Wetlands

Wetlands are among the most productive ecosystems in the world, and home to many specially adapted plant and wildlife species. Wetlands provide many important ecological services.

Chapter 10

Grade Levels/Courses

6th, 7th, 8th, Aquatic Science, Environmental Science

Chapter Objectives

Students will:

1. Carousel around the room to describe various wetlands that occur in Texas.
2. Generate information that they know about playa lakes, riparian wetlands, spring-fed wetlands, sand sheet wetlands, resacas, ciénegas, bottomland hardwoods, and coastal wetlands, tidal wetlands, prairie depressions and forested wetlands.
3. Choose one type of wetland with which they are familiar or a wetland they are interested in and draw a picture including plants and animals that live there.
4. List characteristics of Texas wetlands including playa lakes riparian wetlands, spring-fed wetlands, sand sheet wetlands, resacas, ciénegas, bottomland hardwoods, and tidal wetlands.
5. Design and draw a wetland plant based on a given plant adaptation and label the parts.
6. Describe their plant and its adaptation, the wetland in which it lives, and how that adaptation helps the plant survive.
7. Read the chapter and answer the questions.
8 Explain how biotic and abiotic factors that make up wetland ecosystems function together.
9. Diagram and describe the transfer of energy in a food web for the Texas coastal wetlands.
10. Describe the adaptations and diets of animals in the Texas coastal wetlands.
11. Simulate a flock of birds.
12. Simulate dangers and obstacles of bird migration, modeling the importance of wetlands to bird survival.
13. Write a children's story about bird migration.
14. Assess the health of a wetland based on the diversity of aquatic invertebrates.
15. Read the student guide and answer the questions.

16. Predict the impact of drainage on the organisms in a wetland ecosystem. Describe how technological solutions to problems, such as drainage and agricultural development, can have risks and unintended consequences. Describe possible solutions to potentially harmful environmental changes within a wetland ecosystem.
17. Research bird migration questions using the Internet.
18. Determine the soil percolation rate and observe the color, texture and odor of the soil.
19. Identify soil and water chemistry in a local wetland using soil and water chemistry test kits and equipment.
20. Use course apparatus, equipment, techniques, and procedures.
21. Collect quantitative data from an aquatic environment, including pH, salinity, temperature, mineral content, nitrogen compounds, and turbidity.
22. Identify ways human activity can affect aquatic environments.
23. Predict effects of chemical, organic, physical, and thermal changes caused by humans on the living and nonliving components of an aquatic ecosystem.
24. Analyze the cumulative impact of human population growth on an aquatic system.
25. Use safe practices and conservation of resources in the lab and field.
26. Collect data on soil and water, chemical, physical, and biological characteristics of a wetland, and record information in tables.
27. Draw conclusions based on data collected in the field.
28. Make connections between testing of water and soil chemistry and careers in aquatic science.

Texas Essential Knowledge and Skills in Science

6.1 A, B; 6.2 A, C, D, E; 6.3 B, C; 6.4 A, B; 6.12 A, E; 7.1 A, B; 7.2 A, C, D, E; 7.3 B, C; 7.4 A, B; 7.5 A, B, C; 7.8 C; 7.10 A; 7.11 A, B; 7.12 A; 7.13 A, B; 8.1 A, B; 8.2 A, C, D, E; 8.3 B, C; 8.4 A, B; 8.11 A, B, C

Aquatic Science: 1 A, B; 2 E, F, G, J; 3 B, E; 5 C, D; 9 C; 10 A, B; 11 A, B; 12 A, B, D

Environmental Science: 1 A, B; 2 E, F, G, H, I, K; 3 B, E; 4 A, B, E; 5 B; 6 E; 7 D; 9 E

Materials Needed

Activity 10.1

Chart paper

Print and laminate photos of various wetlands. **Download here:** http://www.tpwd.state.tx.us/publications/learning/aquaticscience/wetlands.pdf

Markers: a different color for each group

Student journals

Pencils/pens

Activity 10.2

Student Guides

Student journals

Pencils/pens

Student *Design a Plant* instruction sheet

Activity 10.3

Laminated copies of *Texas Coastal Wetlands* poster for each group and fact sheets for animals for the class. **Download here:** http://www.tpwd.state.tx.us/publications/learning/aquaticscience/coastal-wetlands.pdf

Science journals

Pens or pencils

Red, green and black Vis-a Vis

Activity 10.4

Computer with Internet connection for research

Chalk or masking tape

Habitat Destruction cards made from magazine pictures

Pictures of different types of wetlands from activity 10.1

Bird cards from magazine pictures or made by students

Activity 10.5

Science journals

Pens or pencils

Rulers

Garden spades or shovels

Stopwatches, watches or clocks

Safety goggles—one per student

Soil test kits may contain tests such as pH, phosphorus, nitrates, and potassium. (Available from science supply catalogs and sometimes local hardware or garden stores)

Water quality test kits, probes, meters or other equipment such as thermometer, pH kit, conductivity meter, dissolved oxygen kit, nitrate kit, etc.

High school students should also have secchi disc, stop watch, tennis ball or piece of wood, salinity test

Binoculars

Field Guides

Garbage bags for litter pick up

Disposable gloves for litter pick up

One copy of each of the following for each student

- Soil Sampling—Percolation and Characteristics student instructions and data sheets
- Data table
- Water Chemistry Investigation sheet for each student
- Physical Water Quality Indicators check sheet with data table
- Invertebrates & Vertebrates as Water Quality Indicators information sheet
- Bug Picking Data Sheet
- Aquatic plants adaptation instructions and information sheets
- Bird count and adaptations data table

Safety Precautions

During active games students will need to take care so that no one is bumped. Students cannot touch in the flocking activity.

Use extra care when handling glass. Only adults should pick up glass. Wear gloves.

Stress field safety.

Vocabulary

- Aerobic
- Anaerobic
- Bottomland
- Carnivore
- Ciénegas
- Coastal
- Consumer
- Decomposer
- Detritus
- Flock
- Habitat destruction
- Habitat restoration
- Herbivore
- Hydric soils
- Hydrophytes
- Migration

- Omnivore
- Percolation
- Playa
- Prairie depression
- Producer
- Resacas
- Riparian
- Sand sheet wetlands
- Spring-fed
- Tidal

Reference Material for Teachers

http://www.tpwd.state.tx.us/learning/resources/publications/posters.phtml

Poster and animal fact sheets, *Coastal Wetlands*

Enrichments

Project WET

- Capture, Store, Release
- Life in the Fast Lane
- Wetland Soils in Living Color
- Macro-Invertebrate Mayhem

Project WILD Aquatic

- Dragonfly Pond
- Wetland Metaphors
- Migration Headache
- Marsh Munchers

Service Learning

- Storm drain stenciling
- Litter pickup

Lesson 10.1: What is a Wetland?

Essential Concept

Every part of Texas has wetlands. These wetlands are varied depending on the climate and physiography of the part of the state where each occurs.

Objectives

1. Students will carousel around the room to describe various wetlands that occur in Texas.
2. Students will generate information that they know about playa lakes, riparian wetlands, spring-fed wetlands, sand sheet wetlands, resacas, ciénegas or desert springs, bottomland hardwoods, and coastal wetlands including tidal wetlands, and prairie depressions.
3. Students will choose one type of wetland with which they are familiar or in which they are most interested, and draw a picture including plants and animals that live there.
4. Students will list characteristics Texas wetlands including playa lakes, riparian wetlands, spring-fed wetlands, sand sheet wetlands, resacas, ciénegas, bottomland hardwoods, and tidal wetlands

TEKS

6.2 C; 6.12 E; 7.2 C; 7.10 A; 8.2 C; 8.11 A, B

Aquatic Science: 2 J; 10 B

Environmental Science: 2 K

Estimated Time

1 class period

Materials

Chart paper

Print and laminate photos of various wetlands (see end of lesson)

Markers: a different color for each group

Student journals

Pencils/pens

Markers, crayons, or colored pencils for drawing

Special Instructions

Attach photos and names of six regions of the state with the types of wetlands found in that region on separate posters. Hang the posters around the room.

