



FOOD WEBS – HERE, THERE, AND EVERYWHERE!

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Grade Level
4th Grade

Subject Area
Life Science

VA SEA is a collaborative project between the Chesapeake Bay National Estuarine Research Reserve, the Virginia Institute of Marine Science's Marine Advisory Program, and Virginia Sea Grant. The VA SEA project is made possible through funding from the National Estuarine Research Reserve System Science Collaborative, which supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is funded by the National Oceanic and Atmospheric Administration and managed by the University of Michigan Water Center.



Title: Food Webs – Here, there, and everywhere!

Focus: Examining how food webs depict the flow of energy and relationships between organisms in the marine environment.

Grade Level

4th grade Life Science

VA Science Standards

Scientific and Engineering Practices:

4.1 The student will demonstrate an understanding of scientific and engineering practices by

- e) developing and using models
- f) obtaining, evaluating, and communicating information

Living Systems and Processes:

4.3 The student will investigate and understand that organisms, including humans, interact with one another and with the nonliving components in the ecosystem.

- a) interrelationships exist in populations, communities, and ecosystems
- b) food webs show the flow of energy within an ecosystem

Earth and Space Systems:

4.7 The student will investigate and understand that the ocean environment has characteristics. Key characteristics include:

- c) interaction of organisms in the ocean

Earth Resources:

4.8 The student will investigate and understand that Virginia has important natural resources. Key resources include:

- a) watersheds and water
- b) plants and animals

Learning Objectives

Students will:

- Identify and label habitats of marine organisms.
- Label organisms' roles within food webs (producer, consumer, decomposer)
- Infer organisms' relationships within Virginia coastal food webs by comparing them to similar relationships in the Arctic marine environment
- Compare and contrast differences between Virginia and Arctic marine food webs
- Translate and apply their knowledge on Arctic food web structure to create a visual depiction of a Virginia marine food web

Total length of time required for the lesson

Preparation of Materials: 1 hour for initial printing and prepping of materials. Optional to laminate materials to reuse each year, which will add 20 minutes of preparatory time.

Time for Lesson: 1 hour in total. Approximately 20 minutes for background presentation with 40 minutes for the hands on activity.

Vocabulary

Arctic – The polar region in the northern hemisphere that is above the 66 ½ latitude line. These ecosystems are very cold and experience at least one full day of darkness in the winter, or light in the summer.

Estuary/Estuarine – Ecosystems in coastal zones where freshwater and saltwater mix.

Habitat – the area where a specific organism lives.

Food Web – a diagram showing the flow of energy through an ecosystem.

Prey – an organism that is consumed by another organism.

Predator – an organism that consumes another organism to gain energy.

Apex Predator – an organism at the top of the food web that does not have a predator.

Producer – an organism that creates its own energy, most commonly from sunlight.

Consumer – an organism that eats other living organisms to gain energy.

Decomposer – an organism that eats other dead organisms to gain energy.

Phytoplankton – microscopic organisms that drift through water and use light and nutrients to create energy.

Zooplankton – small, sometimes microscopic, animals that consume phytoplankton and drift throughout bodies of water.

Background Information

Food webs show how energy moves between plants and animals. Where a specific plant or animal is found can be called its habitat, and the area where all these habitats are found are called an ecosystem. For example, a crab may live on the ocean floor, and a fish in the water above. These habitats combined make an ocean ecosystem. Food webs help us show how all the plants and animals in an ecosystem interact and how energy moves through the system.

Food webs are made of producers, consumers, and decomposers. Each of these groups of organisms get their energy a different way. Producers create their own energy by turning sunlight and nutrients into energy. Producers always form the base of a food web. The most common examples of producers are plants and phytoplankton. Phytoplankton are tiny, microscopic organisms that drift in water (Slide #9). They form the base of all water based food webs. These phytoplankton are a food source for many other animals. Consumers eat other living things to get energy. Consumers come in many shapes and sizes. Some consumers eat producers to gain

energy, and some eat *other* consumers. Examples of consumers include bears, fish, crabs, and zooplankton. Zooplankton are very small, sometimes microscopic, animals that drift in water and eat phytoplankton (Slide #9). They are very important for all water based ecosystems. This is because they get their energy from phytoplankton and are then eaten by bigger animals, like fish and whales. Decomposers are animals that eat other *dead* plants and animals to get energy. Think of these organisms as nature's recyclers. They eat dead plants and animals and turn them into nutrients in the soil or sediment. Some examples of decomposers include bacteria, worms, and other bugs. By decomposing dead organisms, they are making soil, sediments, and nutrients that will give producers energy. This keeps the food web running smoothly!

