SCIENCE • GRADE 4

California Content Standards
Life Sciences: 2.A
Life Sciences: 2.B
Life Sciences: 2.C

Above Level

Energy in Ecosystems

LOOK INSIDE FOR:

- California's Academic Content Standards Covered
- Reproducible Student Book
- Reproducible English-language Arts Activities

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Energy in Ecosystems
California's Content Standards Met

GRADE 4 SCIENCE

LIFE SCIENCES: 2—All organisms need energy and matter to live and grow. As a basis for understanding this concept:

a. Students know plants are the primary source of matter and energy entering most food chains.

b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.

c. Students know decomposers, including many fungi, insects, and micro-organisms, recycle matter from dead plants and animals.

GRADE 4 ENGLISH LANGUAGE ARTS

1.0 WORD ANALYSIS, FLUENCY, AND SYSTEMATIC VOCABULARY DEVELOPMENT

Vocabulary and Concept Development 1.6—Distinguish and interpret words with multiple meanings.

2.0 READING COMPREHENSION

Comprehension and Analysis of Grade-Level-Appropriate Text 2.4—Evaluate new information and hypotheses by testing them against known information and ideas.

Comprehension and Analysis of Grade-Level-Appropriate Text 2.5—Compare and contrast information on the same topic after reading several passages or articles.

Comprehension and Analysis of Grade-Level-Appropriate Text 2.6—Distinguish between cause and effect and between fact and opinion in expository text.

SCIENCE • GRADE 4

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Student Book

Energy in Ecosystems

Print pages 5–18 of this PDF for the student book.

How to Make the Student Book

- **The student book is contained on pages 5–18 of this PDF. It begins on the next page.**
- **To make one student book, or a two-sided master copy that can be photocopied, you will print on both sides of seven sheets of 8.5″ x 11″ paper.**
- **Do a test printout of one book first to familiarize yourself with the procedure.**
- **Follow these instructions carefully.**

First–Select the Paper

Since you will be printing on both sides of the sheets of paper, select a good quality white paper. We recommend using at least a 22lb sheet.

Second–Check Printer Settings

Be sure you have the correct page setup settings for your computer and printer. You will print these pages in landscape format.

Third–Print EVEN Pages

Open the PDF of the book you want to print. Select print from your file menu. In your printer's dialogue box enter pages 5–18 to print. Then select EVEN pages only. It is important to print only the EVEN pages first. Click "Print" to print the even pages. (**Important note**: The first page that prints will be blank. DO NOT discard this page. It will be needed to print the cover in the next step.)

Forth–Print ODD Pages

When the even pages have printed, flip the stack of pages over to print the odd pages. Place the stack back in your printer. Select print from the file menu again. In your printer's dialogue box, select ODD pages. Click "Print" to print the odd the pages.

Fifth–Fold the Book

You now have a complete book. Check to be sure the pages are in the correct order with the book's cover as the top page. Then fold the stack of paper in half.

Sixth–Staple the Book

Use an extended-length stapler to staple the pages together. Place three staples in the spine of the book.

Please note that printers vary in how they output pages. Do a test printing with one book and adjust the procedure as necessary.

If you want to make a one-sided master copy, print ALL pages 5–18 at once. Then select "one-sided to two-sided" on the copy machine.

AL

Energy in Ecosystems

California's Content Standards Met

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GRADE 4 ENGLISH LANGUAGE ARTS

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FOCUS ON CALIFORNIA STANDARDS

SCIENCE • GRADE 4

California Content Standards
Life Sciences: 2.A
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Energy in Ecosystems

by Linda Barr

SCIENCE • GRADE 4

California Content Standards
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Energy in Ecosystems

by
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Curriculum materials for **your** content standards

Table of Contents

What do you think you will learn from this book?

INTRODUCTION

Energy on the Move

Are you full of energy today, or do you feel hungry and need more "fuel"?

You and every other living thing need energy to keep on living. How you get your energy makes you a producer, a consumer, or a decomposer.

In this book, you'll learn which one of these you are. You'll also learn how the energy that keeps you and all living things alive starts with the sun. You'll read how plants turn sunlight into food energy. You'll find out how that energy flows to animals. Some of it flows from plants and animals to you.

Did you know that you are part of food chains? You also have a place in an energy pyramid. If you didn't, you could not survive!

