

Food Web

Grade Level(s): 3-5
Time: 30-45 minutes
Group Size: 10-30

Summary

Students will be introduced to some of the organisms in an aquatic ecosystem. The concept of food webs and the many roles organisms play as consumers, producers, and decomposers will be introduced. Students will participate in an activity to learn how humans play a role in the aquatic food web as anglers and consumers.

Objectives

- Students will be able to identify 1-3 fish specific to fishing site
- Students will be able to construct an aquatic food web
- Students will be able to explain how humans play a role in the aquatic food web
- Students will be able to identify species as producers, consumers, or decomposers

Materials

- *Organism Identification Cards*
- *Food Web worksheet*
- Fish mounts/pictures of fish
- Suggested *Organism Props* for each identification card:
 - Angler: fishing rod with thick fishing line
 - Crab: tongs
 - Plankton: hair band with springs
 - Sun: sunglasses
 - Algae: toothpaste or plastic fish tank plant
 - Bird: noise maker or feathers
 - Bait: air freshener
 - Shellfish: fake pearl necklace
 - Fish: models, pictures, or nose plugs
 - Skate: elbow & knee pads
 - Squid: apron

NYS Learning Standards Core Curriculum MST

Living Environment: Standard 4

Students will: understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

- *Key Idea 5:* Organisms maintain a dynamic equilibrium that sustains life.
- *Key Idea 6:* Plants and animals depend on each other and their physical environment.

Vocabulary

- **Abiotic Factors**- non-living aspects; i.e. water, sunlight, rocks, oxygen
- **Autotrophs**- producers; those that produce oxygen through photosynthesis; i.e. plants
- **Bioaccumulation**- the increase in concentration of a chemical or substance in an organism's body from intake (respiration or ingestion) to which the level of concentration is higher than the surrounding environment (the higher in the food chain an organism is, the higher the concentration levels of toxins will be).
- **Biotic Factors**- living aspects of the environment; i.e. plants and animals
- **Carnivores**- feed solely on other consumers, meat eaters
- **Consumers**-see heterotrophs
- **Decomposers**- consume dead organisms; heterotroph; i.e. bacteria, some insects, and fungi
- **Ecosystem**- community of organisms and their environment; working together
- **Food Chain**- an arrangement of the organisms of an ecological community according to the order of predation in which each uses the next usually lower member as a food source
- **Food Web**- interactive food chains in an ecosystem
- **Herbivores**- primary consumers; feed solely on plants
- **Heterotrophs**- consumers; those that cannot perform photosynthesis; use organic substrates to get energy; i.e. herbivores, carnivores, and decomposers
- **Omnivores**- feed on both plants and other animals
- **Overfishing**-when so many fish are taken from a stock that the population is unable to recover
- **Photic**- sunlit portion of the water
- **Phytoplankton**-microscopic free floating aquatic plants that live in the water
- **Plankton**- tiny free floating aquatic organisms that live in the water
- **Primary Consumers**- see herbivores
- **Producers**- see autotrophs
- **Secondary Consumers**- carnivores, omnivores, and decomposers
- **Tertiary Consumers**- top predators of an ecosystem
- **Zooplankton**- tiny free floating aquatic animals that live in the water

Background

Every living organism needs energy to sustain life. Organisms within a community depend on one another for food to create energy. The simplest of these feeding relationships is referred to as a food chain. A **food chain** is a linear arrangement of at least three organisms in which each uses the organism below as its food source. Within an **ecosystem**, there are many interactive food chains which create a **food web**. Both **abiotic** and **biotic** factors are involved in food webs.

Biotic Factors

At the base of a food web are **producers**, or **autotrophs**, which produce their own food through photosynthesis, such as trees and shrubs. **Consumers**, or **heterotrophs**, are those organisms that cannot make their own food, and therefore must eat producers or other consumers to gain energy. **Primary consumers** or **herbivores** feed solely on producers. There are three types of **secondary consumers**: omnivores, carnivores, and decomposers. **Omnivores** eat both plants and animals, **carnivores** eat only other consumers, and decomposers are those organisms that consume dead materials. Decomposers are not to be confused with scavengers, as scavengers are considered carnivores that eat parts of dead animals. **Decomposers** are recyclers and consume dead materials. Without them, nutrients would not cycle back into the environment, therefore making it impossible for other organisms to sustain life. Last are **tertiary consumers**, or top predators of an ecosystem.

Abiotic Factors

Although not often included in the food web, **abiotic factors** or the non-living aspects of an ecosystem (water, sunlight, temperature, etc.) play an important role. Climate will decide which food resources, and how much water and sunlight, are available to organisms in any given environment. Water and sunlight are necessary for plant growth and photosynthesis, and also provide animals with the basic needs of survival.

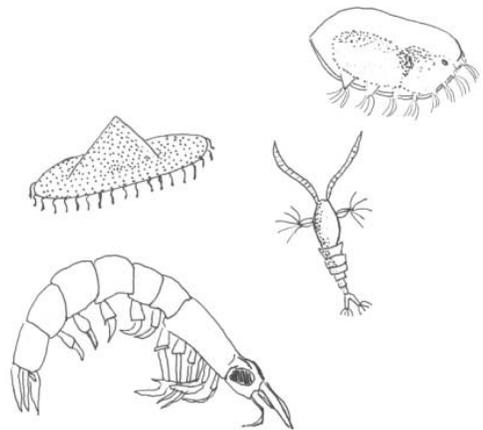
Food Webs and Food Chains

In every environment there are different food webs. For example, as a raccoon leaves the forest at low tide to feed on exposed mussels, the nutrients of one food web can transfer to another. Although the organisms may be different, the order, producers, primary consumers, secondary consumers, and tertiary consumers, is always the same. For the purpose of this lesson, we will focus on aquatic food webs, both salt and freshwater.

Saltwater Food Web

Micro-organisms known as **plankton** are key players in the food web of a marine environment. Occupying the **photic** or sunlit portion of the water are two types of plankton, phytoplankton and zooplankton.

