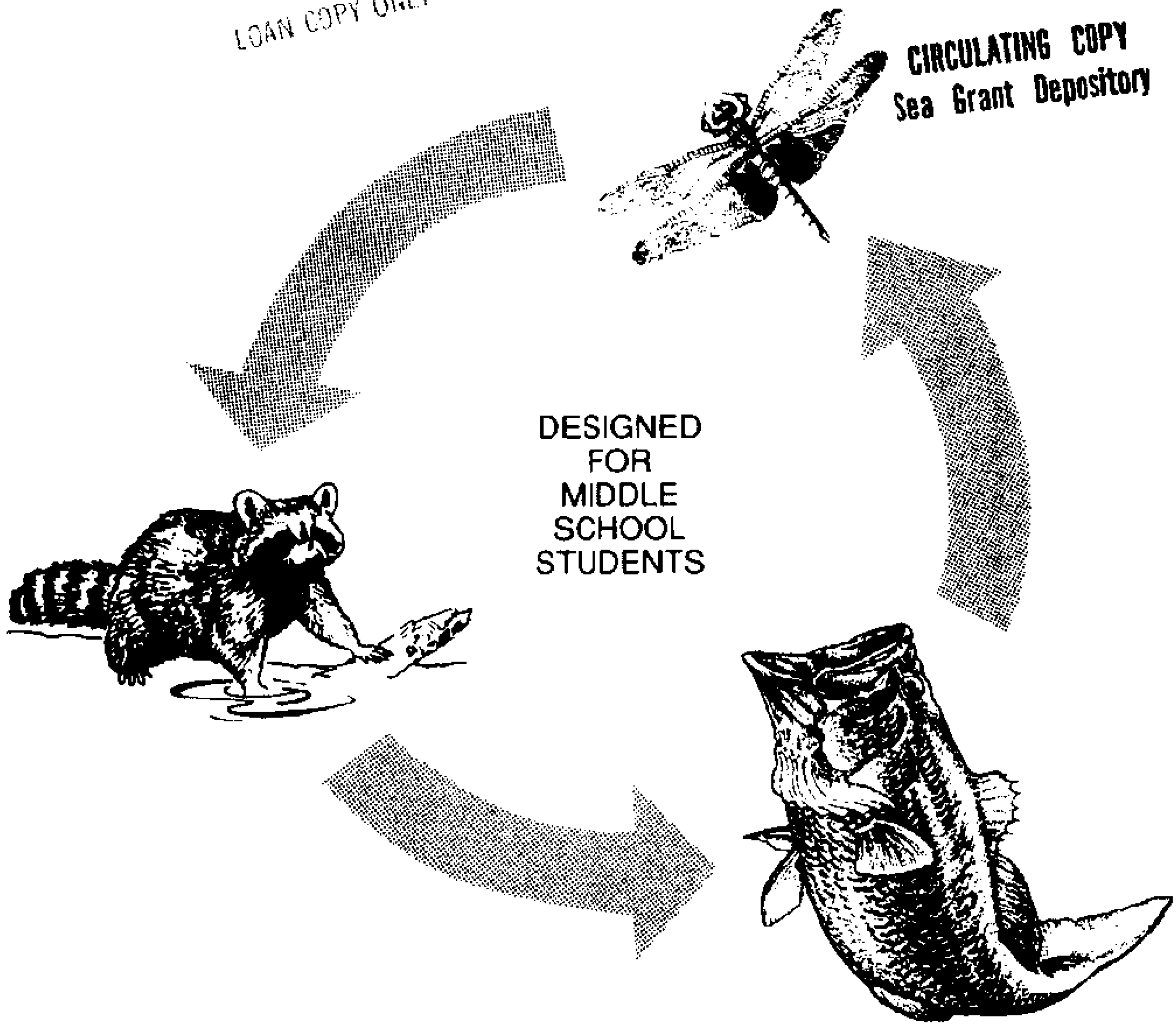
Wetland Activities

FOOD CHAIN • FOOD WEB • ENERGY FLOW



Eleanor Abrams
Lyle Soniat

Louisiana Department of Wildlife and Fisheries
Louisiana Sea Grant College Program

These activities and background information were developed to be used with the Audubon Freshwter Marsh and Saltwater Marsh Poster. The posters are available from your local Audubon Society or from:

National Audubon Society
Route 4
Sharon, Connecticut 06069
(203) 364-0520
The price for the poster will vary according to the number purchased.

Eleanor Abrams, Marine Educational Specialist
Lyle M. Soniat, Marine Educational Specialist
Ken Varden Cover Designer
Bonnie Grayson, Graphics

The activities were developed as a part of the Louisiana Department of Wildlife and Fisheries Aquatic Education Program. To obtain information on how to receive this educational material contact:

Paul Jackson, Aquatic Education Coordinator
Louisiana Department of Wildlife and Fisheries
1213 North Lakeshore Drive
Lake Charles, La 70601
(318) 491-2585

LOUISIANA
SEA GRANT
College Program

Using *Wetlands* Activities with the Audubon Freshwater Marsh/Saltmarsh Poster

The *Wetlands* unit includes three activities that are designed to promote an understanding of the transfer of nutrients and energy through food chains and food webs. Students recognize the interdependence of all living things by this comparison. The activities use the poster to illustrate the basic ecological components of a wetland ecosystem, their relationship via food chains, and finally the flow and loss of energy in a saltwater and freshwater marsh ecosystems.

A. The **Marshes Everywhere Activity** provides an opportunity for students to observe and identify the ecological components of any marsh. Marshes play a vital part in the cycles of many species.

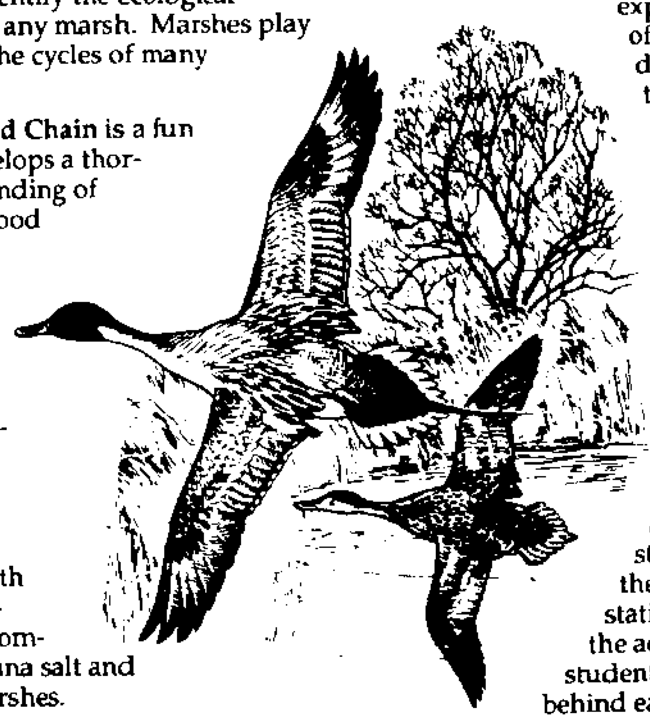
B. **Fish For A Food Chain** is a fun game that develops a thorough understanding of food chains. Food chains are an effective device to help students understand interdependence. In addition, students will have an opportunity to develop some food chains with plants and animals that are common in Louisiana salt and freshwater marshes.

C. **Energy—Is There Enough To Go Around?** is aimed at developing an understanding of energy flow and loss and the impact of energy movement in a food web.

Preview each activity and gather any needed materials before trying them with the students. Take note of the vocabulary words given and go over those unfamiliar to your class. Develop some discussion questions for the closure of the activity to help extend the students' newfound knowledge into other contexts.

With the class, review the **Background Information**. Use the **Freshwater Marsh/ Saltmarsh Poster** to help students visualize the information. Make sure to review new vocabulary words with the class. Reviewing the vocabulary words allows the student to understand each concept individually before it is linked with other concepts.