CHAPTER 1

Plants and Sunlight

Plants use energy from the sun to make their own food. They use a process called **photosynthesis**. *Photo* means "light." *Synthesis* means "put together." During photosynthesis, plants use sunlight to put things together.

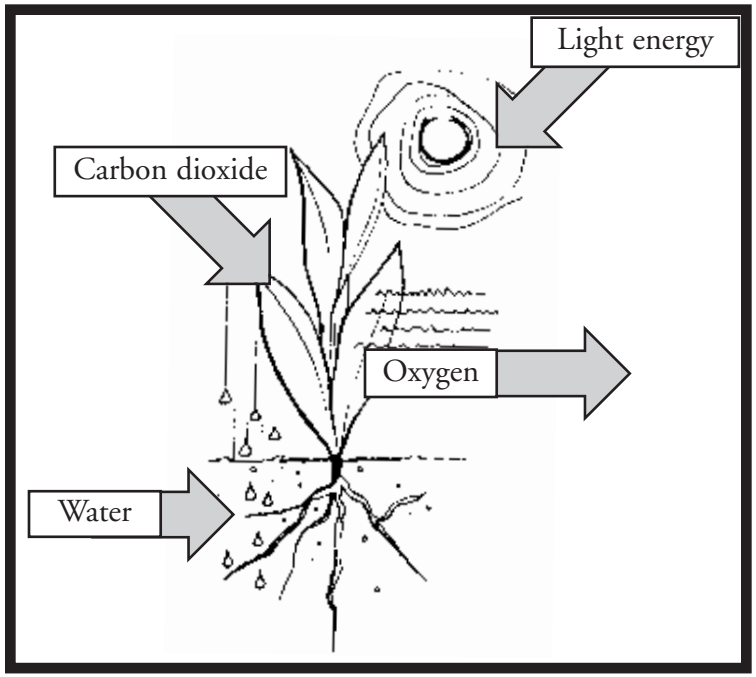
Sunlight has energy. You know this because you can feel this energy when you walk across a sunny beach in your bare feet. One form of energy in sunlight makes the sand hot. The energy in sunlight can also burn your skin if you are not careful.

Plant leaves are filled with green matter. This green matter can trap the energy in sunlight. The leaves use this light energy to "put together" carbon dioxide from the air and water from the soil. This produces a type of sugar. This sugar is rich in chemical energy. Plants use this chemical energy to grow and reproduce.

photosynthesis: the process by which plants use sunlight, carbon dioxide, and water to produce food energy

During photosynthesis, plants also produce oxygen, which is a gas. Plants do not need this gas, but animals do. We must breathe oxygen to survive. In fact, most of the oxygen we breathe comes from billions of tiny plants. They are floating on the surface of the ocean.

Photosynthesis



If there were no plants, we would not have to worry about eating. Why not?

Let's say that a rabbit eats a plant. Its body changes the chemical energy from the plant into other forms of energy. One is heat energy. The rabbit uses this energy to stay warm, grow, and reproduce.

In the same way, the food we eat helps keep our bodies warm. It gives us the energy we need to grow and move. It gives you the energy to read this book.

We need plants to survive. We eat plants when we munch on a carrot or enjoy a bowl of popcorn. Many of us also eat meat, eggs, milk, and cheese. Those foods come from animals that ate plants, such as grass and corn. If those animals did not have plants to eat, we would not have hamburgers or scrambled eggs. If there were no plants to make oxygen, we would not have to worry about eating.

In fact, if the sun did not shine so plants could capture its energy, we would not have food or oxygen. The sun is the main source of energy for Earth's plants and animals. That includes you. In the end, our survival depends on the sun.

CHAPTER 2

Classifying Consumers

Plants are called **producers** because they produce, or make, their own food. Living things that cannot make their own food, including you, are called **consumers**.

Of course, you can make yourself a bowl of popcorn. However, you start with popcorn seeds. You do not start with sunlight, carbon dioxide, and water.

To get the energy you need to live, you and all other animals must consume plants and/or animals. There are four main types of consumers.

Herbivores

An herbivore is an animal that eats only producers (plants). *Herb* means "plant." *Vor* is from a Latin word that means "to eat." So an herbivore is a plant-eater. Herbivores include grasshoppers, rabbits, and mice. Horses, cattle, zebras, giraffes, and deer are also herbivores.

producer: a living thing that makes its own food energy
consumer: a living thing that gets its energy by eating other living things

Carnivore

A carnivore is an animal that eats only other animals. *Carne* means "meat." Wolves, hawks, and lions are carnivores. So are robins and owls.

