Fishing for Conservation

Understanding Texas aquatic ecosystems helps us enjoy, appreciate, and conserve our precious aquatic resources.

Chapter 13

Grade Levels/Courses

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

Chapter Objectives

Students will:

1. Discuss recreational activities at aquatic sites.
2. Review Newton's Laws of Motion.
3. Identify Newton's Laws of Motion in everyday activities including casting a fishing lure.
4. Examine a fish, make a drawing, and label the parts.
5. Research unfamiliar fish and note characteristics.
6. Research fish adaptations.
7. List safety precautions to use when fishing.
8. Read the chapter and answer the questions.
9. Make a drawing showing the habitat of the kind of fish they would like to catch.
10. Apply knowledge of species adaptations in the conservation of Texas' aquatic resources.
11. Apply knowledge of the roles of producers, consumers, and decomposers in the transfer of energy in an aquatic food web in Texas.
12. Demonstrate ethical judgment with regard to the conservation of Texas' aquatic resources.
13. Design an experiment to test the strength of three types of fishing line.
14. Compare actual strength of fishing line to advertised strength.
15. Play a game to learn about fishing regulations.
16. Discuss career requirements and opportunities with a game warden.
17. Conduct a field investigation to find out what fish live in their local aquatic ecosystem.
18. Compare adaptations of fish in their sample.
19. Use safe practices and conservation of resources in the field.
20. Collect data and record information in tables.

21. Draw conclusions based on data.
22. Demonstrate the use of course apparatuses, equipment, techniques, and procedures.
23. Collect quantitative data from an aquatic environment, including pH, dissolved oxygen, salinity, temperature, mineral content, nitrogen compounds, and turbidity.
24. Identify ways human activity can affect aquatic environments.
25. Predict effects on the living and nonliving components of an aquatic ecosystem of chemical, organic, physical, and thermal changes caused by humans.
25. Analyze the cumulative impact of human population growth on an aquatic system.
26. Use safe practices and conservation of resources in the lab and field.
27. Continue recording weather and chemical and physical characteristics of their local aquatic ecosystem for their long-term study.
28. Assess water quality in a local watershed.

Texas Essential Knowledge and Skills in Science

6.1 A, B; 6.2 B, C, D, E; 6.4 A, B; 6.8 B, C, D; 6.12 D, E; 7.1 A, B; 7.2 B, C, D, E; 7.4 A, B; 7.7 C; 7.10 A, B; 7.11 A, B; 7.12 A, C; 7.13 A; 8.1 A, B; 8.2 B, C, D, E; 8.4 A, B; 8.6 A, C; 8.11 A, B, C

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

Environmental Science: 1 A, B; 2 E, F, G, H, K; 3 B, C, E; 4 A, B; 6 E; 9 A, E, G

Materials Needed

Activity 13.1

Science journals

Pencils/pens

Copy of *Casting Instructions* for each student

Rod-and-reel combinations set up with casting plugs (Advanced preparation is required.) Hula-hoops, Backyard Bass or other suitable casting targets such as small "kiddie" wading pools, or wash-tubs (optional)

<u>For each group of 2 students</u>

Ping-pong balls

Two empty two liter soda bottles

String

Spring scales calibrated in Newtons

Activity 13.2

Fish for examination and/or dissection (Obtain from friendly fisherman, seafood store, or science supply catalogue)

Texas Freshwater and Saltwater Fish Flash Cards:
http://www.tpwd.state.tx.us/publications/learning/aquaticscience/fish_flash_cards.pdf
Science journals
Pencils/pens

Videos about learning to fish:
http://www.tpwd.state.tx.us/fishboat/fish/programs/gofishing/videos/08freshwater.phtml
1 copy of *Fishing Instructions* for each student ·
1 copy of *Fish Matrix* for each student
Information on freshwater fish identification:
http://www.tpwd.state.tx.us/landwater/water/aquaticspecies/inland.phtml
Information on saltwater fish identification:
http://www.tpwd.state.tx.us/landwater/water/aquaticspecies/marine.phtml

Activity 13.3
Student Guide
Science journals
Pens/pencils

Activity 13.4
Texas Parks and Wildlife website with fishing regulations
http://www.tpwd.state.tx.us/regulations/fish_hunt/#fish.html
1 copy of the *Scavenger Hunt for Texas Fishing Regulations* for each student
Science journals
Pencils/pens
3 types of fishing line of different strengths

Other possible materials
Scissors
Metric ruler
5 gallon buckets, or other container
Scales
Metric measuring cup, beaker, or graduated cylinder
Water
Tree limb or other strong place to hang buckets

Activity 13.5

May vary depending on the site chosen for the field trip. It could be to freshwater or saltwater.

Rods and reels

Bait

Lures

Casting Instructions

Fishing Instructions

Field Guides

First Aid Kit

Science Journals

Pencils/pens

Copies of Fish Matrix or Data Tables made by students to record fish caught

Invertebrate Sampling:

Bug Picking Water Quality Indicators

Seines and nets including D-frame aquatic dip net and kick seine

Containers for specimen such as:

White trays

Ice cube trays

Hand magnifiers or magnifier boxes

Forceps

In bays or estuaries, use a field guide to identify the invertebrates collected

Water Chemistry Tests

Salinity test, and other water chemistry test kits

Safety goggles

Gloves

In addition, high school students should continue to collect data for their long-term study.

Weather and Water Temperature

Thermometers and weather instruments

Physical Water Quality Indicators check sheet

High school students should also have:

Secchi disc, stopwatch, tennis ball or piece of wood

Special Instructions

If time allows, invite a local game warden to come and talk about the fishing regulations.

Safety Precautions

Make sure students watch others carefully when practicing casting and handling a rod and reel. Practice casting should be done with no hooks, only practice plugs. Sunglasses are not only for the sun when fishing. They help protect eyes.

If the class does a full dissection, students must wear gloves, goggles, and observe safety with sharp objects.

Activities use heavy weight, be sure that the weight is suspended close to the ground (no more than 20 cm.) and keep students back at least 6 feet so as not to have weight fall on feet.

Review field safety guidelines.

Vocabulary

- Acceleration
- Action and Reaction
- Anal
- Anterior
- Anus
- Bony rays
- Casting
- Caudal
- Conservation
- Cover
- Dorsal
- Ethical
- Ethics
- Force
- Gills
- Heart
- Inertia
- Intestine
- Kidney
- Liver
- Motion
- Operculum
- Ovary

- Pectoral
- Pelvic
- Posterior
- Regulations
- Ribs
- Spine
- Stomach
- Swim Bladder
- Tensile strength

Teacher Resources

http://www.tpwd.state.tx.us/fishboat/fish/programs/gofishing/videos/

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

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

http://www.tpwd.state.tx.us/regulations/fish_hunt/#fish.html

Enrichments

Project WILD Aquatic

- Living Research: Aquatic Heroes and Heroines
- Net Gain, Net Activity

Guest speaker

- Texas Parks and Wildlife Department Angler Educator
- Texas Parks and Wildlife Department Game Warden

Fishing Opportunities for Students

There are several avenues to introduce students to the sport of fishing either for leisure or competition.

Competitive:

- The Federation of Student Anglers: www.fishingstudents.com
- http://www.texashighschoolbasschampionship.com/
- The Bass Federation: www.thebassfederation.com
- Bassmaster series: http://www.bassmaster.com/youth

Noncompetitive

- National Fishing in the Schools Program: http://www.schoolofflyfishing.com/
- Texas Parks and Wildlife Angler Education program: http://www.tpwd.state.tx.us/learning/angler_education/learnfish.phtml

Lesson 13.1: Gone Fishing?

Essential Concept

Fishing and other aquatic activities are an important way to learn about aquatic environments.

Objectives

1. Students will discuss recreational activities at aquatic sites.
2. Students will review Newton's Laws of Motion.
3. Students will identify Newton's Laws of Motion in everyday activities including casting a fishing line.

TEKS

6.1 A; 6.2 C; 6.8 B; C, D; 7.1 A; 7.2 C; 7.7 C; 8.1 A; 8.2 C; 8.6 A, C

Aquatic Science: 2 J

Environmental Science: 2 K

Estimated Time

1 class period

Materials

Science journals

Pencils/pens

Copy of *Casting Instructions* for each student

Rod-and-reel combinations set up with casting plugs (Advanced preparation is required.) Hula-hoops, Backyard Bass or other suitable casting targets such as small "kiddie" wading pools, or wash-tubs (optional)

For each group of 2 students

Ping-pong balls

Two empty two liter soda bottles

String

Spring scale calibrated in Newtons

Safety Precautions

Make sure students watch others carefully when practicing casting and handling a rod and reel. Practice casting should be done with no hooks, only practice plugs. Sunglasses are not only for the sun when fishing. They help protect eyes from hooks.

