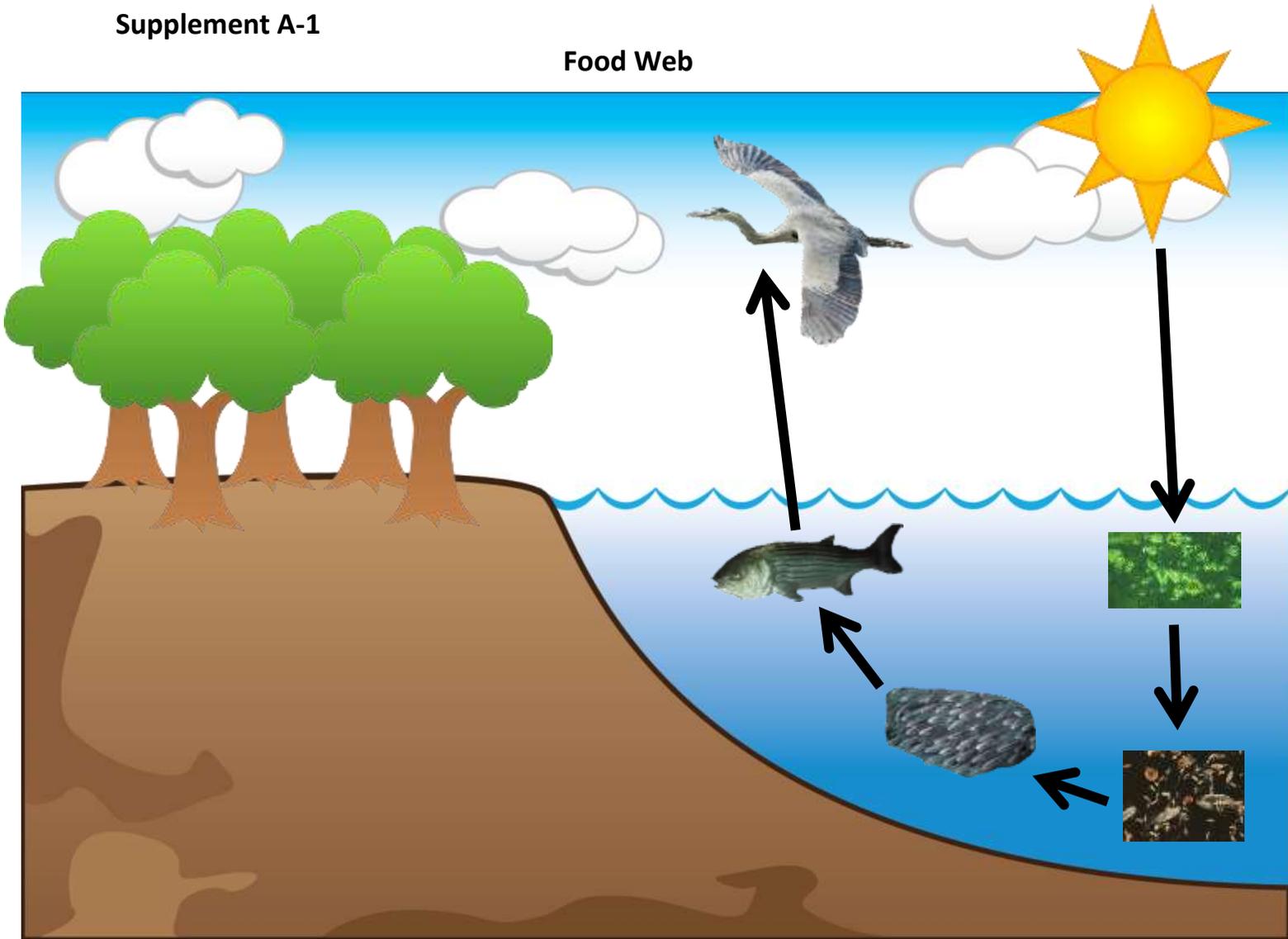


Supplement A-1

Food Web



Explain to students that arrows point in the direction of the flow of energy.

First put the Sun on the board in the sky.

“What uses the sun’s energy to produce food?” Put the phytoplankton near the surface where shown. Put arrow from the sun to the phytoplankton. Phytoplankton are producers.

“What gets its energy by eating phytoplankton?” Place zooplankton on board and arrow from phytoplankton to zooplankton. Zooplankton are consumers.

