form.
Evaporation	The process where liquid water changes to a gas as water vapor.
Evapotranspiration	When plants release water through pores in their leaves back into the atmosphere.
Groundwater	All the water that is found in the ground under the Earth's surface.
Infiltration	Water going down into the ground
Precipitation	Any form of water that falls from clouds and reaches the Earth's surface. Precipitation includes rain, snow, sleet, hail, and other forms.
Surface Runoff	Water that cannot be absorbed into the ground and so flows across the surface (because the ground is too dense or is already filled with water).
Water Cycle	The movement of water between the atmosphere and Earth. It includes: Evaporation, Condensation, Precipitation, Surface Runoff, Transpiration, groundwater and Infiltration.
Water Vapor	Water in the gaseous state.

Lesson 2: *Watershed Wise*

Guiding Questions	What is a watershed? What types of pollutants are found in the watershed? How do humans impact water quality?
Time	1 hour
Student Learning Objectives	• Students will learn about different pollutants that affect water quality. • Students will create a model of a watershed. • Students will learn how humans impact water quality.
Lesson Outline	1. Introduction (5 minutes) 2. Create a Watershed Activity (15 minutes) 3. Watershed Pollution Game (35 minutes) 4. Closing (5 minutes)
Materials	✓ **Lake Champlain Basin Poster** ✓ Build a Watershed Materials o **White paper**, 8.5 x 11 inches, one sheet per individual o Pencils & Markers** Students can use their own or classroom supply. o **2 spray bottles** of water o **Watershed Example** ✓ **Non-Point Source Pollution Cards (4 Yellow)** ✓ **Point Source Pollution Cards (2 Pink)** ✓ Watershed Pollution Game Materials (for each group) o One **cup** per student **(save cups for Lesson 3 & 6)** o **One Watershed Pollution Game Board** o Two **dice** o **Game player piece** for each student o **Human Impact Cards**: forestry, agriculture, & urban o Bag of **beads** to represent pollution o **Set of Indicator Species Cards** (picture of Frog and Eastern Hellbender Salamander) ✓ **Water Goes Poem**

Step 1: Prepare for Your Lesson:

- Review and practice the lesson before arriving to teach.
- Review background information and glossary terms for lesson.
- Arrive early to set up the **Lake Champlain Basin Poster** in the front of the room.
- Review the activity plan with the teacher.
- Ask the teacher to help you make 4 small groups for the Watershed Pollution Game.
- Get out student name tags

Step 2: Introduce yourself and review the last lesson

Write the guiding questions on the board:

- What is a watershed?
- What types of pollutants are found in our watershed?
- How do humans impact water quality?

Ask: *Who can tell me what we learned last class?* Make sure you allow students to answer first; try to get at what they learned, not what they did.

Yes, last class we learned how water is everywhere. We read a story about the water cycle and played a relay game that helped us think about how water travels through the water cycle. Today we are going to look at how water moves within a watershed, and begin to discover how pollutants get in our water and also move throughout the watershed.

Ask: *We started talking about this last class, does anyone recall what a watershed is?*

Watershed: a watershed is like a giant bathtub, where the drain is the river, lake, or stream. The boundary of a watershed is a ridge of land that separates waters flowing to different rivers, basins, or seas.

Step 3: Comprehension Check

Ask: *Can you name the six steps in the water cycle?*

Answer*:* Evaporation, precipitation, infiltration, groundwater, runoff, condensation. (Note - If students aren't able to get all the terms then review the vocabulary words with them)

Step 4: Build a Watershed Activity

For this activity, the students are going to build a tabletop model of a watershed using a piece of **white paper, 8.5x11.**

Explain: *Now, we are going to build our own watershed models. They will look something like this* ***Watershed Example****. At your desk, you are going to get a piece of paper. We are going to add different parts that are found in a watershed.*

Handout: a blank **white paper, 8.5x11** sheet to each student.

Instructions:

A. **Explain**: *We are in a watershed right now – the school is in a watershed.* Show them the location of the school and the watershed boundary on the **Lake Champlain Basin Poster**. Point out that the different colors on the map are different watersheds. Watersheds are outlined by land features such as mountains and valleys.

B. Get students thinking about the watershed their school is in. Brainstorm a list of what can be found within the watershed (one teen teacher can record the list on the board). Responses might include: streams, lakes, ponds, farms, factories, homes, parking lots – anything really!!

C. Have students draw some of these features on their paper **in pencil**. Also, teens should record on the board a list of places to help students add to their watersheds: houses, schools, buildings, roads, farms, factories, construction sites, golf courses, forests, etc.

D. Give them 5 minutes, using pencils only (markers cannot be used – they will be used later in this activity) to add these elements in their watershed. **Tell the students:** *Do not worry*

about spending a long time on the drawings – the pictures are simply to remind you about things in your watershed. (Show a **Watershed example** to your students.)

E. Have the students "gently" crumple their piece of paper into a ball. Show them what you mean by gently.
   Say: *if you crumple the paper too tightly then the activity we are going to do won't work as well.*

F. Gently open the paper, but don't flatten it out completely.
   Say: *This is going to make our watershed become 3D! The highest points on the paper now represent mountain tops and the lowest wrinkles represent valleys.*

G. Have students choose one **marker** color (have students use markers from their classroom) to mark the highest points on their watershed. These are the mountain ridge lines.

H. Choose a second **marker** color to mark the low places where different bodies of water might be, such as streams, rivers, ponds, lakes, etc.

I. Have the students use a **spray bottle** (give them a limit - 5 sprays each!) to gently mist each finished map to represent rain falling onto the watershed (demonstrate how to do this.) The colors of the markers should begin to bleed – this represents the movement of water across land and the runoff of point and nonpoint source pollutants (Note – you have not covered these terms yet so inform the students that you will explain these terms later in the lesson today).

J. Have students observe their watershed.

   Ask: *What do you notice or observe is happening in your watershed?*

K. Discuss their observations about how the water moves through the watershed area. This is the introduction to "runoff".

Teaching Tip:

- Explain that a watershed is a boundary line based on geographic features that are drawn around the places we live.
- Help the students think about the types of things we humans do in our daily lives that might affect the water (e.g., adults build homes and businesses, we create waste that need to be treated, their parents might mow the lawn, etc.).

Step 5: Understanding Runoff

Explain: *Sometimes there is water that sits on or flows over the land- this is called surface water – we are used to seeing this – think of lakes, ponds, and streams. However, when it rains and in the spring as snow melts, some of this water will move to lower elevations, with some eventually making its way to the ocean. Remember how we learned that water is continually moving through the water cycle? Where does this water go? Many places! First, the ground can absorb a certain amount, like a sponge. As the water soaks in through this process called infiltration, it becomes groundwater. Think of the ground as being a sponge, soaking up as much water as it can.*

Ask: *Have you ever used a sponge, or a paper towel, to soak something up, but there was too much liquid so you needed another sponge or paper towel? That happens when there is too much rain or snowmelt.*

The snowmelt and rainwater on the surface of the land moves towards lower elevations, eventually reaching streams, rivers, ponds and lakes – this movement of water over the surface of the land creates what is called "runoff." Let's explore different types of runoff and how they can pose problems for water quality.

Ask: *Can you share an area on your watershed where the colors bleed during the rainstorm? The "bleeding" demonstrates runoff.*

What is creating runoff in your watershed? Create a list on the board.

Answer: Urban stormwater runoff, agricultural runoff, construction runoff, forest clearing runoff, eroding stream banks.

Ask: *What types of things might runoff from a farm if it was in our watershed model?*

Answer: Agricultural area runoff often contains more chemicals which are used to help the crops grow or stay insect free. Sometimes animals, like cows, go to the streams for a drink and add their waste in the streams or breakdown the streambanks causing a lot of dirt to get into the water.

Introduce the concept of point and non-point source pollution*: Point source pollution can be thought of like a pipe from a factory that puts harmful things into the water. You know exactly where this pollution is coming from. Non-point source pollution might be like a farm or roadway where you aren't certain that the pollution is coming from there specifically or someplace else.*

Explain: *Now we'll look at non-point and point sources of pollution.*

Show and Read each: Non-Point Pollution Cards (4 yellow) and **Point Source Pollution Cards (2 Pink)**.

Step 6: Comprehension Check

Background Information for Teens: Depending on the surface and the type of land the water is on, the runoff can be described as urban, meaning city, or agricultural, meaning from farmland. Urban and agricultural runoff can produce intolerable (bad) conditions for some aquatic life. Sewage and fertilizers present in streams promote the growth of algae and, eventually, bacteria that consume oxygen needed by aquatic life. Land uses, such as poorly-protected construction sites or croplands, disturb or destroy natural vegetation and allow sediment to flow into the water. Sedimentation destroys stream habitats by smothering the rocky areas.

Ask: *Where is the first place the water lands?*

Answer: The top of the watershed model – the highest places.

Ask: *Where did runoff come from on your map?*
Answer: Farm, residential, construction site, etc.

Ask: *What path does the water follow?*
Answer: The water flows to the lowest points – taking the path of least resistance. Students can think of this like a ball rolling down a hill.

Ask: *What might occur if there was a building, parking lot or farm in our watershed model?*
Answer: Increased runoff.

Step 7: Watershed Pollution Game

Split the class into 4 groups. Each group should have:

- One **Watershed Pollution Game Board**
- Two **dice**
- Three stacks of **Human Impact Cards**: forestry, agriculture, and urban
- Bag of **beads** to represent pollution
- Stack of **cups** (one for each student in the group)
- **Game player pieces** (one for each student in the group)

Each student should have

- One **cup**
- 5 **beads**
- One **game player piece**

Note: Cards include Eastern Hellbender salamanders and frogs. An Eastern Hellbender represents **high water quality**. A frog represents **moderate water quality**. **Low water quality** receives no amphibian indicator species.

*There can be multiple winners, so be sure there are multiples of each type of indicator species.

Directions for Activity

A. The goal of the journey through the Watershed Pollution Game is to travel through the watershed and see how humans impact water quality.