Print and laminate photos of various wetlands. **Download here:** http://www.tpwd.state.tx.us/publications/learning/aquaticscience/wetlands.pdf

1. East Texas: Bottomland hardwoods
2. Gulf Coast Wetlands: Coastal wetlands, including tidal wetlands, prairie depressions
3. South Texas Wetlands: Sand sheet wetlands, resacas
4. High Plains and Rolling Plains Wetlands: Playas, riparian wetlands
5. Central Texas Wetlands: Spring-fed wetlands, Riparian wetlands
6. Trans-Pecos Wetlands: Mountain spring-fed wetlands, ciénegas or desert springs

Procedure

1. Wetlands Carousel

Put students in groups of 3 to 5 and give each group a different color of marker. Assign each group to start at one of the posters. Students should write on the poster everything they know about the wetlands in that region in 3 to 5 minutes. Students should use the pictures to help them describe the various wetlands. Then each group will rotate to the right to the next poster, review what is already there and add any other information that they know, and then repeat with each poster until all groups have contributed to every poster.

2. Class Discussion

Review the information on the posters and discuss any misconceptions. Review the locations of the wetlands and the climate and physiography of each region of the state. How do the characteristics of the region influence the types of wetlands that are located there? Keep posters on the wall to add new ideas as they come up.

3. Describe Texas Wetland Ecosystems

Ask students to use their journals to list the characteristics of Texas wetlands that they learned about in their discussion including playa lakes riparian wetlands, spring-fed wetlands, sand sheet wetlands, resacas, mountain springs, ciénegas, bottomland hardwoods, and tidal wetlands.

4. Drawing a Wetland

Ask students to choose one type of wetland with which they are familiar or are most interested in, and draw a picture including plants and animals that they think might live in that wetland.

Vocabulary

- Bottomland
- Ciénegas
- Coastal
- Playa
- Prairie depression
- Resacas
- Riparian
- Sand sheet wetlands
- Spring-fed
- Tidal

Lesson 10.2: Reading and Research

Essential Concept

Wetlands are among the most productive ecosystems in the world. Life gathers around wetlands and wetlands give life.

Objectives

1. Students will read the student guide and answer the questions.
2. Students will design and draw a wetland plant based on a given plant adaptation and label the parts.
3. Students will describe their plant and its adaptation, the wetland in which it lives, and how that adaptation helps the plant survive.

TEKS

6.2 C; 6.12 E; 7.2 C; 7.11 B; 8.2 C; 8.11B

Aquatic Science: 2 J; 10 B

Environmental Science: 2 K

Estimated Time

Varies—class time may be provided or reading may be assigned as homework. Allow at least 20 minutes for in-class questions and discussion

Materials

Student Guides

Student journals

Pencils/pens

Student Design a Plant instruction sheet

Procedure

1. Read the Chapter

Have students read *Chapter 10: Wetlands* in the *Student Guide*. Introduce vocabulary terms as needed.

2. Questions to Consider

Assign the *Questions to Consider* as homework or use them in a cooperative learning activity.

1) ***What is a wetland? What three factors must be present for a place to be considered a wetland?***

Wetlands are places where the land and water meet. In a wetland, the soil is saturated or covered with water at least part of the year. Staying wet gives the soil unique properties. In those places, the wetland becomes a home to plants that are specially adapted to live in saturated soil.

2) ***What are some of the different types of wetlands found in Texas? What are the differences and similarities between them?***

Texas has two main types of wetlands: Freshwater wetlands and Coastal wetlands. All wetlands are wet for a major part of the growing season. Some wetlands may have standing water. Others may only appear slightly muddy, or may even seem dry at the ground's surface. But dig a hole and it will fill with water very quickly. The soil holds water like a sponge. Freshwater wetlands include playa lakes, resacas, spring-fed wetlands, riparian wetlands, ciénegas, prairie depressions, and bottomland hardwoods. Coastal wetlands include low-lying areas near bays and estuaries, and where rivers flow into bays and estuaries, and tidal wetlands.

3) ***What is different about wetland soil? How can we recognize it?***

When soil is saturated the space between the bits of dirt is filled with water. This leaves little or no room for air, giving the soil a grayish color and a gooey texture. In the water, tiny creatures break down dead plant and animal matter called detritus. Because the detritus layer settles beneath the water and is not exposed to air, special kinds of decomposers are needed. Anaerobic bacteria, which do not need oxygen to live, are the stars of the wetland ecosystem. As they break down the detritus, they produce sulfur-containing compounds. The sulfur compounds smell like rotten eggs. But the smell tells us the wetland is healthy. The rich detritus nourishes a complex food web.

4) ***What are some examples of the special adaptations found in wetland plants and animals?***

Wetland plants are adapted to take advantage of every ray of sunlight. They have special ways to expose their leaves to the sun and avoid being shaded by other leaves. They also have roots that can pull in water and still get air, too. Plants that grow in shallow water have roots that grow in the mud and hold onto silt. Most of these plants are tall because they have greater support, enabling them to rise above other plants to reach the sun. Cattails, buttonbush, rushes, sedges and arrowheads do this very well. Other plants such as water lilies grow in deeper water, but are still anchored. Plants such as duckweed grow in open water to avoid the shade of taller plants, but they float by using air spaces in their leaves. Their short roots hang free in the nutrient-rich water. Another challenge of wetland plants is how to get enough air for their cells. The cypress tree's roots (called knees) extend up and out of the water. Sedges and rushes have air spaces inside their leaves to take oxygen and carbon dioxide to the roots. Coastal wetland plants, such as mangroves and salicornia, can live in water having a high salinity. These plants are called halophytes.

Examples of adaptations of wetland animals

Whirligig beetles eyes can focus above and below water to help it find prey. Black necked stilt's long legs and specially adapted feet help it walk in mud. Their long slender beaks are able to snatch prey from under water. Frogs long spring-like legs and turtles' shells help them escape predators. Ducks have spoon-like, flattened bills to strain seeds and invertebrates from shallow water.

5) How are wetlands important to fish, birds, and other wildlife?

Wetlands are home to many invertebrates, amphibians, reptiles, fish, birds and mammals. In fact, you can find more animals and plants in an acre of wetland than in almost any other kind of ecosystem. Up to 90% of Texas saltwater and freshwater fish species depend on wetlands for food, spawning, and nursery grounds. Young fish can find protection from larger fish and other predators by staying in the plant-filled shallow water of wetlands. There is plenty of food for young fish in such places. They remain in this cover until they grow large enough to venture out into deeper waters. Without the wetlands, these species would disappear even though there may be plenty of deep water nearby where adult fish can live. Many freshwater fish and most of the important fish and invertebrates in the Gulf of Mexico are dependent on wetlands as a place for their young to feed and grow up safely.

Texas' wetlands serve the vital function of providing migrating waterfowl a place to rest and replenish energy reserves lost in flight. Texas is at the southern end of the Central and Mississippi Flyways. Migratory birds in Texas use these flyways to travel thousands of miles back and forth from our wetlands to nesting areas in the north where they breed, lay their eggs, and raise their young. Then the birds return to Texas in early fall and spend the winter feeding in Texas' wetlands getting ready for the trip back north in early spring. As a result, Texas wetlands are directly connected to wetlands in northern states, in Canada, and even as far away as the Arctic Circle.

Healthy and productive wetlands are needed at both ends of the birds' flight and all along the way. Texas wetlands play an especially important role for both wintering and migrating waterfowl. Texas' prairie and coastal wetlands provide food and lodging for 90% of all ducks and 75 % of all geese in the Central Flyway.

For migrating birds, Texas' 20,000 playa lakes in the High Plains provide important stopover habitat, supplying plants, seeds, and invertebrates that migrating birds must eat to get enough energy to continue their flight north or south.

Citizen conservation groups, together with Texas Parks and Wildlife Department and other state and federal wildlife agencies work to protect and restore wetlands in Texas and everywhere else migratory birds go. Migratory bird hunters buy special stamps to help pay for this wetland conservation.

6) How do wetlands improve water quality?

Wetlands filter out pollutants. Wetland plants absorb pollutants, store them, break them down and in some cases even use them as nutrients. For example, excess plant nutrients

from fertilizers reduce water quality in many streams and lakes. But because wetland plants can store these nutrients, they use them as fuel for growth. Bacteria found in wetlands can even break these chemicals down into harmless gases and release them into the atmosphere. Wetlands also improve water quality by cleansing runoff that comes from higher in the watershed. Because of their flatness and lush plant growth, wetlands slow the flow of water coming into them. In the slow water, suspended soil particles settle out. Wetland plants also filter particles from water, keeping sediment out of streams and rivers.

7) How do wetlands provide natural flood control?

