Living in the Water

All aquatic species, including fish and other aquatic animals, are uniquely adapted to life in or around water.

Chapter 4

Grade Levels/Courses

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

Chapter Objectives

1. Take part in a game to demonstrate their understanding of aquatic adaptations of animals.
2. Define adaptation, identify specific adaptations of aquatic species found in Texas, and explain the role of adaptation in the organism's ability to survive and fill a niche (such as predator, prey, producer, consumer, parasite, or host) in the aquatic community.
3. Define inheritance as the passage of genetic instructions from one generation to the next.
4. Identify the importance of inheritance in aquatic adaptations.
5. Discuss the difference between genetic adaptations and learned behaviors.
6. Examine Texas fish species and record observations.
7. Make accurate labeled drawings of their group's specimen.
8. Identify basic characteristics of organisms that help classify them and use a dichotomous key to identify a fish.
9. Investigate and explain how internal structures may be adaptations that have specific functions.
10. Discuss predator/prey, parasite/host, and producer/consumer relationships.
11. Complete a *Comparison Matrix for Texas Fish* studied.
12. Define species and give a Texas-specific example of an aquatic species.
13. Take part in a field trip to collect aquatic organisms.
14. Examine Texas aquatic organisms and record observations.
15. Compare and describe adaptations that allow a variety of organisms to exist in aquatic environments.
16. Observe and describe how different aquatic environments support different varieties of organisms.
17. Make accurate labeled drawings of their group's aquatic specimen.

18. Complete the *Comparison Matrix* to compare adaptations of various aquatic organisms.
19. Explore short and long term environmental changes that affect organisms and traits in subsequent populations.
20. Diagram the levels of organization in a freshwater ecosystem including organisms, population, community, and ecosystem.
21. Represent energy transfer through the ecosystem in a role playing activity.
22. Differentiate between inherited traits and learned behavior.
23. Synthesize what they have learned to role play the various parts and interactions among members of a freshwater aquatic ecosystem.

Texas Essential Knowledge and Skills

6.1 A, B; 6.2 A, B, C, D, E; 6.3 A; 6.4 A, B; 6.12 D; 7.1 A, B; 7.2 A, B, C, D, E: 7.3 A; 7.4 A, B; 7.5 A, C; 7.10 A; 7.11 A; 7.12 A, C; 7.14 A, B; 8.1 A, B; 8.2 A, B, C, D, E; 8.3 A; 8.4 A, B; 8.11 A, B, C

Aquatic Science: 1 A, B; 2 B, E, F, G, H, J; 3 A, B, E; 10 A, B; 11 A

Environmental Science: 1 A, B; 2 B, E, F, G, H, I, K; 3 A, B, E; 4 A, B, E; 6 C, E

Materials

Activity 4.1

At least 1 print photo per student of an aquatic organisms–these may be photos from *Texas Parks and Wildlife Magazine*, other publications, or from the Internet

Tape or pins

Science journals

Activity 4.2

Student Guide

Science journal

Pencils or pens

Activity 4.3

Dead fish for each group

Field Guides

Copies of *Fish Comparison Matrix* for each student

Magnifiers or microscopes

Access to the *Texas Parks and Wildlife Department Aquatic Species Online Resource Library* at http://tpwd.state.tx.us/huntwild/wild/spices or copies of species *Fact Sheets*

Pens or pencils

Science journals

Computer with Internet connectivity

Activity 4.4

Native aquarium

10 or more gallon jugs

For Each Group

Field Guides

Buckets and other containers

Dip nets

Seines

10-gallon aquarium for the class or smaller aquariums for each group

Note: It is sometimes easier to set up and maintain one large aquarium for the class, but students enjoy making observations of small group aquariums and like to take care of their group's aquarium. The choice should be based on your students and your classroom space.

Activity 4.5

Aquatic organisms from field trip collection

Field Guides

Copies of *Comparison Matrix* for each student

Magnifiers or microscopes

Access to the TPWD Aquatic Species Online Resource Library or copies of specific species *Fact Sheets* at http://tpwd.state.tx.us/huntwild/wild/spices

Pens or pencils

Science journals

Computer with Internet connectivity

Activity 4.6

KWHL Chart

Field Guides

Hand lenses

Microscopes

Metric rulers

Petri dishes

Trays

Probes or plastic spoons

Safety Precautions and Concerns

Students should be careful with lab tools and be aware that some fish have spiny fins that can cause painful stabs. Some organisms can bite or sting.

Review Field Safety Rules

Vocabulary

- Adaptation
- Barbels
- Community
- Ecosystem
- Fins
- Genetic
- Gill covers
- Gills
- Inherited
- Interaction
- Lateral line
- Niche
- Organism
- Population
- Protective coloration
- Salinity
- Scales
- Slime
- Swim bladder

Resource Material for Teachers

http://www.tpwd.state.tx.us/huntwild/wild/species/

http://www.tpwd.state.tx.us/landwater/water/aquaticspecies/

http://www.tpwd.state.tx.us/learning/resources/

http://www.tpwd.state.tx.us/landwater/water/aquaticspecies/

Freshwater Fishes of Texas (TPWD publication)

Salt Water Fishes of Texas (TPWD publication)

Enrichments

Project WET

- Water Address

Project WILD Aquatic

- Fashion a Fish
- Fishy Who's Who

Guest speakers

- Fisheries biologist. Talk about fish adaptations and reproduction.
- Hatchery worker. Talk about fish adaptations and hatchery spawning.

Lesson 4.1: Apt Adaptation

Essential Concept

Aquatic animals have a variety of adaptations, which are acquired over many generations through genetic changes, and inherited by new generations.

Objectives

1. Students will take part in a game to demonstrate their understanding of aquatic adaptations of animals.
2. Students will identify the role of adaptation in the organism's ability to survive and fill a niche in a specific habitat in the aquatic community (such as predator or prey, producer, consumer, parasite, or host).
3. Students will define inheritance as the passage of genetic instructions from one generation to the next.
4. Students will identify the importance of inheritance in aquatic adaptations.
5. Students will discuss the difference between genetic adaptations and learned behavior.
6. Students will explore short and long term environmental changes that affect organisms and traits in subsequent populations.

TEKS

6.12 D; 7.12 A; 7.14 A; 8.11 A, B;

Aquatic Science: 10 B

Environmental Science: 4 B

Estimated Time

1 class period

Materials

At least 1 print photo per student of an aquatic organisms–these may be photos from *Texas Parks and Wildlife Magazine,* other publications or from the Internet

Tape or pins

Colored pencils, markers, or crayons

Science journals

Special Instructions

Teacher will collect or print out at least one photo of an aquatic animal for each student.

Procedure

1. Apt Adaptations Game

Students may play this game as a class, in small groups, or as pairs. The object of the game is to decide what animal you "are" based on its adaptations. One student is "It". The teacher pins or tapes a photo of an aquatic animal on the student's back. "It" has to guess what animal they are, based on their adaptations. Other students can give clues to "It" when asked one of three questions. Questions must begin with "**How do I** ——?" or "**Do I have**———? such as "How do I move?" Or "How do I feed?" etc. Or "Do I have a beak?" **Am I a_____?** Such as "Am I a predator?"

All students will record the questions and answers, and what animal was guessed in their journals for later discussion.

2. Class Discussion

Ask students to break into groups of 4. Students should look in their journals at the adaptations of the animals that each of them had in the game. Student should discuss the following questions in their small groups and answer the questions in their journals:

- **Why are the adaptations important in the environment where each of the animals live and how do they help the animal survive?**
- **Are the adaptations internal or external structures?**
- **Why would the animal develop this adaptation? What environmental factor could have caused a need for this adaptation?**
- **Is the adaptation inherited by the offspring of this organism?**
- **Is the adaptation genetic or is it a learned behavior? How do we know?**

Research Questions

Ask students to do library or Internet research on the organism that they had in the game to answer the following questions.

