From Sun to Sunfish

Aquatic habitats are communities in which complex interactions take place among populations and individual organisms as they compete for limited resources in an interdependent web of relationships.

Chapter 5

Grade Levels/Courses

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

Chapter Objectives

1. Examine the importance of interactions in a community.
2. Relate the interactions of their family in their community with interactions of aquatic organisms in the aquatic community.
3. Take part in a simulation of pond life including adaptation, competition, and limiting factors that reduce carrying capacity in an aquatic habitat.
4. Make a data table with results of changes in the habitat.
5. Synthesize information from the simulation to write a news story.
6. Predict the possible effects of changes in the numbers and types of organisms in an aquatic community on the populations of other organisms within the community.
7. Explain how populations of organisms and individuals within a community compete with one another for resources.
8. Recognize factors that affect the number and types of organisms an environment can support.
9. Explain how a technological solution to a problem can have both benefits and drawbacks such as risks or unintended consequences.
10. Read the student materials and answer the questions.
11. Research at least two fish and add their information to the *Comparison Matrix*.
12. Play a card game to learn about the niches of various organisms in an aquatic ecosystem.
13. Choose 5 organisms that interact in an aquatic system. Students will draw and label a diagram showing the organisms, their niches, and will use arrows to show how the organisms interact in an aquatic ecosystem.
14. Describe a specific example from an aquatic community in Texas of each of the following: producers, consumers, and decomposers. Explain the role each serves in the community.
15. Set up a system for observing and mapping organism behaviors in a native aquarium.

16. Make generalizations about organisms' behavior based on their data from observations and mapping.
17. Make hypotheses about causes of organisms' behavior during observations and mapping.
18. Compare data from observations and mapping with other groups.
19. Plan investigations to test their hypotheses.
20. Evaluate plans for investigations.
21. Conduct their investigations about aquatic organisms behavior and draw conclusions based on their data.
22. Diagram and describe the transfer of energy in an aquatic food web (or the trophic levels in a energy pyramid) in Texas, including producers, consumers, decomposers, scavengers, and predator/prey relationships. Be sure to include the source of energy for the aquatic ecosystem.
23. Students will investigate and explain the effects of energy transformation within an ecosystem in terms of the laws of thermodynamics.

Texas Essential Knowledge and Skills in Science

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

Aquatic Science: 1 A, B; 2 B, E, F, G, H, J; 3 A, D; 4 B; 5 C, D; 10 B; 11 A, B; 12 A, C

Environmental Science: 1 A, B; 2 B, E, F, G, I, K; 3 A, D; 4 A, B, F; 6 D, E; 7 A, D; 8 A; 9 A

Materials Needed

Activity 5.2

Poker chips: two red, two white and two blue chips for each student or (3 × 3 inch squares of colored poster board may substitute)

Sufficient space for students to stand arm's distance apart from one another

Small plastic bag for each student

Chart paper and markers to record results of changes

Science journals

Pencils/pens

Activity 5.3

Student Guide

Science journals

Pens or pencils

Internet and computer

Activity 5.4

For each group of 4 students

Copies of Information Cards from the *Aquatic Community Food Web Scramble* activity

Pictures from magazines or the Internet (optional)

Science journals

Pencils

Colored pencils/pens/markers (optional)

Activity 5.5

Native Aquarium(s) with at least 4 kinds of aquatic organisms

Clear overhead transparencies or cellophane

Tape

A variety of colors of Vis-à-Vis pens (4 colors for each group)

Science journals

Pencils

Timer/clock

Transparent tape

Activity 5.6

Aquatic Community Food Web Scramble information card for each species

Aquatic Community Food Web Scramble nametag for each species

Three 6-foot-long strands of yarn or cord per student

Science journals

Pens/pencils

Butcher paper in 6-foot length for each group, with a few extra in case of accidents

Tempera paint, watercolors, markers, or other art materials

Copies of *Energy Pyramid* chart

For High School

Science journal

Energy Pyramid Game Board

Aquatic Community Food Web Scramble information cards

Safety Precautions

Be sure that students understand that, while they are playing a competitive game, there should be no rough housing.

Vocabulary

- Abiotic
- Adapted
- Autotroph
- Biotic
- Carnivore
- Carrying capacity
- Community
- Compete
- Consumer
- Decomposer
- Energy pyramid
- Erosion
- Eutrophication
- Food chain
- Food web
- Habitat
- Herbivore
- Heterotroph
- Host
- Interact
- Invasive species
- Limiting factors
- Natural selection
- Niche
- Omnivore
- Overpopulation
- Parasite
- Plankton
- Population
- Predator
- Prey

- Producer
- Scavenger
- Sedimentation
- Trophic level

Enrichments

- Visit to an Aquarium

Project WET

- Water Address

Project WILD Aquatic

- Aquatic Times
- Designing a Habitat
- Migration Headache

Project WILD

- Oh, Deer! (Change deer to an aquatic species.)

Guest speakers:

- Aquatic biologist, to talk about energy transformation in an aquatic environment.
- Fisheries biologist, to talk about fisheries management and aquatic communities.
- Hatchery worker, to talk about hatchery spawning and aquatic communities.

Lesson 5.1: Interactions of Living Things

Essential Concept

All living things have needs that must be met in order to survive, and living things must interact with other living things in the community in order to meet their needs.

Objectives

1. Students will examine the importance of interactions in a community.
2. Students will relate the interactions of their family in their community with interactions of aquatic organisms in the aquatic community.

TEKS

6.12 E; 7.13 A; 8.11 A, B

Aquatic Science: 11 A

Environmental Science: 6 E

Estimated Time

20 minutes

Materials

None

Procedure

1. Survival

All living things have certain things they need in order to survive.

- **What do <u>you</u> need to survive?** (Students may come up with a variety of things that they think they need such as a place to live, food, water, clothing, sleep, cars and gasoline for transportation, friends, family, various "indispensable" technological tools.)
- **Which needs are most urgent?** (Examples are food, water, shelter, and oxygen.) You may want to also include space to get the things we need.
- **How do you get those needs met in your daily lives?** (Oxygen is in the air in the space all around us, and requires healthy lungs to extract it. Parents, and sometimes students, work in the community to make money to provide food, water, and shelter.)
- **In the process of work what do you and your parents have to do in the community?** (Interact with other members of the community such as co-workers, bosses, etc.)

- **How is your family like a group of organisms in the aquatic community?** (Organisms in an aquatic community also have needs for survival including food, water, shelter, and oxygen. These aquatic organisms must also interact with other members of the aquatic community to obtain their survival needs.)
- **Can you think of some ways aquatic organisms interact?** (Producer/consumer, predator/prey, parasite/host, food chains and webs are interactions in which organisms depend on each other and may compete.)
- **What would happen if one or more of the things you need were in much shorter supply?** (For humans, when things are in short supply, they get more expensive. When things are expensive fewer people can afford to buy them. We compete more to make more money so we can afford the things we need to survive. Or we find other ways to get what we need such as growing a garden or raising chickens.)
- **How is this like an aquatic community?** (When things are in short supply, in nature, fewer aquatic organisms can get what they need. Organisms must compete more to get what they need. When this happens some animals leave the area, are eaten, use up all their energy seeking to get what they need, or die because their needs can no longer be met. This competition for a limited supply of food, water, shelter, and oxygen is what limits the numbers and types of aquatic organisms that can live in a particular aquatic ecosystem.)

Explain to the class that this chapter will help them understand how fish and other aquatic species interact to get the things they need to survive.

2. Using What We Learned

Ask students to write 1-3 sentences in their science journals about how organisms interact in an aquatic environment.

Vocabulary

- Community
- Compete
- Competition
- Interact

Lesson 5.2: Competition within Frio Pond Community

Essential Concept

Competition for basic survival needs is a basic part of living in an aquatic habitat.

Objectives

1. Students will take part in a simulation of pond life including adaptation, competition, and limiting factors that reduce carrying capacity in an aquatic habitat.
2. Students make a data table with results of changes in the habitat.
3. Students will synthesize information from the simulation to write a news story.
4. Students will explain how populations and individual organisms within a community compete with one another for resources, providing specific examples from an aquatic community of Texas.
5. Students will recognize factors that affect the number and types of organisms an environment can support.
6. Students will explain how a technological solution to a problem can have both benefits and drawbacks such as risks or unintended consequences.

TEKS

6.3 B, C; 6.12 E; 7.3 B, C; 8.3 B, C; 8.11 B

Aquatic Science: 2 H, J; 5 C, D; 11 B; 12 A, C

Environmental Science: 2 I, K; 4 F; 7 A; 8 A; 9 A

Estimated Time

1 class period

Materials

Poker chips: two red, two white and two blue chips for each student or (3 × 3 inch squares of colored poster board may substitute.)

Sufficient space for students to stand arm's distance apart from one another

Small plastic bag for each student

Chart paper and markers to record results of changes

Science journals

Pencils/pens

Special Instructions

If you laminate the poster board pieces, you can reuse them. Note: It usually works better to cut the squares before you laminate so that there are no uncovered edges, which can absorb moisture.

Safety Precautions

Be sure that students understand that, while this is a competitive game, there should be no rough housing.

Procedure

1. **Every Fish for Itself**

Tell students a story about Frio Pond. Frio Pond is a cool, clear pond surrounded by trees, grasses, and other plants. Today we will play a game where you will be a fish living in Frio Pond. You are searching your habitat for some of the things you need to survive.

- **What things will you need?** (Food, water, oxygen are the components of the game shelter and space are not being considered.)

The object of the game is to gather as many poker chips as possible. Each poker chip represents something fish need to survive. Red represents food, blue represents clean water, white represents oxygen. These are all survival needs that can change and limit the number of organisms and populations that can survive in the community. We call them limiting factors. Limiting factors affect the carrying capacity of the community and limit the population of specific species that can survive in the ecosystem.

Have the students stand arm's distance apart from one another. Give each student a small plastic bag.

Designate 1 student as a recorder and give them a marker and a data table on chart paper. (See data table at the end of this lesson

Rules:

- <u>One foot must remain in place at all times</u>. This represents the fact that fish have certain living conditions that they require and generally must remain in habitats with those living conditions.
- Students are not allowed to slide their foot across the ground and may not take a chip from another "fish" if they already have it in their "fin."
- Students may <u>gather only one chip at a time</u>. They must put that chip in their baggie before they can gather another chip. They may start gathering only when told to start and must stop when told to stop.
- Students will have <u>30 seconds</u> to gather their survival needs.
- All fish start over with each trial

Scatter the poker chips on the ground around the students so the chips are about 1-2 feet apart.

Say, “Go!”

After 30 seconds, tell the students to stop. Have students sort and count their chips.

Each fish must have at least two chips of each color in order to survive.

- **How many of their survival needs did each fish get?**
- **Do any fish lack a particular requirement?**
- **What might happen to a real fish that lacked one of its requirements for survival?**

Have the student recorder write the survival rate for “Initial Conditions” on the data table.

2. Fish Adaptations

Point out that not all fish have the same requirements. Some might be adapted to survive in water that is warmer or has less oxygen or is clouded with silt.

Gather the chips both from the ground and from the students.

Randomly designate 1 out of every 4 students as catfish.

Explain that catfish are adapted to survive in water that is warmer or has less oxygen or is clouded with silt. Therefore catfish need to gather only one white chip and one blue chip to survive. They will still need 2 red chips. (Refer students to Chapter 4 for information on catfish.)

Scatter chips and start a new round of the game.

- **How many catfish survived this round?**
- **How many other types of fish survived?**

Compare the survival rate between catfish and other fish. Have the recorder write the survival rates for “Catfish and Other Fish” on the data table

- **How did the populations change?**

3. Overpopulated Aquatic Ecosystem

Gather the chips both from the ground and from the students.

Have them stand together in groups of 3 to 5 with one foot touching the other students’ feet.

This represents a water body that is crowded or that lacks adequate living conditions, and is therefore past its carrying capacity.

- **What do we call the place where organisms find all the things they need to survive?** (habitat)

Scatter chips and start another round.

- **How many catfish and other fish survived?**

Record the survival rates for “Crowded/Poor Habitat” on the data table.

Compare the results of this round to those of the previous rounds. In most cases, students will notice that each fish gathered fewer of their survival needs.

- **How did the populations change?**
- **What can we conclude about a pond that is overcrowded with fish or has poor habitat?**

4. Eutrophication

Excess nutrients (nitrogen) from cattle manure runoff have caused an increase in plant growth in the water.

- **What do you predict will happen?** Ask students to write their predictions in their journals. (Algae will grow out of control, use up the nutrients, die and decay. The decay will use up much of the dissolved oxygen in the water. Refer students to Chapters 1–3.)

Gather the chips both from the ground and from the students and once again have them stand arm's distance apart from one another.

Take out half of the white chips, representing oxygen and redistribute the chips to begin another round.

Record the survival rates for aquatic ecosystem with eutrophication and resulting algae overgrowth on the chart.

- **How did the populations change?**

5. Erosion and Sedimentation Due to Construction

Careless construction in the watershed has caused rapid erosion.

- **What do you predict the effect will be on fish survival?** Ask students to record their predictions in their journals. (Sediment entering the water will clog gills of fish and reduce survival. Refer students to Chapters 1–3.)

Gather the chips both from the ground and from the students.

Take out half of the blue clean water chips.

Redistribute the remaining chips and start another round.

Record the survival rates for "Erosion and Sedimentation" on the chart.

- **How did the populations change?**

6. Invasive Species

A new predator species has appeared that eats the same food as native fish.

- What do we call these non-native species? (Invasive species)
- **What do you predict the effect will be on fish survival?** Ask students to write their predictions in their journals. (More predators in the ecosystem means less food available for native fish species.)

Gather the chips both from the ground and from the students.

