Secrets of the Salt Marsh

Study Guide

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Contents

What are Wetlands?

The word wetland is used to describe areas where the soil is saturated or covered by water for some part of the year. Wetland soils, because they are always wet, lack oxygen. Plants that grow in wetlands must be able to cope with the stresses of flooding and the oxygen poor soils. Wetland plants, or **hydrophytes**, are adapted for life in these wet, oxygen poor soils. Relatively few kinds of plants can live in wetlands. There are many different types of wetlands. They occur in both fresh and saltwater. Each can be identified by its dominant or common plants.

A bog is a wetland with small shrubs and stunted trees, often growing on a thick mat of moss. Bog water is very acidic and poor in nutrients that plants need to grow. Some bog plants, like sundews and pitcher plants trap and "eat" insects to get the nutrients they need. Most bogs are found in areas that were covered with ice during the last ice age.

A swamp is a wetland with trees. In the shade of the tall trees grow smaller trees, shrubs, vines and other non-woody plants. Swamps are found in both the north and south. They occur in low-lying wet areas and along slow-moving rivers. Mangrove swamps which are found in the United States only in southern Florida are found along estuaries and sheltered seashores.

Marshes are wetlands with grasses, sedges, rushes and other non-woody plants. Trees and shrubs are not found in a marsh. Like

swamps, marshes are found in many locations. They occur along the shallow edges of lakes and ponds, along slow-moving rivers in both fresh and salt water.

Salt marshes are found along the Atlantic coast from Canada to central Florida. and along the Pacific coast. North of New Jersey and along the Pacific coast salt marshes are relatively small and are found in sheltered bays and coves. From New Jersey south to Cape Canaveral, Florida, salt marshes form a nearly continuous band. Along this section of the Atlantic coast are a series of narrow, sandy islands called **barrier islands**. South of Cape Canaveral salt marshes are replaced by **sub-tropical** mangrove swamps. On the ocean side of the barrier islands turbulent, sometimes violent surf creates constantly shifting and changing beaches. In direct contrast to the beach front, the waters behind the islands are calm. In these calm shallow waters marshes developed and grew.

Formation of a Salt Marsh

Twenty thousand years ago ocean levels were about 400 feet lower than they are today. Most of the ocean's water was frozen in the glaciers that covered much of North America. The coastline then was about seventy miles east of where it is today. The climate changed and the glaciers began to melt, around 15,000 years ago, and sea levels began to rise. Between 3,000 and 5,000 years ago sea level rise slowed to about a few feet a century. The salt marshes that we see today began to develop.

Along the shallow Atlantic coast ridges of sand became long, narrow islands as surrounding areas were submerged by the rising sea. As sea level rose, these islands, through the action of wind and waves, migrated along with the receding mainland shoreline These barrier islands protect the mainland from the destructive forces of the ocean. In the calm, protected waters behind the islands mud and silt dropped to the bottom and developed into mud flats that were exposed at low tide. Grasses able to withstand inundation in sea water became established on these flats. Seeds or sections of root may have been carried from another marsh by the tide. Seeds may also have been carried onto the flat on the feet of migrating birds.

Once rooted the grasses spread by underground stems called rhizomes. As marsh grasses spread they catch sediments, building up the level of the marsh. As the marsh developed, tidal currents scoured channels creating meandering marsh creeks.

Zonation in a Salt Marsh

Through the centuries the marshes have grown not only in area but also in elevation. Look closely and you will notice a series of zones each dominated by a different **community** of plants and animals. The zones mark very subtle changes in elevation. Relatively few species of plants can grow in salt water environments.

On upland areas next to the marsh grow plants that can tolerate occasional flooding by sea water during floods and the salt spray that is carried off the marsh by the wind. Red cedar, bayberry, groundsel tree and poison ivy are common trees and shrubs found along the marsh edge. Bayberry has small leaves tapered at each end. In the fall it is covered with small, blue-gray, waxy berries which are a favorite food of many migrating birds and were once used to make candles. Groundsel has leaves that are tapered at one end and fat at the other. In the fall groundsel's fluffy, cream-colored flowers bloom. Other plants that grow in this area are wildflowers such as yarrow, Queen-Anne's-lace and seaside goldenrod. Phragmites, a tall, fast growing reed, not able to tolerate frequent inundation by salt water also grows along this upland edge.

