Lakes and Ponds

Lakes and ponds provide habitat for many plants, insects, fish, birds and other wildlife, and important recreational opportunities for Texans.

Chapter 9

Grade Levels/Courses

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

Chapter Objectives

Students will:

1. Use what they know to Think-Pair-Share ideas on differences and similarities between lakes and ponds and rivers and streams.
2. Make a Venn diagram showing the similarities and differences between lakes and ponds, and rivers and streams.
3. Read the student guide and answer the questions.
4. Examine the future of water resources in Texas.
5. Diagram the parts of a lake and explain how biotic and abiotic factors that make up the lake ecosystem function together, including how depth zones determine where populations of species live in the lake.
6. Compare and contrast the characteristics of plants adapted to living in lakes and ponds to those of terrestrial species.
7. Predict the impact of storm water runoff on the organisms in a pond ecosystem.
8. Describe how technological solutions to problems, such as dams, intensive agriculture, and urban development, can have risks and unintended consequences.
9. Describe possible solutions to potentially harmful environmental changes within a pond ecosystem.
10. Build a model of pond succession.
11. Conduct an investigation observing and describing changes in an environment when some components are changed.
12. Collect and record data of how their model changes over time.
13. Make a poster, drawing, or PowerPoint presentation of the process of pond succession.
14. Predict the impact of manmade and natural disturbances on lakes and ponds.
15. Take part in a simulation of the introduction of an invasive species to a lake.

16. Synthesize information to produce a rap, song, poem, public service announcement, brochure, or other product to inform the public about invasive species and ways to combat their spread.
17. Describe energy transfer in a pond food web.
18. Observe microorganisms under a microscope.
19. Record observations.
20. Make drawings of microorganisms.
21. State that all organisms are made up of one or more cells.
22. Identify the basic characteristics of organisms including prokaryotic/eukaryotic; unicellular/multi-cellular; autotrophic/heterotrophic, and classify them in the currently recognized kingdoms.
23. Differentiate between structure and function in plant and animal cell organelles including cell membrane, cell wall, nucleus, chloroplast, cytoplasm, mitochondria, and vacuole.
24. Describe producer/consumer, predator/prey, and parasite/host relationships as they occur in food webs in freshwater.

Texas Essential Knowledge and Skills in Science

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

Aquatic Science: 1 A, B; 2 E, F, G, H, I, J; 4 B; 5 C, D; 10 B; 12 A

Environmental Science: 1 A, B; 2 E, F, G, I, K; 4 D, F; 8 A, D

Materials Needed

Activity 9.1

Student science journals

Pencils/pens

Chalkboard, whiteboard, or chart paper with appropriate writing implements

Activity 9.2

Student Guide

Science journals

Pencils/pens

Activity 9.3

For each Group of 4 Students

Small clear plastic terrarium, or lettuce box

Bottom of a Petri dish or other small container

Gravel

Soil

Water

Spray or squirt bottle

Aquatic plant

Birdseed

Flower seeds such as sunflower seeds

Activity 9.4

A large playing field outside where students can have free movement without bumping into others.

Nametags for each student

Each nametag should have zebra mussels on the back

There should be 10 nametags with larval fish on the front

10 nametags with native mussels on the front

10 nametags with larger fish on the front

In addition, there should be 3 diving duck nametags with nothing on the back

150 blue poker chips or laminated poster board squares to represent dissolved oxygen

150 red poker chips or laminated poster board squares to represent zooplankton

Plastic quart size bags for each student to use to collect game pieces

Chalkboard, whiteboard, or chart paper

Student journals

Pencils/pens

Activity 9.5

Beaker or mayonnaise jar

Dried grass

Pond water

Pipette/eyedroppers

Antibacterial soap for clean-up

Containers of pond water with microorganisms or microorganisms purchased from science supply catalogs

Microscopes

Microscope slides

Cover slips for slides

Petri dishes

Corn syrup or quieting solution to slow down organisms (from science supply catalogs)

Field Guide such as Golden Guide's *Pond Life*

String or thread (optional)

Science journals

Pencils/pens

Safety Precautions

The *Aquatic Invasion* game is competitive. Be sure students are aware of others and there is no bumping or roughhousing.