Procedure

1. Big Fish Stories

Ask students to work individually to write short answers to the following questions in their journals. Then work in small groups to tell about any experiences they have had fishing, and to explore the following questions:

- **Have you ever been fishing? If so, tell about the experience. If not, would you like to go?**
- **How do people find and catch fish?**
- **What are the rules for fishing?**
- **Is anyone in the group an expert fisherman?**
- **What else do people do to enjoy Texas' aquatic resources? Have you ever done any of those things? If so, tell about the experience. If not, would you like to?**
- **What can you do to help conserve Texas' aquatic ecosystems? Have you ever done any of those things? If so, tell about the experience. If not, would you like to?**

Ask each group to report the results of their discussions to the class. Make a note of any students that fish on a regular basis. They may be able to help novices on the field trip.

2. Casting Instructions

Explain to the class that this chapter will help them understand how to find and catch fish, follow the rules for fishing, and enjoy and conserve Texas' aquatic ecosystems.

Distribute one copy of *Casting Instructions* for each student.

Have students read *Casting Instructions*—class time may be provided or reading may be assigned as homework in advance of class. Have students keep the instructions in their notebooks for use on the field study day.

3. Practicing Casting

Take the class outside to a suitable open area such as a ball field, empty parking lot or open lawn. Alternatively, this activity may be done indoors in a suitably large space with a high ceiling, such as a gymnasium. Set out casting targets, (Hoola Hoops will work, or for more fun, use small wading pools or wash tubs with water.)

Guide the class through the casting process. Have students refer to the copy *of Casting Instructions* in their notebooks.

Allow students to practice as time allows; they may need to take turns. Give lots of positive reinforcement and guidance as needed.

4. How Does It Work: Newton's Laws of Motion

Review Newton's Laws of Motion. Put students in pairs, and give each pair a ping-pong ball. Have students sit on the floor about 3 feet from the wall. (The wall needs to be clear

so students can use it in their investigation. The hall might be a good place if students aren't too loud.)

Inertia

Have students set the ball on the floor about 3 feet from a wall.

Ask students to observe the ball.

- **What is happening to the ball?** (It is sitting still/not moving. It is a body at rest.)

If students do not come up with this immediately, continue questioning until they do. For example, you might ask what kind of movement they observe in the ball.

- **Will the ball move if you do not do anything to it?**

The tendency to stay at rest is called **inertia**. Inertia is also the tendency to stay in motion (think of throwing something out in space with no gravity.) It requires some kind of force to overcome inertia.

NEWTON'S FIRST LAW OF MOTION SAYS THAT AN OBJECT AT REST TENDS TO STAY AT REST, AND AN OBJECT IN MOTION TENDS TO STAY IN MOTION (AT THE SAME SPEED AND IN THE SAME DIRECTION) UNLESS ACTED ON BY A FORCE.

Acceleration

Have students devise a force to act on the ball. Don't tell the students how to do this. They may come up with a variety of ways to move the ball. (Throw, roll, blow [if they try this you can supply them with straws to focus the air], thump, etc.)

- **What happened to the ball when you applied a force?**
- **What kind of force did you use?**
- **Did your ball move?**

Have students write down their results in their science journals.

When a force is applied, the ball moves and will continue to move in a straight line until some other force (such as friction or an obstruction) acts on it to slow it down, stop it, or change the direction it is moving. This movement or change of direction or speed is called **acceleration**.

NEWTON'S SECOND LAW OF MOTION SAYS, A CHANGE IN MOTION (IN SLOWER OR FASTER SPEED, OR IN DIRECTION) REQUIRES FORCE.

The larger the mass of the object, the more force is required and the force must also be greater than any other forces working on the object such as gravity or friction.

The formula for acceleration says:

acceleration equals net force divided by mass

a = F/m

The unit of measure for force is Newtons. Spring scales are available calibrated in Newtons. You can actually figure the acceleration rate by measuring how much force it takes to move an object and dividing by the mass of the object.

Example: You can try this with 2 empty 2-liter soda bottles. **Write down your data in your science journal**. Fill one soda bottle about ¼ full of water or sand. Fill the other ¾ full with water or sand. Tie a string around each bottle. Use the hook on a spring scale calibrated in Newtons to hook on to the string and pull on each bottle until it moves across the desk. Look at the spring scale and record the number of Newtons (indicating the amount of force) needed to move the bottle. Now find the mass of each bottle and apply your data to the formula above. **Do the math in your science journal.** You will have the rate of acceleration.

- **Which bottle required the most force to move? Why?**

Action/Reaction

- **When you accelerated the ball, what happened next?** (If you rolled the ball hard enough, it bumped into the wall and bounced off.)

Have students roll the ping-pong ball into a wall. They may try this from different angles.

- **What happens to the ball?** (The ball bounces off at an equal angle, but in the opposite direction from which it hit the wall.)

Have students answer the following questions and make a <u>labeled diagram</u> in their science journal that shows what the ball does.

- **What forces are working on the ball?**
- **Where are the forces operating?**
- **What is the direction of each force?**
- **What is the direction of the motion?**

NEWTON'S THIRD LAW OF MOTION SAYS FOR EVERY ACTION THERE IS AN EQUAL AND OPPOSITE REACTION.

5. Application of Newton's Laws of Motion

We can see examples of Newton's Laws of Motion in real life in many things from walking to rocket flight. Have students explain some ways that forces affect motion in every day life. (Rocket propulsion, swimming, shooting basketballs, riding a skateboard, etc.) **Have students draw a diagram of one of the activities and indicate the forces involved and the direction of the force and direction of the motion**.)

6. Casting and Motion

When we are casting our fishing lure, we are utilizing Newton's Laws of Motion.

Diagram a person casting a fishing lure:

- **What forces are working on the lure?**
- **Where are the forces operating?**
- **What is the direction of each force?**
- **What is the direction of the motion?**

(We apply a **force** to the fishing rod, using our body by pulling the rod back, and then moving the arm forward. As the rod moves forward the line swings, too. We exert a **force** holding the reel still. As we swing, we release the button holding the reel from moving and the line begins to unwind. The hook, bait, sinker, and bobber (float) attached to the end of the line fly high into the air away from you. The **force** of gravity takes over, pulling the hook, bait, sinker, and bobber back toward Earth. They splash into the water. We overcame **inertia**, by applying a **force** (our swing), the hook, bait, sinker, and bobber **accelerated** out from us. Gravity exerted another **force** and pulled the hook, bait, sinker, and bobber down toward Earth where they entered the water. The **action** was the swing we gave to start the motion. When the hook, bait, and sinker enter the water they sink until they reach the end of the line between them and the bobber, at which point we will see a **reaction** as the bobber bobs in the water suspending the hook, bait, and sinker in the water.)

Vocabulary

- Acceleration
- Action and Reaction
- Casting
- Force
- Inertia
- Motion

Student Page

CASTING INSTRUCTIONS

1. Casting is a mechanical activity. The fishing rod extends your arm and allows you to "throw" your lure or bait a long distance with little effort. Casting is a matter of timing and technique, not strength. You don't need to "beef up" to become a good caster. In these directions, left-handers should substitute left for right.
2. **Safety Alert:** Look behind you to make sure that there are no trees or bushes around the area to interfere with your cast and to make sure that no one is standing behind you to get caught by the hook when you are casting. For safety, always practice with plugs, but no hooks to help you learn the basics first.
3. Lightly grip the fishing rod in your dominant hand. Start with your shoulders square to your target, elbow near the front of your rib cage, forearm and rod pointing in the direction of the cast. Let out 5 to 10 inches of line from the tip of your rod to the practice plug, bait or lure which, because the rod is motionless, hangs straight down. Look at your target.
4. Push the button on the reel with your thumb and hold it in.
5. Lift your forearm straight up, keeping the elbow in place or allowing it to rise just a little. The rod will follow backwards. Continue until your hand moves to about the level of your ear.
6. Sweep your forearm forward, again keeping the elbow pretty much in place. When your arm is about halfway back to its original position, or your hand passes your face, let loose the line, by releasing the button. The plug, bait or lure will be propelled forward, pulling line off the reel until the lure lands.
7. Picture a clock face. Think of your elbow as the hub of the clock and your forearm as the hour hand. . Noon is straight up, 9 o'clock is directly in front of you, 6 o'clock is at your feet and 3 o'clock is directly behind you. Start the cast with the pole at about 10 o'clock. Bring your forearm slowly but steadily back so the tip of the pole is at 2 o'clock. Sweep the forearm forward back to 10 o'clock, releasing the line somewhere near 11 o'clock.
8. If your lure shoots up in the air and doesn't go very far or lands on the ground behind you, the line was released too early. If the lure smacks into the ground in front of you, you released the line too late.
9. Remember that the cast has no sudden or jerky motions. Practice until it becomes smooth and nearly effortless.
10. Accuracy is often more important than distance. Many fish remain near protective cover and will strike only those lures that come into their immediate vicinity. Improve your accuracy by casting to definite targets. Make sure you focus on your target while casting.