“What gets its energy by eating zooplankton?” Put minnows in the picture and put an arrow from the zooplankton to the minnows. Minnows are consumers. Since they eat other live animals, they are predators.

“What gets its energy by eating minnows?” Add rockfish to the picture and an arrow from the minnows to the rockfish. They are predators, too.

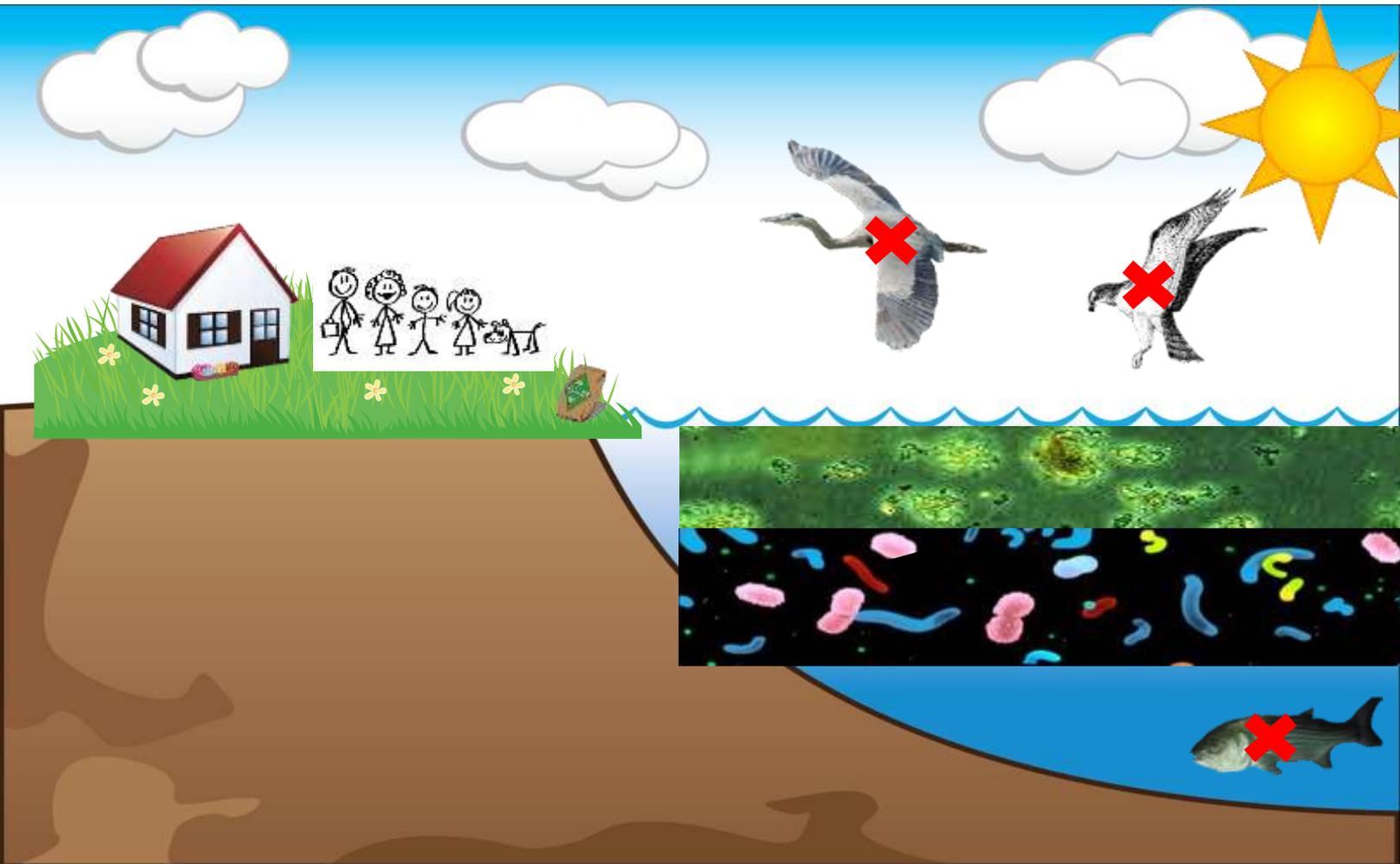
“What gets its energy by eating rockfish?” Add blue heron to the picture and add an arrow from the rockfish to the heron. They are predators, too.