Review the learning outcomes. By telling the class exactly what information the student is expected to know by the end of each activities, the student is cued to information that will be relevant in the upcoming activity.



The activities can be done as a class, but it is recommended that they be used with small groups (three or four) of students. If your class is small enough, it can be divided into four groups (there are two decks of cards in the second activity). Activity stations can be set up around the classroom. As students finish each activity, they can rotate to another station. Make sure to monitor the activities to insure the students understand the concepts behind each activity.

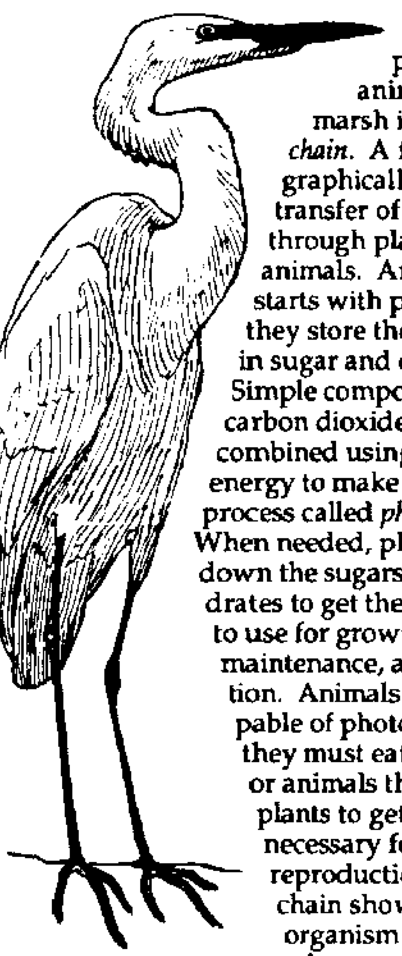
As a class, answer the evaluation questions at the end of each activity. These questions allow the students to extend the knowledge learned in the activities into different contexts by the use of critical thinking. The generalization of new information is important. The more representations the students have of the new information, the more they can use it in different situations.

WETLANDS—FRESH AND SALT

BACKGROUND INFORMATION

General Marsh Ecology

Marshes are an important interface between the land and open water. Life forms are complex and diverse because of the combination of aquatic and terrestrial environments. For example, marshes serve as breeding, resting, and wintering grounds for many migratory birds. Often, open-water organisms move temporarily to wetlands to locate needed food. Besides being areas of high food productivity, marshes are prime areas for spawning eggs and for juvenile young to feed and grow. The young of many species remain in marshes for extended periods of time and then migrate to other environments. Numerous species of fish are directly dependent upon marshes for food, protection, and reproduction.



As in any environment, every plant and animal in the marsh is part of a *food chain*. A food chain graphically depicts the transfer of energy through plants and animals. Any food chain starts with plants because they store the sun's energy in sugar and carbohydrates. Simple compounds such as carbon dioxide and water are combined using the sun's energy to make food in a process called *photosynthesis*. When needed, plants break down the sugars and carbohydrates to get the stored energy to use for growth, tissue maintenance, and reproduction. Animals are not capable of photosynthesis, so they must eat either plants or animals that have eaten plants to get the energy necessary for survival and reproduction. All a food chain shows is which organism is eating which plant or animal.

Organisms that consume similar food in an ecosystem are assigned the same *trophic level* or *consumer level*. So a simple food chain can consist of several different trophic levels. *Primary producers*, or plants, are the first trophic level. They are able to use the radiant energy from the sun to combine carbon dioxide and water to form food. *Primary consumers* are animals that eat plants. *Secondary consumers* eat primary consumers, and *tertiary consumers* eat the secondary consumers.

The individual trophic or consumer levels are further broken down to show the types of foods that animals typically eat. *Herbivores* eat only plants, so they can only be found in the first trophic level of a food chain. *Carnivores* eat only meat, so they can be either a secondary or tertiary consumer. The kind of prey the carnivore is eating designates its temporary consumer level. For example, if a speckled trout eats a fish that has eaten a primary consumer, the trout is a secondary consumer. However, if the speckled trout eats a fish that has eaten a shrimp, then the trout is a tertiary consumer. The last consumer type is the *omnivore*. Omnivores eat plants and animals and, like carnivores, their consumer level is determined according to the plants or animals they recently ate. For instance, a human is an omnivore. If a person eats vegetables, he is a primary consumer. If he eats a steak, he is a secondary consumer. Finally if he eats a speckled trout, he would probably be a tertiary consumer.

As shown above, animals eat a variety of foods. While a food chain cannot show the different kinds of prey an animal can eat, a *food web* can. A food web illustrates the relationships among the consumer types by showing the variety of food an animal might eat in an ecosystem. In addition, decomposers are shown within the food web diagram. *Decomposers* are organisms that feed on dead plants and animals, releasing the energy and nutrients trapped in the dead tissue. The energy is used by the decomposers to live, grow, and reproduce, but nutrients go back into the soil to be used by plants. **All matter is recycled in an ecosystem.**

However, energy does not recycle. **Energy flows through an ecosystem, and some is lost at each trophic level.** Sunlight must pour upon the earth for life to continue. Without the sun, plants and animals would not be able to live, grow or reproduce. Plants capture energy from the sun and that energy is transferred through the food web. In all life processes, such as respiration, growth, tissue maintenance, and movement, heat is given off into the atmosphere. Therefore, energy is lost at each trophic level. At each successively higher level of the food chain, there is less of the original sun energy captured by the plants. In fact, about 10 percent of the energy of one level is passed on to the next level.

For example, a shrimp (a primary consumer) eats a plant and gains 100 calories of carbohydrates. If a flounder (a secondary consumer) eats the shrimp, the flounder gains only 10 calories of the original 100 calories of food energy, because the shrimp will have used up 90 calories in living.

Biologists often represent the flow of energy in an *energy pyramid*. With its broad base, steep sides, and narrow peak, the pyramid represents the loss of energy through the trophic levels. The ecosystem can support many primary consumers, such as rabbits and shrimp, because they eat plants. Remember that plants are low on the energy pyramid and most of the sun's energy has not yet been lost in the form of heat. However, the ecosystem is able to support relatively few tertiary consumers, such as wolves or speckled trout, at the peak. Because of the energy lost and the large amount of food energy required to sustain large predators, there is not enough energy to support a great number of them.

Louisiana Life in Coastal Marshes

Louisiana's saltmarshes and freshwater marshes play an important part in Louisiana's economy. According to recent figures from the U.S. Army Corps of Engineers, Louisiana wetlands produce $17 million worth of furs and hides and $680 million worth of commercial fish and shellfish annually. In addition, $299 million are spent each year on boating and sportfishing and $38 million on waterfowl hunting. The fur and hides produced represent 25 percent of the nation's entire harvest. Louisiana has the largest coastal fin fishery and shellfishery in the country, producing two billion pounds of fish and shellfish annually. This represents 30 percent of the nation's annual commercial harvest. The wetlands are the wintering ground for two-thirds of the ducks and geese that migrate south down the Mississippi flyway each year. The marshes provide recreational opportunities for the sportsman. The associated revenues from licenses and taxes on recreational equipment support state-sponsored programs. Louisiana's coastal wetlands and offshore waters produce about one-sixth of the nation's oil and one-third of its natural gas.

The Louisiana coastal zone is a remarkable geographic feature. Preserving and protecting it for its natural beauty, commercial and recreational value, and cultural heritage is a responsibility for all of us.

