Lesson Summary

Program Title: Aquatic Food Web

Duration: 1.5 Hours

Grade Level: Kindergarten (10-15 students at each station,) total of 50 students maximum

Abstract:

Students will learn the importance of aquatic animals found in rivers through various interactive activities. Each activity will highlight the role of aquatic animals in a river ecosystem. Students will understand the relationship between aquatic animals as prey and predator. Through an aquatic macroinvertebrates investigation, students will learn that the presence of many different aquatic animals is also a good indication of water quality, dependent upon the specific aquatic animal and its pollution tolerance level.

Students Will Be Able To (SWBAT):

- Act out how energy moves through an aquatic ecosystem.
- Observe various aquatic macroinvertebrates collected from a local water source.
- Recognize the effects of pollution on an ecosystem and how different aquatic animals have varying tolerance levels.
- Actively discuss methods of stewardship that they will be encouraged to take part in as they are exposed to daily choices they can make to positively impact waterways.

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Theme:

A river or lake is a special habitat for animals of all sizes which all need clean water to survive. Humans have a role in keeping water habitats clean, so animals can live there!

Goals:

Students will become more knowledgeable with aquatic food webs through both games and observations. They will apply their new understanding to direct actions they can adopt to become stewards of their local waterways.

- Increase awareness of the diversity of aquatic animals in local waterways.
- Recognize how energy flows through a food chain, beginning with solar energy.
- Understand the impacts of pollution on local waterways.
- Identify two or more daily habits that will have a positive impact on local waterways.

Objectives:

Students Will Be Able To:	**Educator verification method**
1. Describe how aquatic animals are significant parts of the water ecosystem.	Students are able to describe a food chain including aquatic animals.
2. Identify and compare different aquatic animals' tolerance to pollution and express that their presence is an indicator to the health of the waterway.	Students are able to give examples of aquatic animals and how they are indicators of water quality.
3. Apply daily habits that help improve water quality in their local waterways.	Students share the daily habits they will adopt to become water stewards.

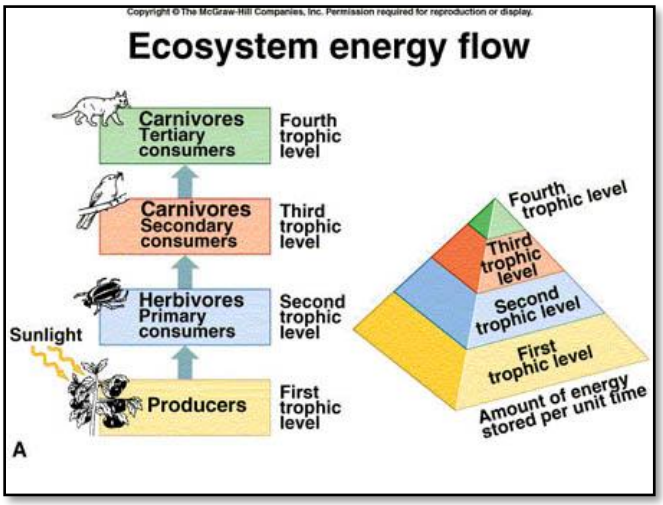
Teacher Background:

Waterways are dynamic features; the constant flow of water shapes the land and provides habitat to many species of plants and wildlife. The aquatic animals, from small insect nymphs to larger mammals, are an important part of a water ecosystem. These organisms are integrated into a diverse food web system, keeping the balance of life going. Certain aquatic animals also indicate the presence of pollution in water as different species have varying tolerance levels to pollution. The health of the waterway can be determined by the aquatic animals observed. The presence of pollution in our waterways is mostly due to storm water (water from rain or snow) running over the many impervious surfaces in our urban areas, i.e. bacteria in dog waste, excessive fertilizer and pesticide use, and motorized vehicle oil leaks. These pollutants have a damaging effect on water quality and in turn harm the inhabiting aquatic animals. Stewardship through pollution prevention is necessary to conserve our water ecosystems.

Background information:

- Concept of energy and the trophic levels in a food chain (Plants get their energy from the sun.)

