Introduction

3rd-5th Marine Menus

Essential Questions:

- How does energy flow in a food web?
- What roles do producers, consumers, and decomposers play in a food web?

Standards

GSE

S5L4: Obtain, evaluate, and communicate information about how microorganisms benefit or harm larger organisms.

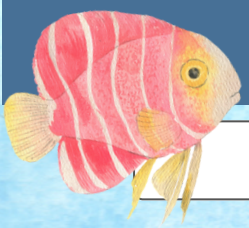
S4L1: Obtain, evaluate, and communicate information about the roles of organisms and the flow of energy within an ecosystem.

S3L2: Obtain, evaluate, and communicate information about the effects of pollution (air, land, and water) and humans on the environment.

NGSS

5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

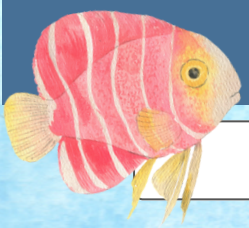
5-PS3-1: Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.



3rd-5th Marine Menus

Background

- **A food web consists of all the food chains in a single ecosystem.**
  - Each living thing in an ecosystem is part of multiple food chains. Each food chain is one possible path that energy and nutrients may take as they move through the ecosystem, and there is usually some overlap.
  - Every link in a food web is connected to at least two others. When one link in the food web is threatened, some or all of the links are weakened or stressed.
- Organisms in food webs are grouped into categories called **trophic levels**.
  - **Producers:** Make their own food through photosynthesis or chemosynthesis and do not depend on any other organisms for nutrition.
  - **Consumers:** To get energy, they eat plants or other animals, while some eat both.
  - **Primary consumers** make up the second trophic level. They are also called **herbivores**. They eat primary producers—plants or algae—and nothing else.
  - **Secondary consumers** eat primary consumers. Secondary consumers are mostly carnivores, although some are omnivores. Some consumers are predators and others are scavengers or parasites.



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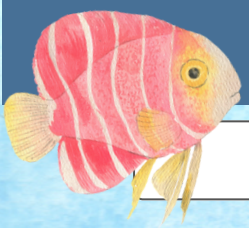
Background

- **Tertiary consumers** are carnivores that eat other carnivores. These are usually the apex predators of a system and are consumed by decomposers when they die. There are usually no other animals native to the area that would hunt for the tertiary consumer.
- **Decomposers:** These organisms get their nourishment from dead organic material, such as decaying plant leaves or dead fish that sink to the bottom of a pond.

- All living things require **energy** to survive and carry out their life processes, such as growth, reproduction, and metabolism.
- This energy comes from the organism's ecosystem and in many cases from the food that the organism eats.
- For much of life on Earth, the primary source of energy is from the Sun.
  - Through **photosynthesis**, plants are able to capture energy from sunlight and use that energy to power reactions that transform carbon dioxide and water into oxygen and sugar molecules.
- Energy decreases with each trophic level. There is always more energy, or biomass, in lower trophic levels than in higher ones. There are always more producers than herbivores in a healthy food web, and there are more herbivores than carnivores.



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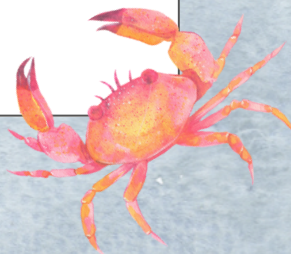
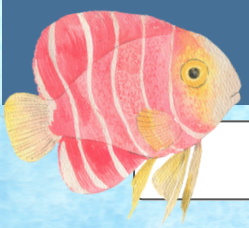
Background

- Marine food webs are usually larger than terrestrial food webs. Scientists estimate that if there are a million producers (algae, phytoplankton, and seagrass) in a food web, there may only be 10,000 herbivores. Such a food web may support 100 secondary consumers, such as tuna. All these organisms support only one apex predator, such as a person.
- Algae such as kelps and rockweeds alongside plants like sea grasses are all important primary producers in coastal regions of the ocean.
- Phytoplankton and algae form the bases of aquatic food webs. They are eaten by primary consumers like zooplankton, small fishes, and crustaceans. Primary consumers are, in turn, eaten by fishes, small sharks, corals, and baleen whales. Top ocean predators include large sharks, billfishes, dolphins, toothed whales, and large seals. Humans consume aquatic life from every section of this food web.
- In the ocean, the most abundant **decomposers** are bacteria, marine worms, echinoderms, crustaceans and mollusks. They all get their energy by breaking down dead organic matter that float around or fall to the bottom of the sea.