High Marsh

The plants in the high marsh are inundated only for a few days each month during especially high tides called **spring tides**. This zone is dominated by marsh elder, a small shrub and two grasses, Spartina patens, or saltmeadow hay and salt grass. They may occur in pure or mixed stands. Saltmeadow hay is a fine, wiry grass usually no more than two feet tall. The weak leaves usually are bent by the wind into swirling mats called **cowlicks**. Dead grass from previous years collects beneath this mat. Small salt marsh snails feed among the dead grass. Several species of insects may be found feeding on the grass. They are preyed upon by a variety of spiders. Saltmeadow hay may be found in pure stands or with another short grass called salt grass. Salt grass has coarser leaves that grow from the stem at a pronounced angle. Salt grass is coarser, with leaves projecting from the main stalk at a pronounced angle. Sea lavender also grows in this zone. It has a few spoon shaped leaves that grow close to the ground. During the summer a thin, branching, wiry, green stalk grows up from the leaves. In late summer the stalk is abloom with many tiny purple flowers. The stalks remain standing well after they die and are conspicuous in the winter marsh.

Low Marsh

As the ground slopes lower it is inundated for varying periods of each high tide. This zone is called the low marsh. Dominated by salt marsh cordgrass, Spartina alterniflora, it appears as a monotonous expanse of grass. Cordgrass is coarser than the high marsh grasses with long 1/4 to 1/2 inch wide leaves. Most of the low marsh is covered by a short form of cordgrass, usually less than two feet tall. Where a marsh creek cuts through the low marsh, roots are inundated for most of each day. This results in conditions that are ideal for cordgrass growth. Here a narrow band of cordgrass four to six feet tall is found. Salt marsh periwinkles live on the blades of tall cordgrass. They feed on the algae which coats the grass. They move up and down the blades above the tide level to avoid predation by fish, crabs and diamondback terrapins. Grasshoppers, leafhoppers and a few other insects feed directly on the plants of the low marsh.

Cordgrass is a **perennial**. Its roots and **rhizomes** live year after year. However, the leaves and flower stalk die each fall. In the winter, wind, ice and tides break off the dead part of the plant. The dead grass is decomposed by bacteria and fungi and slowly breaks down into smaller and smaller pieces. This mixture of dead plant material and the organisms decomposing it is called **detritus**. Many organisms in the marsh ingest this detritus and digest the **decomposers**. The plant material is returned to the marsh undigested. It is repeatedly recolonized by decomposers and ingested by other organisms until eventually the decomposers break it all the way down to its component compounds. Detritus is an important part of the salt marsh **food web**. Various species of worms, mollusks, crabs and fish feed on detritus. An acre of salt marsh may produce up to 10 tons of grass each year. While much of the detritus produced remains in the marsh large amounts may be transported by tides to nourish nearby ocean waters. This detritus contributes immensely to the productivity of coastal ocean waters.

Shallow depressions that hold water after each high tide can be found in the high marsh. As the water evaporates the mud becomes too salty to support most marsh plants. Salicornia (also known as saltwort or pickleweed), a very hardy plant, is able to grow in these salty depressions. In late fall Salicornia turns bright red, adding a brilliant touch of color to the low marsh.

Marsh creeks meander through the low marsh. Along creek banks green sea lettuce and rockweed, a species of brown algae, grows. Rockweed grows attached to the stems and roots of cordgrass and to the hard shells of ribbed mussels. The mussels grow burrowed into marsh banks anchored with special threads to cordgrass rhizomes and roots. The banks of marsh creeks are pockmarked with the burrows of fiddler crabs. During low tide when the banks are exposed these crabs can often be seen scurrying across the mud. Males can be identified by the one enormous claw. Females have two very small claws. The small claws are used to scrape up mud from which the detritus is removed and ingested. The sand that remains is regurgitated as small balls that are often seen in piles near burrow entrances. The male's large claw is not used for feeding but in ritualized territorial and courtship displays. When the tide rises the crabs retreat to their burrows to escape predators

Marsh creeks are inhabited by many species of fish and other marine organisms. Diamondback terrapins are the only reptile that live in the salt marsh. They spend most of their lives in marsh creeks and bays. They may occasionally haul out on a bank to bask. Females emerge each spring to lay eggs in a shallow nest excavated in a nearby upland area above the reach of the tide.