Problems with Louisiana Coastal Marshes

Coastal marshes were formed by deltaic growth in the eastern part of the state. In the western part of the state, coastal marshes were formed from sediments produced primarily from the erosion of deltas. The sediments were transported by westward oceanic currents and added to sediments transported from rivers. The Mississippi River has been the major source of sediment. It has altered its course at least six times over 7,000 years, creating major delta complexes from the Mississippi-Louisiana border to the Vermilion Bay in south central Louisiana. As the river builds, a delta expands farther and farther out into the shallow shelf areas of the Gulf of Mexico. However, as new land builds, the Mississippi's course becomes long and inefficient. It then seeks a shorter path to the Gulf, because water always seeks the path of least resistance. This course change starts a new delta forming in a different location. The old deltaic lobe, no longer actively fed by river sediment, slowly subsides as its soft sediments compact, leading to erosion and, finally, deterioration and disappearance. With new deltas always building, there was continual net marsh gain until the early 1900s when the Mississippi River's flow was finally contained by levees.

Before the Europeans came, native Americans were adapted to the changing Louisiana coastline. Their lifestyle was migratory and they moved from place to place as the landscape of

Louisiana regularly changed. Later settlers arrived and built structures that allowed for regular flooding, but the pioneers wanted to own and use the land's natural resources. As Europeans, they were used to static conditions, expecting land that existed today to exist tomorrow. They were unfamiliar with Louisiana's dynamic landscape, which is unlike most other parts of the United States. They wanted the Mississippi to stay on the same route, so they could build cities and farms. Thus, the battle to control the Mississippi began and is still continuing today.

Historically, the river's sediment load flowed into the wetlands and nurtured the marshes. While the lower Mississippi River has been leveed to some extent for about 250 years, the levees were privately built and maintained. The river often broke through these low poorly constructed levees. The U.S. Army Corps of Engineers succeeded in containing all the river within the levees and floodways in Louisiana after the devastating flood of 1927. Today, the river deposits most of its sediment load in the deep waters of the Gulf of Mexico beyond the continental shelf, thereby losing much of its potential for creating new marshes in shallower areas.

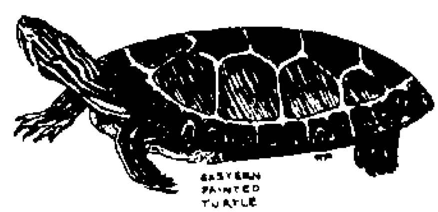
Leveeing is not the only problem. Man is accelerating the natural subsiding and eroding process of old deltas. Access canals for oil and gas drilling, pipelines, and navigation channels all contribute to this loss. Depending upon how this dredged material is deposited onto the marsh vegetation, it could enhance or be destructive to marshes (If it is blown, it will actually build marsh.). Dredging to form and maintain these canals removes sediment from the marshes. However, spoil banks (piled-up dredged material) can prevent the free flow of sediment-carrying water through the marsh. Also, the natural tidal channel is halted by the spoil banks, and nutrients from the ocean are no longer available for the vegetation. Without the ebb and flow of the tides, saltmarsh plants and surrounding soil are never exposed to the air. This exposure is necessary because it allows for the release of toxins that build up in waterlogged conditions. Without this release, saltmarsh plants sicken and die. When the plants die, the soil erodes, and open water is left.

Another activity that can affect marsh loss is the extraction of oil and gas, which can lead to land subsidence. As these materials are removed, a sinking of the soil occurs. Bank erosion causes the widening of canals and natural waterways. Boat wakes washing against the banks can cause unprotected canals to double in width in as few as 20 years.

The one exception to this land loss is occurring at the mouth of the Atchafalaya River. At present, 30 percent of the Mississippi's water and sediment is diverted by the Old River Control Structure into the Atchafalaya River. This diversion has increased delta formation in Atchafalaya Bay. While Atchafalaya delta is the fastest growing and largest new delta in North America, the new delta is not enough to offset land loss in other coastal marshes.

Wetland loss in Louisiana is caused by a combination of natural and man-made influences. Wetland loss would be occurring regardless of human intervention. Remember, a mature delta is abandoned by the Mississippi River, and without the input of new sediments, the land subsides. However, with the changing of the Mississippi a new delta and new wetlands are formed in another part of the state.

Man has interfered with the natural deltaic cycle. By leveeing the Mississippi, the river can not change course and create a new delta. In addition, man's activities have increased loss in the already existing deteriorating coastal wetlands.



Freshwater Marshes

Few people realize the importance of freshwater marsh resources to the early settling of America. Trappers in search of beavers and other furbearers that were abundant in Louisiana marshes mapped rivers and founded outposts. These outposts later grew into settlements such as New Orleans, Baton Rouge, and Natchitoches. Settlers utilized the freshwater marshes' natural resources to feed, clothe, and shelter them.

Too often, though, marshes were viewed as mosquito-infested wastelands to be used for dumping grounds for trash or to be "improved"—that is, drained or filled for agriculture or construction. Drainage had begun as early as the settlement of New Orleans in 1718, and alterations of freshwater marshes and other wetlands have since been carried out on a massive scale.

This loss is prevalent here because Louisiana is richly endowed with wetlands. As much as 40 percent of the wetlands in the lower 48 states are in Louisiana, and this state is experiencing the greatest wetland loss. One of the first values of freshwater marshes observed was the marshes' importance as habitat for wildlife, particularly waterfowl. As wetlands across the nation were destroyed, populations of ducks and geese declined. By 1956, the U.S. Fish and Wildlife Service had developed a wetlands classification based on their value to wildlife and instituted programs to protect environmentally sensitive wetland areas.

Ecology

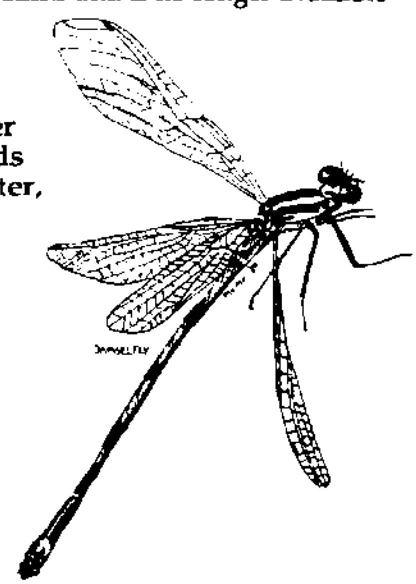
A freshwater marsh, unlike a swamp, is an area dominated by nonwoody, or herbaceous, plants. Often the vegetated areas are interspersed with patches of shallow water. Marshes may be flooded for all or only part of the year. However, they must be flooded enough to sustain vegetation that is adapted to living in water-logged conditions—plants like cattails, reeds, arrowhead, and pickerelweed. (See **Freshwater Marsh Poster**.)

Freshwater marsh communities include habitat for a variety of plants and animals adapted to live in wet conditions. A habitat provides the food, shelter, water, and space an organism needs to survive. For example, a sac-au-lait needs small insects to eat, submerged vegetation in which to hide from predators, water to live in, and enough room to have a territory. A freshwater marsh can provide habitat for sac-au-lait, bass, and many other fish species. Numerous birds, such as songbirds, wading birds, and waterfowl, nest and raise their broods among the vegetation. Many mammals, such as deer, muskrat and nutria, live in the marsh or visit to feed. The exact plant species composition of any particular marsh depends on many things, including geographic location, water chemistry, depth of water, duration of the flooding season, and climate.

Flood Control and Water Quality

At first, wetland preservation was focused on protecting wildlife habitat. Now people are discovering that wetland preservation can provide some alternative solutions to water supply problems. Flood control is a natural function of marshes. Their soils and vegetation act as natural "sponges" that have a tremendous ability to absorb and retain excess water. This storage capacity can save the adjacent area downstream from flood damage. In addition, the presence of wetlands along shores and riverbanks helps to protect those areas from erosion. Root systems of the plants hold soil that would otherwise be washed away.

Some of the excess flood water stored in marshes evaporates, while, some may be fed slowly into streams. Still more of the water may seep underground to recharge the water table. This recharge depends on the soil layers between the marsh and the groundwater. Where the soil is permeable (allows water to flow through spaces between the soil particles), water will seep through. This recharge is important, especially where groundwater is being pumped out to supply human needs such as in Baton Rouge. When marshes are destroyed or paved over, rainwater (instead of being held and slowly seeping into the groundwater supply) runs off into streams and is no longer available for use.