Many consumers and decomposers eat more than one type of plant or animal, just like humans like eating different foods. Food webs are called webs because the way energy moves between plants and animals in an ecosystem is complicated. There are some organisms that are found in every ecosystem, such as phytoplankton and zooplankton in water based ecosystems. These organisms can be found in every ocean, river, and lake on the planet. They form the bottom of water based food webs. Another way to think about food webs is through predator and prey relationships. Predators are organisms that hunt and eat other living plants and animals. This means they are consumers. The plant or animal that a predator eats is called its prey. Finally, the animal that has no predators and is not eaten by other animals is called an apex predator. When apex predators die, they are decomposed by decomposers. This lets the energy stored in their bodies return to the ecosystem and base of the food web.

For this lesson, we are looking at the Arctic coastal ecosystems, which are water based environments near the shore of the Arctic ocean. Arctic coastal ecosystems are special because they are located near the north pole and are very cold. The Arctic is defined as the land located above the 66 ½ degree latitude line. This means that this area has 24 hours of darkness for at least one day in the winter, and 24 hours of light for a day in the summer. These ecosystems are so cold that ice can cover the ocean for large parts of the year. This ice is a habitat for plants and animals that live in the Arctic. In general, Arctic coastal ecosystems have three main habitats, ice, water, and sediment. In each of these habitats there are many different plants and animals that live there, even with the cold temperatures and ice. Many of the food web relationships we see in the Arctic are across these different and create a complex food web which can be seen in Figure 1.

Although the Arctic is a very different ecosystem than coastal Virginia, there are still many similarities in habitats, organisms, and food web structure. Most ecosystems have similar organisms that fill the same role. For example, phytoplankton and zooplankton are found in the water of all coastal ecosystems. While not all plants and animals are the same, there are many similar organisms in Arctic and Virginian coastal ecosystems. Both Virginia and the Arctic have crabs, but different species (Virginia Blue Crabs, Arctic Snow Crabs). The Arctic has blue mussels that live in the sediment and consume phytoplankton to gain energy. Virginia does not have blue mussels, but it does have Eastern Oysters. These oysters also live in the sediment and eat phytoplankton for energy. These sorts of similarities exist throughout all levels of food webs.

