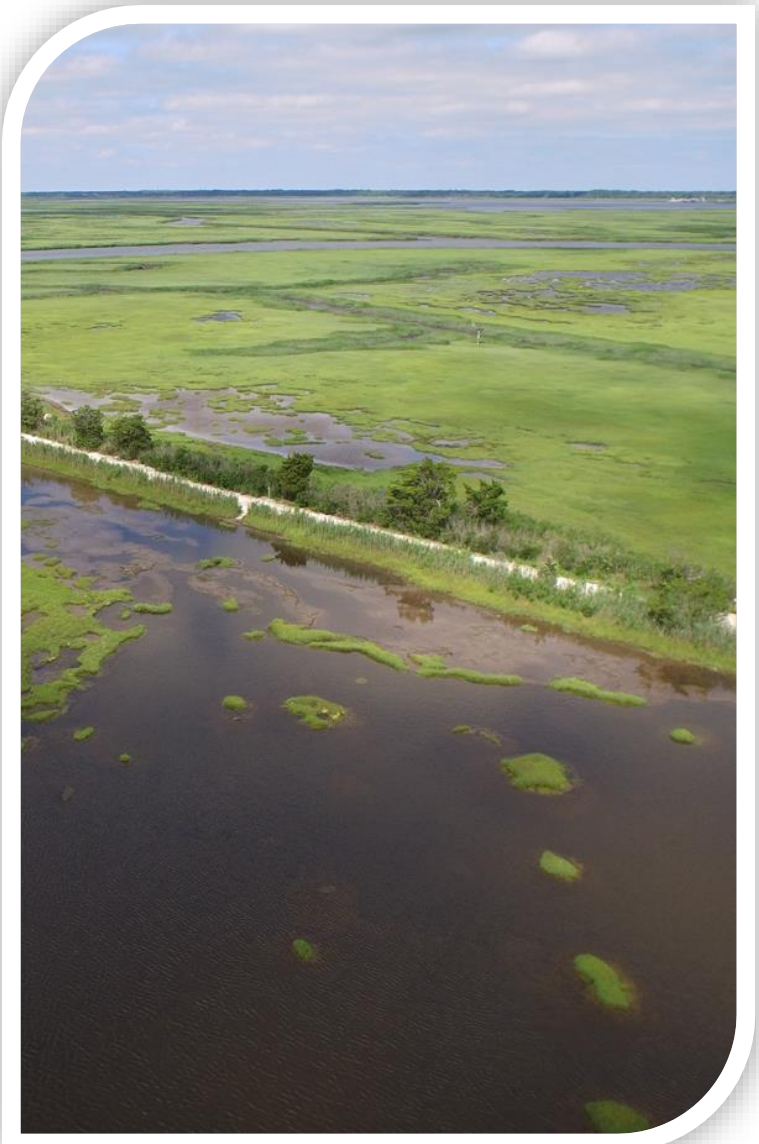
Cycles of Life

Grades 3 – 4



1075 Stone Harbor Blvd, Stone Harbor, NJ 08247
p: 609.368.1211 f: 609.368.3871
wetlandsinstitute.org

Cycles of Life

Food and water. Without them life would not exist. And yet how often do we take them for granted. Turn on the faucet and clean, fresh water flows out for drinking, cooking and washing. Open the refrigerator and there is usually something there to eat. But where did the water and food come from. The water you drink today may have been underground for years or melted from snow and ice in mountains hundreds of miles away. And where did that food in the fridge come from anyway?

This booklet contains information to help you and your students prepare for your trip to The Wetlands Institute. The accompanying activities are designed for before and after sessions and are intended to enhance the learning experience of your visit. However, feel free to use the activities in a manner best suited to the needs of your students.

PRE-VISIT ACTIVITIES

1. **Clouds in the Classroom** will introduce your students to the water cycle as they create clouds and rain in a plastic cup.

2. Where do people fit in the food chain? **Look Who's Coming to Dinner** will demonstrate that people are an important member of the food chain and that our food may come from both wild and domestic plants and animals.

POST-VISIT ACTIVITIES

1. **Caught in a Web: Coral Reef Edition** will introduce your students to the food web and the intricate connections between all plants and animals in this unique ecosystem.

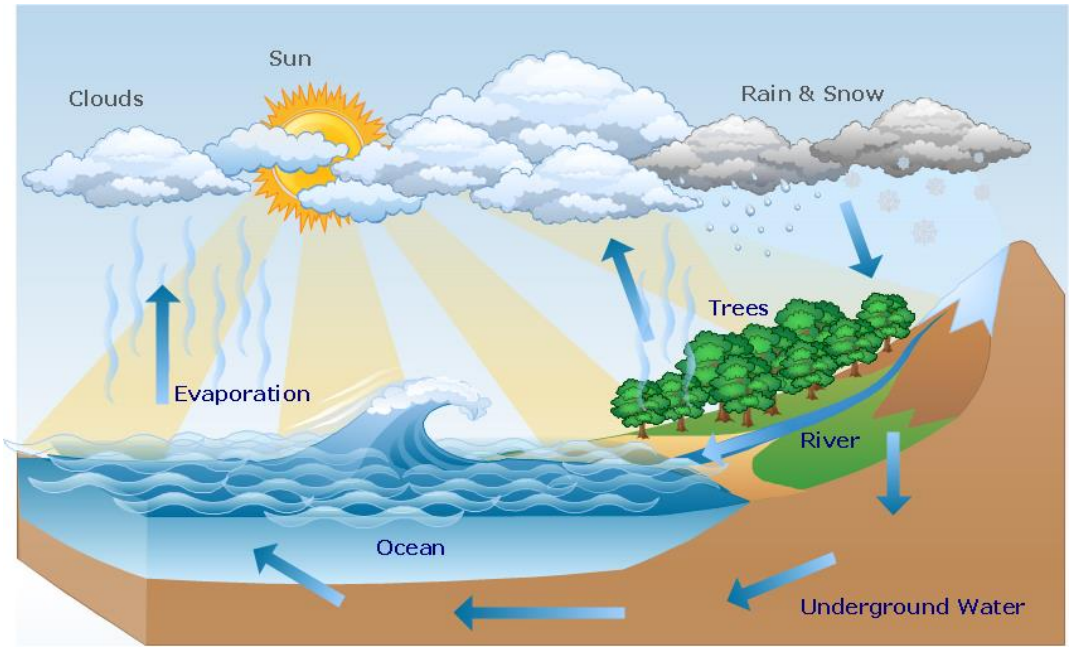
2. How does water flow over the landscape? Does it flow into a river? Is that river connected to another river? Does it flow into a pond or lake? Is there another river flowing out of pond or lake and continuing the journey? Your students will discover the answers to these questions in **Where's My Watershed?**

BACKGROUND INFORMATION

Wonderful Water

Water is essential for all life. While oxygen is also vital some organisms can survive without it. Bacteria, living in marsh mud, thrive in an environment lacking oxygen. But without water life as we know it would not exist. Water seems at first glance such a simple compound. Two atoms of hydrogen attached to one atom of oxygen. And yet water is an extraordinary chemical. No other substance can be found on earth simultaneously as a liquid, solid and gas. Water has the power to dissolve rock forming vast caverns or to scour it away to form grand canyons.