Omnivore

Omnivores eat both plants and other animals. You are probably an omnivore. *Omni-* means "all." Other omnivores include bears and raccoons.

Decomposers

Decomposers get their energy by breaking down dead plants and animals. They help decay, or decompose, dead things. Buzzards, mushrooms, worms, and bacteria are decomposers. They use some of the nutrients they get from dead things to live and grow. The "leftover" nutrients become part of the soil. Then producers absorb these nutrients through their roots. The producers use them to grow. In this way, decomposers help recycle nutrients.

Describe a meal for an omnivore.

CHAPTER 3

Food Chains and Food Webs

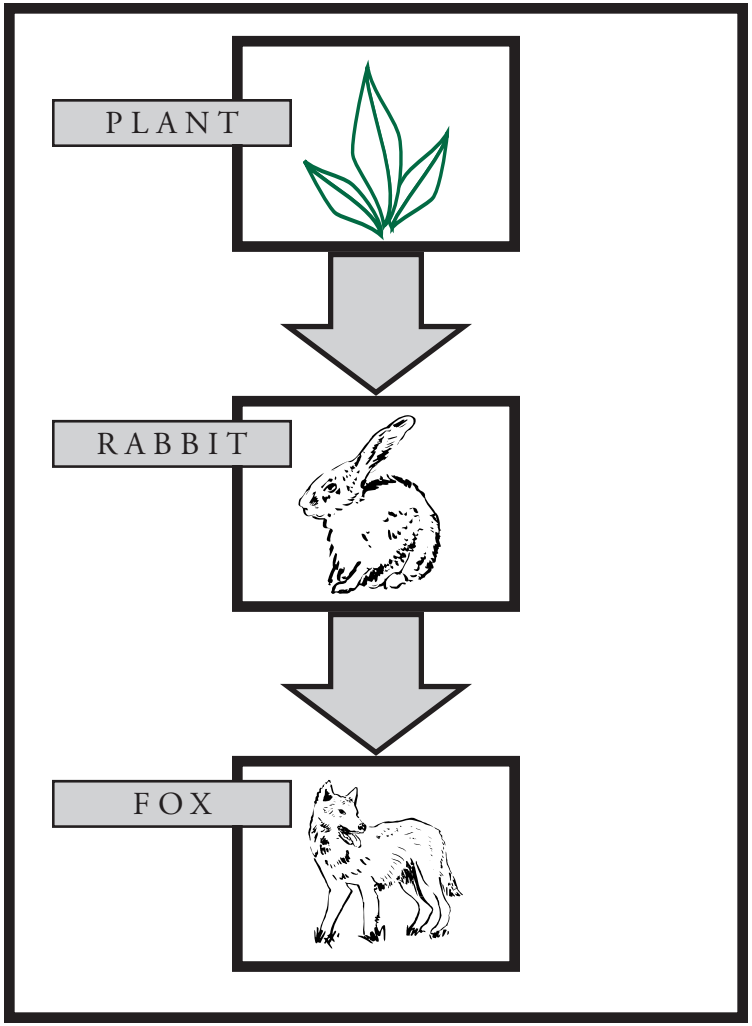
How does energy flow through an **ecosystem**? Plants, such as grass, use the energy from sunlight to make food energy for themselves. The grass uses much of this energy to live and grow and stores the rest.

When a rabbit eats the grass, the energy stored in the grass enters the rabbit's body. The rabbit uses much of this energy to live and grow and stores the rest. When a fox eats the rabbit, the energy stored in the rabbit's body passes to the fox. The fox uses much of the energy to live and grow. It stores the rest. When any living thing dies, decomposers break it down. They use some of its energy and return some of it to the soil.

Food chains, like the one on the next page, show this flow of energy.

ecosystem: all living and nonliving things that live in a certain location

Food Chain



Describe a food chain that ends with you.

In a food chain, plants are called primary producers. One meaning of *primary* is "first." Plants are eaten by primary consumers. Primary consumers can be herbivores, such as rabbits. They can also be omnivores, such as raccoons.

Then some primary consumers are eaten by secondary consumers. Secondary consumers might be carnivores or omnivores. Thus, when an owl eats a rabbit (a primary consumer), the owl becomes a secondary consumer. You are a primary consumer because you eat plants. If you eat meat, eggs, and milk, you are a secondary consumer, too.