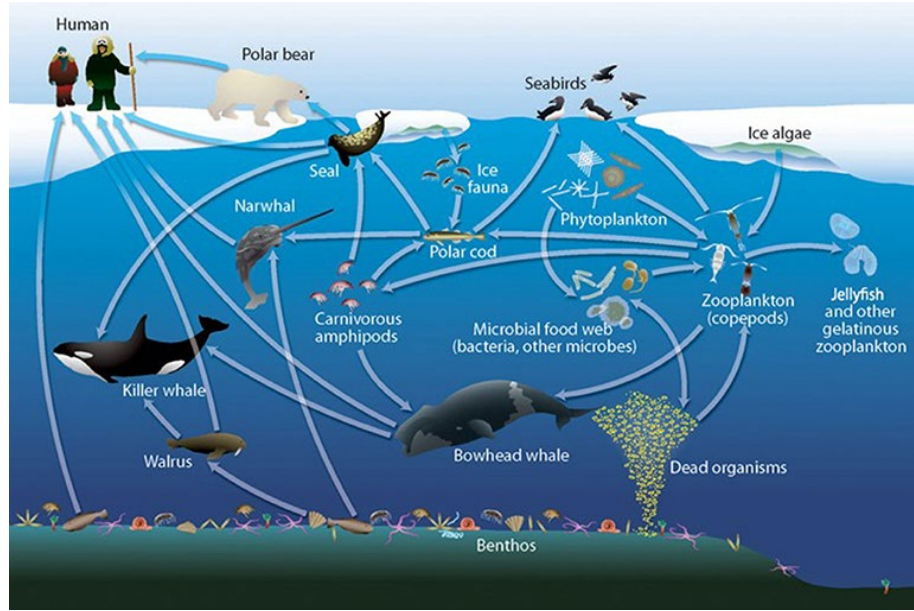


Figure 1: An in depth diagram of the coastal Arctic food web. Students will make a much simplified food web diagram. Image Credit: Darnis et al. (2012)

For this activity, students will use the idea of similar organisms and food web structure to make their own diagram of a Virginia coastal food web. Students will first learn about food web structure and roles. They will then learn about how they show the flow of energy in an ecosystem. Then, they will then learn about coastal Arctic habitats and organisms and see how all this information creates a food web. After reviewing the lesson and material, students will then be given a printout of a blank Virginia coastal ecosystem with unique habitats, and organism card. They will then place the organisms in the correct habitats and then draw arrows between them showing the flow of energy.

Materials and Supplies

Printer Paper
Glue or tape
Organisms print outs
VA Habitat Handout
Colored Markers
Scissors

Optional for reuse:

Laminator
Expo Markers
Erasers

Teacher Preparation

Print materials ahead of time. If you are planning to run the activity in groups, print out one Virginia coastal ecosystem sheet and one set of organisms print outs per group. If working individually, print out one copy of each sheet for every student. There is also the option to do the activity as a class, virtually, which would require no print outs.

Review slides and background material.

Procedure

There are options for students to work in small groups (2-3) or on their own. Prior to the activity, give the associated presentation that provides the students with background information on food webs, food web structure, Arctic coastal ecosystems, and differences and similarities with Virginia Coastal Ecosystems. At the beginning of the presentation, Figure 1 is displayed, asking students to participate in an “I see, I think, I wonder” activity to get students critically thinking about food webs, and to gauge prior knowledge. At the conclusion of the lecture, you will find a simplified diagram of the Arctic coastal food web in similar style to the activity (SLIDE #18 & 20) – leave this up on the projector for students to refer to, or print out the slide separately so that they have the reference to work from. Once the presentation is finished, give each student their ‘packet’ of supplies. This will include the Virginia Coastal Ecosystem habitat diagram, organism cards, and some sort of colored writing utensils (Expos, colored pencils, markers, etc.).

Start with each student labeling the habitats on the Virginia diagram (Marsh, Estuary/Ocean Sediment). After they have labelled each habitat have them sort the organism cards into the correct habitat on the diagram. You may go around the room to check that students have them in the correct habitat or create the Virginia Coastal Diagram on the associated PowerPoint slide simultaneously with students. Ask the students to glue or tape their organisms in the correct habitat. After they have been placed in the correct habitat, students will begin to ‘connect’ the organisms to create their food web. Prompt students to start with phytoplankton, their primary producer, and then draw arrows moving up the food chain (ex: arrow point from

phytoplankton to zooplankton). Prompt students to draw all the food web arrows they see fit, and that higher level organisms may consume more than one type of prey. Make sure to highlight the fact that these arrows indicate the flow of energy throughout the food web. After all the arrows have been drawn, refer to the student work sheet and guide them through each question. You may continue to build the VA coastal food web through PowerPoint with the students or bring up the Answer Key slide at the end to compare results. At the conclusion of the worksheet, ask students to share what organism they thought would be the worst for the food web to lose, and to explain their reasoning. At the conclusion of the activity, you may collect the diagram and worksheet as their assessment.

If students are struggling with identifying the habitat or connections of an organism in the Virginia food web, ask them to look at the Arctic food web. The Arctic food web diagram, and the Virginia food web have been structured to have analogous organisms in each habitat with the same, or very similar, flows of energy. This will rely on students to use their pattern recognition skills and their understanding of similar analogous structure to create their food web.