The low marsh is dotted with many ponds of various sizes called salt **pannes**. They may be only a few inches to three or four feet deep. Pannes almost always have water in them, even when marsh creeks may be empty at low tide. They are filled with sea water twice each month by especially high tides called spring tides. In the summer the water in very shallow pannes may evaporate. The water evaporates but the salt is left behind. Pannes that do not dry completely are populated by mummichogs, sheepshead minnows, grass shrimp, crabs and other small organisms. Widgeon grass, an underwater plant, may grow in the deeper pannes.

Salt pannes are important feeding sites for several species of birds. During the summer herons, egrets, gulls and terns feed in mixed groups of up to several hundred birds in shallow pannes. Each day these **aggregations** must find new pannes in which to feed because they simply eat all of the fish. However, pannes are repopulated by fish on each spring tide. In the winter, waterfowl will feed on the animals and plants found in the pannes.

Animals in the Marsh

Many animals can be found in the marsh. While some of the animals live in the marsh all the time others may be just visiting the marsh in search of food. Many marsh animals are very small, live in the mud or are only found underwater. The most obvious animals are birds. A few kinds of birds nest right in the marsh. Ospreys used to make their large stick and grass nests in dead trees on the barrier islands. Today, Ospreys nest mostly on platforms placed in the marsh especially for them. Laughing Gulls, terns, and Willets all make nests of grass on the marsh surface. When you get close to their nests these birds usually let you know by scolding you, swooping at your head and sometimes even going to the bathroom at you. Other marsh nesting birds like Clapper Rails and Seaside Sparrows are very secretive and usually stay hidden or creep away when danger is near. Red-winged Blackbirds and Boat-tailed Grackles nest in the trees along the edge of the marsh.

Herons, egrets and Glossy Ibises come to the marsh to feed on fish, shrimp and crabs. They nest in groups, called colonies, in trees on islands formed by dredge spoil in the marsh or on the nearby barrier islands. Usually they are seen fishing alone or in small groups. But on early summer mornings groups of hundreds of these birds may feed together in a marsh panne. They often eat all of the fish in the panne.

In the spring and fall many birds stop in the marsh during migration to feed and rest. Many kinds of **shorebirds** rest on the marsh at high tide and hunt for worms and other small animals in the exposed mud of marsh creeks at low tide. In late summer and fall huge flocks of ravenous tree swallows descend on bayberry trees to feed on the multitude of berries. Ducks and geese also stop in the marsh during migration. Brant, Buffleheads and Red-breasted Mergansers stay for the whole winter.

A few mammals also live or feed in the salt marsh. However, they are active mostly at night. Only tracks on marsh mud reveal the presence of raccoons and voles. Like these mammals most marsh animals are hard to see, but they are there. Look beneath the cowlicks of saltmeadow hay and you may find tiny salt marsh snails. They feed on algae and bits of dead plants and animals, called detritus, on the mud and grass stems. Periwinkle snails also feed on algae and detritus and are found on the stems of tall cordgrass.

If you look at the surface of the marsh mud you may see small holes. These are the homes of another detritus eater, the fiddler crab. They get their name because the male has one very large claw that it holds under its head like a fiddle. Females have two small claws. They are shy creatures and run to their holes when they feel the vibrations of foot steps. Purple marsh crabs may also be found on the mud with fiddler crabs. They are only found near the edges of marsh creeks where they dig larger holes than fiddlers. Mud crabs, spider crabs, lady crabs and blue crabs live beneath the water's surface and cannot come up on land. Lady crabs and blue crabs are predators of fish and other small creatures. Spider and mud crabs are scavengers and also eat barnacles and mussels. The horseshoe crab also lives in marsh creeks but is not really a crab. They are more closely related to spiders and scorpions. In the winter only mud, spider and rock crabs are found in the marsh. The others move out to sea, bury in the mud until spring, or stay in their burrows.