Phytoplankton or plant plankton account for 95% of the primary productivity in the ocean. **Zooplankton** or animal plankton eat phytoplankton, and thus are primary consumers. In addition, larger zooplankton will eat smaller zooplankton; small bait fish will eat larger zooplankton; and large predatory fishes will eat the small bait fish. This series of feeding relationships make up the marine food chain. When you factor in other species that feed on the same organism, then the chain becomes a web.



Freshwater Food Web

At the base of the freshwater food web are producers such as algae, duckweed, and lily pads. Because many freshwater systems are small relative to the nearby terrestrial systems, much of the energy in freshwater systems can come from terrestrial sources, such as leaves falling into the water. Consequently, decomposers are often very important in freshwater systems. Just like on land, aquatic plants undergo photosynthesis and provide aquatic organisms with oxygen. Freshwater primary consumers include zooplankton and invertebrates. Smaller prey fish that consume the invertebrates are secondary consumers. Predators at the top level include largemouth bass, smallmouth bass, walleye, chain pickerel, and perch. Humans and carnivorous birds (ospreys) are also included in the freshwater food chain.

Human Impacts

In many food webs, humans can be the top predator and are responsible for the decline in population, or in some cases, the endangerment or even extinction of many species. In aquatic food webs, humans are the top predator when they fish or when they buy and sell fish. Humans can negatively impact aquatic food webs in many ways: by **overfishing**, introducing non native species, or polluting the aquatic ecosystem.

Bioaccumulation in the Food Web

Pollution can accumulate from species to species, moving up the food chain until it eventually affects the whole food web. This process is known as **bioaccumulation**. For example, in a saltwater ecosystem, clams filter out pollutants in the water such as heavy metals, coliform bacteria from sewage contamination, and oil. However, when pollutant levels are high, they build up inside of the clams, concentrating the toxic substances. Higher on the food chain, a blackfish eats the clams and stores the toxins in its body.

Main Activity

Introduction

1. Introduce yourself
2. Introduce the day's activities:
 - a. Prep for upcoming fishing trip
 - b. Fish identification
 - c. Aquatic ecosystems and the ecological interactions in that ecosystem, making a food web

Brainstorming

1. Have students brainstorm a list of plants and animals that live in an aquatic (*freshwater or saltwater*) ecosystem.
2. Write answers on the board.
3. Option for older students: Introduce the following concepts: abiotic, biotic, producers, photosynthesis, and consumers.
 - a. Say: Ecosystems have abiotic factors and biotic factors:
 - i. The abiotic environment (non-living; i.e. water, sunlight, atmospheric gases, temperature, wind, and climate)

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- i. The biotic environment (living organisms; i.e. plants, animals, insects, and bacteria.)

Making a Food Web

Invite a student volunteer to choose an *Organism Identification Card* and read it aloud. That student then pretends to be that organism in the food web. Give that student the Organism Prop corresponding to that organism and ask the student to stand at their desk.

- Crab: tongs
 - Plankton: hair band with springs
 - Sun: sunglasses
 - Algae: toothpaste or plastic fish tank plant
 - Bird: noise maker or feathers
 - Bait: air freshener
 - Shellfish: fake pearl necklace
 - Fish: models or nose plugs
 - Skate: elbow & knee pads
 - Squid: apron
 - Angler: fishing rod with thick fishing line
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- When a student becomes a fish, show the class the fish mount, discuss some features of the fish and then hand the student the prop.
 - Continue having students take turns choosing *Organism Identification Cards*, reading them aloud, and then standing at their desks with the props. Be sure that the last *Organism Identification Card* you share is the “Angler.”
 - Demonstrate how the food web works; begin with the angler and continue working your way through the ecosystem by asking each student questions about his/her organism, such as, “What do you eat?” and/or “What other organism(s) do you depend on?”
 - a. The prop for the angler is a fishing rod. Use the fishing line to make the web; moving from organism to organism.
 - b. Each time the web may be different, depending on the student’s interjections.
 - After the web is formed, discuss the relationships and dependency of the food web. For example, remove one of the organisms from the web. Discuss and show the breakdown of the web when a link is removed.
 - When finished with the exercise, reel in by having each student, one at a time, release the fishing line. Start with the last organism chosen and continue on to the next student whose line went slack.

Wrap up

Relation to Fishing

If going fishing following the lesson, conclude by relating the exercise to fishing. Explain that by knowing how organisms interact in an aquatic food web, we can tell what bait to use when fishing for a specific species. Also explain that as anglers and consumers of fish, we are part of the aquatic food web. We should follow fishing rules and regulations to avoid overfishing certain species.



Review

- Review the fish species introduced during the lesson
- Go over terms producers, consumers, or decomposers
- Assign species to categories (producer, consumer, or decomposer)
- Have the students construct their own aquatic food web or complete the *Food Web Worksheet*
- Ask the students to explain how humans play a role in the aquatic food web

Questions for Discussion

Q: What can a producer do that a consumer cannot?

A: Creates energy by undergoing photosynthesis

Q: What do you call an organism that feeds on dead organisms and or plant material?

A: A decomposer

Q: What is the difference between phytoplankton and zooplankton?

A: Phytoplankton are plant plankton, while zooplankton are tiny aquatic animals

Q: Name a top predator in the aquatic food web

A: Answers can vary: human, osprey, largemouth bass, striped bass

Q: How can humans negatively impact the aquatic food web?

A: Answers can vary: overfishing, not following rules and regulations, polluting

Q: Name an organism that eats zooplankton

A: Larger zooplankton will eat small zooplankton and small baitfish will eat large zooplankton

Q: How can humans help protect the aquatic ecosystem?

A: Answers can vary: By not polluting, following fishing regulations, educating others about fishing rules/pollution

Q: What is overfishing?

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A: Taking so many of a species of fish that the population is unable to recover

Q: What do herbivores eat?

