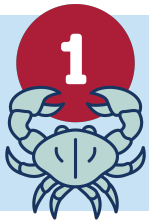
THE UNIVERSITY OF MAINE Cooperative Extension

4-H STEM Toolkit

Activity 1: What is an Ecosystem, and What is a Food Web?

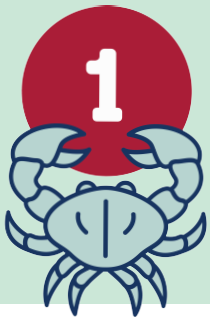
Topic: Youth are introduced to the concept of ecosystems and species interactions in both land and water habitats.

Time: This activity should take approximately 60 minutes to complete.



Materials

- Aquatic species cards
- Land species cards
- Whiteboards
- Whiteboard markers
- Whiteboard erasers
- Printed copies of an example food web
- Aquatic Species fact sheets
- Aquatic Food Web Memory game rules



Learning Outcomes

At the end of this activity, youth should be able to…

1. Understand that an ecosystem is a community of interacting organisms and their physical environment.
2. Explain that food webs show predator and prey relationships and model the flow of energy through ecosystems.

Background Information

The first activity in this kit has youth exploring ecosystems and species interactions. We present ecosystems as collections of species that interact with each other in order to survive. These interactions can take different forms. We have chosen to explore this topic with an ecosystem the youth are familiar with and use predator and prey relationships. Youth begin by looking at a land ecosystem found in many parts of Maine. In short, the sun provides energy to the grass, and then the grass is eaten and used as a home by insects and small animal species, like the grasshopper. This grasshopper is then food for birds and the birds are food for the foxes.

Sun → Grass → Grasshopper → Bluebird → Fox

Youth then expand on this to build a food web model. They then apply what they have learned to add marine and coastal species to their food web:

- Seaweed: an aquatic plant that lives close to the shoreline
- Puffin: a seabird
- Sea urchin: a small sea creature
- Oyster: a type of shellfish

- Clam: a type of shellfish
- Plankton: a microscopic plant or animal that is often eaten by "bottom feeders"
- Cod: a medium sized fish
- Shark: the big ones that live deep in the ocean
- Lobster: a Maine classic!
- Black sea bass: a medium sized fish
- Jonah crab: a crab native to Maine
- Green crab: a crab invasive in Maine
- Asian shore crab: a crab invasive in Maine

Youth explore marine species interactions in the same way they explored the land species interactions, by building a food web to demonstrate predator and prey relationships. They then explore what could happen if a species disappears from the ecosystem.

Vocabulary

- **Aquatic:** relating to water
- **Carnivore:** organisms that eat mainly meat
- **Consumer:** organisms that get their energy from eating plants and animals
- **Decomposer:** organisms that break down dead organic material
- **Ecosystem:** community of organisms living together and interacting in particular a habitat
- **Food chain:** linear sequence that shows how energy is passed from one organism to another
- **Food web:** many food chains that are linked together
- **Herbivore:** organisms that eat mainly plants
- **Omnivore:** organisms that eat plants and animals
- **Producer:** organisms that get their energy from the sun

Methods

Engage

1. Have participants work in small groups of 3-4 youth. If you have a smaller group, have them do this activity in pairs.
2. Ask youth to discuss in their groups what animals they have seen in Maine. If they struggle to come up with ideas you can prompt them with these questions: "What is an animal you see a lot in Maine?" "Do you see different animals in different parts of the state?" "If you could be an animal that lives in Maine, what would you be? Why?" "What kind of habitat would you find yourself in if you were that animal?"
3. Once you start to see conversations slow down, call the groups back together and have them share what they talked about.
4. Introduce today's activity. Example script: "It seems like you have seen many animals around you! Have you ever stopped to think about how all of these species could be connected?" Allow the youth time to answer the question then continue on: "One way these species are connected is what we are going to explore today! I am going to present you with some animals and plants and challenge you to explore how they could be connected. Some connections might be difficult to make – don't worry, just do your best!"

