Why Do Clownfish Play With Poison?

How do living things affect one another?

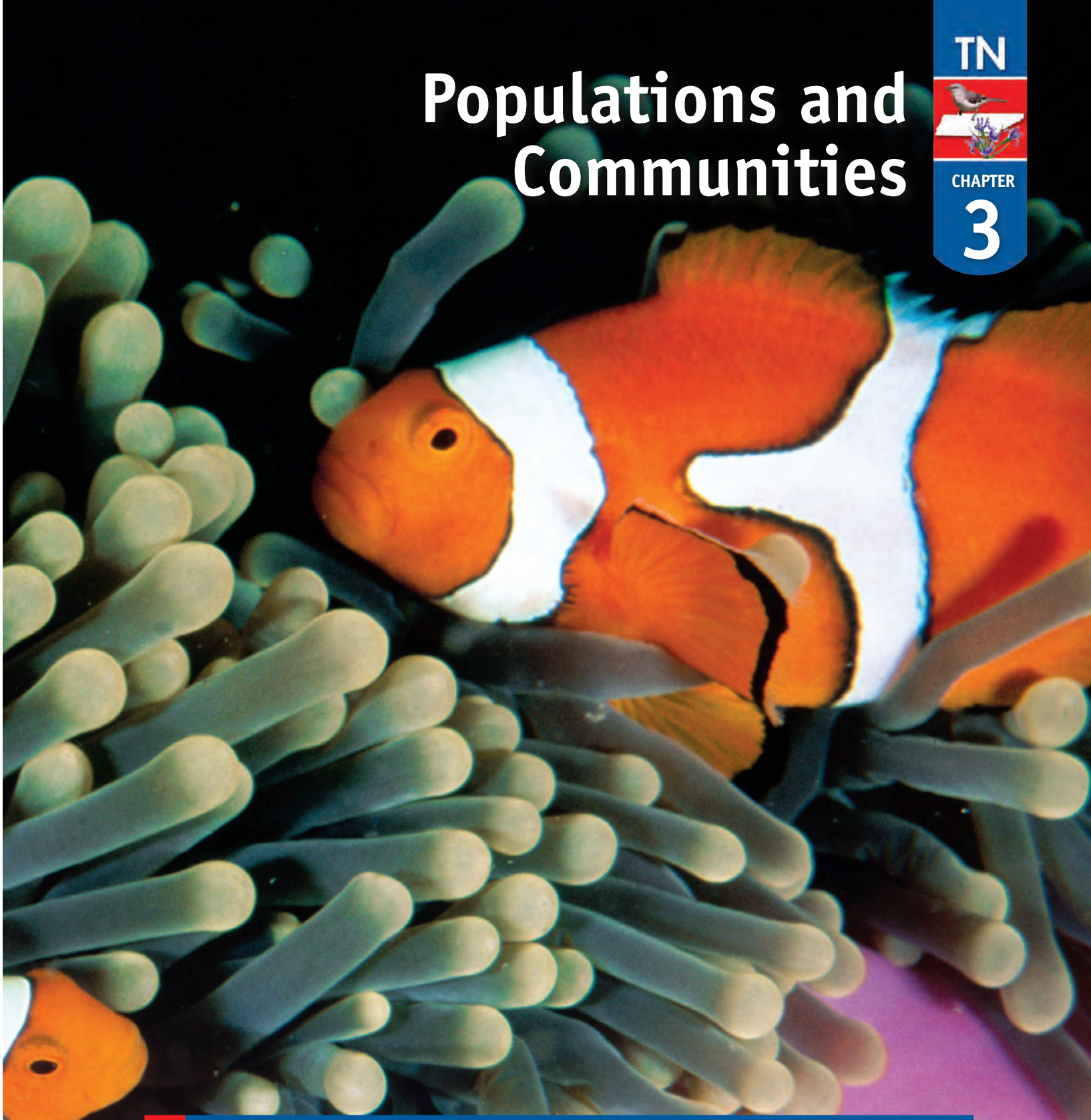
Clownfish live among the poisonous and stinging tentacles of sea anemones to avoid being eaten by larger fish. Amazingly, the clownfish do not get stung! This is because a fluid called mucus protects the skin of the fish. **Develop Hypotheses** **How might a sea anemone benefit from having clownfish around?**

Watch the **Untamed Science** video to learn more about interactions between organisms.

Populations and Communities

TN

CHAPTER 3



Tennessee Academic Standards for Science

6.LS2.1 Evaluate and communicate the impact of environmental variables on population size.
6.LS2.2 Determine the impact of competitive, symbiotic, and predatory interactions in an ecosystem.
6.LS2.6 Research the ways in which an ecosystem has changed over time in response to changes in physical conditions, population balances, human interactions, and natural catastrophes.
6.LS2.7 Compare and contrast auditory and visual methods of communication among organisms in relation to survival strategies of a population.

CHAPTER 3

Getting Started

Check Your Understanding

1. **Background** Read the paragraph below and then answer the question.

Raquel planted a garden in a sunny area near her home. First, she loosened the **soil,** so the plant roots could easily grow. If days passed with no **precipitation,** she watered the plants. That was all she had to do—the rest of what the plants needed came from the **atmosphere!**

Soil is made up of rock fragments, water, air, and decaying plant and animal matter.

Rain, hail, sleet, and snow are all types of **precipitation.**

Earth's **atmosphere** contains oxygen, carbon dioxide, nitrogen, and other gases.

- How do soil, precipitation, and the atmosphere help a plant grow?

Vocabulary Skill

Latin Word Origins Some key terms in this chapter contain word parts with Latin origins. The table below lists two of the Latin words that key terms come from.

Latin Word	Meaning of Latin Word	Example
aptare	to fit	adaptation, *n.* a characteristic that allows an organism to live successfully in its environment
migrare	to move	immigration, *n.* movement into a population

2. **Quick Check** **The terms *immigration* and *emigration* both come from the Latin word *migrare*. Circle the meaning of *migrare* in the table above.**

Chapter Preview

LESSON 1

- organism • habitat
- biotic factor • abiotic factor
- species • population
- community • ecosystem
- ecology

Compare and Contrast
Draw Conclusions

LESSON 2

- birth rate • death rate
- immigration • emigration
- population density
- limiting factor
- carrying capacity

Relate Cause and Effect
Infer

LESSON 3

- natural selection • adaptation
- niche • competition • predation
- predator • prey • symbiosis
- mutualism • commensalism
- parasitism • parasite • host

Relate Text and Visuals
Classify

CCC: Energy and Matter

Scenario Investigation

That Can't Possibly Work!

SEP: Using Mathematics and Computational Thinking

Purpose To investigate the accuracy of the Mark and Recapture population estimating method

Materials
- 15 plastic zipper storage bags
- felt-tip marker
- small items to fill the bags (dried beans, uncooked macaroni, etc.)

Scenario

You have just learned about a method for estimating the size of a population called "Mark and Recapture." Ecologists use Mark and Recapture when it isn't practical for them to count all the individuals in a population. Mark and Recapture involves estimating the size of a population by capturing, marking, and then recapturing some members of the population. This technique can yield a very accurate estimate. Perhaps you are skeptical? You need to see for yourself that this can work.

Mark and Recapture

1. To estimate the size of a population, a researcher visits the study area and uses traps to capture a group of individuals. Each individual is marked with a numbered tag or band and then released unharmed back into the environment.
2. The researcher goes away to allow time for the marked individuals to mix back into the population.
3. When the researcher returns, he or she captures another sample of individuals. Some of the individuals in this second sample will already be marked. The rest will not be marked.
4. The researcher records the number of marked and unmarked individuals in each sample. The researcher then uses a mathematical formula to calculate the size of the population. The researcher can estimate population size from as few as two visits to the study area, but more visits provide a more accurate estimate.

Scientists Are Skeptical

Scientists like to see evidence. When they read or hear about a new claim, their first reaction is to examine the evidence to see if the facts support the claim. When scientists read about a new way of doing something, they are skeptical about that, too. They ask, "Does the new way work as well as the older way of doing the same thing? Is the new way better?"

Procedure

- [ ] **1. The Population** Your teacher will give you a bag filled with small objects. The objects represent a population of lively animals.
- [ ] **2. The Capture and Mark** Capture 10 animals by reaching into the bag and removing them one at a time. (It's okay to look during this step.)
- [ ] **3. The Mark** Mark the captured animals with the marker and return them to the bag.
- [ ] **4. The Mix** Allow the population to mix. Stir them or shake them to get them to move.
- [ ] **5. The Recapture** With your eyes closed, reach into the bag and remove 15 animals.

Procedure *(continued)*

☑ **6. Recording the Data** Record on the data table the number of the recaptured animals that already have a mark.

☑ **7. Return and Repeat** Return the animals to the bag and repeat Steps 4 and 5. Complete a total of 10 recaptures.

☑ **8. Total the Results** After you have entered the counts from the 10 recaptures, add them and record the total number of recaptured animals that had a mark on them.