B. To begin the game each player rolls the **dice**. The player rolling the highest number goes first. Each player takes a turn by rolling the **dice** and moving the corresponding number of spaces on the **Watershed Pollution Game Board**. At each new space, pick up a **Human Impact Card**. **Human Impact Cards** are color-coded to match each section of the game board:
   - Green is forestry
   - Yellow is agriculture
   - Gray/White is urban

   Pick up the correct color of **Human Impact Card** when in each of those sections.

Follow instructions on the **Human Impact Card:**

1. If the impact is positive, remove **beads** from your **cup**.
2. If the impact is negative, add **beads** to your **cup**
3. If you receive a positive before you have **beads** in your **cup**, no action is required.
4. Repeat steps 1-2 until the end of the game.
   a. Note the urban section splits into three paths. It does not matter which path you take. The goal is not to reach the end first, but to have the "cleanest" water (no beads).
   b. When each player has reached the end, they count the number of **beads** in their **cup**.
   c. 0-5 beads receive the **Eastern Hellbender Indicator Species Card**: You have the cleanest water and win the highest honor.
   d. 6-9 beads receive a **Frog Indicator Species Card**: You have moderate water quality.
   e. 10+ beads receive no Indicator Species Card: Your water quality is unfit for an amphibian to live.

Start the Game

A. Setting up the board – 1 per small group
   1. Lay out the **Watershed Pollution Game Board** so that every player has access.
   2. Place **Human Impact Cards** around the board.
   3. Place **game player pieces** on the START space at the top of the board.
   4. Place **beads** in an area where every player has access.
   5. **Write** the number of beads and their indicator species on the board so that when the students total their beads at the end of the game, they will know which species they have earned.

B. Each student starts with a clean **cup** (no beads present). One by one, each student will roll the dice to determine how many spaces they will travel on the **Watershed Pollution Game Board**. After they land on a square they need to take and read aloud a color-coded **Human Impact Card**.

C. Repeat play until each student has reached the end of the river. The river splits once in the urban area, but it does not matter which trail they follow.

D. **Say:** *Count the number of beads in your cup and determine which indicator card you should receive.*

Step 8: Game Wrap-Up

After the game, review the terms **watershed** and **water quality** by asking students to give a definition of those terms and for examples of some positive and negative human impacts they experienced during the activity. Review the terms they may have encountered in these experiences: **soil erosion, sedimentation,** and **leaching**.

Debrief the activity with the students by talking about what happened.

Ask: *Raise your hand if you received an indicator species card. Can one of you please share with us your understanding of what an indicator species is and why they are important?*

Indicator Species: an indicator species is an organism whose presence, absence or abundance reflects a specific environmental condition and can be used to diagnose the health of an ecosystem.

Ask the students:

- *Look at your* **cup**. *How many of you had water quality which allowed you to have* ***Eastern Hellbenders****?* ***Frogs****? Or no amphibians at all?*
- *What happened in the game that you received that particular indicator species?*
- *Would you have done anything differently during the game now that you have seen both the positive and negative impacts?*
- *How do you think your actions might impact water quality in your daily lives?*

Step 9: Closing Words

Thank you for your hard work today! I hope you all enjoyed learning about watersheds, runoff, pollution and how humans can impact water quality! Since we now know water is everywhere, and we know of many ways we use and impact water, I look forward to figuring out exactly HOW MUCH water we use next time we visit.

Close by answering any questions the students might have. Collect student name tags and place in **folder** found in Lessons Material Bag (use for each lesson after this). Return markers to teacher.

Extra Time? You can read the **Water Goes Poem** on the following page. However, close by answering any questions the students might have.

Read: <u>Water Goes</u> Poem (read slowly)

Water goes,
Round and round,
From the sky,
To the ground,
In a cycle,
You can't see,
Water comes to you and me!
Evaporation is a start,
But it's not the only part,
From sea to sky,
Vapor floats,
But leaves enough to float in boats!
In the sky,
Water cools,
Forming clouds,

Like fish form schools,
Condensation makes it dense,
Like dollars have one hundred cents!
Then it falls, precipitation!
It's like group participation…
Rain and hail,
Sleet and snow,
Water falls,
Plants can grow…

Fills up lakes, and streams, and seas,
We can drink it as we please,
Water used to brush our teeth,
Water wets the coral reef!
Water, water, what we need,
We need water to succeed,
And water cycle keeps it fresh,
Water cycle, you're the best!

Important Vocabulary for Teen Teachers	
Glossary	
Indicator Species	An indicator species is an organism whose presence, absence or abundance reflects a specific environmental condition and can be used to tell the health of an ecosystem.
Leaching	Leaching is the process of soluble (able to easily dissolve) chemicals or minerals being washed out of soil as rainwater seeps through it. These chemicals or minerals can become pollutants.
Non-point Source Pollution	Non-point source pollution comes from many sources across the landscape. A specific pollutant source generally cannot be identified.
Point Source Pollution	Point source pollution comes from identifiable sources, such as pipes from a factory.
Runoff	Runoff is the draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.
Sedimentation	Sedimentation is the process of settling or being deposited as a sediment. Sand like or dirt particles set down in a fine layer.
Soil Erosion	Soil erosion describes the wearing away of topsoil. Topsoil is the top layer of soil and is the most fertile because it contains the most organic, nutrient-rich materials. One of the main causes of soil erosion is water erosion, which is the loss of topsoil due to water.
Water Quality	Water quality describes the condition of the water, including its chemical, physical, and biological characteristics.
Watershed	A watershed is the area of land that drains to a common waterbody. It is like a giant bathtub, where the drain is the river, lake, or stream. A watershed boundary is formed by a ridge of land that separates waters flowing to different rivers, basins, or seas.

Lesson 3: *Exploring Water Use and Conservation*

Guiding Questions	What is our impact **as humans** on water quantity? What activities use water? How much water do we use on average each day?
Time	1 hour
Student Learning Objectives	• Students will understand the amount of water their daily activities use. • Students will learn how to track the water they use.
Lesson Outline	1. Introduction (5 min) 2. Daily Water Use (30 min) 3. Conservation Use Match Up (20 minutes) 4. Water Conservation Diaries (5 min)
Materials	✓ Daily Water Use Activity ○ **Blank Index Cards** ○ **Sample Water Use Index Card** ○ **Water Use Answer Key** ○ **Water Use Chart** (on flash drive & laminated) ○ **Beads** ○ **Cups** ○ **Ping-Pong balls** (35 in kit) ○ **Tennis balls** (10 in kit) ✓ **Water Use & Conservation Practice Cards** ✓ **Water Diary Worksheet** (make copies) ✓ **Sample Water Diary**

Step 1: Prepare Your Lesson

- Review and practice your lesson before arriving to teach.
- Note the examples for the class to see, including the:
    1. **Sample Water Use Index Card**
    2. **Sample Water Diary**
- Count the number of students in the class and take out the correct number of **Water Use Cards** and **Conservation Practice Cards**. They need to match. The cards are numbered 1-14 so it is easy to see which ones "match". Therefore, if you only have 20 students – you will need to use matches 1-10. Place these two piles near the front of the room to hand out later.
- Get out all the materials you will need for the **daily water use activity**.
- Get out name tags from previous weeks

Step 2: Introductions and Review of Previous Lessons

Begin by introducing yourself again, today.

Hi, I am (fill in name). I am excited to be joining you all again! Today we are going to focus on how much water we use for daily activities such as brushing our teeth and showering. We have talked about water quality – looking at types of runoff and pollution - and today we will be thinking about how our daily actions impact water quantity.

Write on the board:
Quantity = how much
Quality = how good or bad

Let's think about our last two classes. Who can tell me what we learned? Remember I'm asking what we learned not just what we did.

If the students don't have much to share – ask 2 or 3 of the comprehension check questions below.

Comprehension Check Questions: Ask 2 questions to refresh students' knowledge – try and ask new questions each lesson!

Ask: *What are the stages of the water cycle*?
Answer: condensation, evaporation, precipitation, transpiration, runoff, groundwater.

Ask: *What does precipitation mean*?
Answer: Any form of water that falls from clouds and reaches the Earth's surface. Precipitation includes rain, snow, sleet, hail, and other forms.

Ask: *What are the two ways we describe sources of pollution?*
Answer: Point and non-point.

Ask: *What is runoff?*
Answer: The draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.

Ask: *What are some types of runoff?*
Answer: Urban stormwater runoff, agricultural runoff, construction runoff, forest clearing runoff, eroding stream banks.

Ask: *What does infiltration mean?*
Answer: Water going down into the ground.

Step 3: Introduction to Today's Lesson

Today, we will explore ways humans impact water through consumption (use). Our goal today is to find out how much water we use individually and as a class. I want us to be able to visualize how much water this is. You may be surprised at how much water we use just in our daily lives. This is important to understand because there is only so much water on this Earth. That water is continually being circulated and water is essential for the survival of all life on this planet! That includes humans, plants and animals! Remember,

there is no new water. What we have is what we have. So we need to know how much we use and start to think about ways we can use less.

Write the guiding questions on the board:

- What is our impact as humans on water quantity?
- What activities use water?
- How much water do we use on average each day?

Begin by having students list off the ways they use water every day: *Let's make a list of the ways we use water every day.*

One TRY teacher can record the list on the board while another calls on students.

Ask: *Who has an idea they want to share?*

As the student's brainstorm – **make a list on the board** that categorizes each use by time of day. (See example table below)

Ways We Use Water – Each Day	
Morning	*Shower* *Breakfast* *Brush Teeth*
Afternoon	*Wash hands* *Lunchroom* *Bathroom* *Water fountain* *Classroom activities*
Evening	*Bath/Shower* *Dinner* *Wash Dishes* *Laundry*

Step 4: Transition

*You all just did a great job listing the **ways** we use water every day. Now we will take this one step further to think about **how** much water we use on average in a single day.*

As one teen teacher is writing the ideas on the board, another teen teacher is double checking that all the water use activities are on the laminated **Water Use Chart** in your kit (same as you will project later). If not, add these to the brainstorm list.

