

# Feeding Frenzy

What animal relationships exist in the wetlands? This activity studies food webs and bioaccumulation.

## Concepts

- Plants and animals that live in wetlands have special relationships to each other and to their part-wet part-dry environment.
- Salt marshes are a type of wetland.
- Salt marshes provide habitats for both fresh and salt water species.
- Salt marshes are one of the most productive ecosystems on Earth.
- A food chain is a series of plants and animals that pass matter and energy through the chain by eating one another.
- A food web is one or more overlapping food chains; organisms at one trophic level eat different foods, including other species at their same and lower trophic levels.
- Bioaccumulation occurs when toxic substances accumulate in higher and higher concentrations from one level of the food chain to the next.

## Objectives

Students will:

- identify components of a food web in a salt marsh and their interconnectedness
- produce a model of energy transfer through a food chain
- identify limiting factors
- demonstrate bioaccumulation

## Duration

One hour

## Method

Food web simulation followed by class discussion and diagramming.

## Background

A salt marsh is an important ecosystem found between a land mass and the ocean. Freshwater and saltwater come together to form a unique habitat for wildlife. The constantly changing mixture of water provides food and shelter for species from both habitats.

Salt marshes are one of the most productive ecosystems on Earth – they are five times more productive than a field of wheat! Important producers for this ecosystem are salt marsh grass, pickleweed, and algae that grow and thrive in nutrient-rich waters of estuaries where salt water from the ocean mixes with freshwater from land drainage. These plants constantly produce new growth. Bacteria promote the decay of marsh plants, which in turn produces detritus. Detritus is dead and decaying plant or animal matter. Fiddler crabs, snails, small shrimp, and fish feed on decomposed marsh grasses. Oysters and clams filter detritus and tiny living plants from the water, then become food themselves for crabs, birds, and fish. Many marine organisms and commercially valuable fish species, including flounder, salmon, and striped bass, depend at some point in their lives on salt marsh ecosystems.

Many resident and migratory birds are dependent on salt marshes for food and nesting. Ospreys, sandpipers, and the heron family feed along marsh creeks during the spring and summer, while ducks and northern harriers can be seen in the winter months. Raccoons, shrews, and mice wander through the marsh in search of food, and deer, grasshoppers, and geese feed on the grasses. Marshes also provide critical services (e.g., trapping sediments and nutrients from runoff so that waters in bays and along the coast are clean and clear), as well as being exciting places to see lots of wildlife such as birds, fish, and invertebrates.

At Ballona Wetlands, the salt marsh works in partnership with the coastal strand (sand dunes), upland, and freshwater areas to create supporting habitats. Some native species rely on these supporting habitats for their survival, and for others the complex of coastal wetland ecosystems provides more opportunities for foraging and nesting.

## California Science Content Standards

### 5. Ecology (Life Sciences)

Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:

- 5.a. Students know energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.
- 5.b. Students know matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.
- 5.c. Students know populations of organisms can be categorized by the functions they serve in an ecosystem.
- 5.d. Students know different kinds of organisms may play similar ecological roles in similar biomes.
- 5.e. Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

### Materials

1. construction paper (9 colors)
2. scissors
3. one envelope per student
4. yarn
5. hole punch
6. marker
7. timer
8. chalkboard or butcher paper or poster
9. Overhead transparency "Wetland Food Web" and "Feeding Frenzy Master"
10. Overhead projector

## Activity

This simulation introduces how a salt marsh food web works. First you will discuss what students know about salt marshes. Then you play a game that illustrates how a salt marsh food web works.