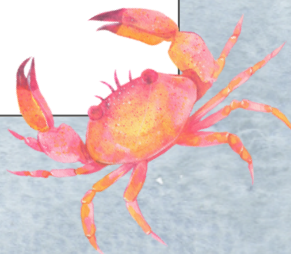




3rd-5th Marine Menus

Background

- Microorganisms play a large role in a food web, especially in marine food webs.
- These organisms include **zooplankton** and **phytoplankton**, which are basically animal plankton and plant plankton. They also often make up the producer and primary consumer levels.
- In the ocean, 95% of the primary production is done by microscopic phytoplankton such as diatoms and dinoflagellates. Phytoplankton contribute 50% of the oxygen in our atmosphere.
- Coral is made up of a calcium carbonate skeleton and **zooxanthellae**, microscopic algae, which can perform photosynthesis and provide nutrition for the coral. Zooxanthellae make up the base of many marine food webs.
- Coral reefs make up about 1% of the ocean floor but provide food and shelter to 25% of ocean life.
- While some microscopic organisms can make up the base of a food web, others can also cause problems for an ecosystem.
- Algae blooms can occur, and can damage the environment by depleting oxygen in the water, which can kill fish and other living creatures. Algae that blooms near the water surface can also block sunlight from reaching organisms deeper in the water.



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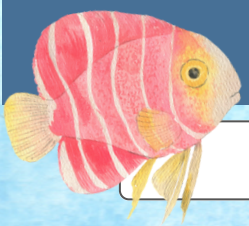
Background

- There are several threats facing food webs, which can cause food webs and entire ecosystems to collapse.
  - **Food Scarcity:** The farther away animals have to travel to get food, the higher the chance of predation or starvation.
  - **Invasive Species**: Many invasive species are voracious eaters and don't have many predators, causing a large disruption to ecosystems.
  - **Ocean Acidification**: As oceans become more acidic, certain populations of shelled animals like clams, oysters, and even sea urchins are reduced, removing a food source for some larger animals.
  - **Overfishing and Pollution**: Biodiversity is a finite resource and humans impact every part of a food web through our own consumption or actions.
  - **Warming Oceans:** Fish that prefer cooler water will migrate away from the warmer surfaces and move deeper into the water column, which makes it difficult for surface level feeders. The lack of zooxanthellae in coral will also mean less photosynthesis which in turn means less nutrients for the coral and less organic material for the food chain.



Lesson

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3rd-5th Marine Menus

Vocabulary

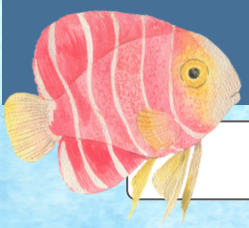
- Producer
- Consumer
- Decomposer

Materials

- Yarn or String
- Scissors
- Animal Cards

Lesson structure:

1. Review with students the terms “producer”, “consumer”, and “decomposer”, and ask students for examples in each category.
2. Ask students to describe the difference between a food chain and a food web. Identify that in both models, arrows are used to represent where the energy flows.
3. Hand each student an animal card and have them stand around the room, organizing themselves into trophic levels: producers, primary, secondary, and tertiary consumers, and decomposers.
4. Next, use yarn to connect the animals. Beginning with the Sun, pass one end of the yarn to your producers. Have students pass the yarn around to each other following the flow of energy. Each student should hold on to the end of the yarn, add in a second string where needed if an animal eats more than one organism.
5. Once the food web is complete, introduce a scenario where constant pollution caused ocean acidification, taking out the population of sea urchins. Have the sea urchins step out of the food web and observe and analyze the results.
6. Repeat for the second food web scenario. Once complete, introduce an invasive species into the food web. Have this student take the string from the consumers. If the animal on the other end of the string doesn’t eat the invasive species, have them drop their string.