☑ **9. Calculate and Count** Use the formula below to calculate your estimate of the population size, and then check your estimate by counting the actual number of animals in the bag:

Trial Number	Total Recaptured	Number Recaptured with a mark
1	15	
2	15	
3	15	
4	15	
5	15	
6	15	
7	15	
8	15	
9	15	
10	15	
Total:	150	

Estimate of Total Population = $\dfrac{\textbf{(total number recaptured) x (number originally marked)}}{\textbf{(total number recaptured with a mark)}}$

Estimated size: _____ Actual size: _____

Conclusion

Let's see what you learned about estimating the size of a population using the Mark and Recapture method. Compare the actual size to the estimated size and answer the following questions.

☑ **1.** How close was your estimate? _____

☑ **2.** Was your estimate too high or too low? _____

☑ **3.** Explain how you could make the estimate more accurate. _____

_____

☑ **4.** Are you still skeptical? Explain. _____

A friend of yours is using the Mark and Recapture technique to study the butterfly population in the area around his school. He first marked and released 50 butterflies. For four weeks, he checked his traps daily, counted the butterflies in the traps, and then released them. He caught a total of 300 butterflies, and 25 of them were marked. He determined that the total population of butterflies is 150. Is he correct? If not, what is the size of the butterfly population he is studying, and what mistake did he make? Prepare a brief answer to send to your friend by e-mail. Show all calculations.

TN

LESSON 1

6.LS2.1

Living Things and the Environment

UNLOCK THE BIG ?

- What Does an Organism Get From Its Environment?
- What Are the Two Parts of an Organism's Habitat?
- How Is an Ecosystem Organized?

MY PLANET DIARY

DISCOVERY

Love Song

The gray, golden brown, and Goodman's mouse lemurs are some of the world's smallest primates. These three lemurs look similar. Looking so similar makes it difficult for the lemurs to find members of their own kind or species during mating season. However, it seems that the lemurs can identify their own species by song. Scientists recorded the mating calls of the three species of lemurs. They discovered that the lemurs reacted more to the calls from their own species. This allows the lemurs to pick the right mate, even at night.

Communicate **Answer these questions. Discuss your answers with a partner.**

1. If you were looking for your sneakers among several pairs that looked just like yours, what characteristics would make it easier for you to find them?

2. What do you think would happen if a lemur mated with a different kind of lemur?

Lab zone® Do the Inquiry Warm-Up *What's in the Scene?*

Vocabulary

- organism
- habitat
- biotic factor
- abiotic factor
- species
- population
- community
- ecosystem
- ecology

Skills

Reading: Compare and Contrast

Inquiry: Draw Conclusions

What Does an Organism Get From Its Environment?

If you were to visit Alaska, you might see a bald eagle fly by. A bald eagle is one type of **organism,** or living thing. Different types of organisms live in different types of surroundings, or environments. **An organism gets food, water, shelter, and other things it needs to live, grow, and reproduce from its environment.** An environment that provides the things a specific organism needs to live, grow, and reproduce is called its **habitat.**

In a forest habitat, mushrooms grow in the damp soil and woodpeckers build nests in tree trunks. Organisms live in different habitats because they have different requirements for survival and reproduction. Some organisms live on a prairie, with its flat terrain, tall grasses, and low rainfall amounts. A prairie dog, like the one shown in **Figure 1,** obtains the food and shelter it needs from a prairie habitat. It could not survive on this rocky ocean shore. Likewise, the prairie would not meet the needs of a sea star.

FIGURE 1

What's Wrong With This Picture?
Most people would never expect to see a prairie dog at the beach.

List **Give three reasons why this prairie dog would not survive in this habitat.**

_____

_____

_____

_____

Lab zone® Do the Quick Lab *Organisms and Their Habitats.*

Assess Your Understanding

got it?

- ○ I get it! Now I know that an organism's environment provides _____
- ○ I need extra help with _____

What Are the Two Parts of an Organism's Habitat?

To meet its needs, a prairie dog must interact with more than just the other prairie dogs around it. **An organism interacts with both the living and nonliving parts of its habitat.**

Compare and Contrast In the paragraphs at the right, circle how biotic and abiotic factors are similar and underline how they are different.

Biotic Factors

What living things can you see in the prairie dog's habitat shown in **Figure 2**? The parts of a habitat that are living, or were once living, and which interact with an organism are called **biotic factors** (by AHT ik). The plants that provide seeds and berries, the ferrets and eagles that hunt the prairie dog, and the worms and bacteria that live in the soil are all biotic factors. Prairie dog scat, owl pellets, and decomposing plant matter are also biotic factors.

Abiotic Factors

Not all of the factors that organisms interact with are living. **Abiotic factors** (ay by AHT ik) are the nonliving parts of an organism's habitat. These factors, as shown in **Figure 2,** include sunlight, soil, temperature, oxygen, and water.

Sunlight Because sunlight is needed for plants to make their own food, it is an important abiotic factor for most living things.

Soil Soil consists of varying amounts of rock fragments, nutrients, air, water, and the decaying remains of living things. The soil in an area influences the kinds of plants and animals that can live and grow there.

Temperature The temperatures that are typical in an area determine the types of organisms that can live there.

Oxygen Most living things require oxygen to carry out their life processes. Organisms on land obtain oxygen from air. Aquatic organisms obtain oxygen that is dissolved in the water around them.

Water All living things require water to carry out their life processes. Plants and algae need water along with sunlight and carbon dioxide to make their own food. Other living things depend on plants and algae for food.

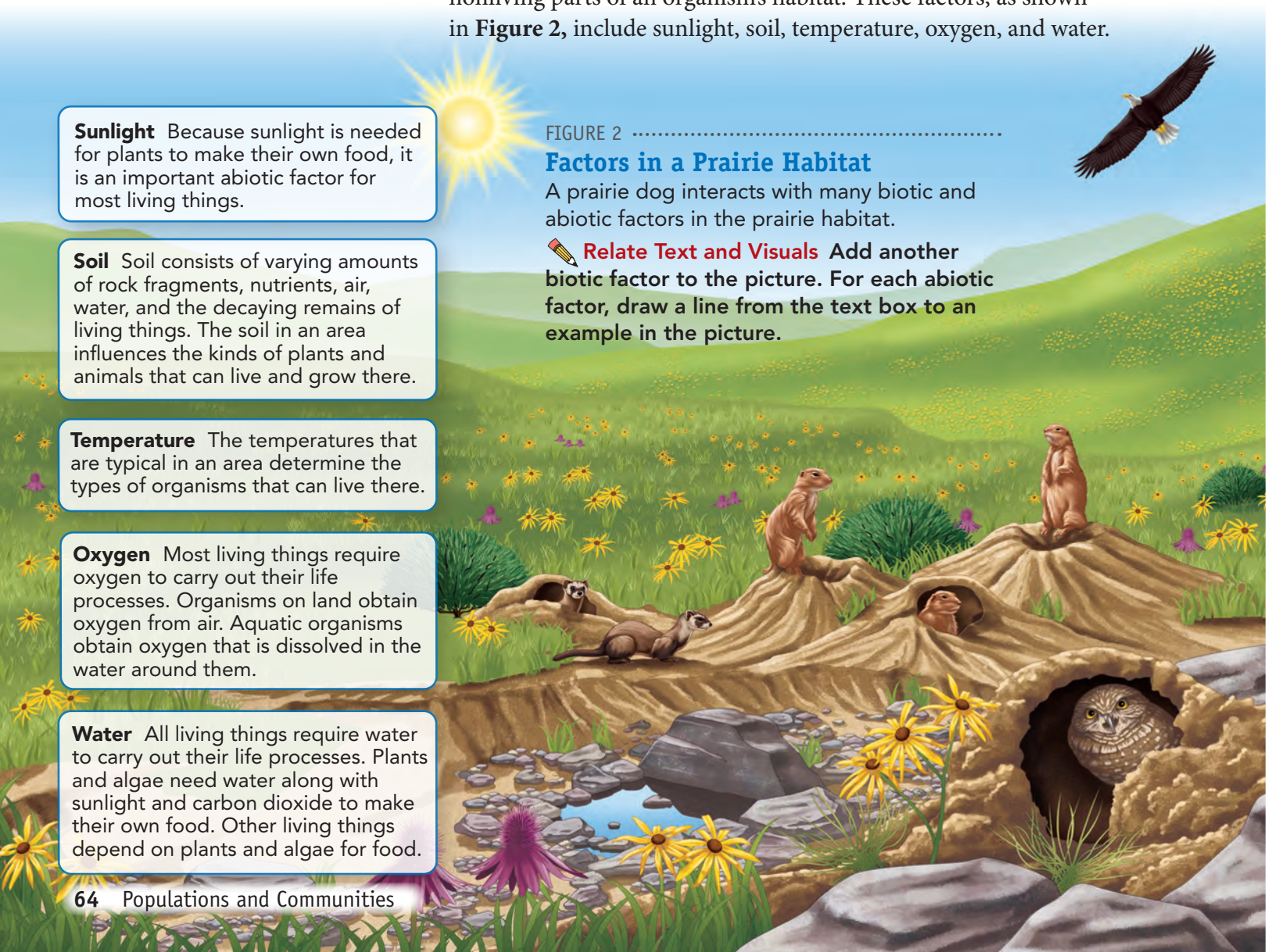


FIGURE 2

Factors in a Prairie Habitat

A prairie dog interacts with many biotic and abiotic factors in the prairie habitat.