5. Pass out the land species cards, one set per group. Have groups take a look at their cards. Give them time to spread the contents on the table so everyone in the group can observe the materials they are working with. At this time they should only have only the land species cards.
6. Have groups sort the species by connections they come up with. Explain that this is a warm up activity to get them thinking about background knowledge they already have about these species. There are no wrong connections that they can make as long as they can explain why they have put something into a category.
7. Encourage all youth in a group to be involved in making decisions about the categories they create and how they sort their species.
8. If you notice any groups struggling you can prompt them with these questions: "Do you notice anything similar between any of the species?" "Would sorting based on plants and animals be appropriate?" "Do you see any connections based on where they live or what they eat?"
9. Encourage deeper thinking with these questions: "Why are you sorting this way?" "What are the connections between these species?" "Why isn't this in the other category?" "Do any of your species fit in more than one category?"
10. Come together and ask the youth to share how their group sorted the species cards. Discuss how their categories for sorting were the same and different.

Explore

Review the video instructions below or watch the video "Activity 1: What is an ecosystem and what is a food web?" https://youtu.be/KhLLuUcfB-k?si=lHlwUX_vFAbAWipu

1. Now that youth have had some experience working with land species, it is time to introduce the idea of an ecosystem. Example script: "You have made some great connections between these species and I think everyone has noticed that these species all live in a similar area. These animals are all part of the same ecosystem. Have any of you ever heard that term before?"
2. If any of the youth have heard the term 'ecosystem' give them a chance to share what they think it means.
3. Clear up any misconceptions that may have come up and define an ecosystem: "An ecosystem is a community of species that all live in the same area and interact with each other in order to survive. One of the easiest ways to think about an ecosystem is to sort all the species together in the order of who eats who or what eats what, and that is going to be our next task!"
4. If youth have not already done so, work together to have youth sort their species into the following categories: **producers** (species that get their energy from the sun, these will be the plants) and **consumers** (species that get their energy from eating other things, these will be the animals). Have them further sort their consumers into the categories: **herbivores** (animals that eat plants for energy), **omnivores** (animals that eat plants and animals for energy) and **carnivores** (animals that eat other animals for energy).
5. Pass out two white boards to each group. Instruct the youth to place the white boards next to each other to make a bigger workspace as shown in Figure 1.

Figure 1: Two white boards side by side to use as a work space.

6. Pass out markers and white board erasers. Ask the youth to look at the land species they have sorted and explain we are going to organize them on the white board based on who eats who. Example script: "Look at the connections we have already made, now we are going to sort your species based on who eats who using the white boards. You will place your cards on the whiteboard and then use the markers to draw an arrow to show who eats who. Arrows show the flow of energy so it points at the organism doing the consuming."
7. Work together as a whole group to build their first food chain (they do not all need to be the same).
    a. Have youth start by drawing a sun on their group's white board.
    b. Ask: "What species can you connect to the sun?" Youth should select a plant (producer) card and draw an arrow from the sun pointing to the plant. Remind them that they have limited space on their boards and many cards to add so they don't want to spread them out too much.
    c. Ask: "What eats the plant?" Youth should select an animal from the herbivore (or omnivore) group and add it to their white board, drawing an arrow from the plant to the herbivore.
    d. Carry on until they have built a food chain with a few species in their chain (they will not have used all their cards). If they notice that more than one species could connect to another, have them pick just one for now. You are looking to have a linear food chain where each species has one arrow connection for energy that it uses and one arrow connection for another species that eats it for energy.

Figure 2: An example of a food chain. The species may vary based on what cards youth choose for this first food chain.

