



Maine Rivers and Perspectives Kit – Introduction



Maps of Maine



Discovering Rivers



Fish Talk



Food Webs



What's in the Water?

Thank you for deciding to use The 4-H Maine Rivers and Perspective Toolkit. This is a new kind of 4-H toolkit designed in collaboration with **Wabanaki Youth in Science (WaYS)** and other cultural knowledge sharers using the two-eyed seeing method. The five **Wabanaki Nations** in Maine are the Penobscot Nation, the Passamaquoddy Tribe at Indian Township, the Passamaquoddy Tribe at Pleasant Point (Sipayik), the Houlton Band of Maliseets, and the Aroostook Band of Micmacs (Mi'kmaq). The two-eyed seeing method was coined by **Elder Albert Marshall (2022)** and describes “the process of seeing the strengths of indigenous ways in one eye, and at the same time seeing the strengths of Western ways in the other eye.”

This toolkit is unique because we are promoting a different way of teaching, with an emphasis on promoting learning for native youth, as well as increasing exposure for all youth to different ways of thinking and seeing the world around them. After the creation of WaYS, from work done by Tish Carr and others, who have brought to the forefront that not only do we need to focus on supporting Wabanaki youth through science programs like WaYS, but we also need to support non-native educators. This is why in this toolkit we are going to attempt to shift the paradigm in the hopes that it will better serve all youth.

The Maine Rivers and Perspectives Toolkit has been co-designed with 4-H, WaYS, and Cultural Knowledge Sharers, with a series of experiences/learning activities that will introduce key science concepts, highlighted in a way not typical of traditional Western science education. There are three notable themes in this toolkit: **valuing perspectives**, **valuing ways of knowing**, and **flexible learning opportunities**.

- 1. Valuing Perspectives:** In each experience, youth will be introduced to the idea of perspectives. They will be exploring new perspectives and learning how we can all see things from different angles, past experiences, and may have creative or different ideas about a topic. This does not mean that one is more right than the other.
 - For example, youth in Experience 1 will be asked to draw their own maps. Youth will be asked to depict Maine from their perspective. Each youth then shares with a peer giving value to both perspectives.
- 2. Ways of Knowing:** Experiences will focus on and value youth ideas and different ways of knowing, rather than having them provide correct answers. This can mean different things to different folks, but one way to describe it might be comparing learning from a textbook to learning from lived experience.
 - Incorporating theme two lends itself to theme three. Learning outcomes are designed to be more flexible to allow the opportunity for the facilitator and youth to explore ideas that come up during the experience. This gives the opportunity to latch onto ideas and experiences youth bring with them, rather than following a cookbook activity.
- 3. Flexible Learning Outcomes:** The third theme is changing the design of the writing to prompt more of an organic experience. This is done by allowing flexibility in each learning experience to be responsive to the needs and interests of youth participants.
 - While these experiences are given a suggested timeframe of about an hour, discussions and opportunities to explore youth ideas and interests may extend beyond the suggested time.
 - Give time to express individual perspectives.
 - An experience doesn't have to fit into a single session, facilitators should use their expertise to help decide to extend learning sessions to longer timeframes or into another session altogether.

Because experiences have been designed to prompt thought and explore learning together, it is important to recognize what the youth might be interested in talking about. When youth express interest in a portion of one of the lessons, if it feels relevant, feel free to explore what the youth want to learn about, don't be afraid to go off track. For example, if youth are interested in a certain animal not mentioned in one of the activities try to find a way to include this animal in a future activity. It is important to allow the students to express what part of the lesson they might want to dive deeper into.

Acknowledgements

Marshall, Albert. (2022). Albert Marshall – Learning to See with Both Eyes (YouTube)
.https://youtu.be/50g_Aamaxq4?si=sVR-wSrV9jDss6XX

Gratitudes

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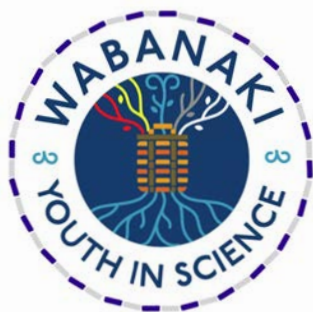
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Experience 1: Maps of Maine

Topic: Youth will be introduced to different maps of Maine and tasked with working together to discover what they represent.

Time: This lesson should take approximately 45-60 minutes to complete.



Materials

- 15 copies of the world map
- 1 folder containing all the facilitator maps
- 15 student copies of (Maps 1-7)
- 25 copies of “My Maine Perspective” (With the outline of Maine)
- 25 copies of “My Maine Perspective” (Without outline of Maine)
- 5 packs of colored pencils
- 5 packs of crayons
- 25 pencils
- 25 Whiteboards and markers
- 25 erasers
- 1 plastic ball with a smiley face
- 1 plastic holder for the smiley face ball.



Learning Outcomes

At the end of this activity, you should be able to:

1. Recognize that we all see things differently and have different perspectives.
2. Explain what a map is used for and discuss some of the features that commonly make up maps.
3. Recognize that there are many different ways to look at maps of Maine.

Background Information

In each experience in this series, the facilitator will provide opportunities for youth to think about perspectives of their own as well as those of others. Experience One engages youth in sharing and considering different views in the context of various Maine maps. This experience starts by introducing the concept of perspective in two ways. The first demonstrates visual perspectives by making observations of a plastic ball from different locations. The second presents a familiar map with a different orientation. Building on these ideas, youth will construct a map of Maine from their own perspective and investigate Maine maps. Youth will learn how maps can be viewed from different perspectives, through this map exploration. For example, they will learn about the Wabanaki Territories and are given a chance to see a new view of maps that they might not have known before. There will be an answer key provided for each map found within the facilitator binder. During this experience, it is important to remind youth that we are not looking for right or wrong answers. The goal is to practice acknowledging views different from our own with value and respect.