Relate Text and Visuals **Add another biotic factor to the picture. For each abiotic factor, draw a line from the text box to an example in the picture.**

apply it!

Salt is an abiotic factor found in some environments. To see how the amount of salt affects the hatching of brine shrimp eggs, varying amounts of salt were added to four different 500-mL beakers.

1 **Observe** In which beaker(s) did the eggs, shown as purple circles, hatch? _____

2 **Infer** The manipulated variable was

_____

3 **Infer** The responding variable was _____

_____

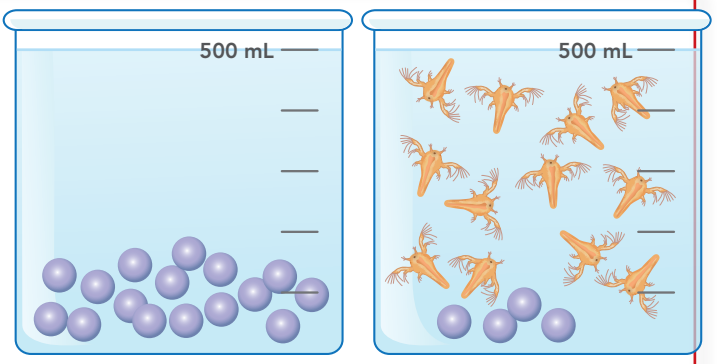
4 CHALLENGE Beaker _____ was the control.

5 **Draw Conclusions** What can you conclude about the amount of salt in the shrimps' natural habitat?

_____

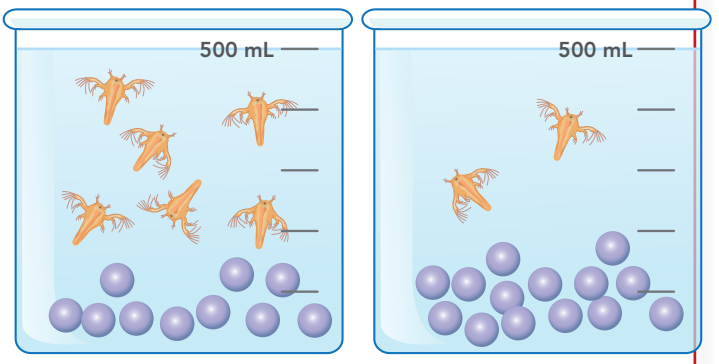
_____

_____



Beaker A
500 mL spring water

Beaker B
500 mL spring water + 2.5 g salt



Beaker C
500 mL spring water + 7.5 g salt

Beaker D
500 mL spring water + 15 g salt

Lab zone® Do the Lab Investigation *World in a Bottle.*

Assess Your Understanding

1a. Interpret Diagrams List two biotic and two abiotic factors in **Figure 2.**

_____

_____

_____

_____

_____

_____

b. Draw Conclusions Name two abiotic factors in your habitat and explain how your life would be different without them.

_____

_____

_____

_____

_____

got it?

○ **I get it!** Now I know that the two parts of an organism's habitat are _____

_____

○ I need extra help with _____

_____

Ecological Organization

How do living things affect one another?

FIGURE 3
In this figure, the smallest level of organization is the organism. The largest is the entire ecosystem.

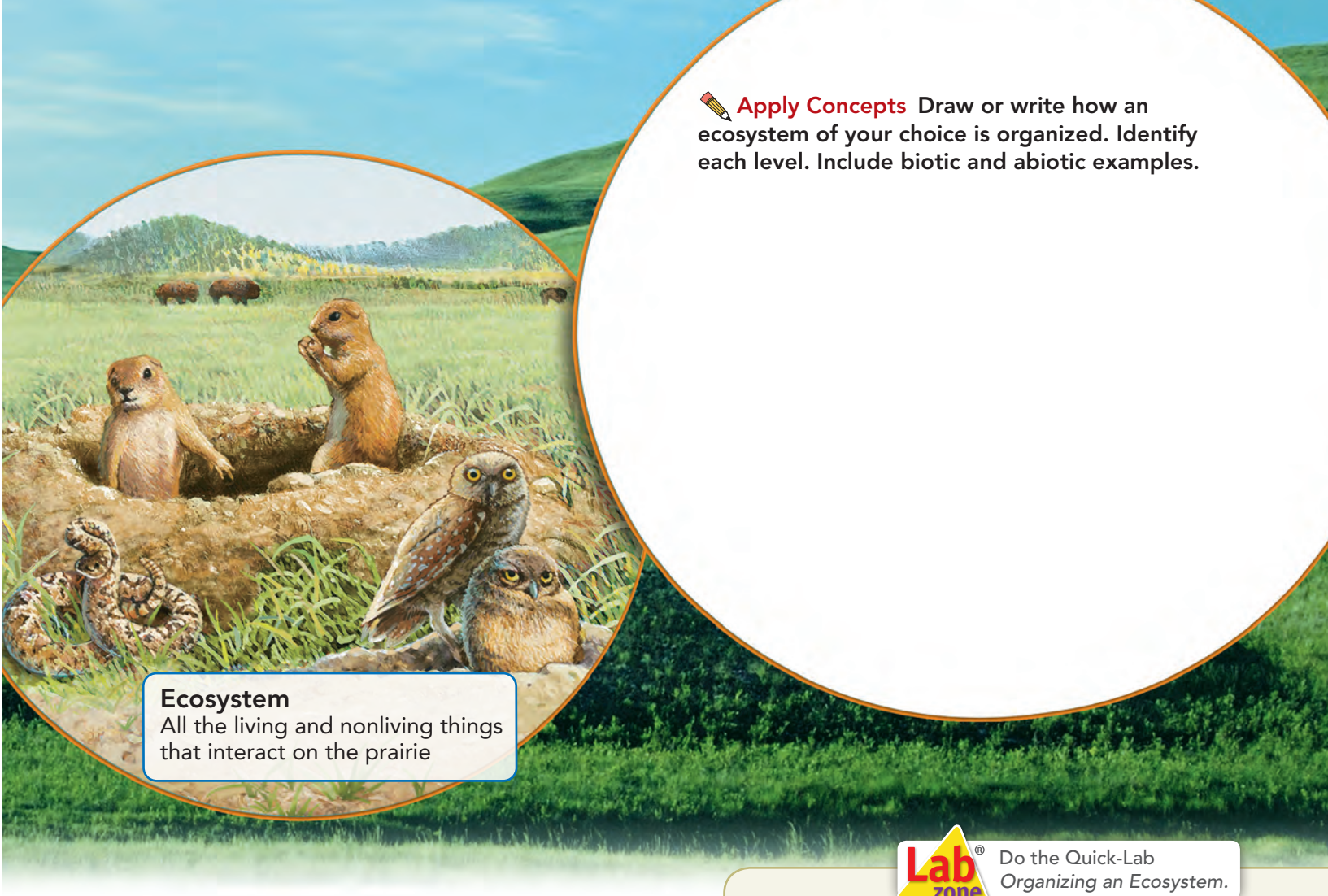
How Is an Ecosystem Organized?

Most organisms do not live all alone in their habitat. Instead, organisms live together in populations and communities that interact with abiotic factors in their ecosystems.

Organisms Black-tailed prairie dogs that live in prairie dog towns on the Nebraska plains are all members of one species. A **species** (SPEE sheez) is a group of organisms that can mate with each other and produce offspring that can also mate and reproduce.

Populations All the members of one species living in a particular area are referred to as a **population.** The prairie dogs in the Nebraska town are one example of a population.

Communities A particular area contains more than one species of organism. The prairie, for instance, includes prairie dogs, hawks, snakes, and grasses. All the different populations that live together in an area make up a **community.**



Ecosystem
All the living and nonliving things that interact on the prairie

Apply Concepts Draw or write how an ecosystem of your choice is organized. Identify each level. Include biotic and abiotic examples.

Ecosystems

The community of organisms that live in a particular area, along with their nonliving environment, make up an **ecosystem.** A prairie is just one of the many different ecosystems found on Earth. Other ecosystems are deserts, oceans, ponds, and forests.

Figure 3 shows the levels of organization in a prairie ecosystem. **The smallest level of organization is a single organism, which belongs to a population that includes other members of its species. The population belongs to a community of different species. The community and abiotic factors together form an ecosystem.**

The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Because the populations in an ecosystem interact with one another, any change affects all the different populations that live there. The study of how organisms interact with each other and with their environment is called **ecology.**

Lab zone® Do the Quick-Lab *Organizing an Ecosystem.*

Assess Your Understanding

2a. Classify All of the different kinds of organisms in a forest are a (community/population).

b. ANSWER THE BIG ? How do living things affect one another?

got it?

- I get it! Now I know that ecosystems are organized into _____
- I need extra help with _____

TN

LESSON 2

6.LS2.1

Populations

UNLOCK THE BIG ?

- How Do Populations Change in Size?
- What Factors Limit Population Growth?

