UNIT 3

Earth's Place in Space

FLORIDA BIG IDEA 5

Earth in Space and Time

The Soyuz rocket launches to the International Space Station in 2012.

I Wonder Why

People have been exploring space for decades. The space program has changed our lives. Why is this?

Turn the page to find out.

Here's Why

Space technology has led to many new discoveries about our universe. It has also made possible many inventions here on Earth.

Essential Questions and Florida Benchmarks

Science Notebook

Before you begin each lesson, write your thoughts about the Essential Question.

SC.4.E.5.1 Observe that the patterns of stars in the sky stay the same although they appear to shift across the sky nightly, and different stars can be seen in different seasons. **SC.4.E.5.3** Recognize that Earth revolves around the Sun in a year and rotates on its axis in a 24-hour day. **SC.4.E.5.4** Relate that the rotation of Earth (day and night) and apparent movements of the Sun, Moon, and stars are connected.

LESSON 1

ESSENTIAL **QUESTION**

How Does Earth Rotate and Revolve in Space?

Engage Your Brain

Find the answer to the following question in this lesson and record it here.

In what ways do we know that Earth moves in space?

_____

_____

_____

ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____

_____

_____

Cause and Effect

Active readers look for ideas that are connected by a cause-and-effect relationship. Why something happens is a cause. What happens as a result of something else is an effect. Active readers look for effects by asking themselves, What happened? They look for causes by asking, Why did it happen?

Day and Night

How can it be morning where you live and yet be nighttime in India? You cannot feel it, but Earth moves in space.

ACTIVE READING As you read this page, draw one line under a cause of day and night. Draw two lines under an effect of day and night.

People once thought the sun moved around Earth. After all, the sun seems to rise in the east and set in the west. Today we know that Earth **rotates**, or spins. This spinning causes day and night. It is the reason that the sun seems to rise, move across the sky, and set.

Have you ever been on a merry-go-round? It turns around a pole in its center. Earth is a little like a merry-go-round with an imaginary pole. This imaginary pole or line is called Earth's **axis**. The axis runs through Earth's center, from the North Pole to the South Pole. Earth rotates on its axis once about every 24 hours. As it rotates, one side of Earth faces the sun. This part of Earth has daytime. The other side of Earth faces away from the sun and has nighttime. As Earth rotates, we have day and night again and again.

DO THE MATH

Use and Represent Numbers

The time it takes a planet to rotate once on its axis is 1 day. The rate of rotation is different for each planet, so the length of a day is different. Find the difference between a day on Earth and a day on other planets. (1 Earth day = 24 hours)

Length of Day:

Venus: 243 Earth days _____

Jupiter: 9 Earth hours, 55 minutes _____

Neptune: 16 Earth hours, 6 minutes

_____





Night

Day

Earth rotates on its axis from west to east. It takes 24 hours for Earth to rotate once on its axis.