Besides helping to recharge the water supply, wetlands function as a filter, removing some pollution and sediment from the water. Because the wetlands slow and hold the water, sediment particles such as sand, silt, and clay can settle out. Excess nutrients in the water from agricultural run-off are broken down by bacteria and other microbes and absorbed by the marsh plants.

When wetlands areas are developed by draining, dredging, filling, or channelization, wastes are no longer purified by normal biological functions. This can result in pollution of the water supply. Some marshes can even process human waste as long as nutrient loads are not excessive and the contents are not too toxic. However, large amounts of pesticides or heavy metals would overload any ecosystem and threaten the health of the marsh.

Saltwater Marshes

Saltmarshes can be found in many coastal areas where the land meets the ocean. Coastal saltmarshes contain flat, soggy land riddled by small channels of water. During each tide, saltwater floods the channels and soaks into the soil. Organisms in these wetlands must adapt to the rigors of constant change. Temperature, salinity, moisture, and available oxygen fluctuate as the marsh is constantly flooded and drained.

While few species can tolerate these challenges, the plants and animals that have adapted can grow abundantly. Plants such as cordgrass and glasswort have special adaptations such as glands for eliminating excess salt. Animals have their special adaptations too. During low tide, fiddler crabs and clams burrow into sand and mud for shelter. Barnacles close their shells tightly to keep from drying out. (See **Saltmarsh Poster.**)

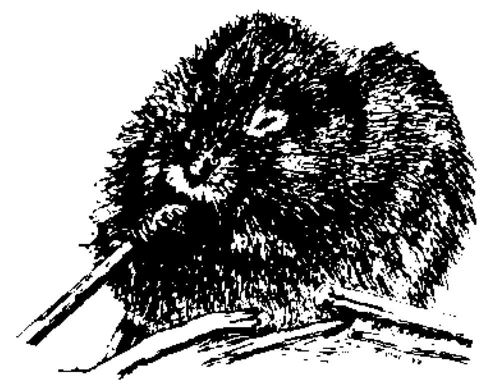
Salt marshes are among the world's most productive ecosystems. Marsh productivity begins as the sun's energy is captured by marsh plants. The plant roots hold the thick shiny mud of the salt marsh and this encourages the growth of other plants such as algae and phytoplankton. When the plants are eaten, the energy is transferred to other organisms. Animals that eat the plants in an ecosystem benefit from the energy and nutrients that are stored in the plants. In turn, these animals are eaten by wading birds such as the great blue heron, whose diet includes fish, crabs, and worms. As the plants and animals in the wetland die, bacteria growing in the mud act as decomposers, freeing nutrients and making them available once again for other plants, algae, and bacteria.

The Detrital Food Web

Marsh plants can also support abundant animal life. Only a few animals feed directly on living cordgrass. More often, the organic material in these plants is consumed after the plants die, when it is broken down into *detritus*. Detritus is plant material enriched with bacteria. Fiddler crabs, snails, insect larvae, bacteria, clams, and even some fish such as mullet and menhaden feed on the detritus. Tides carry some of the rich detritus from marshes into adjacent shallow oceanic areas where it enriches the productive bottom-dwelling communities that include oysters, clams, worms, mudworms, plankton, and fish.

Wildlife

Many birds and mammals find food and shelter in the saltmarsh. Muskrats and nutrias feed directly on the plants. Other animals, such as raccoons, otters, and minks come in search of crabs and mussels. Marshes also provide feeding and resting stops for migrating and wintering birds. Other nonmigrating birds nest in marshes where they eat insects, snails, crabs, and small fish and raise their young.



Saltmarshes provide temporary habitats for many creatures that live out most of their lives elsewhere. They function as nurseries for marine animals that inhabit offshore areas as adults. Young shrimp, redfish, speckled trout, menhaden, and flounder grow into adults in the saltmarsh. Striped bass may rest and acclimate there on the way to upstream spawning grounds, as do many of their juveniles on the way to the ocean. When the marsh is covered with water at hightide, fish and shrimp swim in looking for food. The movement of the tides transports eggs, larvae, and young animals from bays to salt marshes.

Augmenting the high productivity of the saltmarshes is a special condition called the "energy subsidy of the tides." Some animal species, instead of foraging for their food, are fed by the tides' ebb and flow. Filter-feeders, such as clams, oysters, and barnacles, siphon food from the water as every tide brings in a rich supply of detritus. These marsh organisms expend less energy to find food and thus have more energy available for growth and reproduction.

Conclusions

Because the wetlands are vital to wildlife and to human life, we should be prudent in our use and conservation of these valuable resources. These areas are blessed with an abundant beauty. Citizens can push for legislation to further protect the wetlands with laws to limit the creation of new canals and waterways. The best way to help curtail our rapid loss of marshlands is to divert the nutrient-rich rivers back into our marshes. Projects to do this are currently underway. Some existing canals can be closed and filled. Harsh penalties can be assessed for the illegal dumping of pollutants into waterways or for other actions that result in wetland destruction. Legislative bodies can encourage new technologies through economic incentives. These and other measures are necessary so that we may conserve our remaining wetlands.

GLOSSARY

Carnivore - A meat eater.

Consumer - Organisms that are not capable of producing their own food. They are dependent upon getting their energy from eating producers or other consumers.

Community - All the plants and animals in a particular ecosystem that are bound together by food chains and other interrelationships.

Detritivore - An organism that feeds on dead, decaying organisms.

Decomposer - Bacteria and fungi that convert dead organisms into organic materials.

Ecosystem - A natural unit that includes living and nonliving parts interacting to produce a stable system in which the exchange of materials between living and nonliving parts follows paths. All the living things and their environment in an area of any size linked together by energy and nutrient flow.

Energy - Ability to do work and cause changes.

Energy Flow - The flow of energy through an ecosystem.

Energy Pyramid - A diagram that illustrates the flow of energy through the trophic levels.

Food Chain - Transfer of food energy from plants through a series of animals.

Food Web - A combination of many food chains.

Herbivore - A plant eater.

Interdependence - The interrelationships of wildlife with one another and with the various elements of their environment.

Life Cycle - The developmental path an organism goes through from birth to adult.

Marsh - An environment where terrestrial and aquatic habitats overlap.

Omnivore - An animal that eats both plants and animals.

Photosynthesis - Process of plants by which sugars and carbohydrates are made from water and carbon dioxide using sunlight as an energy source.

Predator - An animal that kills and eats other animals.

Prey - Animals that are killed and eaten by other animals.

Primary Consumers- Animals that eat plants.

Primary Producers - Organisms that are able to manufacture food from simple organic substances.

Secondary Consumers - Animals that eat primary consumers.

Tertiary Consumers - Animals that eat secondary consumers.

Trophic level - Organisms that play a similar role in an ecosystem.

Marshes Everywhere

PURPOSE

The **Freshwater Marsh and Saltmarsh Poster** provides an opportunity for students to observe and identify the ecological components of any marsh. Marshes are a vital component of the life cycle for many species. This assignment can be done individually but we recommend that two or three students be assigned to a group for this activity.

PROCESS OBJECTIVES

Students will be able to improve their skills in observing, inferring, classifying, and recognizing various species by:

1. Identifying common inhabitants of both freshwater and saltwater marshes.
2. Illustrating the various trophic levels of a food chain.
3. Combining food chains to create a food web.
4. Comparing ecological relationships of varying species.
5. Illustrating how an economically important species such as shrimp fits into the ecosystem.
6. Discussing the flow of energy and matter through an ecosystem.

Concepts

Ecosystem, marsh, food web, community, energy production, energy flow, interrelationships, interdependence, primary producer, primary consumer, secondary consumer, tertiary consumer, decomposers, herbivore, carnivore, omnivore, life cycle, photosynthesis.