A: Plants

The instructor can also have students complete the *Food Web Worksheet* for assessment.

Web Resources

“Biodiversity & Species Conservation,” NYSDEC

<http://www.dec.ny.gov/animals/279.html>

Website provides information on biodiversity and the human/natural threats to biodiversity

“The Food Web,” Water on the Web.

http://waterontheweb.org/under/lakeecology/11_foodweb.html.

Website provides information on the physical, chemical, and biological components of Lake Ecology. Useful food web vocabulary and food chain/web diagrams.

“Freshwater Fishes,” NYSDEC

<http://www.dec.ny.gov/animals/269.html>

NYSDEC site providing information on a variety of species, with over ten series on fish including: true bass, common minnows, common prey fish, sunfish, and trout.

“Marine Fish,” NYSDEC

<http://www.dec.ny.gov/animals/69149.html>

NYSDEC site providing additional information on common marine species in NY waters

Instructions: Print the Organism ID Cards, fold them in half, and laminate them.

Optional: Punch two holes in the top of the cards to attach string so students can wear the cards around their neck.

Illustration Resources

All Fish illustrations by Duane Raver

Photos from NYS DEC Website:

Clam, Mallard Duck, Wood Duck, Insects, Snapping Turtle, Sunset, Water Celery

Photo from USGS-Red Eared Slider

Photo from National Parks Service-Double Crested Cormorant

Illustrations by Ann Ezelius, NYSDEC Environmental Education Asst.-
earthworm, plankton

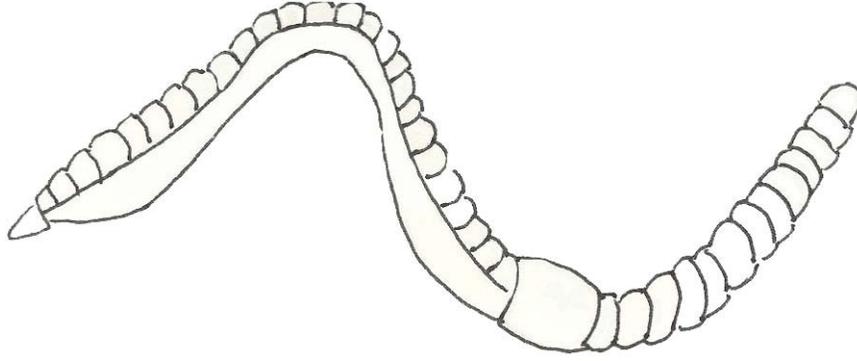


Chain Pickerel

Ø **Fishy facts:** I hide in the weeds and when hungry, I ambush my prey with rapid lunges and very sharp teeth. I have a pattern on my sides that resembles a chain-link fence.

Ø **What's on the menu:** Small fish, worms, crayfish, frogs, mice, and insects.

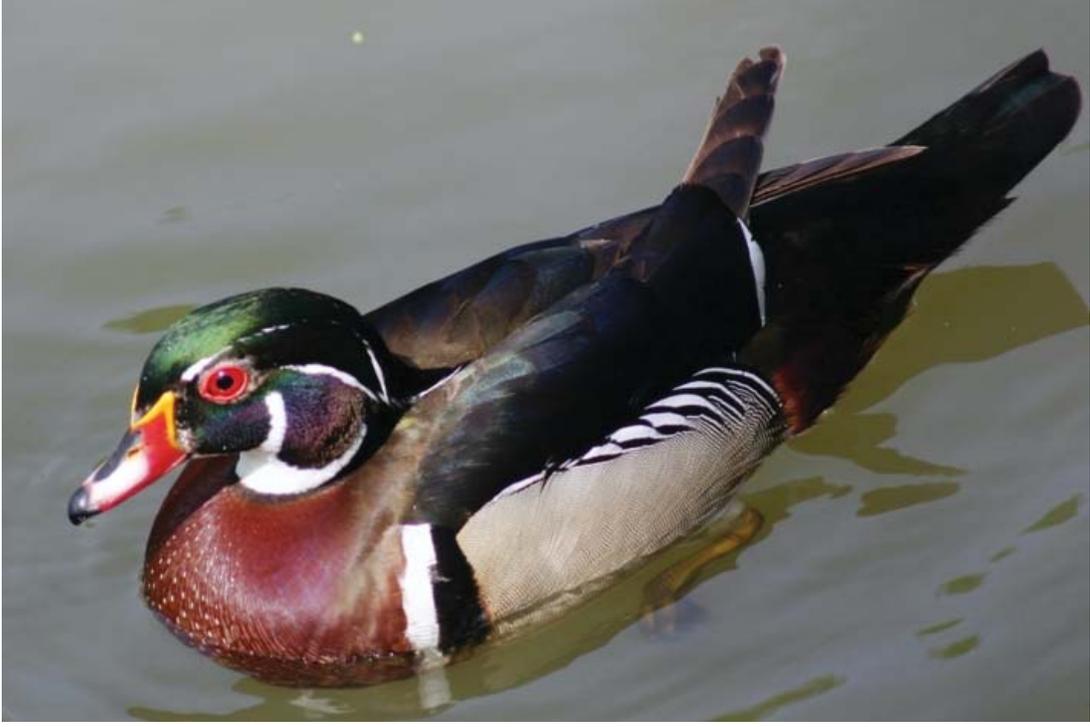
Scientific Name: *Esox niger*
Phylum: Chordata
Class: Actinopterygii



Worms

Ø **Fishy facts:** I am squirmy and some of you might not want to touch me. Many fish enjoy eating me so I am often used as bait. I live in the ground, and if it rains a lot, you might find me squirming my way across your lawn.

Ø **What's on the menu:** Leaf litter and detritus (aka dead material!).



Wood Duck

Ø **Fishy facts:** I like to make my nests in trees near water. After hatching, the ducklings jump down from the nest tree and make their way to water.