Marsh creeks are also home to many kinds of fish. The most abundant are several kinds of minnows. Mummichogs and sheepshead minnows are everywhere. They are especially abundant in small creeks and pannes. Silverside minnows travel in large schools and are the favorite food of small "snapper" blue fish and other fish as well as fish eating birds. Resting on the bottom, waiting for an unwary fish to swim nearby, is the summer flounder. It actually lays on its side, not on its stomach. One eye migrates from one side of its head to the other as it grows. As an adult it has both eyes on the right side of its body. Clinging by their tails to submerged marsh grass stems and seaweeds are seahorses. They slurp up small shrimp with their tube-like mouth. Sharks may also come into the marsh. The smooth dogfish is a small shark that lives in the marsh in the summer. It feeds on crabs and other marsh animals.

Only one kind of reptile lives in the salt marsh. The diamondback terrapin is a turtle. Terrapins spend most of their time in the water feeding on fiddler crabs, shrimp, snails, and dead fish. In the late spring and early summer females come out of the marsh to lay their eggs in nearby upland areas. The female lays eight to ten eggs in a shallow hole. She then covers the nest and returns to the marsh, leaving her babies to fend for themselves. The eggs hatch in about 60 days and the young turtles make their way to the marsh. Some nests are dug up and the eggs eaten by raccoons. Baby turtles may be eaten by raccoons, fish and birds. However, some will grow to be adults and have young of their own.

What Value, Wetlands?

Wetlands are incredibly important **ecosystems**. Many species of plants and animals spend their entire lives in wetlands. Many others find food in wetlands, use them as nesting or nursery grounds or stop in them to rest during migration. Wetlands also help to maintain water quality. Marsh grasses slow run-off and allow sediments to fall out of **suspension**. Marsh plants remove excess **nutrients** and marsh mud can remove toxic **heavy metals** from the water.

Wetlands are also important to humans. Wetlands can control floods and reduce erosion during storms. Coastal wetlands protect the mainland from the destructive power of storm waves. The impact of wetlands on commercial fisheries should be obvious. Almost seventy percent of commercially important fish and shellfish depend on wetlands during some stage of their life-cycle. In New Jersey alone the commercial fishery is worth hundreds of millions of dollars each year. Wetlands also provide valuable open space for recreational activities including hunting, fishing, boating, canoeing, bird watching and hiking.

While the values of wetlands are well known, large areas of wetlands are destroyed each year. At least fifty percent of the wetlands in the continental United States have already been destroyed. Wetlands are still being drained, filled, converted to farmland, built upon and "improved" at an alarming rate. It is estimated that almost 1,000 acres of wetlands are lost every day. Only through universal understanding and appreciation of these beautiful and valuable natural areas can we hope to save the precious wetlands that remain.

Look Who's Coming to Dinner

activity for grades 3 - 6

What role do people and wetlands play in the food chain? People are consumers of a variety of foods, some of which are products of wetlands. In this activity your students will discover their place in the **food web**, investigate where their food comes from, and draw conclusions about their personal connection to a wetland ecosystem.

Procedure:

1. Have your students keep a list of everything they eat in two or three days.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. Now examine the list of foods for products that may have come from a wetland ecosystem. Shellfish and finfish will be the most obvious, but don't forget freshwater wetland products such as rice.

4 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 or shrimp eat.

5. 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? Are people part of wetlands 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? After your students have researched the origins of their foods have them report their findings to the class.

2. Many of the foods that people eat come from domesticated plants and animals grown or raised on farms. But where did these plants and animals originally come from? Have your students research the wild origins of some common animals, fruits and vegetables?