Decomposers show up at all levels of a food chain. They consume the remains of both producers and consumers. Some decomposers, such as earthworms and mushrooms, become food for larger consumers.

How do you know that you are part of a food web?

Food chains exist in all ecosystems. You can also find them in the water. Ocean food chains begin with microscopic organisms that float on top of the water. These are the same tiny plants that produce most of the oxygen you breathe. They are eaten by **microscopic** consumers. These tiny consumers float with them on the surface of the ocean.

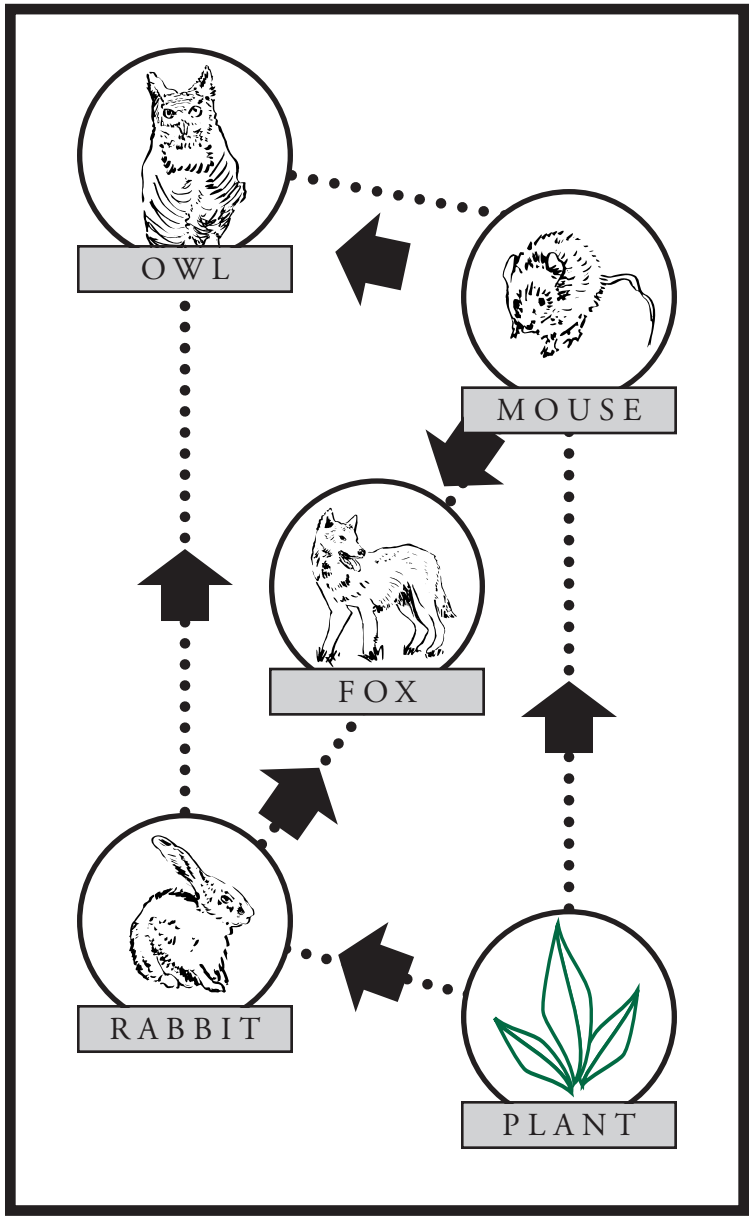
Then small fish eat the microscopic consumers. In turn, they are eaten by larger fish. An ocean food chain may end with a killer whale!

However, one food chain does not tell the whole story. For example, foxes do not eat just rabbits. They also eat mice, birds, and other animals.

Foxes, like most animals, are part of several food chains. Together, these chains make a food web. The next page shows a diagram of this food web.

microscopic: too small to be seen without a microscope

Food Web



Food Webs

In a forest, a bear might end at the top of a food web. However, many food webs end with people. For example, cows eat grass, and then we drink milk and eat steaks and hamburger. Chickens eat corn and grain, and then we eat eggs and chickens. The energy from sunlight is passed from plants to the cow and to the chicken and then on to us.