Wetlands act as giant sponges. Their organic matter and specialized plants take in up to 18 times their weight in water. During periods of heavy rains or runoff, wetlands first hold water then release it slowly back into the watershed. Wetlands slow the flow of water and help reduce damage caused by floods. By holding water and letting it go slowly, wetlands reduce the total amount of water going into lower watersheds. This reduces flood risk and peak flood volume downstream.

8) How do wetlands recharge aquifers?

Wetlands' flatness and lush plant growth slows down the flow of water when it rains. When this happens, water may seep into the aquifer increasing the amount of groundwater. This ability of wetlands to recharge groundwater is especially important in times of drought and in arid parts of the state where communities struggle to deal with declining water tables.

9) Why should we protect wetlands? How can we protect wetlands?

Wetlands help the economy and attract tourists. Texas fishermen catch 30 million pounds of wetland dependent shrimp with a value of $100 million per year. Texas is known around the world for great hunting and fishing. Without healthy wetlands the seafood, fish, birds, and animals we hunt and fish would not be here. Wetlands are also treasured by millions of photographers, boaters, hikers, and wildlife watchers, including tourist who come to Texas just to enjoy the natural beauty our wetlands provide.

To help stop wetlands loss, state and federal conservation agencies work together with wildlife conservation organizations to protect and restore wetlands. Everyone can support efforts to protect wetlands no matter where you live. Do your part to keep trash and other pollution from entering Texas' waters. Visit a wetland. They are easy to see and explore with many plants, and animals along the water's edge or on plants. Canoeing, kayaking, fishing, and birdwatching are just a few of the things you can do while enjoying the beauty of a wetland.

3. Design a Plant

Wetland plants have a variety of adaptations that help them survive. Each student will choose at least one plant adaptation for living in a wetland. Students must design a plant with that adaptation, tell about the kind of wetland in which the plant would live, and

explain how the adaptation helps the plant survive. Post the list on the overhead and allow each student to choose at least one, but not more than two, adaptations for their plant. (Note: If you want to be sure that all adaptations are chosen, you can assign an adaptation to each student.)

Real Wetland Plant Adaptations

- Flexible stems
- Air bladders
- Digestive juices
- Roots in the air
- Air filled roots
- Hanging roots
- Gummy, waxy skin
- Exudes salt crystals
- Salt drops on tips of leaves
- Small flowers
- Sticky, sweet smelling
- Thick, fuzzy, rolled leaves
- Lives symbiotically with fungi
- Low sprawling form
- Buttress roots
- Rot resistant wood
- Large breathing pores
- Stomata on leaf's upper surface
- Finely cut leaves
- Floating flowers

Vocabulary

- Aerobic
- Anaerobic
- Bottomland
- Ciénegas
- Coastal
- Detritus
- Playa
- Prairie depression
- Resacas

- Riparian
- Sand sheet wetlands
- Spring-fed
- Tidal

Student Page

Designing a Wetland Plant

Directions

Wetland plants have a variety of adaptations that help them survive.

1. **Choose at least one plant adaptation for living in a wetland.**
2. **Design a plant with that adaptation.**
3. **Tell about the kind of wetland in which the plant would live.**
4. **Explain how the adaptation provides an advantage to help the plant survive. What is the purpose of the adaptation?**
5. **Draw a picture of the plant, label the parts and point out the adaptation or adaptations you chose to use in your plant.**

Real Wetland Plant Adaptations

1. Flexible stems
2. Air bladders
3. Digestive juices
4. Roots in the air
5. Air filled roots
6. Hanging roots
7. Gummy, waxy skin
8. Exudes salt crystals
9. Salt drops on tips of leaves
10. Small flowers
11. Sticky, sweet smelling
12. Thick, fuzzy, rolled leaves
13. Lives symbiotically with fungi
14. Low sprawling form
15. Buttress roots
16. Rot resistant wood
17. Large breathing pores
18. Stomata on leaf's upper surface
19. Finely cut leaves
20. Floating flowers

Lesson 10.3: Wetland Food Webs

Essential Concept

Wetlands have a large and varied food chain.

Objectives

1. Students will diagram and describe the transfer of energy in a food web of Texas coastal wetlands.
2. Students will learn about the adaptations and diets of animals in the Texas coastal wetlands.
3. Students will predict the impact of drainage of a wetland on organisms living there.
4. Students will list biotic and abiotic factors in a wetland system and explain how they function together.

TEKS

6.2 C; 6.12 E; 7.2 C; 7.5 C; 7.10 A; 7.11 A, B; 8.2 C; 8.11 A

Aquatic Science: 2 J; 5 C; 10 B; 11 A

Environmental Science: 2 K; 4 B; 6 E

Estimated Time

1 class period

Materials

Laminated copies of *Texas Coastal Wetlands* poster for each group and fact sheets for animals for the class from Texas Parks and Wildlife Website

Science journals ·

Pens or pencils

Red, green and black Vis-a Vis

Special Instructions

Download, print, and laminate copies of *Texas Coastal Wetlands* poster for each group and fact sheets for animals for the class. **Download here:** http://www.tpwd.state.tx.us/publications/learning/aquaticscience/coastal-wetlands.pdf

Fact sheets and photos from website include the following: reddish egret, American oystercatcher, black-necked stilt, long-billed curlew, fiddler crab, stone crab, roseate spoonbill, eastern oyster, common blue crab, piping plover, Kemp's ridley sea turtle,

lightning whelk, whooping crane, common raccoon, Texas diamondback terrapin, northern harrier, Atlantic croaker, Atlantic bay scallop, sheepshead minnow, seagrasses, spotted seatrout, red drum, pinfish, gulf salt marsh snake.

Procedure

1. Designing Coastal Wetland Food Webs

Give students a copy of the list of animals to be used in the food web. Give an 8 ½ inches X 11 inches laminated copy of *Texas Coastal Wetlands* poster to each group of 4 students.

Have each group work together to connect a coastal food web using the colored pens. Allow students 10 minutes to make th efood webs. Have students use the red Vis-a-Vis to connect a predator to its prey. Have students use the green Vis-a-Vis to connect primary consumers to producers. Use the black Vis-a-Vis to connect scavengers and decomposers to their food. Students may not know what all of the animals eat. Just have them use their best judgment.

Have each group present one part of the food web to the class. Put the names of the animals on the board and connect the food web as students instruct. When all three parts have been connected, ask students if anyone has a different food web. Continue presenting food webs until all ideas are presented. Discuss any conflicting ideas about what animals eat.

2. Learning About Animal Adaptations and Diets

Give each student one of the animal fact sheets and use the fact sheets to learn more about each of the coastal wetland organisms. Have students write a paragraph about the diet and adaptations of their animal in their science journals. Have each student provide information about their animal and its adaptations to living in a coastal wetland, and then, using what they learned, make corrections or additions to each group's food web and to the class food web on the board. Encourage the class to discuss changes and help decide where in the food chain the organism belongs. Is it a producer, herbivore/consumer, carnivore/consumer, omnivore/consumer, scavenger, or decomposer?

Have students copy the final food web diagram in their science journals. Indicate the transfer of energy in a wetland ecosystem.

3. Predicting Responses to Changes in the Wetland Environment

Ask students to predict the impact of drainage of a wetland on the organisms in a wetland ecosystem. (Drainage removes water—the most vital component of a wetland—from the ecosystem. If drainage is successful, the entire ecosystem and the organisms within it could be permanently lost.)

4. Using What We Learned

Have students write science journal entries listing the biotic and abiotic factors in a coastal wetland ecosystem and explaining how these biotic and abiotic factors function

together.

Vocabulary

- Carnivore
- Consumer
- Decomposer
- Detritus
- Herbivore
- Omnivore
- Producer

Student Page:

Coastal Wetland Organisms for Food Webs

1. Reddish egret
2. American oystercatcher
3. Black-necked stilt
4. Long-billed curlew
5. Fiddler crab
6. Stone crab
7. Roseate spoonbill
8. Eastern oyster
9. Common blue crab
10. Piping plover
11. Kemp's ridley sea turtle
12. Lightning whelk
13. Whooping crane
14. Common raccoon
15. Texas diamondback terrapin
16. Northern harrier
17. Atlantic croaker
18. Atlantic bay scallop
19. Sheepshead minnow
20, Seagrasses
21. Spotted seatrout
22. Red drum
23. Pinfish
24. Gulf salt marsh snake

Lesson 10.4: Migration Stations

Essential Concept

Migrating birds need wetlands as places to stop and rest, and eat in order to complete their migrations.