Keying Into Wetlands

activity for grades 7 -12

When scientists want to identify something they have never seen before they often use a key. In this activity your students will try to identify wetlands using data cards and the following key. On each card is a description of a wetland. The job of your students is to use the key to identify what type of wetland each card represents.

Procedure

A key is fairly simple to use. Each student or group of students should get a data card. Have your students read the cards. To start, go to number one on the key. Read the two statements found at number one and chose the one that best applies to the data card. After each statement is a number or the name of a wetland. If the correct statement is followed by a number go to that number. Repeat this process until they come to a statement followed by a type of wetland. Have your students write the name of their wetland in the space provided on the data card. Use the following answer key to determine if they correctly identified their wetland. If they incorrectly identified a wetland have them try again. If time allows you may wish to have your students identify the wetland on several cards.

Answers

A. Low Salt Marsh
B. Northern Shrub Bog
C. Saw Grass Prairie
D. Aquatic Bed
E. Fresh Tidal Marsh
F. Freshwater Marsh
G. Dune Shrub Wetland
H. Cypress Swamp
I. Peat Bog
J. Mangrove Swamp
K. Tamarack Swamp
L. Southern Hardwood Swamp
M. Non-Persistent Fresh Tidal Marsh
N. High Marsh
O. Estuarine Scrub-Shrub Wetland
P. Cedar Swamp
Q. Southern Shrub Bog
R. Spruce Swamp
S. Non-Persistent Fresh Marsh
T. Northern Hardwood Swamp

Keying Into Wetlands

1. Water salinity is 0.5 ppt or higher.....2
   Water salinity is less than 0.5 ppt.....5

2. Dominant plants are trees or shrubs.....3
   Dominant plants not trees or shrubs.....4

3. Mangroves are dominant plants.....**Mangrove Swamp**
   Marsh elder dominant plant....**Estuarine Scrub-Shrub Wetland**

4. Regularly flooded by tide.....**Low Salt Marsh**
   Irregularly flooded by tide.....**High Salt Marsh**

5. Water is influenced by the tide.....6
   Water is not influenced by the tide.....7

6. Dominant plants only stand above the water during
   the growing season.....**Non-Persistent Fresh Tidal Marsh**
   Dominant plants remain standing throughout
   the year even after they die in winter.....**Fresh Tidal Marsh**

7. Plants are submerged or floating.....**Aquatic Bed Plants**
   Plants are emergent.....8

8. Dominant plant is moss.....**Peat Bog**
   Dominant plant is not moss.....9

9. Plants are trees or shrubs.....10
   Plants are not trees or shrubs.....18

10. Plants are shrubs.....11
    Plants are trees.....13

11. Labrador tea and black spruce are dominant...
.....**Northern Shrub Bog**
Labrador tea and black spruce are not present.....12

12. Leatherleaf is dominant shrub.....**Southern Shrub Bog**
Bayberry is dominant shrub.....**Dune Shrub Wetland**

13. Needle-leafed trees are dominant.....14
Broad-leaved trees are dominant.....17

14. Trees are deciduous.....15
Trees are evergreen.....16

15. Tamarack is dominant tree.....**Tamarack Swamp**
Bald cypress is dominant tree .....**Cypress Swamp**

16. Black spruce is dominant tree.....**Spruce Swamp**
White cedar is dominant tree.....**Cedar Swamp**

17. Red maple is dominant tree.....**Northern Hardwood Swamp**
Sweet gum and tulip are dominant trees...
.....**Southern Hardwood Swamp**

18. Dominant plants only stand above the water
during the growing season.....**Non-Persistent Fresh Marsh**
Dominant plants remain standing throughout the
year even after they die in winter.....19

19. Saw grass is dominant plant.....**Sawgrass Prairie**
Dominant plant is not saw grass.....**Freshwater Marsh**

A. Salt water floods this wetland every day. The dominant plant is smooth cordgrass.

_____

B. Standing fresh water is not always present. Dominant plants are the shrub Labrador tea and stunted shrub-like spruce trees.

_____

C. Fresh water may cover this wetland only during the summer and late fall during the rainy season. The dominant plant saw grass grows year round.