MY PLANET DIARY

Prairie Dog Picker-Upper

Did you know that vacuum cleaners do more than just clean carpets? Across the Great Plains, farmers are using specially designed vacuum cleaners to help them remove black-tailed prairie dogs from the farm land. Prairie dogs can eat crops, cause soil erosion, and endanger cattle and farm machinery. The prairie dog vacuum uses a 4-in. plastic hose to suck prairie dogs out of the ground at 483 km/h! The prairie dogs end up in a padded tank, usually unharmed. They are then relocated or donated to the U.S. Fish and Wildlife Service to be fed to endangered eagles, hawks, and black-footed ferrets.

Prairie dogs

TECHNOLOGY

Communicate Discuss these questions with a group of classmates. Write your answers below.

1. If all of the prairie dogs were removed, how do you think the prairie ecosystem would be affected?

2. Should prairie dogs be used as food for endangered species? Explain.

Lab zone® Do the Inquiry Warm-Up *Populations.*

How Do Populations Change in Size?

Ecologists are scientists who study biotic and abiotic factors of an ecosystem and the interactions between them. Some ecologists study populations and monitor the sizes of populations over time.

Populations can change in size when new members join the population or when members leave the population.

Vocabulary

- birth rate
- death rate
- immigration
- emigration
- population density
- limiting factor
- carrying capacity

Skills

- Reading: Relate Cause and Effect
- Inquiry: Infer

Births and Deaths

The most common way in which new individuals join a population is by being born into it. If more individuals are born into a population than die in any period of time, a population can grow. So when the **birth rate,** the number of births per 1,000 individuals for a given time period, is greater than its **death rate,** the number of deaths per 1,000 individuals for a given time period, the population may increase. The main way that individuals leave a population is by dying. If the birth rate is the same as the death rate, then the population may stay the same. In situations where the death rate is higher than the birth rate, then the population may decrease.

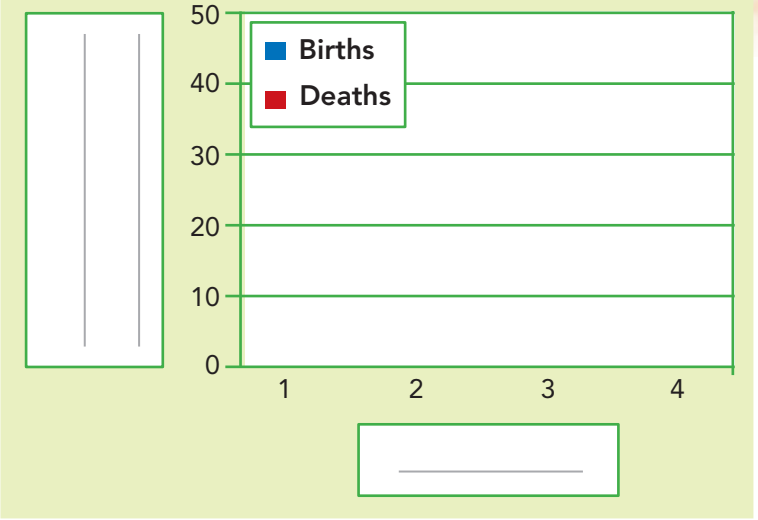
do the math!

Depending on the size and age of the female, an American Alligator can lay between 10 and 50 eggs per year.

Data Table

Year	Births	Deaths
1	32	8
2	28	13
3	47	21
4	33	16

1. **Graph** Using the data table and colored pencils, create a double bar graph showing alligator births and deaths for four years.
2. Label the *x*-axis and *y*-axis.
3. Write a title for the graph.
4. Fill in the graph using the colors shown.
5. **Develop Hypotheses** What factors might explain the number of births and deaths in Year 3?



The Population Statement

When the birth rate in a population is greater than the death rate, the population will generally increase. This can be written as a mathematical statement using the "is greater than" sign:

If birth rate > death rate, population size increases.

However, if the death rate in a population is greater than the birth rate, the population size will generally decrease. This can also be written as a mathematical statement:

If death rate > birth rate, population size decreases.

Vocabulary Latin Word Origins
Both the terms *immigration* ("moving into a population") and *emigration* ("moving out of a population") come from the Latin word *migrare* ("to move"). What do you think the prefixes *im–* and *e–* mean?

Immigration and Emigration

The size of a population also can change when individuals move into or out of the population. **Immigration** (im ih GRAY shun) means moving into a population. **Emigration** (em ih GRAY shun) means leaving a population. For instance, if food is scarce, some members of an antelope herd may wander off in search of better grassland. If they become permanently separated from the original herd, they will no longer be part of that population.

FIGURE 1

Immigration
In 1898, white-tailed deer were almost extinct in Iowa due to over-hunting. The deer population was reestablished as animals from Minnesota, Wisconsin, and Missouri immigrated into Iowa.

Apply Concepts **Using your classroom, describe an example of each of the following.**

Immigration:

Emigration:

Graphing Changes in Population

Changes in a population's size can be displayed on a line graph. Figure 2 shows a graph of the changes in a rabbit population. The vertical axis identifies the number of rabbits in the population, while the horizontal axis shows time. The graph represents the size of the rabbit population over a ten-year period.

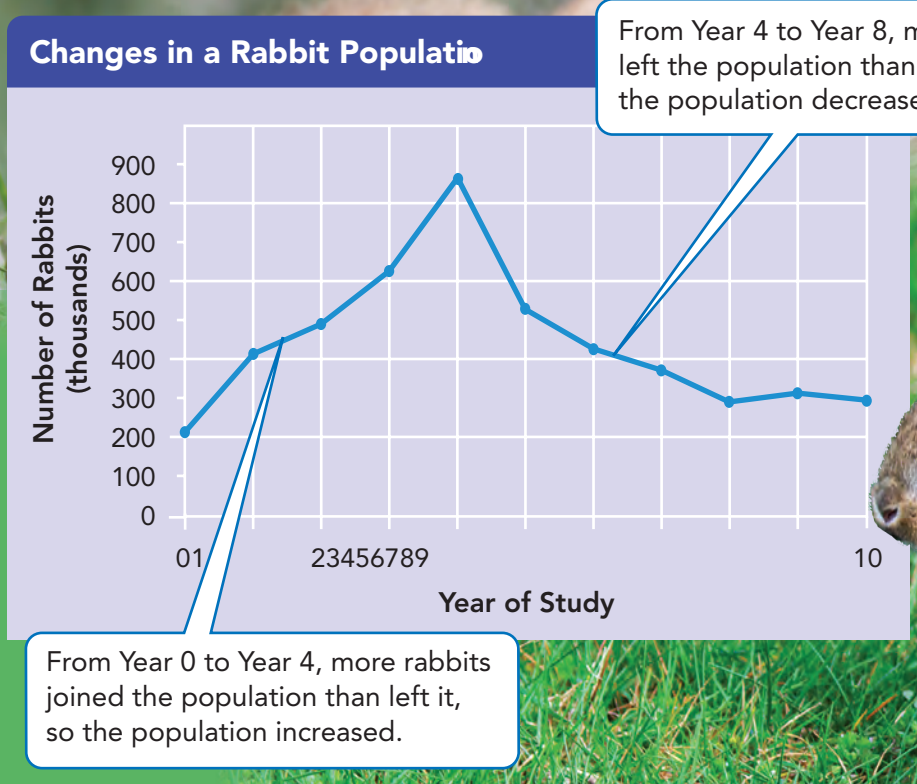


FIGURE 2

Changes in a Rabbit Population

This graph shows how the size of a rabbit population changed over ten years.

1. **Interpret Data** In Year _____, the rabbit population reached its highest point.
2. **Read Graphs** What was the size of the rabbit population in that year? _____
3. CHALLENGE How do you think the rabbit population affected the fox population over the same ten-year period? Explain your reasoning.

Population Density

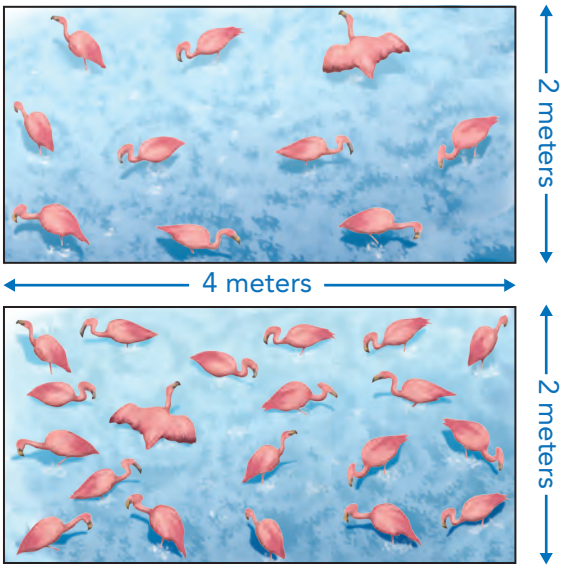
Sometimes an ecologist needs to know more than just the total size of a population. In many situations, it is helpful to know the **population density**—the number of individuals in an area of a specific size. Population density can be written as an equation:

$$\text{Population density} = \frac{\text{Number of individuals}}{\text{Unit area}}$$

For example, suppose you counted 20 butterflies in a garden measuring 10 square meters. The population density would be 20 butterflies per 10 square meters, or 2 butterflies per square meter.

apply it!