- **How are adaptations passed on in genetic instructions? What is a gene?**
- **What type of reproduction does the organism exhibit?**

After discussing all of the questions in small groups, students will share their group's answers in a class discussion. Assign each group one of the questions to report to the class. Other groups will then contribute any additional information they may have thought about when each question was discussed by their group.

Vocabulary

- Adaptation
- Gene
- Genetic
- Inherited
- Reproduction

Lesson 4.2: Reading and Research

Essential Concept

Aquatic species have specific adaptations for living and surviving in water and in particular parts of an aquatic ecosystem.

Objectives

1. Students will read about adaptations of Texas fish as background information for the fish lab in the next activity.
2. Students will make a data table showing fish adaptations and survival advantages.
3. Students will use the chart *Adaptations to the Aquatic Environment from Headwaters to the Ocean* to explore the wide variety of aquatic adaptations.

TEKS

6.2 C; 7.2 C; 8.2 C

Aquatic Science: 2 J; 3 E

Environmental science: 2 K; 3 E

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 Guide

Science journal

Pencils or pens

Procedure

1. Student Reading

Have students read *Chapter 10: Fishing for Answers*. 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 species?

A species is a group of related individuals sharing common characteristics or qualities that interbreed and produce fertile offspring having the same common characteristics and qualities as the parents.

2) What is an adaptation?

An adaptation is a behavior or physical trait that increases a species' chance of survival in a specific environment.

3) How are fish adapted to aquatic environments? List at least 5 adaptations.

Answers may include:

All fish are ectotherms. Their body temperature varies with the surrounding water temperature. This means they need less oxygen and energy to live than animals that keep a more constant body temperature.

All fish have gills to get oxygen from the water.

Fish use fins to move around.

Swim bladders allow fish to adjust their depth in the water.

Many species of fish are covered with protective scales.

Fish are coated with slime, which helps reduce friction as they swim through the water.

Many fish species are dark-colored across the back and light on the belly. This helps them blend in to the dark bottom when seen from above, and with the bright surface when seen from below.

Fish have a line along their sides, called a lateral line, which has tiny organs that enable them to sense vibrations in the water.

4) How do fish swim? Why don't fish sink to the bottom or float on top of the water?

When a bass wants to move forward, it begins a side-to-side wiggle that starts at its front and moves to its back. As this wiggle goes backward, the bass goes forward. Swim bladders keep fish from sinking. The more air it contains, the higher a fish will suspend or float in the water.

5) How do fish see, smell, hear, taste and feel? Do fish have other senses that we do not have?

The placement and shape of the eyes of many species of fish allow them to see almost all the way around their bodies. Many fish can see colors, but those that feed at night or live on the bottom rely heavily on their excellent sense of smell. Some fish, like catfish, have taste buds all over their bodies. They can taste food even before taking it into their mouths. A fish's ears are located beneath the skin on either side of the head. Fish also have a sense organ along their sides, called a lateral line, which contains tiny organs that allow them to sense water vibrations. Lateral lines are visible as faint lines like racing

stripes. These run lengthwise along each side from the gill covers to the base of the tail.

6 What are some adaptations of different species of fish in Texas?

Answers may include:

Darters have protective coloring that makes them hard to see against the stream bottoms where they live.

Channel catfish have long, round bodies that are flattened on the bottom, skin without scales, taste buds all over their bodies, a good sense of smell, and barbels or "whiskers" with many taste buds.

Largemouth bass have large mouths, broad fins, and strong, heavy bodies with wide, sweeping tails.

Red drum can live in freshwater as well as saltwater in Texas' estuaries, bays and the Gulf of Mexico.

7) How do specific adaptations provide survival advantages to particular species? Make a table to show your data.

Answers may include:

Species	Adaptation and advantage	Adaptation and advantage	Adaptation and advantage
Darter	Protective coloring Hide from their enemies	Live on the bottoms of streams Not washed away in floods	Small (one inch long) Allows them to hide among the rocks at the bottom of streams
Channel catfish	Skin color Camouflages them against the bottom	Taste buds all over bodies Have barbels or "whiskers" with taste buds to guide them to food	Long body, flat on bottom Can scavenge along the bottom
Largemouth bass	Colored blotches Hide them in weeds	Large mouths allow them to catch prey such as frogs, fish or crayfish	Broad fins and strong, heavy bodies Allow them to go in any direction (even backwards

8) Using the information in the chapter make a list of the wide variety of aquatic species' adaptations and the environment for which that adaptation is appropriate:

Answers may include:

Species	Adaptation and Environment
Texas blind salamander	No eyes, no pigmentation in skin–living underground in aquifers and springs
Orangethroat darter	Small, protective coloration–living on the bottom of streams among the rocks
Blue catfish	Flat-bottomed body, barbels, taste buds in skin–living near the bottom of dark or muddy waters
River cooter	Basking, large webbed feet–maintaining body temperature and swimming in currents of cold, swift moving waters
Largemouth bass	Large mouth, strong bodies and broad fins–strong swimming predator
Red drum	Favoring shallow, plant-filled water and tolerating changes in salinity–living in bays and estuaries
Eastern oyster	Attaching to surfaces, building a shell–maintaining position and protection from predators in ocean currents and tides
Kemp's ridely sea turtle	Flippers, laying eggs on the beach–swimming and reproducing in Gulf of Mexico or ocean environments
Black legged stilt	Long legs, long beak–finding food in shallow water
Bottlenose dolphin	Traveling in small groups for safety, using echolocation–swimming and finding food over large areas in the ocean
American alligator	Large powerful tails, ability to submerge while eyes and snout remain above water–predatory adaptations in water
Mayfly nymph	Larva stages in water, breathing tubes, holes, bubbles–safety from predators, finding food in streams or ponds
Duckweed	No stems or roots–floating in ponds, streams, or oceans
Water lily	Floating near the water's surface to photosynthesize–plants of aquatic environments
Plankton	Microscopic, large numbers of organisms–floating and carried on the current in water

3. Cast Beyond Tomorrow Question

Ask students to discuss the following questions to apply ideas about adaptations to specific environments.

What unique characteristics of Texas' waters, both freshwater and saltwater, drive adaptations in Texas' aquatic species? How might Texas' aquatic species differ from species in other states, for example in Oregon, Michigan, or New York?

4. Using What We Learned: Create Your Own Aquatic Creature

Scenario:

Students have been scuba diving and unexpectedly found a new organism. Ask students to work in pairs documenting the characteristics of the new aquatic organism they discovered, to make a colored sketch in their science journals of the new species, and write a paragraph describing the organism and answering the questions below.

- **How does your aquatic creature move through the water? What are the advantages and disadvantages of this method of movement?**
- **How and what does your organism eat? What are the advantages and disadvantages of this method of getting food?**
- **What internal organs does this new organism have that are specialized? What is the purpose of these organs? How do these organs help the organism survive?**
- **What external structures does this new organism have that are specialized? What is the function of these structures? How do these external structures help the organism survive?**
- **Doe this organism tolerate pollution or does it require a pollutant free environment? What characteristics are important in making the organism sensitive to or tolerant of environmental pollutants?**
- **What type of reproduction does this organism exhibit? What are it's life stages? At which stages in its life is it most vulnerable and why?**
- **What is the name of your organism?**

Vocabulary

- Adaptation
- Barbels
- Basking
- Fins
- Flippers
- Gills
- Lateral line
- Protective coloration
- Salinity
- Swim bladder
- Webbed feet

Student Page

Create Your Own Aquatic Creature

You have been scuba diving and unexpectedly found a new organism.