_____

D. This wetland occurs along the edges of non-tidal rivers, lakes and ponds. It is dominated by plants that grow completely under water or have leaves and flowers that float on the surface.

_____

E. This freshwater wetland occurs along rivers influenced by tides. Cattails and other dominant plants remain standing all year.

_____

F. The plants in this non-tidal, freshwater wetland, dominated by grasses, rushes and sedges, remain standing year-round.

_____

G. This non-tidal freshwater wetland occurs only in low areas between coastal dunes. The shrub bayberry is the dominant plant.

_____

H. Bald cypress, a large deciduous needle-leafed tree is the dominant plant in this freshwater wetland.

_____

I. This non-tidal freshwater wetland is only found in the far north. Only a few species of moss and lichen can live on its acidic soil.

_____

J. This saltwater wetland only occurs in the U.S. in southern Florida. The dominant plants are salt tolerant mangrove trees.

_____

K. The dominant plant of this northern freshwater wetland is tamarack, a deciduous needle-leafed tree.

_____

L. Fresh water may cover the ground in this wetland only part of the year. It is dominated by broad-leaved trees like sweet gum, bay and tulip trees.

_____

M. This freshwater wetland is influenced by tides. Wild rice and pickerelweed, the dominant plants, decompose quickly after they die and are only found during the growing season.

_____

N. The dominant plants in this saltwater wetland are saltmeadow hay and salt grass. They are only flooded for short periods each month.

_____

O. This saltwater wetland is dominated by the shrub marsh elder. It is only flooded by occasional storm tides.

_____

P. This non-tidal fresh wetland is dominated by white cedar, a needle-leafed evergreen tree.

_____

Q. This non-tidal freshwater wetland, not found north of southern New Jersey is dominated by the shrub leatherleaf.

_____

R. This northern freshwater wetland is dominated by black spruce, a large, evergreen, needle-leafed tree.

_____

S. This freshwater wetland is found along the edges of slow-moving tidal rivers. Wild rice, pickerelweed and arrow arum are only found during the growing season.

_____

T. This non-tidal freshwater wetland is dominated by red maple, a broad-leaved tree.

_____

To Develop or Not to Develop? That is the Question.

activity for grades 7 - 12

Teacher Information

In the following activity your students will take part in a mock town council meeting to decide the fate of a small tidal wetland, an adjacent forested area and a proposal to construct a housing development on the site. The students will assume the roles of individuals and groups involved in this debate. The following information will help you prepare your students for the activity.

Procedure

1. Assign roles to the students. Pick one individual to act as moderator during the council meeting. This student is responsible for maintaining order, recognizing speakers and in the case of a tie vote among the council persons, casting the deciding vote. Chose four other students to act as council persons. Their role is to listen to prepared presentations, ask questions to clarify points of view and then to use the information presented to vote for or against the development proposal. Divide the remainder of the class into six groups. Assign each group one of the following roles.

A) Citizens Environmental Group: is opposed to the development on the grounds that it may increase the chances of flooding during times of heavy rain in developed areas downstream.

B) Local Fishing Club: is opposed to the development on the grounds that it will result in reduced water quality in the stream and will destroy habitat vital to fish populations in the river.

C) Wildlife Biologist: is opposed to development because it will result in destruction of habitat for migratory birds including songbirds, shorebirds, wading birds, raptors and waterfowl. The loss of habitat will also impact local breeding birds.

D) Developer: feels he/she bought the property and should have the right to develop it in any way to make a profit.

E) Construction Workers Organization: is in favor of the development because it would provide many jobs for its members.

F) Chamber of Commerce: in favor of development because the new residents would boost the local economy by spending money at local businesses.

2. Give the students copies of the student reading page and give them some time to do some research on wetlands.

3. After each student has done some research have them meet with their groups to plan their presentation for the meeting. Each group should then chose one person to act as spokesperson during the meeting. That person will state their groups opinion, offer any information in defense of that opinion and answer questions posed by council members.