Optional: If printing in black and white, once all the arrows are drawn you can give students the time to color in their habitat drawings

Assessment

Diagram of Virginia coastal food web and associated worksheet. See Handouts & Worksheets for printouts and answer key.

References

- Darnis, G., Robert, D., Pomerleau, C., Link, H., Archambault, P., Nelson, R. J., Geoffroy, M., Tremblay, J.-É., Lovejoy, C., Ferguson, S. H., Hunt, B. P. V., & Fortier, L. (2012). Current state and trends in Canadian Arctic marine ecosystems: II. Heterotrophic food web, pelagic-benthic coupling, and biodiversity. *Climatic Change*, 115(1), 179–205. <https://doi.org/10.1007/s10584-012-0483-8>
- Ecosystem: Food Web*. (n.d.). Chesapeake Bay Program; Chesapeake Bay Program. Retrieved November 5, 2023, from <https://www.chesapeakebay.net/discover/ecosystem/food-web>
- Emma Goethe, Cecilia Knaggs, Leah Shaffer. (2022, July 27). Arctic Food Webs. ASU - Ask A Biologist. Retrieved November 4, 2023 from <https://askbiologist.asu.edu/arctic-food-webs>
- Food Web*. (2013, May 29). Maryland Sea Grant; Maryland Sea Grant. <https://www.mdsg.umd.edu/topics/food-webs/food-web>
- Hayward, A. G., & Grigor, J. J. (2020). The Bottom of the Arctic's Food Web Is of Top Importance. *Frontiers for Young Minds*, 8. <https://doi.org/10.3389/frym.2020.00122>
- Parker, A. E., & Lehman, P. W. (2021). Powering Life in the Water: Phytoplankton in the San Francisco Estuary. *Frontiers for Young Minds*, 9. <https://doi.org/10.3389/frym.2021.611976>

Handouts & Worksheets

1. Student Worksheet
 - 1A. Student Worksheet Answer Key
2. VA Coastal Habitat Diagram
 - 2A. VA Coastal Habitat Diagram Answer Key
 - 2B. VA Coastal Habitat Diagram Organism Cards

Name _____

Producers & Consumers

Below is a list of the organisms in your Virginia Coastal Ecosystem. Circle the producers in green, and the consumers in black. Circle your apex predator(s) in red.

Osprey	Bay Anchovy	Bottlenose
Phytoplankton	Eastern Oyster	Dolphin
Zooplankton	Blue Crab	Marsh Grass

Base of the Food Chain

- 1) What organism is at the base of your food chain?
- 2) Is this organism a producer or consumer?
- 3) Where does it get its energy from? Draw this near the top of your diagram and add an arrow showing the flow of energy.

Food Web Relationships: Look at your Virginia coastal food web to answer these questions.

- 4) What organism is prey for the greatest number of organisms? Hint: (Count your arrows *leaving* your organisms).
- 5) Is this a producer or consumer?
- 6) What organism in your ecosystem is your apex predator, meaning it has NO natural predators?



- 7) Can you think of a decomposer in the Virginia Coastal Ecosystem? Draw it on your diagram in the correct habitat.

Ecosystem Similarities: Look at your Virginia coastal diagram AND the Arctic coastal diagram to answer these questions.

- 8) What habitat does your Virginia Coastal Ecosystem have that the Arctic coastal system does not?

- 9) What are 2 organisms that are found in both the Arctic coastal ecosystem and the Virginia coastal ecosystem?

- 10) Different ecosystems have similar organisms that have the same roles within food webs. Give an example of an organism in the VA coastal ecosystem and a similar organism in the Arctic coastal ecosystem (EX: Virginia has the Eastern Oyster, The Arctic has blue mussels).

Food Webs – Here, there, everywhere!

Student Worksheet **ANSWER KEY**

Name _____

Producers & Consumers

Below is a list of the organisms in your Virginia Coastal Ecosystem. Circle the producers in green, and the consumers in another color. Circle your apex predator(s) in red.



Base of the Food Chain

1) What organism is at the base of your food chain?

Phytoplankton

2) Is this organism a producer or consumer?

Producer

3) Where does it get its energy from? Draw this near the top of your diagram and add an arrow showing the flow of energy.