Facilitator Note: During the experience, the facilitator should be prepared to talk about how Wabanaki land has been taken over time. This may include acknowledging how different events led to what Wabanaki Nations currently control/have jurisdiction over. This change in land loss is observable from the differences seen between maps 6 and 7. *The Dawnland* micro-credential is a good resource to refer to when trying to make these connections (www.maine.edu/student-success/micro-credentials/list-of-micro-credentials/dawnland/).

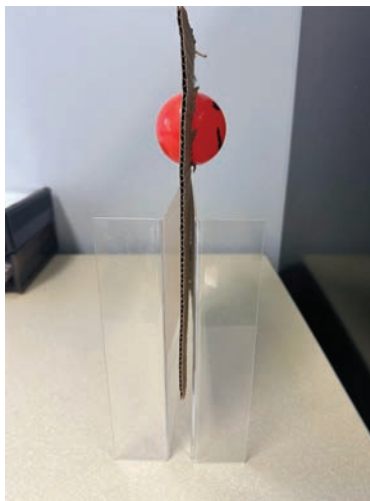
Vocabulary

- **Perspectives:** One's view or attitude toward something; a point of view
- **Map:** A tool used to interpret or represent information about a geographic area

Methods

Part 1: Introduction to Perspectives

- Start by splitting the youth into two groups. Have each group move to opposite sides of the room. Remove the apparatus holding the plastic ball with one side having no face and the other side showing a smiley face.
- Have youth take a moment to examine what they are looking at. After a couple of minutes have them describe what they are seeing in as much detail as possible. Youth will notice that there are two different sides to this ball but depending on which side you are on you would describe it differently. Explain to the youth this is one example of what a perspective is. Notice that everyone is looking at the same object and describing it in two different ways. Finish this exercise by noting that “we will be exploring perspectives in all the experiences in this series.”
- Let the youth know what they are going to be doing for the day.
 - **Something you might say is:** “Today we’re going to be exploring different maps of Maine and learning about new perspectives. Before we start, we are going to look at a familiar map from a different perspective.”
- Show the youth a map of the world upside down and ask who has seen this map before. Explain that some people may prefer the orientation of this map compared to the one commonly used because of the way that they view maps.



Plastic ball setup (Photo Credit: Tyler Tibbetts)

Part 2: Constructing Maps

Now that youth are primed thinking about maps, have them either use a map of Maine (template provided) or make their own map adding anything that they think should be included. Explain to the youth that they will be creating a map of Maine from their own perspective.

- **Engaging questions to ask youth**
 - When you think of Maine, what comes to mind?
 - What do you think should be included in a map of Maine?
 - If needed, have a few examples of features related to maps to share with the youth to get them thinking.
- Where might that show up on your map?
- **Optional questions to ask youth**
 - Do we have rivers? Should animals be included?
 - Should we include our homes?
 - What else might be useful for you to have on your map?
 - Do any features stick out to you?
 - What are some reasons that people would use maps?
 - How would you use your map? (or what makes this map meaningful to you?)
- **Map-pair-share**
 - Have the youth share their maps to get an idea of each other's perspectives. Do this by having the youth partner up and spend a short amount of time (2-4 minutes) explaining their maps to one another.

Part 3: Maine Map Investigation

Now youth have explored their thoughts about maps. In the second part, they will be tasked with looking at the same map and then working together to decipher what the map might represent. This will hopefully spark youth to think about different ways of seeing the same map.

- **Facilitator Note:** One optional way to make another connection with maps in this experience is to add a map of your local area for the youth to try and guess what is being shown. An example of a map used in the Orono area is shown as Map 11 in the facilitator binder.
- Split youth into groups of 3-5.
- Give each group markers and a whiteboard.
- Explain to the youth that they are about to look at maps of Maine and they are tasked with working as a team to figure out what is being shown on each.
- Start by showing Map 1 (this can be done with one of the physical copies or on a projector).
- Youth should take about 2-3 minutes to discuss what they notice about the map and what it might represent.
- Ask the youth what they think the maps represent and have them write an answer on their whiteboard.
- Ask each group to share their ideas.
 - If youth come up with different answers, have a discussion about each group's perspective and have each group explain why they chose their answer. During this time it would be helpful to remind youth that we are not looking for right or wrong answers and that they will be exploring and learning each perspective together through maps being presented. Remind them that we could all still have our own perspectives about what the maps represent.

- While each map is being presented, the facilitator can explore with the student with questions that help lead them to the answer. Many of these maps will be new so it may be hard for the youth to figure out what they represent.
 - **Facilitator Note:** there are some notes on the back of each map related to key features to pay attention to.
- Continue this process with maps 2-7 by repeating the process for Map 1.
- Once the youth have completed talking about the final map, ask them to erase and return their whiteboards, markers, and maps.

Part 4: Reflection

Compare the background knowledge activity and what the youth just learned about maps.

- Were there new maps introduced to you today?
- Do you have more questions about any maps you saw today?
- Why do we think there are so many maps of Maine?
- What did you learn about perspectives?
- Why might it be useful to share our perspectives with others?
- Who makes the maps?
- Who decides what should be included in a map?
- When were the borders (lines) made for each state?
- What are some other examples of things we might see differently?
- **Facilitator Note:** We are hoping that youth will discuss perspectives that are new to them. Youth will probably have questions about some of the new perspectives they saw during the activity.