Reduce the number of red food chips.

Redistribute remaining chips and start another round.

Record the survival rates for fish for “Invasive Species” on the chart.

- **How did the populations change?**

Gather the chips both from the ground and from the students.

Have students make a data table in their science journals and record the results for the game from the information recorded on chart paper.

7. Drawing Conclusion

- **What were the limiting factors in Frio Pond?** (Availability of oxygen, clean water, and food)
- **What helped some species survive when others could not?** (Adaptations)
- **What conditions changed to decrease carrying capacity?** (Overpopulation, eutrophication, invasive species, erosion, and sedimentation)
- **What was the resulting change in population due to each change in condition?**
- **How was the carrying capacity for Frio Pond affected by changes in the habitat?**
- **How was our game/simulation a model of what happens in a real pond?** (Conditions continually change in a real pond. We looked at various changes that might happen in the ecosystem and how these changes might affected the population of fish.)
- **How was the model limited?** (Size, number of variables affecting population in each round, number of species represented, etc.)
- **How could we improve our model to make it more like the real world?**

8. Using What We Learned: Writing a Newspaper Story

Have students write a newspaper article for the *Morning Fish Gazette* in their science journals telling the story of continuing disasters at Frio Pond. Students can have fun with the story, but must include all the pertinent information and causes and results of the disasters.

Students should include how populations of organisms within a community and individuals within a population compete for resources, and factors that affect the numbers and types of organisms that the ecosystem can support.

Give students the *Rubric for Newspaper Story about Frio Pond* before they start writing..

Vocabulary

- Adapted
- Carrying capacity
- Community
- Erosion
- Eutrophication

- Habitat
- Invasive species
- Limiting factors
- Model
- Overpopulation
- Population
- Sedimentation

Student Page

Continuing Disasters at Frio Pond
Rubric for Newspaper Story

I. Organization **Total 25 points**

1. Interesting beginning
2. Clear concise information
3. Organized in a logical way
4. Includes data table

II. Appearance **Total 20 points**

1. Neat, clean, attractive
2. Easy to read
3. Information easy to understand

III. Accuracy **Total 25 points**

1. Information is correct and communicated appropriately.
2. Correct grammar, punctuation, and spelling.
3. Include factors that limit numbers and types of organisms that the pond ecosystem can support.
4. Include information on how individuals within populations and populations within communities compete for resources.

IV. Critical Thinking **Total 30 points**

1. Conclusions are based on logical inferences and generalizations related to data collected.
2. Reasons for conclusions are stated.
3. Possible causes of changes in carrying capacity are discussed.
4. Results of habitat changes are discussed, specifically as they relate to survival rates of particular species
5. Ways to maintain healthy habitat are suggested.

Possible Grand Total` **100 points**

Student Page

Every Fish for Itself Data Table

Change in the Environment	Beginning Population	Population After Change
Trial 1: Control/Baseline	All Fish	All Fish
Trial 2: Adaptations	Catfish Other Fish	Catfish Other Fish
Trial 3: Overpopulation	Catfish Other Fish	Catfish Other Fish
Trial 4: Eutrophication	Catfish Other Fish	Catfish Other Fish
Trial 5: Erosion/Sedimentation	Catfish Other Fish	Catfish Other Fish
Trial 6: Invasive Species	Catfish Other Fish	Catfish Other Fish

Lesson 5.3: Student Reading and Research

Essential Concept

Organisms in an aquatic community fill a niche as they interact with other organisms and compete for survival in their habitat.

Objectives

1. Students will read the student materials.
2. Students will answer the questions.
3. Students will research at least two fish and add their information to the *Comparison Matrix*.
4. Students will use what they have learned about interrelationships of organisms in various niches in an ecosystem to take part in critical thinking about differences in food webs in various aquatic ecosystems (i.e., pond, estuary, Gulf of Mexico).

TEKS

6.12 D; 7.11 A; 8.11 A

Aquatic Ecosystems: 10 B

Environmental Systems: 4 A

Estimated Time

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

The Cast Beyond Tomorrow Question will take 30 minutes

Materials

Student Guide

Science journals

Pens or pencils

Internet and computer

Copies of Comparison Matrix

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 are some of the basic survival needs of all living things?

Most living things require food, water, oxygen, space, and shelter, or protection from the elements and from enemies to survive and grow. Plants make their own food (carbohydrates), but they need sunlight, carbon dioxide, water, and minerals to do so. Most vertebrates need periodic sleep or rest. Some bacteria don't need oxygen.

2) What is a population? What is a community?

A group of one kind of organism living in the same place at the same time is a population of that species. Different populations living in the same place interact with one another. A group of populations of different species living in the same place is called a community.

3) What is habitat? Why is it important? Why must organisms compete for resources? What is carrying capacity?

The physical environment that a species needs to survive is its habitat. Habitat is more than a place. Habitat provides the shelter a species uses to escape predators and the elements, as well as the space it needs for reproducing and for hunting, gathering or producing food. Habitat is important because it includes all the conditions a species needs to survive. Many aquatic plants and animals have very specific needs. They either can't move or can't live in another habitat. When resources in an environment are in short supply, individuals and populations must compete for them. Carrying capacity is the maximum number of individuals in a particular population that an environment can support. The limited biotic (living) and abiotic (non-living) resources in a habitat determine the environment's carrying capacity.

4) What is a niche? Why is it important? What are invasive species? Why are they a problem?

A species' niche includes its way of getting food, the habitat it needs, and the role it performs in the community. Within a community every species has a particular niche. Different species may have similar or even overlapping habitats, but no two species can occupy exactly the same niche in the same community for long.

Example of species, which inhabit specific niches. One species of fish eats insects from the surface. Another fish species eats insects from the bottom. Therefore, the niche is important so that organisms don't compete directly for food. If a new species of fish comes into the habitat and begins to also eat insects from the surface, it will directly compete with the first species of fish for food. Species can also compete for other habitat components such as shelter, space, oxygen, or water.

A species is called invasive if it has been brought (usually by human action) to a place where it did not live naturally, and has survived and expanded its population. When a non-native species can breed and sustain itself in the new habitat, then it may be a

problem because it competes with native species for habitat or food. This competition could make it harder for the native species to survive. Over time, this invasion can unbalance the community. As a result, native species could become endangered.

5) ***What is the source of energy for aquatic communities? How does energy circulate among organisms in an aquatic community?***

Aquatic communities run on sunlight. Energy circulates among organisms through feeding relationships (they eat one another).

6) ***What is a food chain? What is a food web? What is an energy pyramid? What is a trophic level?***

A food chain shows how energy moves from producers to primary consumers to secondary consumers, and so on. Food webs show how different food chains are interconnected. An energy pyramid is another way to look at feeding relationships. If you divide a pyramid into levels, you can see that the widest level is at the base and the narrowest one is at the top. The pyramid shape not only shows what eats what, but how much energy is available at each consumer level. Consumer levels are also known as trophic levels. The word "trophic" comes from a word that means "nourishment". So each trophic level shows a change in the type of nourishment used by the organisms. Producers use sunlight to help them create carbohydrates for nourishment. Primary consumers eat plants. Secondary consumers eat animals (and sometimes both plants and animals). Tertiary consumers (and levels above on the pyramid) are animals that may be top predators that usually don't have anything that hunts them for food once they have grown large. Humans are at the top of Earth's energy pyramid. Decomposers may eat dead plant or animal material or both and recycle nutrients back into the soil for plant use.

7) ***How do predator and prey species keep one another in balance in aquatic communities? What is natural selection?***

Both predator and prey are competing against one another for survival; the predator is seeking food, and the prey is trying to keep from being eaten. Predators play an important role by keeping populations of prey species within the habitat's carrying capacity. At the same time, the amount of prey available in a predator's habitat can limit the number of predators that can live there. Natural selection is the process by which some individuals in a population live to reproduce and some do not, based on their ability to survive and reproduce in their environment. In general, natural selection ensures that only the best-adapted individuals survive to pass on their genetic material.

3. Researching Aquatic Species for the Comparison Matrix

Ask students to look in the reading and find the information on Gizzard Shad and Flathead Catfish. Have students put information in their fish Comparison Matrix. For more information, have them go on the Internet to fill in what they need. They should add 2 other fish that they find interesting.

4. Cast Beyond Tomorrow Question

Students will discuss the question in small groups and then share their ideas with the class.

- **In what ways might food webs, food chains, and predator/prey relationships be different in a pond, an estuary, and the Gulf of Mexico?**

Ask students to write the question from their student guides in their notebooks and discuss their ideas in small groups for 5-10 minutes. Students should write in their journals at least one idea about food webs, food chains, and predator/prey relationships for each of the three ecosystems (pond, estuary, and Gulf of Mexico). If students don't know about estuaries, you may want to spend a few minutes discussing what an estuary is. (This is the area where fresh and saltwater mix and many types of animals have nurseries here. They are the source for fish, shrimp, crabs, etc.)

Ask each group to share their ideas with the class and record their ideas on the white board or an overhead. All students should make a table to record the information for each aquatic ecosystem.

- **What generalization can you make about the food webs in these aquatic ecosystems?** (The pond ecosystem is small and can support few types of organisms, the estuary is rich in habitats and nutrients and can support more types of organisms, the Gulf of Mexico is large and has many types of habitats, and therefore can support many, many types of organisms. Therefore the food webs of these aquatic habitats get increasingly complex (with many more different food chains and many types of predator/prey relationships) as the size, richness of habitat, and numbers of types of organisms increases.)

Vocabulary

- Carrying capacity
- Community
- Energy pyramid
- Food chain
- Food web
- Habitat
- Natural selection
- Niche
- Population
- Predator
- Prey
- Trophic level

Student Page

Comparison Matrix

Species	Average Size Weight Length Advantages & Disadvantages	Body Shape Adaptation Advantages & Disadvantages	Coloration Adaptation Advantages & Disadvantages	Mouth position and teeth Adaptation Advantages & Disadvantages	Method of movement Adaptation Advantages & Disadvantages	Other Adaptation Adaptation Advantages & Disadvantages

Lesson 5.4: What's My Niche?

Essential Concept

All organisms in an aquatic environment fill a particular niche. The niche is their role in the community.

Objectives

1. Students will play card games to learn about the niches of various organisms in an aquatic ecosystem.
2. Students will choose 5 organisms that interact in an aquatic ecosystem, then draw and label a diagram showing the organisms, and their niches, and will use arrows to show how the organisms interact in the aquatic ecosystem.
3. Students will describe a specific example from an aquatic community in Texas including each of the following: producer, consumer and decomposer and explain the role each serves in the community.

TEKS

6.2 C; 6.12 E; 7.2 C; 7.5 C; 8.2 C; 8.11 A

Aquatic Science: 2 J; 5 C, D; 11 A

Environmental Science: 2 K; 4 B

Estimated Time

1 class period

Materials

For each group of 4 students

Copies of Information Cards from the Food Web activity

Pictures from magazines or the Internet (optional)

Science journals

Pencils

Colored pencils/pens/markers (optional)

Special Instructions

You might ask students who would like, to help color the cards to make them more attractive. Then make color copies on cardstock, cut them apart and laminate them to make playing cards.

You will need one set of cards per group of 4 students for ***What's My Niche***.

For ***Aquatic Food Chains*** and ***Aquatic Connections*** use the same cards – with added cards for Nutrients, and Decomposers.

Teachers or students can make the new cards with drawings, words, or photos from magazines.

Make two copies of all of the information/game cards, except the Human card.

Make 5 copies of the Human card.

Make 10 copies of the nutrient cards and decomposer cards.

Laminating the cards will help protect them and make it possible to use them repeated times.

Procedure

1. **What's my Niche?**

Ask students to get in groups of 4. Give out one set of the information cards from the *Food Webs Scramble* in Activity 5.6 to each group.

This game can be played by 4 players or 2 teams and a moderator.

Rules for 4 players:

1) One player deals out all the cards, then the cards are put in a stacks face down.
2) Play moves to the right.
3) Players take turns turning over a picture of an organism to the other players.
4) The other players slap the card and the first one to slap gets a chance to get points.
5) The winner of the slap keeps his hand on the card to show the picture, but covers the information.
6) The winner of the slap gets 1 point for each of the following:
   - The name of the organism
   - Where the organism gets its energy (it's food)
   - Who eats the organism
   - The job the animal performs in the ecosystem (producer, consumer, decomposer, scavenger, parasite, host, prey, predator)
   - The location of the aquatic habitat it lives in (bottom, open water, near plants, etc.)

The original player then reads the card information to the group.

The answering player receives 1 point for each part of the niche of the organism that they can tell. There is a total possibility of 5 points per play. Students may not know a lot of the information at first, but will learn more as they play the game.

This game can be used at other times when students are waiting to do their aquarium observations or have finished their work.

Team Play

For more experienced players you can have 2 teams play, the moderator (teacher) shows the pictures to the teams and keeps score. If the pictures on the cards are too small, the teacher may need to use pictures from magazines or the Internet so students will be able to see them.

- The teams line up on each side of the room and take turns answering.
- The person who is playing can have 2 helpers who help them answer the questions (the 2 nearest neighbors).
- When their turn is over, the person goes to the end of the line and the next person moves up.
- The moderator shows a picture to the other team and again the player can have 2 helpers.
- Points are awarded as in the 2-player game. The Moderator keeps score on the board.

2. Aquatic Food Chains Game

Using the same cards – with added cards for Nutrients, and Decomposers.

Teachers or students can make the new cards with drawings or photos from magazines.

Make two copies of all of the information/game cards, except the Human card.

Make 5 copies of the Human card.

Make 10 copies of the nutrient cards and decomposer cards.

This game is for 3-6 players.