(See figure)



- Concept of habitat (Living things need food, water, shelter, space.)
- Concept of waterways (Rivers, lakes, ponds.)
- Watershed definition: land that sheds water to the lowest point.
- Basic idea of some types of animals that live in the water: fish, insects, mammals.
- Aquatic macroinvertebrates are organisms that live underwater in our streams and rivers, lack a backbone, and can be seen without a microscope.

Materials/Preparation:

1. **Food Web Activity**

Materials

- 19 Cubes with pictures of aquatic animals
- 20 Flags each with a picture of an aquatic plant or animal
- Large poster of the same images of plants and animals with space for students to draw energy arrows to show their journey

Preparation

- Locate open area with enough space to spread out flags.
- Place matching cube at each flag.
- Lay out producer (i.e. plant) flags together in a line as the starting point.

2. **Aquatic Macroinvertebrate Observation**

Materials

- Bins
- Spoons
- Magnifying Sheet
- Holding containers
- Identification sheets
- Laminated inquiry questions list for each table
- Aerator – for educator only
- Net – for educator only
- Large bucket to hold collected water sample and water macroinvertebrates – for educator only

Preparation

- Use large bucket to fill with water sample.

- Use net to dip in waterway near aquatic plants. Shake the net gently next to aquatic plants, underwater, to dislodge macroinvertebrates from plant into net.
- Invert net into large bucket to release collected invertebrates.
- Repeat until your collection size is adequate.
- Spread out bins, approximately equidistant from one another, to allow students to rotate through in stations.
- Place equal amounts of spoons, magnifying glasses, holding containers, and identification sheets per bin station.
- Evenly distribute water sample and aquatic invertebrates into bins.
- Rotate aerator through each bin as needed.

3. Pollution Tolerance Game

Materials

- 30 Flag football belts
- 5 Brightly Colored Vests
- Cones

Preparation

- Locate open area to create boundaries with cones.

4. Stewardship Activity

Materials

- Pictures for where items should go
  - 6 sets of a picture of a trash can
  - 6 sets of a picture of a recycling bin
  - 6 sets of a picture of a compost bin
  - 6 sets of a picture of a storm drain
- Pictures for instructor to hold (1 of each):
  - River
  - Oil on street
  - Soap on street
  - Dog waste
  - Leaves
  - Banana peel
  - Apple core
  - Half eaten sandwich
  - Empty chip bag
  - Straw
  - Food wrapper
  - Empty plastic water bottle
  - Milk carton
  - Empty plastic food container

Preparation

- Set up 6 stations with one picture of a trash can, recycling bin, compost bin, and a storm drain for each student to gather around.

Introduction (in whole group):

Today we are going to learn all about a water habitat including the animals that live there. We are going to talk about how aquatic animals, or animals that live in or near water, are important for keeping everything in the waterway in balance. Aquatic animals are also able to tell us if the water in the river is healthy. We will get to play games and observe real life animals to help us learn all about waterways and what they need to be healthy.

Linkages to consider:

- What type of animals do you think live in the rivers and lakes?
- What do the animals in the water need to survive?
- Can you think of any types of water pollution that might make animals sick?
- What type of animals are hunters in the water? What do they eat?
- Have you ever seen an insect in the water? What are water insects eating?
- How does a plant get its energy?
- How does a water insect get its energy?
- How does a fish or bird get its energy?
- What can we do to keep water clean so that animals can live there?
- Do people need clean water too?

1. **Food Chain Activity (20 minutes): small group station**

Background: Define a food chain or ask if anyone knows what a food chain is: A food chain is a single sequence of energy being transferred into living organisms from producer to consumer. (Kindergarten friendly definition: Plants get their energy from the sun, some animals eat plants, some animals eat other animals; plants and animals are connected through the food they eat to get energy). Example below:

Sun --energy-> **Duckweed: a plant that loves water (producer)** --energy-> **insect larvae/babies (consumer)** --energy-> **Salmon Fry (consumer)** --energy-> **Heron (consumer)**

A food web is many food chains connected together. For example: using the food chain above, salmon fry can also be eaten by larger trout creating another food chain and adding to the food web. A river food web includes many types of plants, invertebrates, fish, mammals, and birds. The presence of aquatic animals is important in maintaining the health of this ecosystem.