Facilitator Note: Experience two has an optional component to be outside near water. If you plan to go outside for this experience now would be a good time to prepare youth to bring the proper shoes and outdoor gear to do this experience.

Supplement to Experience 1: Maps of Maine

- **Lighthouses:** List of Lighthouses in Maine (Wikipedia)
wikipedia.org/wiki/List_of_lighthouses_in_Maine#/media/File:Map_of_All_Lighthouses_in_Maine.png
- **Maine Wildlife: Maine Hunting Zone Maps** (Maine Guides)
maineguides.com/maine-hunting-zone-maps/
- **Mountains: Maps of Mountains in Maine** (Earth at Home)
earthathome.org/hoe/maps/ne/#maine
- **Nations: Tribal Lands in Maine** (Wabanaki Alliance)
wabanakialliance.com/tribal-lands-in-maine/
- **Rivers in Bangor, Maine:**
 - Map Showing the Location of the Penobscot River in Maine, USA and Small Inlet Locations, Figure 1 (Research Gate)
researchgate.net/figure/Map-showing-the-location-of-the-Penobscot-River-in-Maine-USA-small-inset-locations-of_fig1_277938733
 - Map of the Penobscot River including Dams That Will be Removed: Veazie Dam Great (Research Gate)
researchgate.net/figure/Map-of-the-Penobscot-River-Maine-including-dams-that-will-be-removed-Veazie-Dam-Great_fig1_264554380
- **Territories: Native Land website**
native-land.ca/



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Experience 2: Discovering Rivers

Topic: Youth will be introduced to macroinvertebrates found in the rivers of Maine.

Time: This lesson should take approximately 45-60 minutes to complete.



Materials

Outside Activity

- 5-Gallon Bucket with rope attached
- 5 Aluminum trays
- 26 Invertebrate identification sheets
- 20 Tweezers
- 1 Box of gloves
- 10 Microscopes
- 15 Plastic cups
- 15 Plastic spoons

Inside Activity

- 5 One-Gallon Buckets
- 5 River Sample 1 bags
- 5 River Sample 2 bags
- 5 River Sample 3 bags
- 26 Invertebrate identification sheet
- 10 Magnetic fishing poles
- YouTube videos (facilitator will need a way to show these to the group)



Learning Outcomes

At the end of this activity, you should be able to:

1. Recognize the different perspectives about the river.
2. Explain how to collect invertebrate samples and why scientists collect these.
3. Talk about some of the restoration work being done to Maine rivers.

Background Information

During this experience, youth will learn about how aquatic biologists can test river health by looking at the macroinvertebrate samples. Macroinvertebrates are small organisms without backbones and are commonly found in many types of wetlands. Some examples of invertebrates are dragonfly nymphs, mayflies, caddisflies, and snails. Invertebrates respond with a range of sensitivity to many different kinds of pollution and are used for toxicity testing to develop water quality standards. By learning about how invertebrates interact with the water, youth will learn a new perspective on how we can determine water health.

Facilitator Note: The youth may have questions about keeping the riverways clean and the facilitator should be prepared to talk about this.



River sample cards (Photo Credit: Tyler Tibbetts)

This activity is designed to be done both indoors and outdoors. The facilitator should test the location and make sure there are invertebrates to collect. Depending on the location or time of year, getting to the river can be a challenge. If you are unable to make it to a river near your location this activity can also be done indoors. If you are bringing students to the water, it is important to remember that it can be dangerous by the river and to be safe when approaching the river during certain times of the year. It is advised to find a spot before doing the experience making sure that the path is easily accessible for all participants. Please refer to your organization's safety protocol for specific information.

Facilitator Note: During the experience, the facilitator should be prepared to talk about how Wabanaki land has been taken over time. This may include acknowledging how different events led to what Wabanaki Nations currently control/have jurisdiction over. This change in land loss is observable from the differences seen between maps 6 and 7. The Dawnland micro-credential is a good resource to refer to when trying to make these connections (www.maine.edu/student-success/micro-credentials/list-of-micro-credentials/dawnland/).

Vocabulary

- **Perspectives:** One's view or attitude toward something; a point of view
- **Invertebrates:** An animal lacking a backbone
- **Benthic:** Living on the bottom of a body of water
- **Macro:** Visible with the human eye
- **Micro:** Too small to see with the human eye

Methods

Part 1: Introduction

- Ask youth the following questions:
 - What do you think of when you think about a river?
 - Who here has visited a river? When? Where?
 - What do you remember about your experience?
 - Are there any rivers that are meaningful to you/ your family/ your community?
 - Why are rivers important? (if the activity is planned to be outside, have the students answer some of these questions while by the river.)
- **Facilitator Note:** you could do an ice breaker where students are asked to look around in nature and then reflect on how it makes them feel or have them tell stories about what the environment is telling them.
- This would be a good place to talk about Wabanaki activism. They have been instrumental in getting clean water and increasing water quality standards for Maine. Here is a video that can be shared with the youth: *The River is our Relative | The Story of the Penobscot Nation* (YouTube: https://youtu.be/8VCr_bohaw?si=n-kjQGFF2EGdLI6_).