Step 5: Illustrating our Water Use Activity

A. *Looking at the water uses, choose one. I'm going to have you draw a picture of one of these water uses! You will have 5 minutes to do this.*
B. For this activity, each student is going to choose a water use to focus on (from the list we have brainstormed above – encourage students to choose different water use activities but it's OK if there are some duplicates). See the list of these water use activities in **Step 7** to help students generate more ideas. **Do not** project the PowerPoint **Water Use Chart** yet.
C. One TRY teen can pass out **blank index cards** (1 per student). While another draws the template on the board.

Template for Water Use Activity Card:

Water Use: ACTIVITY NAME (Student illustration here) Guess: ? Actual amount: ? GALLONS OF WATER THIS ACTIVITY USES

D. *Please write the water use type at the top of the sheet, then draw your illustration of this activity below! Add your guess (in pencil) on the bottom of the card for the number of gallons you THINK your*

activity uses. Here is my ***Sample Water Use Index Card***. Show them your card.

E. Have students get out their own pencil and markers.
F. If a student finishes early, they may illustrate a second water use activity card while the rest of the class finishes (give ~5 mins for this).

Step 6: How much water do these activities use?

Discuss their cards and their guesses.

Project the **Water Use Chart** and have students find their activity. Then write the ACTUAL amount their activity uses on their **index card** and circle it at the bottom of their Water Use illustration next to their guessed amount.

Ask: *Take a look at this chart. How many of you are surprised by the amount of water your activity uses?*

Next *we're going to see what water use looks like for each of these actions with an activity. (Pass out a* ***cup*** *to each student for them to eventually put their* ***beads*** *into during this activity.)*

A. Use the **Sample Water Use index card** illustration to demonstrate the actual water used using the materials below.

Show them the different materials and explain how each represents different amounts of water:

- 1 **bead** = 1 gallon
- 1 **ping-pong ball** = 10 gallons
- 1 **tennis ball** = 100 gallons

Note: Write the bulleted list of materials and what they represent up on the whiteboard for the students to see.

Now show them a demonstration. For example, if "brushing teeth" was chosen as the Water Use activity, and it takes 2 gallons of water to complete, then set 2 beads in the **cup** in front of the toothbrush illustration written on your index card.

B. **Ask** each student to get the materials they need to create a visual model of how much water their activity uses.

C. After students have created their visual. Have them share their amount with the class. Create a TOTAL water use amount for the entire class by adding them up on the whiteboard.This will allow you to see the **TOTAL** amount of water used for all of these activities.

D. **Ask** students to think about how much water this is – it's a lot! Consider if it is representative of one person's activities in a day. If "yes" you can multiply by the number of students in this class. And keep multiplying for each person in the United States and around the world! (327 million people in US; 7.5 billion in world as of 2017)

Debrief by asking:

- *What do you think about how much water we use?*
- *Does it seem like a lot of water?*
- *Do you think we could reduce the amount of water we use and how?* Have one of the teens write their conservation answers on the board.

Our next activity we are going to look at ways to conserve the amount of water we use.

Step 7: Water Conservation Match Game

A. Hand each student a card from either the **Water Use Cards** pile or the **Conservation Practice Cards** pile. There are 28 total cards. **Make sure that if there are fewer students than cards don't hand out all the cards. The cards have a numbered match. The cards are numbered 1-14 so that it easy to see which one's "match." Therefore, if you only have 20 students – you will need to use matches 1-10.
B. Give them 1 minute to read their card to themselves.
C. The object of this game is to have students "match" their cards and share ideas.

D. A student with a **Water Use Card** should stand and read their card **(the cards are numbered to match).** The student with the matching **Conservation Practice Cards** will stand and read their card. After reading, they should come to the front of the room and stand in a circle. Give them a high 5 as they join you.
E. Keep going until all the cards are read.
F. **Debrief**: When all of the students have found their match let them share any additional conservation practices they might want to add. The teen teacher can add to this by using the **Water Use Answer Key**. **Once the activity is completed the students can hand in their cards and return to their seats.**

Water Conservation Match Game - Answer Key		
Water Use	**Approx. Water Use (Gallons)**	**Water Conservation Practices**
Toilet Flush	2-5	*Choose a half flush option if available.* *Chat with your parents about creating a half flush option by adding a weighted displacement jug into the reservoir. This creates a lower volume flush.*
Bath	30-50	*Choose to take ½ full baths or to take a bath only every few days; if possible, use water after baths to water plants or for the garden. Note: This should be an option only if no soap was used.*
Brushing Teeth	2	*Keep water off when brushing your teeth. Use water when rinsing.*
Taking a Shower	5 /minute	*Chat with your parents about using a shower head that conserves water (called a "low-flow" showerhead). Time your showers; keep them under 5 minutes.*
Washing Clothing	20-30	*Ask your parents to do larger loads instead of smaller loads. Check with your parents about if the washer is one that conserves water.*
Washing Hands	2	*Turn water off when soaping up to washing your hands.*
Drinking Water	½	*If water goes "stale" in your bottle, water a plant with it instead of pouring it down the drain.*
Washing Dishes	8-10	*Use a hot water soak for dishes ahead of time. Turn off water until ready to rinse!*
Dishwasher	12-15	*Run only when full!*
Outdoor watering: 30 min	250	*Try to use sprinkler systems that cover a wide area, this mimics natural rain Use a timer, and monitor often.*
Preparing and cooking meals	10	*While waiting for hot water, fill a plant water jug; this way water is not wasted while waiting for water to warm.*
Drinking Fountain	½	*Fill water bottle while waiting for water to get cold. Since water will warm in the bottle anyways it's a good way to save and use later.*
Pets	½ -30	*This ranges widely because dogs and farm animals use varying amounts of water.* *Use water heaters for large animals to keep water from freezing. Any suggestions for small animals?*
Washing Car	150	*Make a soapy water bucket to clean car initially. Use fresh water only when rinsing. Be sure to wash the car on the lawn to minimize non-point runoff too!*
Eating Meat	2,400	*Did you know it takes 2,400 gallons of water to produce just a single pound of meat? Ask your parents if you can eat "meat-free" one day per week to help minimize your indirect water use.*
TOTAL APPROXIMATE:	100-2,800 /day	*WOW! Each person in this room could use between 100-2,800 gallons of drinkable freshwater each day! This would be like lining up milk gallon jugs to cover from one end of a football field all the way to the other side.*

Step 8: Water Diary

Now that we have learned just how much water we might use in a single day and ways that we can conserve water, I would like you to think about this for the next few days.

For this last activity, I hope we can spend time this week learning how much water each of us actually uses. I am going to hand out a **Water Diary worksheet** *for you to take home to record the ways you use water every day. The goal is to record regular water use for 3 days and then to pick 1 or 2 conservation practices (such as turning the water off when brushing your teeth or taking shorter showers) and record how much less water you use when taking these actions. We'll go over these next time we meet.*

Show your Sample Water Diary – go through it with your students so they understand how to complete it.

Hand out a Water Diary worksheet to each student.

Say: *Next class I hope that we can all share our water diaries and what other water conservation ideas we may have. We are going to wait a couple of days before our next class so you can complete your water diary at home. It is ok if there is a couple of days between classes, we use water every day in ways we don't ordinarily realize.*

Step 9: Closing Words

Thank you for your hard work today! I hope you all enjoyed learning about the ways we use water and, more importantly, the ways we can conserve water! Since we now know water is used in many ways it is going to be important that we begin to think about this in our everyday lives.

Ask: *Please take your water diaries home and share them with your families! Please bring back your completed water diaries and give them to your teacher.*

*Collect **student name tags** and place in **folder** found in Lessons Material Bag (use for each lesson after this). Return markers to teacher.

Important Background Vocabulary for Teen Teachers	
Glossary	
Conservation	The action of conserving something, in particular: preservation, protection, or restoration of the natural environment, natural ecosystems, vegetation, and wildlife.
Quality	How good or bad
Quantity	How much

Lesson 4: *Aquatic Food Chains and Webs*

Guiding Question	How are the living organisms in aquatic (freshwater) ecosystems interdependent and balanced?
Student Learning Objectives	• Students will understand connections in aquatic food webs. • Students will understand how an aquatic food chain differs from an aquatic food web.
Lesson Length	1 hour
Lesson Outline	1. **Introduction (2-3 min)** 2. **Water Diaries (10 min)** 3. **Food Web Activity (20 min)** 4. **Food Chain Activity (20 min)** 5. **Closing – Poem and Questions (5 min)**
Materials	✓ **The Water Cycle Poster** ✓ **Brown Trout Food Web & Aquatic Food Web Posters** (on flash drive) ✓ Food Web Game ○ **Yellow yarn** (1 ball) ○ **Red yarn** (1 ball) ○ **Plastic Rings** (20) ○ **Food web cards** (20 cards) ○ **Food Web Game Key** (figure 2) ✓ **Food Chain Mobile** ○ **Food Chain Sample Mobile** ○ **Food Chain Cutouts** ○ **Construction paper strips** ○ Markers, glue or tape, and scissors (not provided in kit but needed) ✓ ***Links in a Food Chain* Poem** (on flash drive)

Step 1: Prepare for Your Lesson:

- Practice and prepare for the lesson.
- **Review** background information about a food web and a food chain and the glossary found at the end of this lesson.
- You will project the **Brown Trout Food Web Poster**, **Aquatic Food Web Poster, and Links in a Food Chain song** later. Get the projection ready.
- Hang **The Water Cycle Poster** for review.
- Make sure the **yarn** and **Food Web Cards** are available.
- Gather scissors, glue or tape, and markers from the teacher.
- Get out **student name tags**

Step 2: Introduction & Check for Understanding

Begin by introducing yourself again. *We are excited to be back with you all!* (Remind students of your names.)

Today we will be thinking about the natural balance that exists in water (aquatic) ecosystems. As a class, we will do a couple of activities that will show how living things (organisms) are connected and depend on clean water. These organisms (living things) share the clean water we use!

Ask: *Think back to the very first day. Who wants to share something they have learned or remember from earlier lessons? Think about what we learned – not just what we did.*

Comprehension Check Questions: Ask 2 questions from this list to refresh students' knowledge – try and ask new questions each lesson!