Work in pairs and use the following questions to guide you in documenting the characteristics of the new aquatic organisms.

1. Describe the organism in a paragraph to answer the questions.

2. Make a colored sketch of the new species.

3. How does your aquatic creature move through the water? What are the advantages and disadvantages of this method of movement?

4. How and what does your organism eat? What are the advantages and disadvantages of this method of getting food?

5. What internal organs does this new organism have that are specialized? What is the purpose of these organs? How do these organs help the organism survive?

6. What external structures does this new organism have that are specialized? What is the function of these structures? How do these external structures help the organism survive?

7. Doe this organism tolerate pollution or does it require a pollutant free environment? What characteristics are important in making the organism sensitive to or tolerant of environmental pollutants?

8. What type of reproduction does this organism exhibit? What are it's life stages? At which stages in its life is it most vulnerable and why?

9. What is the name of your organism?

Lesson 4.3: Fish Lab and Comparison Matrix

Essential Concept

Fish have specific characteristics and adaptations that help them survive in their aquatic environment.

Objectives

1. Students will examine Texas fish and record observations.
2. Students will make accurate labeled drawings of their group's specimen.
3. Students will use a dichotomous key to identify their fish.
4. Students will investigate and explain how internal structures may be adaptations that have specific functions.
5. Students will discuss predator/prey relationships.
6. Students will complete a *Comparison Matrix for Texas Fish* studied.

TEKS

6.1 A, B; 6.2 A, C, E; 6.4 A, B; 7.1 A, B; 7.2 A, C, E; 7.4 A, B; 7.12 A; 8.1 A, B; 8.2 A, C, E; 8.4 A, B; 8.11 A

Aquatic Science: 1 A, B; 2 E, F, G, J; 3 B, E; 10 A, B

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

Estimated Time

1 class period for examination of specimen and completing the *Fish Matrix*

Allow at least 20 minutes for in-class questions and discussion.

Materials

Dead fish for each group

Field Guides

Copies of *Fish Comparison Matrix* for each student

Magnifiers or microscopes

Access to the *Texas Parks and Wildlife Department Aquatic Species Online Resource Library* at

http://www.tpwd.state.tx.us/huntwild/wild/species/

http://www.tpwd.state.tx.us/landwater/water/aquaticspecies/

or copies of species *Fact Sheets*

Pens or pencils

Science journals

Computer with Internet connectivity (optional)

Special Instructions

Fish Lab: If possible, obtain a native fish specimen for each group of 4 students. You might want to catch your own or have a friendly fisherman donate a few fish. If possible, try to get at least 3 different species of Texas fish. It is also possible to buy fresh fish at a seafood store or buy specimens through science catalogs.

Note: The seafood store **can not** legally leave all organs in place, but they may leave swim bladders, gills, and scales, if you request it. Swim bladders may be deflated or torn, but students will be able to see the placement.

Check to be sure you can access the TPWD Aquatic Species Online Resource Library at *http://www.tpwd.state.tx.us/huntwild/wild/species/*

You will find fact sheets for fish and other native Texas wildlife.

Safety Precautions

Students should be careful with lab tools and be aware that some fish have spiny fins that can cause painful stabs.

Procedure

1. Using a Dichotomous Key

Students should work in groups of 4 to examine their fish very carefully. First students should try to identify their fish.

If you have field guides to identify Texas fish, use those to key out the species.

If you do not have field guides, you may wish to use the Texas Parks and Wildlife fish books, which have excellent pictures. They are ***Freshwater Fishes of Texas,*** and another for ***Salt Water Fishes of Texas.***

Note: Dead fish quickly lose all color, so students should not try to identify fish species by color shown in the identification guides.

Note to the Teacher

For younger students:

Introduction to Dichotomous Keys

If your students do not know how to use a dichotomous key, here is a quick and easy way to get them started. You can vary the characteristics to fit your group. Just start with some more common characteristics and get more and more specific until there is only one person standing. That will be the species that you are keying out and will be described by the final category and all the preceding categories.

Example:

Ask all the students to stand up. This represents the whole set of students.

To key out a student you will need to pick characteristics that they may have or may not have such as:

If you are a student with brown eyes, remain standing. If you do not have brown eyes, sit down.

If you are a student with brown eyes and have on earrings, remain standing. If you do not have earrings sit down.

If you are a student with brown eyes and have earrings and black shoes, remain standing. If you do not have black shoes sit down.

If you are a student with brown eyes and have earrings and black shoes and wear glasses, remain standing. If you do not wear glasses, sit down.

If you are a student with brown eyes and have earrings and black shoes and wear glasses and have on a red shirt, remain standing. If you do not have on a red shirt, sit down.

When there is only one person standing, then that person should be the species that is described by the characteristics: a student, brown eyes, ear rings, black shoes, glasses, and red shirt. You might want to give it a species name such as:

The red shirted, brown eyed, black footed, glassy eyed, earring wearer.

Another Easy Introduction to Dichotomous Keys

You can also give out a variety of plastic fish or photos of fish. (You can find plastic fish in museum shops or sometimes at stores such as Toys-R-Us or Michael's)

Provide chart paper and markers. Have students make a circle around all of the fish to show the set of all fish. Then have them choose a characteristic and divide the set by that characteristic. (Example: dorsal fins with 2 parts or not 2 part fins) Circle each of these sets. Then divide the 2-part dorsal fin set by another characteristic. (Example: oval body shape or not oval body shape.) Circle each of these sets. Then divide the 2-part dorsal fin, oval body shape set by another characteristic. (Example: reddish body color or not reddish color. This may leave you with only one type of fish in a set and give you the species of that fish. (such as longear sunfish, which has 2 part dorsal fins, an oval body shape, and males are reddish).

2. Fish Lab

After identifying the fish that they are observing, have students pick the fish up and see if they can tell what part of the environment that the fish inhabits (bottom, weedy area, open water).

- **What body characteristics might help you decide where this fish lives?**
- **How do you think the fish moves? What direction is the force that it uses to move it through the water forward? How does it change its direction?**
- **Is its shape made for speed or for fitting in a nook to hide, or for lying on the bottom?**

- **Is it built to be a fast or slow swimmer?**
- **Is it colored to hide or to swim in the open?**
- **Can you tell where it produces the most force with its body to move it through the water or cling to the bottom?**

Have students make a drawing of their fish as they discuss the various external structures that help the fish survive in an aquatic environment. Students should label each part as they examine it. (Drawings should include: lateral line, gill covers, eyes, nostrils, ears, mouth, tongue, teeth, fins, scales, slime, coloration, any unusual parts (such as barbels or whiskers on catfish.)

Hand lenses or microscopes help students see interesting details on scales. Many species of fish can be aged by counting rings on their scales.

If you are using fresh caught or lab specimen fish, you may want to look at the internal structures. If you are looking at fish from a seafood store, you may be able to at least see the swim bladder, and gills. Have students make a second drawing indicating placement of internal organs if possible.

Have students check the reading and make sure that they have found all of the parts discussed.

Save fish for reuse in the next activity. (below)

3. Fish Matrix

If you have at least 3 fish species for the fish lab, you may have students complete the fish matrix for those fish species. Ask students to fill in the matrix with their observations.

If students wish to enter more fish in the matrix, then they may go to the TPWD Aquatic Species Online Resource Library, or other in-class library resources to choose other fish.

If you do not have at least 3 species of fish for the fish lab, then students may choose three (or more) Texas fish species to investigate using the *TPWD Aquatic Species Online Resource Library*, or other in-class library resources. Class time may be provided or research may be assigned as homework.