8. Explain that they have built a food chain. A food chain is a series of predator-prey connections between plants and animals that shows the flow of energy from the sun through an ecosystem.
9. Explain that in nature ecosystems aren't this simple. Each species can have multiple connections with other species. Now that they have built a food chain they are going to work with their small group to make connections to add the rest of their species cards to the chain they have already built.

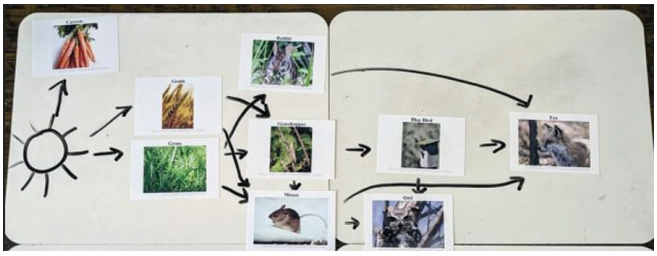


Figure 3: An example of a food web for the land species. Not all youth webs will look the same, they may make different connections based on their background knowledge or they may place the cards in a different order.

10. Youth should work together to place cards on their white board and draw the appropriate arrow to show the flow of energy. This will mean that their food chain will start to grow branches as species connect with multiple other species. Model this for them if they need help understanding. Some species will be connected to many others with many arrows, others will have just a few connections.

Explain

1. When they have added all their species cards ask the youth if they know if what they are creating has a name. They have created a food web! Explain that a food web is many food chains that are connected together. A food web is the building block of ecosystems, each species needs the other organisms they are connected to in order to survive.
2. If there is a projector in the room, you can project an example of a food web for students who may be struggling. A good example is the article, The Bottom of the Arctic's Food Web Is of Top Importance (Frontiers for Young Minds), which shows the arctic food web. If no projector is available, a printed example is included in the kit. Make sure to show a food web of species they are not currently working with.
3. Have youth look at the food web example and go on a gallery walk around the room to observe the food webs other groups have created.
4. Come back together as a whole group and discuss what they saw. Encourage youth to back up their observations with specific evidence that they have. Example questions: "How are all of our food webs the same? How are they different?" "Do all of our food webs need to look the same to show the predator prey relationships between our species? Why or why not?" "How did you make decisions about where to place and how to connect the organisms?" "What do you notice about the example food web?" "How is it the same or different from our food webs?" "Does seeing these different food webs make you wonder about anything?" "Why do you think these connections are called a food web and not a food chain like we learned about earlier in this lesson?"
5. The species cards are not the only species that exist together! Participants might think of others that could be included. Have the youth draw or write the species they are thinking of and add it to their ecosystem. Having youth do this can allow them to see other connections that they can make and let them be creative. This is also helpful if you notice some groups finishing earlier than others, give this task to the quicker groups so everyone still has something to do.

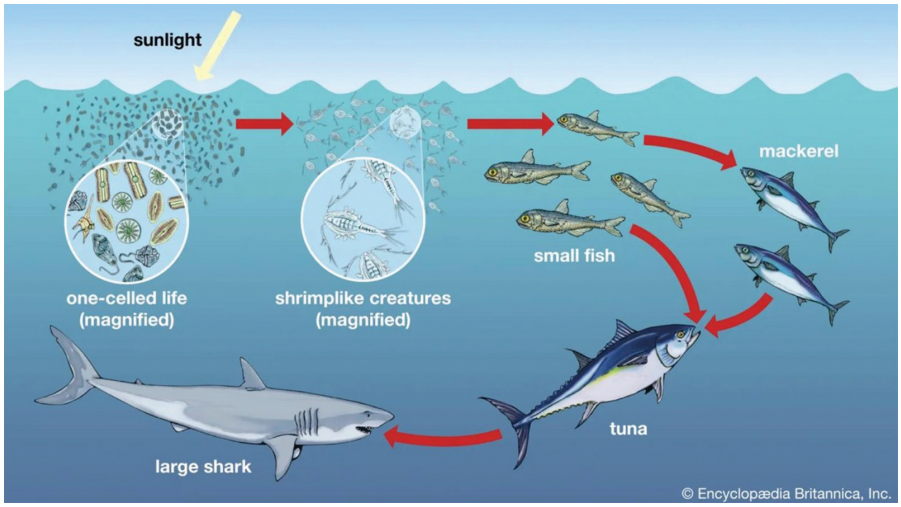


Figure 4: An example of a food web. – Graphic: Encyclopædia Britannica, Inc.