As you can see, all of the energy that keeps your body alive starts with plants. All of the energy that is stored in plants comes from sunlight. All living things, including people, depend in many ways on the sun that shines on us every day. Without the sun, Earth would soon become a very cold, dark, lifeless place.

How can plants continue to grow when the sky is cloudy?

CHAPTER 4

The Energy Pyramid

You have read how energy moves through a food chain. You know that each link uses most of the energy it receives. In fact, each link uses up 90 percent of that energy. Thus, each link passes along only 10 percent of that energy.

For example, a leaf uses up most of the energy it receives from sunlight. Let's say that a rabbit eats the leaf. The rabbit gets only 10 percent of the energy that the leaf received from sunlight.

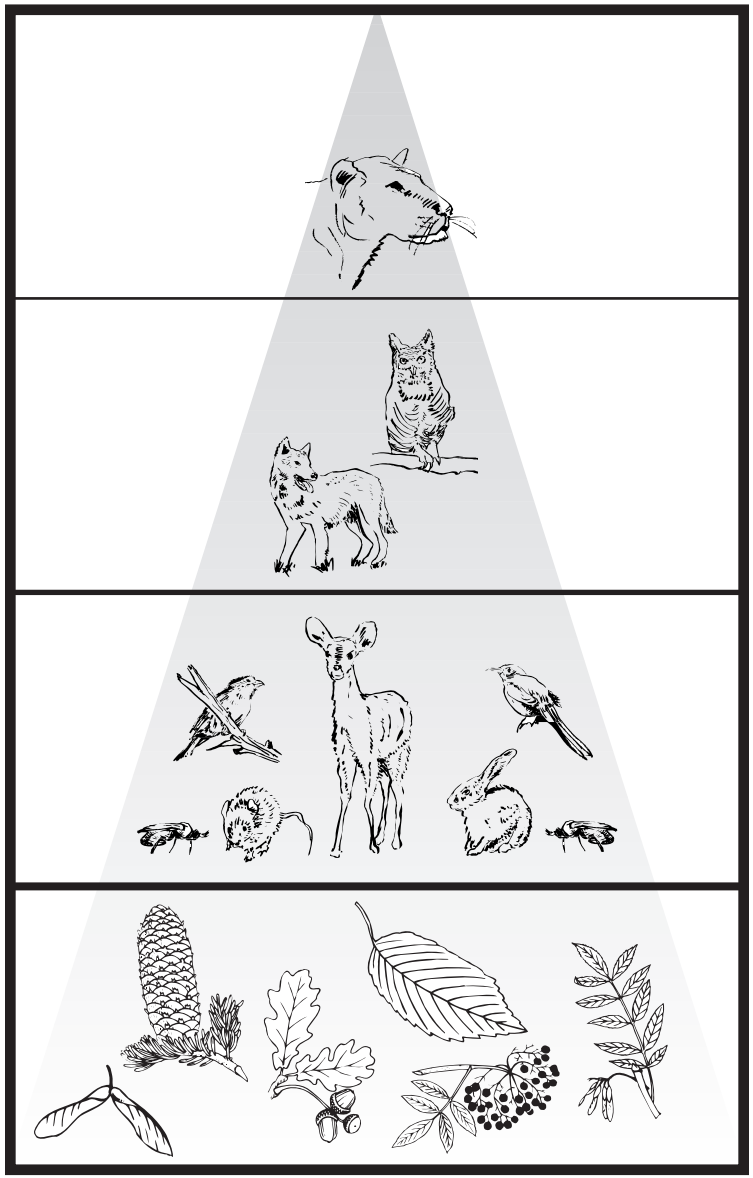
What does this mean to the rabbit? It must eat many leaves to get all of the energy it needs. The rabbit, in turn, uses up 90 percent of that energy. So a wolf must eat many rabbits to get all of the energy it needs.

An energy pyramid is a diagram. It shows the amount of energy that is passed from one level of a food chain to the next. Page 18 shows a forest energy pyramid. Each level has fewer living things than the level below it. Why? Each living thing on one level passes on only a small amount of energy to the next level. An owl must eat many birds and rabbits to get the energy it needs. It takes all of the living things in this pyramid to support one cougar!

Sometimes one level of a food chain has too many living things. Then they must compete for the available food. For example, deer in a large herd must compete with each other for grass and leaves.

Why is an energy pyramid big at the bottom and small at the top?

Forest Energy Pyramid



Not all energy pyramids look alike. In cold climates, the bottom level is tiny moss plants under the snow. In the ocean, it is billions of tiny, floating plants. They are the same plants that produce most of the oxygen you breathe.