1. Lead a classroom discussion about salt marshes. What do you know about salt marshes? Where do we find salt marshes? (Along coasts or bays, in protected areas where fresh water meets salt water. Salt marshes have special birds and animals that live there, dependent on the part wet, part dry habitat. Salt marshes are very productive. Because of human impacts, there are few salt marshes left in California.) **Draw the diagram from page one** on the board or project on overhead projector, and discuss the characteristics of a salt marsh. Note how sea water flows in with the tide, and freshwater flows over it, with some mixing in between. Explain that salt marshes are very rich and productive areas for animals and plants to inhabit because of all the nutrients brought to the marsh by creeks and rivers, and because they are shallow and receive lots of sunlight for plants to grow. Salt marsh inhabitants must be able to live in both fresh and salt water. Ask: Do you know any animals that live in the salt marsh? (Birds, small mammals, fish, and invertebrates such as snails and oysters.) Discuss the ways in which salt water mixes with fresh water.

2. Discuss the importance of detritus in salt marshes. Salt marshes produce lots of detritus (dead or decaying plants and animals). Detritus plays an important part in the salt marsh food web. Producers are the first level in a food web; plants are producers that create food from sunlight. Salt marsh grasses are very abundant and constantly grow and die to become detritus. Bacteria and fungi are decomposers. They break down detritus. Salt marshes produce a lot of food, and plants and animals grow and die to create more detritus. Snails and worms eat detritus, and many of the larger animals eat snails and worms. Grasses, detritus, and bacteria aren't big and flashy like hawks and raccoons, but without them, the salt marsh food chain would collapse!

3. Discuss food webs. What do you know about food webs? (A food web is a way to describe how the living parts of an ecosystem relate. Bigger animals eat smaller animals. There are predators and prey that eat and are eaten. Food webs describe who eats whom.) Display the "Wetland Food Web" diagram on an overhead projector, or draw it on the classroom board. Plants and animals can be arranged in levels of who eats whom, named "trophic levels." Have students help decide who eats whom in the salt marsh food web. Discuss: In any food web, there are producers (mostly plants) and consumers. By growing and being eaten, producers create food for consumers to eat. Food webs also contain predators and prey – predators capture prey for food, and prey are eaten by predators.

## Pre-game Instructions

1. The class will pretend to be animals in the salt marsh. Each animal plays an important role in the food web. In this game, all animals are consumers. The producers, plants, and bacteria that support the detritus-eaters (prey) are not a part of this game (plants and bacteria do not provide much action in an action-oriented game). This is a simulation; in real life, these animals play several roles in the food web.

## Preparation

Collect materials, prepare food tickets and envelopes, create a badge for each student.

### 1. Food Tickets and Envelopes

Cut green construction paper into squares (10 for each student). Mark a quarter of the tickets with the marker – these will later represent the polluted plants and detritus. Shuffle the tickets and place 10 tickets in each envelope at random. Number the envelopes and set aside.

### 2. Badges

Copy the “Feeding Frenzy Master” and cut out the animal descriptions for each student. (See the distribution chart below.) Paste the descriptions onto a construction paper rectangle using a different color for each species. Using a hole punch, punch holes in the top corners of the construction paper. Cut a length of yarn and tie it through the holes, creating a badge for the student to wear. Hand out the badges with the numbered envelopes. (You may want to make a note of which student receives which numbered envelope in case there is confusion later in the game during creation of the food web.)

#### Distribution:

Great Blue Heron	1
Raccoon	1
California Killifish	3
Longjaw Mudsucker	3
Gopher Snake	3
California Horn Snail	7
Cottontail Rabbits	7
Bay Ghost Shrimp	7

2. Give one badge to each student. When students receive their badges, explain that some students will be detritus-eaters and herbivores and others will be carnivores. Discuss the relationship between predators and their prey. Make this table on the board without the X's. Fill in the table as you discuss who eats whom. (Predators are listed in the first column. Note that some of the predators are also listed as prey. This is because there are three levels of consumers in this activity: herbivores/detritus-eaters, carnivores, and top carnivores - carnivores that prey on carnivores as well as herbivores.)