The sun

Food Web Relationships: Look at your Virginia coastal food web to answer these questions.

4) What organism is prey for the greatest number of organisms? Hint: (Count your arrows *leaving* you organisms)

Bay Anchovy

5) Is this a producer or consumer?

Consumer

6) What organism in your ecosystem is your apex predator, meaning it has NO natural predators?

Osprey, Dolphin

- 7) Can you think of a decomposer in the Virginia Coastal Ecosystem? Draw it on your extra organism card and place it in its habitat.

Ex: Bacteria (water, sediment, marsh), Worms (sediment, marsh), Fiddler Crabs (marsh)

Ecosystem Changes and Similarities: Look at your Virginia coastal diagram AND the Arctic coastal diagram to answer these questions.

- 8) What habitat does your Virginia Coastal Ecosystem have that the Arctic coastal system does not?

Marsh

- 9) What 2 organisms are found in both the Arctic coastal ecosystem and your Virginia coastal ecosystem?

Phytoplankton, zooplankton

- 10) Different ecosystems have similar organisms that have the same roles within food webs. Give an example of an organism in the VA coastal ecosystem and a similar organism in the Arctic coastal ecosystem. (EX: Virginia has the Eastern Oyster, The Arctic has blue mussels).

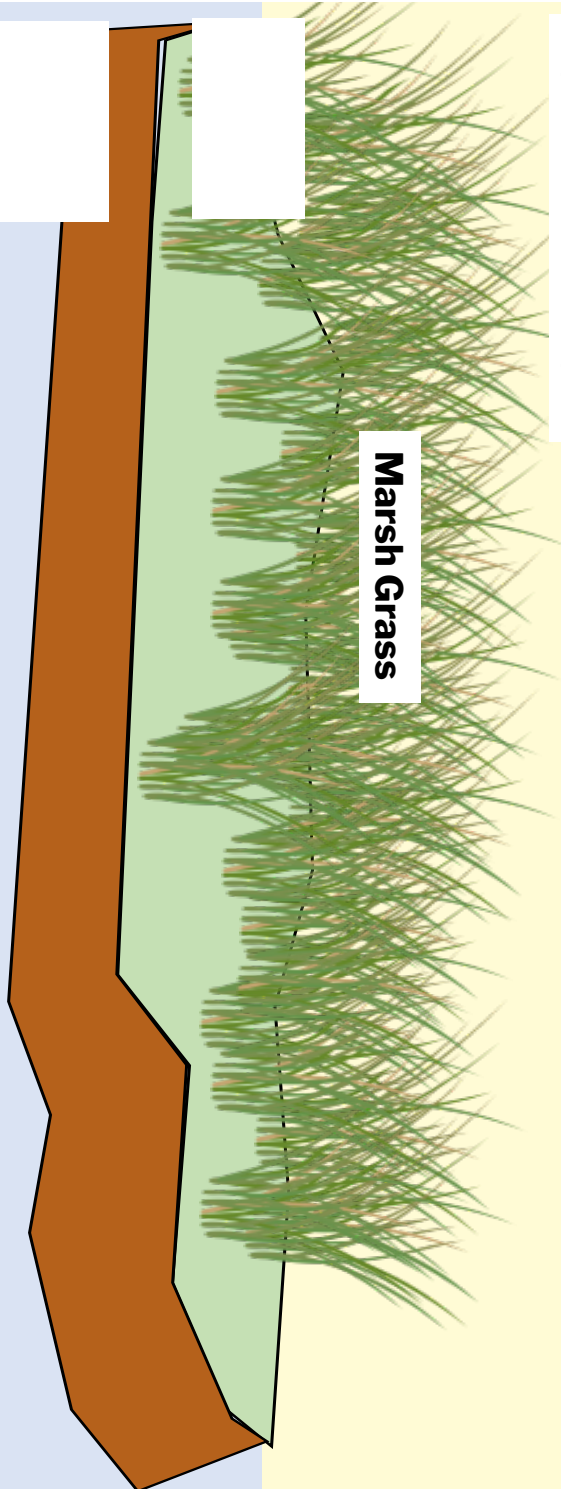
Arctic Cod, Bay Anchovy

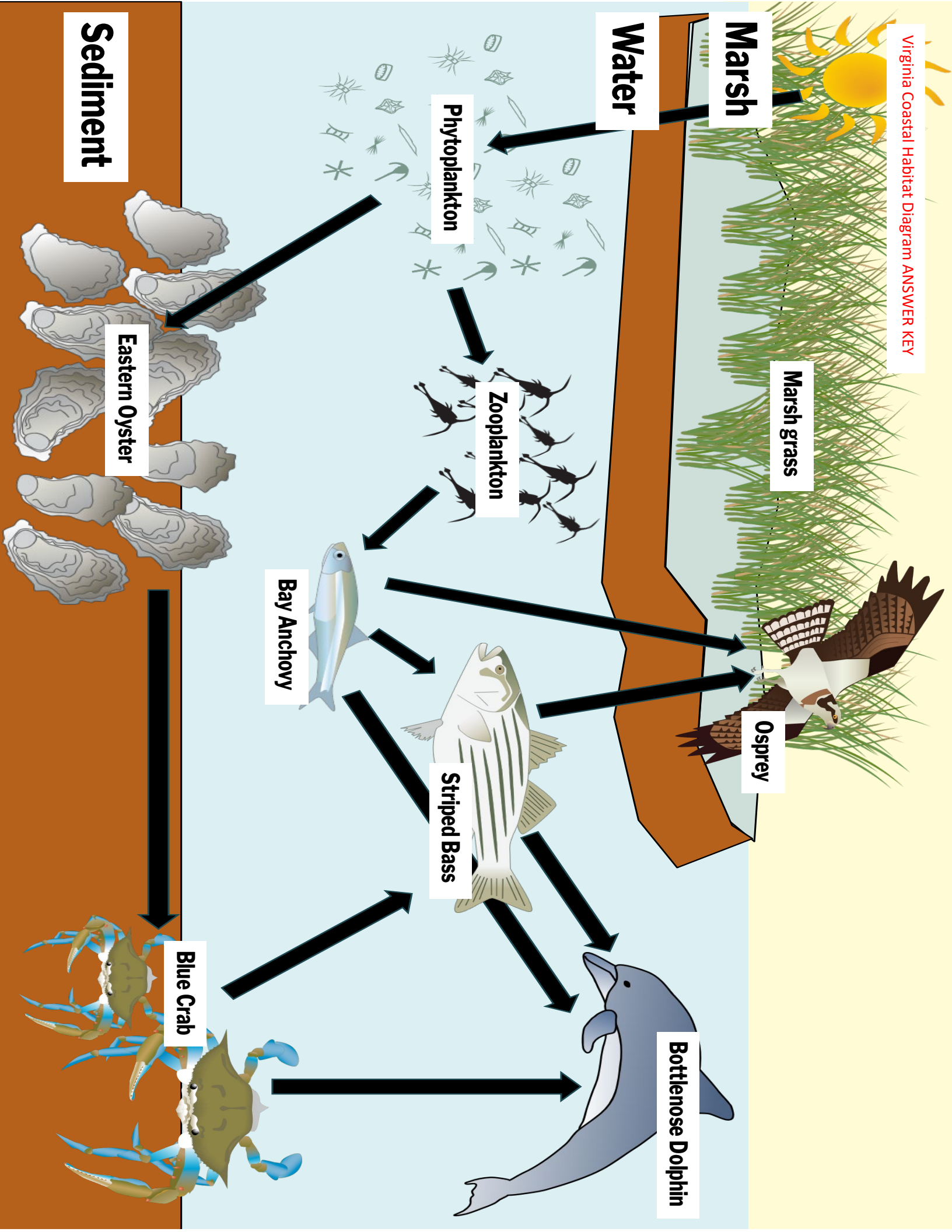
Snow Crab, Blue Crab

Ice Seal, Dolphin

Osprey, Polar Bear (Apex Predator)