Lesson 13.2: Which Fish Am I?

Essential Concept

Knowing fish characteristics and adaptations is important in helping anglers catch fish and in making ethical decisions for maintaining adequate fish populations to provide a balanced community in aquatic ecosystems.

Objectives

1. Students will examine a fish, make a drawing, and label the parts.
2. Students will research unfamiliar fish and note characteristics.
3. Students will research fish adaptations.
4. Students will make a list of safety precautions to use when fishing.

TEKS

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

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

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

Estimated Time

1 class period.

Materials

Fish for examination and/or dissection from a friendly fisherman, a seafood store, or science supply catalog

Science journals

Pencils/pens

Texas Freshwater and Saltwater Fish Flash Cards. **Download here:**
http://www.tpwd.state.tx.us/publications/learning/aquaticscience/fish_flash_cards.pdf

Videos about learning to fish:
http://www.tpwd.state.tx.us/fishboat/fish/programs/gofishing/videos/08freshwater.phtml

1 copy of *Fishing Instructions* for each student ·

Information on freshwater fish identification:

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

Information on saltwater fish identification:

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

Safety Precautions

If the class does a full dissection, students must wear gloves, goggles, and observe safety with sharp objects.

Procedure

1. Parts of the Fish

Provide a fish for each group of 2–4 students to examine. Have students draw a picture of their fish in their science journals and label the parts. For younger students that may be as far as you want to go. External parts that students might label include: scales, nostrils, mouth, tongue, teeth, eye, fins (dorsal, pelvic, pectoral, anal, caudal), lateral line, gill covers (operculum).

For older students, after you do the external drawing, you may wish to do a full dissection. In that case have students make another drawing of the internal parts and label them. They may be able to figure out some of the organs, but they may need to do some library or Internet research to help them figure out other parts. Internally they might include the following parts: stomach, swim bladder, kidney, bony rays in fins, anus, ovary, testes, intestine, liver, heart, gills, spine, ribs.

When students have finished drawings and labels, ask them to share their ideas with the class. Add new vocabulary words as needed. You may want to introduce words to indicate the locations of the different fins on the fish. Possible new vocabulary might include: anterior dorsal and posterior dorsal fins, pectoral, pelvic, anal, and caudal fins. Also you might add operculum for gill cover.

2. Identifying Fish

Post a copy of the fish flash cards on the bulletin board. Post names of fish on the bulletin board but do not match the names with the pictures of fish. Ask students to work as a class to place the names of any fish that they know with the correct fish. You can either cut the names apart or you can use yarn to connect the name with the correct fish. Ask students to classify fish as saltwater or freshwater species. If you are using yarn to connect fish, use blue yarn for freshwater fish and green yarn for saltwater fish. If students, are unable to identify and classify all of the fish, keep the bulletin board up and do the identification again after students do their research.

Texas Freshwater and Saltwater Fish Flash Cards. **Download here:**
http://www.tpwd.state.tx.us/publications/learning/aquaticscience/fish_flash_cards.pdf

Use the fish flash cards to assign each student 1 fish to research. Students can then choose 2 other fish to research. Tell students that each of them will become a “Fish Expert” on 3 species of fish. They will learn about 3 kinds of fish and help other students identify those fish when they are caught. Ask students to go to either the freshwater or marine aquatic species websites, in the materials list, depending on where you will be fishing or what fish they might be curious about, and either assign each student 2 additional fish or allow students to choose 2 additional fish from the websites to fill in the fish matrix. The goal is to get information to help students identify what they catch, so the more fish descriptions you have the better. Students will fill in the fish matrix with

information about fish characteristics and adaptations as they do their research. Each student will present their research to the class and help identify and classify any fish on the bulletin board that have not yet been identified.

For High School

Students will become experts on 3 or 4 closely related species and will learn how to tell them apart. **Examples:** Longnose, spotted, and short nosed gar; largemouth, smallmouth, and spotted bass; white bass, hybrid, and striped bass; channel, blue and flathead catfish; bluegill, green and pumpkin seed; or threadfin and gizzard shad.

Extension: Hold a Fish ID-A-Thon

Have students compete to see which student can identify the most different kinds of fish from photos taken from the Parks and Wildlife Websites. If you have something for a prize, it would be more fun. (Maybe packages of Fish Crackers or Gummy Worms)

3. Sharing What We Learned

Ask students to "share their expertise" with the class by presenting information on their three fish and their characteristics. Keep a list of fish identified and the names of the students who are the "fish expert" for those fish. When someone catches a fish of that type, the "fish expert" will help identify it.

4. Learning to Fish

If you would like to show a short video on learning to fish there are several related videos at the website found in the materials list for this activity. Each video is only about 3 minutes long. Sometimes it helps students to see what to do and then try it themselves.

Distribute one copy of *Fishing Instructions* for each student.

Have students read Fishing Instructions—class time may be provided or reading may be assigned as homework in advance of class. Have students keep the instructions in their science journals for use on the field study day.

5. Safety Precautions

Have students work in groups of 4 to make a list in their science journals of safety precautions that they need to know in order to be safe when fishing. Remind students of appropriate dress for outdoor activities including: hats, sunglasses, sunscreen, etc.

Vocabulary

- Anal
- Anterior
- Anus
- Bony rays
- Caudal

- Dorsal
- Gills
- Heart
- Intestine
- Kidney
- Liver
- Operculum
- Ovary
- Pectoral
- Pelvic
- Posterior
- Ribs
- Spine
- Stomach
- Swim bladder

Student page

Texas Fish and Their Characteristics
Comparison Matrix

Species	Average Size Weight Length	Niche in the Food Web Predator or Prey	Coloration Adaptation Advantage	Adaptation Advantage	Adaptation Advantage
Example: Channel Catfish	20-40 lbs. 24 in.	Predator	Slate blue on the back shading to white on the belly-camouflage	Males guard the nest to protect eggs and young–better survival rate	Upper jaw protrudes to help in catching prey

Student page

FISHING INSTRUCTIONS

Safety Alert:

1. Handle rod carefully at all times.
2. Carry rod with both hands and hold rod tip up. Secure hook in rod guide and tighten the line so the hook cannot swing around.
3. Lean the pole so that it will not fall over, or have a friend hold the pole to bait hook.
4. Before casting, look behind you and to the side to see that no one is near.
5. Never leave hooks baited when you are not fishing. Pets and wildlife can find the bait and get hooked.

Fishing

6. Cast your lure into the water. When the lure has stopped, turn the handle of the reel once or twice to make your line tight.
7. Now wait for a fish to bite.
8. If you are using a bobber and your bobber jiggles, plunges downward or skates across the water, you have a bite. If you are holding your fishing pole, you may feel a tap, a tug or a pull, or the line may go slack.
9. When you suspect a bite, set the hook with a powerful upward jerk of the rod.
10. Keep the rod up high, so your arms and the bend of the fishing pole absorb some of the power of the fighting fish.
11. Small fish can probably be reeled in directly, but if the fish is a large one, trying to haul it in quickly will only break the line. For big fish, allow the fish to swim away, taking line from the reel. (The reel will probably be making a strange sound.) When you can, lift the rod tip up to pull the fish closer, and as you lower the rod tip, reel up any excess line you that you can, repeating this process "pumps" the fish closer.
12. Repeat this process until the fish is close enough to reach.
13. You can draw fish up the bank with your fishing rod until it is close enough to grab by hand, or by backing slowly away from the water.
14. Don't let fish flop on the ground. They could injure themselves. Dip your hands in water prior to picking up a fish. This protects the fish so that your hand doesn't remove the slime layer. Don't put fingers in their gills or eyes. Be careful not to hook yourself when you grab the fish.
15. The fins of sunfishes and bass become rigid when the fish is threatened. Slide your hand down over the fins of small fish starting from the head to lay the spines down and hold them firmly (wetting your hands first). Grasp larger fish over the back of the head, above the gills. Bass, crappie, and small catfish can be safely held by putting your thumb into their mouth, and pinching their lower lip. For catfish, protect

yourself by holding the fish from the underside, with your fingers firmly beneath the pectoral spines. Remember, the barbels are harmless.