Be sure to wash hands with anti-bacterial soap after handling cultures, which contain various bacteria. Also use Clorox wipes or diluted Clorox water to disinfect tables, counters and equipment.

Vocabulary

- Adaptation
- Antennae
- Biodiversity
- Cell membrane
- Cell wall
- Chloroplast
- Cilia
- Climax community
- Dams
- Dissolved oxygen
- Disturbance
- Ecological succession
- Erosion
- Eukaryotic
- Flagella
- Flowing water
- Invasive
- Lakes
- Microorganisms
- Mitochondria
- Multi-cellular
- Native species
- Nucleus

- Oxygen levels
- Photosynthesizing
- Phytoplankton
- Plankton
- Plant buffer
- Pollution
- Ponds
- Primary succession
- Prokaryotic
- Reservoir
- Runoff
- Secondary succession
- Still water
- Taxonomic
- Unicellular
- Vacuoles
- Watershed
- Zooplankton

Reference Material for Teachers

Brochure on preventive measures on Zebra Mussels and Boating
http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_br_k0700_1099.pdf

Enrichments

Project WET

- Macro-Invertebrate Mayhem

Project WILD Aquatic

- Glass Menagerie
- Micro Odyssey
- Pond Successions

Texas Parks and Wildlife

- Hello Invasives–Goodbye Lakes Activity

http://www.texasthestateofwater.org/screening/pdf_docs/Invasives%20Lesson%20Plan.pdf

Service Learning

- Storm drain stenciling
- Litter pickup

Lesson 9.1: Lake and Pond Characteristics

Essential Concept

Lakes and Ponds are standing water while rivers and streams are flowing water. Most lakes and ponds in Texas are formed by dams on rivers and streams and are reservoirs for water. Lakes and ponds, and rivers and streams all support a variety of aquatic organisms.

Objectives

1. Students will use what they know to Think-Pair-Share ideas on differences and similarities between lakes and ponds, and rivers and streams.
2. Students will make a Venn diagram showing the similarities and differences between lakes and ponds, and rivers and streams.

TEKS

6.2 C; 7.2 C; 8.2 C

Aquatic Science: 2 J

Environmental Science: 2 K

Estimated Time

30 minutes

Materials

Student science journals

Pencils/pens

Chalkboard, whiteboard, or chart paper with appropriate writing implements

Procedure

1. Think-Pair-Share

Think about what the differences are between Rivers and Streams, and Lakes and Ponds. Get with your partner and share your ideas. Combine all your ideas into one Venn diagram to share with the class.

2. Class Share

Draw a Venn diagram on the board. Ask each pair of student to add one thing from their Think-Pair-Share Venn diagram to the class diagram until all new ideas have been added. Have students copy the class Venn diagram in their science journals.

3. Looking Ahead

Explain to students that in this chapter they will learn about parts of lakes and ponds and their ecosystems. This chapter will help them understand what a lake ecosystem is and how it functions.

Vocabulary

- Dams
- Flowing water
- Lakes
- Ponds
- Reservoir
- Still water

Lesson 9.2: Reading and Research

Essential Concept

Lakes and ponds hold water for use by people, wildlife, livestock, and industry and have ecosystems with a variety of organisms.

Objectives

1. Students will read the student guide and answer the questions.
2. Students will draw a diagram of parts of a lake and explain how biotic and abiotic factors function together including how depth zones determine where species live in a lake.
3. Students will examine the future of water resources in Texas.

TEKS

6.2 C; 7.2 C; 8.2 C

Aquatic Science: 2 J

Environmental Science 2 K

Estimated Time

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

Materials

Student Guide

Science journals

Pencils/pens

Procedure

1. Reading the Chapter

Have students read Chapter 9: *Lakes and Ponds.* Introduce vocabulary terms as needed.

2. Answering the Questions

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

Questions to Consider

1) Where are ponds and lakes in your community? What role do they play in your economy?

If students do not know the lakes in your area, look on a map to find the local lakes. Lakes provide a wide variety of recreational opportunities from fishing and boating to swimming and water skiing, which bring money into the economy as people buy equipment and supplies.