Water has always been present on earth. At first, locked in the rocks of the crust, then as a vapor and eventually as a liquid and a solid. The amount of water on the planet has remained constant, neither increasing nor decreasing. Water is constantly being moved around from one place to another, from one form to another and used and reused by living things in a process called the **water cycle**.



Ninety-eight percent of the Earth's water is in liquid form in the oceans, lakes, rivers and streams. When heat from the sun warms liquid water it **evaporates**, and as a vapor rises into the atmosphere. As the vapor rises, the temperature of the surrounding air decreases, eventually to a point at which the vapor **condenses** back into a liquid. This liquid water forms clouds. The water molecules, too light to fall back to earth, adhere to small particles, like ice crystals or dust, called **condensation nuclei**. These molecules and their nuclei collide and attach to others to form water droplets. Eventually the droplets become large enough to fall back to earth as **precipitation**. Precipitation may fall into the ocean, rivers and lakes or it may fall on land. Rain falling toward a desert may even evaporate before it

hits the ground and rise back into the atmosphere. If the water falls on the ground it may flow quickly into a nearby stream, pond or storm sewer as **run-off**. Or, it may soak into the ground and become **groundwater**. Some groundwater slowly seeps deeper into the ground and accumulates in sandy layers called **aquifers**. Where an aquifer touches the earth's surface or the bottom of a river, lake or ocean, water flows out of the earth as a spring.

Aquifers provide many communities with clean drinking water. A **well** is a hole that is dug or drilled into an aquifer. Water can then be pumped to the surface to be used by people. Beneath southern New Jersey are a number of aquifers. Several wells at The Wetlands Institute, drilled as part of a U.S. Geological Survey study, record the change in level and quality of the water in these aquifers. The shallowest aquifer is found just below the surface and extends to about 80 feet below the surface. The deepest well extends from 230 feet to 340 feet below the surface. Several communities in southern New Jersey get their drinking water from this deep aquifer. Many homes especially in rural areas get their water directly from wells.

In many areas, towns store water from aquifers in water towers. The water is then pumped to individual homes. To supply large cities with water, manmade lakes, called **reservoirs** are created by damming rivers. New York City gets much of its drinking water from reservoirs on the Delaware River. Eventually, though it may take hundreds of years, groundwater will return to the sea.

Some groundwater is absorbed by the roots of plants. Most of this water travels from the roots to the leaves, where it may be used to make food during **photosynthesis**. However, much of this water is released into the air as a vapor through pores in the surface of the leaves in a process called **transpiration**. This water vapor returns to the atmosphere to go through the cycle again. The wet climate of rain forests is primarily due to the large quantity of water released by the plants in the forest.

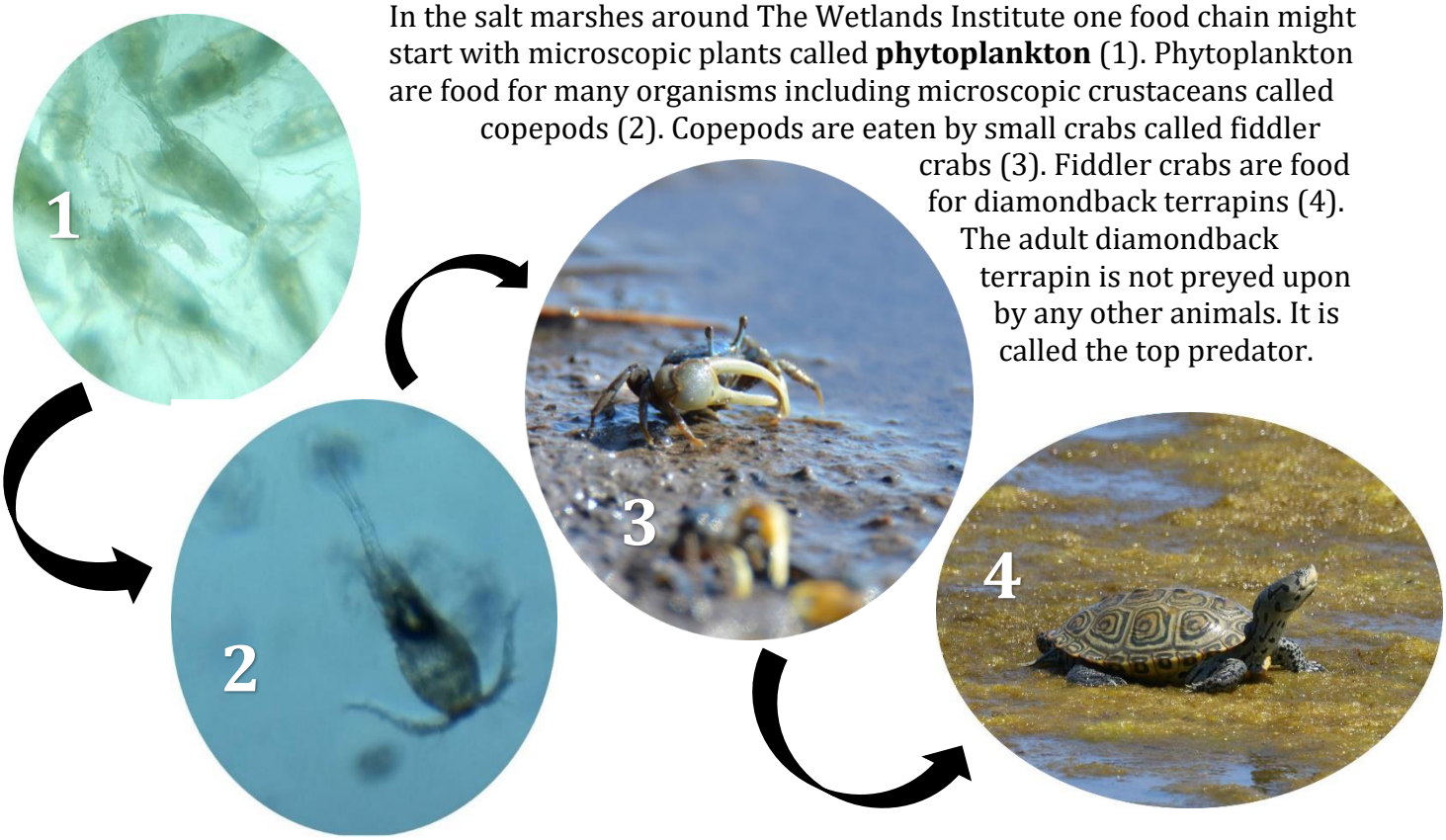
Food for Thought

Food is also important to all living things. The energy in food is what fuels the processes of life. Energy and **nutrients** are passed from one living thing to another in the **food chain**. Though energy only passes one way through the food chain, nutrients are recycled over and over. Every food chain is interconnected, forming a more complex arrangement called a **food web**.