Basic rules:

1) Goal is to collect the most cards through completing food chains.
2) There will be cards in your HAND and cards in food chains on the table.
3) Once a card is played in a food chain it cannot be taken out of the chain.
4) Points:
    - All cards in food chains are worth 1 point.
    - All cards still in your hand at the end subtract 1 point.
    - A chain harvested by humans (meaning it ends with a human) is worth no points.
5) The game ends when no one can play anymore.
6) ***A "complete" food chain includes at least Nutrients, Producers, Consumers, and a Decomposer to end the chain (or a human card)***. ***Complete food chains can be said to "loop" also.***

To play the game, follow these steps in order.

<u>Set up</u>

1) 7 cards are dealt to each player
2) In this game players do not maintain 7 cards at all times. The number of cards in each hand changes.
3) Set remaining cards in the center of the table, face down as the draw pile.
4) With the 7 cards, each player lays down any food chain links they can make with their own cards.
5) Place cards on top of each other, the lowest thing on the food chain is played down first with the animal or plant that utilizes or eats it on top of it so that both card names can be seen. (Example: **nutrients cards** would be covered by **a producer card,** the producer card could be covered by an **insect that eats it,** etc.)
6) If you made a "complete" food chain. Set it aside upside down. It is done. No one can change this food chain.

<u>Playing – After the game is set up</u>

After everyone uses the cards they are dealt to make any food chains that they can. Then the turns start, each turn consist of 3 things in this order:

1) Draw one card and add it to your hand.
2) Add cards to the top or bottom of your own food chain ***or to another's food chain,*** **o**r make new chains (2 or more cards are needed to start a new chain)
   - Adding a card to another player's food chain allows you to steal their *whole chain*. Move it in front of you.
   - "Complete" chains cannot be stolen or played on once they are turned over.
   - Cards can only be added to one end of the chain at a time, not both ends in one turn.
   - There are no limits to how many cards can be played in a turn.
   - If playing a card allows a player to put two chains together, they can do that also.
3) After you have built as many food chains as you can, pick a predator (any secondary consumer) from your hand and demand food from the other players.

If you do not have a predator, draw till you get one.

Other players must give up one card that is eaten by this predator *if they have one*.

These cards are not placed on food chains in this turn, but are kept in your hand until the next turn.

Example: After playing, I hold up my bass card and say to one of my neighbors, "If you have a blue gill or crayfish feed me." I add the card to my hand for my next turn.

Your turn is over. If you completed a food chain, turn it upside down and set it aside for scoring later.

The next person's turn starts.

Human cards – these either can take cards away from the game (no points to anybody) or double points.

A **Human** card removes a food chain from play and no points are received for that food chain. Obviously you wouldn't want to do this to you OWN chains, but you might want to use it to nullify your neighbor's food chain.

If you add a human to someone's food chain, it doubles the points for that food chain, but those points go to you.

Ending the game

The game is over when all the cards are used or those left are unusable.

A player receives 1 point for every card in a food chain that is on the table, and 2 additional points for any completed food chains (nutrient to decomposer with at least 3 cards).

Cards still in a player's hand are minus 1 point each.

The winner is the player with the most points.

3. Aquatic Connections Game

This is a game for 2-3 players.

The goal of the game is to run out of cards in your hand first. Then cards in other people's hands give you points.

It takes several rounds to win this game.

A total score of 15 wins the game.

Set up

Deal 5 cards to each player, then place all remaining cards in a central pile face down.

Turn the top card of the draw pile and put it face up next to the draw pile for the first playing stack.

Playing

1) The first player draws a card from the face down deck of cards. If it directly interacts with the starter card (prey or predator side of the food chain), the card is placed on top of the starter card.
2) The player may play any number of cards from their hand after drawing one card from the deck
3) If a Nutrient card is drawn it is placed on the table to start another playing stack.

4) If the card has no direct interaction with any playing stack the player puts that card in their hand.
5) The next player draws a card and can play on any pile and can play any number of cards from their hand as well.

Special cards

- A Decomposer card does not end a chain as it did in the last game. It can be covered by a nutrients card and the cycle continues.
- When a Human card is played on a stack, players can no longer add to the stack. Turn that stack upside down.

Ending the game

When a player clears their hand, play stops and they receive a point for each card left in the other players' hands.

If the winning score isn't reached when the deck runs out, reshuffle the cards and play another round.

4. Applying What We Learned: An Aquatic Community Diagram

Ask students to draw a diagram in their journals showing at least ten organisms from a Texas aquatic community, whose niche they learned about in the games. They should label each organism and its niche and use arrows to show how the organisms interact in an aquatic community. Be sure to include the Sun, producers, consumers, and decomposers. **Examples:** Sun (source of energy), algae (producer), water boatman (herbivore), snails (herbivore), springtail (decomposer), mussel (scavenger) backswimmer (predator/carnivore), turtle (predator/carnivore), fish (predator/carnivore), leech (parasite on fish and turtles), human (omnivore)

Arrows should point from the source of the energy to the user of the energy (what is eaten to the eater).

Vocabulary

- Carnivore
- Community
- Consumer
- Decomposer
- Herbivore
- Host
- Niche
- Omnivore
- Parasite

- Predator
- Prey
- Producer
- Scavenger

Student Page

What's My Niche?

This game can be played by 4 players.

Rules for 4 players

1. One player deals out all the cards. Then the cards are put in a stacks face down.
2. Play moves to the right.
3. Players take turns turning over a picture of an organism to the other players.
4. The other players slap the card and the first one to slap gets a chance to get points.
5. The winner of the slap keeps his hand on the card to show the picture, but covers the information.
6. The winner of the slap gets 1 point for knowing each of the following.
   - The name of the organism
   - Where the organism gets its energy (it's food)
   - Who eats the organism
   - The job the animal performs in the ecosystem (producer, consumer, decomposer, scavenger, parasite, host, prey, predator)
   - The location of the aquatic habitat it lives in (bottom, open water, near plants, etc.)

The original player then reads the card information to the group.

The answering player receives 1 point for each part of the niche of the organism that they can tell. There is a total possibility of 5 points per play.

Student Page

Aquatic Food Chains

Use the same cards as for *What's My Niche* – with added cards for Nutrients, and Decomposers.

This game is for 3-6 players.

Basic rules:

1. Goal is to collect the most cards through completing food chains.
2. There will be cards in your HAND and cards in chains on the table.
3. Once a card is played in a food chain it cannot be taken out of the chain.
4. Points:
   - All cards in food chains are worth 1 point.
   - All cards still in your hand at the end of the game subtract 1 point.
   - A chain harvested by humans (meaning it ends with a human) is worth no points.
5. The game ends when no one can play anymore.
6. ***A "complete" food chain includes Nutrients, Producers, Consumers, and a Decomposer to end the chain (or a human card)***. ***Complete food chains can be said to "loop" also.***

<u>Set up</u>

1. 7 cards are dealt to each player
2. In this game players do not maintain 7 cards at all times. The number of cards in each hand changes.
3. Set remaining cards in the center of the table, face down as the draw pile.
4. With the 7 cards, each player lays down any food chain links they can make with their own cards.
5. Place cards on top of each other, the lowest thing on the food chain is played down first with the animal or plant that utilizes or eats it on top of it so that both card names can be seen. (Example: **nutrients cards** would be covered by **a producer card,** the producer card could be covered by an **insect that eats it,** etc.)
6. If you made a "complete" food chain, set it aside upside down, it is done. No one can change this food chain.

Playing – After the game is set up

After everyone uses the cards they are dealt to make any food chains that they can. Then the turns start, each turn consist of 3 things in this order:

- Draw one card and add it to your hand.
- Add cards to the top or bottom of your own food chain ***or to another's food chain,*** **o**r make new chains (2 or more cards are needed to start a new chain)
- Adding a card to another player's food chain allows you to steal their *whole chain*. Move it in front of you.
- "Complete" chains cannot be stolen or played on once they are turned over.
- Cards can only be added to one end of the chain at a time, not both in one turn.
- There are no limits to how many cards can be played in a turn.
- If playing a card allows a player to put two chains together, they can do that also.
- After you have built as many food chains as you can, pick a predator (any secondary consumer) from your hand and demand food from the other players.

If you do not have a predator, draw till you get one.

Other players must give up one card that is eaten by this predator *if they have one*.

These cards are not placed on food chains in this turn, but are kept in your hand until the next turn.

Example: After playing, I hold up my bass card and say to one of my neighbors, "If you have a bluegill or crayfish feed me." I add the card to my hand for my next turn.

Your turn is over. If you completed a food chain, turn it upside down and set it aside for scoring later.

Human cards – these either can take cards away from the game (no points to the player who made the food chain) or double points (to the player who puts the human on the food chain).

A **Human** card removes a food chain from play, and no points are received for that food chain by the player who built it. Obviously you wouldn't want to do this to you OWN chain, but you might want to nullify your neighbor's food chain.

If you add a human to someone's food chain, it also doubles the points for that food chain, and those points go to you.

Ending the game

The game is over when all the cards are used or those left are unusable.

A player receives 1 point for every card in a food chain that is on the table, and 2 additional points for any completed food chains (nutrient to decomposer with at least 3 animals).

Cards still in a player's hand are minus 1 point each.

The winner is the player with the most points.

Student Page

Aquatic Connections

This is a game for 2-3 players.

The goal of the game is to run out of cards in your hand first. Then cards in other people's hands give you points.

It takes several rounds to win this game.

A total score of 15 wins the game.

Set up

Deal 5 cards to each player, then place all remaining cards in a central pile face down.

Turn the top card of the draw pile and put it face up next to the draw pile for the first playing stack.

Playing

1. The first player draws a card from the face down deck of cards. If it directly interacts with the starter card (prey or predator side of the food chain), the card is placed on top of the starter card.
2. The player may play any number of cards on to stacks from their hand after drawing one card from the deck
3. If a **Nutrient** card is drawn it is placed on the table to start another playing stack.
4. If the card has no direct interaction with any playing stack the player puts that card in their hand.
5. The next player draws a card and can play on any pile and can play any number of cards from their hand as well.

Special cards

- A **Decomposer** card does not end a chain like in the last game. It can be covered by a nutrients card and the cycle continues.
- When a **Human** card is played on a stack, players can no longer add to the stack. Turn that stack upside down.

Ending the game

When a player clears their hand, play stops and they receive a point for each card left in the other players' hands.

If the winning score isn't reached when the deck runs out, reshuffle the cards and play another round.

Lesson 5.5: Native Aquarium Observation

Essential Concept

Each native species has a specific habitat within aquatic ecosystems where it can best meet its needs for survival.

Objectives

1. Students will set up a system for observing and mapping organism behaviors in a native aquarium.
2. Students will make generalizations based on their data.
3. Students will make hypotheses about causes of organisms' behavior.
4. Students will plan investigations to test their hypotheses.
5. Students will compare data with other groups.
6. Students will plan an investigation.
7. Students will evaluate plans for investigations.
8. Students will carry out their investigations and draw conclusions based on their data.
9. If time and cost allow, visit a nearby aquarium such as the Texas State Aquarium in Corpus Christi, Dallas Aquarium, etc.

TEKS

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

Aquatic Science: 1 A, B; 2 B, E, F, G; 4 B; 5 C; 11 A

Environmental Systems: 1 A, B; 2 B, E, F, G, K; 6 E

Estimated Time

Varies. This activity can be repeated, if you wish to gather more data.

Materials

Native Aquarium(s) with at least 4 kinds of aquatic organisms

Clear overhead transparencies

A variety of colors of Vis-à-Vis pens (4 colors for each group)

Science journals

Pencils

Timer/clock

Transparent tape

Special Instructions

Clear laminating film can be run through the laminator with nothing inside, if you don't have other clear film to use on the side of the aquarium.

If you will be collecting, check the following website to see if any permits are needed. http://www.tpwd.state.tx.us/business/permits/land/wildlife/educational/

Procedure

1. **Mapping Behavior**

We can learn information about the niche an organism occupies by studying the behavior of organisms and recording movements systematically.

Provide each group of 5 students with a sheet of cellophane, transparencies, or laminating film to cover one side of the aquarium. This will be taped to the side of the aquarium as a clear sheet so students can mark the locations of each organism using a different color Vis-à-Vis.

Have each group choose 4 organisms to observe. Ask students to make a key to show the color they are assigning to each organism. (Example: Blue/Bluegill, Red/Gambusia, Orange/Crawdad, and Green/Snail.) **Note:** This is a good combination of organisms so that none are eaten by any of the others, but whatever variety you have will be interesting to observe. Try to keep predators in separate aquariums from their prey.)

Instructions:

One group member will tape the clear sheet on the aquarium and use a grease pencil to label it with the group name or number and trace an outline of the aquarium and its immobile features such as rocks, plants, and surface of the water.

At the same time each day, one team at a time will have a turn to map the locations of the 4 organisms that they have chosen to observe. One member of the group will be the timekeeper each day and the other members will be assigned one of the types of organisms and will find those individuals and mark their location on the clear sheet with the Vis-à-Vis assigned to that organism**.** You may wish to have students rotate jobs in the group so that everyone has a turn to do timekeeping and everyone gets to mark locations of different organisms.

When the team has finished their observations, they will remove their clear sheet with locations marked and use it to make a diagram in their journals of locations marked, and label where each type of organism is located. Wipe the clear sheet clean with a damp paper towl before the next observation.

In addition to the clear sheet, each student will have an aquatic organism observation page in their journals where they make a data table with the date, type of organism, and description of the actions of that organism. These descriptions should include behaviors that won't show up on the maps, which only show location. It might be something such as darting away from the glass when the student approaches, feeding, various types of movements, injuries, or other behaviors.

Each team will have 10 minutes to do their mapping and observations. Two minutes to put up their clear sheet and allow the organisms to settle back down. Five minutes to map organisms' movements, and 3 minutes to write observations of their organism.