2) What kind of organism makes up the greatest amount of living material in a pond?

Plankton makes up about 87 percent of the living material in a pond.

3) Besides providing food, what other roles do plants have in lake and pond ecosystems?

As plants move in, they sink their roots into the pond bottom and hold the soil, making the water even clearer and allowing more plants to grow at greater depths. Plants give off oxygen as a byproduct of photosynthesis. Small animals seek shelter among the plants and parts of plants growing underwater, which offer hiding places from predators. Plant beds serve both as shelter from predators and as a food source for insects.

4) How are plants that live under water similar to plants that live on land? How are they different?

Plants that live underwater are like plants that live above water. They need water, carbon dioxide, sunlight and nutrients such as phosphorous and nitrogen. But water plants have special adaptations that help them thrive in their underwater environment. Waxy or slimy coatings protect them from drying out when water levels drop. Porous stems or leaves let them absorb minerals right from the water.

5) How do oxygen levels in ponds change during each 24-hour period?

Oxygen levels in a pond are high while the sun is shining and plants are photosynthesizing, but they can drop dramatically at night.

6) How do ponds change over time?

As ponds age, they fill with sediment and organic material. They become smaller, shallower ponds. In time the pond will become a wetland, then as it fills even more, a meadow. This natural process is called pond succession.

7) How are lakes similar to ponds? How are they different?

Lakes are bigger than ponds. While lakes and ponds have much in common, a lake's larger size makes for some differences. In a lake, the amount of oxygen dissolved in the water stays pretty even over a 24-hour period. Wind on a lake can whip up high waves mixing air into the water. The ecology of the lake's shoreline zone is like a pond's ecology. A lake also has an open-water zone away from shore, as far down as sunlight reaches. Some species of fish spend most of their time in this zone, swimming into the shoreline zone now and then to feed or spawn. In the deep-water zone, below the open-

water zone, not enough light reaches the bottom for plants to grow. Dead organic matter sinks to the lake bottom, where bacteria and other decomposers break it down. Dissolved oxygen continues to be used for decomposition, but no surface water mixes with the deep water and no light penetrates to allow photosynthesis which would replenish oxygen, so deep water is low in dissolved oxygen. The temperature in a lake is fairly even from day to day in a given season. However, in summer, lake water is much warmer on top in the shoreline zone and the open-water zone than in the deep-water zone.

8) How can lakes and ponds be kept healthy?

Because every water body is a reflection of its watershed, good watershed management is important to keeping a pond healthy. Stopping excess erosion and runoff loaded with excessive amounts of fertilizers, pesticides or other pollutants is key. Keeping a 100-foot-wide buffer of thick plant growth around the pond helps filter out pollutants and eroded earth before they reach the pond. A plant buffer will greatly improve the pond's health and extend its life. The same is true for lakes.

3. Diagramming the Parts of a Lake

Using the information in the Student Guide, diagram the parts of a lake and explain how biotic and abiotic factors that make up the lake ecosystem function together, including how depth zones determine where populations of species live in the lake.

4. Challenge Questions

Engage students in a class discussion to think about lakes and the future of water resources in Texas by asking them to think about the following question:

- **What are the benefits and costs of building new reservoirs (dams for lakes) as a solution for Texas' future water needs? Consider the economy and the environment in your discussion.**

Vocabulary

- Erosion
- Lake
- Oxygen levels
- Photosynthesizing
- Plant buffer
- Pollution
- Pond
- Runoff
- Watershed

Lesson 9.3: Changing Environments
Pond Succession

Essential Concept

Ponds are dynamic systems, changing over time as sediments and decaying matter fill them in and succession turns ponds into meadows.

Objectives

1. Students will build a model of pond succession.
2. Students will conduct an investigation observing and describing changes in an environment when some components are changed.
3. Students will collect and record data of how their model changes over time.
4. Students will make a poster, drawing, or PowerPoint presentation of the process of pond succession.
5. Students will predict the impact of manmade and natural disturbances on lakes and ponds.