Ø **What's on the menu:** Berries, seeds and insects

Scientific Name: *Aix sponsa*
Phylum: Chordata
Class: Aves



Scientific Name: *Perca flavescens*
Phylum: Chordata
Class: Osteichthyes

Ø **What's on the menu:** Adult perch dine primarily on immature insects, larger invertebrates, and the eggs and young of other fish.

Ø **Fishy facts:** You can tell me apart from other perch because I have 5 to 9 black vertical bars on my sides. If you catch me, be careful of my sharp spines and gill plates.

Yellow Perch



Scientific Name: *Lepomis gibbosus*
Phylum: Chordata
Class: Actinopterygii

- Ø **Fishy facts:** I have sharp spines on my dorsal fin, so be careful when handling me. You can tell me apart from the bluegill because my gill flap is black with a red or orange spot on it.
- Ø **What's on the menu:** Insects, mosquito larvae, snails, and smaller fish.

PUMPKINSEED



Insects

- Ø **Fishy facts:** Whereas many aquatic insects eat plants, some like the nymph or young stage of the adult dragonfly shown are predators mainly on other insects. Some large nymphs can eat a small fish!
- Ø **What's on the menu:** Dead plant material, aquatic plants



LARGEMOUTH BASS

Ø **Fishy facts:** I have a very keen sense of sight, and as long as the water is clear I can see anywhere from 5 to 100 feet! I can live for 23 years and grow to be about 10 pounds.

Ø **What's on the menu:** Anything I can get my mouth around! When I'm small I enjoy plankton and insects. As I grow, I target larger organisms such as fish, small mice, and baby ducks.

Scientific Name: *Micropterus salmoides*
Phylum: Chordata
Class: Actinopterygii



Snapping Turtle

Ø **Fishy facts:** I am the state reptile of New York. In the wild, I can live for 30-40 years! I enjoy hanging out in the mud and basking in the sun. Be careful though, my beak may not have teeth but it is powerful.

Ø **What's on the menu:** Aquatic plants, invertebrates, fish, frogs, reptiles (including snakes and smaller turtles), unwary birds and small mammals.

Scientific Name: *Chelydra serpentina*
Phylum: Chordata
Class: Reptilia



Scientific Name: *Chrysemys scripta elegans*
Phylum: Chordata
Class: Reptilia

Ø **What's on the menu:** Aquatic plants, insects, and fish.

Ø **Fishy facts:** I enjoy being in the water but on hot sunny days you can find me sunning myself on a rock or log. If I see a predator coming my way, I will *slide* off of the rock or log to hide. I am not native to this area, but many people had me as a pet and then let me go into the wild.

Red Eared Slider



Aquatic Plants

Ø I include all of the plants that live in the water. I help put oxygen and glucose (energy) into the water by a process known as photosynthesis. Without me, fish and other species would not survive. I am the beginning of the food chain and also a source of food.

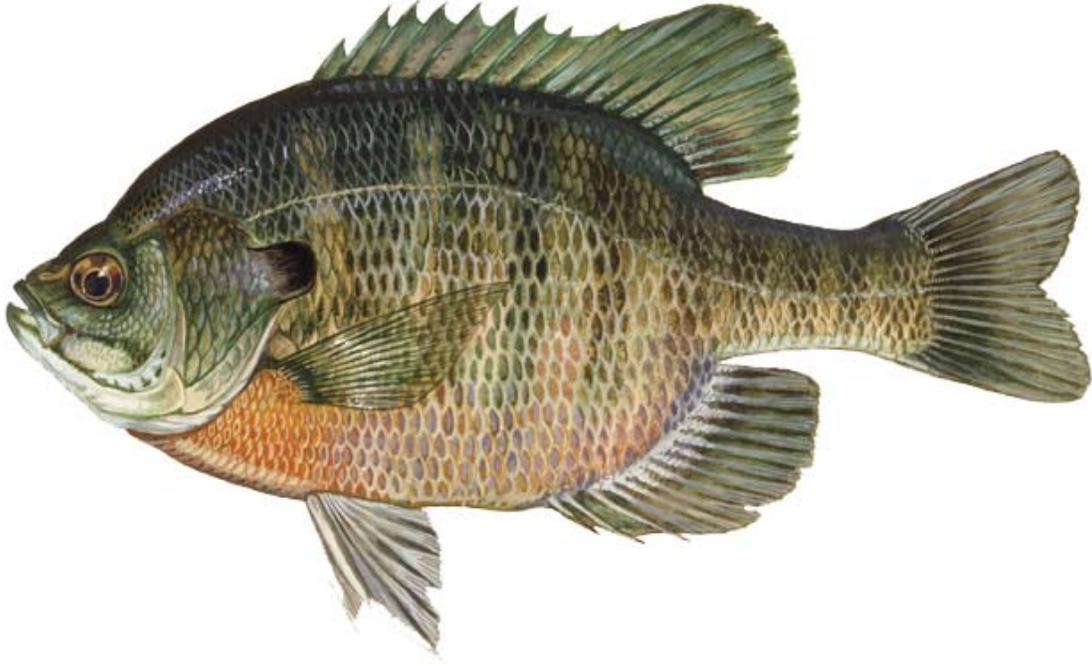


Scientific Name: *Anas platyrhynchos*
Phylum: Chordata
Class: Aves

Ø **What's on the menu:** Insects and plant matter.

Ø **Fishy facts:** I am a dabbling duck. When I want to eat, I tip myself beak first into the water (my bottom points into the air) and the water filters through my beak so I can harvest food from beneath the surface.

Mallard



Bluegill

- Ø **Fishy facts:** If you are freshwater fishing for the first time, I might be the first fish you catch! I am also known as a panfish because I fit perfectly in a pan.
- Ø **What's on the menu:** I enjoy eating small invertebrates and very small fish.