Explain to the students that this is a **food chain**.

Another example food chain could be Sun→Submerged Aquatic Vegetation (SAVs; producer) →Red Head Duck (consumer)

Supplement A-2

Food Web Out of Balance



In a small town on the Chesapeake Bay, a little family wanted to live near the water. To do this, they needed to build a house to live in. So they cut down some trees and built a home by the water with a lovely view. To make their home even better, they wanted lush green lawns, so they planted some grass to play in. To help the grass go thickly and quickly, they put down lots of fertilizer. Fertilizer is used to give plants the nutrients they need to grow. The fertilizer was put down before a major rain storm and did not have time to soak into the ground; instead it flowed into the Bay as runoff. When these nutrients came into the Bay, it caused too much algae to grow. When the algae died, it became food for the bacteria that decompose it. The bacteria use up the dissolved oxygen in the water as they decompose the algae. Without oxygen in the water, the animals cannot live. The result is called a dead zone. When the things in the water die, what happens to predators like the heron and osprey?

Supplement B

Causes of Food Web Imbalance

Cause	Example
Too many nutrients	<ol style="list-style-type: none">1. Using too much fertilizer or using fertilizer before a rainstorm2. Septic tanks that are not working properly3. Waste water treatment plant overflow during a storm
Invasive plants	Phragmites, English Ivy and bamboo are all non-native plants that out-compete the local native plants.
Decline in native predators	Animals such as the white-tailed deer are over-populated in Maryland due to a decrease in wolf populations. With no native predator, the deer are free to increase their numbers and overeat native plants.
Nonnative animals	Nutria look like beavers with long thin tails. These animals were brought to Maryland for their fur; without any predators they cause the food web to be out of balance because they over-populate.
Pollution	Pollution in the Bay has caused a decline in oysters, which affects the animals that eat them, such as the Striped Bass, Rockfish, and humans. Pollution also declines the oysters' ability to filter the water in the bay.
Destruction of habitat	With the destruction of wetlands, many birds, such as the Great Blue Heron, do not have food or shelter.
Overharvesting	Rockfish, oysters, and blue crabs have declined because of overharvesting.
Climate Change	With the climate changing so quickly, many organisms will not have time to adapt.

Supplement C

Station #	Facts
#1 Food Web (Skunk)	Brainstorm what skunks may eat. <i>Insects, worms, small animals like frogs and salamanders, berries, plants/leaves/roots.</i> Point out holly trees – they produce small red berries only in winter, which provide food for many species when food is scarce. This is an example of keeping the food web in balance – <i>trees provide food, and in turn animals that eat the berries help to spread the seeds so the trees can reproduce.</i>
#3 Wetlands (Beaver)	What might beavers eat? <i>Leaves, bark, twigs, aquatic plants.</i> Is this a good habitat for beavers? <i>Yes, there is food, water, shelter and enough space to live.</i> It is rare to find beaver scat due to habitat loss and over-hunting. Point out beaver log and ask how beavers can change their environment. <i>They build dams that cause water to pool and <u>wetlands</u> to form. Wetlands are habitats for a wide variety of organisms.</i> Discuss the effects of losing beavers in the food web. <i>We would have less wetland habitats.</i>
#4 Consumers/ Scavengers (Opossum)	Opossums prefer to live near a water source with surrounding vegetation. Is this a good habitat for them? <i>Yes, there are lots of trees and water.</i> What might they eat? Is this a good place for them to find food? <i>Yes, they are <u>scavengers</u>; they will eat small rodents, fish, crustaceans, fruit, leaves, seeds, and decaying organisms.</i> Review different kinds of consumers. <i>Predators, scavengers, decomposers.</i>
#5 Predators (White-tailed Deer)	Look at green briar plants around the trail. Some have been chewed on. <i>Deer have adapted to eat them, even the thorns, especially in winter when vegetation is scarce.</i> What do we call animals that eat other animals? <u>Predators</u> . Can you think of any predators in Maryland that eat deer? <i>Wolves were once the main predators of deer but they no longer live here due to habitat loss and over-hunting.</i> Discuss how a lack of predators can affect the food web. <i>Without predators, deer over-populate; with too many deer, food becomes scarce for deer and other species – too many deer can throw an entire food web out of balance.</i>
#6 Trees/Erosion (Red Fox)	This is the first predator we've come across. What do you think a fox might eat in this environment? <i>Rodents, birds, fish, frogs, certain types of plants and fruits.</i> Why are foxes important in the food web? <i>They are predators that help keep prey populations in balance.</i> Point out signs of <u>erosion</u> coming downhill from the parking lot. <i>This runoff carries <u>sediment</u> with it, as well as pollution (gas, oil, road salt in winter). Too much sediment and pollution clouds the water, so sunlight cannot reach aquatic plants – without sunlight they cannot produce oxygen, so aquatic species that need oxygen die.</i> Look at all the trees in the area and discuss their role in decreasing pollution. <i>Tree roots slow the flow of water and the pollution it carries by soaking it in before it reaches the water. After being filtered by trees, the water that flows into the Bay is much cleaner.</i>
#7 Climate Change (Squirrel)	What is a squirrels' diet? <i>Seeds, nuts, fruits, fungi, green plants.</i> Discuss how the dead tree/stump is helpful to a squirrel. <i>Provides shelter, can be used as a storage area to stockpile food for winter, provides hiding places to escape from predators.</i> How are squirrels helpful to trees and plants? <i>Spread seeds by eating and by harvesting/burying in winter and not returning.</i> How does climate change affect the relationship between squirrels and plants? <i>If weather becomes too hot or too cold, squirrels would have to relocate which would leave fewer animals to help trees reproduce.</i>
#8 Habitat (Dead Tree)	No scat at this station – stop at “stream and marsh” sign. If the hike started at station 1, then this is the last station; do not proceed to station 9. Look at the dead tree. Make similar points to the ones at station 7. <i>Even though this tree is dead, it's still full of life. It provides a habitat for many organisms like insects (<u>decomposers</u>) and small rodents, which also serve as food sources for their larger predators.</i>