It is helpful if the groups are assigned an order to do their observations. **Example:** Group 1 will do their observations for the first 10 minutes of class. Group 2 will do their observations for the second 10 minutes of class, etc. Other groups can be doing other activities from other lessons while the observations are going on. **Example:** Students could play one of the card games from the last activity, or read student materials and answer questions.

Guide the first group through the first observation as a class demonstration. It requires students to work together cooperatively, and be well organized in order to be able to observe all of the organisms at the same time, which may reveal interactions among the organisms.

Or you may wish to have smaller aquariums for each group to observe.

Procedure for mapping:

- Assign one team member of the group to each type of organism.
- One group member will trace around the objects in the aquarium (be sure the student has the center of the aquarium at eye level.
- One team member will watch the clock and call "time" every 30 seconds for 5 minutes.
- The mapping team members will put a number on each of their organisms each time the timekeeper calls, "Time." So there will be 10 numbers for each organism at the end of 5 minutes.
- All team members will fill in their data tables for each organism as they spend the next 3 minutes observing. Students may each observe different organisms and trade information with other students so they work cooperatively to get observations of all 4 types of organisms.

2. Making Generalizations

After all groups have done observations, have each group look at its native aquarium data.

- **Are there any patterns in the locations of each type of organism?**
- **Are the locations of the organisms related to any particular object or stimulus?** (plants, rocks, bubbler, observer, etc.)
- **If there is more than one of each species of organism, do the same species tend to stay together or do they move away from each other?**
- **Were any of the movements related to the students movements?**
- **Were any of the movements related to other observations made by the group?**

Write down any relationships you can see in the data you collected. (**Example:** Dragonfly nymphs tended to stay near plants, bluegill fish tended to stay in open water,

snails tended to stay on the bottom, on plants, or on algae growing on the side of the aquarium, and water boatman tend to stay near the surface diving from time to time.)

3. Making Hypotheses

- **Why do you think this is happening? What do you think causes the organism to behave in a particular way?** (Dragonfly nymphs were possibly hiding from fish, bluegills were possibly looking for food, snails were eating, water boatman were looking for food.)
- How could you test your hypotheses? Plan an investigation to test one of your hypotheses.

Have groups share their data and explanations from the observations and mapping. If the class is using one large aquarium for their observations, overlay the maps for each group on the last day.

- **Is the data showing the same patterns throughout the day?**
- **What explanations were generated in each group based on the data?**
- **What investigations were planned by each group?**

4. Evaluating Investigation Plans

Have the class work together to evaluate the plans of each group for investigations and add or change procedure as needed.

5. Conducting Investigations

Have each group conduct its investigation and report back to the class. Topics will vary, but may include short-term changes to the environment, isolation of organisms from other organisms, from plants, or rocks, introduction of food, light, movement, or other changes to external stimuli.

Have each group keep data tables and procedures in their journals. Each group should draw conclusions based on their data.

Alternatives to Making a Native Aquarium

You might take a class to a local aquarium or zoo or even a pet store to do this assignment as a field trip. Call ahead of time to see if there are group discounts and such for student groups at the zoo or aquarium, or to get permission from an aquarium/pet store to bring your class. The cities of Lake Jackson, Houston, Kemah, Galveston, San Antonio, Abilene, Ft. Worth, Dallas, Corpus Christi, and Athens all have aquariums or zoos with aquariums. Check your local area for facilities close to you.

Vocabulary

- Conclusions
- Data
- Generalizations
- Hypotheses

- Mapping
- Niche
- Systematic observations

Lesson 5.6: Aquatic Food Web Scramble

Essential Concept

Aquatic food webs are complex and varied.

Objectives

1. Students will take part in a simulation to model food webs in an aquatic community.
2. Students will look at responses of organisms to changing conditions in an aquatic community.
3. Students will synthesize what they learn, and depict the changing conditions of an aquatic ecosystem using before and after murals.
4. Students will diagram and describe transfer of energy in an aquatic food web and/or energy pyramid.
5. Students will investigate and explain the effects of energy transformation within an ecosystem in terms of the laws of thermodynamics.

TEKS

6.2 C; 6.3 A, B, C; 12 D; 7.2 C; 7.3 A, B, C; 7.5 A, B, C; 7.8 A, B, C; 7.13 A; 8.2 C; 8.3 A, B, C; 8.11 A, B, C

Aquatic Science: 2 H, J; 3 A, D; 5 C, D; 11A,B; 12 A, C

Environmental Science: 2 I, K; 3 A, D; 4 B; 6 D; 7 D; 9 A

Estimated Time

1 class period for the simulation and class discussion

1 class period for the mural

1 class period for the pyramid diagram, or this may be started in class and finished as homework

1 class period to play the game

Materials

Aquatic community *Food Web Scramble* information card for each species

Aquatic community *Food Web Scramble* nametag for each species

Three 6-foot-long strands of yarn or cord per student

Science journals

Pens/pencils

Butcher paper in 6-foot lengths for each group, with a few extra in case of accidents

Tempera paint, watercolors, markers, or other art materials

Copies of the *Energy Pyramid Chart*

For High School

Copies of the *Energy Pyramid Game* board – these might need to be drawn by the students on large pieces of butcher paper to fit the card sizes. See example game board at end the lesson.

Special Instructions

This activity uses the same cards as *What's My Niche?*, *Aquatic Food Chains*, and *Aquatic Connections* card games in Activity 5.4.

Species nametags will need to be copied on to cardstock, laminated, and then cut on the dotted lines to make tags. Also make a nametag for the sun. This could be a sun cut from construction paper and laminated or just the word "Sun".

Punch a hole in the upper corners of each tag. Tie the ends of a 3-foot strand of yarn or cord to each hole. Students may hang these around their necks during the game.

String or yarn will need to be cut in 6-foot lengths (3 lengths per student). Tie the ends of yarn or string or singe the ends of nylon cords to prevent unraveling. Brightly colored braided nylon string or Mason's chalk line, available at most hardware stores, works well.

For High School

- Make 15 copies of the algae and diatoms cards
- Make 4 copies of all the other producer cards
- Make 2 copies of all the other information cards except the following cards, which you will leave out of the game to simplify it. (Muskrat, Beaver, Canada Goose, Horsehair Worms, Mayfly Adult, Mallard Duck)

Divide the cards into the following groups and Label them with their group number in the top right corner of each card.

1) **Producers:** (42 cards) – label each card with a big **P** in the right hand corner

   Algae, Pondweeds, Diatoms, Cattails, Duckweed

2) **Primary Consumers:** (38 cards) - label each card with a big **C1**

   Water Boatman, Rotifers, Mosquito (male) Isopods (pill bugs), Copepods, Water flea, Scuds, Mosquito Larva, Seed Shrimp, Snails, Mussels, Tadpoles, Mayfly Larva, Bloodworms, Springtail, Stonefly Nymph

3) **Secondary Consumers:** (24 cards) – label these with a big **C2**

   Flatworms, Whirligig Beetle, Damselfly Adult, Caddisfly Larva, Horsefly Larva, Diving Beetle, Water mites, Damselfly Nymph, Dragonfly Adult, Backswimmer, Dragonfly Nymph, Water Strider, Red Winged Blackbird.

4) **Tertiary consumers:** (16 cards)– label all these cards with a big **C3**

   Fishing Spider, Leech, Giant Water Bug, Water Scorpion, Leopard Frog, Tiger Salamander, Crayfish, Bluegill

5) **Quaternary Consumers:** (20 cards) –label these cards with a big **C4**

Bullfrogs, Largemouth Bass, Water Snake, Channel Catfish, Snapping Turtle, Kingfisher, Heron, Raccoon, Mink, Ribbon snake

6) **Quinary Consumers**: Humans – label these 2 cards with a big **C5**

On the backs of ALL the cards write – "Nutrients/Detritus"

Make/draw the playing board on big pieces of paper –chart paper, butcher paper, or posterboard.

Procedure

DAY ONE

1. Building an Aquatic Community

Students will take part in a simulation game to help them understand the complexity of aquatic food webs.

This game is designed for groups of 15 to 30 students.

Spread the plant and animal nametags on a table.

Mix the information cards and give each student one card at random, keeping the extra cards.

Assign 1 student to be the sun.

Have each student carefully read his/her entire card to himself/herself, and then pick up the corresponding nametag and three strings.

Check to be sure each student understands the information about the plant or animal he/she is playing. Explain terms and concepts as needed. Be sure each student recognizes his/her plant or animal.

Rules

Tell students that the objective of the game is to develop a self-sustaining community beginning with random populations of plant and animal species.

After the community is established, various factors will be changed to illustrate the interdependency of the community.

Each type of animal or plant listed represents a population of unknown size.

Playing the Food Web Scramble Game

Divide the students according to the information on the cards into the following groups:

- Plants—producers
- Animals that eat only plants—primary consumers or herbivores
- Animals that eat both plants and animals—secondary consumers or omnivores
- Animals that eat only other animals—secondary consumers, carnivores or parasites

The person that represents the sun will be in the center. Have the plants (producers) surround the sun in the center of the playing space.

Primary consumers surround plants and give one end of a string (food line) to each type of plant they eat.

Have students sit on the ground or floor.

Animals that eat both plants and animals (secondary consumers or omnivores), and animal eaters (secondary consumers, carnivores or parasites) surround plant eaters, giving a food line to each major food they eat. Students may receive more than one string if they are eaten by more than one organism.

Check to be sure all students have an adequate food supply for their survival needs and call the group's attention to any inadequacies. **Any student with an inadequate food supply steps to the sidelines (dies) for the moment.**

The group of adequately fed students comprises the community.

2. Evaluating the Viability of the Community

Discuss the community that has been formed, noting presence or absence of major food sources or plant types, the proportion of plant eaters to animal eaters, etc. Have the class decide whether the community could survive.

Make selective substitutions from the extra cards, using students from the sidelines or the community as necessary to produce a well-established community that includes all students.

Have students change nametags as well as cards when making substitutions.

Have students raise the food lines over their heads and note the complexity and web-like appearance.

3. Changing Environmental Conditions in the Community

Explain that each change in the conditions in an area will cause corresponding changes among the community members.

When conditions change, those students who are eliminated must step to the sidelines, taking their food lines with them.

They may then be assigned a new role to reestablish the community with the new conditions.

Discuss each change as it occurs. Students may think of other changes you can make, if you have time.

The following changes are suggested, but many others are possible.

1) Seasonal Changes

Most groups will assume summer conditions when beginning.

Explain that changing to winter causes great differences due to migration, hibernation, plant dormancy, etc.

Photosynthesis continues to occur in aquatic communities even when the water is covered by ice as long as sunlight can penetrate the ice layer. It stops if ice is snow-covered,

preventing sunlight from reaching plankton.

Take out half of the plants.

What happens to the community and its populations? (plant eaters will die off (be sidelined) and animals that ate the plant eaters will die off (be sidelined)

Point out the temporary and cyclical nature of these natural changes.

- **What are some examples of how species have adapted to these temporary cyclical changes in conditions?** (When plants die off, plant eating populations decline or consumers adapt. Some ectothermic organisms become less active in colder weather, and therefore require less food. Some become dormant, hibernate, or, if they can, migrate [Example: birds].)
- **What happens in spring?** (Plants regrow and animal populations increase.)

Restore the habitat and its community to warm weather conditions. (Restore all the students who had been sidelined.)

2) Drought Conditions

Explain that low water conditions cause crowding and greater competition for food, less shoreline area, and increased access for terrestrial predators.

Extreme drought conditions (i.e., drying up of ponds) could eliminate some organisms.

Some microscopic species can live in small puddles, and some can even survive in dried up mud, where they wait for water to refill the pond or stream when they become active again.

Air breathers would travel to other areas or die.

Make appropriate changes to the community.

- Do you think that these changes would be temporary and cyclical or permanent? (It depends on how long the drought lasts.)

Point out the distinction between the death of an individual and the elimination of a population.

Restore the habitat and its community to normal conditions.

3) Building Development in the Watershed

Tell the class that the surrounding grassland or woodland is being converted to a housing development without proper erosion control methods used during construction or adequate control of runoff from the home sites.

- **What do you predict the results of this new construction will be?** Ask students to write their predictions in their journals. (Sediment entering the water, possible fertilizer and pesticide pollution from lawns or increased runoff velocities and habitat destruction will alter the community and reduce survival. Refer students to Chapters 1–3.)

Make appropriate changes to the community.

- **What happened?** (sediments may cloud the water cutting off sunlight and

clogging gills of animals, herbicides may kill off plants, pesticides may kill off animals.)

- **Do you think that these changes would be temporary and cyclical or permanent?** (It depends on whether the people in the new development value the aquatic habitat. They may make an effort to restore the water quality with appropriate erosion control and be more careful in their use of herbicide and fertilizer. Then the aquatic community could come back.)

Restore clean water conditions bringing back sidelined students.

4) Cattle in Watershed

Tell the class that the surrounding grassland or woodland is being converted to a livestock operation without fencing along the stream or waste management.

- What do you predict the results of this new livestock operation will be? Ask students to record their predictions in their science journals.

(Increased pollution from cattle wastes may cause algae overgrowth and fish kills. Sediment entering the water from cattle trampling the banks and stirring up the mud bottom increases turbidity and reduces photosynthesis. There are few if any shoreline plants. All these will alter the community and reduce survival. Refer students to Chapters 1–3.)

<u>Make appropriate changes to the community adding more plants.</u>

- **What happened?** (Too many plants may block light, or increased sediments may kill off plants causing plant die off, then decay, and depletion of oxygen suffocating some animals.)
- **Do you think that these changes would be temporary and cyclical or permanent?** (If the cattle rancher understands what is happening or has an expert's help, he may apply appropriate controls such as reseeding of plants along the shore to restore erosion control, water tanks, and fencing to keep cattle out of the stream.)