TEKS

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

Aquatic Science: 1 A, B; 2 E, F, H, J; 4 B; 12 A

Environmental Science: 1 A, B; 2 E, F, G, I, K; 4 D; 8 A, D

Estimated Time

1 class period to set up the model, 5-10 minutes per day for observations and data recording, 20 minutes for class discussion and time during class or as homework for the project

NOTE: It is suggested that the teacher set up their own model before asking the class to do this activity. Teachers will then be aware of problems and complications that may arise.

Materials

For each Group of 4 Students

Small clear plastic terrarium, or lettuce box

Bottom of a Petri dish or other small container

Gravel

Soil

Water

Spray or squirt bottle

Aquatic plant

Birdseed

Flower seeds such as sunflower seeds

Student journals

Pencils/pens

Computer with PowerPoint program (optional)

Procedure

1. Building the Model

Ask each group of students to use the materials to set up a terrarium model of a meadow with a small pond. Use masking tape to put your table number on the lettuce box. Spread a layer of gravel in the lettuce box for drainage and add about 4-5 cm of soil on top. Make a small indention in the soil for the Petri dish. The top of the Petri dish should be level with the soil. Sprinkle a small amount of soil in the bottom of the Petri dish and fill it with water to represent a pond. Put a small aquatic plant in the pond such as duck weed or algae. Scatter birdseed over the soil and in the pond to represent seeds blown into the area, and spray with water. Place the terrariums in a sunny window. Do not put a lid on the lettuce box. Water every 2-3 days by spraying with water. You may spray the pond as well as the meadow, but do not add extra water to the pond. Sprinkle a few grass seeds on both the meadow and pond every few days.

- **What external stimuli are the aquatic plants responding to?** (the amount of water in the environment)
- **What external stimuli are the seeds responding to?** (the amount of water in the environment, sunlight, soil)

Water will evaporate from the pond and after several days the pond will dry up and the aquatic plant will die. Grass seeds will begin to grow. Continue to add a few birdseeds and begin to add some sunflower seeds to the terrarium after a week to represent the transition from pond to meadow. Continue to spray with water (rainfall) to keep soil damp.

Have students develop a data table to keep a record of changes they make to the environment and responses they observe in the terrarium such as: the number of squirts of water, the number and types of seeds added to the model, and the number of days they observe the model, along with changes they observe in the model environment such as percent of soil covered with plants, amount of water in Petri dish, condition of the aquatic plant.

Students may keep the terrarium going for up to two weeks.

2. Disturbance and Regrowth

Discuss the results of the experiment with the class. Any process, whether natural or manmade, that changes something in the habitat is called a disturbance.

- **What disturbance happened in the model that caused the changes in the environment?** (less water in the pond, more seeds in the environment–soil may have washed into the pond during watering, some seeds may have sprouted and died causing eutrophication, decaying plants also helped fill the pond)

Succession is the word we use to describe the changes in the environment that change the ecology including all the interrelationships in an environment such as changing from a pond to grassland, or grassland to brush, and brush to a forest. Ecological succession is going on all the time, even if we do not notice it. Succession turns small ponds into dry land, changes meadows to brush land, and helps areas burned by fires to come back to green fields and new trees.

- **If the plant life is changing, what other changes do you think might happen with ecological succession in the real world? (**Each step along the way in a series of changes brings a new plant community into the environment. If this were happening in the real world, each new step in the succession would also bring new animals to fill the niches created in the environment.)

Primary succession happens when bare rock begins to break down through growth of lichens and mosses. It may take hundreds of years before a climax community such as a forest is reached.

A climax community is a late stage or final stage in the development of an ecological community where composition of plants and animals is relatively stable and well matched to environmental conditions. Climax communities can maintain themselves over long periods of time if there are no disturbances to the environmental conditions.

Secondary succession begins in a place where a disturbance has occurred either by a natural or manmade change to the environment. A climax community such as a forest may be reached in fewer years than in primary succession, but it is still a slow process.