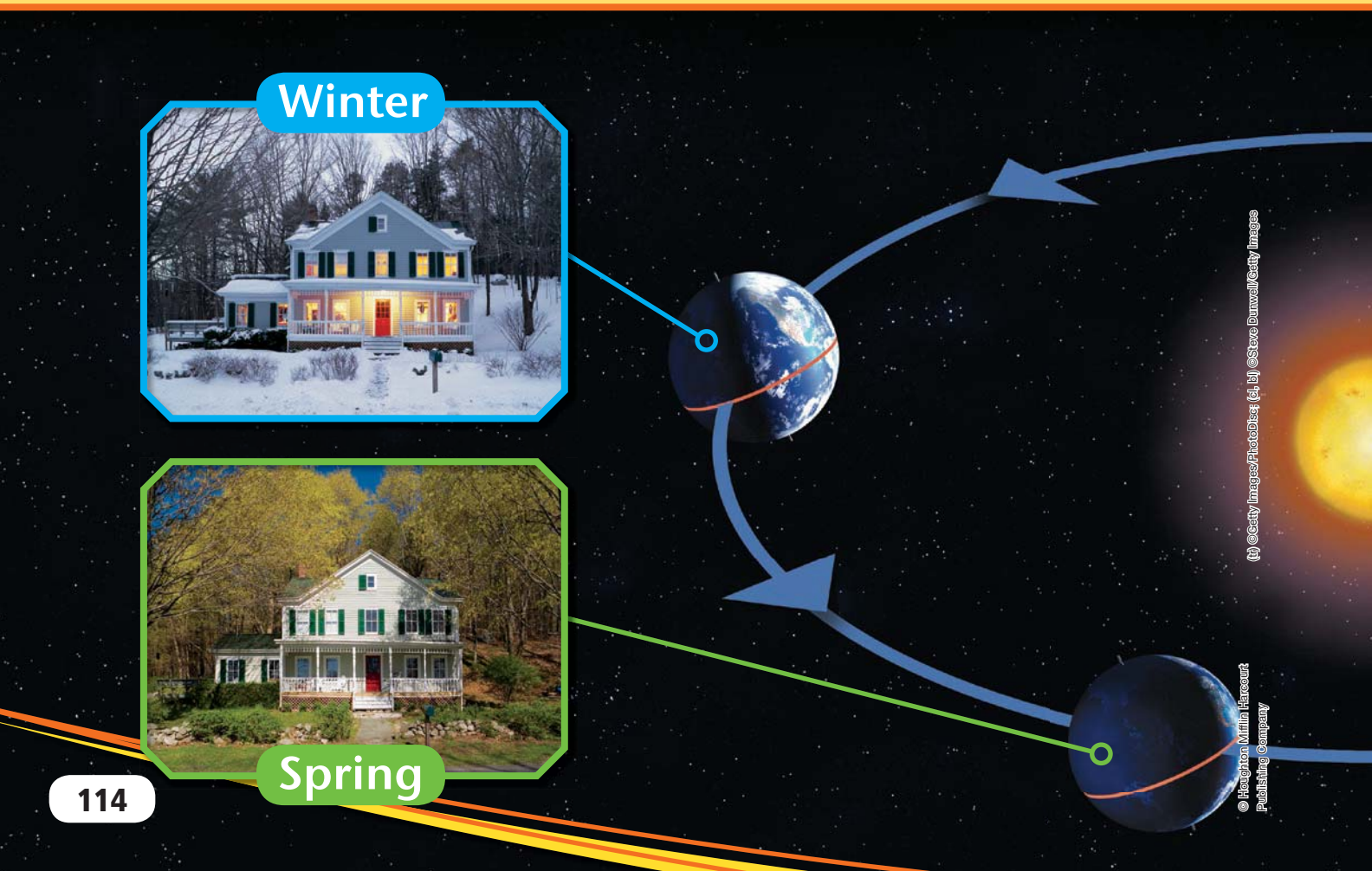
Seasons

When it is summer in the United States, it is winter in Brazil. How can two places have a different season at the same time of year?

ACTIVE READING As you read this page, draw one line under the cause of the seasons.

Earth rotates on its axis, which is tilted to one side. Earth also moves in another way. It *revolves*, or follows a path, around the sun. The path that Earth takes around the sun is called an **orbit**. Earth takes about 365 days to make one orbit around the sun. As Earth moves around the sun, Earth's axis stays tilted in the same direction. The tilt of Earth's axis and its orbit cause the seasons.

Earth is divided into halves called *hemispheres*. The upper half is the Northern Hemisphere. The lower half is the Southern Hemisphere. In June,



the Northern Hemisphere is tilted toward the sun and gets more rays of sunlight. There are more hours of daylight, and it's warmer. It's summer there.

In June, the opposite season is occurring in the Southern Hemisphere. Why? The Southern Hemisphere is tilted away from the sun and gets less sunlight. There are fewer hours of daylight, and it's cooler. It's winter there.