Elaborate

1. Give instructions for the next part of the activity. Example script: "I am going to pass out more species cards to connect to the food web you have already made. These species represent an aquatic ecosystem. There will be some connections to your land food web, but not as many as between your land species. You are going to play a cooperative game to work together to add all of your aquatic species cards to your food web."
2. Pass out the aquatic species cards, the instructions for the Aquatic Species Food Web Memory and the Aquatic Species Fact Sheet and two more white boards to expand their work area.
3. Explain how to play the game. Remind youth that this may be different from the memory games they are familiar with so they should pay careful attention.
   - **a.** Remove Asian shore crabs and green crabs from your deck of cards. Set these two cards aside for now. You will use them later.
   - **b.** Lay cards face down in a grid pattern. There are eleven cards so they will not make a rectangle.
   - **c.** The youngest player goes first.
   - **d.** To take a turn, the player flips over one card.
   - **e.** The player identifies what species they have on their card and reads the fact sheet about that species out loud to the group.
   - **f.** The group decides together if they can add the species to their existing food web by connecting it to another species already in the food web. If there is disagreement the player who is taking their turn makes the final decision.
   - **g.** If the card can be added to the food web the player adds the card and draws an arrow to show the flow of energy through the ecosystem. More than one arrow may be drawn to represent multiple connections between different species.
   - **h.** If the card cannot be added to the food web at this time the card is flipped back over to remain in play.
   - **i.** Play goes to the next person in the circle (the group can decide which direction play goes in).

Figure 5: Two more white boards should be placed next to the land species food web to expand the work area.

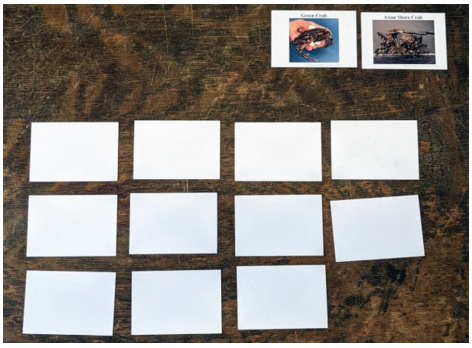


Figure 6: Aquatic species cards in a grid face down. The two invasive crab cards are set to the side for now.

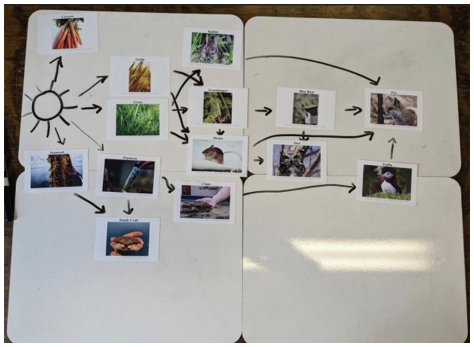


Figure 7: After a few turns the aquatic species food web begins to grow alongside and connected to the land species food web.