16. Immobilize fish by holding them upside down. Remove the hook by hand or with needle-nose pliers. If the fish is hooked deeply in the gills or stomach where the hook cannot easily be removed, clip the line as close to the hook as possible. The hook will fall out after a time, with minimal damage to the fish.
17. Measure the fish from the tip of the snout to the end of the tail, with the fish laid flat and the tail lobes pressed together. Weigh and identify the fish quickly and make a data table to record bait, tackle and location caught.
18. Release fish as soon as possible. The longer the fish remains out of the water, the less its chances of surviving. Stressed fish, often just sit there in the water without moving. Fish can often be revived if you hold them upright in the water, and move them slowly back and forth, until they can swim away under their own power. Fish have a good chance of surviving after being caught many times, if they are handled carefully.
19. If the line becomes snagged, ask for adult help. Carefully pull or cut the snagged line. Jerking the line is dangerous and may result in a hook flying through the air.

Lesson 13.3: Reading and Research

Essential Concept

Fishing requires knowledge of fish and their habitat, niches, food webs, and communities. Fishing has rules and requires ethical behavior in order to protect the environment and living things in it.

Objectives

1. Students will read the chapter and answer the questions.
2. Students will make a drawing showing their fishing strategy and the habitat of the kind of fish they would like to catch.

TEKS

6.2 C; 6.12 E; 7.2 C; 7.10 A; 7.13 A; 8.2 C; 8.11 A, B, C

Aquatic Science: 2 J; 10 A; 12 C, D

Environmental Science: 2 K; 9 A, E, G

Estimated Time

Varies—class time may be provided or reading may be assigned as homework. Allow at least 40 minutes for in-class questions and discussion, and drawing diagram.

Materials

Student Guide

Science journals

Pens/pencils

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 does it mean to think like a fish?

It means that you use what you have learned about fish, habitats, food webs, niches, trophic levels, and aquatic ecosystems to help improve your fishing success.

2) How can knowing about aquatic communities and food webs be used to improve fishing success?

Use bait that looks or smells like a fish's natural food. Cast your line where you think fish are feeding. Fish may scour the bottom, hunt near the surface or swim anywhere between. Their need for cover attracts them to structures such as rocks, logs and plants. Fish use cover to escape predators and to help them ambush prey. Ask yourself, "If I were a fish, where could I hide from enemies and find food?"

3) How can knowledge of fish adaptations be used to improve fishing success?

- Bluegill have a small mouth because they eat small insects.
- Channel catfish are adapted to feed at night. They depend on barbels or "whiskers" with many taste buds and a good sense of smell to guide them to food even in dark, muddy waters. They can taste food even before taking it into their mouths.
- Largemouth bass are predators. Their large mouths enable them easily to catch frogs, fish, crayfish and other animals.
- All fish are nearsighted, but the placement and shape of their eyes allows them to see almost all the way around their bodies.
- Lateral lines let them sense water vibrations coming from each direction.
- Fish have good hearing, but they are especially good at hearing low-frequency sounds. "Keep quiet or you'll scare away the fish" is good advice when you're on a fishing trip.

4) What is cover for fish and why is it important in fishing? What weather factors improve fishing success?

Cover is the place that a fish might hide from predators or wait for prey to swim near. Structures such as rocks, logs, docks, coral reefs, undercut banks, and aquatic plant beds provide cover for fish.

Weather affects fish, but not always in predictable ways. Fish seem to prefer eating during the low light conditions of morning and evening rather than in the bright sun of midday. Cloud cover mimics these low-light periods and may help get fish to bite. A light to moderate wind is often better than no wind. Fish will move into shallower water to feed in windy conditions.

5) List at least five observations that would help an angler be successful?

- The edge of a lake's shoreline zone usually produces the most fish.
- In rivers, fish often feed where the flow changes direction or slows down.
- In flowing water, there is less current near the bottom. Because of this, many fish in fast-flowing streams rest with their bellies almost touching the bottom or tend to rest downstream behind rocks where they are shielded from current. Most fish in a river face the flow of water and wait for food to come to them. Fish in current rarely move

far for food.

- Look for minnows or signs of other prey such as sounds of frogs jumping, or small fish splashing, or look for birds eating small fish or for hatching insects.
- Young fish can find protection from larger fish and other predators by staying in the plant-filled shallow water of wetlands.

6) Why are rules about how many fish you are allowed to catch important?

These rules help Texans share limited resources and keep our ecosystems healthy. Length limits give fish a chance to grow and spawn before people are allowed to catch and keep them. Number limits assure that no one takes too many. Taking too many of a particular species can upset the balance in the food web affecting all organisms in the community. Rules about fishing limits can help us to make sure our aquatic ecosystems and other resources stay diverse, balanced and healthy far into the future.

7) What is an ethical angler? What are some important things an ethical angler does?

Ethical people use good judgment, respect property rights, and respect the rights of others who are using the water. Ethical behavior includes picking up your trash, collecting and properly disposal of fishing line, never dumping any pollutants, never releasing live bait fish into the water, and carefully handling and releasing alive all fish you catch but do not intend to keep. Ethical anglers value and respect the aquatic environment and all living things in it.

8) How do anglers contribute to fish conservation?

To learn more about conserving Texas' aquatic resources, visit the Texas Parks and Wildlife Department's web site. You can also visit your local TPWD office or a nature conservation center.

- Better yet, go outside and visit your favorite local aquatic resource.
- Begin thinking of it as YOUR lake, pond, river, stream, wetland or estuary.
- Always bring a trash bag when you visit, and take a moment to leave the spot in better shape than you found it.
- Report invasive species.
- Be a mentor and take someone fishing.
- Start or join a Stream Team and adopt a water body (you're not limited to streams). Learn more about checking water quality by taking a Stream Team Volunteer Water Quality Monitoring class.
- Volunteer to become a Master Naturalist.
- And if you're up to the challenge, choose a career in conservation and make aquatic resources your life's work.
- Above all, enjoy your aquatic resources and use them wisely!

3. Cast Beyond Tomorrow Question

Ask students to discuss the following question.

- **What are some things you can do as an angler to improve aquatic ecosystems for the future?**

4. Where Will I Fish?

Ask students to do some research to find 3 places nearby where they can fish.

- Find out how to get access to the place
- Tell what type of fish would be available
- Write directions to the site in their journals
- **What safety precautions would you need to take?**
- **Is there any other information or requirements you would need to know in order to fish at this place?**

Ask students to make drawings of themselves fishing. In the drawing show the underwater habitat of their fish and show where they would be on the surface and where to cast their line to catch the fish.

- **Why is where you cast your line important?**
- **What kind of fish would you try to catch?**
- **What strategy would you use to find the fish?**
- **What would be appropriate bait for your fish?**

Vocabulary

- Conservation
- Cover
- Ethical
- Ethics

Lesson 13.4: Fishing Line Experiment

Essential Concept

Fishing line has a test number that tells the amount of weight that it will take to break it. Because of its strength, leftover fishing line can be a hazard for many aquatic organisms when left behind. Fishing regulations include the importance of keeping fishing line out of the environment and other rules to help keep our aquatic ecosystems healthy.

Objectives

1. Students will design an experiment to test the strength of three types of fishing line.
2. Students compare actual strength of fishing line to advertised strength.
3. Students will play a game to learn about fishing regulations.
4. Students will discuss career requirements and opportunities with a game warden.

TEKS

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

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

Environmental Science: 1 A, B; 2 E, F, G, H, K; 3B, C, E; 4 B; 6 E; 9 G

Estimated Time

2 class periods

Materials

Texas Parks and Wildlife website with fishing regulations:

http://www.tpwd.state.tx.us/regulations/fish_hunt/#fish.html

1 copy of the *Scavenger Hunt for Texas Fishing Regulations* for each student

Science journals

Pencils/pens

3 types of fishing line of different strengths

For each group of 4 students

(Possible materials that might be suggested by students)

Scissors

Metric ruler

5 gallon buckets, or other container

Scales

250 ml. measuring cup, beaker, or graduated cylinder

Water

Tree limb or other strong place to hang buckets

Special Instructions

If time allows, invite a local game warden to come and talk about the fishing regulations and careers.

Safety Precautions

Activities use heavy weight, be sure that the weight is suspended close to the ground (no more than 20 cm.) and keep students back at least 6 feet so as not to have weight fall on students' feet.

Procedure

1. Testing Tensile Strength of Fishing Line

Each package of fishing line has a test number listed on the package. Usually it is stated in pounds and kilograms. This information is provided to let anglers know how much weight it takes to break the line. It is called **tensile strength.** Tensile strength is the amount of tension from a force that a material will withstand before it breaks, tears, or stretches.

- **How could you test fishing lines to find out if they actually hold the weight that the package claims.**

Put this question on the board and ask students to generate some ideas for testing their fishing line. Write down all ideas students generate. Help students evaluate each idea. Work with the class to come up with one method for their experiment.