Part 2: Investigating Invertebrates (Outdoor Option)

- Have the youth be prepared to go outside for this activity. Depending on the weather, this could involve needing proper dress wear like snow or rain jackets. Remind youth that they would want proper footwear before doing this activity. Also, this would be a good place to let the youth know the safety expectations for being outside for the activity. After talking about expectations, remind youth that they will need to be safe when traveling to and being around the river.

- Next, explain what an aquatic biologist does for a job and introduce a video that shows what the youth will be doing today. An aquatic biologist is a professional who studies organisms that live in water. Here is a video that can be shared with the youth: *Benthic Basics – Sampling With a Kick Net* (YouTube:<https://youtu.be/CaGRQ02wURo?si=Cqt7fmC7q33BpLX->).
- Break the youth up into groups of 3-5 and have the groups decide who wants to help carry the buckets.
- As the group is traveling to the river, have them stop midway to reflect on their surroundings. “How does this make you feel?” and “What do you notice?” Have the youth share in their groups the responses to these questions. Remind students that this is another example of perspectives.
- Once you are out at the water (**reminder to look at the background for safety information**) explain to the youth what they will be doing today.
- Start by asking the youth if they know what a benthic macroinvertebrate is. Give them a moment to explain their ideas.

Optional Questions:

- Have you ever seen bugs in the river/ stream?
- What did they look like?
- If they have a hard time coming up with ideas, ask them if they know what a vertebrae is. If they say no then have all the youth reach out their hand and then feel the back of their neck and explain that these are vertebrae. Next, explain that invertebrates don’t have a spine. **Benthic** means anything living on the bottom of a water source and **macro** means anything that we can see with our eyes. For example, if it was micro that would mean that we could not see it with our eyes.
- Before doing the demonstration this is a good point to talk with the youth about the importance of respectfully treating the organism that we will be looking at today.
- Demonstrate to the youth how to collect a sample. Throw the bucket on the string into the river and slowly pull it back making sure that sediment is collected.
- Use the plastic cups to put some of the samples into a tray and show the students how to find invertebrates. Use spoons to move the invertebrates from the tray to the paint trays so it’s easier for the youth to see the different invertebrates. In the video shown earlier, this process is demonstrated. *Start at 5:00* for a review of what this would look like for youth (YouTube video: <https://www.youtube.com/watch?v=CaGRQ02wURo>).
- Now that the youth are ready, have the groups go one-by-one to collect samples.
- Once the youth have collected their samples, have them identify them using the identification sheet. For example, if a youth collects a dragonfly larva they would pull out the identification sheet and try to see which picture it looks the most like. If the youth are having a hard time identifying their samples, the facilitator could be available to show some examples.
- After collecting samples, have the youth brainstorm reasons why we would want to collect these samples.
 - What role might invertebrates play in the health of the rivers?
 - Do fish eat them?
 - What other things in the water might be related to invertebrates?
- After some time discussing, explain to the youth that the invertebrates can be used to help identify how “healthy” the water is. If there is a high diversity of invertebrates it usually means that the water is healthier.

Part 2: Investigating Invertebrates (Indoor Option)

Start by asking the youth if they know what a benthic macroinvertebrate is. Give them a moment to explain their ideas.

Optional Questions:

- Have you ever seen bugs in the river/ stream?
- What did they look like?
- If they have a hard time coming up with ideas, ask them if they know what a vertebrae is. If they say no then have all the youth reach out their hand and then feel the back of their neck and explain that these are vertebrae. Next, explain that invertebrates don't have a spine. **Benthic** means anything living on the bottom of a water source and **macro** means anything that we can see with our eyes. For example, if it was **micro** that would mean that we could not see it with our eyes.
- Next, explain what an aquatic biologist does for a job and introduce a video that shows what the youth will be doing today. Here is a video that can be shared with the youth: *Benthic Basics – Sampling With a Kick Net* (YouTube).
- Break the youth up into groups of 3-5 and then explain to them what they will be doing today. Each group will have a bucket that they will be sampling from using a magnetic fishing pole.
- Show the youth an example of a sample that they are going to take. Pull out the magnetic wand (fishing pole), reach it into the bucket, and collect a sample. Explain to youth how what they are doing is only a model of what real scientists do.
- Next, have all the students start with **River Sample 1**. Each group will have one bucket. Each bucket should be filled with the invertebrates labeled River Sample 1. There should be 5 bags with this label so each bucket has the same sample inside. Youth in each group should take turns collecting a sample. As they collect each sample they should share with the group what they collected and each member of the group should record that species on the identification sheet for River 1. They should continue doing this until they have collected all the invertebrates from the river sample.
- Next, once the youth have determined all the invertebrates in the sample they have to work together to figure out the quality of the water that they just sampled. They should determine that from River Test 1 that the water is pretty clean because there was a diverse amount of invertebrates.
- Youth should do the same process for River Samples 2 and 3. River Sample 2 should have a moderately diverse population of invertebrates which means the sampled water is not so great. After they collect River Sample 3 it is important to recognize that this sample is the least diverse which indicates this water sample is the worst of the three. If youth have a hard time determining the health of the samples, remind them that some invertebrates are sensitive to pollutants. When those invertebrates that are sensitive to pollutants aren't present, this means that the water in that area has some pollutants present which means the water quality is worse.

Part 3: Reflection

- After doing the activities there should be a time for the youth to ask any additional questions that they might have.
 - What did you notice?
 - What do you wonder?
 - What do you want to know more about?
- Now that students have had a chance to talk about water quality, refer to some of the work that the Penobscot Nation is doing to help restore the rivers in Maine. This can be noted from the video above. Discuss as a group:
 - Does anyone know of other ways to test water quality?
 - How could we test to see if the water is healthy?