Scientific Name: *Lepomis macrochirus*
Phylum: Chordata
Class: Actinopterygii



Freshwater Mollusks

- Ø **Fishy facts:** I include many different species such as: snails, scallops, clams, mussels and oysters. All species in the phylum Mollusca have a complete digestive tract. Some species, such as the snail, have eyes, while others, such as the clam, do not.
 - Ø **What's on the menu:** Freshwater clams filter water to get their food; plankton and algae. Snails use their radula to scrape up aquatic plants as they move.
- Phylum: Mollusca*

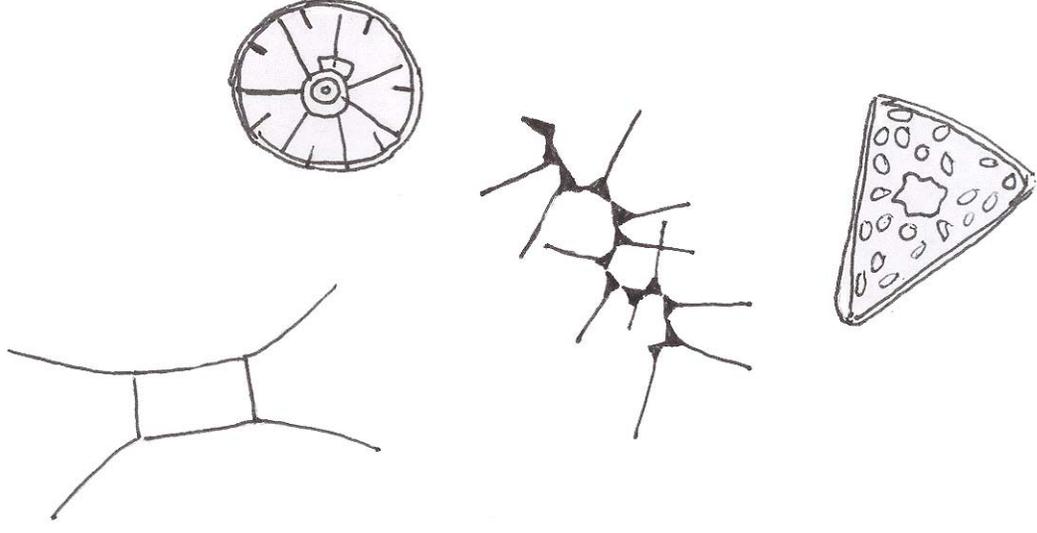


sun

∅ I am the only star found in your solar system and am about 4.5 billion years old! One hundred and nine Earths would be required to fit across my belly, and I could fit over 1.3 million Earths inside it! I provide energy to all the creatures on Earth; without me no one would survive.

Plankton

- Ø **Fishy facts:** Contrary to popular belief, I am not evil. Yes, I may try to steal the Crabby Patty on SpongeBob SquarePants, but in real life I help provide oxygen and food to many aquatic critters. In a process called "photosynthesis," I take in carbon dioxide and water, and turn them into oxygen and sugar.
- Ø **What's on the menu:** Sunlight, carbon dioxide, and water.





Brown Bullhead

Ø **Fishy facts:** Because of my poor eyesight, I taste the mud for food with my whiskers! Be careful if you pick me up; my pectoral and dorsal fins have spines. I may be a fish, but I do not have scales.

Ø **What's on the menu:** Algae, plants, mollusks, insects, fish eggs, and fish.

Scientific Name: *Ameiurus nebulosus*
Phylum: Chordata
Class: Actinopterygii



Cormorant

Ø **Fishy facts:** Did you know that you can find me in saltwater *and* freshwater? When I see something I want to eat in the water, I dive in and propel myself through the water with my feet. I can hold my breath for almost a minute underwater!

Ø **What's on the menu:** I enjoy eating fish, eels, and even water snakes.

Scientific Name: *Phalacrocorax penicillatus*
Phylum: Chordata
Class: Aves

Instructions: Print the Organism ID Cards, fold them in half, and laminate them.

Optional: Punch two holes in the top of the cards to attach string so students can wear the cards around their neck.

Illustration Resources

Fish Illustrations by Duane Raver- Bluefish, Striped Bass

Fish Illustrations by Nim Lee- Summer Flounder, Sea Robin

Illustrations by Ann Ezelius-Zooplankton

New York Sea Grant, LI Sound Study-brown seaweed

NYSDEC-Hard clam, blue crab, sunset, squid, silverside, ring billed gull

NOAA-little skate

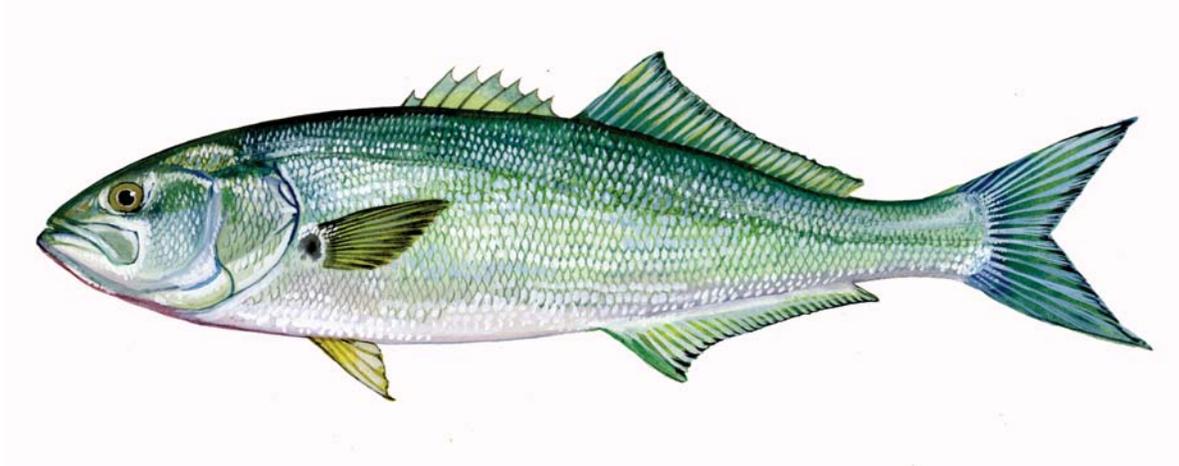


Hard Clam

Ø **Fishy facts:** I am an invertebrate. That means I don't have a backbone. Even though I look small inside my shell, I have a heart, kidneys, and a digestive system. Scientists call me a "filter feeder," because I like to eat small critters in the water called "plankton."