Objectives

1. Students will take part in a game to simulate a flock of birds.
2. Students will research bird migration questions.
3. Students will take part in a simulation of bird migration modeling the importance of wetlands to bird survival.
4. Students will write a children's story about bird migration.

TEKS

6.3 B, C; 6.12 E; 7.3 B, C; 7.11 B; 7.12 A; 7.13 A, B; 8.3 B, C; 8.8 C; 8.11 C

Aquatic Science: 2 H, J; 3 B; 12 A, D

Environmental Science: 2 I, K; 4 A; 9 E

Estimated Time

1 class period

Materials

Computer with Internet connection for research

Chalk or masking tape

Habitat Destruction cards made from magazine or Internet pictures

Pictures of different types of wetlands from activity 10.1

Bird cards from magazine pictures or made by students

Special Instructions

The flocking game can be played in the gym or outside.

Preparation for *Migration Stations*: The migration stations simulation can be done either outside on the concrete or inside the classroom. You will need to draw a large grid (like *Hopscotch*) with 10 squares each about 3 ft. X 3 ft. You can draw the grid with chalk outside on the concrete or for inside, you may wish to use tape to put the grid on the floor. (For those of you who don't remember *Hopscotch*, you just draw connected boxes on the sidewalk and jump from box to box on one foot. If you put a rock in a

square, you can't jump in it.) Make a start and finish line by labeling one end of the grid as **South America** and the other end could be labeled **Canada.**

Note: Be sure those students understand that these are not the only migration destinations. Some birds fly from the Arctic to the Antarctic. Each type of bird has its own migration pattern.

If possible, you can laminate magazine pictures of various birds. You may want to provide magazines and let students find the pictures. (**Note:** *Birds and Blooms*, *Audubon*, and *Texas Parks and Wildlife* have good pictures for use in this game.) If you don't have pictures, just let students write the name of their bird on a card and draw a picture of it. They can get ideas from a field guide. Students are to fly from one end of the migration grid to the other without stepping out of the boxes.

You will need to represent types of wetlands and put them on the grid. Use the photographs from Activity 10.1. (Spring-fed wetlands, playa lakes, riparian wetlands, resacas, bottomlands, ciénegas, mountain spring wetlands, coastal tidal wetlands) You can make more than one copy of some of the pictures and use some picture more than once.

You will also need some laminated sheets for *Habitat Destruction Cards.* Again, they can be magazine pictures, drawings, or just written words, but these cards should have a big red X on them. You will need to include cards for:

- Urban Sprawl in Wetland
- Development of a Big Resort on a Coastal Wetland
- Deforestation of a Bottomland Wetland
- Drought Dries Up a Spring-fed Wetland
- Corporate Agriculture on a Drained Playa Lake Wetland
- Succession Changes a Resaca to a Grassland and Brush
- Land Cleared and Houses Built along a Riparian Wetland

That will give you 7 *Habitat Destruction Cards*.

Safety Precautions

These are kinesthetic activities. Students will need to take care so that no one is bumped. Students can not touch in the flocking activity.

Procedure

1. Bird Migration Research

Assign each group of 2-3 students one of the following questions to research on the Internet:

- **What is bird migration?** (The seasonal movement of birds)
- **Why do birds migrate?** (As a response to internal and external stimuli to find a place with enough food, to return to an area where they breed and raise their young)

- **How do birds prepare to migrate?** (They eat more food, and store it as fat for the long migration.)
- **When do birds migrate?** (Some birds fly at night like songbirds and look for food and rest during the day. Other birds such as hawks migrate by day so that they can catch the thermal updrafts over the land. Insectivores, such as swallows and swifts, also fly during the day and feed on insects as they travel. Flocking birds such as waterfowl and finches also fly during the day. And some hummingbirds make part of their flight with no stops in 24 hours across the Gulf of Mexico to the Yucatan Peninsula. Many birds use wetlands along the migration route to rest and eat. Some stay only for a short time, while others may stay for weeks depending on the weather and how much fat they have stored.
- **How far do birds migrate?** (Different distances for different birds–The longest distance is flown by the arctic tern, which flies 18,600 miles from their breeding grounds in the Arctic to the Antarctic. This is possible because these terns eat fish and feed along the way. Some other bird species only fly as far as they need to find food.)
- **What dangers do birds face on their migration?** (Inadequate food supply, loss of resting places due to development or pollution, predators, storms, collisions with objects in their paths, becoming disoriented due to light pollution)
- **At what altitudes do birds migrate?** (Geese and ducks fly very high. Bar-headed geese have been recorded at altitudes as high as 29,000 feet when they migrate over the Himalayas. That is over 5 miles in altitude. Most night-migrating songbirds will fly below 2,000 feet when they are flying over land. They may fly as high as 6,500 feet, and sometimes higher to reach favorable winds. Birds fly lower in headwinds and higher in a tailwind so that they can get where the wind is the fastest.)
- **How fast do birds fly?** (Songbirds fly about 20-30 miles per hour. Waterfowl and shorebirds fly around 30-50 miles per hour. If they have a tailwind, birds can fly even faster.)
- **How do birds navigate during migration?** (Birds rely on visual landmarks, which may be learned, such as mountains, rivers, coasts, or even buildings. In addition, there is a genetic component to some birds' migration. Birds such as cuckoos, raised by another species, still find their way to the breeding grounds used by other cuckoos. Birds also use the sun, stars, and the Earth's magnetic field to help them find their way. Birds that fly at night use the patterns of the stars and special stars to help them. They may memorize the position of the constellations in relation to the North Star. Also, birds have an internal structure including a tiny grain of a mineral called magnetite just above their nostrils in their bill, or in their brains or eyes. This helps them use the Earth's magnetic field to orient their flight. In addition to the stars, sun and Earth's magnetic field, petrels and pigeons can even use their sense of smell to help them find their way.
- **How do we learn about bird migration?** (Scientific research, including bird banding, helps scientists learn about migration. Just as we did in the mark and recapture activity, scientists put bands on birds so that if they are recaptured or

found after they die, the band number can be reported to the Bird Banding Laboratory and the record tells them where the bird was first banded and how far it had traveled. Migration counts are also done each year to learn the numbers and species of birds that are in a given area. Even weather radar can give us information about migrating birds, which can be seen on radar when they migrate through an area in heavy concentrations.)

When the students finish their research, have them write a short report of what they found out and share it with the class. Students should take notes in their science journals so that everyone has the answers to all the questions.

2. Flocking Game

In this game the goal is for the students to **move as a group**, simulating a flock of birds, to show flock advantages in escape from predation.

You may want to do this activity outside or in the gym, depending on the number of students in your class. Have students gather in a tight "flock". They should stand with their arms to their sides. Their shoulders will represent their wings. Students must travel as a unit, but their shoulders must not touch. If their wing tips brush against another bird's wings, they will have a collision and the birds will crash and die.

Have the flock "fly" at a slow jog toward a point ahead. When they arrive at the spot they must veer off in another direction. (Do not tell them which direction to go.) Birds can not talk or use hand signals, so students should not either. The idea is for students to get the feel for the challenge that birds encounter while migrating in a flock. (There may be some confusion, or maybe students will choose a strategy to follow the leader.)

- **How do you think birds stay together in flocks without bumping into each other.** (Accept any ideas based on logical reasoning. No one knows for sure.)

Introduce the idea of a predator attacking the flock. Peregrine falcons use a technique of diving into flying flocks from above. The birds can't see the falcon above them. When the flock splits up the falcon captures stragglers. In this part of the game the teacher will be the falcon. The falcon kneels down a few yards ahead of the group. Remember, the flock can't see him, because the falcon is flying above them.

Have the flock fly straight toward the falcon. Have the falcon stand, which will indicate the time when the flock spots him. The flock must split to avoid being caught and eaten.

The falcon can only run straight ahead with arms extended as talons. The falcon can only tag birds that are directly in the line of flight. (This rule is made to simulate falcons diving, when they cannot maneuver very well. They are only able to fly straight in front of them.

- **Was the falcon able to catch any of the flocking birds?**

Try again and this time, run at an angle through the flock. Evaluate why any bird might have been caught.

- **Did the Peregrine catch a bird on every try?**
- **Where is the safest place in the flock?**
- **Would the safe place change depending on where the falcon split the flock?**

3. Migration Stations

You may want to do this activity outside or in the gym, depending on the number of students in your class. You will need to make a large vertical grid (like hopscotch) with 10 squares about 2 ft. x 2 ft. You can draw the grid with chalk outside on the concrete or inside with the grid taped to the floor.