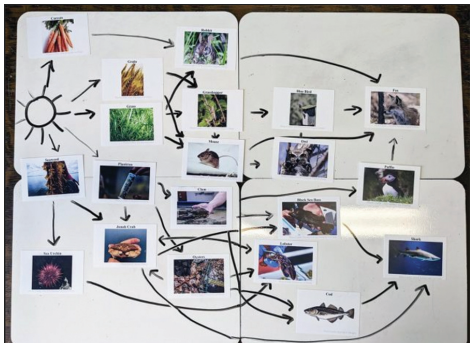


Figure 8: An example of a food web with all of the species cards added. This may not look the same for all groups depending on the connections they added and order they placed their cards in. This group could go back through the Aquatic Species Fact Sheet and add more connections.

j. Play continues until all eleven cards are added to the food web.

k. As groups finish, tell them: "If you finish with extra time, go back and see if you can add arrows for other connections between species that you missed the first time. Think about other species you could add to your food web (they need to be ones that could be found in your ecosystem in nature. You won't find a tiger in the Gulf of Maine, but you might find a person or a whale). Use the predator/prey connections mentioned on the fact sheet to help you. Write that species on your white board and decide as a group what other species it could be connected to and draw arrows to show the flow of energy. As a group, talk about what kind of impact that species would have on your ecosystem."

4. Offer help to groups who are struggling. Some questions you can ask to try and encourage deeper thinking: "Can you think of more than one connection for this species?" "What species do you think eats the most other species?" "Is this species a plant or animal?" "Do you think this species is an herbivore, omnivore or carnivore?" "What do you think might eat this species you have placed on your board?"
5. Note: there can be more than one connection between species. If the youth are struggling with this concept, direct students to look at the example food web and ask them to think about similarities/differences between what they have created and what an expert has created.
6. When the food webs are complete, call the youth back together and ask them to share what they created. You may choose to do this as a gallery walk. Have youth walk around the room to look at what other groups created.
7. Once the youth are back at their table, give them a minute to think about what they saw or to discuss with their group. Ask them some reflection questions: "Were there similarities between the food webs?" "Were there differences between the food webs?"
8. Read out loud the fact sheet about the Asian Shore Crab and Green Crab. Have groups add these two species to their food web. Have them think with their group about the consequences of these two invasive species on the ecosystem. Example script: "These invasive species are voracious eaters and have very few predators. They have come into your ecosystem and reproduced rapidly. They have eaten all of one of the species they are connected to in your food web. Together with your group decide which species that is." Continue on: "The species you just chose is no longer part of the ecosystem, how does that change the web you have created? Show this by adjusting your food web."

9. Ask: "What will happen to the species this one is connected to?" (Answer: Some will increase in numbers and some will decrease. Have youth identify which ones will increase and which ones will decrease.) Youth can use a plus sign next to species whose populations would increase and a minus sign next to species whose populations would decrease. Groups should remove species they think would no longer survive and show what would happen to the species connected to that one.
10. Ask youth to reflect on the food web changes by discussing: "How many other species would be impacted if these two invasive crabs were introduced into the ecosystem we created today?" "Are only species with direct connections (arrows) to the invasive crabs impacted by their presence in the ecosystem or are there indirect impacts to other species? Why do you think that is?" "Is this a healthy ecosystem that is sustainable?" (Answer: The food web could fall apart after losing some of the species!)

Evaluate/Reflect

1. Ask youth to reflect on their learning by asking these questions: "Were there any connections that surprised you?" "Have you seen any of these connections in real life?" "How would you describe an ecosystem to your friends or family?" "What do you wonder about the connections between species in an ecosystem?"

Extension

1. Mention a species off the top of your head. Ask youth to write the name of the species on a white board. Ask youth if they can connect the new species into the web they have created. Adding a new species may require them to add other species to the web to make a connection – that is fine! Challenge youth to think about how all species are connected.
2. Humans can be added to almost every food web. Challenge the youth to add humans into the web they have already created.
3. The activity "Oh Deer" from *Growing Up WILD: Exploring Nature with Young Children* can be used as a supplement to this activity.

NGSS alignment

- 5-PS3-1 Energy (Next Generation Science Standards) www.nextgenscience.org/pe/5-ps3-1-energy
- 5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics (Next Generation Science Standards) www.nextgenscience.org/pe/5-ls2-1-ecosystems-interactions-energy-and-dynamics