- **How has the system in our model changed?** (Less water was available, causing loss of aquatic plants. Erosion of soil into the pond, making it shallower. Growth and decay of some seeds, and growth of more seeds as the environment in the pond changes from aquatic to terrestrial.)
- **How does succession restore habitats and ecosystems?** (Example: A stream cuts through a field, the stream becomes a river, the river meanders as it flows, a flood increases the flow rate and cuts off the meanders from the river creating an oxbow lake, a wetland is created, a drought comes drying up the lake, slowly grasses and brush grow restoring the field.)
- **What are some natural and manmade disturbances that might cause succession to take place?** (Fires, storms, floods, volcanic eruptions, drought, diversion of rivers, deforestation for lumbering, building of office buildings or homes, draining of wetlands, etc.)

3. Predicting Changes Due to Disturbances

- **What impact will storm water runoff cause for the organisms in a pond ecosystem?** (As water runs downhill through the pond's watershed, it picks up small bits of soil. This erosion brings sediment to the pond, replacing water with soil and creating more shallow areas. Decaying plants and animals fall to the pond bottom, adding to and enriching the sediment. Plants thrive in the rich sediment and take up more space. In time the pond will become a wetland, then as it fills even more, a meadow forms. The surface water that fills a pond also can bring pollution. Excess soil and plant nutrients can overload the water in the pond and unbalance its growth cycle. A common result of this imbalance is too much algae growth. Algae overgrowth makes the water cloudy and shades out rooted plants. When the excess algae die, it creates a lot of decomposing material that uses up oxygen and chokes fish. This can speed up pond succession.)
- **How is our model like real succession of a pond? How is it different? What are the limitations of our model?**

4. Using What We Learned

Ask students to make a poster, drawing, PowerPoint, or other visual representation of ecological succession in a pond. They should show at least 3 steps in the succession from pond to a grassland/meadow. Students should also include any animals they would expect to live in the area in each stage of succession represented in the three drawings.

Vocabulary

- Climax community
- Disturbance
- Ecological succession
- Primary succession
- Secondary succession
- Systems

Lesson 9.4: Aquatic Invasion

Essential Concept

Invasive species can take over an ecosystem if they are able to survive and reproduce and have few predators.

Objectives

1. Students will take part in a simulation of introduction of an invasive species to a lake.
2. Students will synthesize information to produce a rap, song, poem, public service announcement, brochure, or other product to inform the public about invasive species and ways to combat their spread.

TEKS

6.2 C, D, E; 6.3 B, C; 6.12 E; 7.2 C, D, E; 7.3 B, C; 8.2 C, D, E; 8.3 B, C; 8.11 B

Aquatic Science: 2 F, H, J

Environmental Science: 2 F, I, K; 4 F

Estimated Time

1 period for the simulation game and another class or homework for the project

Materials

A large playing field outside where students can have free movement without bumping into others.

Nametags for each student

Each nametag should have zebra mussels on the back.

There should be 10 nametags with larval fish on the front

10 nametags with native mussels on the front

10 nametags with larger fish on the front

In addition, there should be 3 diving duck nametags with nothing on the back.

150 blue poker chips or laminated poster board squares to represent dissolved oxygen

150 red poker chips or laminated poster board squares to represent zooplankton

Plastic quart size bags for each student to use to collect game pieces

Chalkboard, whiteboard, or chart paper

Student journals

Pencils/pens

Special Instructions

These amounts are for a class of 30 students. You can adjust the numbers of nametags and poker chips as needed to fit your class size. Write *Zebra Mussels* on the back of each nametag except the diving ducks. Laminate the nametags so that they can be reused.

Safety Precautions

This game is competitive. Be sure students are aware of others and there is no bumping or roughhousing.

Procedure

1. Aquatic Invasion Game

The object of the game is:
to get enough dissolved oxygen and zooplankton to survive.

Species	Survival Needs Dissolved Oxygen	Survival Needs Zooplankton
Larval Fish	6	6
Native Mussels	6	6
Larger Fish	10	10
Zebra Mussels*	2	2
Diving Ducks*		14

*These two species will participate later in the game.

Ask students to put on the nametags. Scatter the poker chips in a large area so all students have access to the game pieces.
The teacher should keep a record of the number of non-survivors for each round and the number of zebra mussels in each round for use later in a data table and graph.