Restore normal conditions and bring back sidelined (dead) players.

5) Herbicide use

Tell the class that herbicide is being used to control weeds in the watershed.

- What do you predict will happen? Ask students to write their predictions in their journals. (Depending on the type of herbicide, aquatic plants could be destroyed, which could completely disrupt the food chain. Refer students to Chapters 1–3.)

<u>Make appropriate changes to the community.</u>

This is one way to end the game.

- **What kinds of changes to the aquatic ecosystem did we see in our simulation/model?** (Abiotic changes such as temperature, nitrogen and other chemicals, sediments and biotic changes to the number and types of organisms that could survive in the aquatic ecosystem)

- What are the external stimuli to which organisms were responding in our model? List these external stimuli in your journal add other external stimuli that might affect organisms in an aquatic community. (seasonal changes [temperature], weather changes [drought], erosion and sedimentation, herbicides [pollution from human causes]. Other external stimuli might include amount of light, temperature, amount of water, speed of current in water, salinity, acidity, and other chemical changes in water, etc.)

When these types of changes happen they change the carrying capacity of the ecosystem.

- **How does the model represent the real world?**
- **What are the limitations of the model?**

DAY TWO

4. Assessing What We Learned: Making a Mural

Give each group of four students a long piece of butcher paper and markers, paint, pencils and erasers.

Assign each group of 4 students <u>one of the changes in the aquatic community</u> that the students experienced in the simulation.

Have students draw a mural depicting their changing environment.

Their mural should show the community <u>before the change</u> and the results that they predict might happen in <u>response to the change</u>.

You should have 5 before and after murals, which can be linked together to show various changes occurring in the aquatic ecosystem.

DAY THREE

5. Making an Energy Pyramid

Give each group of 4 students a set of cards. Ask students to use the cards to help them draw an energy pyramid including trophic levels. ("Trophic" comes from a word that means "nutrition".)

Ask students to answer the following questions from this and the next section of the lesson in their journals.

- **What is an autotroph?** (Students should break the word down. " Troph" means nutrition and "auto" means self. So if an organism is an autotroph, it makes its own nutrition. Therefore plants are one kind of autotroph. There are other autotrophs that use chemicals rather than sunlight to make their food. Autotrophs are the producers of energy used by other organisms.
- **What is a heterotroph?** (Students should, again, break the word down. "Troph" means nutrition and "hetero" means other. So heterotrophs get their nutrition from some other organism. All animals are heterotrophs. Heterotrophs make up the consumer levels of the energy pyramid.)

Each trophic level of the pyramid gets its nutrition from different sources. Producers are autotrophs that make their nutrition from sunlight or chemicals. They are at the base of the pyramid. All other life depends on them.

Primary consumers (herbivores) get their nutrition from plants and are at the second trophic level of the pyramid. All consumers are heterotrophs.

Secondary consumers eat other consumers and sometimes both plants and animals and are at the third trophic level of the energy pyramid.

Tertiary consumers and higher levels are the top predators. They have no predators that eat them once they reach a large size such as dolphins, sharks, turtles, etc. Humans are at the highest level of the pyramid.

6. Energy Pyramid Game

Set up: See *Special Instructions* at the beginning of the lesson.

Playing the game

General Rules

1) Win by accumulating the most points by the time the habitat is full
2) The habitat is full when it can support 2 human cards.
3) Three cards must be played at each turn, cards are played in their trophic level on the board – **P**'s in the **Producer** level, etc.

If the cards you play cannot be "supported" by the correct number of previous trophic level organisms in the habitat, it dies. It doesn't matter if the card doesn't specifically say it eats the thing below it in the trophic level, as long as there are **2 P's, 1 C1 can survive in the game. As along as there are 2 C4's a human can survive. But a second human can't survive until all 4 C4's are in place.**

4) When a card dies it is turned over and is added to the nutrient/detritus bottom layer.

For Example: The first player of the game will play three random cards, they will all three die and become nutrient, because they could not live in a habitat with no food there for them. This will probably happen to the second player too, unless they have a producer card that can be sustained by the nutrients now in the habitat due to the dead previous cards.

5) When a trophic level is full, no more cards can be played on it (except if the card says it can eat something else in that same level.

For example: Giant water bugs can eat small frogs, so if a leopard frog was already in **C3**'s level, supported by enough **C2**'s, someone could go ahead and replace the leopard frog if they had a Giant water bug.

6) When the nutrient/detritus level is full just add newly dead cards to a discard pile that will be used to recycle cards to players.

Points

Players receive points at each turn, but not all plays earn the same amount of points. Here are the point levels:

- **Each card that dies and becomes nutrients/detritus: 1point**
- **A producer card is played and can live: 2pts**
- **A C1 card is played and can live: 3 pts**
- **A C2 card is played and can live: 4 pts**
- **A C3 card is played and can live: 5 pts**
- **A C4 card is played and can live: 6 pts**
- **A C5 human card is played and can live 7pts.**

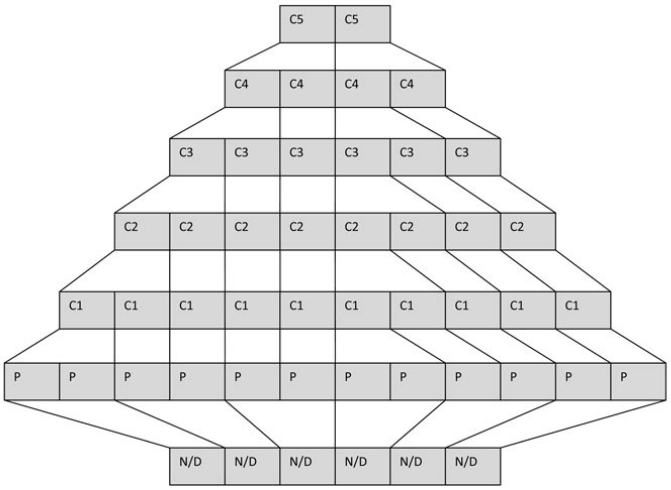
How to begin and play:

1) Stack all cards face down in the middle of the board, each player draws one card, highest trophic level goes first. Put those cards back at the bottom of the stack
2) Each player draws 5 cards.
3) First player plays 3 cards (They will all die–3 points)
4) First player draws 3 more cards to maintain 5 cards
5) Second player plays 3 and draws three, etc, etc, placing cards where they can live, or they die.
6) When the draw pile is empty replenish it with the excess nutrient/detritus stack.
7) Game ends when 2 humans are supported. Student with the most points wins.

Example of Energy Pyramid

Game Board

(An enlarged version is provided on the following page)



This will need to be drawn on a large piece of butcher paper or easel paper to play the game, the lines guide the player to how many previous spots must be full for the card to be supported in the environment as long as cards are played from left to right on each trophic level. For example, three two living P cards are needed to keep the first C1 card alive, but only one more P card allows one more C1 to live. Alternatively it could be used as a guide to how to place the cards and not actually a game board.

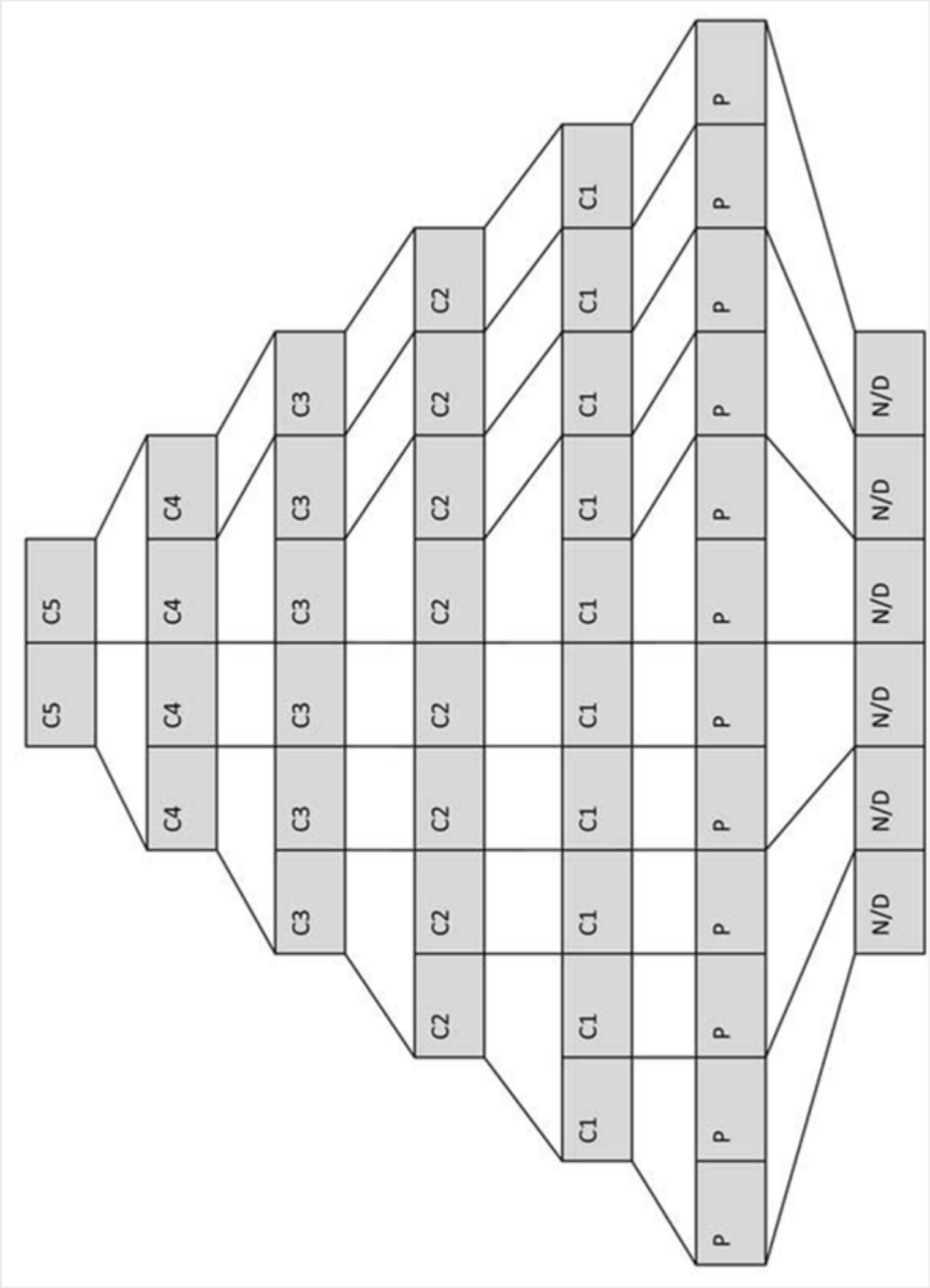
Description: **Nutrient/Detritus** level has 6 places for cards, **P** level has 12, **C1** level has 10 places for cards, **C2** has 8, **C3** has 6, **C4** has 4 and **C5** has 2.

It takes **1 nutrient card to sustain 2 P card**. (This represents how the producer can increase the amount of energy in its level above what is available from the energy of the sun.)

Play cards from the left to the right on each level and follow the lines on the Game Pyramid for help.

The winner is the student who accumulates the most points.

Energy Pyramid Game Board



7. Understanding the Energy Pyramid

Ask students to answer the following questions in their Science Journals.

- **Why are there fewer individuals in each trophic level?** (Energy is lost every time it is transferred to the next level.)
- **Does this game accurately demonstrate the loss of energy in the natural environment**? (No, in the real world nearly 90% is lost at each level.)
- **When all the game pieces are on the board, if 6 of the producer cards are taken out of the system. How many organisms will die because of the lack of support at the producer level?** (**6 P** cards support, **5 C1s**, which support **4 C2's** and on up the pyramid etc. So if **6 P cards** are gone, **15 cards** will be taken out of the pyramid.)
- I**f you wanted to increase the population of C4 animals in the environment, what would you have to make sure you increase as well?** (There would have to be a large increase in all lower levels also to support that growth)
- **Why are their more P cards than nutrient cards?** (Producers are the only ones that can create more organic material from inorganic material by using the power of photosynthesis.)

8. Critical Thinking

- **How does the scientific explanation represented by the energy pyramid help us understand aquatic ecosystems better?**

It shows how energy comes directly from the sun, is transformed by plants, the producers in the first trophic level of the energy pyramid, from solar energy to chemical energy, and used for growth, metabolism, and reproduction for survival of the species.

What is left of the chemical energy is stored and passed on to the primary consumers, in the second trophic level of the energy pyramid, when plants are eaten. Primary consumers use some of that energy for growth, metabolism, and reproduction for the survival of the species. When they are eaten by secondary consumers the rest is passed on to the organisms that eat them.

Secondary consumers [on the third trophic level of the energy pyramid] take what is left of the energy and use it for growth, metabolism, and reproduction for the survival of the species.

Any energy that is left, is either passed on to a higher level, or recycled by decomposers back into the chemicals needed by plants to transform solar energy to chemical energy.

- **Do you think that decomposers are represented accurately by the energy pyramid?**
- **How might decomposers' role in the energy pyramid be represented?** Some people put them with primary or secondary consumers depending on what they eat. Others put them in a third consumer category after carnivores. Let the class decide how they think decomposers should be represented in the energy pyramid.

9. Thought Question

- **Does anyone have an idea for a clearer way to represent the transformation of energy through an ecosystem?**

Ask students to think about this and any ideas that they generate should be recorded in their student journals. You might want to give extra points to anyone who comes up with an interesting idea of another way of representing energy transformation and transfer in an ecosystem.