Ø **What's on the menu:** Plankton.

Scientific Name: *Mercenaria mercenaria*
Phylum: Mollusca
Class: Bivalvia



Bluefish

Ø **Fishy facts:** I am a very fast swimmer. I often swim in schools chasing the packs of small fish. Fishermen call me a "snapper" when I am small. I have very sharp teeth, so please be careful if you catch me!

Ø **What's on the menu:** Herring, silversides, clam, and squid.

Scientific Name: *Pomatomus saltatrix*
Phylum: Chordata
Class: Osteichthyes



Scientific Name: *Larus argentatus*
Phylum: Chordata
Class: Aves

- Ø **Fishy facts:** I live along the coast, as well as inland. I like to follow fishing boats and wait for the bait to be thrown in the water. Fisherman will look to see where we are feeding on bait fish to find the bigger fish to catch.
- Ø **What's on the menu:** Clams, shellfish and fish.

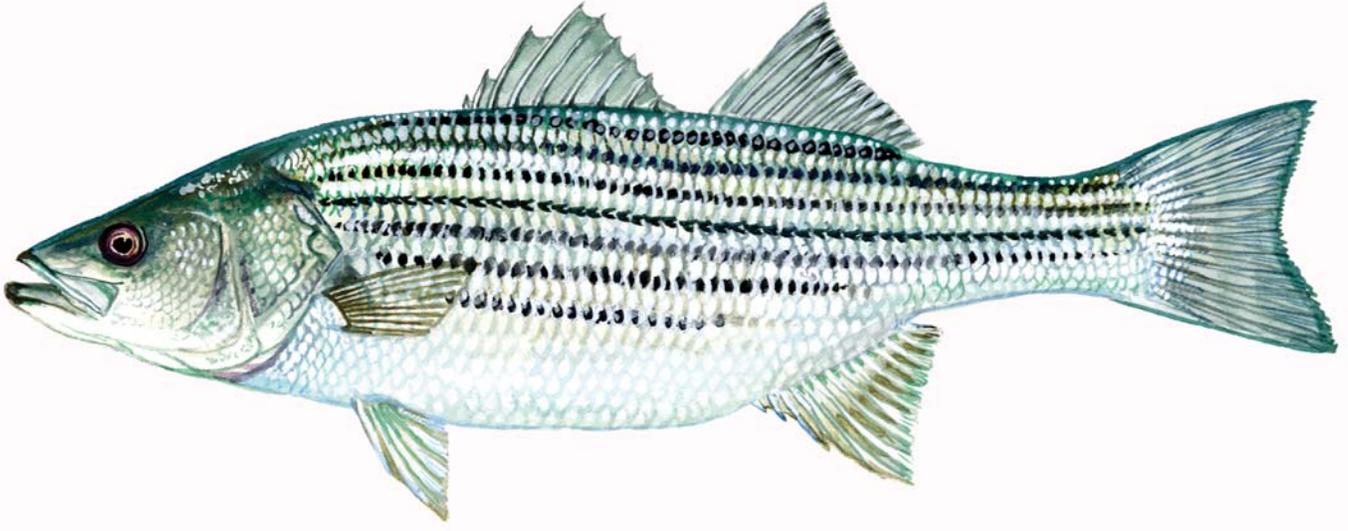
Ring Billed Gull



Blue Crab

- Ø **Fishy facts:** I am the crab you all like to eat. But be careful, when alive, I have razor sharp pincers! I can also swim very fast using my back legs called "swimmerets."
- Ø **What's on the menu:** Fish, oysters, clams, snails, shrimp, worms and other crabs.

Scientific Name: *Callinectes sapidus*
Phylum: Arthropoda
Class: Crustacea



Striped Bass

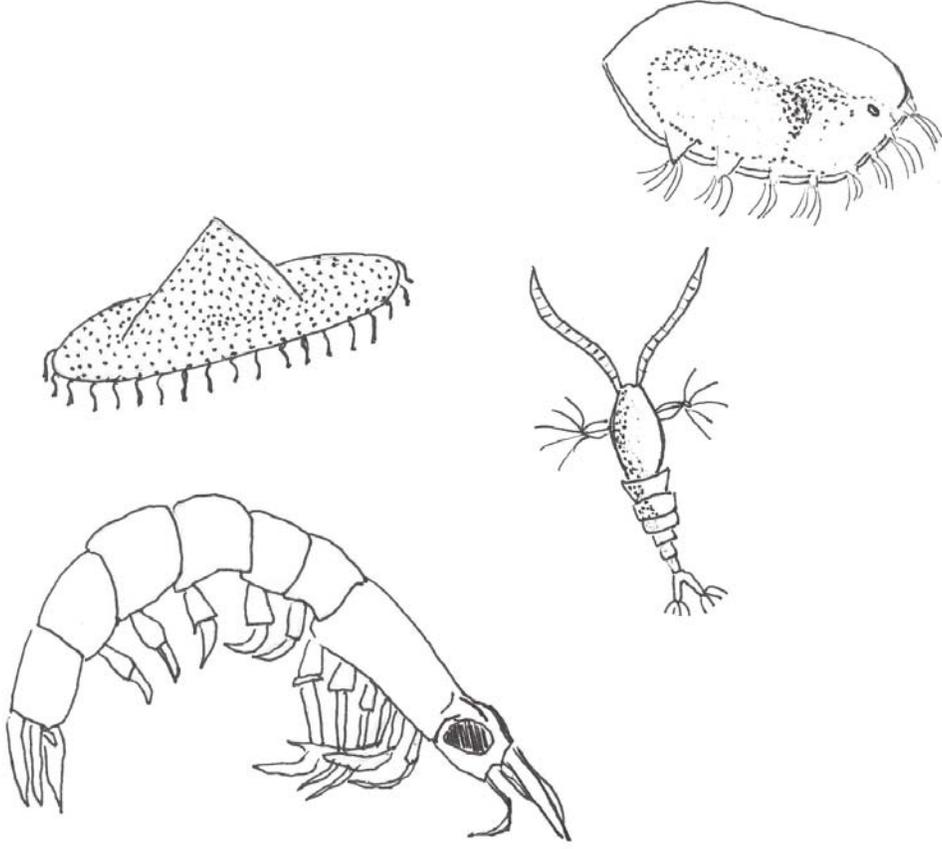
- Ø **Fishy facts:** I am what scientists call an “anadromous” fish. That means that I spend most of my life in saltwater, but I swim to freshwater to reproduce. Because I don't have any teeth, you can hold me by the mouth if you catch me. But watch out for my dorsal fin, I have very sharp spines!
- Ø **What's on the menu:** Almost any kind of small fish as well as several invertebrates, particularly crabs and squid.