<p>#9 Native Species (Goose and Raccoon)</p> <p>Invasive Species (Phragmites)</p>	<p>Goose <u>scat</u> is green, raccoon is brown. Why do you think goose scat is green? <i>They eat grasses and other plants.</i> What might raccoons find to eat in areas around the hike? <i>Fish, crabs, etc. in the creek, berries from trees, insects.</i> Look at raccoon tracks in sand around pier. Talk about <u>native</u>, <u>non-native</u>, and <u>invasive</u> species. Point out <u>phragmites</u>, which are invasive. Point out native cattails and bulrushes. Look for signs of other non-native species. <i>Boats, houses, docks, pets, and humans.</i> What changes can non-native species make? <i>Humans have built along shorelines, phragmites have destroyed native habitats, pets can reduce populations of prey species, human development is invading native habitats.</i> Point out other evidence of organisms using this environment to survive. <i>Another dead tree, chewed-on briars, lack of berries on holly trees in winter.</i></p>
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Supplement D

Vocabulary

Scat – wild animal droppings

Native Species– species that occur naturally in a particular area and have been living there for a long time

Non-native Species – species that do not occur naturally in a particular area; they have been introduced, often by humans; non-native species are not always harmful

Invasive Species – a species that is destructive to the balance of the natural food web in an ecosystem by outcompeting other species and/or destroying the habitat (usually non-native but occasionally native)

Phragmites – an invasive species of wetland grasses originally from Asia that was introduced to the Chesapeake region for their looks and erosion control; they have spread rapidly and invaded native habitats around our wetlands (compare marsh shoreline near Arlington Echo to shoreline across the creek overgrown with phragmites)

Habitat – the natural home or environment of a particular species

Wetland – a transition area between the land and the water with spongy, muddy soil such as a marsh, swamp, or bog

Erosion – the weathering away of soil by the flow of water, wind, or ice (in this lesson we are referring to water erosion)

Sediment – dirt and other debris that clouds water as it washes into it, and eventually settles on the bottom of the water

Algae bloom – a rapid increase or accumulation in the population of algae, often a result of excess fertilizer or waste washing into an aquatic environment

Producer – organisms that make their own food from sunlight; plants

Consumer – organisms that feed on producers, or on other consumers (ex: deer, fox)

- **Predator** – consumers that get their energy from other consumers (ex: eagle)
- **Scavenger** – consumers that mainly feed on decaying biomass, such as meat or rotting plant material (ex: raccoon)
- **Decomposer** – organisms that break down dead or decaying matter (ex: bacteria)