Curriculum Guide Reference

Life Science Curriculum Guide (1984): Bulletin 1614, obj. 13, 14a, 14b, 15, 26b, 31, 38, 40, 81, 82, 84c, 84e, 85,

METHOD

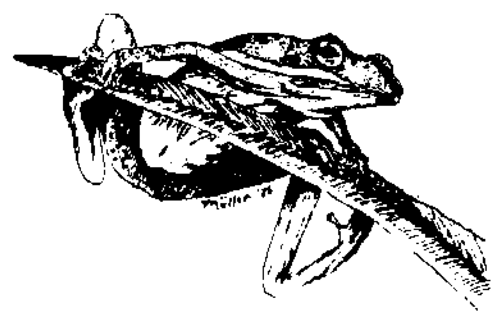
This activity is a cooperative learning exercise. The teacher can have a work station for groups of students to look at the **Freshwater Marsh/Saltmarsh Poster** or have the entire class look at the poster. The class size will determine the teacher's choice of arrangement for the exercise.

The poster and following questions will help direct the students attention to the complexity of life in wetlands. The students will be (a) identifying consumer types such as herbivores, carnivores, and omnivores, (b) exploring simple predator/prey relationships, and (c) constructing food chains as well as food webs using typical marsh organisms found in the poster.

The teacher should teach the background information (especially the **General Marsh Ecology** section) if the students are not familiar with the following concepts: predator, prey, herbivores, omnivores, carnivores, food chain, food web, trophic level, energy flow, energy pyramid, and decomposers.

MATERIALS

A Freshwater Marsh/Saltwater Marsh Poster



PROCEDURE

Follow the directions for both the freshwater marsh and the saltwater marsh sides of the poster.

1. List four predators and their prey.
2. Each student should create a simple food chain from the marsh scene with at least four trophic levels. You can include man in your food chain.
3. Identify all the different trophic levels in the food chain.

4. Identify which organisms are herbivores, omnivores, and carnivores in your food chain.
5. What role does the sun play in the food chain?
6. Draw an energy pyramid for your food chain.
7. Sketch a food chain, with man at the fourth trophic level, and another chain with man at the fourth trophic level. Use a pumpkinseed at the third trophic level in your freshwater marsh food chain. Use the flounder at the second level in your food chain for the saltmarsh.
8. With all the food chains each person in the group created, make a food web by connecting all the plants and animals you can from the food chains. Make sure you add the decomposers.
9. Which of the organisms may contribute to freshwater marsh loss? Can you think of any animals not shown in the poster that contribute to marsh loss in Louisiana? Explain.
10. How many reptiles are in the poster?
11. How many amphibians are in the poster?
12. Why are amphibians rare in saltmarshes when they are numerous in freshwater marshes?
13. How many different crustaceans can you locate? Explain what benefit there is to having a shell in a saltwater marsh?
14. Which associated species might be affected by the loss of mosquitos in a freshwater marsh? Which associated species might be affected by the loss of shrimp in the saltmarsh?
15. What would be the effect of the loss of producers?
16. How can over-harvesting of any of the species in the poster affect the food web? What would happen to the energy flow if certain species became extinct?

EVALUATION

Have each student draw a food web using as many of the organisms in the following list as he or she can connect. Have the students justify their connections.

a. crab	k. redwinged blackbird
b. small bass	l. frog
c. shrimp	m. heron
d. copepods	n. hawk
e. large perch	o. muskrat
f. crayfish	p. dragonfly
g. clams	q. deer fawn
h. raccoon	r. alligator
i. mosquito	s. crab
j. man	t. muskrat mound

Teacher's Answers to the Evaluation Questions

Freshwater Marsh

1. Student answers will vary.
Mink - Duck
Pickerel frog - damselfly
Mosquitofish - mosquito larvae
Freshwater mussel - scud
2. Student answers will vary.
Duckweed—mallard—mink—man
3. A food chain can include a primary producer, a primary consumer, a secondary consumer, and a tertiary consumer. Sometimes a student will find a quarternary consumer.
4. Student answers will vary.
Producers, herbivore, carnivore, and omnivore
5. The sun provides the needed energy for plants and animals to live.
6. Energy pyramids will vary depending on the types of food chains drawn.
7. Student answers will vary.
Duckweed—pumpkinseed—man
Duckweed—mosquito larvae —pumkinseed—man
8. Student answers will vary.
9. Muskrats contribute to freshwater marsh loss. In Louisiana, the nutria also contributes to marsh loss.
10. One.
11. Three
12. The salt in saltwater can dehydrate amphibians and their eggs.
13. Three.

14. Mosquito larvae are food for many fish such as the mosquitofish. When they become adults, mosquitos are food for many species of birds.

15. If the marsh lost all the producers, the food web would collapse. All animals would die.

16. While many species have alternative food sources, some species are specialized to one. Thus, these specialized species may die from an insufficient amount of energy and nutrients.

Saltmarsh

1. Student answers will vary.
   Laughing gull - minnows
   Redwinged blackbird - grasshopper
   Winter flounder - shrimp
   Barnacles - amphipods

2. Student answers will vary.
   Saltmarsh cordgrass detritus—shrimp—flounder—man

3. Student answers will vary.
   Producer—detritivore—carnivore—omnivore

4. A food chain can include a primary producer, a primary consumer, a secondary consumer, and a tertiary consumer. Sometimes a student will find a quarternary consumer.

5. The sun provides the needed energy for plants and animals to live.

6. Energy pyramids will vary depending on the types of food chains drawn.

7. Student answers will vary.
   This can't be done because flounders are carnivores and cannot eat plant material. Therefore, flounders cannot occupy the second trophic level reserved for primary consumers (such as herbivores or detritivores).

8. Student answers will vary.

9. Not applicable.

10. None.

11. None.

12. The salt in saltwater can dehydrate amphibians and their eggs.

13. Seven. A shell can protect the animal from predation and prevent excessive drying out during low tides.

14. Many fish, crab, and bird species depend on the shrimp as a food source.

15. While many species have alternative food sources, some species are specialized to one. Thus, these specialized species may die from an insufficient amount of energy and nutrients.

16. If the marsh lost all the producers, the food web would collapse. All animals would die.

EXTENSIONS

1. Students can be assigned to write a report on individual organisms, discussing their habitat, feeding habits, and any special adaptations.

2. Have students research predator-prey relationships. Is man a predator or a prey? Can the students think of any situation where man is a predator? What about a prey? Talk about the role of diseases in a food web.

3. Have students create their own marsh scenes using the cut-and-paste method.

4. Research the economic aspects of various species indigenous to Louisiana. Remember to find out how the over-harvesting or under-harvesting of a species would affect any ecosystem.

5. Discuss the importance of the role of the detritivores in the saltmarsh.

Fish For A Food Chain

PURPOSE

This game provides a fun method for developing a thorough understanding of food chains. In addition, students will have an opportunity to develop some food chains that are common in Louisiana salt- and freshwater marshes.

PROCESS OBJECTIVES

Students will be able to develop and improve their skills in observing, inferring, classifying, recognizing number relations, communicating, predicting, and decision-making by:

1. Identifying common organisms in a Louisiana freshwater marsh and saltmarsh.
2. Illustrating the various trophic levels of a food chain.
3. Combining trophic levels to form a food chain.
4. Discussing the flow of matter through an ecosystem.
5. Consolidating the food chains into food webs.

Concepts

Ecosystem, marsh, food chain, community, interrelationships, interdependence, trophic level, primary producer, primary consumer, secondary consumer, tertiary consumer, herbivore, carnivore, omnivore.

Curriculum Guide Reference

Life Science Curriculum Guide (1984): Bulletin 1614, obj. 13, 14a, 14b, 15, 26b, 31, 38, 40, 81, 82, 84c, 84e, 85,

METHOD

This activity is a card game that helps students learn to identify Louisiana food chains. Groups of three or four students will be able to develop believable food chains by drawing and discarding cards from a deck of 52 playing cards. Each playing card represents one trophic level within a food chain.