Have students record their findings by completing rows of the comparison matrix. Have students add the matrix to their notebooks. A similar matrix will be used in later activities.

4. Applying What We've Learned

If you have a native aquarium from a previous field trip, you may wish to key out any fish you have in your aquarium and include their data in the *Fish Matrix.* If you have not yet set up a native aquarium, use the *Fish Matrix* in conjunction with *Activity 4.4.*

Vocabulary

- Adaptation

- Barbels
- Fins
- Gill covers
- Gills
- Lateral line
- Protective coloration
- Scales
- Slime

Fish included in Texas Parks and Wildlife Department Aquatic Species Online Resource Library

Fish are scaled, ectothermic vertebrates found in water environments. They fall into three main groups: agnatha or jawless fish including lampreys and hagfish, chondrichthyes or cartilaginous fish including sharks, skates, and rays, and osteichthyes or bony fish including all other fish. Most fish lay eggs, though a few species give birth to live young.

Alligator Gar *(Atractosteus spatula)*
American Eel *(Anguilla rostrata)*
Atlantic Croaker *(Micropogonias undulatus)*
Atlantic Cutlassfish *(Trichiurus lepturus)*
Big Bend Gambusia *(Gambusia gaigei)*
Bigmouth Buffalo *(Ictiobus cyprinellus)*
Black Buffalo *(Ictiobus niger)*
Black Bullhead *(Ameiurus melas)*
Black Crappie *(Pomoxis nigromaculatus)*
Black Drum *(Pogonias cromis)*
Blacktail Shiner *(Cyprinella venusta)*
Blue Catfish *(Ictalurus furcatus)*
Bluegill *(Lepomis macrochirus)*
Bowfin *(Amia calva)*
Chain Pickerel *(Esox niger)*
Channel Catfish *(Ictalurus punctatus)*
Clear Creek Gambusia *(Gambusia heterochir)*
Cobia *(Rachycentron canadum)*
Comanche Springs Pupfish *(Cyprinodon elegans)*
Common Carp *(Cyprinus carpio)*
Common Snook *(Centropomus undecimalis)*
Crevalle Jack *(Caranx hippos)*
Fathead Minnow *(Pimephales promelas)*
Flathead Catfish *(Pylodictis olivaris)*
Flier *(Centrarchus macropterus)*
Florida Pompano *(Trachinotus carolinus)*
Fountain Darter *(Etheostoma fonticola)*
Freshwater Drum *(Aplodinotus grunniens)*
Gafftopsail Catfish *(Bagre marinus)*

Gizzard Shad *(Dorosoma cepedianum)*
Golden Shiner *(Notemigonus crysoleucas)*
Grass Carp *(Ctenopharyngodon idella)*
Greater Amberjack *(Seriola dumerili)*
Green Sunfish *(Lepomis cyanellus)*
Guadalupe Bass *(Micropterus treculii)*
Hardhead Catfish *(Arius felis)*
Lane Snapper *(Lutjanus synagris)*
Largemouth Bass *(Micropterus salmoides)*
Leon Springs Pupfish *(Cyprinodon bovinus)*
Longear Sunfish *(Lepomis megalotis)*
Longnose Gar *(Lepisosteus osseus)*
Paddlefish *(Polyodon spathula)*
Pecos Gambusia *(Gambusia nobilis)*
Pigfish *(Orthopristis chrysoptera)*
Pinfish *(Lagodon rhomboides)*
Rainbow Trout *(Oncorhynchus mykiss)*
Red Drum *(Sciaenops ocellatus)*
Red Shiner *(Cyprinella lutrensis)*
Red Snapper *(Lutjanus campechanus)*
Redbreast Sunfish *(Lepomis auritus)*
Redear Sunfish *(Lepomis microlophus)*
Redfin Shiner *(Lythrurus umbratilis)*
Rio Grande Cichlid *(Cichlasoma cyanoguttatum)*
San Marcos Gambusia *(Gambusia georgei)*
Sheepshead *(Archosargus probatocephalus)*
Sheepshead Minnow *(Cyprinodon variegatus)*
Shortnose Gar *(Lepisosteus platostomus)*
Smallmouth Bass *(Micropterus dolomieu)*
Smallmouth Buffalo *(Ictiobus bubalus)*
Southern Flounder *(Paralichthys lethostigma)*
Spotted Bass *(Micropterus punctulatus)*
Spotted Gar *(Lepisosteus oculatus)*
Spotted Seatrout *(Cynoscion nebulosus)*
Striped Bass *(Morone saxatilis)*
Striped Mullet *(Mugil cephalus)*

Tarpon *(Megalops atlanticus)*
Texas Shiner *(Notropis amabilis)*
Threadfin Shad *(Dorosoma petenense)*
Tripletail *(Lobotes surinamensis)*
Vermilion Snapper *(Rhomboplites aurorubens)*
Walleye *(Sander vitreum)*
Warmouth *(Lepomis gulosus)*
White Bass *(Morone chrysops)*
White Crappie *(Pomoxis annularis)*
Yellow Bass *(Morone mississippiensis)*
Yellow Bullhead *(Ameiurus natalis)*

Student Page

Texas Fish and Their Characteristics
Comparison Matrix

Species	**Average Size** **Weight** **Length**	**Body** **Adaptation** **Advantage**	**Coloration** **Adaptation** **Advantage**	**Adaptation** **Advantage**	**Adaptation** **Advantage**

Lesson 4.4: Field Trip
Collecting for Native Aquarium

Essential Concept

Aquatic species have specific characteristics and adaptations that help them survive in their aquatic environment.

Objectives

1. Students will take part in a field trip to collect aquatic organisms.
2. Students will classify aquatic organisms using a dichotomous key.
3. Students will compare and describe how adaptations allow organisms to exist in aquatic environments.
4. Students will describe producer/consumer, parasite/host, predator/prey relationships in a freshwater aquatic ecosystem.
5. Students will identify basic characteristics of organisms that help classify them.

TEKS

6.1 A, B; 6.2 A, C, E; 6.4 A, B; 6.12 D; 7.1 A, B; 7.2 A, C, E; 7.4 A, B; 7.11 A; 7.12 A, C; 7.14 B; 8.1 A, B; 8.2 A, C, E; 8.4 A, B; 8.11 A

Aquatic Science 1 A, B; 2 E, F, G, J; 5 A, B, C, D; 10 A, B

Environmental Science: 1 A, B; 2 E, F, G, H, K; 4 A, B, E

Estimated Time

Varies depending on distance to travel for a field trip

Materials

Science journals

<u>Native aquarium</u>

10 or more plastic gallon jugs

<u>For Each Group</u>

Field Guides

Buckets and other containers

Dip nets

Seines

10 gallon aquarium for the class or smaller aquariums for each group for short term observations

Note: It is sometimes easier to set up and maintain one large aquarium for the class, but students enjoy making observations of small group aquariums and like to take care of their group's aquarium. The choice should be based on your students and your classroom space.

Note: If it is not possible to collect organisms for your native aquarium, several Regional Education Service Centers in Texas have science centers that will supply live specimens like danios, elodea, or tetras free to classrooms in their regions.

Special Instructions

Native aquarium: Be sure to have student field trip permission and do a pre-visit to the site to check on safety and access. Obtain permission to visit private property.

For Aquatic Science Course: Make copies of data pages used at the end of the lesson to use for field activity.

Safety Precautions

Review Field Safety Rules

Note for Aquatic Science Course: If possible, make this the second field trip to your long-term aquatic study site. Conduct the same tests for water quality as in Chapter 1.9, in addition to collecting for a native aquarium. Don't forget to take weather readings also. In addition, students should note interrelationships among producers, consumers, and decomposers and identify the way organisms are interdependent.