Scientific Name: *Morone saxatilis*
Phylum: Chordata
Class: Osteichthyes

Plankton

Ø **Fishy facts:** Contrary to popular belief, I am not evil. Yes, I may try to steal the Crabby Patty on SpongeBob SquarePants, but in real life I help provide oxygen and food to many aquatic critters. In a process called "photosynthesis," I take in carbon dioxide and water, and turn them into oxygen and sugar.

Ø **What's on the menu:** Sunlight, carbon dioxide, and water.

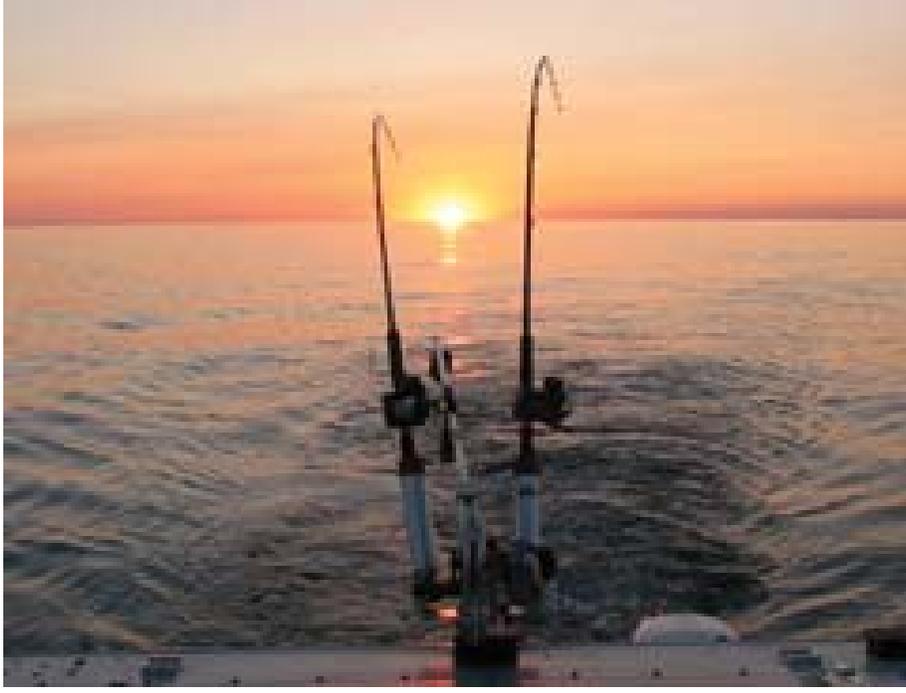




Seaweed

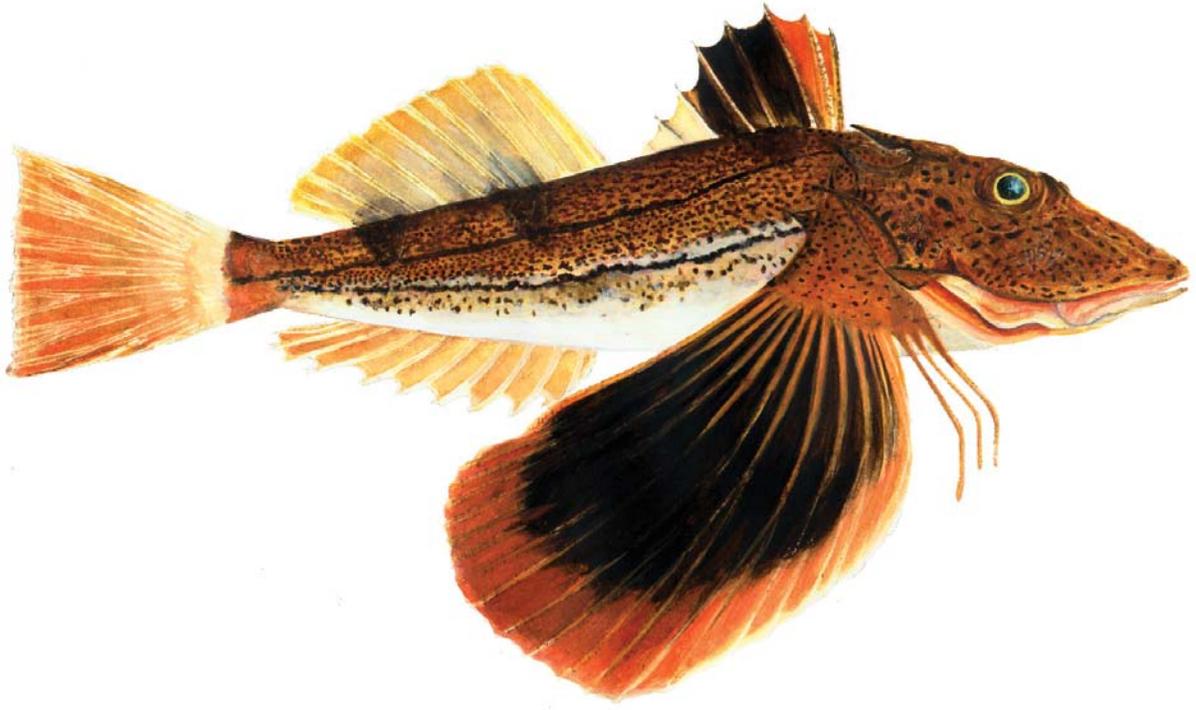
Types: Red, green, brown, and blue-green