In the pond on the top, there are 10 flamingos in 8 square meters. The population density is 1.25 flamingos per square meter.



1 Calculate What is the population density of the flamingos in the pond on the bottom?

_____

2 Infer If 14 more flamingos landed in the pond on the bottom, what would the population density be then?

_____

3 CHALLENGE What do you think would happen if the population density of flamingos in the pond on the bottom became too great?

_____

_____

_____

Lab zone® Do the Quick Lab *Growing and Shrinking.*

Assess Your Understanding

1a. Review Two ways to join a population are _____ and _____.

Two ways to leave a population are _____ and _____.

b. Calculate Suppose a population of 8 wolves has produced 20 young in a year. If 7 wolves have died, how many wolves are in the population now? (Assume no wolves have moved into or out of the population for other reasons.)

_____

got it?

○ **I get it!** Now I know that population size changes due to _____

_____

○ I need extra help with _____

_____

What Factors Limit Population Growth?

When the living conditions in an area are good, a population will generally grow. But eventually some environmental factor will cause the population to stop growing. A **limiting factor** is an environmental factor that causes a population to stop growing or decrease in size. **Some limiting factors for populations are weather conditions, space, food, and water.**

Climate Changes in climate conditions, such as temperature and the amount of rainfall, can limit population growth. A cold spring season can kill the young of many species of organisms, including birds and mammals. Unusual events like tornadoes, hurricanes, and the flood shown in **Figure 3** can also have long-lasting effects on population size.

Relate Cause and Effect As you read about the four factors that can limit populations, fill in the graphic organizer below.

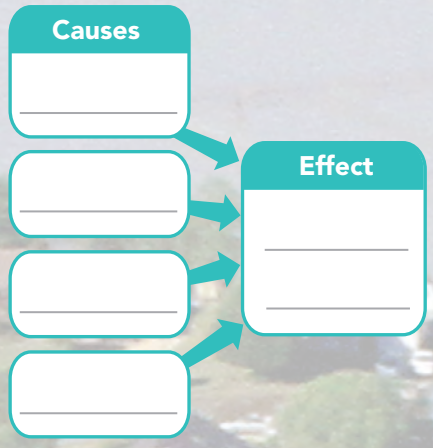


FIGURE 3

Weather as a Limiting Factor

A tornado or a flood can destroy nests and burrows. The flood in Nashville and surrounding area in May of 2010 shows how extensive the damage can be on an ecosystem.

Identify **Name two types of natural disasters that you think can also limit population growth.**

did you know?

Some plants, like the black walnut tree, release chemicals into the environment that discourage other plants from growing too close. This process is called allelopathy (uh luh LOP uh thee).

Space Space is another limiting factor for populations. Gannets are seabirds that are usually seen flying over the ocean. They come to land only to nest on rocky shores. But the nesting shores get very crowded. If a pair does not find room to nest, they will not be able to add any offspring to the gannet population. So nesting space on the shore is a limiting factor for gannets. If there were more nesting space, more gannets would be able to nest. The population could increase.

Figure 4 shows how space is also a limiting factor for plants. The amount of space in which a plant grows determines whether the plant can obtain the sunlight, water, and soil nutrients it needs. For example, many pine seedlings sprout each year in forests. But as the seedlings grow, the roots of those that are too close together run out of space. Branches from other trees may block the sunlight the seedlings need. Some of the seedlings then die, limiting the size of the pine population.

Food and Water Organisms require food and water to survive. When food and water are in limited supply, they can be limiting factors. Suppose a giraffe must eat 10 kilograms of leaves each day to survive. The trees in an area can provide 100 kilograms of leaves a day while remaining healthy. Five giraffes could live easily in this area, because they would need just 50 kilograms of food a day. But 15 giraffes could not all survive—there would not be enough food. No matter how much shelter, water, and other resources there were, the population would not grow much larger than 10 giraffes. The largest population that an area can support is called its carrying capacity. The carrying capacity of this giraffe habitat would be 10 giraffes. The size of a population can vary, but usually stays near its carrying capacity because of the limiting factors in its habitat.

FIGURE 4

Space as a Limiting Factor

If no more tulip plants can grow in this field, the field has reached its carrying capacity for tulips.

List **Name three things a plant needs to survive.**

apply it!

Giant pandas live in the mountains of south central China. Most (99 percent) of the pandas' diet is made up of the bamboo plant. Bamboo is not nutrient rich. Pandas spend 55 percent of their day eating between 9 and 38 kilograms of bamboo. Getting enough bamboo to eat can be a challenge. Farming and the timber industry have destroyed the pandas' habitat and bamboo forests. In addition, when a bamboo plant flowers, the plant dies and does not regrow for several years. It is difficult for scientists to know exactly how many giant pandas exist in the wild. The best estimate is that there are about 1,600 of them. Due to the small population size, this species is classified as endangered.

Communicate **Write a letter to the editor that describes how food and space may be limiting factors for the giant panda species. Add a headline to your letter.**

Lab zone® Do the Quick Lab *Elbow Room.*

Assess Your Understanding

2a. Summarize When the climate changes or there is not enough _____ or _____ or _____, a population can (begin/stop) growing in size.

b. Relate Cause and Effect Choose a limiting factor and describe the factor's effect on population growth.

got it?

- ○ I get it! Now I know that populations can be limited when _____
- ○ I need extra help with _____

TN

LESSON 3

6.LS2.2, 6.LS2.7

Interactions Among Living Things

UNLOCK THE BIG ?

- How Do Adaptations Help an Organism Survive?
- What Are Competition and Predation?
- What Are the Three Types of Symbiosis?

MY PLANET DIARY

Predator Power

What predator can close its jaws the fastest? You might think it is a lion or a shark, but you would be wrong. It is the trap-jaw ant that has the fastest strike in the animal kingdom. The trap-jaw ant closes its mouth around its prey in 0.13 milliseconds at speeds of 35 to 64 meters per second! The force created when its jaw snaps shut also helps the ant escape danger by either jumping up to 8.3 centimeters high or 39.6 centimeters sideways.

A trap-jaw ant stalks its prey.

FUN FACT

Communicate Answer the questions below. Discuss your answers with a partner.

1. How does the trap-jaw ant's adaptation help it avoid becoming the prey of another organism?

2. What are some adaptations that other predators have to capture prey?

Lab zone® Do the Inquiry Warm-Up *Can You Hide a Butterfly?*

How Do Adaptations Help an Organism Survive?

As day breaks, a sound comes from a nest tucked in the branch of a saguaro cactus. Two young red-tailed hawks are preparing to fly. Farther down the stem, a tiny elf owl peeks out of its nest in a small hole. A rattlesnake slithers around the base of the saguaro, looking for breakfast. Spying a shrew, the snake strikes it with needle-like fangs. The shrew dies instantly.

Vocabulary

- natural selection
- adaptation
- niche
- competition
- predation
- predator
- prey
- symbiosis
- mutualism
- commensalism
- parasitism
- parasite
- host

Skills

Reading: Relate Text and Visuals

Inquiry: Classify

Figure 1 shows some organisms that live in, on, and around the saguaro cactus. Each organism has unique characteristics. These characteristics affect the individual's ability to survive and reproduce in its environment.

Natural Selection

A characteristic that makes an individual better suited to a specific environment may eventually become common in that species through a process called **natural selection.** Natural selection works like this: Individuals whose unique characteristics are well-suited for an environment tend to survive and produce more offspring. Offspring that inherit these characteristics also live to reproduce. In this way, natural selection results in **adaptations,** the behaviors and physical characteristics that allow organisms to live successfully in their environments. For example, the arctic hare has fur that turns from gray to white in the winter which helps camouflage the hare against the snow.

Individuals with characteristics poorly suited to a particular environment are less likely to survive and reproduce. Over time, poorly suited characteristics may disappear from the species. If a species cannot adapt to changes in its environment, the entire species can disappear from Earth and become extinct.

FIGURE 1

Saguaro Community

Describe Circle two examples of how organisms interact in this scene. Describe each one.

Communication as Adaptation

Communication, or the exchange of information, shows how organisms may use both physical characteristics and behaviors as adaptations to their environment. Some of the ways that organisms communicate are very similar to humans. Just as you can send a message with both your words and your body language, animals communicate with both **auditory** methods, or using sound, and **visual** methods, or displays that are seen. Whether the communication is auditory or visual, it always involves a sender who delivers the information, and a receiver who gets and responds to the information. Communication may involve information that helps organisms to locate food, find or attract mates, defend territory, or avoid becoming another organism's meal.

Auditory communication In many cases, auditory signals are used as a means of warding off predators, or animals who hunt others. Sometimes the message is sent from a threatened animal to its potential predator. The rattlesnake near the saguaro cactus, in **Figure 1,** may sound its rattle loudly—an auditory warning to the red-tailed hawk that attacking the snake comes with the risk of a venomous bite. In other cases, the receivers of auditory warnings are other animals under threat. When a meerkat spots a predator, it sends out a distinctive bark to warn the rest of its colony. Both the snake's rattle and the meerkat's alarm call developed through natural selection: animals that used these behaviors were more likely to survive and pass on the ability to communicate. Auditory communication also is used to increase the chance of finding or attracting mates, as is the case for many male songbirds that use their songs to attract females.