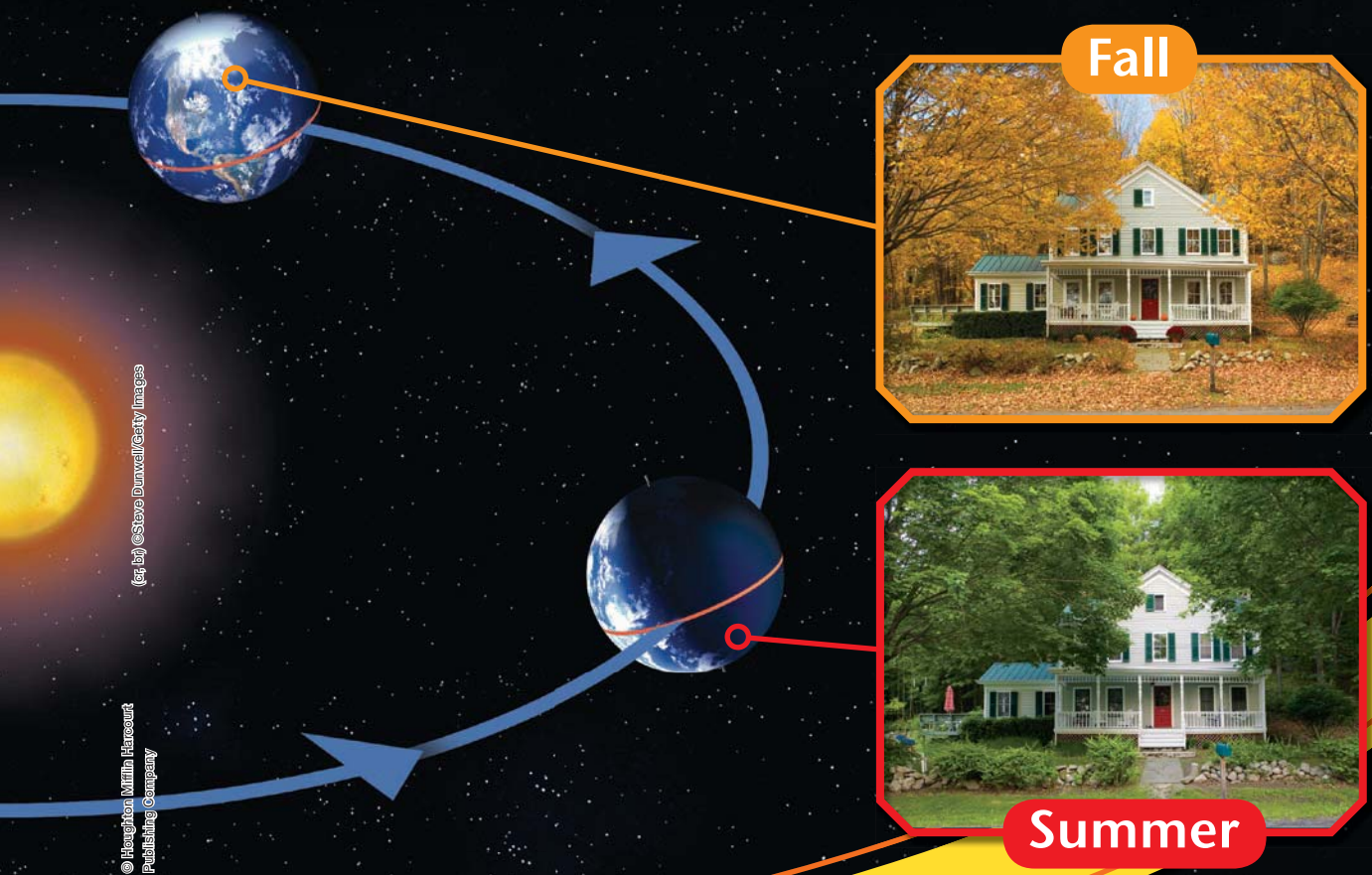
In December, the Northern Hemisphere is tilted away from the sun. It's winter there. At the same time, the Southern Hemisphere is tilted toward the sun. So, it's summer in the Southern Hemisphere.

Home Sweet Home

What season is it where you live? Draw a picture of Earth. Label where you live.

Seasons In the Northern Hemisphere

When the North Pole is tilted away from the sun, that part of Earth has darkness for nearly 24 hours each day. When the North Pole is tilted toward the sun, that part has about 24 hours of daylight!



Patterns in the Sky

The stars of the Big Dipper form a pattern at night. The pattern looks like a giant spoon.

ACTIVE READING As you read these pages, draw a circle around words or phrases that provide details about constellations.

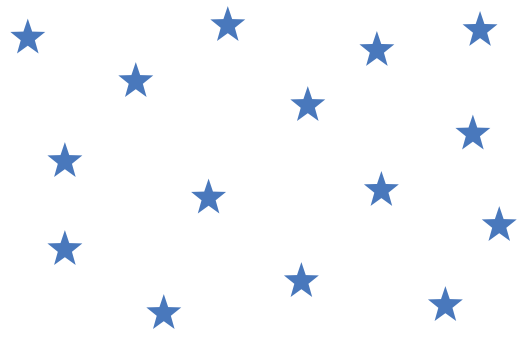
For thousands of years, people have looked at star patterns. A star pattern, or **constellation**, is a group of stars that seems to form a pattern in the night sky. The early Greeks named constellations after animals or people from stories called myths. The Big Dipper is part of a constellation called *Ursa Major*, or Great Bear. Orion is a constellation named after a hunter in a Greek myth.

As Earth rotates on its axis, constellations seem to move across the night sky. Like the sun, they seem to rise in the east and set in the west. Stars above the North Pole, however, seem to move in a circle.

The positions of the constellations seem to change with the seasons. This is because we see different parts of space as Earth revolves around the sun. The stars in the constellations do change a little over time. However, it might take millions of years for a constellation to change its shape!

Connect the Stars

Connect the stars to draw a constellation. Use all or some of the stars. What is the name of your constellation?



_____

_____

These pictures show stars seen from the same location during summer (at left) and winter (at right). The constellations seem to change their places in the sky.

For thousands of years, people have seen pictures in the stars. They connect the stars to make a pattern or shape.