Discuss controlling variables.

To be able to compare two different experiments only one variable may be changed. Everything else must be the same. **For Example:** The type of knot used to tie the line to a weight must be held the same on all trials. Discuss the fact that if all groups conduct the same experiment using the same method, it is like repeating the experiment several times. Repetition of the experiment provides a more reliable answer than only doing the experiment once.

Divide the class into groups of four and have them conduct the experiment. Students should develop a table to record their results. Have students graph their results for all 3 types of fishing line. Students should draw conclusions based on the data that they collect. When all students have completed the experiment, have them share their information with the class. Find class averages for each type of fishing line. Graph the average results for each type of fishing line compared to the advertised strength on the box.

- **Did all fishing line hold the weight described in the promotional materials on the package?**
- **Did all groups get similar answers?** (If one group's data doesn't agree with the data of other groups, discuss why the differences may exist.)
- **Did they follow the same procedures?**
- **Did they measure carefully?**

Discuss outliers and how we treat incongruous data.

- **Why is the tensile strength of fishing line important?** (Students will probably say that it helps the angler know if his line will hold a big fish.)

If they don't think of environmental implications, ask:

- **What is the importance of the strength of fishing line to the environment?** (Any fishing line left behind is a hazard for all living things in an aquatic environment. Because it is so strong, it is difficult for an animal to get untangled from it or break loose from it. It can also get hung on things under water and make it difficult for the animal to move around and find food.)

Extension

Anglers have to tie a lot of knots. Perhaps have the class learn a few fishing knots and conduct strength experiments on different knots. Use the same type of fishing line for every trial. They should find that some knots are much stronger than others and that some people tie better knots than other people. This is a variable that needs to be controlled. The same person should tie all knots in order to have results that can be compared. Some knots that you might try include, the normal square knot, the improved clinch knot, Palomar, Trilene knot, etc.

2. Fishing Regulations

Have students go to the website in the materials list. It will take you to *Recreational Fishing and Hunting Regulations*. Put in "fishing line" in the Search box. It will take you to a page where you will find "TPWD: Fishing Ethics: Do the Right Thing" will be the second thing down. Click on it and scroll down to "Conserve Fish and Aquatic Ecosystems".

Under #2 is the regulation. "Place excess **fishing line**, bait boxes, and litter in trashcans or pack it out with you. A major cause of injury for fish and wildlife along waterways is getting tangled in abandoned **fishing line**, not to mention that people and boat propellers can also get tangled."

There are other important fishing regulations that we need to know about. We will do a scavenger hunt to find out what some of these regulations are. Hand out the *Scavenger Hunt for Texas Fishing Regulations.* Have students use the TPWD website for the scavenger hunt: http://www.tpwd.state.tx.us/regulations/fish_hunt/#fish.html

3. **Guest Speaker**

Invite a Game Warden or Texas Parks and Wildlife Angler Educator to come to answer questions about fishing rules and talk about careers.

Vocabulary

- Regulations
- Tensile strength

Student Page

SCAVENGER HUNT FOR TEXAS FISHING REGULATIONS

Directions

Find answers to questions or complete the statements on fishing rules using the *Texas General Fishing Rules* on: http://www.tpwd.state.tx.us/regulations/fish_hunt/#fish.html

Use the **Search** box as needed to help you.

Permits General Information

1. At what age must you have a fishing permit? _____
2. Do you need a fishing permit to fish in a pond or lake completely located on your own property? _____
3. Do you need a fishing permit to fish in a river that passes through your property? ____
4. Does a Texas resident who is mentally disabled need to purchase a fishing permit to be legal to fish? _____

Texas Fishing Permits

1. How much does a resident fishing permit cost? _____
2. Who can buy a lifetime fishing permit? _____

Length and Bag Limits for Fish

1. What is the length limit of a largemouth black bass caught in Texas? ____
2. What is the daily bag limit on a flathead catfish? _____
3. What is the length limit on walleye?_____
4. What is the length limit for red drum? _____
5. Can you keep a 35-inch red drum? _____

Name five Texas freshwater fish.

1. _____
2. _____
3. _____
4. _____
5. _____

Do You Know the Fishes of Texas?

Identify and match the following Texas fish to the description given:

(There is one extra fish in the list.)

A. Amberjack

B. Bluegill

C. Flounder

D. Tarpon

E. Red drum

F. Spotted seatrout

G. Channel catfish

1. These fish have a dark spot at the base of the dorsal fin, vertical bars on their sides, and a relatively small mouth. The back and upper sides are usually dark olive green blending to lavender, brown, copper, or orange on the sides, and reddish-orange or yellow on the belly. Colors are more intense in breeding males, and vertical bars may take on a reddish hue.

2. Males of this fish average 19 inches (48 cm) in length. Females are 25 inches (63 cm) long on average. Males and females weigh 2 to 3 pounds (1 to 1.3 kg). Distinguishing characteristics include a dark gray or green back and silvery-white below, with distinct round spots on back, fins and tail; black margin along the edge of tail; soft dorsal (back) fin with no scales; and one or two prominent canine teeth usually present at the tip of the upper jaw.

3. The most distinguishing mark on this fish is one large black spot on the upper part of the tail base. Having multiple spots is not uncommon for this fish but having no spots is extremely rare. Its colro ranges from a deep blackish, coppery color to nearly silver. The most common color is reddish-bronze. It is a fast growing fish reaching approximately 11 inches and one pound in its first year, 17-22 inches and 3 1/2 pounds in two years, and 22-24 inches and 6-8 pounds in three years. prefer shallow waters (1-4 feet deep) along the edges of bays with submerged vegetation such as seagrasses. They are found over all bottom types but they seem to prefer areas with submerged vegetation and soft mud. These fish are also commonly found around oyster reefs.

4. This fish is compressed laterally and spend most of its life lying and swimming along the bottom on its side. The left side is always the "up" side. They grow rapidly and may reach 12 inches in length by the end of their first year. Males seldom exceed 12 inches, but females grow larger than males and often reach a length of 25 inches.

5. This is a large reef fish found in the Gulf. The back is bluish purple, the sides yellowish and the underside silver. They have a distinctive dark band on the sides of the head which angles from the front of the back fin, through the eye to the mouth. The tail fin is lunate or moon-shaped. Although they average about 20 pounds, they can weight in at more than 170 pounds. The Texas record is 115 bounds and 66.5 inches.

6. This fish has no scales, a single bony spine in each pectoral fin and the dorsal fin, and 8 barbels around the mouth. They have a deeply forked tail and the upper jaw is longer than the lower jaw. The dorsal and pectoral spines are sharp. They are typically 15-25 inches, can reach over 40 inches. Usually weigh 2-10 pounds, can reach 37 pounds.

All endangered fish species must be returned unharmed immediately to the water. Name two of these species in Texas.

1. _____

2. _____

***How to Measure a Fish (total length*)**

1. The total length of a catfish is measured from the _____ to the _____ with the mouth closed and the tail lobes pressed together.

Catch on to Catch-and-Release Fishing

Although practicing catch-and-release fishing is not a requirement, the regulations booklet provides guidelines anglers can follow that will increase a fish's chances of survival. In addition, if you catch an undersized fish, you get to practice "catch-and-release." Name two techniques for catch-and-release. Some possibilities include:

1. _____

2._____

SCAVENGER HUNT FOR TEXAS FISHING REGULATIONS
Answer Key

Permits General Information

1. At what age must you have a fishing permit? **17 years of age**

2. Do you need a fishing permit to fish in a pond or lake completely located on your own property? **No**

3. Do you need a fishing permit to fish in a river that passes through your property? **Yes**

4. Does a Texas resident who is mentally disabled need to purchase a fishing permit to be legal to fish? **No**

Texas Fishing Permits

1. How much does a resident fishing permit cost? **$11–$47**

2. Who can buy a lifetime fishing permit? **Any Texas resident**

Bag and Length Limits

1. What is the length limit of a largemouth black bass caught in Texas? ____14 inches___

2. What is the daily bag limit on a flathead catfish? _____5_____

3. What is the length limit on walleye? _No minimum_____

4. What is the length limit for red drum? _____3_____

5. Can you keep a 35-inch red drum? Only if you attach a Red Drum Tag

Name Texas freshwater fish.

Any five of the following:

Black bass (largemouth, smallmouth, spotted, Guadalupe)

Catfish (channel, blue, flathead, black bullhead, yellow bullhead)

Crappie (black, white)

White, yellow and striped bass

Bluegill, sunfish, carp, buffalo, drum, gar

Paddlefish

Trout (rainbow and brown)

Do You Know the Fishes of Texas?