Salt Marsh Food Web: Who's Eating Whom?						
	California Killifish	Longjaw Mudsucker	Gopher Snake	California Horn Snail	Bay Ghost Shrimp	Cottontail Rabbit
Great Blue Heron	X	X	X			
Raccoon	X	X				
California Killifish				X		
Longjaw Mudsucker					X	
Gopher Snake						X

3. Explain the rules of the game.

a. Each student represents an organism in the salt marsh. The student's badge color signifies the type of organism the student represents. Before the game starts, have the students present the information on their badge in order to familiarize the class not only with the types of animals in the game, as well as which students they will be searching for in the game.

b. Each animal has an envelope of food tickets, representing the food the animal has consumed.

c. The detritus-eaters and herbivores are released into the game area first (California Horn Snail, Bay Ghost Shrimp, Cottontail Rabbit); after 10 seconds, their predators are released into the game area (California Killifish, Longjaw Mudsucker, Gopher Snake); 20 seconds later, the top carnivores are released into the game area (Great Blue Heron, Raccoon).

d. Predators tag their prey by tapping them on the shoulder.

e. The prey must give over all of their envelopes to the predators when tagged.

f. Each predator must tag three appropriate animals of prey within the time period to stay alive. The time period represents one tidal cycle (low to high and back to low tide). Terrestrial predators can only feed when the tide goes out, and marine predators can only feed when the tide comes in. Therefore, all predators are limited by a time constraint within which they must acquire enough food.

g. When students are tagged and hand over their envelopes, they sit quietly in place decomposing in the salt marsh.

### **Playing the game**

1. Get settled where the game will be held. All students should have their envelopes with them. Predict: Ask students what they think will happen in this game. Will all the predators be able to collect enough food to survive? How will the predators know which prey is appropriate to eat (By the color of their badge [representing their appearance including behaviors] – the predators know by experience what they are looking for, what tastes good and is relatively easy to catch.) Will they run out of prey? (No, in a healthy salt marsh, there are more prey than predators. In an unhealthy habitat, perhaps one into which humans have either developed or dumped polluted water and trash, the food web breaks down, with less food for all.)

2. Set the boundaries of the game (a circle drawn on the pavement outdoors, a boundary set by stationary objects [from that tree to this fence], or a large string circle indoors). Tell students there will be a set time limit.

3. Have the detritus-eaters and herbivores spread out within the boundaries, and start the timer. Release the first predators 10 seconds later and the last predators 20 seconds after that.

4. Tell predators to capture their prey (tap on shoulder, take the envelopes). Call time when appropriate (after some predators have acquired three food tokens – time may vary, but do not allow enough time for all predators to get three tokens.)

5. Students hold on to their envelopes for discussion.

### **Results and Reflection**

1. Back in the classroom, discuss results. Have the students recall who tagged them and draw the food web on the chalkboard (or butcher paper or poster). Trace the path of the food consumed throughout the food web (mark the number of the envelope beside each student that possessed it at some point during the game). Ask: Did every predator capture three animals of prey during the time period? Why, when there is so much food out there, do all animals get their fill? (Some, like people, are more mobile and selective about what foods they eat in the marsh because they can get food in other habitats. Others are more selective in what they eat.) What happens to all the animals that don't get eaten? (They die and decompose, creating more detritus for detritus-eaters to eat.)

2. Discuss bioaccumulation. Bioaccumulation occurs when toxic substances accumulate in higher and higher concentrations from one level of the food chain to the next. Explain that an unknown pollutant has been deposited in the salt marsh. This pollutant has been absorbed by the marsh grass. Plants cannot metabolize/decompose some chemicals so they store them. The plants have absorbed a small amount of the pollutant. Open the envelopes in order and count the number of marked tickets (representing pollution in plants and detritus). Trace the pollution through the food web by adding the number of "polluted" tickets next to the envelope from which it came.

## Conclusions

Plants and animals that live in a habitat are related to each other by what they eat. Salt marshes are very rich and productive habitats that support a wide variety of animals. These animals depend upon special conditions to survive, including a part wet, part dry environment, and a daily exchange of fresh water and salt water. It is important to protect remaining salt marshes so plants and animals have a home.

## Extensions and Applications

1. Research and locate a salt marsh near you. Arrange a field trip to the salt marsh, and locate some of the plants, animals, and birds in the salt marsh food web.