Every food chain begins with the sun. Green plants and algae, in the process called photosynthesis, "capture" sunlight. Plants use this energy to combine water, carbon dioxide and other substances to produce sugars and other compounds we call food. Because plants make their own food they are called **producers**. All other organisms must eat plants or animals in order to obtain the energy and nutrients they need to survive. These organisms are called **consumers**. Consumers can be placed into many different categories based on what they eat and how they get their food. Consumers that eat only plants are called **herbivores**. Herbivores are usually the first consumer in any food chain. Consumers that

eat other animals are called **carnivores**. Carnivores that catch and kill their food are called **predators**. Consumers that eat both plants and animals are called **omnivores**. Another group of consumers eat only dead animals. These consumers are called **scavengers**.

In the salt marshes around The Wetlands Institute one food chain might start with microscopic plants called **phytoplankton** (1). Phytoplankton are food for many organisms including microscopic crustaceans called copepods (2). Copepods are eaten by small crabs called fiddler crabs (3). Fiddler crabs are food for diamondback terrapins (4). The adult diamondback terrapin is not preyed upon by any other animals. It is called the top predator.



If top predators did not die, all of the energy and nutrients passed along the food chain would accumulate in them, like water behind a dam. But most of the energy and nutrients have already been lost along the way. Energy is lost as heat, during vital body functions, and when muscles are used. Nutrients and heat are both lost in the animal's droppings. For example, in order to meet its energy and nutrient requirements the osprey must eat many flounder. The flounder must eat many silversides, which need many copepods, which eat lots of phytoplankton. A food chain is like a pyramid. It has a very wide base, the phytoplankton, which supports levels that get increasingly smaller until you reach the single point at the top, the top predator.

Top predators are sometimes indicators of the health of the environment in which they live. The osprey is a good example of this. Ospreys were once very abundant. At one time about 500 pairs of ospreys nested in New Jersey. By the 1960s very few nesting osprey were seen and those that did nest rarely produced young. Scientists realized that something was wrong.

Tissue samples from ospreys and their eggs revealed high concentrations of a pesticide called dichloro-diphenyl-trichloroethane or DDT. DDT was used widely in New Jersey in the 1940s and 1950s to control populations of many insect pests including salt marsh mosquitoes. The pesticide made its way into marshes, ponds, rivers and lakes. However, the concentrations of DDT in osprey were much higher than the concentrations found in the water. Phytoplankton absorbed DDT from the water with the nutrients they used to make food. Once absorbed the DDT remained locked inside the phytoplankton. Concentrations of the pesticide inside the phytoplankton became higher than in the surrounding water. Eventually the phytoplankton was eaten by copepods. DDT accumulated in copepods which ate the phytoplankton. This occurred in each step of the food chain until in ospreys DDT concentrations became so high that the birds laid thin shelled eggs. When the female tried to incubate the eggs they broke and no young were hatched. The use of DDT was banned in the United States in 1972 and since then, ospreys have made a remarkable comeback. By 2013, osprey numbers returned to historic levels.

Osprey Chicks

Adult Male Osprey

Eventually, top predators; like osprey, will die. Usually, all plants and animals that are not eaten die of injuries, disease or old age. When an animal dies it may be eaten by a scavenger. The remains of the carcass are "eaten" by another group of organisms, the **decomposers**. Decomposers, which are primarily bacteria and fungi, break down the complex compounds of dead plants and animals absorbing some for their own use and releasing the rest into the environment to be recycled by producers to start the cycle anew.

Clouds in the Classroom

This simple activity will demonstrate the water cycle and the formation of clouds and precipitation.

Materials:

- Plastic cups
- Plastic wrap
- Rubber bands
- Warm water
- Ice cubes

Procedure:

1. Divide the class into groups of three or four students.

2. Discuss the three states or forms that water can take, liquid, solid and gas. What must happen to water for it to move from one state to another? Where could you find water in each of its three states? Can water be found in all three states in one place? (Hint: think about the refrigerator)

3. Give each group a plastic cup, a piece of plastic wrap, and a rubber band.

4. Tell the students that they will be creating a water cycle in the cup. What they will need now? Water! Fill each cup about 1/3 to 1/2 full. The experiment will progress faster if the water is warm. The students now have a miniature ocean

5. Have one student place the plastic wrap on top of the cup, pulling it taut so the top is smooth, while another student places the rubber band around the top of the cup to hold the plastic wrap down tightly.

6. Have another student place an ice cube on top of the plastic wrapped cup. Tell your students that it is important that they not touch the ice cube during the rest of the experiment.

Ask the students to predict what will happen. If the water evaporates, what will happen to it? The water will evaporate and the vapor will rise in the cup. Vapor will collect at the plastic. The ice on the plastic will cause the vapor to condense forming a fog on the plastic. Your students now have a cloud in the cup. As more vapor condenses the water droplets get larger eventually falling back into the cup as rain.

Look Who's Coming to Dinner

What role do people play in the food chain? People are consumers and must eat a variety of foods in order to stay healthy. In this activity your students will discover their place in the food web and investigate where their food comes from.

Procedure:

1. Have your students keep a list of everything they eat in one day. This should include breakfast, lunch, dinner and all snacks.

2. In class have the students divide the foods on their lists into those derived from plants and those from animals. Some will be easy, and others more difficult. Corn is a vegetable. Chicken is an animal. But what about chocolate? Chocolate has several ingredients, some are from plants, like cocoa and sugar, but milk comes from an animal.

3. After the foods have been classified have the students make a food web with their foods. With vegetables and other plant foods the food chains will be short. Only three links; sun, plant, student. Food chains that include animals will be longer. The students will have to find out what foods animals, like cows, pigs and chickens, eat. If students have fish on their list that are caught in the wild the food chains will be more complicated.

4. Discuss the food webs with the whole class. Where did most of the food in the students' food webs come from? Are any human foods caught in the wild? Most seafood, with a few exceptions, is still caught from the wild. What other consumers might people compete with for the same food? Do any wild animals feed on the crops that people grow to feed themselves and domesticated animals? Are people important members of food webs?

Extensions:

1. Have your students do research to find out where their food comes from. Which foods are grown or raised in their home state? Which foods come from other states? Did any of the students' food come from a foreign country? Which foods were caught in the wild? Where do these foods come from and how are they caught? What are some of the wild origins of common animals, fruits and vegetables?After your students have researched the origins of their foods have them report their findings to the class.

Caught in a Web: Coral Reef Edition

This activity will introduce your students to the interdependent relationships between plants, animals and people in this unique ecosystem. It can be conducted either in the classroom or outdoors.

Materials:

- Strong string or twine in 5', 10' and 20' lengths
- Caught in a Web: Coral Reef Edition Pictures, one for picture per student (included)

Procedure:

If conducted outside mark an area with a small circle surrounded by two concentric rings one 5' from the small circle and the next 10' from the small circle. Inside mark a similar playing field with colored tape or masking tape that will fit the dimensions of the room.