This activity will allow the students to experience the energy transferred in a food web by representing the energy itself. Aquatic plants and animals found in local waterways will be the food web's producers and consumers. The students (or energy) will travel from producer to primary consumer, and primary consumer to secondary consumer, etc. Each student will move independently to visualize how this transference of energy is necessary for an animal's survival.

Each specific plant and animal incorporated into this activity will have their own illustrated flag. The flags will be spread out around an open outdoor space. The flags should be placed upright, to allow students to easily see where to move next. Each plant or animal flag will also have a corresponding large

foam die. The corresponding dice will have their faces labeled with animals that can consume the current animal flag that the student (or energy) has travelled to; the die face directs to which flag the student must move next.

Theme: "Energy first comes from the sun and can be used by plants, then moves up the food chain as animals eat plants and other animals."

Instructions: Recall students experience learning about how plants get their energy (sun), where do you think the energy goes after that? Explain to students that all living things need energy. Plants make or produce their own energy by collecting sunlight. Animals eat or consume that energy. Energy is like food for plants! Ask, "What are your favorite foods that give you energy?" "Do humans produce or consume our energy?" Plants are the only things getting energy directly from the sun, they are the producers that start the food chain. Humans get energy from the sun in a way, because we consume plants!

Explain to students that food webs show **how different plants and animals are connected to each other by eating (or consuming) one another for food**. Provide an example of a food chain to ensure understanding, then explain that **food webs are many food chains joined together.**

Explain to students that this activity will focus on learning more about animals that live in waterways. Small animals, such as water insects, to big animals, such as beavers, all have jobs in keeping the water habitat healthy. One of these important jobs is being food for another animal. Ask students if these animals in the food chain can survive without food? To understand water animals' important job as food for other animals, explain to students that they will participate in an activity to see some of the different animals that can be found living in their waterways and how they are all part of a big food web.

Gather students in a large circle to explain the rules and objectives of the activity. The following steps are written out as if directed towards students.

Everybody will start off being *energy*. Since the energy in our food chain starts with the sun, we all get to pretend to be sunlight energy. Sunlight energy will move up the food chain as animals eat or get eaten.

1. Energy will be moving in the food web from animal to animal.
    a. Direct their attention to the open space with all flags and dice.
2. Plants are the only things that get energy directly from the sun, so you will all start at the producer/plant flags lined up here.
    a. Direct their attention to the starting point at the line of producer/plant flags.
3. At each flag, there is a picture of an animal that lives in, or near, water.
    a. Walk over and highlight a few.
    b. Salmon
    c. Aquatic Worm
    d. Dragonfly Nymph
4. Each flag has one die that stays with the flag. You will roll the die and move to the animal that it lands on. When you move to the next animal, that animal has eaten the animal you were at before. Remember you are the *energy* moving from animal to animal as food.
    a. Demonstrate once. Highlighting the starting plant, going to which animal was rolled, and enacting the energy that is moving *into* that animal as the smaller animal gets eaten.
    b. Emphasize using walking feet for safety.

   c. Emphasize not throwing the die but gently rolling it in front of you.
5. In a food web, many animals might be food for more than one animal. If someone is already at the flag with the animal you have rolled, instead of taking the die, you can wait your turn.
   a. Encourage the students to wait in a line for their turn if there is more than one person at a flag.

Break up the students to have equal amounts of students at each producer/plant flag to start. Give students the cue to start rolling the die and begin the activity. Use instructors and chaperones to help the students find animal flags as needed and to facilitate die rolling and lining up at flags.

Bring students back together in a large group circle and ask them where they travelled as energy in the food web. What animals became food for each other? Have them turn to a neighbor to do a partner share. Engage a few students to share their food chains with the entire group, drawing the energy arrows of their journey on the poster. Explain to students that each person experienced their own food chain, and everyone's food chain can be put together to create a food web!