See *Special Instructions* to set up the game. Place a wetland location card on each square.

You may wish to have each student choose a bird, draw a picture and make a nametag on a 3 in. X 5 in. card. (See *Special Instructions* above.)

Have students line up at the beginning of the course. Tell students that they are birds migrating north. Each of the squares represents a wetland along their route where they can stop and eat and rest. Students must hop on one foot from square to square. If two squares are side by side, the student can put down both feet.

Round 1

Ask students to migrate northward on the course. They do not have to step on every square, but they must stay within the course. All students should be successful on the first migration.

Round 2

Use the laminated *Habitat Destruction Cards* to destroy some of the wetlands. Example: Tell students you are a big developer in an urban area and you are draining and building condos on a wetland, which will destroy the habitat where migrating birds have been stopping to rest and eat. Students may not touch a foot in the square where the *Urban Development Card* is placed. If a student should touch that square, they die and must move to the sidelines.

Round 3

After all the students have been through the course destroy two more habitats and repeat the procedure. Try to X off the squares so that the intact wetlands are farther apart.

Round 4 and 5

Continue to destroy wetlands two at a time until you have used all of the *Habitat Destruction Cards* or until all students are unable to complete their migrations. Don't cover every square, but put the *Habitat Destruction Cards* out in a way that not all the wetlands are destroyed, but they are so far apart that students cannot make the jump from one safe wetland to the next.

Round 6

Restore some of the wetlands by telling students that a conservation group has bought the land and is restoring it to a wetland habitat. You don't have to restore every square, but

put back two strategic wetlands so that students will be more likely to be able to complete the migration.

Ask students to make the migration journey again.

Extensions

You may want to make the rules a little harder by asking students to make it through the course in a certain amount of time. If students exceed the time limit, the migration was not successful and they die.

Or you may want the students to gather food on their journey. You can use bean bags or tokens such as poker chips to represent food. Take away food tokens when the Habitat Destruction Card is in place. Students will need to collect a certain amount of food on their migration to complete the trip successfully.

You could also use reproduction as a variable. Start with a few students, any surviving students get to reproduce by adding another student. When wetland breeding habitat is taken away, birds die.

What Does the Model of Bird Migration Show Us?

- **What happened on the migration when wetland habitat was destroyed?** (Some birds failed to complete their migration.) **Why did this happen?** (There was not enough food or places to rest close enough together so that birds either went hungry or just couldn't reach the next stop.)
- **What did you notice about the food supply when wetland habitat was destroyed?** (There was less food available.)
- **How is this model like the real migration of birds? How is it different?**
- **What are the limitations of the model?**
- **How do migrating birds depend on wetlands during their migration?**
- **How do you think that restoring wetlands helps migratory birds?**
- **What might happen to a species of birds that lost all their migratory stops?**

4. **Using What We Learned**

Use what you learned in the *Migration Station* model to write a story for younger children about a migrating bird's adventures on his/her first migration. You may use the Internet to do some research for your story. **Make at least 3 drawings to illustrate your story. Use the Rubric to help you write your story.**

Include the following in your story:

- **What kind of bird are you?**
- **What do you see on your migration?**
- **Where do you stop for food and rest?** Describe a favorite wetland where you stop.

- **What kinds of obstacles did you overcome to finish your migration to the nesting grounds?**

Vocabulary

- Flock
- Habitat destruction
- Habitat restoration
- Migration

Student page

Rubric for Stories

I. Story **20 points**

1. The beginning gets the reader's attention.
2. The story is appropriate for young children.
3. The purpose of the story is clear.
4. The story is clear, and detailed.

II. Illustrations **20 points**

1. The pictures are neat and clean.
2. The pictures are colorful.
3. The illustrations help move the story along.
4. The illustrations help to show the components of the ecosystem needed by the animal in the story.

III. Organization **20 points**

1. The title is interesting or catchy.
2. Information is clear and concise.
3. The story has a beginning, middle, and end.
4. The illustrations make the story easy to understand.

IV. Accuracy **20 points**

1. The story answers all the questions in the assignment.
   - What kind of bird are you?
   - What do you see on your migration?
   - Where do you stop for food and rest? Describe a favorite wetland where you stop.
   - What kinds of obstacles did you overcome to finish your migration to the nesting grounds?

V. Grammar and Punctuation **20 points**

1. Story should be neatly written.
2. Uses complete sentences.
3. Uses appropriate punctuation.
4. Uses correct spelling.

TOTAL **100 Points**

Lesson 10.5: Field Trip to a Wetland

Essential Concept

Wetlands are precious resources that supply valuable habitat and require protection.

Objectives

1. Students determine the soil percolation rate and observe the color, texture and odor of the soil.
2. Students use water and soil chemistry test kits and equipment to identify soil and water chemistry in a local wetland.
3. Students demonstrate the use of course apparatuses, equipment, techniques, and procedures.
4. Students collect quantitative data from an aquatic environment, including pH, salinity, temperature, mineral content, nitrogen compounds, and turbidity.
5. Students identify ways human activity can affect aquatic environments.
6. Students will predict effects on the living and nonliving components of an aquatic ecosystem of chemical, organic, physical, and thermal changes caused by humans.
7. Students will analyze the cumulative impact of human population growth on an aquatic system.
8. Students use safe practices and conservation of resources in the lab and field.
9. Students collect data on soil and water, chemical, physical, and biological characteristics of a wetland, and record information in tables.
10. Students draw conclusions based on data.
11. Students make connections between evaluating wetland habitat and careers.

TEKS

6.1 A, B; 6.2 A, C, D, E; 6.4 A, B; 6.12 E; 7.1 A, B; 7.2 A, C, D, E; 7.4 A, B; 7.5 A, B; 7.8 C; 7.10 A; 7.11 A; 7.13 A, B; 8.1 A, B; 8.2 A, C, D, E; 8.4 A, B; 8.11 A, B, C

Aquatic Science: 1 A, B; 2 E, F, G, J; 3 E; 5 C D; 7 C; 9 C; 10 A, B; 11 A, B; 12 A, B, D

Environmental Science: 1 A, B; 2 E, F, G, H, K; 3 B, E; 4 A, B, E; 5 B; 6 E; 7 D

Estimated Time

These activities can be done as an all-day field investigation or set up on the school grounds or nearby natural area to be completed on 3 consecutive days.

Minimum time 3 class periods, if done on the school grounds

Including field trip, you will need 1 whole day in the field and 1 class period for review of data and writing Field Report (reports can be finished as homework).

Materials

Clip boards

Science journals

Pens or pencils

Rulers

Garden spades or shovels

Stopwatches, watches or clocks

Safety goggles—one per student

Soil Test kits may contain tests for pH, phosphorus, nitrates, and potassium. (available from science supply catalogs and sometimes from local hardware and garden stores)

Water quality test kits, probes, meters or other equipment. Kits, meters or other equipment may include thermometer, pH kit, conductivity meter, dissolved oxygen kit, nitrate kit, or other tests or probes that are appropriate.

Binoculars

Field Guides

Garbage bags for litter pick up

Disposable gloves for litter pick up

High school students should also have secchi disc, stop watch, tennis ball or piece of wood, salinity test

One copy of each of the following for each student or have students make their own tables.

- *Soil Sampling—Percolation and Characteristics* student instructions and data sheets
- *Litter and Debris Tally*
- *Physical Water Quality Indicators* check sheet with data table
- *Invertebrates & Vertebrates as Water Quality Indicators* information sheet
- *Bug Picking Data Sheet*
- Aquatic plants adaptation instructions and information sheets and data table
- Bird count and adaptations data table
- Student made data tables for Soil and Water chemistry based on the tests that students use
- *Weather Observations and Measurements*

Special Instructions

Obtain Soil Testing kits and prepare students for using these new tests. A practice can be done using soil from the school grounds before going into the field. Keep data from school grounds for comparison with wetland samples.

Safety Precautions

When collecting litter and debris, use extra care when handling glass. Only adults should pick up glass. Wear gloves. Stress field safety. (See *Field Trip Information* at the beginning of the curriculum guide.) Always wear long pants and closed toe shoes for outdoor activities.

Procedure

1. Studying Soil in a Wetland

Explain to students that this field investigation has many parts. Some data tables are made for them and some data tables they will need to make in their journals. Students should answer questions in their science journals.