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Experience 3: Fish Talk

Topic: Youth will learn about the different parts of fish by building their own.

Time: This lesson should take approximately 45-60 minutes to complete.



Materials

- multi-colored clay
- sheets of paper
- scissors
- popsicle sticks
- tissue paper
- rubber bands
- copies of the fish diagram



Learning Outcomes

At the end of this activity, you should be able to:

1. Describe different parts of fish.
2. Define why each part is necessary for the fish to function.
3. Talk about the common fish found in Maine rivers.
4. Describe the process of respectful handling of animals.

Background Information

In this experience, youth will be learning about fish. They will learn the structure and functions of different parts of fish by making them out of clay. Some key structures to think about are gills, eyes, scales, and fins. Some questions to consider when working with youth: How do gills work? Why do fish have eyes in certain locations (not all have eyes in the same place on their body)? What are scales used for? During this experience, it is important to remind students about the respectful handling of animals when they are in nature. Also, remind youth that fish, depending on your perspective, could be seen as more significant. Fish could be the main source of food for some communities compared to others. For some youth, this may be the first time that they are introduced to fish in Maine and they may have a hard time coming up with different species. It would be helpful to have the Maine wildlife website (Species Information: Fisheries: Fish & Wildlife: Maine Dept of Inland Fisheries and Wildlife: <https://www.maine.gov/ifw/fish-wildlife/fisheries/species-information/index.html>) available to introduce new species to youth. Some species to highlight would be Salmon and Alewives.

Vocabulary

- **Scales:** Helps to protect from predators and parasites and also reduces friction with the water
- **Eyes:** Used for sight
- **Nostrils:** Used for detecting odors for the presence of food in the water
- **Mouth:** Taking in food and water
- **Gill:** The organ used to get oxygen from water
- **Dorsal Fins:** Used for quick turns and stability
- **Caudal fin:** Used to move forward and steer
- **Pectoral fin:** Side-to-side direction and speed
- **Pelvic fin:** Used for balance
- **Lateral line:** Used to feel low vibrations in the water

Methods

Part 1: Introduction

Start by asking the students “If you could be a fish what kind of fish would you be and why?” Have one youth start with a ball and share their answer to the questions. After they are done sharing they should pass the ball to the next youth to share their answer.

Optional additional questions:

- Where do you live?
- Why do you live there and not the ocean?
- (Be prepared for lengthy answers)
- Explain to youth that today we’re going to be discovering different parts of a fish. Before they start, engage youth with thinking about what they already know about fish:
 - I want to know what you think of when you think of fish.
 - Has anyone ever had a pet fish?
 - Does anyone like to go fishing?
 - Does anyone have a friend or family member who fishes for their livelihood?
 - How do our perspectives change the way we view fish?
- After engaging them with these questions, have youth brainstorm different species of fish that are found in Maine. This can be done in groups or individually.
- After the youth have talked about the species they know, show them some of the fish that are on the Species Information: Fisheries: Fish & Wildlife: Maine Dept of Inland Fisheries and Wildlife website, giving them a chance to see the different types of fish we have here in Maine.

Part 2:

Now that students are thinking about fish, have them discuss the different parts of a fish with a visual by handing out the fish diagram to each student. This is a good time to have them try and sketch fish and their parts before doing the activity.

- Optional additional question: Do you recognize any of these parts of a fish? (Reference *Parts of A Fish: Different Parts of A Fish with Functions & ESL Picture:* <https://englishstudyonline.org/parts-of-a-fish/>.)
- Start some discussion about what features fish have that humans don’t and why. This can be done by simply asking the youth what’s the difference between fish and humans. Trying to get them to note things like gills and fins. The goal is to get them thinking about common fish parts and this can be helpful to students who are not familiar with fish.

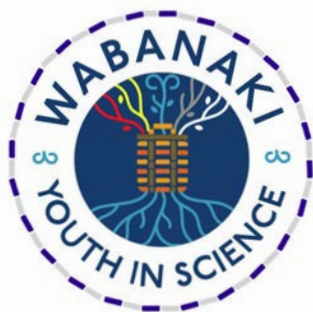
- After discussing common fish parts, the facilitator should disperse materials to youth to build their own fish models. Mention to the youth that they are encouraged to have as much freedom as possible when they go to construct their fish.
- As they are working, walk around asking each student why they added what they did, preparing them to share with the whole class at the end of the activity.
- After about 15-20 minutes of crafting, have the students start to share their fish and describe the different features. Here are some possible questions to have the students think about when reflecting on their fish:
 - How did they feel constructing their fish?
 - How did they decide what to do?
 - Which parts or features of fish stand out to them and why?
- As students bring up each part, have them try to describe what the part is used for. For example, if they say gills, ask the youth why the gills are important.
- After spending some time having the youth describe their fish, give them a chance to continue working on their model.
- Once they have completed their fish ask them what changes they might have made and why?
- After model construction is complete, mention some parts of the fish that did not get mentioned.
- Have the students try to guess what the functions of each part are and then explain what they are for.

Part 3: Reflection

- Have the youth reflect by answering the following questions:
 - “What did we learn about fish that we didn’t know before?”
 - “What are some questions that we still have about fish?”

Supplement to Experience #3:

Visit the English Study Online website to download the Visual Dictionary–Parts of a Fish graphic. <https://englishstudyonline.org/parts-of-a-fish/>



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Experience 4: Food Webs

Topic: Youth will be introduced to concepts related to food web dynamics.