Procedure

1. Field Trip to Collect for a Native Aquarium

If you have not already set up a native aquarium, now would be a good time to do so. If possible, take students to a nearby pond or stream. Depending on the size and number of the aquariums you will set up, you will need to take 10 or more gallon jugs to collect water. You will need enough water to fill the aquarium(s) and several gallons of water to replenish your supply of water. (Tap water has too much chlorine to use in your aquarium. You could also buy de-chlorinator at pet stores.)

Other containers such as buckets will be needed to hold organisms as they are collected. Allow each student to have an opportunity to collect something.

Collect enough aquatic plants to maintain oxygen levels in the aquarium(s). You will also need rocks and pebbles for the bottom dwellers to hide in.

Students should collect samples of aquatic plants, aquatic insects, fish, snails, tadpoles, and whatever macro-invertebrates you find. Be sure you keep predators such as dragonfly nymphs, crawdads, turtles, frogs, or toads in a separate aquarium(s) and feed them daily.

Have students make note in their journals of observations about the field trip site noting plant cover, any erosion they see, and land use and water quality around the pond or along the stream.

Have students work in groups of 4 to collect in various parts of the pond or stream, and with various types of equipment.

Have students set up aquarium(s) when you return to class.

2. Setting Up a Native Aquarium

1) If you bring pond or stream water back from your field trip in plastic jugs, this step is not necessary. Otherwise BEFORE you get the fish or other live specimens, put gravel and water into the aquarium, set up a filter and begin cycling water. Let water cycle for a few days to let the chlorine dissipate from the water.

Discuss with the class how this aquarium is like or different from a natural aquatic ecosystem.

- **What are the similarities and differences?**
- **What could we add to make it more like the natural environment?**
- **What is the basis of all ecosystems?** (Producers)

2) If you are collecting on the field trip bring plants, such as algae covered rocks, to put in the aquarium. If you are not taking the field trip, add elodea or other aquatic plants to the aquarium, add a light or put the aquarium near sunlight.

Does the plant need anything else? (Yes, nutrients from the soil.)

3) When you are collecting ask students to bring a few rocks, sediment, and gravel from your field trip site. If you are not taking the field trip, bring these ingredients from any nearby stream and add them to the aquarium.

If you are using a filter, explain to students that it can be considered a home for helpful bacteria that break down organic material back into basic nutrients. It also moves the water so it is constantly gets more oxygen from the air. Those two functions are much more important than "filtering" out dirt. The natural world doesn't have a "filter" it recycles the nutrients. The rocks, gravel, and soil from a nearby stream provide our much needed microorganisms.

4) Add the other organisms you collected from the stream. If you did not take the field trip, add 2 fish for every 10 gallons. Danios are hardy fish to use.

- **What might happen if we put in too many fish and other organisms in the aquarium? (**Fish eat the yummy protein we feed them, and excrete ammonia, which can build up in the aquarium and could kill them.)
- **How can we overcome the ammonia problem? (**The bacteria housed in the filter will convert the ammonia to nitrogen providing nutrients that fertilize the plants and will be used to help plants grow.) You can also take out about 1/3 of the water and replace it with new pond water or de-chlorinated water.
- **What will happen if there are no plants?** (The nutrients will just build up in the tank, no one will use them, and the fish will die.)
- **What will happen if the filter stops running?** (Oxygen levels go down, waste doesn't get decomposed, and fish die)
- **What else might we add to make the aquarium more natural?** (Other organisms we collected on the field trip such as snails, insects, tadpoles, etc.)

5) Monitor the aquarium in class at least every week, preferably on the same day of the week, or even every day with test strips for ammonia, and nitrogen.

If the aquarium is functioning as the stream does in nature, ammonia should be quickly converted to nitrogen, and plants will use that to grow. There should not be a build-up of any chemicals.

- **Why might we see spikes in one of the nutrients?** (Perhaps we have too many fish, not enough fish, not enough plants, or not enough bacteria to convert the amount of ammonia produced to nitrogen.)

Here are some of the reactions that might occur.

Ammonia too high? (Too many fish, not enough bacteria, filter was just changed destroying bacteria colony)

Nitrite too high? (Bacteria colony is not well established.)

Nitrate too high? (Bacteria are doing their job, but not enough plant growth is happening or perhaps there are not enough plants, or plants can't grow because of other limiting factors such as too little sun.)

Algae is growing a lot on the tank? (Bacteria are doing their job providing lots of good nitrates, which the algae likes. Either add more plants to take up more of the nitrates, add more snails to eat the algae, or take out some fish to cut down on the ammonia being put in the tank.)

As in all things in the natural world, maintaining a natural aquarium is a balancing act. It is a great way for students to learn to be problem solvers, working on a small scale. These problem solving skills can be applied later to the larger natural world.

Vocabulary

- Adaptation
- Appendages
- Barbels
- Fins
- Gill covers
- Gills
- Lateral line
- Protective coloration
- Salinity
- Scales
- Slime
- Swim bladder
- Webbed feet
- Other words as needed on the field trip

Student Page

WATER CHEMISTRY INVESTIGATION

Objective

1. Record your group's observations about the color and odor of each water sample in the table below.

2. Following the directions for each meter, test kit or other equipment to test each water sample and record data in the table below.

Group: _____ (names)
Date: _____

Physical and Chemical Characteristics of Unknown Water Samples

Water sample	Temperature (^{o}C)	Color	Odor	Foam	pH	Conductivity _____ (units)	Dissolved oxygen _____ (units)	Nitrates And/or phosphates _____ (units)	Water sample source

Student Page

WEATHER OBSERVATIONS AND MEASUREMENTS

Objective

Obtain, record, and present weather data.

Directions

1. Find a reliable source of daily information about the weather in your area.
2. Record today's weather data for your area. Be sure you report the source of each piece of data, the date and location for which it was reported.

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		

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

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. Print out the Texas Parks and Wildlife *Bug Picking Data Sheet* at **the end of this lesson** to help identify invertebrates found in creeks and indicate which invertebrates are associated with clean water and which predominate in polluted water.