There will be a poster at the end, in the same mirrored image of the food chain/pyramid, questions will be asked, "who started at…?" or "who ate this same animal/plant?" The visual aid will be used to map the journey. This will facilitate the discussion at the end.

As students enact animals going further up the food chain, they all will end at the same apex predator (definition: An apex/alpha/top predator is at the top of the food chain in a certain habitat. Examples are orca whales, wolves, or even a great blue heron. Apex predators are very important because they can influence the number and type of other animals in the habitat and can keep it in balance). Students can play the game again at a different starting point to illustrate that energy is moving up through the food chain, they will always end at the same apex predator at the top.

Tips for instructors:

- Depending on level of understanding, introduce terms: producer and consumer/predator and prey.
- Keep explanations brief to retain students' attention.
- Give ample time for students to rotate through the food web multiple rounds.

2. Aquatic Macroinvertebrate Dip Observation (20 minutes)-small group station

Background: Macroinvertebrates are small in size but a fundamental part of water ecosystems. This activity will allow students to observe various aquatic macroinvertebrates found in a local waterway. It will allow students to get a hands-on approach to identify invertebrates and their behavior. Certain invertebrates spend their entire lives in water, i.e. a *scud* or *predacious diving beetle*. Other invertebrates that the students might find are the nymph or larvae form of adult terrestrial invertebrates, i.e. the *dragonfly* nymph or *caddisfly* larva. Nymphs and larvae have separate definitions. Nymphs and larvae both undergo metamorphosis to metabolize into their adult forms, but some nymphs already look similar to their adult forms, excluding size, while larvae have a different appearance and will undergo complete metamorphosis.

Students will have the opportunity to gently practice using science tools and to treat the observed aquatic macroinvertebrates with respect, as they will be returned to the water habitat after observation.

Theme: Tiny insects in the water are food for bigger animals. The insects that live in water can tell us how healthy their habitat is.

Instructions: Explain to the students that they will observe real, living macroinvertebrates that live in a water habitat. They will be split into six groups (or whatever number of groups is appropriate for the current classroom,) and they will spend a few minutes at each station, then rotate to the next station to observe a new sample of aquatic macroinvertebrates.

Briefly define the terms aquatic and macroinvertebrates. Aquatic = water, and invertebrates are animals without a backbone. Macro= large enough to see without a microscope. Direct them to feel their backbone. Are people invertebrates? Clarify they belong to another group of animals called vertebrates, which are animals that have a backbone. Explain to students that the animals observed at the stations will all be aquatic invertebrates, animals without a backbone living in water. Some of them may be worms, snails, baby insects, adult insects, and even crustaceans-relatives of crabs and shrimps!

Gather students around to explain the rules and objectives of the activity. The following steps are written out as if directed towards students.

1. Make a large circle, standing shoulder to shoulder around this demo station.
2. Each station has as large bin with a sample of water and in the water are the aquatic invertebrates! (Point out or discuss where the water sample was collected.)
3. Each station also has tools you will use to *gently* observe these aquatic invertebrates. The tools are spoons, holding containers, and magnifying sheets/lenses. As good scientists, it is very important to be gentle as these are living animals, and we know they are an important part of the water habitat. Demonstrate proper tool use.
4. The way to see these animals is to look for movement! Before stirring up the water sample with your tools, take a look and see if you can see them moving or swimming around. You may be surprised to notice that even something that looks like a stick or plant part, or even a tiny speck might be an animal!
5. You will also have an identification sheet to help you name the animals you observe.
6. Any invertebrate you want a closer look at can be gently scooped into the holding container, along with plenty of water for the invertebrate to swim and breathe. (Restate that water is their habitat, they need water to stay alive.)
7. When you're done, turn the container upside down and give it a swirl in the water. Make sure no one is stuck in the container!