Time: This lesson should take approximately 45-60 minutes to complete.



Materials

- pictures of animals from Maine
- Maine wildlife guide
- ball of yarn
- scissors
- blank pieces of paper
- pencils

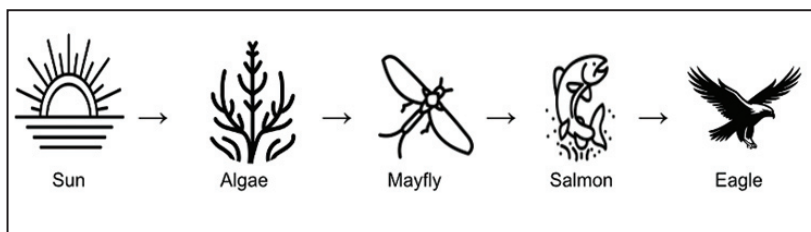
Learning Outcomes

At the end of this activity, you should be able to:

1. Explain what a food web is and why it is important.
2. Talk about what could happen if fish were removed from the food web.
3. Explain what a food chain is and how it could relate to Maine river ecosystems.

Background Information for the Facilitator

During this experience, youth will learn about food chains and how they can be used to form food webs. Food chains are introduced first because they are what make up food webs. A food chain is one example of how energy flows through the food web. An example of energy flow through a chain given to youth is portrayed below



(Photo Credit: Pixabay)

- In this food chain example it can be seen how energy is moving in a linear fashion. Starting with the sun and ending with the eagle.
- The energy transfer process starts with the sun and is transferred to the algae through the process of photosynthesis.



- After the process of photosynthesis, mayflies will eat the algae which gives them energy.
- Next salmon will consume the mayflies to get the energy.
- This chain ends with the eagle consuming the salmon to get energy.
- Decomposers are missing from this chain but are important to acknowledge as part of the whole food web cycle. Decomposers recycle dead material back into the environment by breaking it down into nutrients used by producers. Continuing the example above, when the eagle dies, its body would be broken down by decomposers like bacteria and insects into materials such as water, carbon dioxide, and minerals, fertilizing plant growth.

This food chain example includes ideas from previous experiences. This was intended to hopefully allow the youth to draw the connections between fish and invertebrates discussed during Experiences 2 and 3. When explaining the example food chain, it is important to remind youth that all energy for life comes from the sun. Plants get their energy from the sun through the process of photosynthesis. In the example, food chain algae is a producer because algae make their own food. Mayflies, salmon, and eagles are considered consumers because they can't make their own food and have to eat other living things to get their energy. During this experience, it would be important to note some of the impacts that the removal of a species might have on a food web. For example, a good question for discussion would be what would happen if the salmon population was removed from Maine rivers? Many impacts would happen if salmon were removed from the rivers. One of these impacts would be less food supply for humans and other animals.

Vocabulary

- **Food chain:** One example of the flow of energy through a food web
- **Food web:** A collection of food chains together to show many routes for the flow of energy
- **Decomposers:** Decomposers break down material that was once alive and release nutrients back into the environment

Methods

Part 1: Introducing the flow of energy

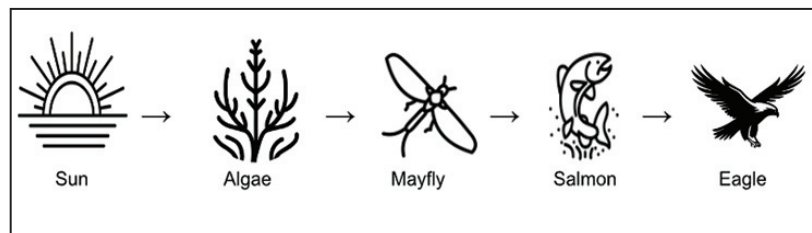
- Have students start thinking about food web-related ideas by having them answer the following questions:
 - What food did you have for breakfast today?
- Use what the students tell you to give an example of how energy flows.

Facilitator Note: This conversation could look something like this:

- After asking the youth what they had for breakfast, ask them
 - “Why do we eat breakfast?”
- Give them a chance to think about the question and try to help them reach an answer similar to getting energy for the day. Next, ask the youth:
 - What is cereal made from?
- Give the youth a chance to think and come up with an answer. Then explain that cereal is made from a lot of things, but they all start from grains like wheat, rice, or oats.
- Next, explain to the youth that grains are plants and ask them:
 - Do you know how plants get their energy?
- After giving the youth some time to think about the question, explain that plants get their energy from the sun through the process of photosynthesis.

Part 2: Food Chains

- Next, introduce the idea of a food chain. Explain that a food chain is an example of the flow of energy in a linear fashion usually starting with the sun. Note that they started to make a food chain when talking about what they had for breakfast. Energy started from the sun which went to the cereal and then was consumed by them for breakfast.
- Expand the discussion by applying what was just learned about food chains to how it works for fish and invertebrates. The sun gives energy to algae which live in the river. Then the algae is eaten by the invertebrates that we looked at earlier. Fish eat the invertebrates and other things from the river, and then the eagle consumes the salmon from the river. Decomposers are missing from this chain but are important to acknowledge as part of the whole food web cycle. Decomposers recycle dead material back into the environment by breaking it down into nutrients used by producers. Continuing the example above, when the eagle dies, its body would be broken down by decomposers like bacteria and insects into materials such as water, carbon dioxide, and minerals, fertilizing plant growth. Model this process using the pictures provided to make the food chain.