Marsh Grass





Marsh

Water

Sediment

Marsh grass

Phytoplankton

Zooplankton

Bay Anchovy

Striped Bass

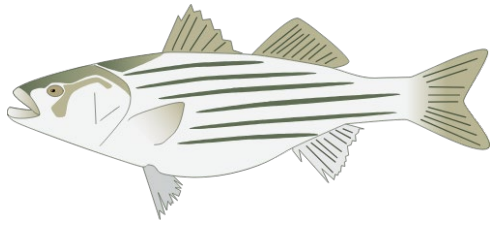
Osprey

Blue Crab

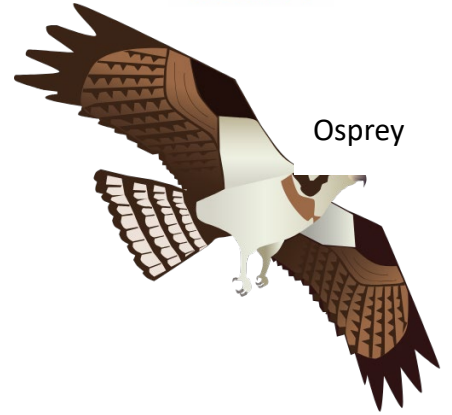
Bottlenose Dolphin

Eastern Oyster

Virginia coastal habitat organism cards



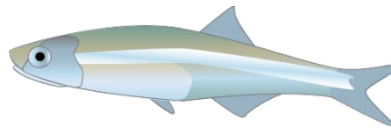
Striped Bass



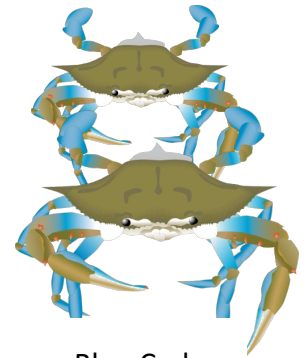
Osprey



Zooplankton



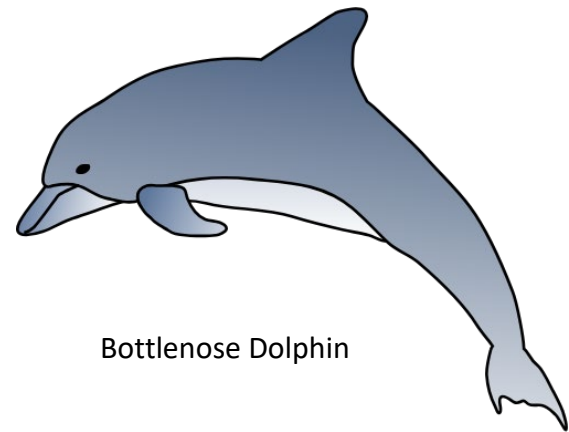
Bay Anchovy



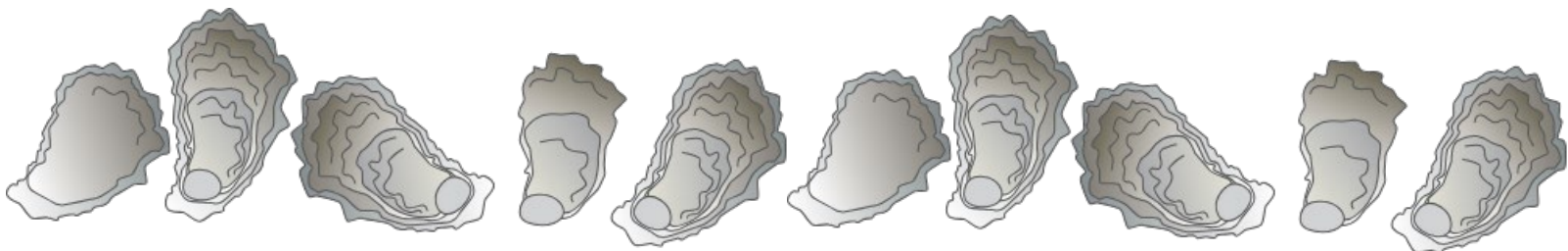
Blue Crab



Phytoplankton



Bottlenose Dolphin



Eastern Oyster