Thoroughly explain and demonstrate the purpose of each item in the station and how to use them. Emphasize being gentle and slow as they move through the water sample with their tools. Split up the students into groups and assign each group a station. Remind them they will rotate after a few minutes of observation, show them in which direction they will rotate. Give an example of a pollution tolerant invertebrate and a pollution intolerant invertebrate and show them which type of invertebrate can't live in polluted or unhealthy water and which invertebrate can only live in the cleanest water. If you find the pollution intolerant animal, it is a good sign that the water is clean and healthy. What does it mean if you *can't* find this animal?

Allow the students to observe then give a cue that they will rotate soon. Instruct them to take out all spoons from the water bin, empty holding containers, and make sure the tools are ready for the next group. Rotate the students and repeat until all groups have rotated through each station.

Tips for instructors:

- Introduce definitions of nymph and larva.
- Prepare the stations with tools prior to the arrival of the students.
- Having a demo station staged some distance away from the actual stations will make it easier to maintain student attention.
- Circulate among the students to help identify the invertebrates.
- Do not rotate through all stations if short on time. It is a more beneficial experience for the students to give ample time at a station than to shorten and rush through.
- Practice counting legs and recognizing patterns, similarities, and differences between macros.
- The more facilitators the better, so each station has an adult to engage students in inquiry. Empower educators/chaperones with talking points at each station.

Ask students what kind of animals they found. What can we determine about how clean the water is, based on our findings?

3. Pollution Tolerance Game (20 min)-small group station

Background: A waterway's biodiversity is an indicator of its wellbeing. (*Biodiversity*: many different types of plants or animals in a given habitat.) A variety of pollutants run off from our urban areas, over impervious streets such as driveways and sidewalks, and flow directly into our waterways. Certain aquatic macroinvertebrates have varying tolerance levels to pollution. Mayfly nymphs and caddisfly larvae, for example, are intolerant to high levels of pollution. They, and other intolerant invertebrates, are sensitive to the changes in water quality brought on by pollution. Invertebrates such as leeches and midge fly larvae are tolerant of pollution. They, and other tolerant invertebrates, are able to thrive in polluted water conditions. Then there are those in-between species of invertebrates that are somewhat tolerant of pollution; dragonfly and damselfly nymphs are able to survive in waters of semi-polluted conditions. The presence of *only* pollution-tolerant species indicates unhealthy and polluted water. While the opposite is true if there is a population of intolerant species.

Theme: Different animals can tolerate (stand/survive in) more pollution in their habitat than others.

Instructions: Explain to students they are going to play a game to learn how certain aquatic invertebrates handle surviving with pollution in the water.

Define pollution with the students: What is it? Where does it come from? Pollution is not from nature. It is something introduced into the environment by humans and causes it harm. List some causes of pollutants in our waterways with students, i.e. oil leaks from cars, soap, paint, excessive pesticide and fertilizer use, bacteria from dog waste, plastic and trash, etc.

Gather students around to explain the rules and objectives of the activity. The following steps are written out as if directed towards students.

In this game, students will either be *pollution* or *invertebrates*. Pollution will be able to tag the invertebrates, but certain invertebrates might need to be tagged multiple times to be completely out of the game.

1. If you are chosen to be a pollution for a round, you will wear a brightly colored vest.
    a. Show them a pollution vest.