10. For High School: The Laws of Thermodynamics

First Law of Thermodynamics: During any biological, physical, or chemical process, energy cannot be created or destroyed. It only changes form.

The Second Law of Thermodynamics: Energy quality becomes less reusable or produces less work with every use.

- **How are the laws of thermodynamics demonstrated in the energy pyramid?**

In the energy pyramid we can see that much energy is used at each trophic level for metabolic heat.

We study organisms as part of the energy pyramid because it helps us picture the continual exchange of energy between organisms, both as consumed mass, and as the flow of metabolic heat. This explains why endotherms, animal that are able to maintain a constant body temperature despite changes in the temperature of the environment, expend more energy (maintaining body temperature) than ectotherms, animals whose body temperature is close to that of the environment. All animals other than birds and mammals are ectotherms.

We can also see this law when we study locomotion as organisms use food-derived energy to support movement, in addition to homeostatic thermoregulation.

This constant change of energy at each trophic level from chemical energy to heat energy through metabolism or to mechanical energy through movement, is among the reasons why more organisms can be supported in the environment at the lower trophic levels of the energy pyramid than at the top of the energy pyramid.)

Vocabulary

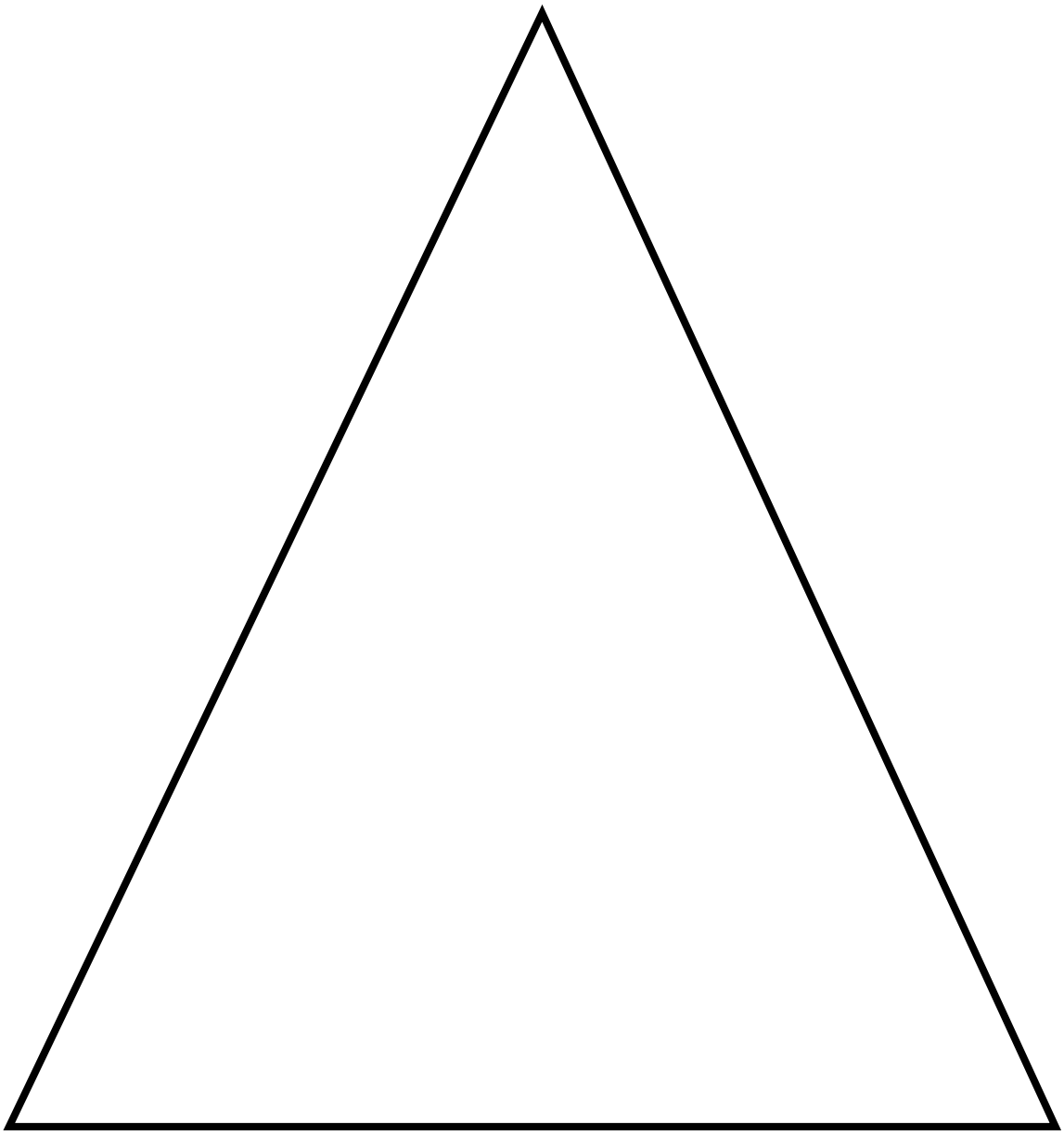
- Autotroph
- Carrying capacity
- Community
- Decomposer
- Drought
- Energy pyramid
- Food chain
- Food web
- Habitat
- Heterotroph

- Invasive species
- Natural selection
- Niche
- Parasite
- Population
- Predator
- Prey
- Primary consumer
- Producer
- Quaternary consumers
- Quinary consumers
- Secondary consumer
- Survival needs
- Tertiary consumer
- Trophic level

Student Page

Energy Pyramid

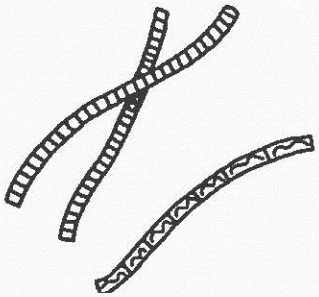
Divide the pyramid into four levels. Fill in organisms that would go at each trophic level and label the trophic levels.



Game Cards

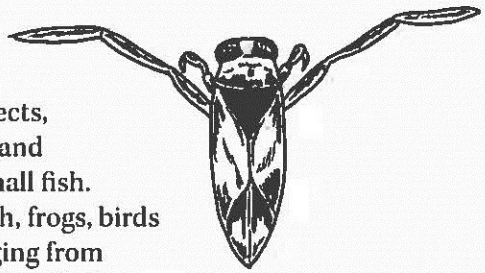
ALGAE

Producer: Many varieties are found in ponds
Predators: Animals that eat aquatic plants
Habitat: Along shoreline and in open water
• Must have sunlight to produce food
• Along with other plants, algae are the first link in the food chain



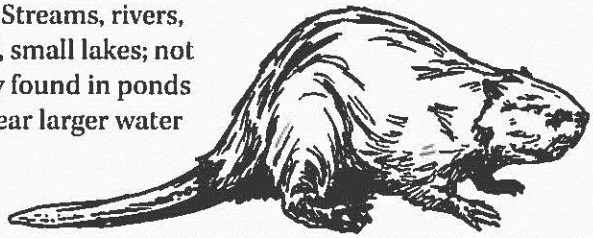
BACKSWIMMER

Foods: This fierce predator eats other insects, invertebrates and sometimes small fish.
Predators: Fish, frogs, birds
Habitat: Hanging from surface, occasionally free swimming, on or among vegetation



BEAVER

Foods: Bark and twigs of shoreline trees; summer foods include water lilies, pondweeds, cattails
Predators: Coyotes, bobcat, otters, minks and—most importantly—man
Habitat: Streams, rivers, marshes, small lakes; not normally found in ponds unless near larger water source

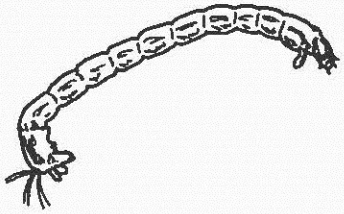


BELTED KINGFISHER

Foods: Mostly fish, some insects, frogs, lizards
Predators: Raccoons, snakes; skunks prey on young and eggs
Habitat: Nests in banks near pond; hovers over water or sits on overhanging branches

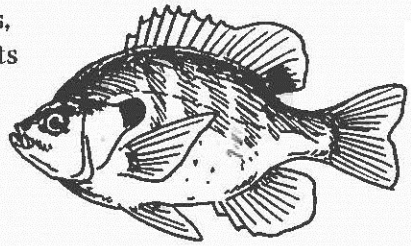
BLOODWORMS

Foods: Plankton, detritus
Predators: Large and small fish
Habitat: Bottom sediments of pond; not really a worm but the larva of a midge fly



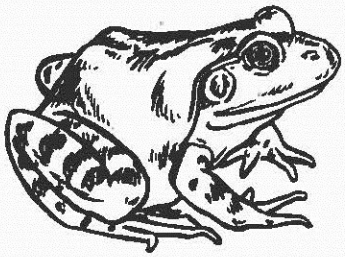
BLUEGILL

Foods: Mayflies, other insects, crustaceans, small fish, crayfish, snails; algae when animal foods are scarce
Predators: Bass and other fish, snapping turtles, herons, osprey; Adults prized by anglers
Habitat: Open water or along shoreline where food is abundant.



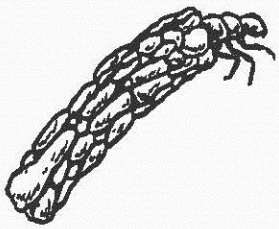
BULLFROG

Foods: Any small animal it can catch and swallow whole, including insects, crayfish, small snakes, minnows, other frogs
Predators: Any meat-eater that can catch and eat it: snakes, herons, fish, raccoons, humans
Habitat: Shores of lakes, ponds, streams



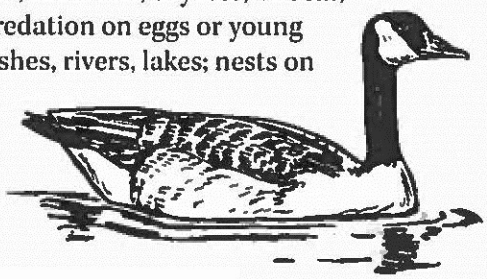
CADDISFLY LARVA

Foods: Small crustaceans, insects, worms, diatoms, algae; some species are entirely predacious.
Predators: Fish, diving beetles, giant water bugs
Habitat: Submerged stems of plants in shallow water (They construct a tube-like shell from bits of plants.)



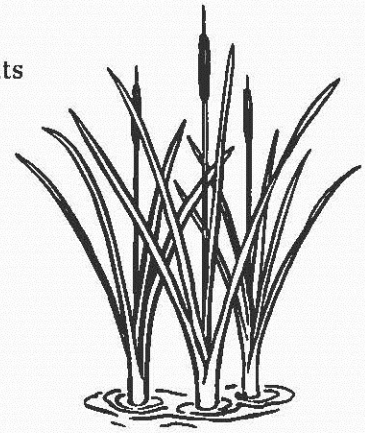
CANADA GOOSE

Foods: Wetland grasses, grains, sedges, roots of water plants
Predators: Fox, raccoons, coyotes, bobcat, man; most predation on eggs or young
Habitat: Marshes, rivers, lakes; nests on ground; defends nest vigorously



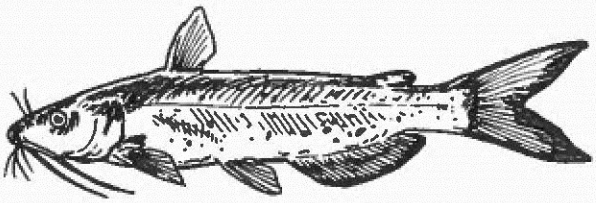
CATTAILS

Producer: Tall, erect plants with long leaves and usually a green or brown head
Predators: Aphids, caterpillars, moths, beetles, birds, small mammals
Habitat: Rooted along shoreline

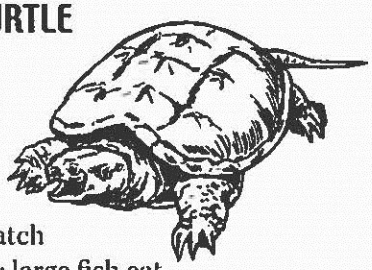


CHANNEL CATFISH

Foods: Fish, insects, crayfish, mollusks, plants
Predators: Young are eaten by other fish. Adults are prized by anglers.
Habitat: Open water or bottom of ponds where they have been stocked



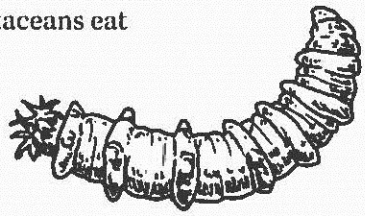
COMMON SNAPPING TURTLE



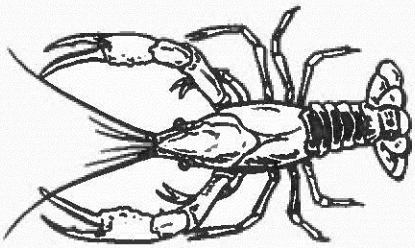
Foods: Insects, crayfish, fish, snails, earthworms, amphibians, snakes, small mammals, birds, aquatic vegetation
Predators: Few. Humans catch adult turtles for their meat; large fish eat young; snakes or raccoons or other mammals eat eggs; sometimes hosts to leeches
Habitat: Prefer ponds with muddy bottoms, submerged logs and snags and lots of vegetation

CRANEFLY

Foods: Larvae can be either predacious on worms or insects, or herbivorous, depending on species. Some adults feed on nectar but many do not eat at all.
Predators: Birds. If near water, fish eat adults. Fish, crustaceans eat larva.
Habitat: Wet moss and vegetation along shoreline