Ask: *What are some stages in the water cycle?*
Answer: Condensation, evaporation, precipitation, transpiration, runoff, groundwater, collection

Ask: *What does evaporation mean?*

Answer: Heat from the sun makes water rise up as vapor to the skies.

Ask: *What are two ways of describing how pollution can enter our watershed?*

Answer: Point and non-point

Ask: *What is runoff?*

Answer: The draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.)

Ask: *What are some types of runoff*?

Answer: Urban stormwater runoff, agricultural runoff, construction runoff, forest, stream bank erosion

Ask: *What does infiltration mean?*

Answer: Water going down into the ground

Step 3: Water Diaries – Check in!
Facilitate a class discussion.

Ask:

- *Who can tell me what we learned last time from our water diaries?*
- *Who has been recording things in their water diary and wants to share?*
- *What is one thing you suggested to your family that you'd recommend they do to save water in your home?*
- *What did you learn about how much water you use? Has anyone changed the way they use water?*
- *Does anyone have any questions or comments about their water dairies that they would like to share?*

Step 4: Introduce the Concept of Food Webs and Food Chains

Today, we will explore the many interconnected creatures that share our clean water. We will create a food web to show how organisms (living things), even humans, rely on other organisms to survive. The link to the survival of all organisms is our healthy bodies of water.

Explain: *You will be thinking as a class about food webs and food chains that are specific to water (or aquatic) environments.*

Ask: *Can anyone name an aquatic environment?*

Answers include: Puddle, pond, lake, river, stream, ocean, etc.

Ask: *Does anyone know what an ecosystem is?*

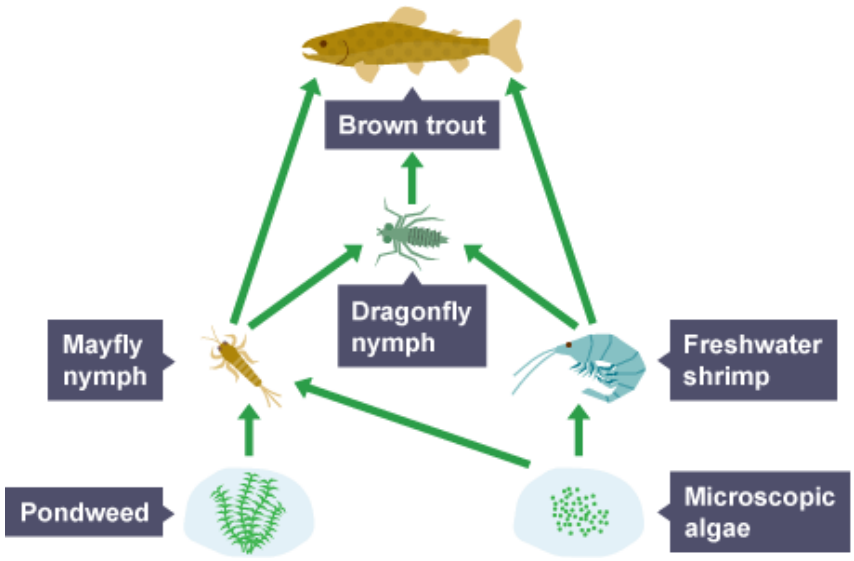
Ecosystem: A community of **living** organisms along with the **nonliving** parts of their environment (things like air, water and mineral soil), interacting as a system.

Step 5: Project the Brown Trout Food Web Poster

Step 6: Food chains and food webs

Today we're going to think about what a food chain and a food web are and how they are different. Please see the diagram on the board that shows a food web that exists in streams, rivers and lakes.

Brown Trout Food Web



Ask:

- *What do you notice about this picture?*
- *What do you think the arrows mean?*
- *How are they different?*

Answer: This brown trout food web shows the way that energy is moved up the food chain or within the food web. Food webs show the interaction between organisms and how they depend on each other. A food chain shows a single line within the food web where energy from the food organisms eat goes up the chain to their predators. We are going to do 2 activities today. The games will be based off the connected relationships of plants and animals in the food web and their relationships in food chains.

Next we are going to play a game that will be similar to what this poster is showing. You'll be able to better understand the relationship between all of these organisms.

Step 7: Set Expectations

Do you remember how I get your attention? *If I raise both hands. I expect you to raise your hands and give me your attention. I will do this to get everyone quiet so I can give the next direction.*

Demonstrate Quiet Practice: Show them your quiet hands up in the air so they recall the signal for quiet attention.

Step 8: The Food Web Game – Directions

- As the instructor, hold the "Sun" **Food web card**, 2 balls of **yarn (1 yellow + 1 red)**, and a **plastic ring** (Refer to **Figure 2: Food Web Game Key** at the end of this lesson as a guide for how the food web looks.)
- Put **10 food web cards** in a circle on the ground.
- Then, instruct 10 students to go stand by these cards.
- Hand the rest of the students (those not in the circle) a **Food web card** from the remaining set.
- Ask students to find their match and pair up as partners.
- Give each partner-pair a **plastic ring**.
- Give students 2-3 minutes to familiarize themselves with their cards.
- **Note:** Mention that each partner-pair will be responsible for reading their card aloud to their peers, so they should practice reading the highlighted vocabulary written on each card. Tell the students to raise their hand if they need help. Make yourself available to help students practicing these words or answering questions about their cards.

Teaching Tips!

- Make sure you have matches for each of the cards you pass out.
- If there is an odd number of students a TRY teacher may need to "play."

Start the activity:

A. Read the description on the "Sun" **Food web card**.
B. Then proceed to read the action step on the "Sun" **Food web card**, **while threading the yellow and red yarn through the plastic ring.**

C. Holding the 2 **yarn** colors and the **plastic ring**, ask for the student-pair with the "Phytoplankton" **Food web card** to raise their hands.
D. Walk to the student-pair and hand the **yarn** to them. Have them thread the two colors of **yarn** through their shared **plastic ring**.
E. Return to your place in the circle, letting the **yarn** thread through your **plastic ring**.
F. Ask the student-pair to read their card. For example, students with the "Phytoplankton" **Food web card** will read aloud: "I am a very small plant that floats in the lake water. There are a few different types of plants like me, with names like Green Algae, Diatoms, and Blue-Green Algae. I take sunlight and change it into energy for myself in a process called photosynthesis [sounds like "photo-sin-thuh-sis"]. I am a primary producer because I create nutrients and energy that other organisms in the lake need, and they eat me to get it!"
G. Next, the student will **read** the Action Step found on the back of their card. For example, students with the "Phytoplankton" **Food web card** will read aloud: "I get eaten by Zooplankton! [sounds like "zoo-plank-ton"]"
H. Lastly, the students will **do** their Action Step. For example, one of the student-pair with the "Phytoplankton" **Food web card** will hand the **yellow and red yarn** to the students with the Zooplankton card, keeping a hold of their own **plastic ring,** then they will return to their place in the circle.
I. The activity will continue as student-pairs read their **Food web cards**, ask the corresponding student-pair to raise their hands, walk the **yarn** over, and continue the process until the last card is read, and the **yarn** is handed back to the sun.
J. **Note:** In the case where a **Food web card** Action Step requires students to hand **yarn** to multiple student-pairs, such as the Zooplankton and Juvenile & Shad Fish, have the students read cards in the order of the number displayed on the card's front. Handing first to one then the other.
K. **Direct** the students to carefully lay their yarn (and **plastic rings**) on the ground and look at the web that has been created by the interaction of organisms.

L. **Explain** that many factors can disrupt a food web: pollution, overfishing, and habitat destruction.

M. Next select a student to be "removed." What happens when they remove 1 species from the food web? (have that student take step back from the activity and drop the ring) Add this student back in and try this 2-3 times with different species. *What happens if we take out a species from the bottom of the food web? What about from the top of the food web?*

N. At the end – have students sit down and drop string. One of the teen educators should wind up the two different colored strings to avoid them being tangled.

Debrief - Ask students to reflect on the game. Prompt them with the following questions:

- *What did you observe during the game?*
- *Were there any species more connected to others? Less connected?*

Teaching tip: Wind up your yarn and collect the cards at the conclusion of this activity so that the materials are **ready to go** next time the class is taught!

Step 9: Food Chain Mobile

Project the **Aquatic Food Web Poster** as a guide up on the wall, students will cut out, color, and make their own **Food Chain Mobile**.

Go over the **Aquatic Food Web Poster** by reading the poster to the students starting at the bottom and working your way up. Remind them that a food chain is only one part of a food web. Go over the terms and common names of the animals listed.

Say: *The first level in our chain are the producers, decomposers and nutrients.* **Note:** Detritus is essentially dead things – decomposed material. *You can see that plants and algae make up this level in our*

food chain. The next level are the primary consumers, what animals do you see on this level? Next we have the secondary consumers, on this level the animals can be predators or prey. What does that mean? **Eat or be eaten!** *The top level is the tertiary level, what animals do you see there?*

Pass out the Food Chain Mobile cutouts. Using the supplies in the classroom plus the **construction paper strips**, let the students make a mobile by coloring and cutting out one animal from each of the levels up the food chain

- producers, decomposers and nutrients
- primary consumers
- secondary consumers
- tertiary (top level consumers)

For example, a student might use an algae from the producers cutouts, a duck from the primary, a sturgeon from the secondary and a heron from the tertiary. These should be glued or taped (check in with teacher about which one is best) onto the strips of construction paper in a line working from the bottom to the top! Arrows can be drawn to show the progression from one animal to the next. When done coloring and gluing/taping, have students clean up their work stations.

Note: Check in with teacher to see if they want these to be hung up in the classroom or taken home.* Any leftover materials can be taken home or recycled

Aquatic Food Web

The Detroit River and Lake Saint Clair are part of the Great Lakes basin that provides an important food source for the region and the country. Below are sample species in the Great Lakes Aquatic Food Web.

Top of the Food Chain

Tertiary (Top-Level) Consumers

Humans, certain bird and fish species.