2. Have students list possible pollutants in the estuary and investigate ways to prevent, reduce, or eliminate chemical pollutants. Research the effects of bioaccumulation in several species (eagles and alligators). Students should report, make a bumper sticker, or write an eco-poem about the animal.

### Additional Resources

Bioaccumulation: A Resource Guide For Oceanography and Coastal Processes (p IV-15-16). Administered by: The University of Southern Mississippi. Published for: Institute of Marine Sciences – J.L. Scott Marine Education Center and Aquarium.

When the Rivers Run Dry: Water—The Defining Crisis of the Twenty-First Century  
Fred Pearce, Beacon Press 2006. ISBN: 0807085723

Along The Food chain: [http://www.riverdeep.net/current/2002/09/090902t\\_foodchain.jhtml](http://www.riverdeep.net/current/2002/09/090902t_foodchain.jhtml)

A Salt Marsh Food Web: <http://www.promotega.org/nsc30026/foodweb.html>

Dynamics of a Salt marsh: <http://www.dnr.sc.gov/marine/pub/seascience/dynamic.html>

The Ecology of Marine Fishes/California and adjacent waters/Published February 2006/University of California Press: <http://www.ucpress.edu/books/pages/10513.html>

# Feeding Frenzy Master

 <p>Great Blue Heron <i>Ardea herodias</i></p>	<p>Size: 4 feet tall; wingspan to 6 feet; weighs 5 pounds</p>
	<p>Diet: carnivorous: small fish, frogs, salamanders, lizards, snakes, crawfish, small birds, rodents, insects</p>
	<p>Predators: bobcats</p>
<p>The Great Blue Heron is a huge, long-legged, long-necked wader. It has special neck vertebrae that create an "S" shape, which allows the neck to curl up like a spring to attack prey. It also allows the heron to fold its neck while flying. Great Blue Herons are bluish gray in color with a black crown stripe on a whitish head. They are commonly seen standing motionless in freshwater or saltwater shallows waiting for small fish, frogs, or invertebrates to pass by. They use their massive bills to spear their prey, toss it into the air, and swallow it whole.</p>	

 <p>Raccoon <i>Procyon lotor</i></p>	<p>Size: 26 to 40 inches long; weighs 10 to 30 pounds</p>
	<p>Diet: omnivorous: fish, shellfish, frogs, salamanders, insects, birds, eggs, mice, carrion, fruit, nuts, vegetation, corn, cat food, human garbage</p>
	<p>Predators: bobcats, coyotes, foxes, owls, dogs, humans</p>
<p>Raccoons are easily recognized by the black "mask" across their eyes and bushy, ringed tail. Their long, coarse hair is grayish with black tips, and they have a broad head with a pointed snout. Their finger-like toes are long, thin, and flexible, making them able to handle objects much like humans. Raccoons are highly opportunistic and will eat just about anything they can get, which enables them to thrive in many environments. They are typically active at night, looking for food and often "washing" or dipping their food in water.</p>	

 <p>California Killifish <i>Fundulus parvipinnis</i></p>	<p>Size: 2 to 4 inches long</p>
	<p>Diet: omnivorous: insects, amphipods, copepods, algae, worms, fish, eggs, snails</p>
	<p>Predators: herons, egrets, ducks, larger fish, humans (sportfishers use killifish as bait)</p>
<p>The killifish is pale olive green with splotches on the upper surface. The fins are transparent, becoming bright yellow in the breeding season. The male has about 20 crossbars; the female has seven to eight. The killifish has a protruding lower jaw and a tilted mouth for surface feeding. When disturbed, killifish often bury themselves head-first in the mud. Killifish host the adult stage of a parasite that depends on the fish being eaten by a bird to complete its life cycle. To increase the chance that the killifish is eaten by a bird, the parasite infects the fish's brain, causing it to swim erratically at the surface to attract a bird's attention.</p>	