The first person with a believable hand consisting of a sun card, a primary producer card, a primary consumer card, a secondary consumer card, and a tertiary consumer card wins. An example of a believable freshwater marsh food chain is a sun card, a pickerelweed card, a mosquito card, a frog card, and a blue heron card. An unbelievable food chain may consist of a sun card, a pickerelweed card, a raccoon card, a frog card, and a blue heron card. This food chain is unbelievable because a frog would not eat a raccoon under any circumstances. While this is a clearcut example, it may be necessary to research a particular animal's food habits if a discrepancy arises.

At the teacher's discretion, the winner may be required to identify the types of consumers within the trophic levels in his food chain before an official winner can be named. For example, a primary consumer might be a herbivore or an omnivore. Clues are provided on the playing cards.

There are two different decks, one with plants and animals typical of a Louisiana saltmarsh, the other with plants and animals typical of a Louisiana freshwater marsh. Many of the plants and animals can be found within their appropriate habitats on the **Freshwater Marsh/Saltmarsh Poster**.

MATERIALS

There are two different decks of cards. One is for freshwater marshes, the other is for saltmarshes. In each deck, masters are provided to make 52 cards necessary for each group of three or four players. All the plant and animal sheets must be copied twice to create the deck of 52 cards. To avoid confusion, duplicate the two different decks of cards on differently colored paper. This will simplify separating the cards in case they get mixed together.

Make sure each deck consists of four suns, 16 producers, 14 primary consumers, 14 secondary consumers, and four tertiary level consumers. Cards can be duplicated, glued onto rectangle-shaped heavy stock paper, and laminated from the masters provided at the back of this activity.

PROCEDURE

1. The teacher reproduces the playing cards provided and glues them to rectangle-shaped heavy stock paper. Laminate them if possible. Make sure each group has all 52 playing cards containing the right proportion of trophic levels, for either freshwater marshes or saltmarshes.
2. A student deals out five cards to each player and himself and places the rest of the cards face down in the center.
3. The dealer then takes the top card from the deck. He must discard either the card picked up from the top of the deck or one from his hand and place it face up in the discard pile.
4. The next player can take the top card on the discard pile or a card from the top of the deck. He checks his hand and must discard one card.
5. The game continues until one person gets a hand consisting of five cards that would constitute a believable food chain. If a student declares a winning hand and the food chain is unbelievable, that student must wait out two turns before he can draw a card.
6. At the end of the game, have the students connect their food chains into a food web.

EVALUATION

1. Describe where man fits into a food web.
2. Have the students diagram a food web common to a Louisiana freshwater marsh and a saltmarsh.
3. Discuss the impact on a food web if man introduced a species that had no predators into an ecosystem.
4. What is the impact on a food chain if man over-harvests one species? What about in a food web?

Teacher's Answers to the Evaluation Questions

1. Humans are an intricate part of most wetland food webs. In a freshwater marsh, we harvest ducks, geese, rabbits, fish, mussels, fur-bearing animals, and turtles. In a saltmarsh, we harvest seafood such as crabs, oysters, shrimp, and mussels. Other species man harvests include waterfowl, fur-bearing animals, and fish such as flounder, redfish, and speckled trout.
2. Diagrams will vary from group to group.
3. Most introduced species do not survive, though some do. These species often have no predators and they quickly populate a new area. Native species can be crowded-out by the introduced species.
4. If man over-harvests one species in a food chain, then the higher trophic (or higher consumer) levels have no food. Without any food source, the transfer of energy and nutrients stops and those organisms die. However most animals are not dependent on a single food source. While over-harvesting of a species will put a strain on the food web, most species will switch to an alternative food source. However, if a species is specialized to feed on that one food source, then a part of the food web might be lost because of lack of food.

EXTENSIONS

1. Students can be assigned to write a one-page report on the prey of certain Louisiana predators.
2. Have the students connect common Louisiana food chains into a food web for a freshwater and saltwater marsh. Keep the growing food webs on a piece of poster board and add to them during the year as you talk about new Louisiana plants and animals.
3. Have students describe the predator-prey relationships within the food chains. What happens when a predator or prey is increased or decreased?
4. Have students research the extermination of some of Louisiana's top predators. Examples are the red wolf and the panther. Could we reintroduce these predators today? What happens to the balance of the food web with the loss of a species?
4. Give a real-life example of what happens to a food web when man upsets the balance by under-harvesting a species, over-harvesting a species, or introducing an exotic species.

Energy — Is There Enough To Go Around?

PURPOSE

Energy—Is There Enough To Go Around? is an activity aimed at developing a thorough understanding of energy flow and loss and the impact of energy movement in a food web.

PROCESS OBJECTIVES

Students will be able to develop or improve their skills in observing, inferring, classifying, recognizing number relations, recognizing space/time relationships, communicating, predicting, and decision-making by:

1. Illustrating the various trophic levels of a food chain.
2. Comparing ecological relationships of varying species.
3. Determining the extent of energy loss among organisms within a food chain.
4. Providing an example of energy loss among organisms within a food chain.
5. Comparing the stability of a food web with the stability of a food chain.
6. Discussing the impact of altering the balance of a food chain or a food web.

Concepts

Ecosystem, marsh, food chain, energy production, energy flow, interrelationships, interdependence, trophic level, primary producer, primary consumer, secondary consumer, tertiary consumer, photosynthesis

Curriculum Guide Reference

Life Science Curriculum Guide (1984): Bulletin 1614, obj. 13, 14a, 14b, 15, 26b, 31, 38, 40, 81, 82, 84c, 84e, 85,

METHOD

Using jellybean models, students will mathematically determine the loss of energy through a simplified food chain.

MATERIALS

One hundred jellybeans for the first demonstration that involves four students (10 more jellybeans for any additional demonstrations), four large paper cups, a knife

PROCEDURE

1. Hold up a jar of 100 jellybeans. Explain to the students that the 100 jellybeans represent 100 units of energy from the sun that is photysynthesized by plants. Tell your students to imagine that each jellybean (energy unit) is energy available for plants and animals to live and reproduce. Have them visualize that 90 percent (or 900 jellybeans) of the sun's energy that reaches the earth is never utilized by plants. For a more detailed account refer to **General Marsh Ecology** in the unit's background information.
2. Four students each receive a paper cup and decide who will represent phytoplankton (single-celled plants), zooplankton (single-celled animals), a minnow, and a flounder.
3. Count 100 jellybeans and put them in the phytoplankton's cup. That is the amount of energy the phytoplankton photosynthesized from 100 units of energy from sunlight reaching the earth.
4. The phytoplankton may consume 90 of the 100 jellybeans photosynthesized. (If the teacher desires, the students do not have to eat the jellybeans.) This represents the energy burned up in tissue maintenance (plants release carbon dioxide as a waste product into the air during respiration), growth, and reproduction. The 10 jellybeans left over represent the energy that is stored in the plant's tissue from the original 100 units of the sun's energy that the phytoplankton photosynthesized. That energy is available for any consumer.
5. The zooplankton eats the phytoplankton and receives the 10 units of energy (10 jelly beans). The zooplankton may consume nine units of energy. As in plants, the nine units of energy (nine jellybeans) are burned up in

growth, tissue maintenance (animals release carbon dioxides as a waste product into the air during respiration), or reproduction. The remaining one energy unit is stored as fat or in body tissue. This is the energy available for any higher level consumer.

6. The minnow eats the zooplankton and receives the one jellybean. With the knife, divide it into 10 parts. The minnow may consume nine of those parts. The other tiny part of jellybean (one-tenth) left is the amount of energy available for any higher level consumer.
7. The flounder eats the minnow and gets the one-tenth of a jellybean. The model started out with 100 units of sun and the flounder received one-tenth of an energy unit.