Homo sapiens (Human)

Ardea herodias (Great Blue Heron)

Esox masquinongy (Muskie)

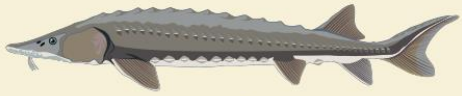
Micropterus dolomieu (Smallmouth Bass)

Stizostedion vitreum (Walleye)

Secondary Consumers

Smaller fish and other species. Some species may be both predators and prey.

Perca flavescens (Yellow Perch)



Acipenser fulvescens (Lake Sturgeon)

Neogobius melanostomus (Round Goby)

Primary Consumers

Smaller fish and other species. Some species may be both predators and prey.

Zooplankton (*Daphnia*, Waterflea)

Gammarus (Amphipod, Scud)

Dreissena polymorpha (Zebra Mussel)

Hirudinea (Leech)

Decapod crustacean (Crayfish)

Aythya valisineria (Canvasback)

Oligochaeta (Worm)

Physidae (Pouch Snail)

Chironomidae (Midge Larvae)

Ephemeroptera (Mayfly Nymph)

Osmerus mordax (Rainbow Smelt)

Base of the Food Chain

Producers, Decomposers & Nutrients

Macrophytes, phytoplankton and zooplankton (microscopic plants and animals) and detritus.

Valisneria americana (Wild Celery)

Macrophyte (Aquatic Plant)

Bacteria, Fungi and Detritus

Phytoplankton (Algae)

Not to scale. Adapted from *the Life of the Lakes* MICHU 09-400 Michigan Sea Grant, www.miseagrant.umich.edu

Step 10: Winding Down: A Quiet Food Web Poem

Say: *As our watershed science class ends today, I would like to end with a song/poem. Once we are seated and listening, I will pass out cards that combined make up a song/poem. What I like about reading this song/poem is it gives us time to reflect on what we have learned and appreciate the wonders of aquatic (water) ecosystems. I think it is important to remember that thinking creatively, like in these song/poems, allows us to be more observant as scientists.*

Project: *Links in a Food Chain Song*

Links in a Food Chain (full song/poem) can be found within this link (or on the zip drive). There are 6 versus of **Links in a Food Chain Song.** Have a different student read each verse (can either read from paper copy or from projector). They are numbered in the order that they should be read.

Note: The song/poem should be read aloud first and then sung to the tune of "the old lady who swallowed a fly."

Step 11: Closing Words

Thank you for your hard work today!

Remember: *Food webs show the interaction between organisms and how they depend on each other. A food chain shows a single line within the food web where energy from the food organisms eat goes up the chain to their predators.*

I really had fun with you! In previous lessons, we have investigated where water is and how it moves, and today we looked at what lives in these water bodies. I would like for us to think about how healthy ecosystems with lots of diversity (different living organisms) might indicate there is healthy water quality. Next time we come we are going to learn how to do a Stream Health Check Up and learn about how to tell if our water is healthy.

Remind the Students: *Please take home your* ***Food Chain Mobile*** *to share with your family or check in with the teacher to see if they can be hung in the classroom!*

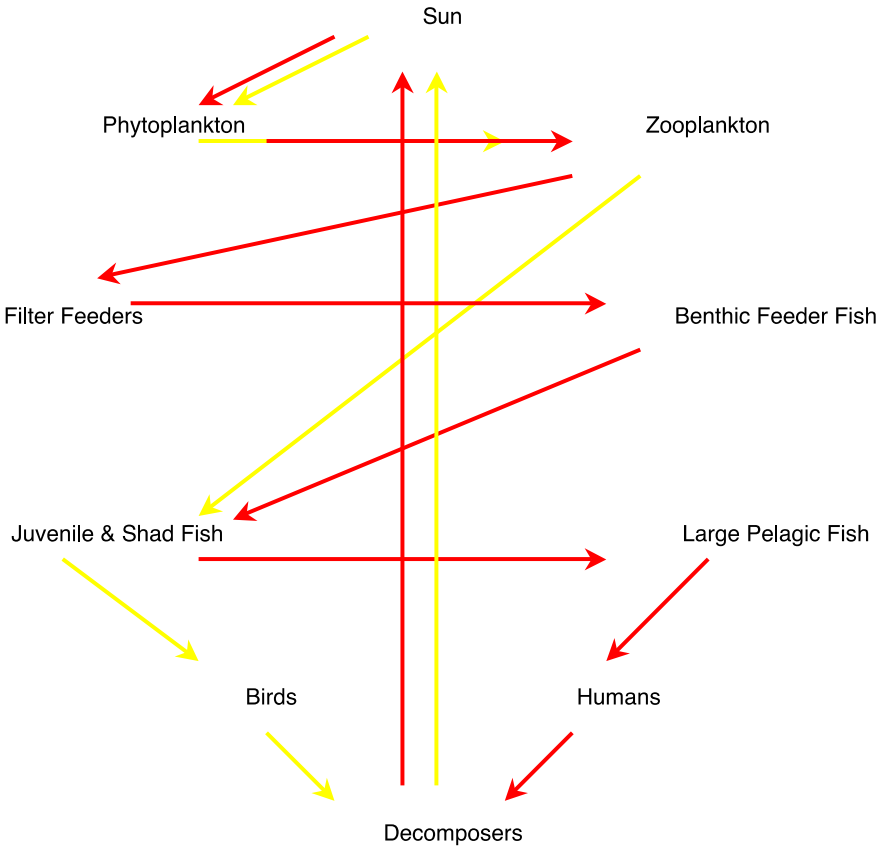
Close with answering any questions the students might have & collect/put away **student name tags** in the **folder**.

Reminder: ask the teacher about a space for the 3 "Stream Reach Channels" you will need for Lesson 5. These are spaces marked on the floor representing streams.

Important Background Vocabulary for Teen Teachers	
Glossary	
Ecosystem	A community of living organisms in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system.
Energy Transfer	The conversion of one form of energy into another, or the movement of energy from one place to another.
Food Chain	A food chain shows a single, connected path of energy flow through an ecosystem. Some animals only eat plants while some animals eat other animals. A food chain shows the different levels of eating within an ecosystem. The arrows show the flow of energy from one organism to the next. Most food chains begin with the sun.
Food Web	Food webs show many relationships and how food chains often overlap. The same three types of organisms are in food webs: producers, consumers and decomposers. Good food webs should also include the sun as the initial source of energy. We can get a very good idea of how plants and animals interact with one another by looking at, or constructing, a food web.
Organisms	An individual animal, plant, or single-celled life form.
Predators	An animal that naturally preys on others.
Primary Consumer	Primary consumers are located at the bottom of the food pyramid. Plants are the most common form of "producers."
Secondary Consumer	Secondary consumers are organisms, primarily animals, which eat primary consumers. They can be classified as carnivores, or meat eaters, and omnivores, which eat both plants and meat.
Tertiary Consumer	A tertiary consumer is a carnivore at the topmost level in a food chain that feeds on other carnivores. They feed only on secondary consumers.

Figure 2: Food Web Game Key

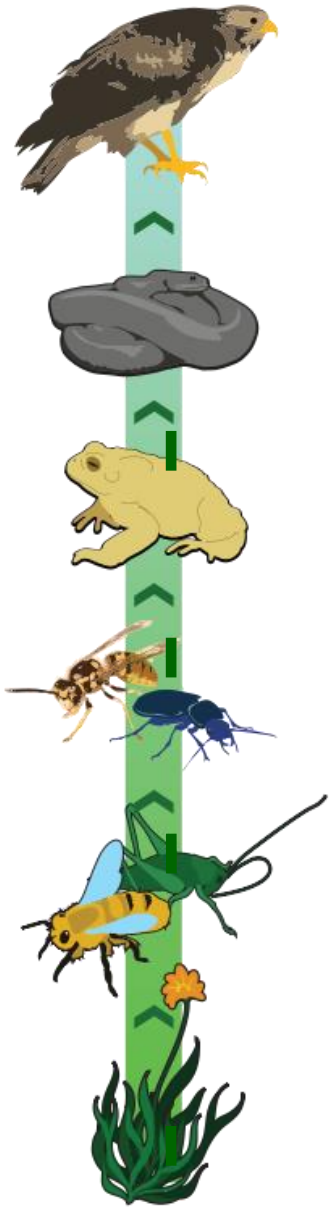
Diagram of Food Web Activity
(Potential enactment, shuffling cards will change pattern of red and yellow lines. Bird's eye view)



Background Information: Food Chains and Food Webs

All animals need energy to run, breathe, and hunt, and they get this energy by consuming food. Think about what you ate today: that is helping you walk, think, and read! Food chains and food webs are similar to each other, but they are not the same. We will explore the differences here.

A food chain shows a single, connected path of energy flow through an ecosystem. Some animals only eat plants while some animals eat other animals. A food chain shows the different levels of eating within an ecosystem. The arrows show the flow of energy from one organism to the next. Most food chains begin with the sun at the bottom. Let's examine the example on the right.



There are three types of organisms in a food chain: producers, consumers and decomposers.

1. **Producers**. These organisms absorb the sun's energy and convert the energy into food for themselves, allowing them to grow larger, make flowers and fruit, etc. An example of a producer is a plant, such as the flower in the picture.

2. **Consumers**. These organisms, mostly animals, can be split into a few categories:

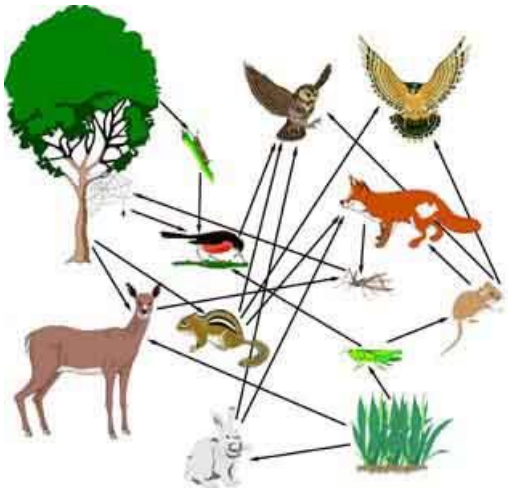
(Illustration By LadyofHats (Own work) [CC0], via Wikimedia Commons

- **Primary consumers** only eat plants, so they are called **herbivores**. The primary consumers in the picture are the bee and grasshopper.
- **Secondary consumers** eat primary consumers. Many secondary consumers also eat plants, which makes them **omnivores** (meat and plant eaters). The secondary consumers in the picture are the wasp and beetle.
- **Tertiary consumers** eat the secondary consumers and are usually **carnivores** (meat eaters). The tertiary consumers in the picture are the frog and snake.
- **Quaternary consumers** eat the tertiary consumers and are **carnivores**. The quaternary consumer in the picture is the hawk. In this picture, the food chain ends with the hawk, which claims the title as the top carnivore.