1. Give each student in the class a picture. Have them try to decide whether the organism is a producer or consumer.

2. Have the student with the sun stand on the small central circle. The producers will then stand on the middle circle and consumers on the outer circle.

3. Ask the producers where they get their energy. Connect each producer with a 5' piece of twine. The sun holds one end, the producer the other.

4. Now ask the consumers that eat plants to raise their hands. Which plant or plants does each consumer eat? Connect the consumers to the plants they eat with twine. When all plants and consumers are connected ask consumers that eat other animals to raise their hands. Connect these consumers to their food.

5. When all food web connections are completed take a minute to discuss the interdependence of plants and animals. Are any consumers connected to more than one plant or animal? Are any consumers connected to only one kind of food? Which animals eat both plants and animals?

6. Ask your students what might happen if a plant or animal disappeared from the food web. How would it affect the rest of the food web? Choose an animal to disappear. Which animals eat the animal chosen? Do any animals eat only the one that disappeared? What would happen to this animal? Now choose a plant to disappear. How does the plants disappearance affect the food web? Does the disappearance of a plant have more of an impact than the disappearance of an animal? How do people fit in the food web?

Extensions:

1. Have the students do some research to find out about the animals you used in the food web. They should try and find answers to the following questions.

    a. Is the animal an herbivore, a carnivore, or an omnivore?
    b. What animals or plants does the animal eat?
    c. How does the animal catch its food?
    d. Does the animal have special adaptations for acquiring its food?

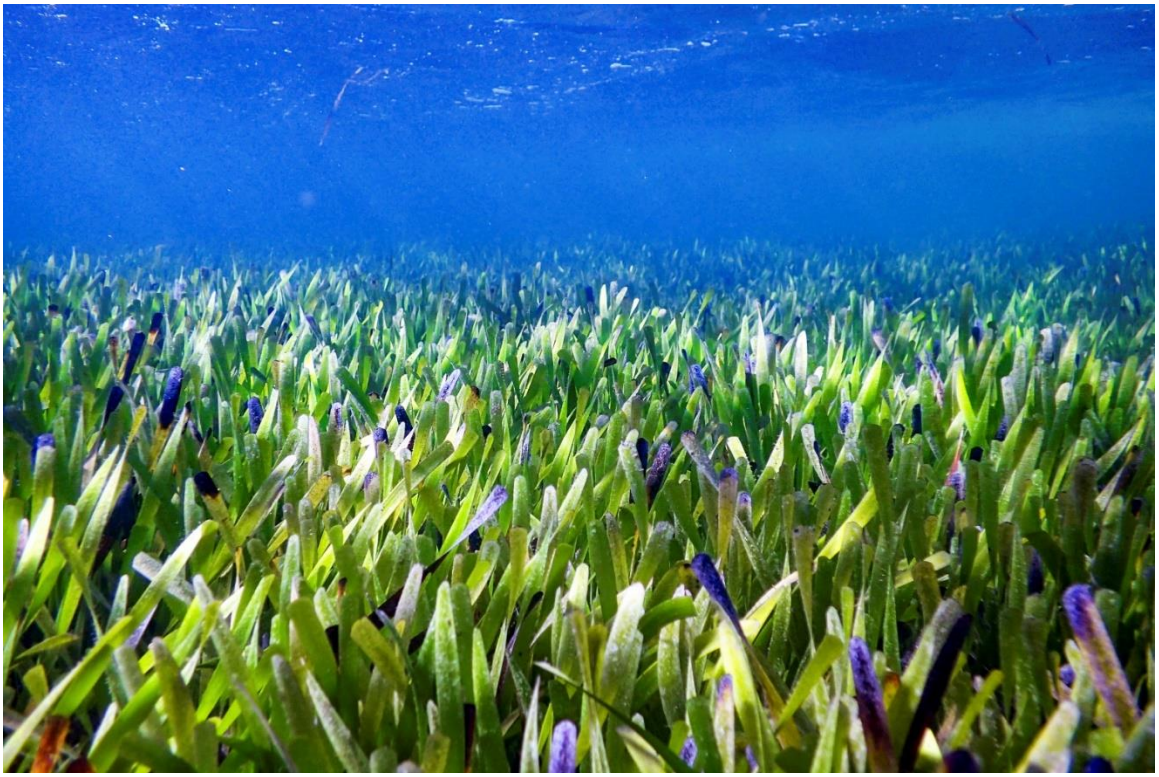
2. Animals can be classified by the foods they eat. An animal's diet can include plants, animals or both. Some animals are generalists. They eat a wide variety of food items. Others are specialists and may feed on just one species of plant or animal. Have your students define the following feeding types and find an example of each:

1. Herbivore	6. Frugivore
2. Carnivore	7. Piscivore
3. Omnivore	8. Nectarivore
4. Scavenger	9. Generalist
5. Insectivore	10. Specialist

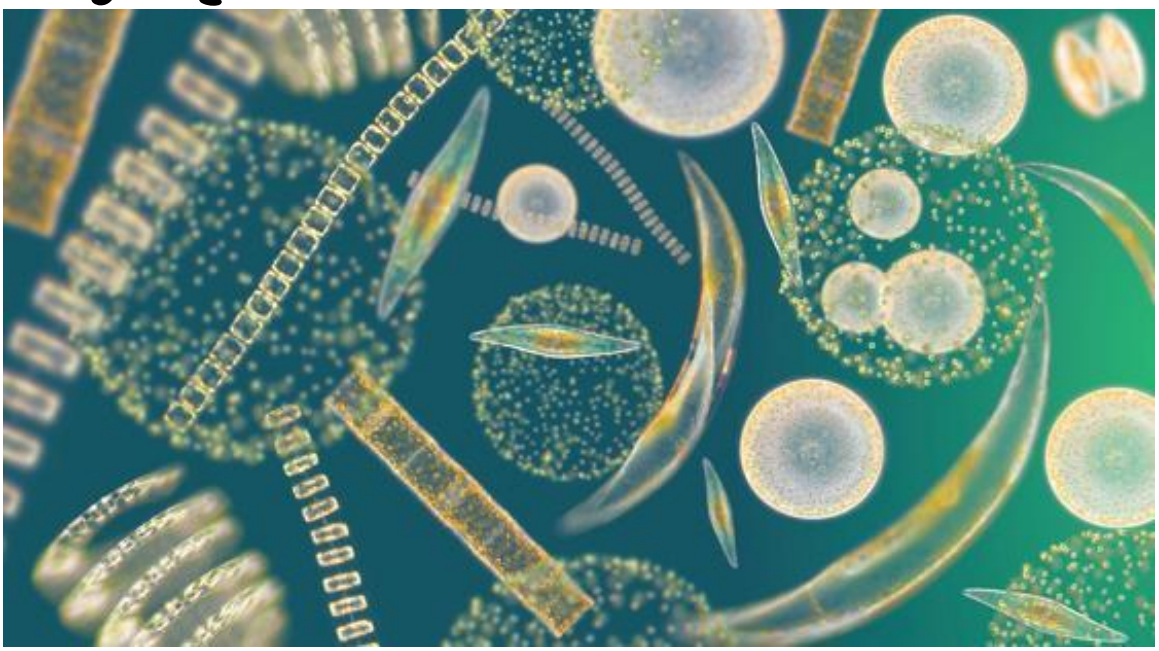
3. Have the students compare this food web to the Salt Marsh food web they explored while at The Wetlands Institute. How is it similar? How is it different? What challenges are each ecosystem facing that make the food web vulnerable to disruption?