Identify and match the following Texas fish to the description given:

A. Amberjack

B. Bluegill

C. Flounder

D. Tarpon

E. Red drum

F. Spotted seatrout

G. Channel catfish

1. These fish have a dark spot at the base of the dorsal fin, vertical bars on their sides, and a relatively small mouth. The back and upper sides are usually dark olive green blending to lavender, brown, copper, or orange on the sides, and reddish-orange or yellow on the belly. Colors are more intense in breeding males, and vertical bars may take on a reddish hue.

   B. Bluegill

2. Males of this fish average 19 inches (48 cm) in length. Females are 25 inches (63 cm) long on average. Males and females weigh 2 to 3 pounds (1 to 1.3 kg). Distinguishing characteristics include a dark gray or green back and silvery-white below, with distinct round spots on back, fins and tail; black margin along the edge of tail; soft dorsal (back) fin with no scales; and one or two prominent canine teeth usually present at the tip of the upper jaw.

   F. Spotted seatrout

3. The most distinguishing mark on this fish is one large black spot on the upper part of the tail base. Having multiple spots is not uncommon for this fish but having no spots is extremely rare. Its color ranges from a deep blackish, coppery color to nearly silver. The most common color is reddish-bronze. It is a fast growing fish reaching approximately 11 inches and one pound in its first year, 17-22 inches and 3 1/2 pounds in two years, and 22-24 inches and 6-8 pounds in three years. prefer shallow waters (1-4 feet deep) along the edges of bays with submerged vegetation such as seagrasses. They are found over all bottom types but they seem to prefer areas with submerged vegetation and soft mud. These fish are also commonly found around oyster reefs.

   E. Red drum

4. This fish is compressed laterally and spend most of its life lying and swimming along the bottom on its side. The left side is always the "up" side. They grow rapidly and may reach 12 inches in length by the end of their first year. Males seldom exceed 12 inches, but females grow larger than males and often reach a length of 25 inches.

   C. Flounder

5. This is a large reef fish found in the Gulf. The back is bluish purple, the sides yellowish and the underside silver. They have a distinctive dark band on the sides of the head which angles from the front of the back fin, through the eye to the mouth. The tail fin is lunate or moon-shaped. Although they average about 20 pounds, they can weight in at more than 170 pounds. The Texas record is 115 bounds and 66.5 inches.

   A. Amberjack

6. This fish has no scales, a single bony spine in each pectoral fin and the dorsal fin, and 8 barbels around the mouth. They have a deeply forked tail and the upper jaw is longer than the lower jaw. The dorsal and pectoral spines are sharp. They are typically 15-25 inches, can reach over 40 inches. Usually weigh 2-10 pounds, can reach 37 pounds.

   G. Channel catfish

All endangered fish species must be returned unharmed immediately to the water. Name two of these species in Texas.

smalltooth sawfish; fountain darters; Big Bend, San Marcos, Pecos or Clear Creek gambusia; or Leon Springs or Comanche Springs pupfish

How to Measure a Fish (total length)

1. The total length of a fish is measured from the **tip of the snout to the end of the tail** with the mouth closed and the tail lobes pressed together.

Catch on to Catch-and-Release Fishing

Although practicing catch-and-release fishing is not a requirement, the regulations booklet provides guidelines anglers can follow that will increase a fish's chances of survival. In addition, if you catch an undersized fish, you get to practice "catch-and-release." Name two techniques for catch-and-release. Some possibilities include:

- **Minimize the time fish is out of the water (no longer than you can hold your breath).**
- **Use barbless hooks.**
- **Avoid removing the slime/mucus layer, which protects fish from parasites and infections. Wet your hands before handling the fish.**
- **Avoid excessive handling of the fish.**
- **Do not squeeze or drop the fish.**
- **Don't put your fingers in the fish's gills or eye sockets.**
- **Place fish in the water, gently supporting the mid-section and tail until it swims away.**

Lesson 13.5: Fish Sampling and Ecosystem Assessment

Essential Concept

Fishing helps us learn about aquatic environments.

Objectives

1. Students will conduct a field investigation to find out what fish live in their local aquatic ecosystem.
2. Students will compare adaptations of fish in their sample.
3. Students will use safe practices and conservation of resources in the field.
4. Students will collect data and record information in tables.
5. Students will draw conclusions based on data.
6. Students demonstrate the use of course apparatuses, equipment, techniques, and procedures.
7. Students collect quantitative data from an aquatic environment, including pH, dissolved oxygen, salinity, temperature, mineral content, nitrogen compounds, and turbidity.
8. Students will identify ways human activity can affect aquatic environments.
9. Students will predict effects on the living and nonliving components of an aquatic ecosystem of chemical, organic, physical, and thermal changes caused by humans.
10. Students will analyze the cumulative impact of human population growth on an aquatic system.
11. Students use safe practices and conservation of resources in the lab and field.

In Addition High School Students:

12. Will continue recording weather and chemical and physical characteristics of their local aquatic ecosystem for their long-term study.
13. Will assess water quality in a local watershed.

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; 7.10 A; 7.11 A; 7.13 A; 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, H, J; 5 A, B, C, D; 7 C; 10 A, B; 11 A, B; 12 A, B, C, D

Environmental Science: 1 A, B; 2 E, F, G, H, I, K; 4 A, B, E; 5 A, B, C; 7 A, C, D; 8 A; 9 A, B, C, E

Estimated Time

Depending on the distance to the site, the field trip could take from 1 class period to 1 full day.

Materials

May vary depending on the site chosen for the field trip. It could be to freshwater or saltwater.

Rods and reels

Bait

Lures

Casting Instructions

Fishing Instructions

Field Guides

First Aid Kit

Science Journals

Pencils/pens

Copies of *Fish Matrix* or data tables to record fish caught

Invertebrate Sampling:

Bug Picking Water Quality Indicators

In bays or estuaries, use a field guide to identify the invertebrates collected

Seines and nets including D-frame aquatic dip net and kick seine

Containers for specimen such as:

White trays

Ice cube trays

Hand magnifiers or magnifier boxes

Forceps

Water Chemistry Tests

Salinity test, and other water chemistry test kits

Safety goggles

Gloves

In addition, high school students should continue to collect data for their long-term study.

Weather and Water Temperature

Thermometers and weather instruments

Physical Water Quality Indicators check sheet

High school students should also have:

Secchi disc, stopwatch, tennis ball or piece of wood

Safety Precautions

Remind students of safety precautions in the field.

Procedure

1. Fishing

To cut down on the number of rods and reels that you need, you may want to have students in two or three groups For these activities, it is best to practice catch and release fishing. Use pliers to mash down the barbs on hooks to facilitate releasing the fish. While one group is fishing, another group can collect and identify invertebrates, and a third group can test water chemistry. You will need at least three adult leaders to guide these groups. Then groups can switch so that all students have an opportunity to participate in all activities.

Ask students to determine what fish live in the nearest local aquatic ecosystem by collecting fish from various places in the ecosystem. Ask student "Fish Experts" to help identify fish caught. Record Size and adaptations in the *Fish Matrix*. Record bait, tackle, and location (near brush, in open water, etc.) in *Fishing Data* table.

- **How many different types of fish were caught by your group? By the whole class?**
- **Was there a difference in numbers of fish caught at different times of the day? Why or why not?**
- **Were more fish caught in some locations than in other locations? Why or why not?**
- **Was one kind of bait more successful in catching fish than other baits? Why or why not?**
- **Were you surprised by how many or how few fish you caught? What is the most important component of fishing as a sport?** (Patience)

Note: Is students do not catch any fish, you might wish to try seining to get a few to identify.

2. Invertebrate Sampling

For Freshwater: Using the *Bug Picking Sheet* assess the health of the aquatic ecosystem based on the aquatic invertebrates found there. Tally numbers of each invertebrate collected.

For Saltwater: If you are in a saltwater ecosystem, you will find very different invertebrates. Use a field guide to help you identify them, make a data table in your science journal, and tally the numbers of invertebrates collected or observed.

- **Which organisms live in riffles, pools, near banks, on the bottom, and in channels of their stream or in the estuary or bay and what adaptations do they have for life in that habitat?**

Ask students to compare adaptations of organisms from different habitats.

- **What do the invertebrates found in the environment tell you about the quality of the water and habitat?**

3. Water Chemistry

Use the water testing kits to find the salinity, pH, nitrates, phosphorus, dissolved oxygen and other water chemistry results.

Have students conduct tests and make data tables in their science journals to record results.