FIGURE 2

Auditory Communication

This meerkat (above) and this songbird (top) both use auditory communication for different reasons. Meerkats use auditory communication to avoid predators. In a study of song sparrows, females chose males to mate with based on how well they learned songs.

Describe How is a male songbird's song an example of natural selection?

Visual communication
Visual communication involves displays, postures, or gestures, which may be either permanent or temporary. Visual communication is more common during the day when organisms are more easily seen. As with auditory communication, one purpose of visual cues is to ward off predators. Brightly colored animals are often also poisonous. For example, the flashy colors of the poison dart frog advertise the fact that it is poisonous to would-be attackers.

Through natural selection, many predators have developed the adaptation of recognizing and avoiding these easy-to-spot, but toxic prey! Visual information plays an important role in mating rituals as well. In some species of birds, such as the greater sage grouse, males perform elaborate dances for female audiences. The females choose mates based on their dancing ability, which is an indicator of how healthy the males are. Honeybees dance for others, too—but in their case the purpose of the dance is to share information with other bees about the direction and distance toward patches of flowers containing nectar or sources of water. Whether communicating to find a fit mate or cooperating to find food, communication through such displays helps ensure that the most beneficial traits of a population are passed on to the next generation.

FIGURE 3

Visual Communication
Sage grouse come together in groups called leks, where females watch the group dance in order to choose the most fit mate.

Infer How is the sage grouse dance an example of natural selection?

Assess Your Understanding

got it?

- ○ **I get it!** Both auditory and visual communication
- ○ I need extra help with

Niche The organisms in the saguaro community have adaptations that result in specific roles. The role of an organism in its habitat is called its **niche.** A niche includes what type of food the organism eats, how it obtains this food, and what other organisms eat it. A niche also includes when and how the organism reproduces and the physical conditions it requires to survive. Some organisms, like the birds in **Figure 4,** share the same habitat but have very specific niches that allow them to live together. **Every organism has a variety of adaptations that are suited to its specific living conditions and help it survive.**

apply it!

Organisms occupy many niches in an environment like the one in this picture.

1 Identify List two abiotic factors in the picture.

_____

2 Interpret Diagrams Describe the niche of the squirrel in the picture.

_____

_____

3 Make Generalizations What adaptations might the squirrel have that make it able to live in this environment?

_____

_____

Lab zone® Do the Quick Lab *Adaptations for Survival.*

Assess Your Understanding

1a. Define Adaptations are the _____ and _____ characteristics that allow organisms to live successfully in their environments.

b. Explain How are a snake's sharp fangs an adaptation that help it survive in the saguaro community?

_____

_____

got it?

○ **I get it!** Now I know that adaptations are _____

_____

○ I need extra help with _____

_____

What Are Competition and Predation?

During a typical day in the saguaro community, a range of interactions takes place among organisms. **Two major types of interactions among organisms are competition and predation.**

Competition Different species can share the same habitat and food requirements. For example, the flycatcher and the elf owl both live on the saguaro and eat insects. However, these two species do not occupy exactly the same niche. The flycatcher is active during the day, while the owl is active mostly at night. If two species occupy the same niche, one of the species might eventually die off. The reason for this is **competition.** The struggle between organisms to survive as they attempt to use the same limited resources is called competition. For example, weeds in a garden compete with vegetable crops for soil nutrients, water, and sunlight.

In any ecosystem, there are limited amounts of food, water, and shelter. Organisms that share the same habitat often have adaptations that enable them to reduce competition. For example, the three species of warblers in **Figure 4** specialize in feeding only in a certain part of the spruce tree.

Cape May Warbler
This species feeds at the tips of branches near the top of the tree.

Bay-Breasted Warbler
This species feeds in the middle part of the tree.

Yellow-Rumped Warbler
This species feeds in the lower part of the tree and at the bases of the middle branches.

FIGURE 4

Niche and Competition

Each of these warbler species occupies a very specific location in its habitat. By feeding on insects in different areas of the tree, the birds avoid competing for food and are able to live together.

1. **Predict** What could happen if these warbler species fed in the same location on the tree?

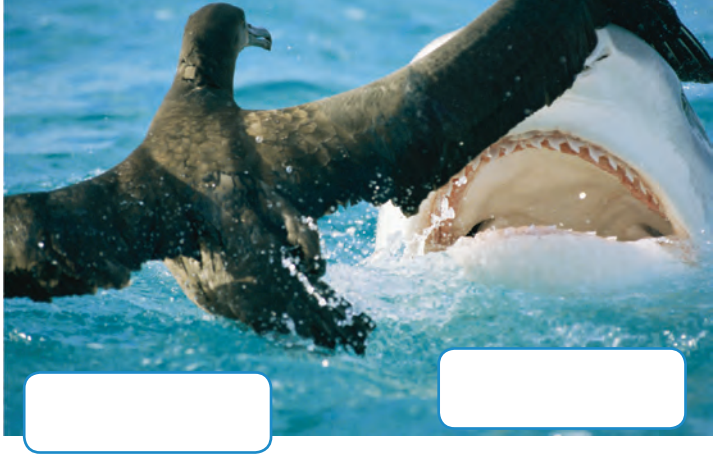
2. **List** For what resources do the tree and the grass compete?

FIGURE 5

Predation

This tiger shark and this albatross are involved in a predator-prey interaction.

Interpret Photos **Label the predator and the prey in the photo.**



Predation

In **Figure 5,** a tiger shark bursts through the water to seize an albatross in its powerful jaws. An interaction in which one organism kills another for food or nutrients is called **predation.** The organism that does the killing is the **predator.** The organism that is killed is the **prey.** Even though they do not kill their prey, organisms like cows and giraffes are also considered predators because they eat plants.

Predation can have a major effect on a prey population size. Recall that when the death rate exceeds the birth rate in a population, the population size can decrease. So, if there are too many predators in an area, the result is often a decrease in the size of the prey population. But a decrease in the number of prey results in less food for their predators. Without adequate food, the predator population can decline. Generally, populations of predators and their prey rise and fall in related cycles.

Remember that predators are part of a food chain. Predators are consumers, which are organisms that obtain energy by feeding on other organisms. Sometimes consumers eat other consumers, and sometimes they eat plants, which are producers, or organisms that can make their own food. To complete the food chain, decomposers break down dead organisms and return the raw materials to the ecosystem.

FIGURE 6

Predator Adaptations

A jellyfish's tentacles contain a poisonous substance that paralyzes tiny water animals. The sundew is a plant that is covered with sticky bulbs on stalks. When a fly lands on a bulb, it remains snared in the sticky goo while the plant digests it.

Make Models **Imagine an ideal predator to prey upon a porcupine. Draw or describe your predator below and label its adaptations.**

Predator Adaptations Predators, such as those in **Figure 6**, have adaptations that help them catch and kill their prey. A cheetah can run very fast for a short time, enabling it to catch its prey. Some predators, such as owls and bats, have adaptations that enable them to hunt at night when their prey, small mammals and insects, are active.

Prey Adaptations How do organisms avoid being killed by effective predators? The smelly spray of a skunk and the sharp quills of a porcupine help keep predators at a distance. As you can see in **Figure 7,** organisms have many kinds of adaptations that help them avoid becoming prey.

False Coloring Predators may be confused by a false eyespot and attack the wrong end of the fish. This allows the fish to swim safely away in the opposite direction.

Mimicry The mimic octopus (top) imitates the coloring, shape, and swimming style of the venomous sole fish (bottom) to discourage predators.

Warning Coloring Like many brightly colored animals, this frog is poisonous. Its bright blue and yellow colors warn predators not to eat it.

Protective Covering Have you ever seen a pinecone with a face? This is a pangolin, a small African mammal. When threatened, the pangolin protects itself by rolling up into a scaly ball.

Camouflage Is it a leaf? Actually, it's a walking leaf insect. But if you were a predator, you might be fooled into looking elsewhere for a meal.

FIGURE 7

Defense Strategies

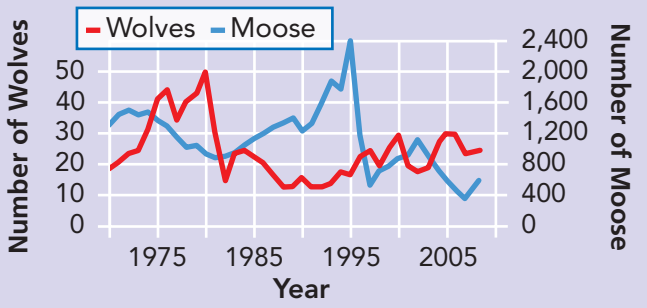
Organisms display a wide range of adaptations that help them avoid becoming prey. **Communicate** **In a group, rate each prey adaptation from 1 (best) to 5 (worst) in the circles. Explain your best choice.**

do the math!

Predator-Prey Interactions

On Isle Royale, an island in Lake Superior, the populations of wolves (the predator) and moose (the prey) rise and fall in cycles. Use the graph to answer the questions.