Students should visit a local wetland. There will be different types of wetlands in different parts of the state. For the High Plains plan to do this study when there is water in the playa lakes perhaps after a rain. Spring-fed wetlands will have water most of the time if a drought is not too severe. Riparian wetlands also will be wet except in severe drought. East Texas bottomland wetlands and most coastal wetlands have some water all of the time although prairie depressions may dry and salinity may increase in coastal wetlands in drought times. South Texas resacas and sand sheet wetlands are ephemeral and you will need to check to see if they are wet before taking students in the field.

Students will look at various characteristics of wetland soils. If you are doing the activities on the school grounds have students work in small groups in varying locations in order to compare results from different sites. In the field, choose 3 sites and assign student groups to each site.

Provide each student with a copy of *Soil Sampling—Percolation and Characteristics*.

See example below.

Lead the class through the procedure.

SOIL SAMPLING— PERCOLATION AND CHARACTERISTICS

Directions

1) If there is standing water at the site, use a ruler to measure the depth of the standing water. Measure in centimeters from the soil surface to the top of the water and record the result. If there is standing water**, do not dig a test hole**.

2) If there is no standing water at the site, dig a hole 30 centimeters square and 30 centimeters deep using a spade or shovel.

3) Measure the rise in water level in the hole during an approximate 30-minute period.

4) Calculate percolation rate in centimeters per minute and record it below.

5) Examining Soils. While waiting**,** examine some of the hydric soil from the hole. When soil is saturated the space between the bits of dirt is filled with water. This leaves little or no room for air, giving the soil a grayish color and a gooey texture. These gray, blue, even black wetland soils also may have irregularly shaped reddish-brown or orange-yellow mottles, indicating the presence of iron in the soil. Record your observations in

the table under color and texture.

6) Soil Smell. In the water, tiny creatures break down dead plant and animal matter called detritus. Because the detritus layer settles beneath the water and is not exposed to air, special kinds of decomposers are needed. Anaerobic bacteria, which do not need oxygen to live, break down the detritus. They produce sulfur-containing compounds, which smell like rotten eggs. Remove a small piece of soil from the hole. Crush this piece between thumb and forefingers and smell it to determine if hydrogen sulfide is present. Record your observations.

7) Cleaning up. Fill in your soil hole when you are done!

Have students compare their results and place the completed data sheets (found as the end of this lesson) in their science notebooks.

2. Soil and Water Chemistry

Students will collect soil and water chemistry data and make observations using soil testing kits and water testing kits.

If you have an aquatic site on the school grounds, the water and soil chemistry data can be done there. If you make a field trip to a wetland all of your tests can be done there.

The water testing kit may include pH, salinity, nitrates, dissolved oxygen, and phosphorus. The soil testing kit may include tests for nitrates, phosphorus, potassium and pH. Have students make the same soil tests of a non-wetland at the school grounds. **Make a data table to record your results at your school grounds and three sites at the wetland.**

- **How does the chemistry of wetland soils compare to soil on the school grounds?**

3. Physical and Biological Indicators of Water Quality

Students should look at the *Physical Indicators of Pollution* check sheet, water temperature, turbidity, color, odor, foaming, and conductivity.

Have students also look at the *Invertebrate and Vertebrate Water Quality Indicators* information sheet, and macro-invertebrate identification sheets such as the *Bug Picking* sheet from Texas Parks and Wildlife Department and **decide what water quality they think may be indicated by the macro-invertebrates and vertebrates** they find in the wetland. If you are in a saline environment, you will have different invertebrates. Use a field guide to help you identify these organisms.

- **Where do humans impact of the water come from to this wetland ecosystem?**

Make a list of human activity near the wetland. Have students analyze the cumulative impact of human population growth on this wetland ecosystem. Students should predict how human activities impact physical, chemical, and thermal changes in the water, which will affect the living and nonliving components of the wetland ecosystem.

- **How might this impact changes in the wetland over the coming years?**

4. Plant Adaptations in a Wetland

Use the *Student Instruction* sheet for *Wetland Plant Adaptations Drawings and Descriptions* to investigate the ways that plants are able to survive in a wetland.

All plants need sunlight, oxygen and a way to reproduce. Hydrophytes, those plants that live in water-logged soils, have adapted unique ways to survive. Use your eyes and hand lens to observe closely and use the *Student Information* sheet, *Wetland Plant Adaptations* sheet to help you answer these questions and fill in the *Plant Adaptations Data Table.*

1) Find a plant living in a wetland. Notice its size and shape. Describe or draw it in your journal.

- **In what habitat is it living?**
- **How does its size and shape enable it to live in a wetland?**

2) Find a plant living in a wetland. Feel its texture. Describe it.

- **How does its texture help it survive in a wetland?**

3) Cut the stem of a plant crosswise. In your journal, draw or describe what you see. Use your hand lens to look closely.

- **How does what's inside help the plant obtain oxygen.**

4) Look at the leaves. Describe or draw what they look like in your journal.

- **Does the shape or position help them compete with other plants? How?**

5) Can you see flowers (or other reproductive parts)? Describe or draw them.

- **How are they adapted for reproduction in a wetland?**

6) Dig up one small plant whose species is found in abundance in the wetland and look at its roots. Describe or draw a picture of the roots.

- **How are these roots suited for living in hydric soils?**

7) If this is a salty wetland, how is this plant adapted for living with salt water?

5. Making Bird Count and Adaptations Observations

Provide binoculars and field guides for students to look for birds. Students should use their journals and write down the name of the bird (or a description and look for the name of the bird in a field guide later), and tally the number of each type of bird that is seen. Note any adaptations that birds exhibit to survive in wetlands. (Feet, beaks, legs, movements, etc.)

- **How many different types of birds did you see?**

- **Were there fewer or more birds at the wetland than at any of the other aquatic ecosystems you have visited?**
- **Are there fewer or more birds than at the school grounds?**
- **What kinds of adaptations did you find and what are the ways these adaptations help birds survive in a wetland?**

6. Litter and Debris Tally

Have a contest to see which group can pick up the most litter. Ask students to use disposable gloves and garbage bags to pick up litter in the wetland. Each group should have 2 garbage bags: one bag for recyclables and one bag for non-recyclables. Use the data sheet provided to tally the number of each type of material (glass, plastic, etc.) you find in the litter. Recycle items that are recyclable.

7. Classroom Discussion

Weigh the bags and find the average weight picked up per student. Determine how much litter could have been picked up if every student in the school came to the wetland and picked up an equal amount of litter and debris.

- **Which items were recyclable?**
- **What was the largest thing you found?**
- **What was the smallest thing you found?**

8. Field Study Report

Review data and answers to questions as a class and help students set up data tables and graphs as needed. Have students work in their groups to use all of the information you gathered to **write a report comparing the wetland with other aquatic ecosystems where you have collected data**.

Divide the report into four sections: 1) Physical Characteristics of the Wetland, 2) Chemical Characteristics of the Wetland and 3) Biological Characteristics of the Wetland. 4) Conclusions drawn based on your data about the similarities and differences in the wetland and another aquatic ecosystems you have studied.

- **What effects would urbanization and other human activities or natural occurrences such as migration, storms or other natural changes have on this wetland?**
- **If you found polluting chemicals in soil or water, were you able to determine the causes as point source or non-point source pollution?**
- **What types of things could we do to take care of this wetland?**

8. Challenge Question

Write the following questions on the board and have students discuss them in small groups and then share their group's ideas with the class.

Question:

- **Since we now know how valuable wetlands are to the environment, the Texas economy, and to people, why are we still losing wetlands?**
- **What could Texans do to prevent losing more wetlands?**

List at least five things that you could do.

9. Careers in Aquatic Science

Ask students to research careers in aquatic science on the Internet and relate careers to their experiences gathering data at the wetland. Search for careers in aquatic science first. Then search government entities such as Texas Parks and Wildlife Department, Texas Commission on Environmental Quality, Natural Resource Conservation Service. Write a paragraph in your science journal about opportunities in aquatic science careers and what education is needed to qualify for those careers.

Vocabulary

- Anaerobic
- Detritus
- Hydric soils
- Hydrophytes
- Percolation

Student page

Student Check List for Field Activities

Directions

Collect data and fill in the data tables provided.
Answer the questions in your science journal.
Make 2 more data tables–1 for soil chemistry and 1 for water chemistry.
Check off each activity as you finish it.
Put all data sheets in your science journal.