EVALUATION

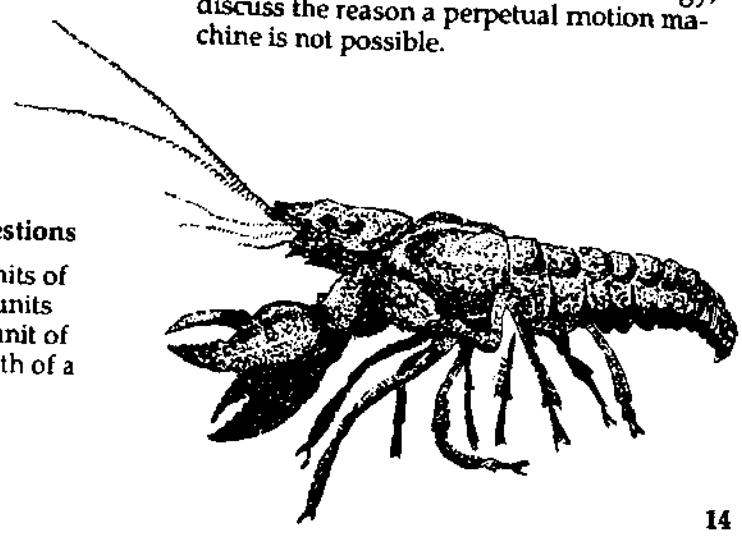
1. How many of the 100 energy units that the plants photosynthesized did each organism in the food chain receive?
2. What happened to the remainder of the energy from the level before?
3. How much of the original 100 units of energy that the plants photosynthesized from the sun would reach man if he caught and ate the flounder?
4. How much more energy would the minnow receive if it directly ate the phytoplankton?
5. If a human wanted to be energy efficient what part of the food chain should he eat?
6. What happens in a food chain if the phytoplankton dies?
7. What happens in a food chain if the flounder dies?
8. Why do biologists show energy loss in the shape of a pyramid?
9. Why is "energy loss" important to know about if we want to help feed the world's human ever-growing human population?

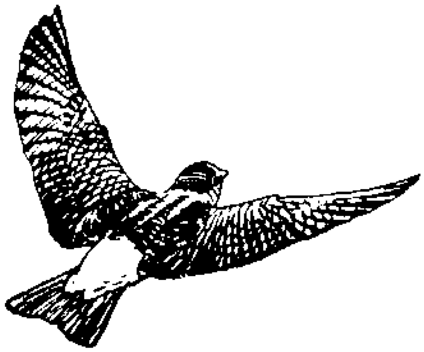
Teacher's Answers to the Evaluation Questions

1. The phytoplankton received the 100 units of energy. The zooplankton received 10 units of energy. The minnow received one unit of energy. The flounder received one-tenth of a unit of energy.
2. The energy was used in tissue maintenance, growth, and reproduction.
3. The man would receive one-hundredth of a unit of energy.
4. The minnow would receive 10 times more energy.
5. Humans should eat the phytoplankton.
6. All the organisms along the food chain will die eventually if the phytoplankton dies.
7. If the flounder dies, the organisms below on the food chain will still survive.
8. Because energy at each trophic level is lost through tissue maintenance, growth, and reproduction, there is less and less energy available for the next level of the food chain.
9. Even if all humans became vegetarians (herbivores), the world could still only support as many people as there was food. There is a limit to the number of people that can survive on this planet.

EXTENSIONS

1. What happens to the flow of energy to speckled trout if man overharvests the shrimp population?
2. What happens to the flow of energy if man introduces an exotic plant such as water hyacinth into the food web? Water hyacinths are not eaten by herbivores.
3. Discuss man's need for energy to do work. What kinds of energy are humans running out of today? Talk about the advantages and disadvantages of solar energy to run a city.
4. In the past, scientists were trying to build a perpetual motion machine. Applying what you have learned about the flow of energy, discuss the reason a perpetual motion machine is not possible.



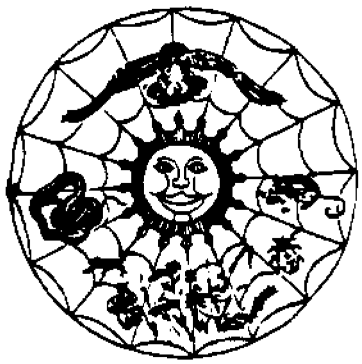


Swallow

Swallows eat mosquitos.

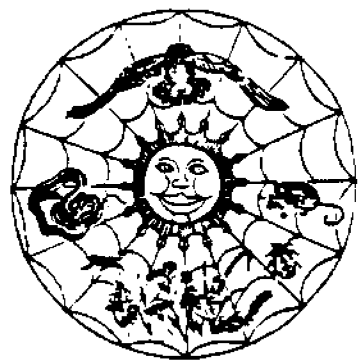
Alligator

Alligators eat raccoons, pickerel, and small snapping turtles.



Sun

The beginning of the food chain.

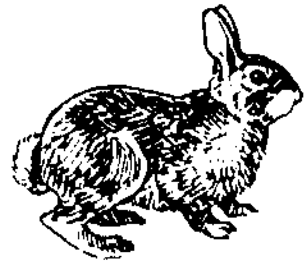


Sun

The beginning of the food chain.

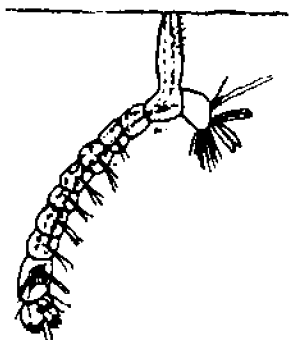
Mussel

Mussels eat phytoplankton and detritus (dead plant material).



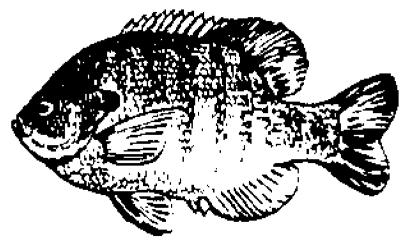
Rabbit

Rabbits eat live plant material.



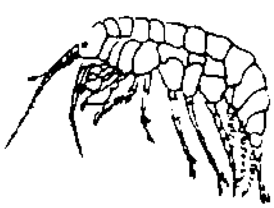
Mosquito larvae

Mosquito larvae eat phytoplankton and detritus (dead plant material).



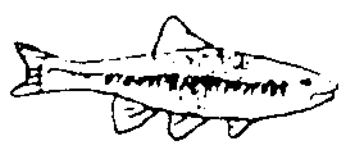
Blue Gill

Blue gills eat insect larvae.



Scud

Scuds eat copepods and ostracods.



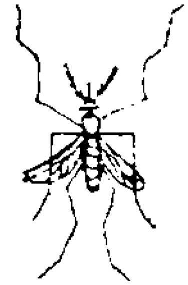
Mosquitofish

Mosquitofish eat mosquito larvae and scuds.

FRESH

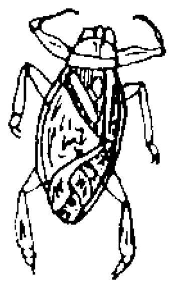
Raccoon

Raccoons eat small painted turtles, mussels, and baby rabbits.



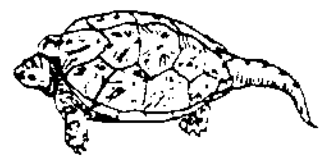
Mosquito

Female mosquitos feed on the blood of rabbits, muskrats, and raccoons.



Giant Water Bug

Giant water bugs eat small minnows.

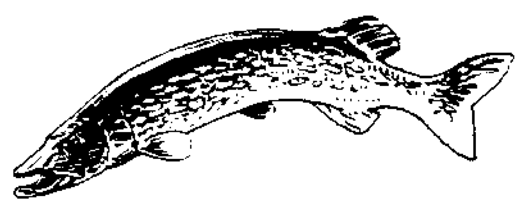


Snapping Turtle

Snapping turtles eat small minnows, baby muskrats, and small painted turtles.