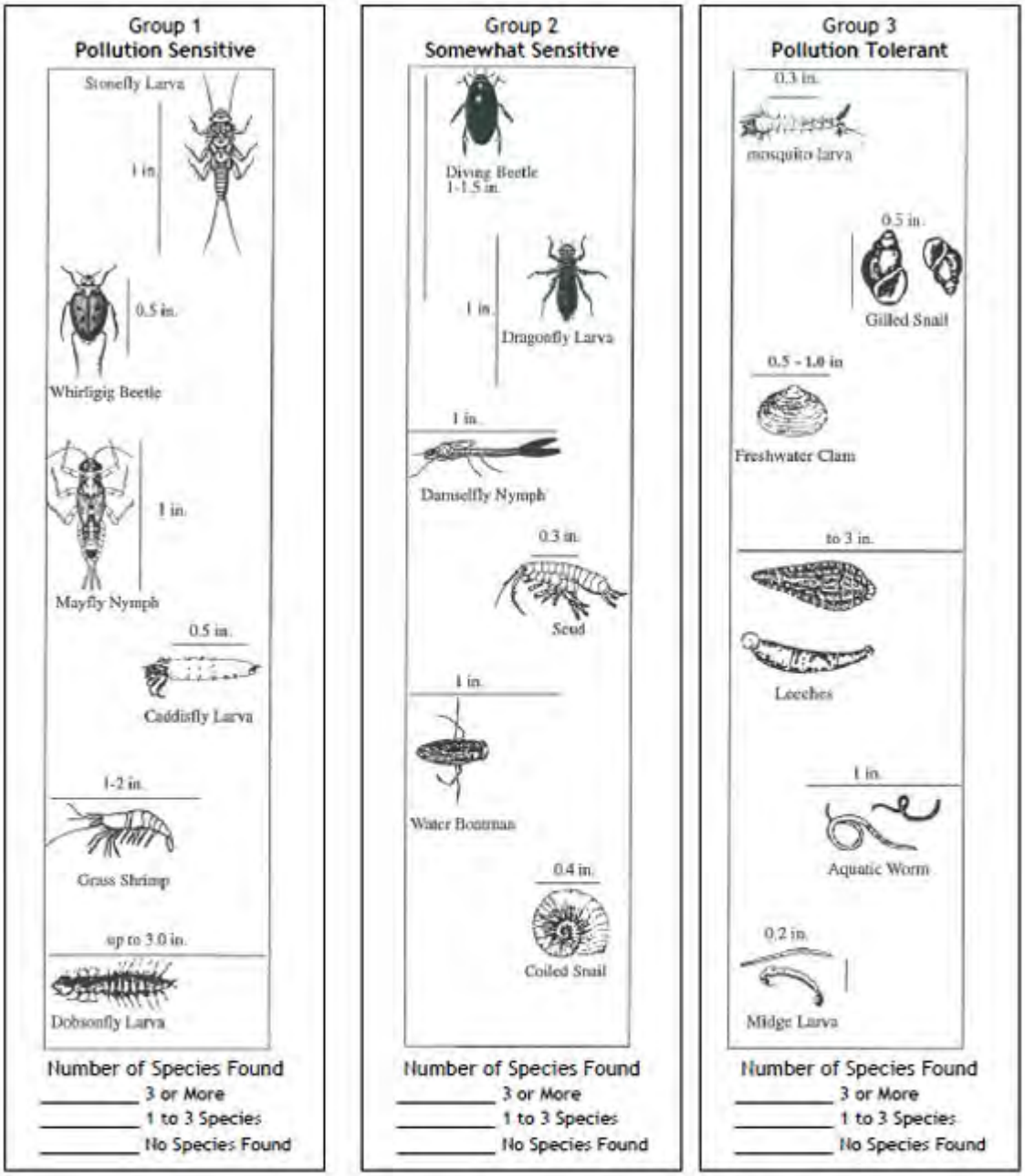
Vertebrates

- 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.

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**

Lesson 4.5: Aquatic Organisms
Comparison Matrix

Essential Concept

Aquatic organisms have specific characteristics and adaptations that help them survive in their aquatic environment.

Objectives

1. Students will choose at least three aquatic organisms observed on the field trip or in the native aquarium, and identify adaptations that help them survive in an aquatic environment.
2. Student will describe producer/consumer, parasite/host, predator/prey relationships in a freshwater aquatic ecosystem.
3. Students will observe and describe how different aquatic environments support different varieties of organisms.
4. Students will examine Texas aquatic organisms and record observations.
5. Students will make accurate labeled drawings of their group's organisms.
6. Students will use a dichotomous key to identify their aquatic organisms.
7. Students will fill in the *Comparison Matrix* to compare adaptations of aquatic organisms.

TEKS

6.1 A, B; 6.2 A, C, E; 6.4 A, B; 7.1 A, B; 7.2 A, C, E; 7.4 A, B; 7.10 A; 7.11 A; 7.12 A; 8.1 A, B; 8.2 A, C, E; 8.4 A, B; 8.11 A, B

Aquatic Science: 1 A, B; 2 E, F, G, J; 10 A, B

Environmental Science: 1 A, B; 2 E, F, G, H, K; 4 A, B

Estimated Time

1 class period for examination of aquatic organisms, using a key, and completing the *Aquatic Organisms Comparison Matrix*

The written assignment can be done as homework or done in class.

Materials

Aquatic organisms from field trip collection

Field guides

Copies of *Comparison Matrix* for each student

Magnifiers or microscopes

Access to the *TPWD Aquatic Species Online Resource Library* or copies of specific species *Fact Sheets* at http://tpwd.state.tx.us/huntwild/wild/spices

Pens or pencils

Science journals

Computer with Internet connectivity

Rubric for written work

Science journals

Safety Precautions

Students should be careful with lab tools and be aware that some organisms can bite.

Procedure

1. Using a Key

Fish

If you did not key out any species from your aquarium and include their data in the *Fish Matrix* when doing *Activity 4.3*, do so at this time. See *Activity 4.3* for ideas on introducing dichotomous keys.

Other Aquarium Organisms

Look at organisms other than fish that you caught on your field trip. Ask each group to key out a different species from your collection. Use a field guide to help you key out those organisms and see all the different types of animals you have in your native aquarium(s).

Each group can report to the class on the species they chose to key out. A list of organisms collected can be generated and displayed as groups report to the class. If there are more organisms in your aquarium, you may wish to have students add those to the list. Have students record the list in their journals.

2. Aquatic Organisms Lab

Ask students to choose organisms from the class native aquarium collection. Students will examine their organism to look for adaptations to aquatic life. The organisms that students choose will vary depending on the location of your field trip site and the quality of the water. Students often collect a variety of aquatic insect nymphs, such as dragonflies, mayflies, mosquito larva, stoneflies, etc. There may also be bloodworms, snails, water striders, diving beetles, leeches, etc. In addition, depending on the season, students may find tadpoles, toads, salamanders, frogs, or turtles. Some students may choose to examine aquatic plant material brought back from the field trip such duck weed, water lilys, algae, etc.

Students should make a drawing of their organism and label the parts.

- **What adaptations does the organism have to help it survive in an aquatic environment?**

- **How do its adaptations help it live in a specific microhabitat in an aquatic environment?**
- **How do its adaptations help it compete with other species in this habitat?**

3. Aquatic Organism Comparison Matrix

Ask students to choose three or more non-fish aquatic species found on the field trip or they may use one organism that they saw on the field trip, but which was not collected such as spoonbills, snapping turtles, or alligators. They may use the organism they have been examining as one of their 3 if they wish. Students will learn more about their 3 organisms using the *TPWD Aquatic Species Online Resource Library*, field guides, or other in-class or library resources. Class time may be provided or research may be assigned as homework.

Have students record their findings by completing rows of the comparison matrix. Have students add the matrix to their journals.

4. Interview With an Aquatic Organism

Have students choose one of the species they studied and report their findings in the form of a 3-paragraph interview, biography or first-person narrative from the point of view of the plant or animal. Give students the rubric for written work before they start this assignment so that they know exactly what is expected of them.

Vocabulary

- Adaptation
- Gills
- Protective coloration
- Scales
- Slime

Texas Parks and Wildlife Department (TPWD)
Aquatic Species Online Resource Library

Information is provided on the following organisms:

Amphibians typically are vertebrates, which change from an aquatic, water-breathing, limbless larva (or tadpole) to a terrestrial or partially terrestrial, air breathing, four-legged adult. This group includes: frogs and toads, salamanders and newts, and caecilians (limbless amphibians). Learn more about amphibians.

Barred Tiger Salamander *(Ambystoma tigrinum mavortium)*

Barton Springs Salamander *(Eurycea sosorum)*

Blanco Blind Salamander *(Eurycea robusta)*

Bronze Frog *(Rana clamitans clamitans)*

Houston Toad *(Bufo houstonensis)*

Marbled Salamander *(Ambystoma opacum)*

San Marcos Salamander *(Eurycea nana)*

Southern Leopard Frog *(Rana sphenocephala)*

Texas Blind Salamander *(Eurycea rathbuni)*

Birds are air-breathing vertebrates. Their body is covered with feathers. Birds have beaks, wings and scale-covered legs. All birds lay eggs that are covered with a calcium carbonate shell.