3. **Decomposers**. These organisms turn dead material (such as a fallen tree, or a dead hawk) into soil and recycle nutrients so they can be re-used by producers to create food. Decomposers

are not shown in this picture, but they live underground where the flower's roots are. Decomposers include earthworms, small soil beetles, fungi, and bacteria.

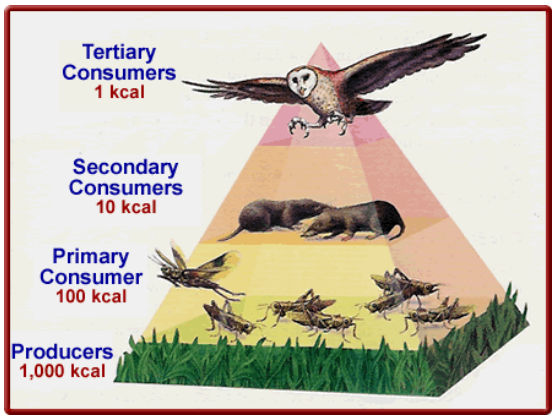
A food web shows how food chains overlap. The same three types of organisms are in food webs: producers, consumers and decomposers. Good food webs should also include the sun as the initial source of energy. We can get a very good idea of how plants and animals interact with one another by looking at, or constructing, a food web. How is the picture at the right different from the food chain picture above?



http://www.bigelow.org/edhab/images/food_web.jpg

In the picture to the right, there are multiple lines from one organism to another. We see that the grass in the bottom right hand corner is eaten by more than just the grasshopper; it is also a food source for the rabbit and the deer. In this food web, we see that there are many top carnivores, not just one. We can identify three: the owl, the hawk and the fox. We can also note the owl, the hawk, and the fox are shown as secondary and tertiary consumers in this food web. The deer is a primary consumer because it only feeds on plants, which makes it an herbivore. As you can see, food webs are more complex than food chains, but they represent what goes on in real life much better than a food chain!

An energy pyramid shows how energy moves throughout an ecosystem. As you move up the pyramid levels, approximately 90% of the food's original energy is lost from level to level because animals must use their own energy to consume and digest food. The consumers at the top of the pyramid do not have as much energy available to them because their food, another animal, is simply not very good at converting the food it eats into energy in its body.



http://www.mlms.logan.k12.ut.us/~mlowe/EnergyPyramid.gif

In the picture above, we can see that energy (shown here as kilocalories (kcal)) is lost as we move up the pyramid from producer to tertiary consumer. This above diagram also gives you an idea that it takes a lot of plants to support the predators at the top of the pyramid, such as this owl.

Lesson 5: *Stream Scientists - Understanding Stream Health*

Guiding Question	How can aquatic freshwater organisms like benthic macroinvertebrates be a water quality indicator?
Student Learning Objectives	• Students will be able to identify water quality indicators (i.e., benthic macroinvertebrates). • Students will understand pollution tolerance levels as indicators of water quality.
Lesson Length	1 hour
Lesson Outline	1. **Introduction (2-3 min)** 2. **Benthic Macroinvertebrates (20 min)** 3. **Stream Scientists and Sorting (25 min)** 4. **Writing our Acrostic Water Poems & Common Stream Critters Coloring Sheet (12 min)**
Materials	✓ **Macroinvertebrate Identification Flashcards (20)** ✓ **Macroinvertebrate Identification Key** ✓ **(3) Envelopes with sorted BMI Paper Samples (2 sets)** ✓ **Macro Mania Sorting Sheet Poster** ✓ **"How tolerant…" Answer Sheet** ✓ **Masking tape** ✓ **Stream labels (2 sets)** ✓ **Example Acrostic Poem** ✓ **Flash drive with videos** ✓ Markers**(Not provided in kit) ✓ **White paper, 8.5 x 11** ✓ **Common Stream Critters Coloring Sheets** (take home activity)

Step 1: Prepare for Your Lesson

- Review and practice the lesson before arriving to teach.
- Get projector & speakers set up in order to show 2 videos. Make sure sound works ahead of time.
- If you did not ask at the end of Lesson 4, then check in with the teacher about creating three "Stream Reach Channels."
- Then, before class, build 3 stream reaches. The stream reach (this means a section of stream) is a lane marked with **masking tape**, (or the area between rows of desks). They are long columns.
- The **BMI Paper Samples** should already be sorted into 3 separate **Envelopes** labeled Stream 1, Stream 2, and Stream 3 (Extra set = Stream A, Stream B, and Stream C). These will be the BMIs for each of the stream reaches. If they are not already sorted correctly, follow the **"How tolerant…" answer sheet** for which insects go into which stream **envelope**.
    - You will have a total of 6 envelopes (or 2 sets for this activity). The second set (Stream A, B & C) is for students to do a round 2 if time!
- Using Stream 1, 2, 3 envelopes, go ahead and put the insects into the stream reaches (place them along the **masking tape**). It does not matter which group of students is put into which stream reach. Group 1 goes in one stream, group 2 in another and group 3 in the final.
- You will have **stream labels** to mark the stream reaches for the stream sorting activity, these will be used later.
    - **Excellent Water Quality or Very Intolerant of Pollution**
    - **Fair-Good Water Quality or Moderately Intolerant of Pollution**
    - **Poor Water Quality or Very Tolerant of Pollution**
- Put out student name tags

Step 2: Introduction & Check for Understanding

Ask: *Think back to the last class where we played a food web game and built a food chain mobile. Who wants to share something they learned about food webs or food chains?* (Ideally you want students to share that organisms are interconnected.)

Answer: The activities we did showed the way that energy is moved up the food chain or within the food web. Food webs

show the relationship between organisms and how they depend on each other. A food chain shows a single line within the food web where energy from the food animals eat goes up the chain to their predators.

Explain: *Today we will be learning about specific types of aquatic (freshwater) organisms. We will learn how these organisms can survive in water that has different levels of water quality. Just like air pollution can make it hard to breathe, water pollution can make it hard for aquatic (benthic) organisms to survive. Think back to the game in Lesson 2 where an indicator species (the frog or the salamander) meant that the water was healthy or unhealthy based on their tolerance level of low oxygen or pollution.*

Today, we are going to pretend we are stream scientists. As scientists, we can get clues for how clean the water is without running chemical tests. We do this by seeing what types of aquatic bugs (benthic macroinvertebrates – BMI) are present in the stream. Some BMIs (which is what we'll call these organisms) love clean water, so if we find lots of these types in the water, we might expect the water quality to be quite good. However, if we only find the types of BMIs that can tolerate, or live with pollution and none of the BMIs that cannot tolerate pollution, we might wonder if the water is clean! So, what we are going to create today are some streams with BMIs in them and together we will determine if the streams are healthy or not.

Write guiding question on the board:

- How can aquatic freshwater organisms like benthic macroinvertebrates be a water quality indicator?

Step 3: Introduce the Concept of Benthic Macroinvertebrates

A. **Introduce today's lesson:** *Today, we will explore which types of critters live in healthy streams, specifically Benthic Macroinvertebrates. Benthic Macroinvertebrates are small organisms that live primarily on the bottom of streams. You can see them without a microscope and they do not have backbones (vertebrae).*

B. **Explore BMIs:** *Pass out the* ***Macroinvertebrate Identification Flashcards*** *and let students explore what these organisms look like. For many students, the idea that things smaller than fish live in streams will be new!*
C. ***Ask:*** *Who wants to share their benthic card and a fun fact about it?*
D. **Explain:** *If the stream is healthy and the water quality is high we have a* ***Happy Benthic Habitat,*** *which is a diverse community of benthic macroinvertebrates (BMIs). These animals live in the riffles (places where water passes over rocks creating "white" water) in streams. They like these places because they are high in dissolved oxygen. As you look through the* **Flashcards**, *some of these BMIs are VERY sensitive to pollution, while some are moderately sensitive, and some are tolerant of poor water quality conditions.*

Step 4: Watch the Videos

Share: *I want to start by showing you two videos that dive deeper into understanding BMIs.*

Project the following 2 video links

1) This first video highlights what BMIs are and what their role is in monitoring stream health (specifically in the Pennsylvania area)
Link:
https://www.youtube.com/watch?v=1HysvsXcmVI

2) Next, this video goes in depth on the method of sampling for BMIs
Link:
https://www.youtube.com/watch?v=ieG2H52nxkQ

Ask: *Was there anything from the videos that surprised you? How many of you would like to one day go into a stream and look for critters yourself?*

Step 5: Sampling the Stream

For this next activity you will be using the BMIs that you've already distributed to the three stream reaches from the **envelopes** containing the **BMI Paper Samples**, plus the **Macro Mania Sorting Sheet handouts (8.5x11)**. There are three different streams that you've made that will represent varying water quality:

poor, fair-good, excellent. The **stream labels** for the streams will be used later.

Say: *The stream reach (this means a section of stream) is a lane marked with **masking tape,** (or the area between rows of desks). They are long columns.*

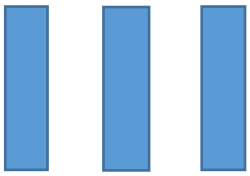


Figure 3: Stream Reach 1,2,3 can be marked with masking tape lines. Or choose space between desks.

Step 6: Let's Be Stream Scientists, Today!

Together we are going to become Stream Scientists and assess the health of the 3 streams here on the floor.