1. Soil Sampling–Percolation and Characteristics
2. Physical Indicators of Pollution
3. Soil Chemistry (make your own table)
4. Water Chemistry (make your own table)
5. Invertebrate and Vertebrates as Water Quality Indicators
6. Bug Picking Tallies
7. Wetland Plant Adaptations Drawings and Descriptions
8. Plant Adaptations Data Table
9. Bird Data Table
10. Litter and Debris Tally

Student page

INSTRUCTIONS FOR SOIL SAMPLING PERCOLATION AND CHARACTERISTICS

Objective

Determine the soil percolation rate and observe the color, texture and odor of the soil.

Directions

1. **If there is standing water at the site**, use a ruler to measure the depth of the standing water. Measure in inches from the soil surface to the top of the water and record the result. If there is standing water, **do not dig a test hole**.

2. **If there is no standing water at the site, dig a hole** 12 inches square and 12 inches deep using a spade or shovel.

3. Measure the rise in water level during an approximate 30-minute period.

4. Calculate percolation rate in inches per minute and record it below.

5. While waiting the 30 minutes for soil percolation, examine some of the soil from the hole. When soil is saturated the space between the bits of dirt is filled with water. This leaves little or no room for air, giving the soil a grayish color and a gooey texture. These gray, blue, even black wetland soils also may have irregularly shaped reddish-brown or orange-yellow mottles, indicating the presence of iron. Record your observations under color and texture.

6. In the water, tiny creatures break down dead plant and animal matter called detritus. Because the detritus layer settles beneath the water and is not exposed to air, special kinds of decomposers are needed. Anaerobic bacteria, which do not need oxygen to live, break down the detritus. They produce sulfur-containing compounds, which smell like rotten eggs. Remove a small piece of soil from the hole. Crush this piece between thumb and forefingers and smell it to determine if hydrogen sulfide is present. Record your observations.

7. Fill in your soil hole when done!

Student page

Data for Percolation Rate

SOIL SAMPLING— PERCOLATION AND CHARACTERISTICS

Group: _____
(names)

Date: _____

Location:_____

Water level change after 30 minutes: _____ centimeters.

Percolation rate = water level change after 30 minutes ÷ 30 = _____ centimeters per minute.

Soil Characteristics

Site	Depth of standing water (centimeters)	Percolation rate (centimeters per minute)	Color	Texture	Odor

Student Page

Physical Indicators of Pollution

Some stream conditions may be indicated by observations of **physical indicators** of water pollution such as color, odor, and foaming.

Color of Water

Green color may indicate the possibility that nutrients from fertilizer or manure runoff may be flowing into the stream and feeding algae.

Orange-red color may indicate the possibility of acid draining into the creek from mining or industrial waste.

Light brown (muddy or cloudy) color indicates sediment caused by erosion, which may come from ground that is disturbed and left open upstream.

Yellow color coating the streambed may indicate sulfur entering the creek from industrial waste or some operation using coal.

A multi-colored *sheen* on the water may indicate oil floating on the water and may come from ***nonpoint source runoff*** from cars and roads or dumping of oil along the stream.

Yellow brown to dark brown may indicate acids released from decaying plants such as dead leaves collecting in the stream. This color is common in streams that drain marshes or swamps.

White cottony masses on the creek beds indicate the possibility of a fungus found in sewage. Check for sewage or other organic pollution.

Odor

The smell of **rotten eggs** is an indicator of sewage pollution, but may also be present in swamp or marshy land.

A musky smell may indicate the possibility of untreated sewage, livestock waste, algae, or other conditions.

A *chlorine* smell may be caused by a near-by sewage treatment plant chlorinating their effluent.

Foaming

White foam greater than 1-3 inches high may indicate the presence of detergents from industrial or residential waste entering the creek.

Conductivity

If you have a conductivity meter, it can indicate the presence of inorganic solids such as chloride, nitrate, and sulfate, (ions which carry a negative charge) and phosphates such as sodium, magnesium, calcium, iron, and aluminum (ions which carry a positive charge). Organic compounds such a oil, phenol, alcohol, and sugar do not conduct electricity very well and therefore have a low conductivity when in water.

Student page

Data for Physical Characteristics of Wetlands

Water sample Site	Temperature (^{o}C)	Color	Odor	Foam	Conductivity	Turbidity
A						
B						
C						

Student page

Invertebrates and Vertebrates as Water Quality Indicators

Invertebrates

A stream with:

- A great variety of insects, with few of each kind, indicates clean water.
- Less variety of insects, with greater abundance of each kind, indicates that there is too much organic matter in the water.
- Finding only one or two kinds of insects in great abundance indicates severe organic pollution caused from excessive human or livestock waste or high algae populations.
- If no insects are found, but the stream appears clean there may be some type of toxic pollution, which includes chemical pollutants such as chlorine, acids, metals, pesticides, and oil.
- Excessive sediment may be caused by erosion or discharge from a pipe and may reduce the amount of water in the stream causing extreme temperatures, and causing a loss of oxygen, which may smother insects resulting in a reduction of the number of animals in the area.

Note about Invertebrates

The types of **invertebrates** found can help students know about the quality of the water. Use the *Bug Picking Data Sheet* to help identify invertebrates found in creeks and indicate which invertebrates are associated with clean water and which predominate in polluted water.

Vertebrates

- If fish are exhibiting some odd behavior such as jumping out of the water or being non-responsive, it may indicate toxins in the creeks. A chemical analysis is needed to find the source of the toxin. Contact the TCEQ.
- If there are no fish or other vertebrates in the creek, it may indicate that the creek is stressed from urban runoff, sewage, or toxins entering the stream. Chemical analysis is needed to the find the source of the problem. Contact the TCEQ.

Note: Coastal Wetlands may have no insect larvae, but may have other invertebrates. Record the invertebrates you find. Use a field guide to identify as many as possible or describe the invertebrate.

Student page

Invertebrate and Vertebrate Water Quality Indicators

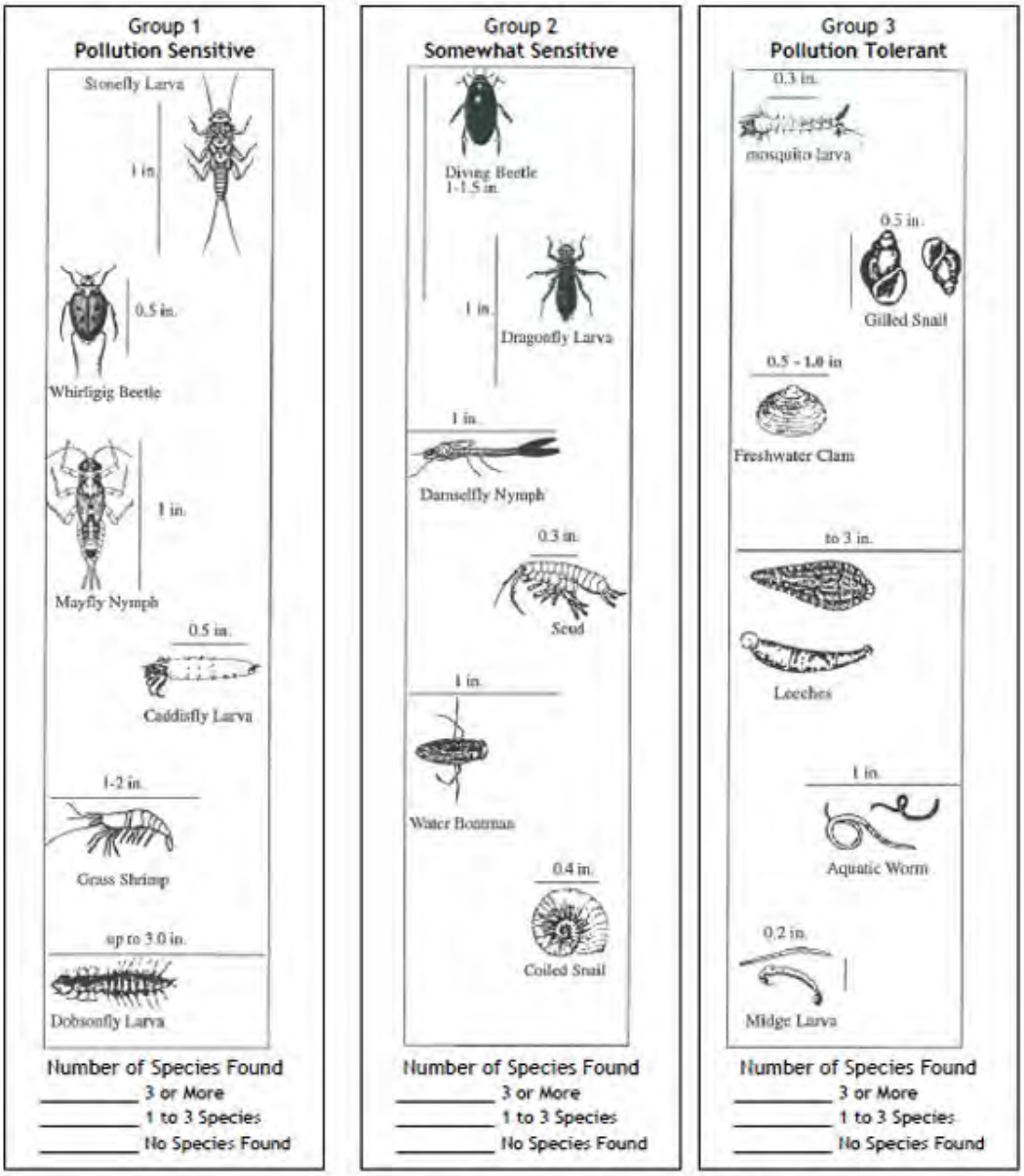
Invertebrate Species	Tally	Name or Describe Vertebrates Present	Tally	Vertebrate Behavior