Marsh Hawk

Marsh hawks eat muskrats, rabbits, and raccoons.



Pickerel

Pickerel eat giant water bugs, sac-au-lait, and mosquitofish.

Cattail

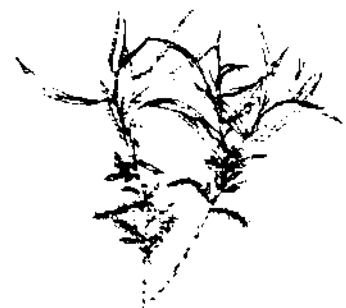
Cattails roots are eaten by muskrats and nutrias.

Millet

Millet seeds are choice duck and geese food.

Bulltongue

Bulltongue contributes to the detrital food chain. It is eaten by zooplankton, insect larvae, and mussels.

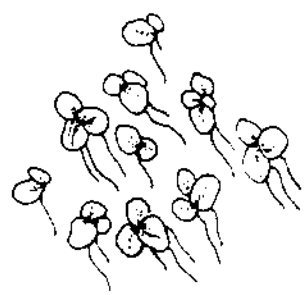


Willow

The leaves are eaten by deer.

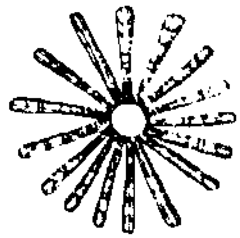
Pickerelweed

Pickerelweed roots are eaten by nutrias and muskrats. The seeds are eaten by ducks and geese.



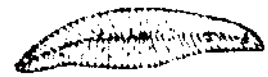
Duckweed

Duckweed is eaten by ducks.



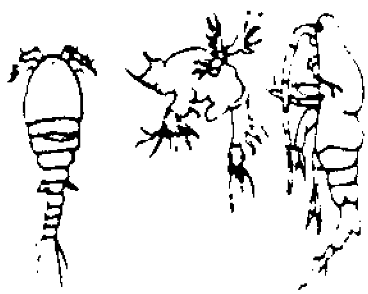
Algae

Algae are eaten by zooplankton, insect larvae, and mussels.



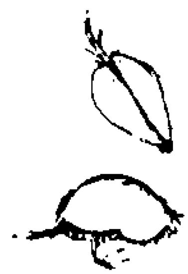
Phytoplankton

Phytoplankton is eaten by zooplankton, insect larvae, and mussels



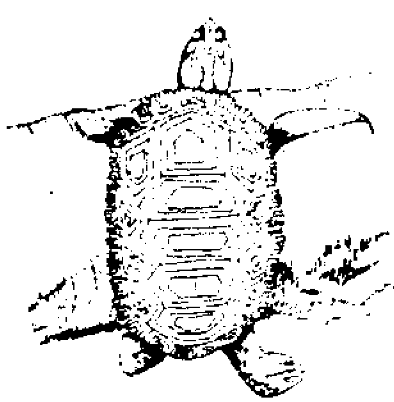
Copepod

Copepods eat algae and phytoplankton



Ostracod

Ostracods eat algae and phytoplankton.



Painted turtle

Painted turtles eat plant material.

Muskrat

Muskrats eat cattails and pickerel weed

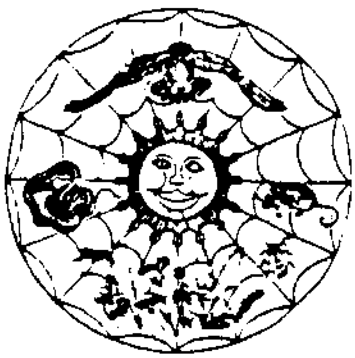
FRESH

Sea Otter

Sea otters eat any type of fish, crabs, mussels, and oysters.

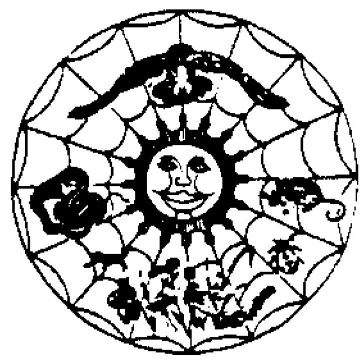
Seagull

Seagulls eat crabs, menhaden, killifish, and silversides.



Sun

The beginning of the food chain.



Sun

The beginning of the food chain.

Snowy egret

Snowy egrets eat any small fish

Raccoon

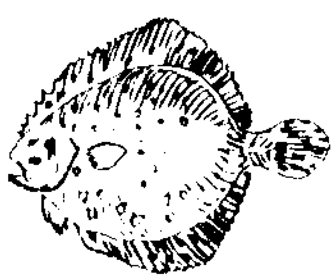
Raccoons can eat mussels, grasshoppers, and blue crabs

Silverside

Silversides eat zooplankton

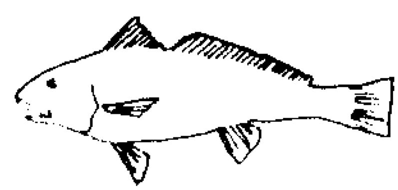
Ghost Crab

Ghost crabs eat mussels and oysters



Flounder

Flounders eat silversides, menhaden, and killifish.



Speckled Trout

Speckled trout eat silversides, menhaden, and killifish.

SALT

Shrimp

Shrimp eat detritus (dead plant material)

Menhaden

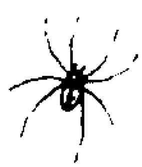
Menhaden eat phytoplankton and algae.

Mussels

Mussels eat phytoplankton, algae, and detritus (dead plant material).

Brown Pelican

Brown pelicans eat fish such as shad and menhaden.



Predatory Spider

Predatory spiders eat grashoppers.

Oyster Drill

Oyster drills eat oysters.

Needlegrass

Needlegrass is part of the detrital food web. It is eaten by sea cucumbers, periwinkles, mussels, clams, and shrimp.

Saltmarsh Bulrush

Saltmarsh bulrush is part of the detrital food web. It is eaten by menhaden, shad, mullet, and clams.

Zooplankton

Zooplankton eat phytoplankton.

Grasshopper

Grasshoppers eat live plant material.

Shad

Shad eat phytoplankton and algae.

Polychaete

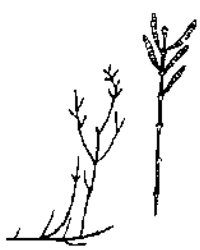
Polychaetes eat detritus (dead plant material).

Smooth Cordgrass

Smooth cordgrass is a part of the detrital food chain in a saltmarsh. It is eaten by blue crabs, shrimp, mole crabs, coquinas, polychaetes, and snails.

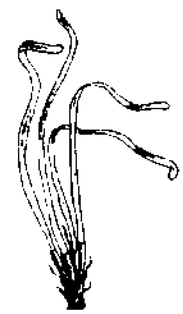
Wiregrass

Wiregrass is part of the detrital food web. It is eaten by menhaden, mullet, and shrimp.



Glasswort

Glasswort is part of the detrital food chain. It is eaten by oysters, crabs, coquinas, mussels, polychaetes, snails, and clams.

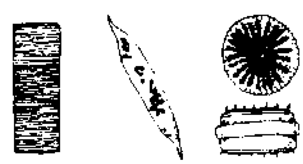


Seagrass

Seagrass is part of the detrital food web. It is eaten by periwinkles, sand dollars, and zooplankton.

Salt Grass

Salt grass is part of the detrital food chain in a saltmarsh. It is eaten by sand dollars, snails, sea cucumbers, and mussels.



Phytoplankton

Single-celled plants that live in the water. They are eaten by menhaden, mussels, and barnacles.

This public document was published at a total cost of $3,594.37. Three thousand five hundred copies of this document were published in this printing at a cost of $3,594.37. This document was published by State Printing Office, P.O. Box 94095, Baton Rouge, LA 70898-9095, to provide information on fisheries habitat in Louisiana. This material was printed in accordance with the standards for printing by state agencies pursuant to R.S. 43:31.