Wolf and Moose Populations on Isle Royale



SOURCE: www.isleroyalewolf.org

1 **Read Graphs** What variable is plotted on the horizontal axis? What two variables are plotted on the vertical axis?

2 **Interpret Data** How did the moose population change between 2002 and 2007? What happened to the wolf population from 2003 through 2006?

3 **Draw Conclusions** How might the change in moose population have led to the change in the wolf population?

4 **Explain** What adaptations does a wolf have that make it a successful predator?

5 **Predict** How might disease in the wolf population one year affect the moose population the next year?

Lab zone® Do the Quick Lab *Competition and Predation.*

Assess Your Understanding

2a. Review Two main ways in which organisms interact are _____ and _____.

b. Describe Give an example of competition. Explain your answer.

c. Apply Concepts Owls often prey on mice. What adaptations do you think the mice have that help them avoid becoming prey?

got it?

○ **I get it!** Now I know that competition and predation _____

○ I need extra help with _____

What Are the Three Types of Symbiosis?

In addition to competition and predation, symbiosis is a third type of interaction among organisms. **Symbiosis** (sim bee OH sis) is any relationship in which two species live closely together and at least one of the species benefits. **The three main types of symbiotic relationships are mutualism, commensalism, and parasitism.**

Mutualism

In some relationships, two species may depend on one another. This is true for some species of acacia trees and stinging ants in South America. The stinging ants nest only in the acacia tree, whose thorns discourage the ants' predators. The tree also provides the ants' only food. The ants, in turn, attack other animals that approach the tree and clear competing plants away from the base of the tree. This relationship is an example of **mutualism** (MYOO choo uh liz um). A relationship in which both species benefit is called mutualism. Other examples of mutualism can be seen in **Figure 8.**

FIGURE 8

Mutualism

An oxpecker rides and snacks aboard an impala. The oxpecker eat ticks living on the impala's ears. This interaction is an example of mutualism because both organisms benefit.

1. **Infer** How does the oxpecker benefit?

2. **Infer** How does the impala benefit?

3. **CHALLENGE** Explain how the relationship between the hummingbird and the flower is an example of mutualism.

Commensalism

Have you ever seen a bird build a nest in a tree? The bird gets a place to live while the tree is unharmed. This relationship is an example of commensalism. **Commensalism** (kuh MEN suh liz um) is a relationship in which one species benefits and the other species is neither helped nor harmed. In nature, commensalism is not very common because two species are usually either helped or harmed a little by any interaction.

Parasitism

Many family pets get treated with medication to prevent tick and flea bites. Without treatment, pets can suffer from severe health problems as a result of these bites. A relationship that involves one organism living with, on, or inside another organism and harming it is called **parasitism** (PA ruh sit iz um). The organism that benefits is called a **parasite.** The organism it lives on or in is called a **host.** The parasite is usually smaller than the host. In a parasitic relationship, the parasite benefits while the host is harmed. Unlike a predator, a parasite does not usually kill the organism it feeds on. If the host dies, the parasite could lose its source of food or shelter.

Some parasites, like fleas and ticks, have adaptations that enable them to attach to their host and feed on its blood. Other examples of parasitism are shown in **Figure 9.**

Relate Text and Visuals List the names of the parasites and the hosts in **Figure 9**.

Parasites	Hosts

A parasitic cowbird laid its eggs in a yellow warbler's nest. The cowbird chick is outcompeting the warbler chicks for space and food.

Fish lice feed on the blood and other internal fluids of fish.

Dwarf mistletoe is a small parasitic flowering plant that grows into the bark of trees to obtain water and nutrients.

FIGURE 9

Parasitism

There are many examples of parasitic relationships. Besides fleas, ticks, and tapeworms, some plants and birds are parasites. **Explain Why doesn't a parasite usually kill its host?**

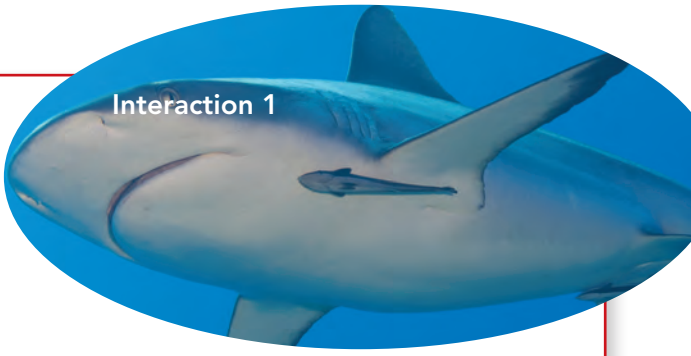
apply it!

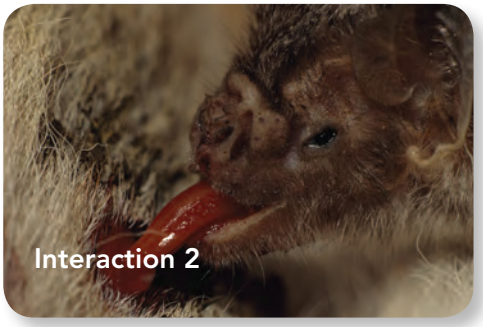
Classify Each photograph on the right represents a different type of symbiosis. Classify each interaction as mutualism, commensalism, or parasitism. Explain your answers.

Interaction 1: A remora fish attaches itself to the underside of a shark without harming the shark, and eats leftover bits of food from the shark's meals.

Interaction 2: A vampire bat drinks the blood of horses.

Interaction 3: A bee pollinates a flower.





1. Interaction 1

_____

_____

2. Interaction 2

_____

_____

3. Interaction 3

_____

_____

Lab zone® Do the Quick Lab *Type of Symbiosis.*

Assess Your Understanding

3a. Identify The three types of symbiosis are _____, _____, and _____.

b. Classify Microscopic mites live at the base of human eyelashes, where they feed on tiny bits of dead skin. What type of symbiosis could this be? Explain your answer.

_____

_____

_____

c. Compare and Contrast Name each type of symbiosis and explain how the two species are affected.

_____

_____

_____

_____

_____

_____

_____

got it?

○ **I get it!** Now I know that the three types of symbiosis differ in _____

_____

○ I need extra help with _____

_____

CHAPTER 3

Study Guide

REVIEW THE BIG ?

Living things interact in many ways, including competition and _____, as well as through symbiotic relationships such as mutualism, commensalism, and _____.

LESSON 1 Living Things and the Environment

- An organism gets the things it needs to live, grow, and reproduce from its environment.
- Biotic and abiotic factors make up a habitat.
- The levels of organization in an ecosystem are organism, population, and community.

Vocabulary

- organism • habitat • biotic factor
- abiotic factor • species • population
- community • ecosystem • ecology

LESSON 2 Populations

- Populations can change in size when new members join the population or when members leave the population.
- Some limiting factors for populations are weather conditions, space, food, and water.

Vocabulary

- birth rate • death rate • immigration
- emigration • population density
- limiting factor • carrying capacity

LESSON 3 Interactions Among Living Things

- Every organism has a variety of adaptations that are suited to its specific living conditions to help it survive.
- Two major types of interactions among organisms are competition and predation.
- The three main types of symbiotic relationships are mutualism, commensalism, and parasitism.

Vocabulary

- natural selection • adaptation • niche • competition
- predation • predator • prey • symbiosis • mutualism
- commensalism • parasitism • parasite • host

Review and Assessment

LESSON 1 Living Things and the Environment

1. A prairie dog, a hawk, and a snake are all members of the same

a. niche. **b.** community.

c. species. **d.** population.

2. Grass is an example of a(n) _____ in a habitat.

3. Sequence Put these levels in order from the smallest to the largest: population, organism, ecosystem, community.

4. Apply Concepts Name two biotic and two abiotic factors you might find in a forest ecosystem.

5. Draw Conclusions In 1815, Mount Tambora, a volcano in Indonesia, erupted. So much volcanic ash and dust filled the atmosphere that 1816 is referred to as the "Year Without a Summer." How might a volcanic eruption affect the abiotic factors in an organism's habitat?

6. Write About It Write at least one paragraph describing your habitat. Describe how you get the food, water, and shelter you need from your habitat. How does this habitat meet your needs in ways that another would not?

LESSON 2 Populations

7. All of the following are limiting factors for populations except

a. space. **b.** food.

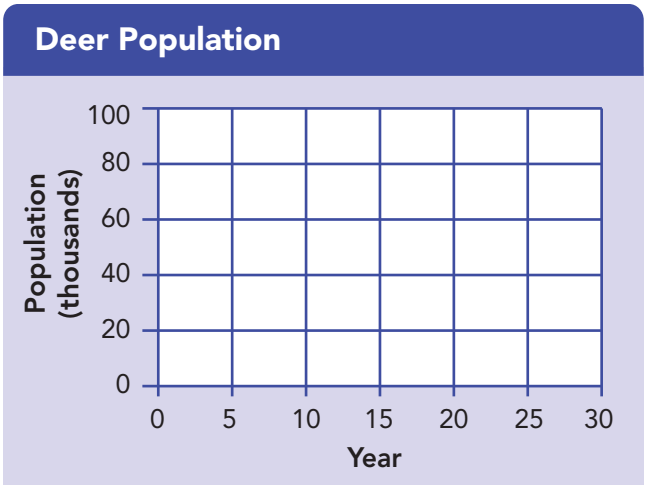
c. time. **d.** weather.