Caught in a Web: Coral Reef Edition Pictures

Sea Grass



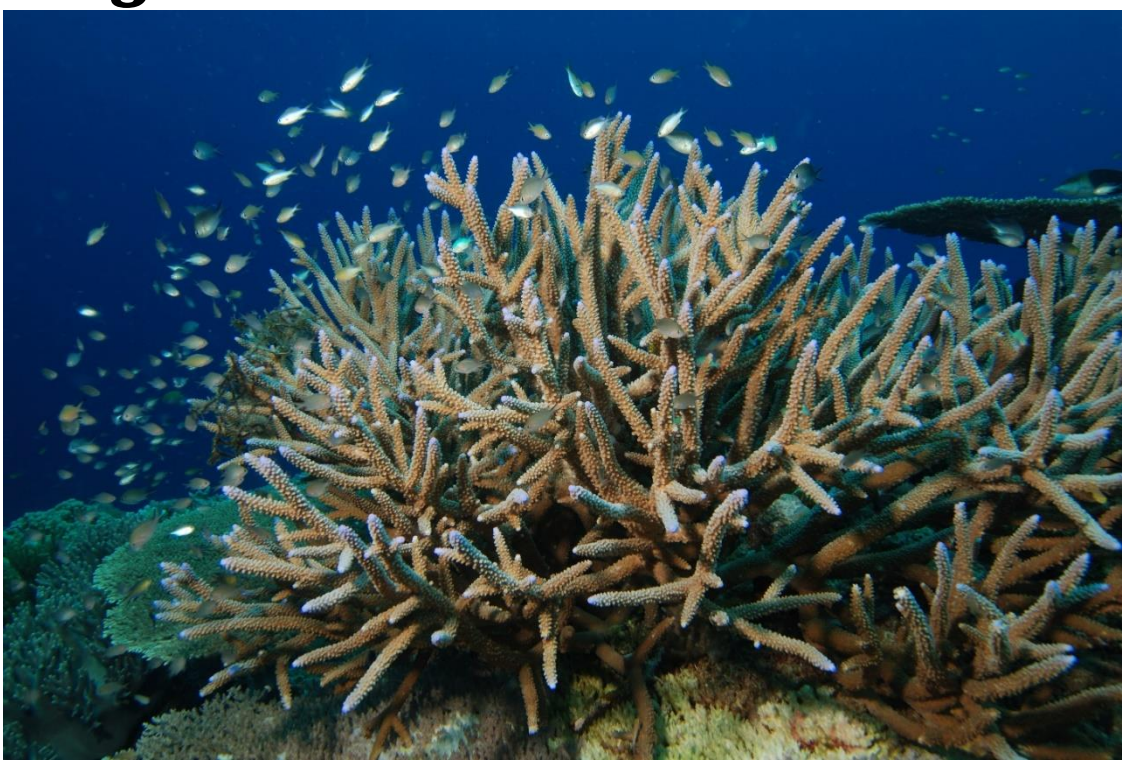
Phytoplankton



Red Macroalgae

Yellow Brain Coral

Staghorn Coral



Parrotfish

Copperband Butterflyfish

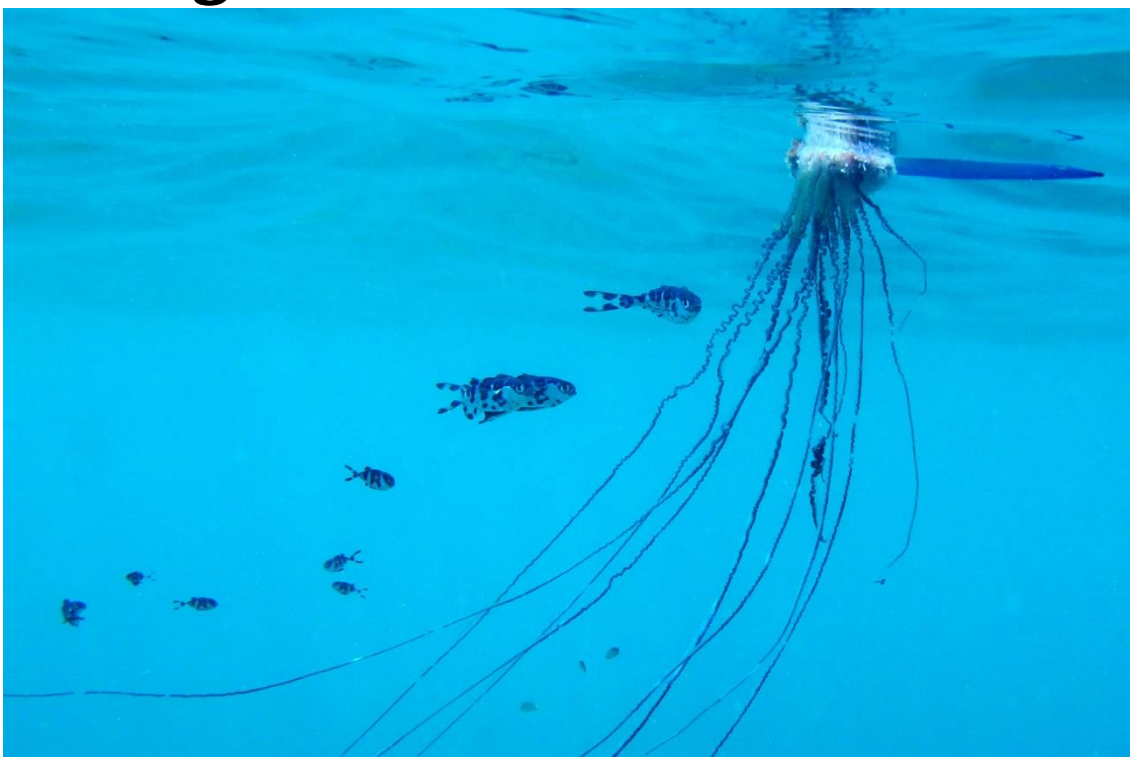
Black White Butterflyfish

Southern Eagle Ray

Clownfish

White Striped Anemone

Portuguese Man o' War

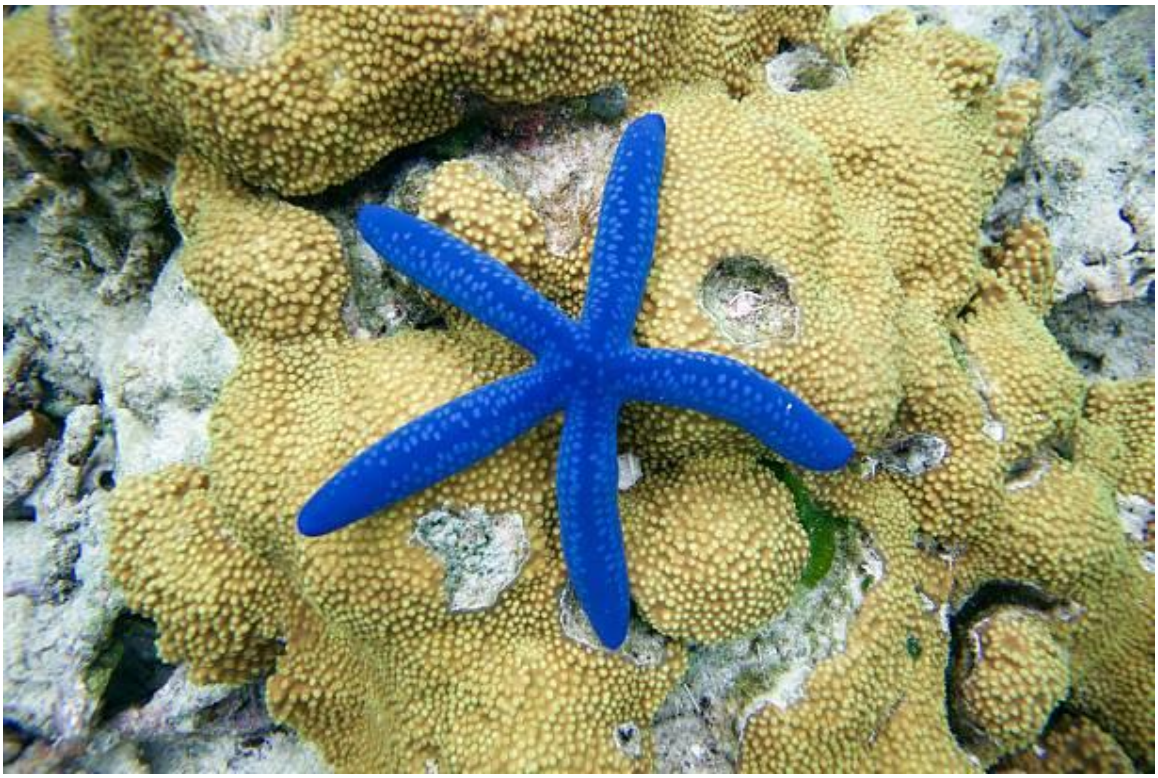


Giant Clam

Green Sea Turtle

Loggerhead Sea Turtle

Blue Sea Star



Spotted Reef Crab

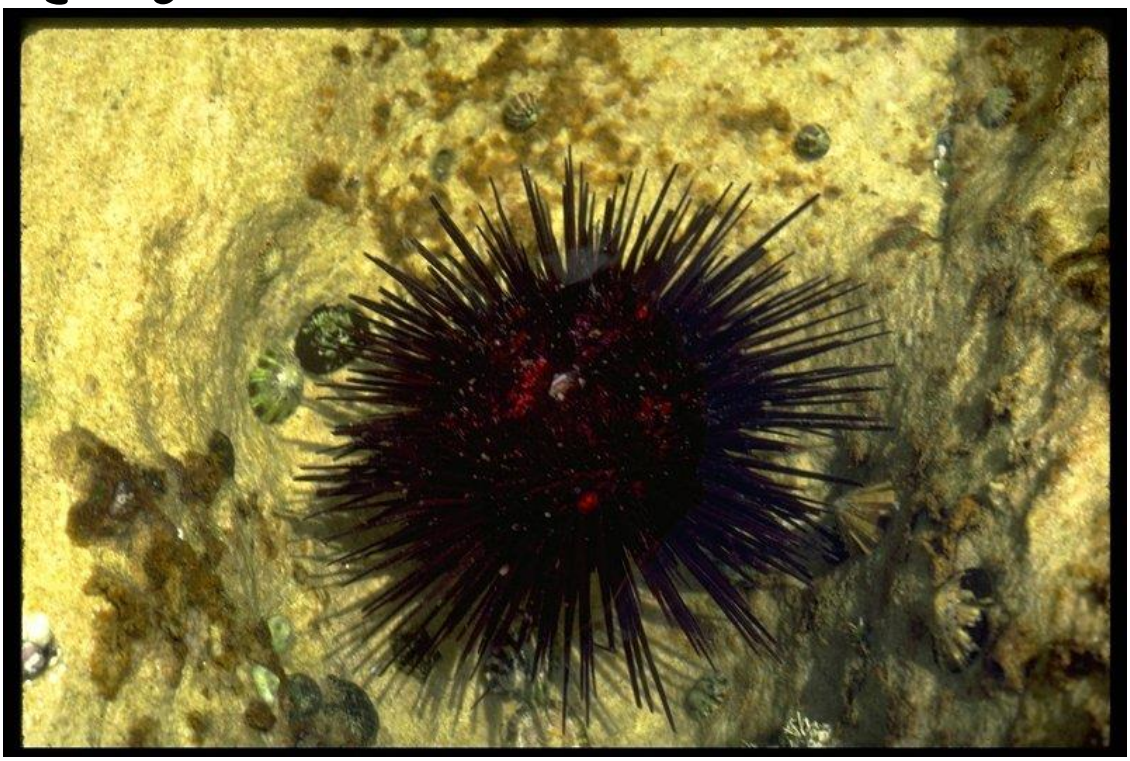
Blacktip Reef Shark

Sea Snake

Blue Ringed Octopus

Dolphin

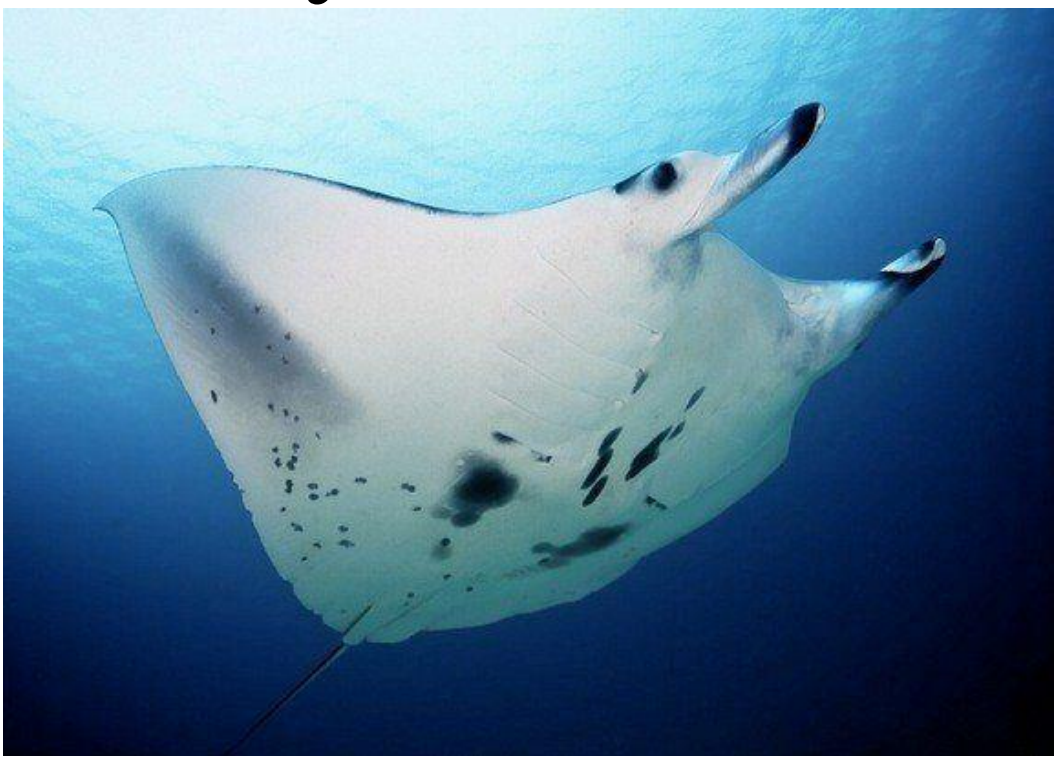
Spiny Sea Urchin



Fiddler Shark

Guitar Shark

Manta Ray



Great White Shark

Remora

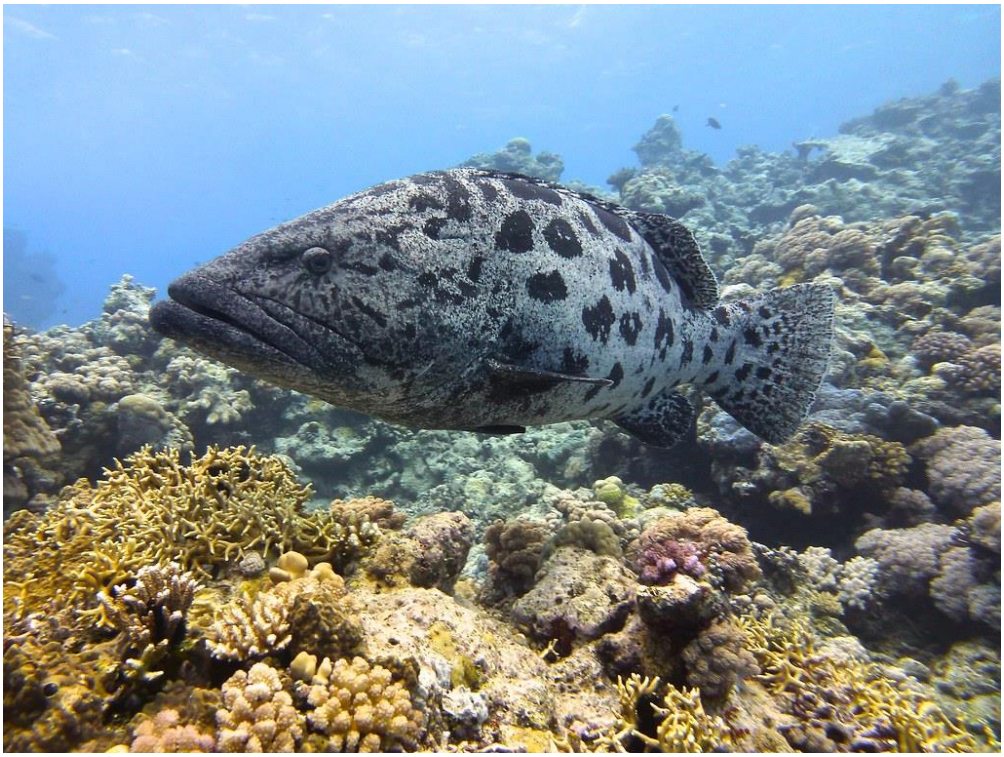
Clown Goby

Banggai Cardinalfish

Zooplankton

Blue Tang Surgeonfish

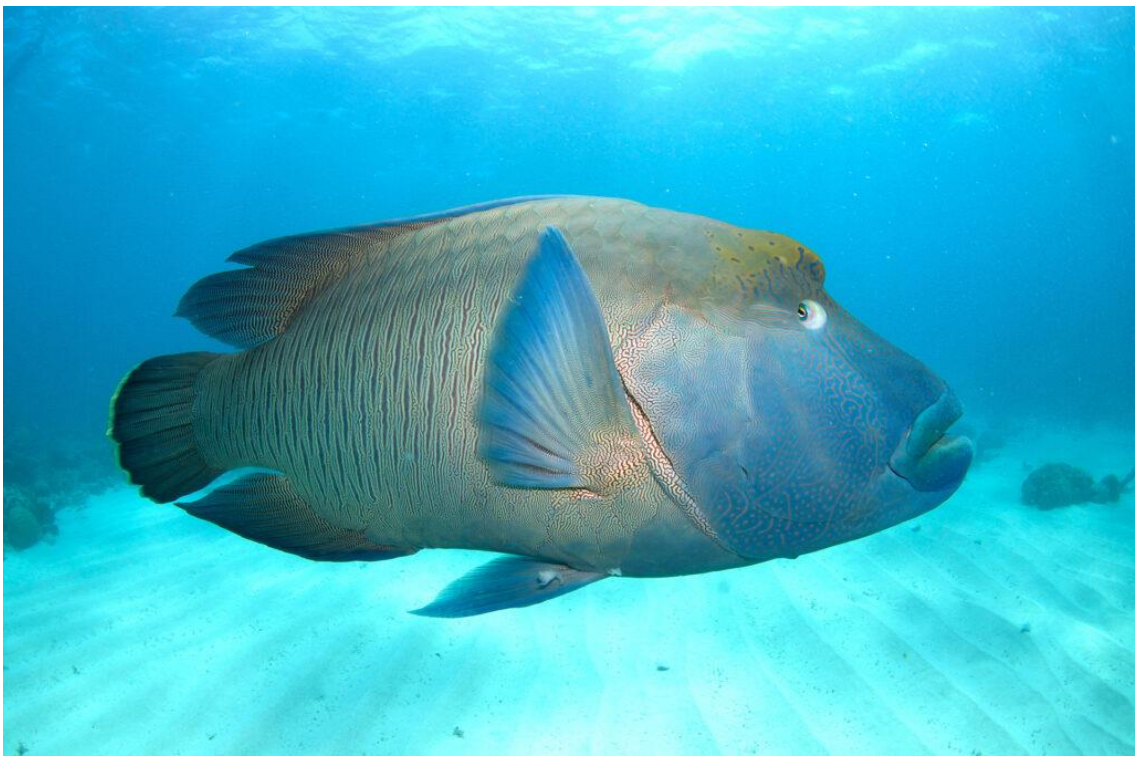
Potato Cod



Coral Cod

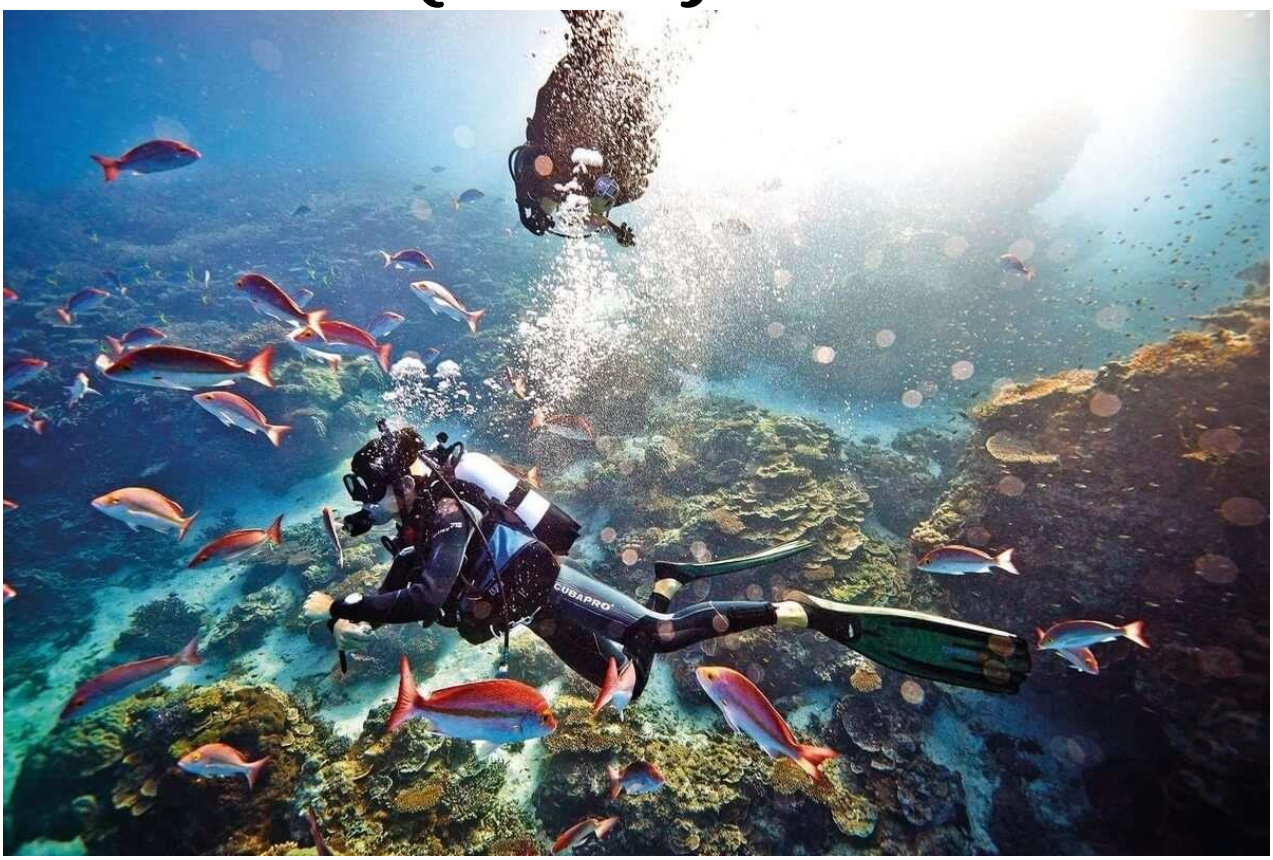
Reef Lobster

Maori Wrasse



Pacific Cleaner Shrimp

Scuba Diver (Human)



Where's My Watershed?

How does water flow over the landscape? Does it flow into a river? Is that river connected to another river? Does it flow into a pond or lake? In this activity, your students will explore the landscape of a watershed. They will identify mountains and valleys and begin to understand how water travels through its environment.