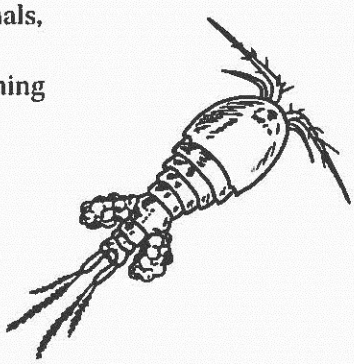
CRAYFISH



Foods: Both plants and animals (Sometimes crayfish are predators and sometimes they act as scavengers.)
Predators: Raccoons, otters, fish, wading birds, frogs, turtles (Some people consider crayfish a delicacy.)
Habitat: Ponds and streams; sometimes in burrows or under logs or vegetation

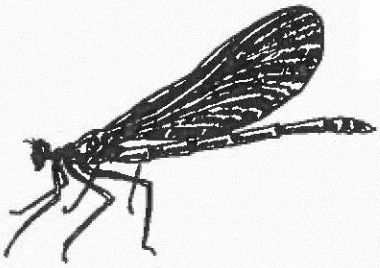
CYCLOPS

Foods: Microscopic animals, algae, detritus
Predators: Nearly everything that eats plankton
Habitat: Open water and shallow water of ponds



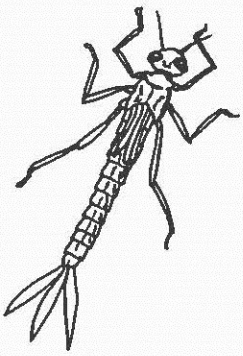
DAMSELFLY ADULT

Foods: Mosquitoes, flies, other insects
Predators: Fish, birds
Habitat: Emergent vegetation and open air over pond



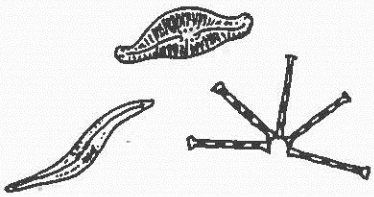
DAMSELFLY LARVA

Foods: Insect larvae, worms, small crustaceans; occasionally small fish and tadpoles
Predators: Fish, larger insects, crustaceans
Habitat: Hides among algae and other vegetation along the shoreline



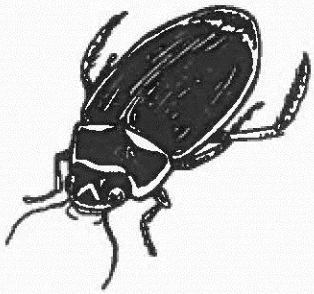
DIATOMS

Producer: Microscopic algae
Predators: Insects, fish, microscopic animals; diatoms are a major part of the phytoplankton, which is the basic food source for all consumers.
Habitat: Free-floating or suspended in open water



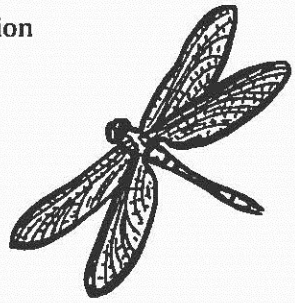
DIVING BEETLE

Foods: Caddisfly larva, or any small animal they can capture (Diving beetles are ferocious predators with large jaws that eat other insects.)
Predators: Reptiles, amphibians, fish, wading birds, raccoons, skunks.
Habitat: Usually in weedy shallows along shoreline.



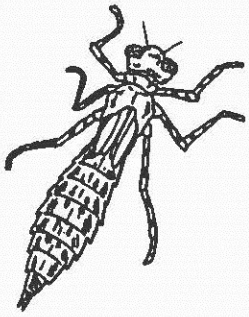
DRAGONFLY ADULT

Foods: Mosquitoes, flies, other insects
Predators: Birds, fish
Habitat: Emergent vegetation and open air over pond



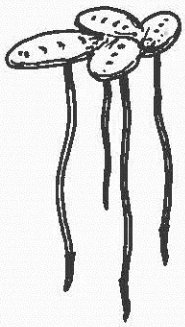
DRAGONFLY LARVA

Foods: Insect larvae, worms, small crustaceans; occasionally small fish and tadpoles
Predators: Fish, larger insects, crustaceans
Habitat: Hides among algae and other vegetation along the shoreline



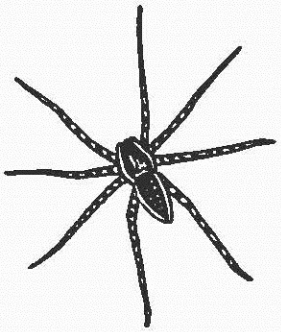
DUCKWEED

Producer: Small, single-leafed floating plant; rootlets dangle in water
Predators: Flatworms, insect larvae, ducks, geese
Habitat: Free-floating on pond surface



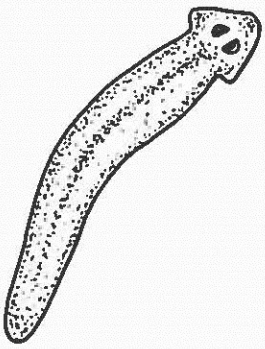
FISHER SPIDER

Foods: Mostly insects, occasionally small fish and tadpoles
Predators: Snakes, frogs, some birds
Habitat: Surface of pond in dense aquatic vegetation



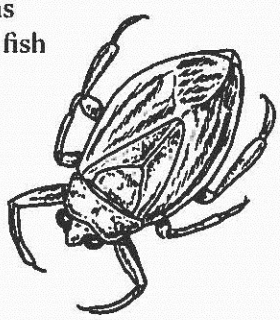
FLATWORM (Planaria)

Foods: Small animals, living or dead protozoans or nematodes
Predators: Worms, insects, crustaceans
Habitat: Under stones and submerged leaves in dark areas



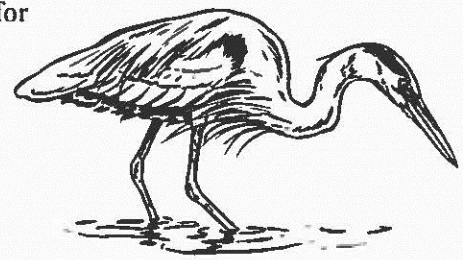
GIANT WATER BUG

Foods: Fiercely predacious, attacking insects, crustaceans and even tadpoles, frogs and fish several times their size
Predators: Fish, frogs, shorebirds
Habitat: Hanging from the surface or among vegetation; occasionally free-swimming



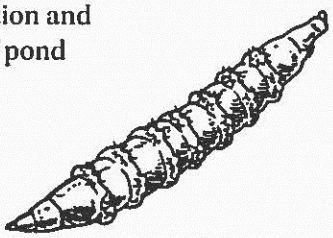
GREAT BLUE HERON

Foods: Mostly small fish, limited numbers of frogs, crayfish, insects and mice
Predators: Fox, coyotes, bobcat; too large for most predators
Habitat: Marsh, river, lakes; nest in colonies in tops of large, stream-side trees



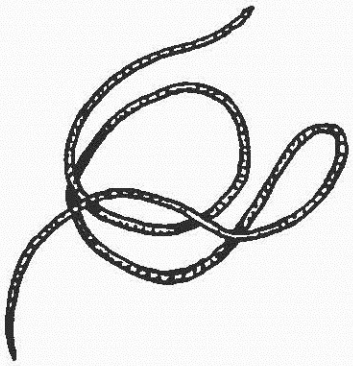
HORSEFLY LARVA

Foods: Worms, snails, other small insects in the water
Predators: Fish, birds
Habitat: Among vegetation and along bottom at edge of pond



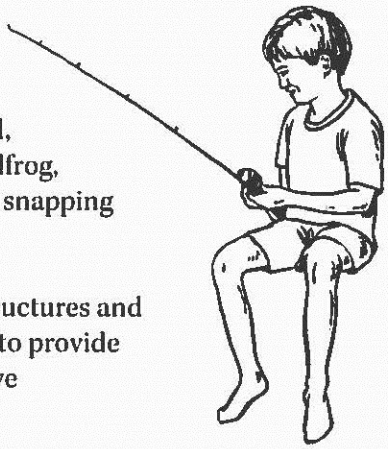
HORSEHAIR WORMS

Foods: Immature are parasites on various crustaceans, mollusks or insects. Adults do not eat.
Predators: Fish, giant water bugs
Habitat: Quiet water



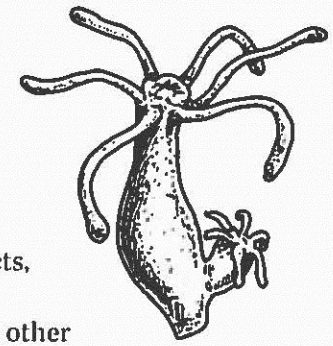
HUMANS
(Anglers)

Foods: Bass, bluegill, channel catfish, bullfrog, green frog, crayfish, snapping turtles
Predators: None
Habitat: Designs structures and alters environment to provide suitable places to live



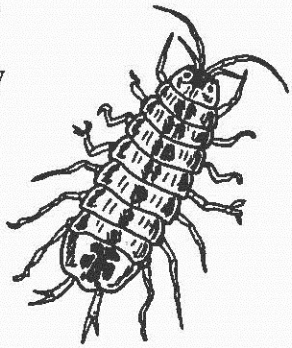
HYDRA

Foods: Tiny (microscopic) animals are trapped in its stinging tentacles. Also, small crustaceans, insects, small clams and fish, seed shrimp, water fleas
Predators: Carnivorous insects, water beetles, trout fry
Habitat: Attached to twigs or other vegetation at the bottom of ponds



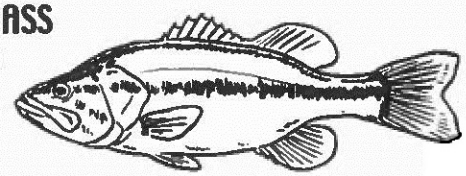
ISOPODS (Sowbugs)

Foods: Detritus; decaying plants on the bottom
Predators: Few; seldom eaten by fish. Some are intermediate hosts for nematodes of fish, birds and amphibians.
Habitat: Bottom dwellers able to stand acid water. Some species prefer clear, cold water; all hide beneath rock and other debris.



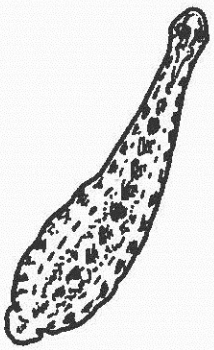
LARGEMOUTH BASS

Foods: Adults feed on fish, crayfish, frogs and large insects. Young feed on daphnia and other small crustaceans.
Predators: Snapping turtles, herons; small fish are eaten by larger fish. Anglers prize large fish.
Habitat: Open water or along edge where food supply is abundant.



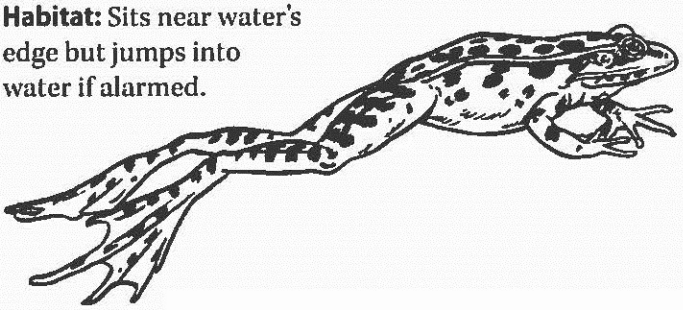
LEECH

Foods: Parasite that feeds on the blood of animals. Most attach to fish, turtles, frogs, snails, insect larvae and worms.
Predators: Fish
Habitat: Bottom dwellers



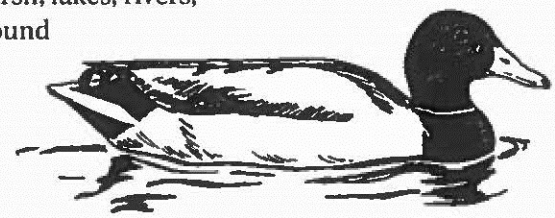
LEOPARD FROG

Foods: Insects, spiders, other invertebrates
Predators: Raccoons, snakes
Habitat: Sits near water's edge but jumps into water if alarmed.



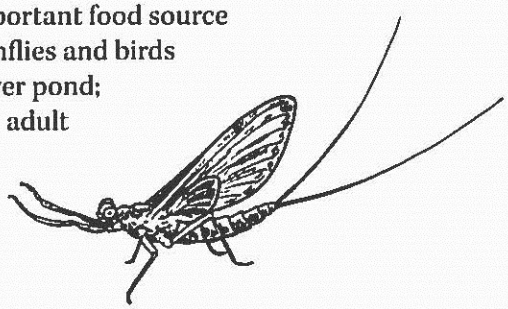
MALLARD DUCK

Foods: Smartweed, corn, acorns, seeds of many water plants, some aquatic invertebrates
Predators: Fox, coyotes, bobcat, mink, man, raccoon, skunk
Habitat: Marsh, lakes, rivers; nests on ground



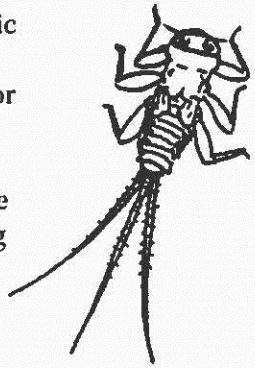
MAYFLY ADULT

Foods: Adults only live long enough to reproduce; they do not eat at all.
Predators: Important food source for fish, dragonflies and birds
Habitat: Air over pond; short life as an adult may last only a few hours



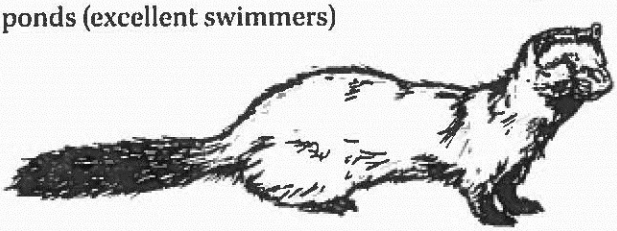
MAYFLY LARVA

Foods: Small plants, animals, organic debris, diatoms
Predators: Important food source for fish and other insect-eaters such as dragonfly larva and beetles
Habitat: Various species burrow, live on the bottom or are free-swimming among aquatic vegetation.