Round One

At a signal from the teacher, the students scramble to collect as many game pieces (poker chips) as possible. When the teacher calls time (20 seconds), students determine which native organisms have survived based on the needs of each species for dissolved oxygen and zooplankton. Each animal must have at least the required number of each game piece to survive. Survivors remain the same species for the next round.

Round Two

Meanwhile a boat has been brought to the lake with zebra mussels on the hull. Each animal that did not survive can turn their nametag over and become zebra mussels and reenter the game.

Collect all the game pieces and scatter them again. Have students collect as many as possible in 20 seconds. At the end of Round Two, have each animal count the number of pieces they have collected and see if they survived.

Select three students from those that did not survive to become diving ducks. Any other animals that did not survive become zebra mussels.

Round Three

The diving ducks and the larger fish may collect food tokens as before and also can eat any of the other animals by tagging them and taking all the game pieces from each animal as it is tagged. The tagged animal that has been eaten is out of the game and must go to the sidelines.

The round is over when all of the game pieces have been eaten.

Students should count the number of survivors of each species and discuss why each survived. (Refer to the chart above.)

Ask students to make a data table including changing conditions in all rounds of the game, with the number of survivors of each species, and the number of zebra mussels for each round.

For more information on zebra mussels and other invasive species in Texas go to the Internet and look at www.TexasInvasives.org

2. Analyzing the Data

- **What was the impact of the zebra mussels on the native species?**
- **Why did the zebra mussels affect the large fish?**
- **How do zebra mussels destroy an ecosystem and its biodiversity?**
- **How could we keep zebra mussels out of lakes?** (Clean boats after use to remove all vegetation and zebra mussels, and wash equipment with a high pressure spray to remove microscopic larvae, drain water from boat, engine, bilge, live-wells, and bait buckets before leaving the lake, open all compartments and allow boat and trailer to dry completely for a week or more before visiting another lake or river.)
- **How is the simulation like the real invasion of a lake by a non-native species? How is it different?**
- **What are the limitations of our model?**

3. Using What We Learned

Ask students to work together in groups of 3 or 4 to develop a rap, song, poem, brochure, public service announcement, or other product to inform the public about the problems in lakes with invasive species such as zebra mussels, and how this invasion can be combated. Students may use information from Texas Parks and Wildlife or other information on the Internet to research an invasive species.

Vocabulary

- Biodiversity
- Dissolved oxygen
- Invasive
- Native species
- Zooplankton

Name tags for the Game

Larval Fish

Native Mussels

Diving Ducks

Larger Fish

Lesson 9.5: Microorganisms in Ponds

Essential Concept

Plankton is important in the food chain and is made up of many different types of very small organisms found in ponds.

Objectives

1. Students will observe microorganisms under a microscope.
2. Students will record observations.
3. Students will make drawings of microorganisms.
4. Students will state that all organisms are made up of one or more cells.
5. Students will identify the basic characteristics of organisms including prokaryotic/eukaryotic; unicellular/multi-cellular; autotrophic/heterotrophic, and classify them in the currently recognized kingdoms.
6. Students will differentiate between structure and function in plant and animal cell organelles including cell membrane, cell wall, nucleus, chloroplast, cytoplasm, and vacuole.
7. Students will describe producer/consumer, predator/prey, and parasite/host relationships as they occur in food webs in freshwater.

TEKS

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

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

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

Estimated Time

2 class periods and perhaps some homework to finish drawings

Materials

Beaker or mayonnaise jar

Dried grass

Pond water

Pipettes/eyedroppers

Antibacterial soap for clean-up

Containers of pond water with microorganisms, or microorganisms purchased from science supply catalogs

Microscopes

Microscope slides

Cover slips for slides

Petri dishes

Corn syrup or quieting solution to slow down organisms (available from science supply catalogs)

Field Guide such as Golden Guide's *Pond Life*

String/thread (optional)

Science journals

Pencils/pens

Special Instructions

Be sure the grass used for hay infusions has not had herbicides or pesticides The hay infusion needs to be made at least five to seven days in advance to obtain microorganisms. Ten to fourteen days will give you the most variety and density of organisms. Be sure to use a pipette to aerate the culture every day. In two to three weeks you should have several different types of organisms. You can continue adding pond water and new organisms will continue to develop including flagellates, ciliates, and diatoms during weeks four and five and amoeba and more flagellates in weeks nine and ten. Collect from different places in the culture to get the most variety of organisms (top, bottom, near debris, and middle of the jar).