- Ø **Fishy facts:** Plants, such as me, provide you with the air or oxygen that you breathe. Using organs called “chloroplasts” and the sun, we take in carbon dioxide and water; and turn them into oxygen and sugar. This process is called “photosynthesis.”
- Ø **What’s on the menu:** Sunlight, carbon dioxide, and water.



S u n

Ø I am the only star found in your solar system and am about 4.5 billion years old! One hundred and nine Earths would be required to fit across my belly, and I could fit over 1.3 million Earths inside it! I provide energy to all the creatures on Earth; without me no one would survive.



Sea Robin

- Ø **Fishy facts:** I'm not a bird, but my pectoral fins look like wings. They help me defend myself against predators. I live on the bottom and my legs help me move around. If you are lucky enough to catch me, I might just bark at you!
- Ø **What's on the menu:** Shrimp and small fish.

Scientific Name: *Pronotus carolinus*
Phylum: Chordata
Class: Actinopterygii



Squid

Ø Fishy facts: I move backwards using jet propulsion. I suck water into my body and then release it outward to move. Most of you know me as "calamari" – fried squid.

Ø What's on the menu: Fish and invertebrates.

Scientific Name: Loligo sp.
Phylum: Mollusca
Class: Cephalopoda

Little Skate

Ø **Fishy facts:** People often mistake me for a sting ray because we look very similar. However, I won't sting you; I have no stingers. I live on the bottom.

Ø **What's on the menu:** Hermit crabs, clams, and shrimp.

Scientific Name: *Leucoraja erinacea*
Phylum: Chordata
Class: Chondrichthyes



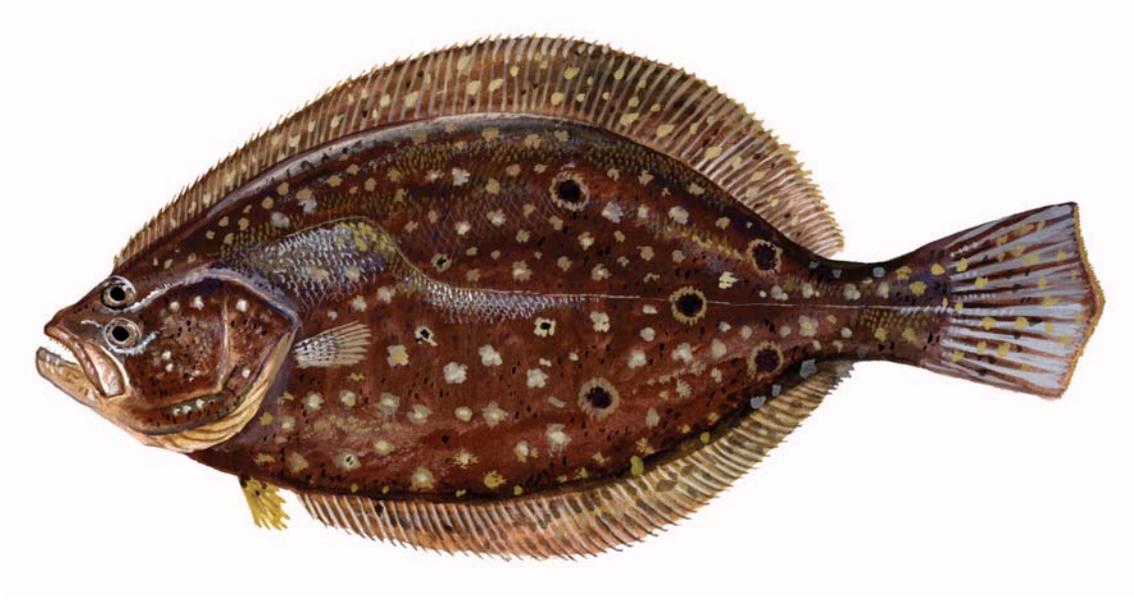


Silver Side

Ø **Fishy facts:** Most fishermen call me "spearing," aka the bait. I don't get very big--15 centimeters at most. You'll often find me swimming in large schools. Safety in numbers!

Ø **What's on the menu:** Plankton and occasionally algae.

Scientific Name: *Menidia menidia*
Phylum: Chordata
Class: Osteichthyes



Fluke or Summer Flounder

- Ø **Fishy facts:** I am a type of flatfish, meaning that I lay flat on the bottom, and have both eyes on one side of my body. I am known as a predator. To protect myself from being eaten, I can change colors or camouflage myself to look like the marine floor.
- Ø **What's on the menu:** Squid, clam, and small fish.

Scientific Name: *Paralichthys dentatus*
Phylum: Chordata
Class: Osteichthyes

Who's Who? in the Food Web

Name: _____

1. Name one or more producers from the food web exercise.
2. Name one or more consumers from the food web exercise.
3. List three fish species you may catch/caught on your fishing trip.
4. Which one is NOT a consumer (circle your answer):

Algae

Crab

Clam

Hawk

5. Draw a picture of a consumer, producer or decomposer from the food web exercise.

Identify your animal/plant: _____

Why is your animal/plant a producer, or consumer, or decomposer?