4. After all groups have made their presentations and there are no further questions, council members should secretly vote for or against the development. The moderator should also vote at this time. Votes are collected by the moderator and revealed to the rest of the class. The moderator's vote is only revealed in order to resolve a tie among the council members.

After the meeting and the vote discuss the outcome of the activity. Ask the students if they feel that their meeting was like a real council meeting that might take place in their community.

Extensions

1. What regulations or laws are on the books to protect wetlands from harmful human activities? Contact local, county, state and federal agencies to find out about laws regarding wetlands in your community or state.

2. Have the students do research projects on different kinds of wetlands. Have them address questions regarding; geographical range of their wetland, common plants and animals of that wetland; how the wetland is important to humans, and if and how the wetland been adversely affected by humans.

Student Information

The Placid River flows through a heavily urbanized area along the mid-Atlantic coast. The tidal stretches of the river have mostly been crowded by industrial and residential development. However, one privately owned area is still in a relatively natural state. In the shallows along the shoreline are estuarine salt marshes and wide

intertidal mud flats. Adjacent to the marshes is a one hundred and fifty acre woodland. While seemingly small and insignificant, the area supports an impressive variety of wildlife. The river's mudflats attract thousands of migratory shorebirds, of several species, during spring and fall migration. Endangered Peregrine Falcons are occasionally seen in pursuit of shorebirds over the river. Herons and egrets search for small fish in the shallows during the warmer months. The nearby forest are feeding areas for migrating songbirds while a few species remain to nest.

The property was recently purchased by a developer who has submitted a proposal to the town council for a townhouse development he wishes to build on the site. The plan calls for filling large areas of wetlands and clearing much of the forest. Several community groups have voiced opposition to the plan. However several other groups have come out in support of the development. A council meeting has been arranged to discuss the proposal and allow all parties to make their opinions known. When all arguments have been heard, the council will vote to grant or deny permits for the development.

Procedure

1. After you have been assigned a role you will be given some time to do research about wetlands and wetland issues. Always keep in mind the point of view of the group you are representing even if it is different from your own.

2. Work together with your group to formulate the ideas you wish to present to the council. You may be asked questions by the council persons so be prepared to answer any questions you think they might have.

3. One person in each group will be assigned as spokesperson and will present your group's ideas to the council. They should be the only person to speak during the meeting.

4. The council persons will listen to all arguments and vote for or against the proposal when all presentations and questions are completed. Ballots are passed to and read by the moderator.

5. The moderator is responsible for conducting the meeting. The moderator will recognize speakers and maintain order at all times. The moderator also votes with the council. The moderator's vote is only revealed in the case of a tie.

Vocabulary

Aggregation a loose knit, social group containing individuals of the same species.

Barrier island a narrow, usually long, sandy island that forms along gently sloping shorelines and acts as a barrier between the mainland and the sea.

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

Cowlick tufts of grass twisted and turned to one side, as if licked by a cow.

Decomposer any organism that feeds by degrading organic matter.

Detritus fragments of organic matter and the bacteria and fungi decomposing the fragments

Ecosystem a community of organisms and their physical environment interacting as an ecological unit.

Food web the network of interconnected food chains of a community

Heavy metal metallic elements of high relative density; includes cadmium, copper, gold, silver, mercury, nickel, and zinc.

Hydrophyte any plant adapted to live in water or very wet habitats.

Life cycle those stages through which an organism passes between the production of gametes by one generation and the production of gametes by the next.

Nutrient basic compounds of which organic material is composed.

Panne a natural basin or depression, especially one containing water or mud, which may dry at certain times leaving a salt deposit.

Perennials plants which persist for several years with a period of growth each year.

Rhizome a more or less horizontal, underground stem

Shorebird name in America for a large group of similar or related birds which typically have relatively long legs and bills, most of which migrate long distances and are often but not always found along shorelines.

Spring tide especially high and low tides caused by the combined gravitational pull of the moon and sun occurring on each new and full moon.

Sub-tropical of, pertaining to, or designating the regions bordering on the tropical zone.

Suspension a dispersion of fine, insoluble, particulate matter in a fluid.

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