Student page

Note: Bug Picking Data Sheet courtesy of Texas Parks and Wildlife Department

Use tally marks to keep count of each type of invertebrate.

Bug Picking Data Sheet



Conclusions: **(Remember that the data you are taking will not give conclusive evidence of clean or polluted water, but might indicate the need for further investigation.)**

1. What conclusion can you draw if you found species in Group3, but not in Groups 1 or 2?
2. What conclusion can you draw if you found several different species in each of the groups?
3. What could be happening upstream, on land around the water upstream, or in your present location to affect the water quality where you are sampling?

This water appears to be: **Not Polluted** **OK** **Polluted**

Student page

Wetland Plant Adaptations Drawings and Descriptions

All plants need sunlight, oxygen and a way to reproduce. Hydrophytes, those plants that live in water-logged soils, have adapted unique ways to survive. Use your eyes and hand lens to observe closely and use the "Wetland Plant Adaptation Sheet" to help you answer these questions and fill in the *Plant Adaptations Data Table.*

1. **Find a plant living in a wetland. Notice its size and shape. Describe or draw it in your journal.**
   - In what habitat is it living?
   - How does its size and shape enable it to live in a wetland?

2. **Find a plant living in a wetland. Feel its texture. Describe it.**
   - How does its texture help it survive in a wetland?

3. **Cut the stem of a plant crosswise. In your journal, draw or describe what you see. Use your hand lens to look closely.**
   - How does what's inside help the plant obtain oxygen.

4. **Look at the leaves. Describe or draw what they look like in your journal.**
   - Does the shape or position help them compete with other plants in some manner?

5. **Can you see flowers (or other reproductive parts)? Describe or draw them in your journal.**
   - How are they adapted for reproduction in a wetland?

6. **Dig up one small plant whose species is found in abundance in the wetland and look at its roots. Describe or draw a picture of the roots.**
   - How are these roots suited for living in hydric soils?
   - If this is a salty wetland, how is this plant adapted for living with salt water?

Student page

Wetland Plant Adaptations	Advantage	Examples
Submerged Plants:		
thin skin	to absorb nutrients from water	milfoil, pondweed
flexible stems	will bend. not break	most wetland plants
finely cut leaves	to increase surface area for absorbing sunlight to photosynthesize	milfoil, elodea
Floating Plants:		
air bladders	for floating (no roots)	bladderwort
digestive juices	to eat insects for nutrients	bladderwort
hanging roots	to absorb nutrients	duckweed
Rooted Plants:		
stomata on leaf's upper surface	to allow gas exchange	lilies
flowers smell,	to attract insects to pollinate	yellow water lily
Emergent Plants:		
spongy stem	to transport gases	cattails
large breathing pores	to exchange gases	willows
air filled roots	get gases from upper plant	willows
roots in air	to get oxygen	mangroves
buttress roots	to get oxygen	cypress
gas-transporting tissues	to transport oxygen and carbon dioxide	cordgrass
rot-resistant wood	to prevent decay	cedar, cypress

Student page

Wetland Plant Adaptations	Advantage	Examples
Salt-Tolerant Plants		
gummy, hairy, waxy skin	to prevent salt absorption	cinquefoil, sea thrift gumweed, pickleweed,
holds water in cells	to maintain water supply	pickleweed
oxygen-rich layer around roots	to obtain oxygen	cordgrass
exudes salt crystals	to get rid of excess salt	saltgrass
salt drops on tips of leaves	to get rid of excess salt	pickleweed
large, hardy seeds to keep salt water from flowing in	to maintain salt balance in cells	pickleweed
low, sprawling form	to reduce water loss from wind exposure	pickleweed, jaumea
small flowers	uses little energy	sedges, rushes, bulrushes
parasitic	to obtain nutrients from other plants	salt marsh dodder
Bog Plants		
sticky, sweet smelling	to attract insects for nutrients	sundew, pitcher plant
leaves upright,	to reduce surface area for drying out from exposure to the sun	Labrador tea, cranberry
thick, fuzzy, rolled leaves,	to prevent water loss from evapotranspiration	Labrador tea
live symbiotically with fungi	to obtain nutrients	orchids, heath plants

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Plant Adaptations Data Table

Species	Size	Shape	Texture	Stem Cross section	Leaves	Flowers	Roots	Salt Adaptation

Student page

Bird Data Table

Bird Name	Tally	Adaptations	Advantage of Survival	Migratory or Resident

Questions:

1. **How many different types of birds did you see?**
2. **Were there fewer or more birds at the wetland than at any of the other aquatic ecosystems you visited?**
3. **Are there fewer or more birds on the school grounds?**
4. **What kinds of adaptations did you find and what are the ways these adaptations help birds survive and reproduce in this wetland?**

Student page

Litter and Debris Tally

Record the trash you collect.

Item	Tally	Total
Plastic		
Glass		
Metal		
Paper		
Styrofoam		
Rubber		
Wood		
Cloth		
Other		

Questions:

1. **Which items are recyclable? Mark an R by the recyclable items.**
2. **Which was the largest item you found?**
3. **Which was the smallest item you found?**

Student page

WEATHER OBSERVATIONS AND MEASUREMENTS

Name: _____

Date: _____

Location: _____

Weather factor	Observation or measurement	Information source
High temperature		
Low temperature		
Wind speed		
Wind direction		
Atmospheric pressure		
Relative humidity		
Precipitation		
Cloud cover		

Chapter 10: Assessment

Directions

Select the best answer for each of the following multiple-choice questions.

1. Which of these statements is true about Texas wetlands?

A There are wetlands in all parts of Texas.

B Wetlands provide places for migratory birds to rest and feed.

C Wetlands have standing water all year round.

D A and B

2. Plants living in wetlands have:

A Have thick stems adapted to hold water

B Have thorns and spines for protection

C Have roots that can pull in water and still get air

D None of the above

3. Predict the impact of flooding on the organisms in a wetland ecosystem.

A Some fish, plants or other aquatic life could be washed downstream.

B Floods could promote subsequent growth of wetland plants once the waters recede.

C Fresh nutrients would be brought in by the flood..

D All of the above

4. What three factors are required for a place to be considered a wetland?

A Saturated soil, diverse plant and animal community, standing water

B Standing water, plants specially adapted to live in saturated soil, water year around

C Saturated soil, wet for a major part of the growing season, plants specially adapted to live in saturated soil

D Standing water, wet for a major part of the growing season, plants specially adapted to live in standing water

5. What is detritus?

A A complex web of relationships between living and non-living things

B The variety and number of different organisms and populations, and the way they live together

C Dead plant and animal matter in the process of decay

D None of the above

Chapter 10: Assessment

Directions

Write your own answer for each of the following questions.

1. **What is detritus? What are anaerobic decomposers? Explain how the biotic and abiotic factors that make up the wetland ecosystem, including detritus and anaerobic decomposers, function together.**

2. **Technological solutions to perceived problems can have risks and unintended consequences. Justify this statement by using the drainage of a Texas wetland as an example.**

3. **Suggest a possible solution to potentially harmful environmental changes within a wetland ecosystem caused by the drainage of a Texas wetland.**