However, most pyramids have no more than four levels. As energy flows through the food chains, little is available by the fourth level. That level is often one animal. It could be a cougar, an owl, a killer whale—or you.

Yet all energy pyramids begin with plants. It takes millions or billions of producers to support a small number of herbivores and a few carnivores. The producers provide the energy that moves through the food chains. However, the source of this energy is sunlight.

What would one energy pyramid on a farm look like?

CHAPTER 5

DDT and Food Chains

For many years, farmers, foresters, and gardeners used the chemical DDT to kill harmful insects. For example, 79 million pounds of DDT were sprayed on crops in 1959. Yet by the early 1970s, scientists realized that DDT was also wiping out helpful insects. That included bees. It was killing fish and birds, too. In fact, DDT killed nearly all of the bald eagles.

DDT did not kill the eagles directly. Instead, it worked its way through the food chain. A large lake in Africa showed how that happened. The lake was sprayed with DDT to kill mosquitoes. They can carry disease. The amount of DDT in the water was only 0.002 parts per billion. That's about one drop of DDT in the entire lake.

However, plants in the lake absorbed the DDT. The DDT in them rose to 2.5 parts per million. Small fish ate many plants. Then bigger fish ate many small fish. Some big fish ended up with 5 to 10 parts per million of DDT in their bodies. Crocodiles that ate many big fish had levels as high as 34 parts per million.

Eagles also ate many big fish with DDT in their bodies. The high amounts of DDT did not kill the eagles. Instead, it made their eggshells too thin, so few chicks hatched.

As scientists learned more about DDT, they warned people not to use it. In 1972, DDT was banned in the United States, but other nations still use it.

Can you think of another example of how conclusions and ideas change as new knowledge is gained?

Glossary

consumer—a living thing that gets its energy by eating other living things

decomposer—an organism that gets its energy by breaking down dead plants and animals

ecosystem—all living and nonliving things that live in a certain location

herbivore—an animal that gets all of its energy from producers (plants)

microscopic—too small to be seen without a microscope

photosynthesis—the process by which plants use sunlight, carbon dioxide, and water to produce food energy

producer—a living thing that makes its own food energy

To Find Out More . . .

Want to learn more about energy in ecosystems?

Try these books

Desert Food Chains by Louise Spilsbury. Heinemann, 2004.

Food Chains by Peter Riley. Franklin Watts, 1999.

Food Chains and Webs by Holly Wallace. Heinemann, 2006.

Learning About Food Chains and Food Webs with Graphic Organizers by Jonathan Kravetz. PowerKids Press, 2006.

Access these Web sites

You can learn more about food chains and the energy pyramid at this Web site. You can even create your own food web.
www.vtaide.com/png/foodchains.htm

This Flying Turtle Web site will tell you more about food chains, the energy pyramid, and the flow of energy through plants and animals.
www.ftexploring.com/me/me2.html

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ENGLISH-LANGUAGE ARTS • GRADE 4

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English-language Arts Activities

Energy in Ecosystems

Print pages 20–24 of this PDF for the reading activities.

Use Context Clues

TRY THE SKILL

Some words have several meanings. You can use context clues to decide which meaning is being used in a certain sentence. For example, *bark* can mean "the outside of a tree trunk" or "the sound a dog makes." Which meaning is used in the sentence below?

The woodpecker found insects under the bark.

The words *woodpecker* and *insects* are clues to the meaning of *bark* in this sentence. The insects are under the bark of a tree. Here, *bark* means "the outside of a tree trunk."

Read each word and its meanings. Then read each sentence. Shade in the letter of the correct meaning of that word in the sentence.

flies Ⓐ an insect with wings Ⓑ moves through the air

1. Flies eat whatever they can find, so most of them are omnivores.

matter Ⓐ a substance Ⓑ a subject being considered

2. Green matter in plants traps light energy from the sun.

story Ⓐ a floor in a building Ⓑ a retelling of events

3. A food chain does not tell the whole story.

store Ⓐ a business that sells things
Ⓑ to save something

4. Plants store the energy of the sun.

leaves Ⓐ goes away Ⓑ parts of a plant
Ⓒ extra sections to make a table longer

5. Photosynthesis takes place in leaves.

left Ⓐ a direction Ⓑ did leave Ⓒ not used

6. Very little energy is left at the top of an energy pyramid.

Draw Conclusions

Authors often do not tell you everything you need to know. To figure out more, you can draw conclusions. First, you think about what you read and what you already know. Then you compare the new information with what you know and draw a conclusion.