8. _____ occurs when individuals leave a population.

Use the data table to answer the questions below. Ecologists monitoring a deer population collect data during a 30-year study.

Year	0	5	10	15	20	25	30
Population (thousands)	15	30	65	100	40	25	10

9. Graph Use the data to make a line graph.



10. Interpret Data In which year was the deer population the highest? The lowest?

11. Develop Hypotheses In Year 16 of the study, this region experienced a severe winter. How might this have affected the deer population?

CHAPTER 3

Review and Assessment

LESSON 3 Interactions Among Living Things

12. In which type of interaction do both species benefit?

a. predation **b.** mutualism

c. commensalism **d.** parasitism

13. A parasite lives on or inside its _____.

14. Relate Cause and Effect Name two prey adaptations. How does each adaptation protect the organism?

15. Make Generalizations Competition for resources in an area is usually more intense within a single species than between two different species. Suggest an explanation for this observation. (*Hint:* Consider how niches help organisms avoid competition.)

16. Write About It Some scientists think that the relationship between clownfish and sea anemones is an example of commensalism. Other scientists think that the relationship is mutualism. If this relationship is actually mutualism, how might both the clownfish and sea anemone benefit?

How do living things affect one another?

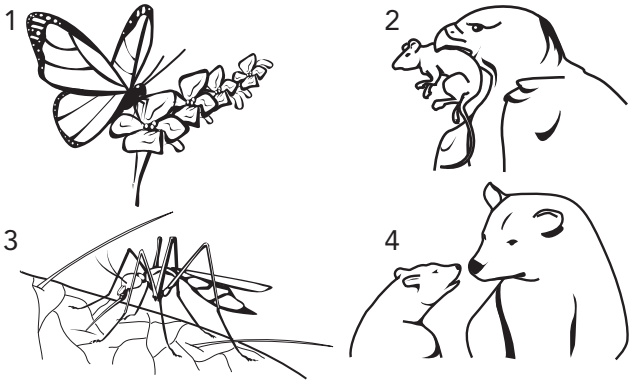
17. In Lesson 3, you learned that fleas are parasites that live on family pets. Are humans also affected by parasites? Using at least three vocabulary terms from this chapter, describe one or more parasites that interact with humans and the effect the parasites have on humans.

TNReady Prep

6.LS2.1, 6.LS2.2, 6.LS2.7

Read each question and choose the best answer.

1. Symbiotic relationships include mutualism, commensalism, and parasitism. Which of the images below shows mutualism?



A Image 1
B Image 2
C Image 3
D Image 4

2. In general, which of the following is a true statement about population size?

A If birth rate < death rate, population size increases.
B If death rate < birth rate, population size decreases.
C If birth rate > death rate, population size increases.
D If death rate > birth rate, population size increases.

3. Ecosystems have different levels of organization. A group of similar organisms makes up a _____, which, along with other types of organisms, makes up a(n) _____.

A species, population
B habitat, ecosystem
C population, community
D population, habitat

4. Three different bird species all live in the same trees in an area, but competition between the birds rarely occurs. Which of the following is a likely explanation for this lack of competition?

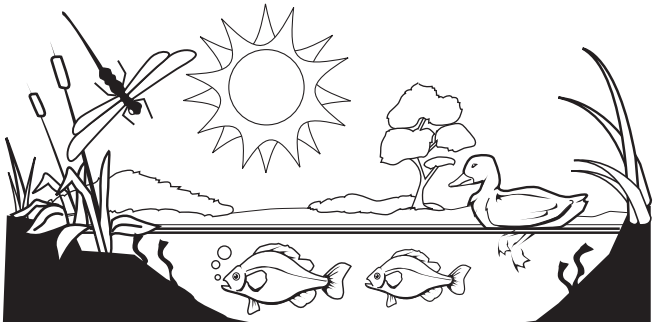
A The three species occupy different niches.
B The three species eat the same food.
C The three species have a limited supply of food.
D The three species live in the same part of the trees.

5. There are 100 squirrels living in a forest that is 5 square miles. What is the population density of the squirrels living in the forest?

A 10 squirrels per square mile
B 20 squirrels per square mile
C 50 squirrels per square mile
D 500 squirrels per square mile

Constructed Response

Use the diagram below and your knowledge of science to help you answer Question 6. Write your answer on a separate piece of paper.



6. An organism interacts with both the biotic and abiotic factors in its habitat. List three biotic factors and three abiotic factors shown in the drawing above.

ECOLOGIST

These lupine plants are growing out of the volcanic ash on Mount St. Helens, 20 years after its last eruption.

Suppose your workplace were on the side of a volcano! Roger del Moral is an ecologist who spends a lot of time on the side of Mount St. Helens, a volcano in Washington State.

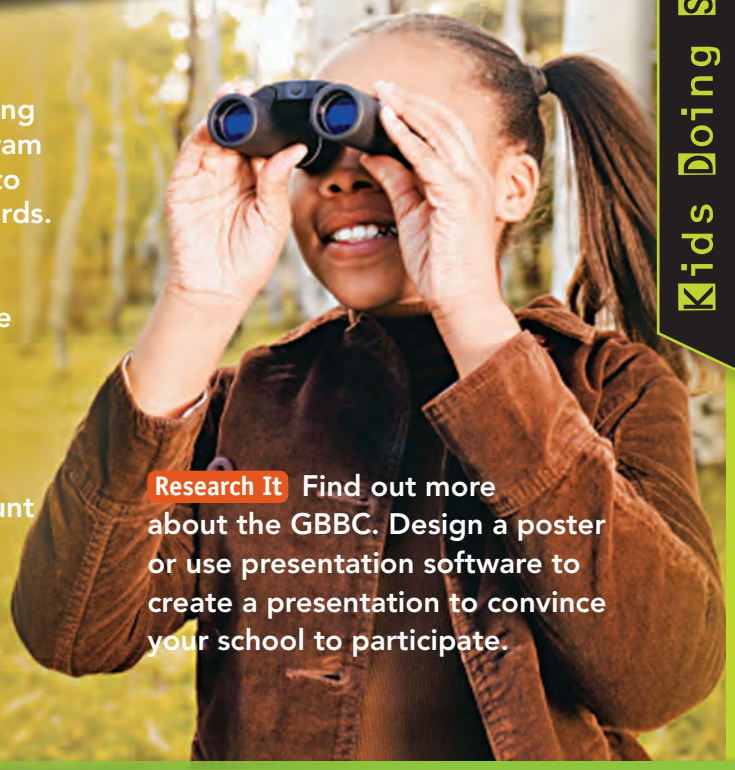
When Mount St. Helens erupted in 1980, it destroyed as much as 518 square kilometers of forest. Del Moral and his team study how plant communities form in the aftermath of volcanic eruptions. They visit the volcano regularly to identify plants and estimate the remaining populations of plants to describe how the plant communities are recovering. This work enables researchers to develop more effective ways to help areas recover from human-caused environmental changes.

Del Moral loves his work and says, "My work on Mount St. Helens allows me to follow my passion, train students, and contribute to a better understanding of how the world works."

If you are interested in ecology, try volunteering or interning at a local park or field museum. National parks also have Junior Naturalist programs designed to give you experience in the field.

Compare It **Find a park in your neighborhood or town and describe the kinds of plants you find. Make a table in which you list each kind of plant, describe it, describe where it grew, and draw conclusions about the reasons why it might have grown there.**

BINOCULAR BOOT CAMP



▼ Populations of common and rare birds can be estimated based on input from students like you!

Scientists need all the help they can get estimating large populations! Binocular Boot Camp, a program for kids in Sonoma Valley, California, trains kids to identify the songs, calls, and flight patterns of birds. Participants form teams and identify and count as many birds as they can in one afternoon. The information they gather gets entered into a huge database of bird observations.

You don't have to go to Binocular Boot Camp to help, though. For four days in February, schools, clubs, and individuals in the United States and Canada take part in the Great Backyard Bird Count (GBBC). All you need to do is count birds for 15 minutes, then fill out a form to help scientists learn how climate change, habitat change, and other factors affect bird populations.

Research It Find out more about the GBBC. Design a poster or use presentation software to create a presentation to convince your school to participate.

Bird Radio

How accurate are estimates of bird populations? Scientists at North Carolina State University wondered whether background noise affects scientists' ability to count bird populations. They used Bird Radio to find out.

Bird Radio won't be on the top 40—unless birds get a vote. It plays bird songs to simulate a wild bird population. Researchers adjusted background noise and the number of different bird songs. They learned that this affected people's ability to estimate the number of "birds" singing on Bird Radio. Even slight increases in background noise reduced the accuracy of population counts by up to 40 percent! Scientists are using these data to develop better ways to estimate bird populations.

Test It Create a log sheet for population estimates. The next time you are in a room with other people, close your eyes and try to estimate the number of people in the room. Then count them. Was your estimate close? What factors affected it? Try this experiment in five different settings and record what happens each time.