2. Everyone else will be an invertebrate. Invertebrates will wear a flag football belt. The belts will have one flag, two flags, or three flags.
3. Some invertebrates will wear a belt with only one flag.
    a. Show them a belt with one flag. If the pollution tagger gets one of your flags, you are out for that round. (Give instructions on where to go if you are out of the game.)
4. Some invertebrates will wear a belt with two flags.
    a. If the pollution tagger gets one of your flags, you're not out! You still have one flag left and you are still in the game, but if your second and last flag is taken, you are out of the game for now. (Give instructions on where to go if you are out of the game).
5. Some invertebrates will have a belt with three flags.
    a. Show them a belt with three flags. What do you think that means?
6. Introduce a question for the students to consider: What does it mean for an invertebrate to have one flag, two flags, or three flags when they are trying to survive in the water with pollution? Allow students to think about it and explain that you'll discuss this question again when after the game.
7. Pollution will be tagging you by pulling on your flags. If all your flags are pulled, then you are out of the game for that round and need to come stand with the teacher or designated chaperone.
8. Invertebrates cannot hide or hold onto their flags.
9. Pollution cannot pull more than one flag at a time. If you pull a flag off of an invertebrate, you have to move onto another invertebrate. Pollution must hold onto the flags they gather and not drop them on the ground.
10. Point out the cones and explain that these are the waterway boundaries. An aquatic invertebrate will not survive out of the water so make sure you stay in the boundaries! Chaperones/instructors can reinforce this by standing around border and letting macros know they're "drying out" if students step outside boundaries.
11. Assign certain students to be *pollution*. Demonstrate to the rest of the students how to put on the flag football belts, request the help of other adults to put belts on students.
12. Play a round, collect materials in an orderly fashion to reassign roles (students who had three belts can have one belt for the next round, students who were pollution can become an invertebrate, etc.). Repeat the rounds, adding in more pollution with each round.
13. At the end of the game round(s), restate the question prompted at the beginning of the game: *what does it mean for an invertebrate to have one flag, two flags, or three flags when they are trying to survive in the water with pollution?* Take student responses, then discuss: certain invertebrates are able to survive in a lot of pollution, some pollution, or they may not be able to survive if there is even a little pollution. Invertebrates that cannot survive in pollution had only one flag, what does that mean? Invertebrates that can survive in *some* pollution had two flags. Invertebrates that can survive in a lot of pollution had three flags. Those flags showed us how much pollution the animals can tolerate. Define *tolerate:* it basically means how much of something you can stand. Give examples; some people can stand or tolerate hot weather, but I cannot tolerate hot weather very well. Can you? Just like we can tolerate different amounts of things like heat, invertebrates in the water can tolerate different amounts of pollution. If the water is really badly polluted, however, none of the animals would be able to survive very long.

14. Connect it to the invertebrates they investigated. The blood worm, mosquito larvae, and some of the snails can tolerate a lot of pollution. The caddisfly larva that makes its home out of sticks or stones, and the mayfly larva cannot tolerate pollution.
15. After the final round, discuss with the students how the invertebrates (even the pollution tolerant ones) can't survive with more pollution continually being added into the river.

Tips for instructors:

- Introduce grade level appropriate pollutants.
- Add a surplus of pollution for the final round to showcase the great volume of pollution in our waterways disturbing the water quality and harming the aquatic animals.
- Mix up the rounds with only intolerant, somewhat tolerant, tolerant invertebrates, or certain levels of each. It doesn't always have to be equal amounts.
- Rather than completely undoing the belts, loosen them and have students step out of them as they are switching belts.

4. Stewardship Activity (20 minutes)- all together as a big group

Background: Storm water runoff is large problem for the health of our waterways. Pollution from human influence starts off on the surface but washes away with rain and down storm drains to lead into the closest waterway. Most common types of storm water runoff include oil leaks, metals from our cars, bacteria from dog waste, chemical fertilizer, and pesticide use. These pollutants disturb water quality and in turn harm aquatic animals.

Theme: You can help keep water clean! Manage your waste to keep water clean. We can all help keep water habitats healthy.

Instructions: Spend a bit of time reflecting on the stations the students have visited and what they learned so far. Introduce to students they will be playing a game in teams. Explain to students they will be answering questions in teams on how certain items should be disposed of.

Explain to students that certain items can be recycled, composted, or thrown into the trash/landfill. Highlight where their teams will gather and how each team will have a set of 3 pictures: one of a trash can, a recycling bin, a compost bin, and a storm drain.

Gather students around to explain the rules and objectives of the activity. The following steps are written out as if directed towards students.

Explain to students that in this game, they will be split up into teams and they will learn about some actions they can take, maybe even starting today, to keep the rivers and streams clean so animals can live there and have a healthy habitat.