To practice, read this paragraph:

A forest food web might end with an owl or a bear. However, many food webs end with people. For example, cows eat grass, and then we drink milk and eat steaks and hamburger. Chickens eat corn and grain, and then we eat eggs and chickens. The energy from sunlight is passed from plants to the cow and to the chicken and then on to us.

Why do many food webs end with people?

You can draw a conclusion to answer this question. You read that in a forest, a food web might end with a bear. Think about why that's true. Nothing eats bears—except some people, maybe. That's also why many food webs end with people. Nothing eats people—except the occasional bear.

TRY THE SKILL

Read this passage. Then answer the question that follows it.

Leaves use light energy to "put together" carbon dioxide from the air and water from the soil. This produces a type of sugar. This sugar is rich in chemical energy.

Plants use this chemical energy to grow and reproduce. When an animal eats the plant, its body changes the chemical energy from the plant into other forms of energy. One is heat energy. The animal uses this energy to stay warm, grow, and reproduce.

Plants produce chemical energy. Do they produce heat energy, too? Draw a conclusion and explain it.

_____

_____

_____

_____

Compare Details

TRY THE SKILL

When you look for information for a report, you should check several sources. However, they might offer different information. What can you do?

First, you must check the source. Is the author an expert? Does the information come from a trustworthy organization? Was the information written recently?

For example, you read in this book that only 10 percent of energy is transferred from one level of an energy pyramid to the next level. You find the same information in one Web site. This site is approved by a science teachers' organization.

However, another Web site says that "about half" of the energy is passed along. Readers can change the information in this Web site. You compare the sites and decide that the second one is not trustworthy.

You read in this book that most food chains have only four links. Read the information from the two Web sites below.

- One Web site explains a 2002 study by a professor at Cornell University. She found that living things in the water use less energy holding themselves up. That means they can pass along more energy to the next level. She says that a land food chain rarely has more than three links. With less energy lost, a water food chain can have six links.
- The second Web site is approved by science teachers. This Web site says that most food chains have no more than four or five links. Otherwise, the animals at the end of the chain would not get enough energy to stay alive.

1. Which Web site do you think is correct? Or are they both correct? Explain your answer.

_____

_____

_____

Tell Facts from Opinions

TRY THE SKILL

A fact can be proved. For example, scientists can measure how much energy is in a rabbit's body.

An opinion is what someone believes. For example, a gardener might say that rabbits are destructive. However, other people might disagree with this opinion.

Being able to tell facts from opinions makes you a better reader. Opinion sentences often have words such as better, worse, should, difficult, toughest, and easy. Here are more examples:

Facts

All living things depend on the sun.
Carnivores eat only other animals.

Opinions

People should eat only plants.
Most decomposers are icky.

Mark each statement below *F* for fact or *O* for opinion.

1. People who eat only plants are healthier than people who are omnivores. ____
2. A food chain does not show the complex relationships in an ecosystem. ____
3. The movement of energy through an ecosystem is wasteful. ____
4. The movement of energy through an ecosystem is fascinating. ____
5. Decomposers cannot produce their own food. ____
6. The amount of fish that killer whales eat is amazing. ____
7. Scientists should study the energy pyramid to reduce world hunger. ____
8. The animals on Earth could not survive without the plants floating on the ocean's surface. ____

On the back of this page, write one fact and one opinion about how energy moves through an ecosystem.

Answer Key

Use Context Clues

1. A

2. A

3. B

4. B

5. B

6. C

Draw Conclusions

Possible answer: No, plants do not produce heat energy. They do not need heat energy because they do not keep themselves warm. Animals do keep themselves warm, so their bodies change some of the chemical energy from plants into heat energy.

Compare Details

Possible answer: Both are probably correct. The first Web site is a study that was done recently by an expert. This book does not compare land and water food chains. If it did, it might agree that water food chains could be longer than four links. The second Web site has the same information as this book and is approved by science teachers.

Tell Fact from Opinion

1. O

2. F

3. O

4. O

5. F

6. O

7. O

8. F

Fact example: Even carnivores depend on the energy in sunlight.

Opinion example: The best form of energy is chemical.