Ask: *Has anyone been to the doctor and had your temperature taken? Stream scientists are kind of like doctors. They go to the stream and run tests to gather information about the health of the water. As stream scientists, we will also gather information to see if we can figure out how healthy these stream reaches are.*

Show the **Macro Mania Sorting Sheet Poster** and explain how scientists use it. Once scientists have identified the insects, they have a good idea of the health of the streams as there are specific insects that can only tolerate clean water.

Explain: *After collecting the BMI, the scientist identifies them using a key (like the **flashcards**) then sorts it like the **Macro Mania Sorting Sheet handout (8.5x11)**. Today we are going to do this too.*

I'm going to split you into three teams. Your team will look at the BMIs that are in the stream reach and determine which of the three stream types your BMI are from. Once your team has completed the activity, your team will decide which stream label best describes

where your BMI live. You will come up to me and get a **label** *and mark your stream.*

- **Excellent Water Quality or Very Intolerant of Pollution**
- **Fair-Good Water Quality or Moderately Intolerant of Pollution**
- **Poor Water Quality or Very Tolerant of Pollution**

Directions:

1. Split the class into 3 teams and assign them to a stream (feel free to ask teacher if you need assistance splitting them into 3 groups).
2. Give students a **Macro Mania Sorting Sheet handout (8.5x11)**.
3. Each team will look at the BMIs in their stream and determine the health of their stream. When finished, the team will decide which stream type their BMIs are indicating. Once they agree, they will get a **stream label** from the teen teacher to mark their stream and wait for the other groups to finish.
4. **Round 1**: Students get **envelope** labeled 1, 2, or 3
    i. If students have time, student groups get an **envelope** labeled A, B, or C to complete a second round of the activity.
5. **Clean up:** All the BMIs should be collected from each stream reach and put back in the corresponding **envelope**. Then, the **envelope** should be returned to the teen teacher.
6. **Note:** Teen teachers can remove tape from the floor at the end of the activity

Step 7: Determine Stream Health

Review: Once the students have completed the activity and are seated, review the three categories of water quality in the streams.

Ask: *Using your* ***Macro Mania Sorting Sheet handout (8.5x11)*** *and looking at our streams, who can tell me one BMI that is intolerant, meaning it can't survive if there is a lot of pollution?*

Answer: stonefly, mayfly, caddisfly, snail (opens to the right), riffle beetle

Follow up: *If this BMI is intolerant of pollution what does that tell us about water quality? Is it poor, good, or* ***excellent****?*

Ask: *Who can tell me one BMI that is fairly intolerant of pollution?*
Answer: dobsonfly, crayfish, dragonfly, cranefly, sowbug, black fly, scud, filtering caddisfly
Follow up: *If this BMI is fairly intolerant of pollution what does that tell us about water quality? Is it poor, **good**, or excellent?*

Ask: *Who can tell me one BMI that is tolerant of pollution (meaning it can live in streams with a lot of pollution)?*
Answer: aquatic worm, pouch snail (opens to the left), midge
Follow up: *If this BMI is tolerant of pollution what does that tell us about water quality? Is it **poor**, good, or excellent?*

Share with the students your favorite benthic. Use the example below if you don't have a favorite.

Example: *My favorite benthic is the caddisfly – this BMI is intolerant of pollution and is found in streams that have excellent water quality. This benthic is my favorite because of the creative casing it makes to protect itself. It also uses this casing to wiggle around in and move water around to get dissolved oxygen to breath.*

Teaching tip:
At the conclusion of the activity, have the students assist you in putting the **BMI Paper Samples** back in their envelopes (use the **Macro Mania Sorting Sheet handout (8.5x11)** as a guide). Make sure the BMIs are in the correctly labeled envelopes at the end of the game. That way the next class will have organized materials! Don't forget to remove tape if you used it.

Debrief:

Ask: *What did you notice as a difference between the BMIs in each of the streams?*

Answer: The BMIs are getting hardier or more worm-like as you go from intolerant to tolerant with pollution.

Ask: *How can monitoring a stream for BMI provide information about water quality?*

Answer: The BMIs provide us with a clue as to how polluted the stream might be or that the level of oxygen in the stream is low.

Step 8: Celebrating Water through Poetry! (If time!)

Say: *Part of being a watershed steward is also to have fun and be creative! We have read some poems over the last few lessons. Since we have time, I would like to share an acrostic poem I wrote about water!* Share the **Example Acrostic Poem.**

Directions: Pass out **blank white paper** and have students get out **markers.** Instruct students to write and/or illustrate an acrostic water poem. You can explain an acrostic poem builds off of the spine of a word like "WATER". The word is written vertically on the page. Then, for each letter W-A-T-E-R a related water themed line is written starting with the associated letter. Have students write a 5-8-line acrostic poem or draw a picture about water (this can be what they like to do with water, what water looks like, anything about water!) Show the students the **Example Acrostic Poem** or write WATER on the board as shown below. Encourage students to create their own!

W-e all rely on water **A**-lways present above, below and around us **T**-otally fun to swim in summer **E**-xcellent water quality keeps us happy **R**-eally important, let's keep it clean

Illustrate: As students finish, they can illustrate their poems on the same page.

Share: Have students take their poems home to share with their families! Also, hand out **Common Stream Critters, Coloring Sheet.** *You can take home these BMI's to color. After looking at the* **Flashcards** *today, what color was your BMI?* Most do tend to be brownish. ***Why?*** To camouflage themselves in the stream.

Teaching Tips!

- To help students think creatively (and avoid some writers block) you might want to write some words on the board that remind the class of water (this will also help them with the spelling of some of the new vocabulary words) examples: ripple, blue, flowing, liquid, etc. Give more examples.

Step 9: Closing Words

Thank you for your hard work today! I really had fun with you! We now have worked hard to be stream doctors! It is important to think about how healthy a stream is by looking at the number and type of BMIs. Next time we will take everything we have learned so far and think about how we can help keep waterways clean and healthy in our communities. We will, as stream doctors and stream scientists, explore solutions to help prevent pollution.

Close with answering any questions the students might have & collect **name tags**/put in **folder**.

Important Background Vocabulary for Teen Teachers	
Glossary	
Adaptation	Adaptation is a change or the process of change by which an organism or species becomes better suited to its environment.
Benthic Macroinvertebrates	Benthic (bottom) macro (can be seen with our eyes) invertebrates (no spine) are small animals living among stones, logs, sediments and aquatic plants on the bottom of streams, rivers and lakes (in the benthic zone). They are large enough to see with the naked eye (macro) and have no backbone (invertebrate).
Dissolved Oxygen	Dissolved oxygen is the amount of oxygen that is dissolved (and hence available to sustain aquatic life) in a body of water such as a lake, river, or stream.
Environment	The environment is the surroundings or conditions in which a person, animal, or plant lives or operates.
Freshwater	Freshwater is natural water that is not salty or brackish.
Organism	An organism is an individual animal, plant, or single-celled life form.
Tolerant	A plant or animal that is tolerant can endure specified conditions or treatment.

Lesson 6: *Stewardship-Conserving and Protecting our Waterways*

Guiding Question	What are specific ways we can help protect our waterways?
Student Learning Objectives	• Students will consider how they can be stewards of a watershed. • Students will be able to list specific best management practices for keeping the water in their everyday lives clean and healthy. • Students will generate ways of sharing their watershed knowledge.
Lesson Length	1 hour
Lesson Outline	1. **Introduction (2-3 min)** 2. **Water Conservation Read Aloud (20 min)** 3. **Sum of the Parts Activity (20 min)** 4. **Droplets of Change (10 min)** 5. **Closing and Assessment (5 min)**
Materials	✓ **Book*: Save Our Stream!*** ✓ Sum of the Parts Activity ○ **White paper, 8.5 x 11** ○ **Non-Point and Point Source Pollution Cards (shared with Lesson 2)** ○ **Beads & Cup** (shared with Lesson 1, 2, & 3) ○ Markers / crayons *not included in kit ○ **Example river** ✓ **Watershed Science Extension Activities handout** for teacher ✓ **Water droplet questions** ✓ **TRY Participant Assessments and TRY Assessment Answer Key** ✓ **Example Poem *Raindrops!***

Step 1: Prepare for Your Lesson:

- Review and practice the lesson before arriving to teach.
- Make sure you have class copies of the **TRY Participant Assessments**
- Get out student name tags

Step 2: Introduction & Check for Understanding

Begin by introducing yourself again and let your students know that today is your last class with them.

Write the guiding question on the board:

- What are specific ways we can help protect our waterways?

Review what you have covered over the last few class periods. Use the comprehension check questions below to encourage students to share what they learned (not just what they did!).

Comprehension Check Questions: Ask 2 questions to refresh students' knowledge – try and ask new questions for this lesson!

Ask: *What are some stages of the water cycle?*
Answer: condensation, evaporation, precipitation, transpiration, runoff, groundwater, collection

Ask: *What does precipitation mean?*
Answer: Any form of water that falls from clouds and reaches the Earth's surface. Precipitation includes rain, snow, sleet, hail, and other forms.

Ask: *What's one way you can save water in your home?*
Answer: Don't flush the toilet every time you go. "If its yellow, let it mellow." Turn the water off when brushing teeth. Keep a jug of water in the refrigerator if you want cold water.

Ask: *What is runoff?*
Answer: the draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.

Ask: *What helps scientists determine if a river is clean?*
Answer: The living organisms in it, Benthic Macroinvertebrates.

Ask: *What is the difference between a food web and a food chain?*
Answer*:* The food web connects all living things where the food chain is a direct connection between particular animals**.** The food chain is part of the food web.

Step 3: Introduce Stewardship

Explain: *Today we will put together all of the pieces we have learned about water and water health, and we will think about specific ways we can conserve and protect our local waterways. We want you to help your community keep rivers, streams and lakes healthy!*

Step 4: Understanding Stewardship – Read Aloud

To start we are going to read the **Book: *Save Our Stream!*** *to get our minds thinking about ways we can protect water. Today we're going to be thinking about all of the cool things we have learned about water!*

We want to think about the following questions:

- *How can I conserve water?*
- *How can I keep water clean (so we can drink and play safely)?*
- *How do I know water might be clean or not?*
- *How can we SHARE what we have learned with our community at school?*

Read: *Save Our Stream!*

After the story: *How does the story connect with the 5 lessons we've had with water? What's one new thing from the book that you learned? Are there activities in the book you might share with your family?*

Teaching Tips!