American Avocet *(Recurvirostra americana)*

American Kestrel *(Falco sparverius)*

American Oystercatcher *(Haematopus palliatus)*

Black-crowned Night-heron *(Nycticorax nycticorax)*

Black-necked Stilt *(Himantopus mexicanus)*

Bufflehead *(Bucephala albeola)*

Burrowing Owl *(Athene cunicularia)*

Eastern Brown Pelican *(Pelecanus occidentalis)*

Eskimo Curlew *(Numenius borealis)*

Interior Least Tern *(Sterna antillarum athalassos)*

Long-billed Curlew *(Numenius americanus)*

Muscovy Duck *(Cairina moschata)*

Pied-billed Grebe *(Podilymbus podiceps)*

Piping Plover *(Charadrius melodus)*

Reddish Egret *(Egretta rufescens)*

Roseate Spoonbill *(Platalea ajaja)*

White-faced Ibis *(Plegadis chihi)*

Whooping Crane *(Grus americana)*

Invertebrates are animals with no backbone. They may live on land or in water, and may be covered by a shell or exoskeleton.

Blue Crab *(Callinectes sapidus)*

Eastern Oyster *(Crassostrea virginica)*

Fiddler Crab *(Uca rapax)*

Gulf Stone Crab *(Menippe adina)*

Lightning Whelk *(Busycon perversum pulleyi)*

Mammals are air-breathing vertebrates. Their body is covered with hair. All mammals feed their young milk. Most mammals give birth to miniature versions of themselves. For more information and additional species, see *The Mammals of Texas*.

Bottlenose Dolphin *(Tursiops truncatus)*

River Otter *(Lutra canadensis)*

Plants are multicellular nonmobile, photosynthesizing organisms adapted to live on land. They consist of leaves and/or stems that capture the sun's energy and an underground root system. This group includes: moss and liverworts, ferns, conifers, and flowering plants.

Bald Cypress *(Taxodium distichum)*

Little Aguja Pondweed *(Potamogeton clystocarpus)*

Lloyd's Mariposa Cactus *(Sclerocactus mariposensis)*

Texas Wild-rice *(Zizania texana)*

Reptiles are air-breathing vertebrates. A tough leathery skin that has embedded scales covers their body. Most reptiles lay eggs, though some give birth to fully-formed young. This group includes crocodiles, alligators, turtles, snakes, and lizards.

American Alligator *(Alligator mississippiensis)*

Concho Water Snake *(Nerodia paucimaculata)*

Green Sea Turtle *(Chelonia mydas)*

Gulf Salt Marsh Snake *(Nerodia clarkii)*

Hawksbill Sea Turtle *(Eretmochelys imbricata)*

Kemp's Ridley Sea Turtle *(Lepidochelys kempii)*

Leatherback Sea Turtle *(Dermochelys coriacea)*

Loggerhead Sea Turtle *(Caretta caretta)*

Red-eared Slider *(Trachemys scripta elegans)*

Western Cottonmouth *(Agkistrodon piscivorus leucostoma)*

Yellow Mud Turtle *(Kinosternon flavescens flavescens)*

Student Page

Texas Aquatic Organisms and Their Characteristics Comparison Matrix

Species	Body Shape Adaptation & Advantage	Coloration Adaptation & Advantage	Appendages Adaptation & Advantage	Other Feature Adaptation & Advantage

Student Page

Rubric for Written Work

I. Organization **65 points**

1. Each paragraph:
   - Contains an introductory sentence that clearly states your purpose
   - Contains at least two supporting sentences that use relevant details
   - Contains a concluding sentence
   - Provides clear information
   - Contains a main idea
   - Progresses in a logical order
2. The story:
   - Has a beginning, middle, and end
   - Stays on topic

II. Accuracy **20 points**

1. Includes at least 3 important accurate ideas about the organism's life and 3 descriptions of aquatic adaptations

III. Mechanics **15 points**

1. Uses correct grammar, spelling, and punctuation

TOTAL POINTS: 100

Lesson 4.6: Native Aquarium Investigations

Essential Concept

Aquatic organisms have specific characteristics and behavioral adaptations that help them to survive and function in the community of their aquatic ecosystem.

Objectives

1. Students will compare and describe how adaptations allow organisms to exist in aquatic environments.
2. Student will describe producer/consumer, parasite/host, and predator/prey relationships in a freshwater aquatic ecosystem.
3. Students will observe and describe how different parts of aquatic environments support different varieties of organisms.
4. Students will identify basic characteristics of organisms that help us classify them.
5. Students will diagram the levels of organization in a freshwater ecosystem including organisms, population, community, and ecosystem.
6. Students will represent energy transfer through the ecosystem in a role-playing activity.
7. Students will differentiate between inherited traits and learned behavior.
8. Students will synthesize what they have learned to role-play the various parts and interactions among members of a freshwater aquatic ecosystem.

TEKS

6.1 A, B; 6.2 A, B, C, D, E; 6.4 A, B; 6.12 D; 7.1 A, B; 7.2 A, B, C, D, E; 7.4 A, B; 7.5 A, C; 7.11 A; 7.12 A, C; 7.14 B; 8.1 A, B; 8.2 A, B, C, D, E; 8.4 A, B; 8.11 A, B, C

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

Environmental Science: 1 A, B; 2 B, E, F, G, H, I, K; 4 A, B, H; 6 C, E

Estimated Time

<u>KWHL Chart and small group work</u>

1 class period

<u>Lab Time</u>

Varies depending on what questions are chosen for students to investigate.

<u>Role Play</u>

Varies–class time or homework can be used to plan and build puppets or costumes for role-playing parts of an aquatic ecosystem.

1 class period for presentations

Materials

Science journals

KWHL Chart

Field guides

Hand lenses

Microscopes

Metric rulers

Petri dishes

Trays

Probes or plastic spoons

Art materials such as construction paper, tissue paper, paper plates, paper bags, markers, socks, google eyes, pipe cleaners, empty boxes, feathers, felt, (or whatever craft supplies you or students may have)

Other materials as needed

Special Instructions

When deciding on investigations, be aware that some questions that students generate may take longer than one class period to investigate. The choices among the questions that students generate to investigate may be made by the teacher, if necessary.

Safety Precautions

Use lab equipment safely.

Procedure

1. KWHL Chart

Ask students to work together as a class to develop some questions that they would like to investigate about the organisms in their native aquarium using a KWHL Chart. (See KWHL Chart at the end of the lesson.)

A KWHL Chart is a way to help the teacher understand what students **Know,** (prior knowledge and misconceptions), what they **Want to find out,** (developing questions), **How they can find out,** (developing procedures), and what they **Learned**, (conclusions drawn based on data).

Students may come up with a variety of questions in the KWHL process. You may wish to choose only a few (one for each group) or you may wish to investigate only one question by the whole class. You may even decide to look at all the questions over a period of time.

Some questions students might generate with the KWHL Chart for investigating their native aquarium(s) might include things such as:

- **How much food will _____(a toad, salamander, dragonfly nymph, etc.) eat per day?**
- **What are the microhabitats in our native aquarium?**
- **Which microhabitat in our aquarium is occupied by _____ (insert the name of one of the organisms in your native aquarium)?**
- **What are the parts of the freshwater community represented in our native aquarium (organisms, populations, community, and ecosystem)?**

You may have students diagram the community in your native aquarium.