1. An instructor will show you a picture of an item. For example, this picture of an apple core.
2. Once you see the picture you turn to your group and talk about where the item should go. It might be hard, but it's important to not shout out your answer!
    a. Show them their set of a trash can, recycling bin, compost bin, and storm drain picture. Naming and briefly reviewing the ultimate fate of items put in each.

3. For your team to answer a question, one representative will hold up a picture of a trash can, recycling bin, compost bin, or a storm drain after the instructors says it is time to answer. Make sure you're taking turns with who gets to be your team's representative. (Invite instructors/chaperones/teachers to help with this.)
4. Remember to talk to your group to make sure everyone agrees with the answer.
5. Remember to not shout out the answer.

Divide the students into teams. Regain their attention and tell them the game is beginning. Start with any picture. Give students time to think, discuss with their groups, and give them the signal to hold up their answer picture. Establish a pattern of showing the picture, reminding them to quietly discuss, signaling for answer, and regaining their attention for next picture. Repeat till all the pictures are shown or until student attention wanes.

If the students do not answer correctly, it gives flexibility to create discussion to the preferred way of disposal.

Briefly explain each round if necessary. For example: the chip bag should go into the trash bin, the plastic bottle should be recycled, and food scraps like this banana can be composted. Give some information about why: what it is made out of (paper, metal, and plastic bottles can be recycled,) flimsy plastic like chips wrappers are garbage, apple cores and other scraps from fruits and vegetables (maybe worm food) can be composted.

At the end of the game, collect all materials and ask students to gather around. Have them sit/stand in a circle or gather them in a group in front of you. It would be helpful to move them from the jeopardy game area to a new space to keep their attention.

Hold up the picture of a storm drain. Explain to students there are many things that should not be going down the storm drain but into trash.

Hold up the picture of the river along with a picture of a storm drain. Explain to students whatever goes down a storm drain will lead directly into nearby streams, wetlands, and rivers without being cleaned.

Remind students about the discussion of pollution. Pollution is not from nature; pollution in rivers and waterways can make it hard for animals to live there, especially those that cannot tolerate pollution. Hold up pictures of oil leaks, soaps, and dog waste. Explain that things like oil leaks, soaps, and dog waste will wash into storm drains when it rains and lead into our waterways making them unhealthy for aquatic animals. To keep our waterways clean, the only things that should be going down storm drains are water and leaves. Hold up pictures of leaves.

Begin to discuss water conservation and ways students can help to prevent oil leaks, soaps, and dog waste from washing down our storm drains with the rain.

- Example conservation solutions
    - Check your car for leaks
    - Fix your car leaks
    - Take your car to a commercial wash. These places have systems for treating and reusing the water before it goes down the storm drain.
    - Pick up your dog waste with a plastic bag and throw it away. Dog poop and poop from animals that eat processed foods can lead to diseases, this includes humans.

- Save materials by recycling what we can.

Getting back to the storm drain and what we can do to keep pollution from entering waterways, introduce the phrase, “only rain down the drain.” Have students repeat over several times.

Tips for instructors:

- Students might need frequent reminders to quietly discuss answers with their group and to not shout out answers. Use methods to facilitate group discussion including think, pair, share; ask students if their answer is “add-on,” “repeat,” or “new idea.”
- If you see students becoming unruly, end the jeopardy game early and move them into the end conservation discussion.

Inquiry/Guiding Questions:

Food Web Activity

- How does it affect the food web if one of the producer and/or consumer is removed?
- How many plants does it take to eventually feed one salmon?

Aquatic Macroinvertebrate Dip Observation

- What were the names of some aquatic macroinvertebrates observed? What does that tell about our water?
- What do you notice about their bodies? How might that help them survive?

Pollution Tolerance Game

- What happened to the invertebrates when we added in more pollution with each round?
- What are the types of pollution added during the game?

Stewardship Activity

- What can you do to help keep our water clean?
- Why is it important to keep our water clean?