 <p>Longjaw Mudsucker <i>Gillichthys mirabilis</i></p>	<p>Size: up to 4 inches long</p>
	<p>Diet: carnivorous: ghost shrimp, crabs</p>
	<p>Predators: larger fish, egrets, herons, humans (sportfishers use the mudsucker as bait)</p>
<p>This fish is brownish to olive in color with dark spots. It has a large mouth with the upper jaw reaching as far back as the pectoral fin. The face is bluntly rounded. The pelvic fins unite to form a deep, pocketed cup which allows the fish to attach to the substrate. Mudsuckers are able to burrow into the mud and survive under extreme conditions of reduced oxygen and elevated temperature. Instead of breathing through gills, longjaw mudsuckers absorb oxygen from the air through veins in their mouths. Males build nests in mud banks and defend their territories by raising their fins, which turn black, opening their jaws wide, and pushing intruders with their mouths.</p>	

# Feeding Frenzy Master

(Second Page)

 <b>Gopher Snake</b> <i>Pituophis malanoleucus</i>	Size: 5 to 6 feet long
	Diet: carnivorous: rodents, gophers, rabbits, birds, eggs, lizards
	Predators: hawks, foxes, coyotes

A large, heavy snake with a yellow or cream background color and black, brown, or reddish-brown blotches on its back and sides. A dark stripe runs across its small head. Gopher snakes usually hunt during the day by moving slowly through burrows and nests, using their keen sense of smell to find rodents, rabbits, or baby birds and eggs. They kill their prey by constriction and swallow it whole. If the weather is very hot, they will rest during the day and sleep at night. When a gopher snake is threatened, it hisses loudly and sometimes flattens its head and vibrates its tail, although it has no rattle.

 <b>California Horn Snail</b> <i>Cerithidencalifornica</i>	Size: 1-3/4 inches long
	Diet: herbivorous: detritus and benthic diatoms (which form a dense mucus mat on the surface of the mud).
	Predators: killifish, shorebirds

This snail is slender, from one to one and three-quarter inches long with a brown, spiral tail. The California horn snail had the important role of clearing decaying plants and algae from the mudflats, upholding wetlands' reputation for high productivity. It is extremely tolerant of estuarine conditions, being able to survive for many days in fresh water.

 <b>Cottontail Rabbit</b> <i>Sylvilagus audubonii</i>	Size: 13 to 17 inches long; weighs 2 to 3 pounds; females are larger than males
	Diet: herbivorous: 90% grass; also roots, bark, fruits, vegetables
	Predators: coyotes, foxes, bobcats, hawks, owls, snakes, cats

A small rabbit that is light tan to gray, with white underneath. The tail is rounded and looks like a cottonball. They have large hind feet and ears that are relatively short for rabbits. Cottontails are active in the early morning, late afternoon, and night, but may be seen at any time of the day. During the day, they may rest in the shade of large shrubs, in burrows, or within thickets. When startled or frightened, cottontails may freeze, scrunching down to blend into the surroundings, or they may run for cover. They run in zig-zag pattern, at up to 20 miles per hour. This species has more athletic ability than many other rabbits; cottontails have been seen swimming and climbing trees to escape predators.

 <b>Bay Ghost Shrimp</b> <i>Callinassa californiensis</i>	Size: 4 to 5 inches long
	Diet: omnivorous: plankton, detritus
	Predators: fish, sharks, shorebirds, humans (sportfishers use them as bait)

The soft shell of this shrimp is pale pink and orange. The adult males have one pincer that is much larger than the other. The ghost shrimp has four pairs of legs and a large fan-shaped tail. The shrimp burrows constantly, forming ever-changing tunnels as deep as 30 inches with many branches. It extends its fourth pair of legs against the walls of its burrow for support while digging with the second and third pairs. Its tail is used to block burrow entrances for protection. It filters and ingests detritus and plankton from the continuous stream of mud that circulates through its burrow as it digs. The bay ghost shrimp can tolerate large changes in salinity and live without oxygen for more than five days by lowering its heart rate and respiration.