Review microscope use with students. Note the importance of using the fine adjustment so as not to touch the cover slip with the lens.

Safety Precautions

Be sure to wash hands after handling cultures, which contain various bacteria. Also use Clorox wipes or diluted Clorox water to disinfect tables, counters and equipment.

Procedure

1. Getting Ready

You may wish to take students to a pond and collect water. If you are teaching aquatic science, students can also collect data for their long-term studies including weather, land use, invertebrates, water chemistry (dissolved oxygen, pH, nitrates, phosphorus, etc.) or other data that they have been collecting throughout the year. If you do not want students to collect, you can go to the pond and collect it yourself, or you can order microorganisms from science supply catalogues. You will need to order the organisms about a week in advance of this lesson to allow time for shipping. You can grow your own organisms in a hay infusion with dried grasses and a little pond water.

2. Hay Infusion Option

Put a handful of grass in the beaker or jar and add pond water. Put this in a place that will receive light, but not in direct sunlight since that will heat the water and reduce oxygen content.

Use a pipette to pump air into the jar to aerate the culture every day. Let the mixture incubate for 8-10 days at room temperature. Add more pond water if the water begins to evaporate.

Check the culture every two to three days to check on progress of microorganism growth. Be sure to wash hands with antibacterial soap after working with the culture in which bacteria will be growing. Bacteria are important as food for other microorganisms. Also disinfect equipment and countertops.

Use a pipette to collect small water samples from the top of the water, the bottom of the jar, and near the plants in the middle of the culture to find the widest variety of organisms. Look at each slide using various powers of magnification. If organism are moving too quickly to observe, add a drop of corn syrup to each sample or use quieting solution to slow them down. Look at the slide both before and after adding the corn syrup or quieting solution.

3. Pond Water/Option

Set up containers of pond water (Do not use tap water as chemicals will kill your organisms.) Students may put a little pond water in a Petri dish and collect organisms with eyedroppers. Or if you wish to collect and concentrate them ahead of time, you can set up containers using this technique several days before students will be using them.

- Suspend a slide in the pond water with a thin string or sewing thread.
- If the slide is plastic, you can make a hole at one end to tie the thread to the slide.
- If the slide is glass, tape the string to one end of the slide.
- Keep the slide and string from falling into the water by tying a pencil to the other end and placing it across the container.

Over several days microorganisms should collect on the slide. Dry one side of the slide and put a cover slip over the other side so that water will not get on your microscopes.

4. Review of Food Chains

You can connect this lesson to earlier lessons with a review of food chains/webs. You can pass out the cards from Lesson 5 to remind students of all the different parts of an aquatic food chain. Let each group put together at least one food chain with at least ten organisms and diagram it in their journals.

Pull the plankton cards out of the food webs. What phytoplankton do you have? (algae, diatoms) What zooplankton do you have? (rotifers, copepods, hydra, daphnia)

Ask students to recall the plankton (phytoplankton and zooplankton) that so many other animals depend on for food. The organisms that you look at today will provide some examples of the kinds of organisms that make-up the populations of plankton.

5. Micro-Organism Observations

In their science journals, ask students to write down questions that they have about microscopic organisms. Students may generate a variety of questions such as:

- **Is there more than one type of microscopic organism in the pond water?**
- **How many different kinds can we find?**
- **What do microorganisms look like?**
- **What are the different ways these organisms move?**
- **How do the organisms eat?**
- **Do the organisms have any sense organs that we can see (eyes, antennae, mouths, etc.)?**

Have each group share their questions with the class and use these to develop a list of class questions.

Ask students to work in groups of 2 or 3. While one student is using the microscope other students can be preparing their slides, making data tables, or drawing their organisms.