NGSS 3-Dimensions Connections:

Dimensions from Framework	What students are doing
Science and Engineering Practices (SEP) Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. Use a model to represent relationships in the natural world. Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas.	● Participate in a food web activity where they act out how energy moves through an aquatic ecosystem. ● Observe various aquatic macroinvertebrates collected from a local water source. ● Play a pollution tolerance tag game to represent the effects of pollution on an ecosystem and how different aquatic animals have varying tolerance levels to survive.

	● Actively discuss methods of stewardship that students will be encouraged to take part in as they are exposed to daily choices they can make in order to have a positive impact on waterways.
Disciplinary Core Ideas (DCI) All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	● Participate in a food web activity where they act out how energy moves through an aquatic ecosystem. ● Actively discuss methods of stewardship as they are exposed to daily choices that can be made to have a positive impact on waterways.
Crosscutting Concepts (CC) Systems in the natural and designed world have parts that work together.	● Participate in a food web activity where they act out how energy moves through an aquatic ecosystem.
Performance Expectation (P.E.) supported: Use observations to describe patterns of what plants and animals (including humans) need to survive. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.	

Five E Learning Model:

Engage: How does the lesson pique the learner's interest and allow them to express their existing thoughts and opinions on the subject?	Students are engaged with the subject through interactive games and hands on observation of real, living aquatic organisms.
Explore: How does the lesson allow students to interact with each other, and observe their surroundings. Does the lesson include problem solving or coming up with an answer to the question?	There are many opportunities for direct observation of aquatic samples. Students are given the opportunity to form their own answers during all the activities.
Explain/Elaborate: How does the lesson help students make a connection between new and former experiences. How does the lesson encourage students to record, reflect, and	Students learn about appropriate stewardship through discussions with one another. Throughout the lesson and activities, students will be asked guiding questions and will explain

explain their new understanding to others?	concepts such as pollution, energy, food chain, and tolerance.
Evaluate: How will the students be encouraged to reevaluate their understanding of the phenomena and demonstrate what they have learned?	Students will dispose of their trash properly and encourage others to do the same.

Post-lesson activity for Kindergarten students:

This recommended reading and reflection also introduces a potentially new concept: Adaptations.

Watch (on YouTube) or read the book "Are you a Dragonfly" by Judy Allen and Tudor Humphries. Pause and talk to review and reinforce concepts from the field trip.

Recommendations for when to pause and talk (based on watching the YouTube reading):
https://www.youtube.com/watch?v=xnULzIIWTtA)

Pause @ 30 seconds in, the mother dragonfly is laying her eggs in the habitat of a dragonfly. Review **Habitat**: Food, Water, Shelter, Space! Where does a baby dragonfly live? In a river or stream habitat! Let's pay attention to what the baby dragonfly eats!

Pause @ 1 minute, there are a lot of features or characteristics that help this baby dragonfly survive. Those special features or behaviors that help it to survive are called **adaptations!** What are some special adaptations of a dragonfly that helps it survive? (A "grabber"/mask that is used to grab prey to eat! Skin that sheds as the dragonfly grows.) How are you like a dragonfly? Do you have the same adaptations?

Pause @ 1:20min, a dragonfly is a hunter/predator, but it could get eaten by other animals too! Remember, animals are connected to each other in the **food chain**, meaning they eat and get eaten. Energy travels from plants to animals to other animals in this way. Where does all that energy start from? The Sun! Who might try to eat a baby dragonfly? Ducks, water beetles, etc. (Optional: talk about the adaptations of ducks and water beetles that make them especially skilled at hunting and eating dragonflies.)

Pause @ 3min, the dragonfly now has a new habitat: where does it live? In the air, but it is still flying over ponds, rivers, and other water habitats. Now the adult dragonfly has some different adaptations. Can you name them? Wings for flying, big eyes, the ability to breath air, legs for catching food, etc. The adult dragonfly is eating different foods now that it's in the air. What does it eat? Mosquitos, flies, midges (small flies), wasps, butterflies. What might eat a dragonfly? Birds, spiders, etc.

End @ 3:55, Brief discussion about how we are people, not dragonflies, but dragonflies and people all need clean water to survive. Facilitate a discussion about what we can do as humans to help keep the water clean and free of pollution.