- **What do the water chemistry tests tell you about conditions in the ecosystem?**
- **Answer the following questions in your journal:**
- **What human uses do you observe along the aquatic ecosystem?**
- **How might these human uses affect the organisms in the aquatic ecosystem?**
- **What effects on the living and nonliving components of an aquatic ecosystem would you predict given chemical, organic, physical, and/or thermal changes caused by humans in this area?**
- **What do you see as the cumulative impact of human population growth on this aquatic system?**

Have high School students continue recording weather and chemical and physical characteristics of their aquatic ecosystem for their long-term study.

4. Field Study Data and Report

Ask students to record data and observations in appropriate tables for their science journals. When you return to the classroom ask students to analyze their observations and other data to draw conclusions about the quality of the aquatic ecosystem, and any human caused pollution noted. Use this information to write a report on your field investigation. You may wish to have students make reports individually, or you may wish to have each group make a report to which all members of the group contribute. Use the *Field Report Rubric* for grading. Give the rubric to students before they take part in the field trip so they know what is expected of them on the field trip and in their reports.

Vocabulary

- Bay
- Channel
- Estuary
- Macro-invertebrates
- Marsh

- Pool
- Riffle
- Riparian zone
- Salinity
- Streambed
- Stream bottom
- Stream order

Student page

Rubric for Field Trip and Field Reports

I. Works well with cooperative group. 25 points

1. Gets along with others.
2. Takes part in discussions, but doesn't take over.
3. Completes assigned task for the group.
4. Helps develop data tables.
5. Helps draw conclusions.

II. Takes part in field activities and keeps Science Journal up to date. 25 points

1. Presents data clearly and neatly in tables and graphs.
2. Develops tables with appropriate headings.
3. Develops graphs with appropriate headings, labels, and intervals for data.
4. Includes sufficient detail in journal entries.

III. Uses data to make generalizations. 30 points

1. Discusses data with group.
2. Draws logical conclusions supported by the group's data.
3. Writes accurate field report including:
   A. Summary of what was done on the field study including a sentence about the purpose of the field study.
   B. Summary of observations made and data collected.
   C. Reasonable conclusions drawn from observations. Is there other information you need to know about the aquatic ecosystem studied? How could you obtain that information?
   D. Evaluate techniques used for gathering and recording data. Is there something you could improve in your next field study? Were there potential sources for error? How might this affect your conclusions?
   E. What environmental problems did you find? How could you help solve the problem or conserve the aquatic ecosystem you studied?

IV. Final Product 20 points

1. Science Journal is neat.
2. All entries are neatly written in clear language.
3. Written entries are correctly spelled.
4. Math is accurately computed.
5. Area around field site is cleaned-up.

Total Possible Points 100 points

Student Page

Fishing Field Trip

Answer the following questions in your journal:

Fish

1. How many different types of fish were caught by your group? By the whole class?
2. Was there a difference in numbers of fish caught at different times of the day? Why or why not?
3. Were more fish caught in some locations than in other locations? Why or why not?
4. Was one kind of bait more successful in catching fish than others? Why or why not?

Aquatic Invertebrates

For Freshwater: Using the *Bug Picking Sheet* assess the health of the aquatic ecosystem based on the aquatic invertebrates found. Tally numbers of each invertebrate collected.

For Saltwater: If you are in a saltwater ecosystem, you will find very different invertebrates. Use a field guide to help you identify them, tally numbers of each invertebrate collected or observed, and answer the questions.

1. Which organisms live in riffles, pools, near banks, and in channels of their stream or in the estuary or bay and what adaptations do they have for life in that habitat?
2. Compare adaptations of organisms from different habitats.
3. What do the invertebrates found in the environment tell you about the quality of the water and habitat?

Weather and Water Chemistry

1. What happens in this aquatic ecosystem when not enough rain falls?
2. What might happen to this ecosystem if urbanization expands to this area?
3. What might happen to the ecosystem if flood, hurricane or other event hit this area?
4. If the results of your tests and observations indicate pollution in this aquatic ecosystem, what might have caused it? What types of pollution did you detect?
5. Did you see evidence of habitat restoration or other conservation measures?

Human Uses of Habitat

1. What human uses do you observe along the aquatic ecosystem?
2. How might these human uses affect the organisms in the aquatic ecosystem?
3. What affects on the living and nonliving components of an aquatic ecosystem would you predict given chemical, organic, physical, and/or thermal changes caused by humans in this area?
4. What do you see as the cumulative impact of human population growth on this area?

Student page

Texas Fish and Their Characteristics
Comparison Matrix

Species	Average Size Weight Length	Niche in the Food Web Predator or Prey	Coloration Adaptation Advantage	Adaptation Advantage	Adaptation Advantage
Example: Channel Catfish	20-40 lbs. 24 in.	Predator	Slate blue on the back shading to white on the belly-camouflage	Males guard the nest to protect eggs and young–better survival rate	Upper jaw protrudes to help in catching prey

Student page

Fishing Data

Name of Fish	Bait Used	Tackle Used	Location Caught

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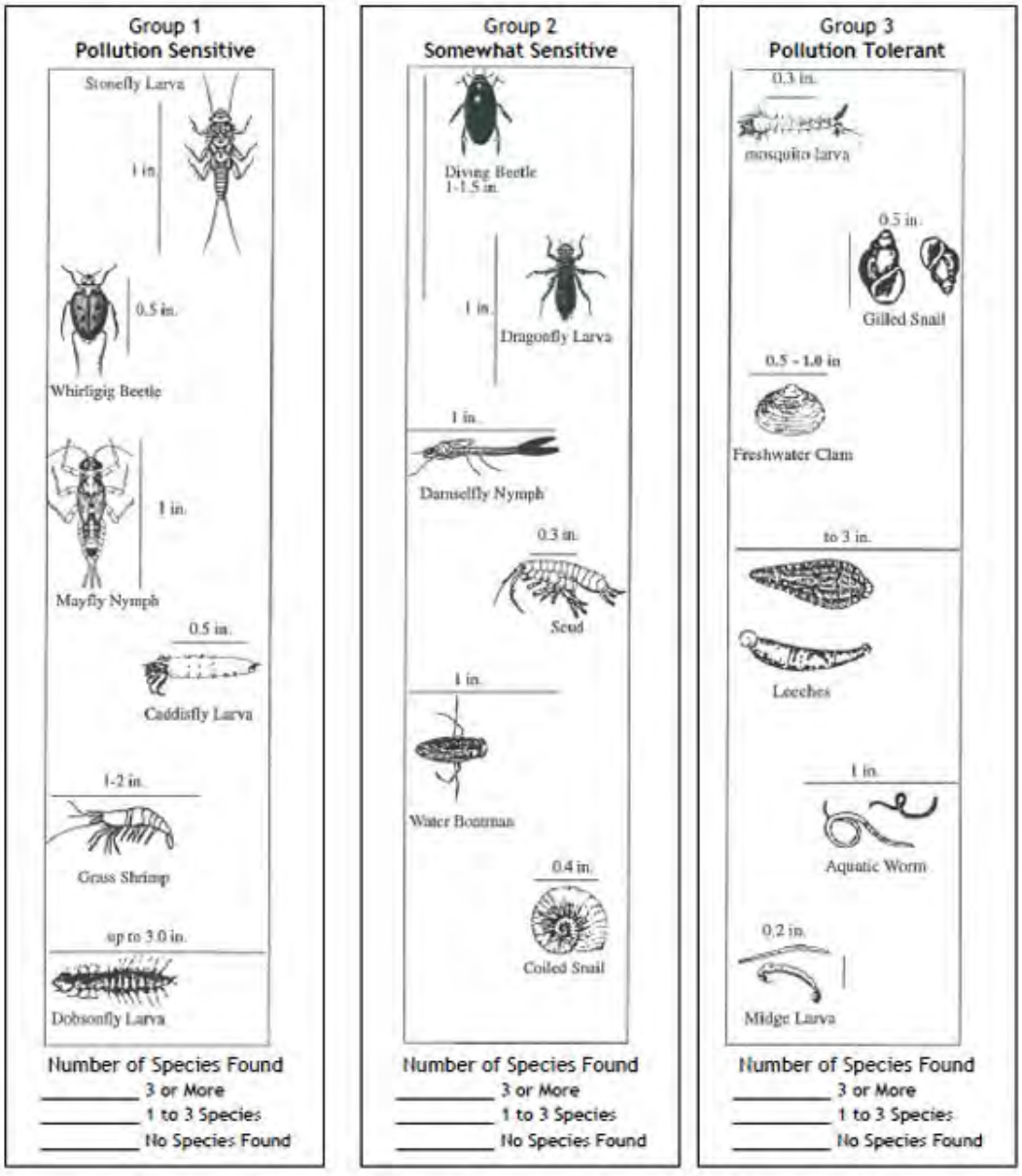
Note: Bug Picking Data Sheet courtesy of Texas Parks and Wildlife Department

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**

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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.