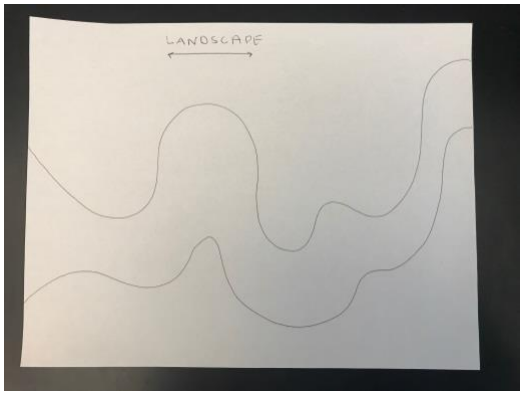
- If the students are sitting on the ground it may be helpful if you kneel or sit in a chair so you are off the ground and students in the back can see you and the book.
- After each page pause and let the students look at the pictures and/or ask questions.
- Read **slowly** and clearly. Read the notes along with the story.

Step 5: Sum of the Parts Activity

1. Tell the students they are going to create a river.

2. Give each student an **8.5x11 piece of paper** and have them get markers or crayons from their desk.

3. Have the students turn the paper so that it is landscape. This is important because at the end of this activity we will line up all the students' stream reaches to create a river. Show them the **example river** like below.



4. Instruct the students to create a river across their page – the river needs to start and end on the ends of the page.

5. Have the students decide what is "upstream" and what is "downstream" on their paper.

6. On the board write the "required" and "optional" items for their landscape. Encourage the students to get creative. Give them about 10 minutes to draw.

7. **Do not add the bead values to the board until the students are done with their drawings.**

Required	***Optional***
• *River* • *1 House (+1 bead)* • *1 Farm (+2 beads)* • *Road (+1 bead)* • *Wastewater Treatment Facility OR Factory (+2 beads)*	• *Park (-2 beads)* • *Forest (-1 bead)* • *Animals (+2 beads)* • *Plants and trees (-1 bead)*

8. Go around the room and write a number on the top right-hand corner of each student's paper.

9. Have them line up their numbered river landscapes in numeric order (1, 2, 3 …)on the floor based on their drawing to create a larger river.

10. Take a few moments for students to share their landscape. They should identify any features on their landscape that pollute or add materials to the waterway or actions that would help keep pollutants from their waterway.
    a. Pick 2-3 types of pollution the students list and ask students ways they think they could prevent pollution from getting into the water – then, brainstorm other possible solutions.
    b. If students are stuck you could remind them of good practices the children took in the **Book: *Save Our Streams!*** Or use the tips from the best management practices list in the table.

11. **Now:** Write on the board the number of beads for each landscape feature students will receive in the activity. See the table above.

12. **Note:** As you go to each numbered landscape in this activity, if a student has any form of "pollution" – give them the listed number of **bead(s)** in a **cup. (This one cup will be passed down the line**

of students as they do this activity.) If a student has drawn plants and trees along their river (to prevent "pollution") take the bead out of the **cup**. As a reference, use the **nonpoint and point source cards** (also from Lesson 2) as well as tips from the best management practices table in the background information section of this lesson. If there is a form of pollution or prevention drawn on a student's landscape that isn't listed on the board, have the class help you assign a bead value. Add it to the board.

13. **Begin:** *Now we will look at your landscape and move downstream beginning with Number 1.*

14. **Ask Student with "Number 1":** *What features on your landscape cause pollution?* (The other students can help in evaluating.) *What features help keep pollution out? Beads will be added or subtracted as we move from stream to stream. You will pass the cup with beads added or taken out as pollutants are added or deleted. Please announce what kind of pollutant is represented by the **bead** before you pass it on. Number 1 will pass their **bead**(s) in the **cup** to Number 2, Number 2 will pass everything to Number 3 and so on until the last student is holding all the **beads** in the **cup**.*

Wrap up: After all the items have reached the final student, discuss the activity. *How did those students toward the middle or at the end of the river feel as they looked at the number of beads in the cup they received? Could a student downstream be affected by the actions of a student upstream? Could upstream users alter the water quality for those downstream? What might indicate whether the water is healthy or not?*

Step 6: Celebrating Water through Action

Say: *Part of being a watershed steward is also to review what we have learned so far and think of creative ways to make change. Let's have fun and be creative! We will be answering the following questions, on our **water droplet questions** and creating our droplets for change.*

1. *What is one fact about water or water quality that I have learned?*

2. *What is one action or practice I can adopt to protect waterways and prevent pollution?*
3. *What is one question I still have about water?*

Explain: *A droplet of change is each of us doing one small thing that hopefully will result with your family or community making big changes – or a river of change! An example might be the student who suggested we no longer use plastic straws as they aren't recyclable and they end up in the landfill. This student was able to get some fast-food restaurants to stop using plastic straws. Now the shops no longer have straws or they have paper straws that can be recycled.*

Use the questions to help the students think about what they want to do for their droplet of change. You can start by asking students the questions and writing a few of the ideas on the board as examples.

Give students 10 minutes to work on these. Explain they can work quietly on these more after they finish the TRY participant Assessment as well.

Step 7: TRY Participant Assessment

Give the **TRY Participant Assessment** to students and collect when finished. Go over the answers with your class. An **TRY Participant Answer Key** is in your kit as a reference. Remember, you will need to give the tally sheet of these assessments to the TRY Coordinator within one week of finishing today's class.

Step 8: (If time) Read the Example Poem *Raindrops!*

Step 9: Closing Words

Say: *Thank you for your hard work today! I have had fun working with all of you! We have learned so much about water and how to help conserve and protect the waterways we live near. I hope we can all be good water stewards every day, every action counts!*

Close with answering any questions the students might have, collect **name tags,** and put them in **folder**.

Give extension activities handout to the classroom teacher!

	Important Background Information for Teen Teachers Solutions / Best Management Practices for Non-Point Pollution
Source	Best Management Practice
Roads and Streets	• dispose of paints, solvents, and gas cans at approved waste sites, not in storm drains or street gutters • fix your car and truck if you have oil or fuel leaks
Agriculture	• read and follow labels before using chemicals, fertilizers and pesticides • fence areas where cows might damage the stream banks or add manure to the stream
Logging	• prevent dirt from reaching streams and lakes by building terraces • leave plants and trees as a grassy zone in areas by streams
Construction	• put up a plastic sheet to control dug up soil from getting into streams or eroding hillsides • plant ground cover to reduce erosion
Residential	• only use fertilizers when a soil test reveals it needs it • wash cars on the lawn • cut lawn no shorter than 3" in height, cut not more than 1/3 of the length of the grass blades in any one cutting and leave the clippings on the lawn

4-H20 Lesson and Activity References

Lesson 1

Modified from: 4-H20 Ambassadors Program – University of Kentucky

Lesson 2

Modified from: 4-H20 Ambassadors Program – University of Kentucky
Modified from: The Nature of Teaching - Purdue Extension

Lesson 4

Aquatic Food Web Poster modified from: Life of the Lakes, MICHU 09-400, Michigan Sea Grant, www.miseagrant.umich.edu
http://www.miseagrant.umich.edu/lessons/lessons/by-broad-concept/life-science/food-chains-and-webs/

Brown Trout Food Web Poster:
http://www.bbc.co.uk/schools/gcsebitesize/science/triple_ocr_21c/further_biology/ecosystems/revision/6/

Background Information: Food Web and Food Chains: www.Sciencebob.com

Lesson 5

Modified from: Macroinvertebrate Mayhem – Minnesota Department of Natural Resources

Common Stream Critters, BMI coloring, Christine Elder:
http://christineelder.com/wp-content/uploads/2015/05/stream-insects-page.pdf

Lesson 6

Modified from: Sum of the Parts Activity - Project WET

Book: *Save Our Stream!* Colin Polsky & Jane Tucker, illustrations by Julia Miner

4-H2O Program – Standards

Lesson 1: The Water Cycle

Grade 3-4

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes

- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-ESS2-1),(5-ESS3-1)

Lesson 2: Watershed Wise

Grade 3-4

Science and Engineering Practices

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Crosscutting Concepts

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- A system can be described in terms of its components and their interactions. (5-ESS2-1), (5-ESS3-1)

Lesson 3: Exploring Water Use and Conservation

Grade 3-4
Science and Engineering Practices
Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

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Disciplinary Core Ideas
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- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

Crosscutting Concepts
Systems and System Models

- A system can be described in terms of its components and their interactions. (5-ESS2-1),(5-ESS3-1)

Lesson 4: Aquatic Food Chains and Webs

Grade 3-4
Ecosystems: Interactions, Energy, and Dynamics- **HS-LS2-4.**
Use mathematical representations to support claims for
Using Mathematics and Computational Thinking
Science and Engineering Practices

- Use mathematical representations of phenomena or design solutions to support claims.

Disciplinary Core Ideas
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level..

Crosscutting Concepts
Energy and Matter

- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Lesson 5: Stream Scientists – Understanding Stream Health

Grade 3-5

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. *(secondary to 3-LS4-4)*

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS4-2), (3-LS4-3)

Scale, Proportion, and Quantity

- Observable phenomena exist from very short to very long-time periods. (3-LS4-1)

Systems and System Models

- A system can be described in terms of its components and their interactions. (3-LS4-4)

Lesson 6: Stewardship- Conserving and Protecting our Waterways

Grade 3-4

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. (K-ESS3-3)

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. *(secondary to K-ESS3-3)*

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed and used as evidence. (K-LS1-1)

Cause and Effect

- Events have causes that generate observable patterns. (K-ESS3-3)

Systems and System Models

- Systems in the natural and designed world have parts that work together. (K-ESS2-2),(K-ESS3-1)