Evaluation

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Evaluate

1. After creating the initial food web, ask students to share their observations about how all the organisms are connected. Ask them to hypothesize what might happen if some species were removed from the ecosystem.
2. Ask students to analyze the impact of adding invasive species into the ecosystem, the effects of pollution, and the impact of humans on a food web.
3. Evaluate students' understanding of producers, consumers, and decomposers' roles by asking them what a healthy ecosystem needs more of, and what a food web needs to support a large number of omnivores.

Extend

1. Have students draw their own food web or create a food web puzzle.
2. Research specific food webs in ecosystems near your location, identifying potential threats that may disrupt the ecosystem.
3. Learn more about invasive species and other potential threats disrupting food webs.

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Print and cut the cards

Sun	Seaweed
Kelp	Sea Urchin

Print and cut the cards

Crab

Octopus

Sea Otter

Green Sea Turtle

Print and cut the cards

White Shark

Garibaldi Fish

Marine Worms

Hagfish

Answer Key

Producers: Seaweed, Kelp
Primary Consumers: Sea Urchin, Crab, Green Sea Turtle
Secondary Consumers: Garibaldi Fish, Octopus, Sea Otter
Tertiary Consumer: White Shark
Decomposers: Marine Worms, Hagfish

Seaweed and Kelp receive energy from the sun.
Sea Urchins, Crabs, and Green Sea Turtles all eat Seaweed and Kelp.
Garibaldi Fish, Sea Otters, and Octopus eat Crabs.
Garibaldi Fish also eat Sea Stars.
Sea Otters and Octopus eat Sea Urchins.
Sea Otters eat Octopus, Crabs, Sea Urchins, and Garibaldi Fish.
White Sharks eat Green Sea Turtles, Sea Otters, Octopus, and Garibaldi Fish.
Hagfish and marine worms eat the remains of all the above animals once they've completed their life cycle.

Threats to the ecosystem:
Sea Otters are a keystone species. If they were to be removed from the ecosystem, the sea urchin population would be able to increase, which could result in the kelp forests being completely devoured. This would mean less habitat space for the animals and could cause the ecosystem to collapse. Sea urchins are also threatened by pollution and ocean acidification, causing their population to decline, removing a food source for many organisms.

Print and cut the cards

Sun

Coral and Zooxanthellae

Phytoplankton

Grazing Fishes

Print and cut the cards

Zooplankton	**Shrimp**
Young Fish	**Groupers**

Print and cut the cards

Black Tip Reef Shark

Sea Cucumber

Lionfish

Answer Key

Producers: Coral and Zooxanthellae, Phytoplankton
Primary Consumers: Grazing Fishes, Zooplankton
Secondary Consumers: Shrimp, Young Fishes
Tertiary Consumer: Groupers, Snappers
Apex Predator: Black Tip Reef Shark
Decomposers: Sea Cucumber

Zooxanthellae, which live in corals, get energy from the Sun.
Grazing fishes and Zooplankton get energy from the algae that grows in corals.
Shrimp and Young Fishes eat Zooplankton.
Groupers and Snappers eat the Young Fishes and Shrimp.
Black Tip Reef Sharks eat the Fish species.
Sea cucumbers eat the remains of all the above animals once they've completed their life cycle.

Threats to the ecosystem:
Invasive species: Lionfish
Lionfish are opportunistic feeders and will eat all the Young Fishes, Shrimp, and Grazing Fishes from an ecosystem. This means there are no fishes left for Groupers, Snappers, or Black Tip Reef Sharks. Without the Grazing Fishes, algae will overgrow on corals. This algae will block the Sun and kill the corals. Because lionfish also eat cleaner fishes that feed on parasites in an ecosystem, the populations of harmful parasites will increase as well.