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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 13 Assessment

Directions

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

1. How do weather conditions affect fishing success?

- **A** Hot weather makes fish seek cooler water.
- **B** Not always in easily predictable ways
- **C** Snow and ice guarantee fishing success.
- **D** Both A and B

2. Fish in flowing water tend to face:

- **A** Upstream
- **B** Downstream
- **C** Perpendicular to the current
- **D** No particular direction

3. The best time to fish is:

- **A** Mid-day
- **B** Morning and evening
- **C** When there is no wind blowing
- **D** From 2 to 4 p.m.

4. Aquatic resource conservation is:

- **A** Best left to professionals
- **B** Limited to certain times of the year
- **C** Unnecessary because Texas has plenty of water
- **D** Everyone's responsibility

Apply your knowledge of these species' adaptations and their roles in the transfer of energy in Texas' aquatic food webs to predict the best bait or lure to use to catch:

5. Largemouth bass

- **A** Live minnow
- **B** Bare treble hook
- **C** Plastic worm dipped in stink bait
- **D** Artificial fly that mimics a mayfly

6. Bluegill

A Live minnow

B Bare treble hook

C Plastic worm dipped in stink bait

D Artificial fly that mimics a mayfly

7. Channel catfish

A Live minnow

B Bare treble hook

C Plastic worm dipped in stink bait

D Artificial fly that mimics a mayfly

Apply your knowledge of these species' adaptations and habitat needs to predict where to find:

8. Largemouth bass

A In a shallow weedy area

B In weeds adjacent to open water

C In a big hole in an underwater log on the bottom of a pond

D Open water zone of a lake

9. Bluegill

A In a shallow weedy area

B In weeds adjacent to open water

C In a big hole in an underwater log on the bottom of a pond

D Open water zone of a lake

10. Channel catfish

A In a shallow weedy area

B In weeds adjacent to open water

C In a big hole in an underwater log on the bottom of a pond

D Open water zone of a lake

Chapter 13 Assessment Directions

Write your own answer for each of the following questions.

1. More effective fishing methods represent a technological solution to the problem of obtaining food for humans. Predict how this could have both potential benefits and drawbacks such as risks or unintended consequences to aquatic ecosystems.

2. Justify the following statement: Fishing regulations, limits, and seasons are among the best solutions to preventing overuse of fishery resources and allow all Texans to enjoy fishing.

3. Apply your knowledge to recommend another solution to potentially harmful environmental changes within aquatic ecosystems in Texas.

4. Tell one way to make science experiments more reliable and why this is important.

5. Explain an everyday occurrence that illustrates Newton's Laws of Motion.

   Explain where the forces are operating, the direction of the forces, and the direction of the motion.

Chapter 13 Assessment Answer Key

Multiple-choice questions

1. How do weather conditions affect fishing success?

B Not always in easily predictable ways

2. Fish in flowing water tend to face

A Upstream

3. The best time to fish is

B Morning and evening

4. Aquatic resource conservation is

D Everyone's responsibility

Apply your knowledge of these species' adaptations and their roles in the transfer of energy in Texas aquatic food webs to predict the best bait or lure to use to catch:

5. Largemouth bass

A Live minnow

6. Bluegill

D Artificial fly that mimics a mayfly

7. Channel catfish

C Plastic worm dipped in stink bait

Apply your knowledge of these species' adaptations and habitat needs to predict where to find:

8. Largemouth bass

B In weeds adjacent to open water

9. Bluegill

A In a shallow weedy area

10. Channel catfish

C In a big hole in an underwater log on the bottom of a pond

Write-in questions

1. More effective fishing methods represent a technological solution to the problem of obtaining food for humans. Predict how this could have both benefits and drawbacks such as risks or unintended consequences to aquatic ecosystems.

Answers may include:

Potential benefits:

More effective fishing methods could lead to easier to obtain, cheaper and more abundant food. This could provide better nutrition and greater health for humans. This could result in wealth accumulation and population growth. Less time and energy spent pursuing food could allow time and energy to be spent developing technology, art and culture.

Potential drawbacks:

More effective fishing methods could lead to over-exploitation of the resource, or over-fishing—taking out more fish than natural processes can replenish. Over-fishing could result in a decline in fish populations and destabilization of the ecosystem. Fish and other species in the aquatic community could decline or become extinct. Humans could exceed their carrying capacity in the region and also begin to decline.

2. Justify the following statement: Fishing regulations, limits and seasons are among the best solutions to preventing overuse of fishery resources and allow all Texans to enjoy fishing.

Answers may include:

Fishing regulations, limits and seasons help Texans share limited resources and keep our ecosystems healthy.

- **Rules protect species by limiting the time of year during which they may be taken.**
- **Length limits give fish a chance to grow and spawn before people are allowed to catch and keep them.**
- **Number limits assure that no one takes too many.**
- **Texas' rules are based on scientific data and research provided by fisheries biologists. The regulations, limits and seasons they prescribe can help us to make sure our aquatic ecosystems and other resources stay diverse, balanced and healthy far into the future. The greater the biodiversity in an ecosystem, the healthier, more sustainable and better balanced it is, and the more resilient it is to potentially harmful environmental changes.**

3. Apply your knowledge to recommend another solution to potentially harmful environmental changes within aquatic ecosystems in Texas.

Answers vary but may include some of the following:

- **Always bring a trash bag when visiting aquatic resources, and take a moment to leave the spot in better shape than you found it.**
- **Avoid spilling and never dump any pollutants, such as gasoline or oil, into the aquatic environment.**
- **Be careful not to harm fish when doing catch-and-release fishing. Wet hands before handling fish. Carefully handle and release alive all fish that are unwanted or not allowed, as well as other animals that may be caught accidentally.**
- **Choose a career in conservation and make aquatic resources your life's work.**
- **Follow rules of ethical conduct in the use of aquatic resources and teach others to do so, too.**
- **Get involved with nature—go outside and visit local aquatic resources.**
- **Join a Texas Stream Team and help clean up a stream.**
- **Keep buffer zones of plant growth around water bodies.**
- **Keep no more fish than needed for eating, and never waste fish.**
- **Learn and obey angling and boating rules, and treat other anglers, boaters and property owners with courtesy and respect.**
- **Learn more about watershed conservation.**
- **Learn to check water quality.**
- **Practice good watershed management by stopping excess erosion and runoff loaded with fertilizers, pesticides or other pollutants.**
- **Put all trash, including used lines, leaders and hooks, in proper containers and help to keep fishing sites litter-free.**
- **Replenish fish populations by hatchery spawning and stocking.**
- **Respect property rights, and never go on to private lands or waters without permission.**
- **Support enforcement of water laws and rules that penalize polluters.**
- **Take action to prevent the spread of invasive plants and animals, and never dump live bait into the water.**
- **Take part in conservation activities.**
- **Value and respect the aquatic environment and all living things in it.**
- **Visit a Texas Parks and Wildlife office or a conservation nature center.**
- **Volunteer to become a Master Naturalist.**
- **Work to pass legislation protecting aquatic ecosystems in Texas.**
- **Work with Ducks Unlimited and other citizen conservation groups to protect and restore wetlands.**

- **Work with farmers, ranchers and other land users to help them prevent erosion, improve water quality, manage nutrients and protect and preserve wildlife habitat.**
- **Become part of a Texas Stream Team.**

4. Tell one way to make science experiments more reliable and why this is important.

Repeating an experiment either by the same researcher or by other researchers using the same procedure should provide us with the same or similar results. If it doesn't, either the procedure was not followed exactly, something being tested did not remain constant, or the experiment does not answer the question we were investigating. Repeating the experiment is important because it helps us know that our results are accurate.

5. Explain an everyday occurrence that illustrates Newton's Laws of Motion.

Explain where the forces are operating, the direction of the forces, and the direction of the motion.

The illustration in the lesson is casting a fishing line, but others are acceptable.

We apply a force to the fishing rod, using our body by pulling the rod back, and then moving the arm forward. As the rod moves forward the line swings, too. We exert a force holding the reel still. As we swing, we release the button holding the reel from moving and the line begins to unwind. The hook, bait, sinker, and bobber (float) attached to the end of the line fly high into the air away from you. The force of gravity takes over, pulling the hook, bait, sinker, and bobber back toward Earth. They splash into the water. We overcame inertia, by applying a force (our swing), the hook, bait, sinker, and bobber accelerated out from us. Gravity exerted another force and pulled the hook, bait, sinker, and bobber down toward Earth where they entered the water. The action was the swing we gave to start the motion. When the hook, bait, and sinker enter the water they sink until they reach the end of the line between them and the bobber, at which point we will see a reaction as the bobber bobs in the water suspending the hook, bait, and sinker in the water.