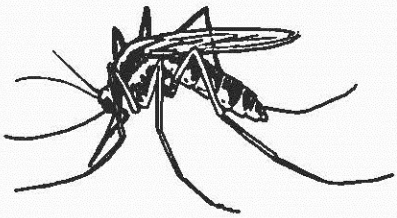
MINK

Foods: Rabbits, muskrats, other small mammals, birds, fish, crayfish, frogs, crustaceans, insects
Predators: Humans, dogs, foxes, owls, coyotes, bobcats
Habitat: In or near wetland habitat including ponds (excellent swimmers)



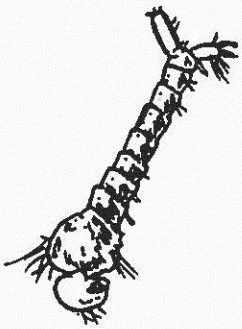
MOSQUITO ADULT

Foods: Females suck mammal blood; males feed on plant juices, if at all.
Predators: Dragonflies, damselflies, other insects, birds, frogs, fish, bats
Habitat: Air over water and surrounding areas



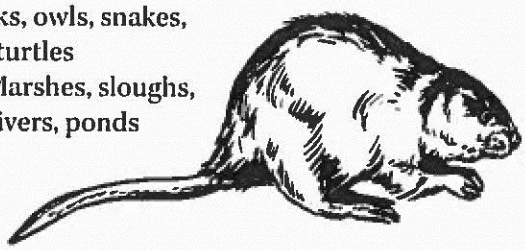
MOSQUITO LARVA (Wigglers)

Foods: Tiny plants and animals suspended in the water
Predators: Fish, other insects
Habitat: Mostly surface, but dive and hide if threatened



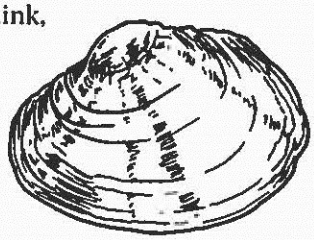
MUSKRAT

Food: Roots, bulbs and foliage of cattails, pondweeds, rushes and wild rice; will eat fish, frogs and insects if plants are not available
Predators: Minks, humans, large hawks, owls, snakes, snapping turtles
Habitat: Marshes, sloughs, streams, rivers, ponds and lakes



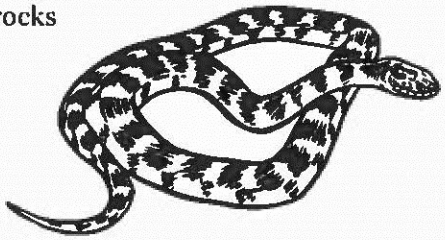
MUSSELS (Clams)

Foods: Small bits of organic matter suspended in the water; since they eat small bits of animal matter, they are considered scavengers.
Predators: Fish, muskrats, mink, otters, raccoons and some turtles, which are able to open the shells or eat smaller ones
Habitat: On the bottom of ponds and streams



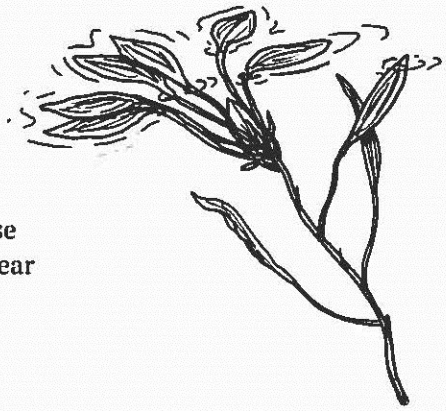
NORTHERN WATER SNAKE

Foods: Crayfish, frogs, tadpoles, small fish, worms, insects
Predators: Hawks, owls, large game fish eat young snakes
Habitat: Under rocks or debris near shore of ponds, lakes, streams and rivers



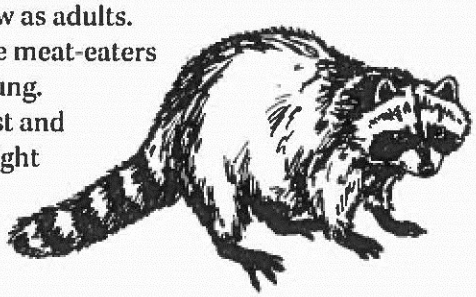
PONDWEEDS

Producers: aquatic seed plants
Predators: Birds, muskrats, beaver, deer, moose
Habitat: Rooted near shoreline



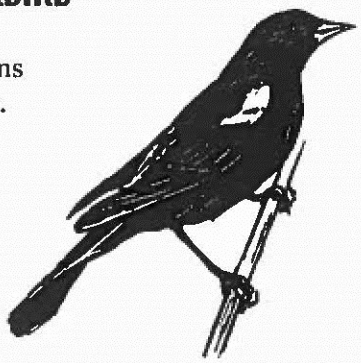
RACCOON

Foods: Wide variety of small animals, insects, fruits, seeds, garbage, crayfish, frogs, some fish
Predators: Few as adults. Humans, large meat-eaters take some young.
Habitat: Forest and forest edge; night time visitor to a pond



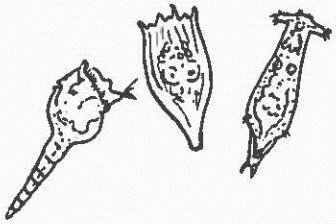
RED-WINGED BLACKBIRD

Foods: Insects, seeds.
Predators: Few. Raccoons and snakes will eat eggs.
Habitat: Nest in cattails, migrate in winter



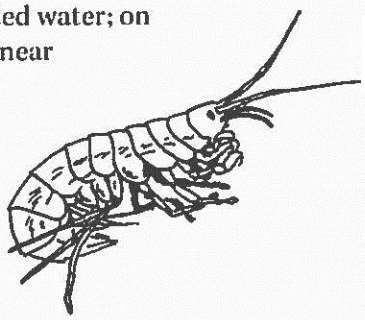
ROTIFERS

Foods: Microscopic plants and animals
Predators: Worms, crustaceans
Habitat: Near shoreline and around aquatic plants; some occur in open water



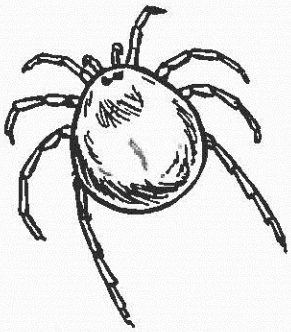
SCUDS (Sideswimmers)

Foods: Scavengers on plant and animal debris
Predators: Birds, fish, insects, amphibians
Habitat: Clear, unpolluted water; on and among vegetation; near bottom of pond; they avoid light.



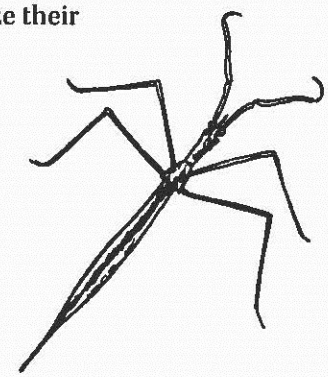
WATER MITES

Foods: Insects, worms; some are parasitic.
Predators: Hydras, insect, fish
Habitat: Creep on bottom and on vegetation



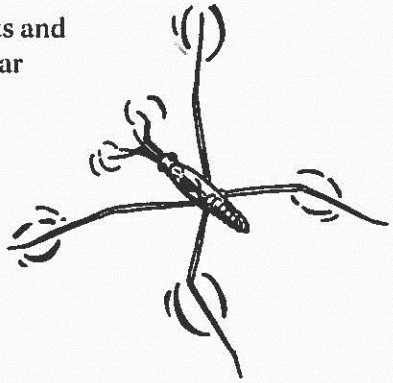
WATER SCORPION

Foods: Small insects; They seize their prey with powerful forelegs similar to preying mantis.
Predators: Animals that eat insects
Habitat: Ponds and weedy sections of lakes and streams; hides just under the surface among vegetation; long breathing tube at rear



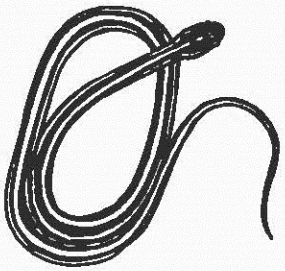
WATER STRIDER

Foods: Prey on insects and small crustaceans near the surface
Predators: Some fish, birds
Habitat: Surface of water; often seen "skating" over the surface in search of food



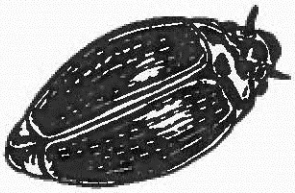
WESTERN RIBBON SNAKE

Foods: Worms, fish, tadpoles, frogs, toads, salamanders, mice, sometimes other small snakes
Predators: Hawks, owls, snapping turtles, herons; some fish eat small snakes.
Habitat: Near water, ponds, swamps, marshes, sloughs, streams and rivers



WHIRLIGIG BEETLE

Foods: Whirl in circles collecting insects and organic debris at the surface
Predators: Fish, birds, frogs, snakes, other animals that eat insects
Habitat: On the surface, often among vegetation; eyes are divided and can see above and below water at same time



ALGAE	BELTED KINGFISHER
BEAVER	BLUEGILL
BLOODWORMS	BULLFROG
BACKSWIMMER	CANADA GOOSE

CHANNEL CATFISH	COMMON SNAPPING TURTLE
CRANEFLY	CRAYFISH
CADDISFLY LARVA	COPEPODS
CATTAILS	DAMSELFLY NYMPH

DIVING BEETLE	DRAGONFLY ADULT
DRAGONFLY NYMPH	DUCKWEED
DAMSELFLY ADULT	FISHING SPIDER
DIATOMS	GIANT WATER BUG

HORSEFLY LARVA	HORSEHAIR WORMS
HUMANS	HYDRA
FLATWORM (Planaria)	ISOPODS (Sowbugs, Pill bugs)
GREAT BLUE HERON	LEECH

MALLARD DUCK

MAYFLY ADULT

MAYFLY LARVA

MINK

LARGEMOUTH BASS

MOSQUITO ADULT

LEOPARD FROG

MUSKRAT

WATER SNAKE	PONDWEEDS
RACCOON	RED-WINGED BLACKBIRD
MOSQUITO LARVA	ROTIFERS
MUSSELS	SEED SHRIMP (Ostracods)

SPRINGTAIL	STONEFLY NYMPH
TADPOLES	TIGER SALAMANDER
SCUDS	WATER BOATMAN
SNAILS	WATER MITES

WATER STRIDER

Western Ribbon Snake

WHIRLIGIG BEETLE

Water Flea (Daphnia)

Water Scorpion

Chapter 5 Assessment

Directions

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

1. Complete this analogy: Individual is to population as

A Water is to surface tension.

B Fish is to gills.

C Niche is to habitat.

D Population is to community.

2. Which of these is correct about a community in the environment?

A Multiple communities make up a population

B A community inhabits a specific niche

C Multiple populations of species make up a community.

D Each species inhabit multiple niches

3. Which of the following statements about competition is true?

A Individuals within a population may compete with other individuals of the same species.

B Individuals within a population may compete with individuals of different species.

C A population within a community may compete with other populations within the community.

D All of the above

4. Carrying capacity is the result of which of the following:

A Different populations living in the same place interact with one another.

B Within a community every species has a particular niche.

C While living organisms have the capacity to produce populations of infinite size, environments and resources are limited.

D Most energy pyramids can continue for only four or five trophic levels and can support only a few top-level consumers.

5. **Which of the following statements about invasive species is true?**
   - **A** The invasive species may compete with native species for habitat or food.
   - **B** Invasive species are not subject to natural selection.
   - **C** Invasive species play an important role by keeping populations of prey species below their carrying capacity.
   - **D** None of the above

6. **What is the biggest threat to aquatic communities?**
   - **A** Predator/prey relationships
   - **B** Natural selection
   - **C** Human-caused habitat destruction
   - **D** All of the above

7. **Complete this analogy: Competition is to _____ as _____ is to food webs.**
   - **A** Competitor; decomposer
   - **B** Natural selection; sunlight
   - **C** Prey; consumer
   - **D** None of the above

8. **Why can most energy pyramids continue for only four or five trophic levels and support only a few top-level consumers?**
   - **A** Most of the available food energy is changed to heat energy or kinetic energy moving up each trophic level.
   - **B** Animals use energy doing tasks such as hunting and keeping their bodies warm.
   - **C** Only a little of the original energy from the sun passes from one trophic level to the next.
   - **D** All of the above

9. **In a stream, a predator that eats insects only from the gravel bottom is said to fill that specific ____ of the habitat.**
   - **A** Population
   - **B** Trophic level
   - **C** Niche
   - **D** Community

Chapter 5 Assessment

Directions

Write your own answer for each of the following questions.

1. **Create an imaginary aquatic community capable of existing in Texas with populations of at least two examples of each of the following:**
   - Producers, consumers, and decomposers/scavengers
   - Specify producers by placing them in rectangles, consumers in circles, and scavengers/decomposers in triangles
   - Draw (or diagram) and describe the transfer of energy within the community. Use the back of this page.

2. **Create a graphic organizer to specify which populations of organisms within your community (above) compete with one another, and for what resources.**

3. **Predict the outcome in the community if one of the populations (you choose which) were completely removed from the community.**