The groups should develop a table to record their observations including how each organism looks (color, shape, relative size, moving parts, or any other parts they can see).

- **How are the organisms acting? Are they just moving around randomly or are they looking for food or eating? If so, what are they eating?**
- **How do they move? Are they slow or fast, do they have appendages that help them move, are there flagella or cilia, etc.?**

Then students should try to identify their organism in a field guide (such as Golden Guide, *Pond Life*) or on the Internet.

Students should answer the class questions and the following questions.

- **How many different microorganisms were you able to isolate and identify?**
- **Which lens magnification was most helpful in viewing microorganisms?**

Have students identify the basic characteristics of microorganisms they observe.

- **Are these organisms prokaryotic or eukaryotic?**
- **Are they unicellular or multi-cellular?**
- **Are the organisms autotrophic or heterotrophic?**
- **What taxonomic kingdom do the organisms belong to?**
- **What adaptations do these organisms have? How do these adaptations help the organisms survive in an aquatic environment?**
- **Do you observe any predator/prey activity?**
- **Which organisms are producers and which are consumers?**

Ask students to look for parts of the cell in their organisms.

- **Can you see the cell membrane or cell wall?**
- **Are there chloroplasts?**

- **Can you see a nucleus?**
- **Do you see vacuoles?**
- **Can you find the mitochondria?**

6. Drawing Microorganisms

Ask each student in each group to choose one of the microorganisms and draw a picture of it showing its color, shape, and parts. Students should label parts that they saw in their observations.

Vocabulary

- Adaptation
- Antennae
- Cell membrane
- Cell wall
- Chloroplast
- Cilia
- Eukaryotic
- Flagella
- Microorganisms
- Mitochondria
- Multi-cellular
- Nucleus
- Phytoplankton
- Plankton
- Prokaryotic
- Taxonomic
- Unicellular
- Vacuoles
- Zooplankton

Chapter 9: Assessment

Directions

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

1. Predict the impact of sediment and nutrients brought by storm water runoff on a lake or pond ecosystem.

A Lake water would rise.

B There would be no long-term damage.

C Pond succession would speed up.

D All of the above.

2. Predict the oxygen level in a pond.

A The amount of oxygen dissolved in the water stays pretty even over a 24-hour period.

B The water is too deep for plants to grow on the bottom, making it oxygen poor.

C Oxygen levels are high each day while the sun is shining and plants are photosynthesizing, but they can drop dramatically at night.

D None of the above.

3. Which of the following is important to slowing pond succession and keeping a pond healthy:

A Keeping a 100-foot-wide buffer of thick plant growth around the pond.

B Stopping excess erosion.

C Stopping runoff loaded with fertilizers, pesticides or other pollutants.

D All of the above.

4. A lake has most of its life:

A In a ring around the shoreline, reaching out as far as it can survive.

B In open-water zone away from shore, as far down as sunlight reaches.

C In the deep-water zone.

D Both A and C.

5. Plants living in lakes and ponds:

A Have long, thin, flexible stems that offer little resistance to the current and strong root systems to hold them in place.

B Include tiny, free-floating species of algae and are the food base of the ecosystem.

C Have waxy or slimy coatings protect them from drying out when water levels drop, and porous stems or leaves let them absorb minerals right from the water.

D Both B and C.

6. Plankton in ponds:

A Make up the base of pond food webs.

B Are tiny, often microscopic organisms.

C Make easy prey for other aquatic life.

D All of the above.

Chapter 9: Assessment

Directions

Write your own answer for each of the following:

1. Describe how technological solutions to problems can have risks and unintended consequences. Justify your answer by using one of the following as an example:

- Damming a stream to create a lake or pond
- Urban development in the watershed of a lake or pond
- Intensive agriculture (such as cattle or row crops) in the watershed of a lake or pond

2. Suggest a possible solution to potentially harmful environmental changes within a stream ecosystem caused by the technological solution you chose in the previous question.

3. On a separate sheet of paper, diagram the parts of a lake and explain how biotic and abiotic factors that make up the lake ecosystem function together.

4. What is the importance of lakes to Texas populations and to the economy?