Materials:

- Paper
- Tape
- Blue water soluble markers
- Green permanent markers
- Spray bottle, filled with water
- Sponge/towels
- Trays (or complete outside for easy clean-up)

Procedure:

1. Take two sheets of paper.
2. Crumple one sheet, open it, but do not straighten it out completely.
3. Tape the corners of the crumpled paper to the surface of the other paper.
4. The crumpled paper will look like a relief map. Identify the types of "land": hills, mountains, valleys, plateaus, etc.
5. Use a **blue** marker to trace the ridge lines.
6. Predict where the major "rivers" might be and where water might collect after a "rainfall".
7. Use a **green** marker to trace the rivers and water collection areas.
8. Take the spray bottle and mist your relief map.
9. Observe how the water flowed, where it collected and how the topography (the surface features) affected the drainage patterns.
10. Let your watershed dry and you will have a cool piece of art to display.

Extensions:

1. Build your own Tinfoil River. Somewhere outside, lay down a roll of tinfoil and fold up the sides about an inch. Take a hose and allow the water to "flow" down the "river". The water shouldn't be blasting, just a gentle flow will work. Or, to conserve water, you can use two buckets, one at the beginning and end of the tinfoil river.

    a. Add twists and turns in your tinfoil river. Add natural materials to create stick bridges, stone rapids and other river features.
    b. Add some sand to the river and watch how the water moves sediment around.
    c. Have students make tinfoil boats to float down the river. Have students race the boats down the river.

2. Make observations of how water changes land. In an outdoor space, draw a circle on the ground. Have students make observations of the area. Then pour a bucket of water in the space. Make observations about how the water changed the space.

    a. Where did the water go? How did the water change the land? Did the land change the water? What would happen if you conducted this experiment in the forest? On the beach? What about if the experiment was conducted at different times of year?

Vocabulary

Aquifer a water bearing stratum of permeable rock, sand or gravel.

Carnivore a flesh eating animal.

Community all of the species which occur in the same habitat.

Condensation nuclei a small particle, usually dust or an ice crystal, on which water molecules condense to form a water droplet.

Condense to change from a gas to a liquid.

Consumer an organism that feeds on other organisms.

Decomposer an organism that feeds by degrading organic matter.

Evaporate to change from a liquid to a gas.

Food chain a sequence of organisms through which energy is transferred through feeding.

Food web the network of interconnected food chains of a community.

Groundwater water that exists underground in saturated zones beneath the land surface.

Herbivore an organism that feeds on plants.

Nutrient basic compounds of which organic material is composed.

Omnivore an organism that feeds on a mixed diet of plant and animal matter.

Photosynthesis the biological process in which carbohydrates are produced from carbon dioxide and water through the action of chlorophyll exposed to light energy.

Phytoplankton microscopic plant life unable to move freely against prevailing currents.

Precipitation rainfall, snow, sleet, hail, etc.

Predator an organism that kills other organisms for food.

Producer an organism that synthesizes complex organic substances from simple organic compounds.

Reservoir manmade lakes that supply drinking water to cities.

Run-off that part of precipitation that is not held in the soil but drains freely away.

Scavenger an organism that feeds on dead animals.

Transpiration loss of water from an organism through pores or membranes.

Water cycle a process by which water is constantly being moved around from one place to another, from one form to another and used and reused by living things throughout.

Well a hole that is dug or drilled into an aquifer.