(Photo Credit: Pixabay)

Part 3: Food Webs

- Now that youth are familiar with talking about food chains it's time to introduce the idea of food webs.
- Food webs are more complex than food chains. They are essentially a bunch of interconnected food chains. Explain that this is what the youth are going to be modeling today, making up simple food chains and expanding them to food webs.
- Start by placing all of the pictures of Maine species on a table with the sun in the middle. Then task the youth with making food chains starting with the sun.
- The youth will take a piece of yarn and they will tape from the sun to another part of the web demonstrating the flow of energy. Next, they will connect the plant they connected to the sun to another animal. Youth will take turns doing this until they have made what looks like a web.
- Explain that this is the food web mentioned before made of all the smaller food chains. During the process discuss how some species are more connected to other species than others and what this could mean.
- Next, hand out the Maine wildlife guides and ask the students what Maine species they might be interested in adding to the web. Have the youth decide in groups up



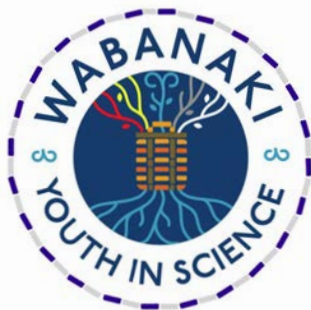
Food web images (Photo Credit: Tyler Tibbetts)

to 5 species they would like to add. After adding the new species to the web, the youth should try to determine how they would fit them into the already existing web.

- Once the web is constructed the facilitator will help model what it would look like if one of the species was removed from the web and the impacts that it would have on the rest of the web.
- Ask the youth questions before moving on to the next part of the activity:
 - Which picture has the most yarn on it?
 - What does it mean when the picture has so many yarn connections?
 - What would happen if the fish or invertebrates were removed from the food web? Give them a chance to reason out what would happen with the yarn ecosystem.
 - What would happen if a fire burned down all the trees?
 - What would happen if the sun wasn't there?
- These scenarios can be modeled by flipping over the picture of the fish and seeing how the species connected to the fish would be affected. The same process can be done with the trees and the sun. After explaining the scenario to the students, give them a chance to reason out what would happen to the food web.

Part 4: Reflection

- After completing the experience here are some reflection questions to consider:
 - Why might it be important that we are trying to restore salmon populations in Maine?
 - Are fish populations important? Why or why not?
 - Why should we be concerned about each kind of plant or animal?
 - Why is it important that we keep the invertebrates and fish happy and healthy? How could this benefit our community?
 - What could happen if the ecosystem or a food chain is disrupted?



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Supplement to Experience #4

Food Web Photos (all photos by Pixabay)



Deer



Bald Eagles



Snowy Owl



Squirrel



Algae Pond



Black Bear



Invertebrate



Bobcat



Autumn Leaves



Grass



Caterpillar



Nature



Sun



Worm



Experience 5: What's in the Water?

Topic: Youth will be introduced to eDNA and how it can be used to identify species.

Time: This lesson should take approximately 45-60 minutes to complete.



Materials

- river scene pictures
- eDNA sample sheets
- Big Tracks, Little Tracks by Millicent E. Selsam
- sheets of blank paper
- pencils
- projector or way to display a short video



Learning Outcomes

At the end of this activity, you should be able to:

1. Explain at a basic level how eDNA works.
2. Talk about how eDNA can be used to help fulfill our duties to be in good relations.

Background Information for the Facilitator

Environmental DNA (eDNA) is collected by scientists to discover what species are currently living in a specific area. The samples used to gather eDNA evidence can be taken from the water, air, or soil. One key takeaway for youth about eDNA is that it is used to tell what is present in an environment. During this experience, youth will be tasked with looking at a picture of an environment and trying to determine what is going on. They will determine what they see compared to “eDNA results” that will be introduced in the second part of the experience. Through storytelling, they will explain what they notice about the environment. If youth struggle with storytelling, the facilitator could remind them about previous experiences to help them construct stories about what might be happening in the scene. For example, in the scene, there are bear tracks and the facilitator may ask the youth what they think the tracks might tell us. During the second part of the experience, the youth will be looking at “data” that resembles what an eDNA sample might look like. The idea behind the sample is that if a species has a green light for one of the samples that means that species was present in the environment that youth looked at. If there was a red light that means that the species was absent from the environment and if there was a yellow light that means that the data was inconclusive or uncertain. Using these sample sheets the youth

will be asked to continue the story of the environment using a different perspective. One thing to note for this portion of the activity is that beavers will be present in the data collection but were not shown in the pictured scene.

While youth are telling their stories about the environment, remind them about perspectives and how we can all be seeing the same pictures but we may have different stories to tell about what's going on. This will reinforce different points of view using the same information.

Vocabulary

- **eDNA:** Environmental DNA, genetic material left behind by species (hair, fluid, skin)
- **Ecosystem:** An environment where the land and species are interacting with each other

Methods

Part 1:

- Begin by asking youth what stands out to them about the past few experiences the group has shared. This could be done in small groups or as a whole group, where everyone shares something they found interesting or that leaves them with new questions. Facilitators may want to remind the youth of some of the material discussed in the last few weeks (maps, invertebrates/ water sampling, parts of a fish, food chains, and food webs).
- Introduce a book called *Big Tracks and Little Tracks*, a story about following animal prints by Millicent E. Selsam
- Ask the youth:
 - What do they think a nature detective would do before reading the book?
 - What does the title imply?
 - Why do they think tracks might be important to pay attention to?
- Read the book out loud. As you lead the youth through the book ask questions like: What is something that tracks could tell us? or What are some other ways that could tell us if a species was present in an environment?
- After finishing the book, have the youth make a prediction about how big they think a black bear track is. After they have made their predictions, let them explore some pictures of tracks in comparison to humans so they can see how big some tracks are.
- As a group, discuss:
 - What surprised them about the life-size tracks?
 - Which tracks would they like to see?
 - Have they seen any of these tracks, or any tracks before?