- **What niches are filled by the organisms in our aquarium?** (predator/prey/decomposer/scavenger/producer/consumer/parasite/host).
- **What food chain, web, or trophic pyramid is represented by our native aquarium?**
- **Is it possible to teach _____ (insert name of organism) to come for food?**
- **How does the population of various organisms in our community vary over time?**
- **What factors affect population cycles?**

Discuss the questions generated and choose questions that you will be able to investigate. (control variables, time needed, etc.) Whatever questions are generated by students using the KWHL Chart, ask students **how** they could find the answers to their questions, how much time would be needed to answer the question, and what equipment they would need to carry out their investigations.

Have students divide into groups of 4 and **choose a question**, **write their procedures** (how they will answer their question), **develop data tables** to record information, and **carry out the investigation**. Have students refer to the class work on the KWHL Chart as they work on their investigation. (Or the teacher may choose one question for the whole class to investigate and point out that by having all groups investigate the same question, their data is more reliable, because it is like repeating the experiment a number of times.)

Depending on the questions investigated, it may take from one period to a week, or even a semester to finish the investigations.

When the investigations are finished, have students **draw conclusions based on their data**. These conclusions can be added to the KWHL Chart under **What we Learned.**

2. Using What We Learned:

Role Playing Interactions in Aquatic Ecosystems

After serious science investigations, sometimes it's nice to have a really fun way to apply what we learned. You may wish to video tape these activities. You can use a rubric to evaluate the student products. Be sure to give the rubric to students before they begin developing their role-play.

Students will work in small groups to develop puppets or costumes for a role-play of

interactions in a native aquarium to show how the aquatic ecosystem functions.

Each student in a group should role-play a different organism. (Students may select any plant or animal in the native aquarium or any organism that they saw on the field trip including birds, insects or insect larvae or nymphs, other invertebrates such as snails, crawdads or worms, amphibians, fish, reptiles, mammals, or plants.)

Each organism must either have a costume or a puppet representing its adaptations. Costumes or puppets can be made with construction paper, tissue paper, paper plates, paper bags, markers, socks, google eyes, pipe cleaners, empty boxes, feathers, felt (or whatever craft supplies you or students may have).

Students will work together in their group to plan how to role-play their organisms living and interacting in an aquatic ecosystem.

Writing a Paragraph

Each student will write one paragraph about their organism's adaptations, niche and interactions with other organisms in the ecosystem.

Vocabulary

Adaptation

Community

Ecosystem

Interaction

Niche

Organism

Population

Student Page

KWHL	What I **Know**	
	What I **Want** to Know	
	How can I find out	
	What I **Learned**	

Student Page

Rubric for Role Play

I. Puppet Show or Role Play Presentations 20 points

1. The beginning gets attention.
2. The purpose of the story is clear, showing **interactions in the aquatic community**.
3. Students speak clearly and distinctly.

II. Costumes/Puppets 10 points

1. The costumes/puppets are neat, clean, and colorful
2. The costumes/puppets help to show the **adaptations** of the organism.

III. Organization of the Presentation 15 points

1. Information is clear, detailed, and shows the **niche** occupied by the organism.
2. The story has a beginning, middle, and end.

IV. Accuracy 15 points

1. The story includes at least **3 important aspects** of the organisms life.

V. Written Component 20 points

1. The written paragraph gives detailed information about the organism, its **adaptations and niche** in the ecosystem **and how it interacts with other organisms in the community**.
2. Students use correct grammar, spelling, and punctuation.

6. Student Cooperation 20 points

1. Students work together cooperatively to problem solve.
2. Students follow directions from the teacher.
3. Students all participate equally in the role-play presentation.
4. Students conserve materials.

TOTAL POINTS: 100

Chapter 4 Assessment

Multiple Choice Questions

Directions

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

1. **How can some fish change their depth in the water column?**
   - **A** Water's surface tension.
   - **B** By using their fins.
   - **C** The more air a fish's swim bladder contains, the higher the fish will suspend or float in the water.
   - **D** B and C

2. **Which of the following statements about adaptations is true?**
   - **A** Creatures can choose adaptations that will provide them with survival advantages.
   - **B** Species adaptations provide them with survival advantages in a particular environment.
   - **C** All aquatic species have the same adaptations.
   - **D** Both B and C

3. **What is a species?**
   - **A** A group of related individuals sharing common characteristics that interbreed and produce fertile offspring having the same common characteristics as the parents.
   - **B** Animals with a backbone, which are adapted to live in aquatic environments
   - **C** A group of individuals that live together and need each other to survive
   - **D** Both B and C

4. **What is the function of a fish's lateral line organ?**
   - **A** To taste food even before taking it into their mouths
   - **B** To help them hide from their enemies
   - **C** To reduce friction as fish swim through the water
   - **D** To sense vibrations in the water

5. **Why are fish coated with slime?**

A To absorb up to 85 percent of the oxygen available in the water

B To help them blend in to the dark bottom when seen from above, and with the bright surface when seen from below

C To reduce friction as fish swim through the water and to protect them from disease

D None of the above

Open-ended Questions

Directions

Write your own answer for each of the following questions.

1. Draw a Venn Diagram on a separate sheet of paper and use it to sort some adaptations of the three species of fish you studied.

Be sure to label each part of the diagram with the name of the fish species it represents.

2. Design an Aquatic Animal

Design a non-fish aquatic animal, make a drawing of your animal, describe its adaptations, and explain how the adaptations help it survive. Adaptations should provide it with the following advantages:

It can see nearly all the way around itself.

It can walk on mud easily and swim.

It can stay warm.

It has special sensory parts.

3. Assess the survival advantage of the 3 fish using the adaptations in your diagram:

One adaptation, which is shared by all 3 fish

One adaptation, which is shared by 2 fish but not by the third fish

One adaptation, which is displayed by only 1 of the 3 fish

Chapter 4 Assessment Answer Key

Multiple-choice questions

1. How can fish change where they are in the water column?

C The more air a fish's swim bladder contains, the higher the fish will suspend or float in the water.

2. Which of the following statements about adaptations is true?

B Species adaptations provide them with survival advantages in a particular environment**.**

3. What is a species?

A A group of related individuals sharing common characteristics or qualities that interbreed and produce fertile offspring having the same common characteristics and qualities as the parents.

4. What is the function of a fish's lateral line organ?

D To sense vibrations in the water

5. Why are fish coated with slime?

C To reduce friction as fish swim through the water and to protect them from disease

Open Ended Questions

1. Draw a Venn Diagram of adaptations of the 3 fish you studied.

Answers will vary depending on the fish used by each group.

All fish have gills so that should be in all 3 circles.

If a catfish was one of the specimens, then 2 fish will have scales, and 1 will have smooth skin.

Body shape, mouth shapes, eye placement, coloration, etc. may differ among some species.

Catfish have barbels.

Other answers may vary depending on the fish used in the diagram.

2. Survival advantages of the 3 fish.

All fish have gills -- necessary for survival.

Some fish have scales and some do not -- can be protective and aid in survival.

Only the catfish have barbels -- helpful in finding food in dark and muddy waters.

Each fish species is adapted to survive in its particular habitat.

3. Design an Aquatic Animal

Students should generate a drawing with labels and explanatory descriptions that depict an imaginary non-fish aquatic animal that has the following adaptations:

Answers may include:

Eyes on the sides of its head, on stalks, or bulging out from the head allow the aquatic animal to avoid predators because it can see nearly all the way around itself.

Webbed feet or flippers allowing the aquatic animal to walk on mud easily, also make it a powerful swimmer.

Water-repellant fur or feathers, or fat insulating the aquatic animal, helps it stay warm even in cold water.

Special feelers, antennae, whiskers, or mouthparts or senses on unusual places on the body such as smelling with its feet, help it to sense when food is near making it a good predator.