Explore




- Explain that they are being tasked with becoming nature detectives. Together we are going to look at a picture (using a River Scene sheet provided in the tool kit) and determine what we think it is trying to show us. Everyone may not have the same ideas about what the picture is depicting, and that is ok. Let the youth know that they will be tasked with telling stories about the river scene after they have had time to examine it.
- Split the youth up into groups of 3 to 5.
- Give the youth about 5 to 10 minutes to examine the scene. Youth should notice that there are a number of species that were discussed in previous lessons. Youth are encouraged to tell stories based on material they learned in previous activities. Provide paper if the youth would like to take notes and ask them to prepare to tell stories based on what they can see from the scene.

- After they have had time to make sense of the River Scene and talk with their group about the story, or at least part of the story they see, have everyone gather in a circle. This will be the time to share the stories that have emerged. Encourage each youth to tell a story about one of the species that they see. As they tell their story, allow the youth a chance to build on other stories with other observations that they might have made about the species. Go around the room and allow each youth/ group a chance to tell their story about what they are seeing. Feel free to add priming questions that are related to topics already discussed in prior experiences.
 - Are invertebrates present?
 - Are there fish present?
 - What about an eagle?
 - Do we notice any species that we haven't talked about before?

Part 2: eDNA Sample

- After the students have had a chance to tell their story about the environment, introduce a new perspective by introducing what Environmental DNA (eDNA) is. Scientists collect eamples from rivers and on land to find this type of DNA in order to discover what species are currently living there.
- This is a 2-minute video that gives a good quick explanation for the youth to know what eDNA is. Show this video explaining what eDNA is: *What is environmental DNA (eDNA)?* (YouTube: <https://www.youtube.com/watch?v=TQdTV1rAlWY>).
- Hand out the eDNA sample sheet to the youth to interpret what the data means. Explain that there are a few key things to help understand this new type of story:
 - On the left, the species name is listed.
 - Next to each species' name are three samples. One was collected in the spring, one collected in the summer, and then finally, one was collected in the winter.
 - Notice that there are traffic lights.
 - The green traffic light indicates that an eDNA sample was found for that species which means they are present in the environment that we observed during that time.
 - The yellow light indicates that the species might be present.
 - The red light indicates that no eDNA was found which would mean that the species was not present in the environment.
 - There is a key on the back to help decipher the data.




Facilitator demonstration: Start by modeling to the youth how to interpret the eDNA data about the salmon.

Species Name	Sample 1 (Spring)	Sample 2 (Summer)	Sample 3 (Winter)
Salmon			

Visit the Supplement to Experience #5: eDNA Sample page for full table of information.

You might say something like: “For the salmon, I see the spring sample shows a green light. The key below will tell me what this means. It says, ‘the green light means the species was present in the environment.’ So I know there must have been salmon in the area during the spring. The samples taken during the summer and winter also show a green light. This means the salmon must have been around in those seasons as well.”

- Whole group interpretation:
 - Next, work together as a whole group to interpret the data for the Algae.

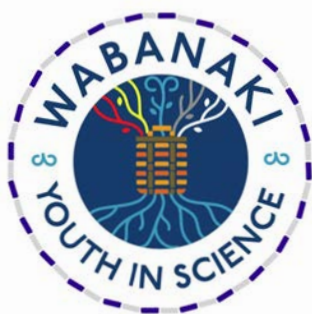
Species Name	Sample 1 (Spring)	Sample 2 (Summer)	Sample 3 (Winter)
Salmon			

Visit the Supplement to Experience #5: eDNA Sample page for full table of information.

- Help them work together to go one season at a time, determining what the color of the traffic light is and what that means in terms of absence or presence.

Independent work:

- After completing the group interpretation, give students time to work independently to interpret the remaining data. Once they have had enough time to look at the data, ask them to connect the story they are constructing from the data with the story they have constructed from the River Scene. If the youth have a hard time doing this ask questions like:
 - Why might the bear not be present in the winter?
 - Does anyone notice that a beaver is present in the environment?
 - Why don't we see it from our observation?
 - Help the youth draw connections between the data and the environment.
- After all the stories have been told about the environment, ask the youth if they have other questions related to the topics discussed in the experience. You could ask questions like:
 - What did others notice that you might not have noticed?
 - How did you conclude some of your observations?
 - How might you use this new view on perspectives the next time you have an opportunity to explore the woods or watershed?


































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Supplement to Experience #5

eDNA Sample

Species Name	Sample 1 (Spring)	Sample 2 (Summer)	Sample 3 (Winter)
Salmon			
Dragonfly larvae			
Bear			
Beaver			
Eagle			
Salamander			
Brook Trout			
Bass			
Alewife			
Algae			
Sun Fish			
Rainbow Trout			
Smelts			

Key

- Circle with a checkmark for "Present."
- X inside a square for "Not Present."
- Question mark in a triangle for "Might Be Present."

Supplement to Experience #5

River Scene



A vibrant river ecosystem featuring a deer, eagle, blue jay, bear, and squirrel, surrounded by forest plants, berries, insects, and a leaping fish. Photo: OpenAI DALLÉ-3