Sum It Up »

Read the summary statements below. Each one is incorrect. Change the part of the summary in blue to make it correct.

1. Day and night are caused by Earth's revolution around the sun.	
2. Earth revolves around the sun once every 24 hours.	
3. Earth's seasons are caused by Earth's revolution and rotation in space.	
4. During winter in the Northern Hemisphere, there are more hours of daylight and it is warmer.	
5. When it is spring in the Northern Hemisphere, it is summer in the Southern Hemisphere.	
6. Constellations appear to move across the night sky because of Earth's tilt on its axis.	

Brain Check

LESSON 1

Name _____

Vocabulary Review

1 Unscramble letters to fill in the blanks with the words from the box below.

Use the hints to help you unscramble the letters.

1. X A I S _ _ _ _
   [Hint: an imaginary line through Earth]

2. T E R A O T _ _ _ _ _ _
   [Hint: Earth's spinning in space]

3. R I B O T _ _ _ _ _
   [Hint: Earth's path in space]

4. E S O A N S S _ _ _ _ _ _ _
   [Hint: caused by Earth's trip around the sun]

5. L E O V R E V _ _ _ _ _ _ _
   [Hint: Earth does this once a year.]

6. S T E L C O N A L I O N T _ _ _ _ _ _ _ _ _ _ _ _ _
   [Hint: a pattern of stars in the night sky]

seasons	revolve	orbit
axis	constellation	rotate

* Key Lesson Vocabulary

Apply Concepts

2 Draw a picture of the sun and Earth. Draw lines to show Earth's axis and rays from the sun. Label which side of Earth has day and which side has night.

3 At sunset, the sun appears to sink down below the horizon. How would a scientist describe sunset?

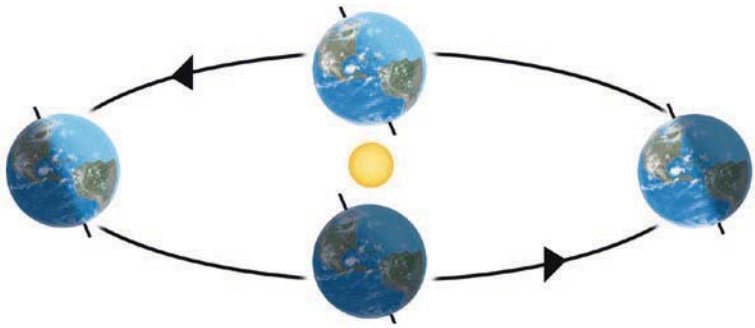
_____

_____

_____

4 In Florida, the constellation Orion is seen in the night sky during the winter months. During the summer, Orion can't be seen. Why is Orion only visible during part of the year?

5 Imagine you are going on a ride in a spacecraft next to Earth. Your trip takes one whole year. Describe Earth's tilt in the Northern Hemisphere during your trip. What happens as a result of the tilt?



6 Suppose a friend from the Southern Hemisphere plans to visit you in December. Write an e-mail explaining what kind of clothes to pack and why.

Take It Home! See *ScienceSaurus*® for more information about the solar system.

SC.4.E.6.5 Investigate how technology and tools help to extend the ability of humans to observe very small things and very large things. **SC.4.N.2.1** Explain that science focuses solely on the natural world.

Meet the Spacemen on Earth

Neil deGrasse Tyson

Neil deGrasse Tyson was born in New York City in 1958. His love of stars and space began when he visited the planetarium at age 9. Tyson is an astrophysicist, a scientist who studies the universe. In 1995, Tyson became the director of New York City's Hayden Planetarium. He was twice selected by the government to join a space exploration board. Tyson has written nine books on the universe.

Tyson is the director of New York City's Hayden Planetarium. His research uses the Hubble Space Telescope and other telescopes all over the world.

Michael Kobrick

Michael Kobrick is a scientist at NASA. His work helped make three-dimensional maps showing Earth's surface. The maps are made using data recorded from space. In 2000, the shuttle recorded data for 80% of Earth's land surface. This important data is used by scientists, engineers, and even businesses. In 2009, new images gave scientists data for 99% of Earth's surface. Kobrick is working to make an even better map of Earth.

Kobrick's new digital elevation maps give scientists more information about Earth's surface than ever before.

In 2000, a single pass of the shuttle recorded data of Earth's surface using two radar antennas and a 200-foot mast.

Be an Astrophysicist!

Label each satellite photo with the number of the matching description.

1. A satellite sent back a picture of a lake. It is flat, blue, and has land all around it.
2. In a city, many buildings are grouped close to one another. The bright lights also can be seen in the satellite photo.
3. In a satellite photo of a volcano, red streaks of lava from an eruption can be seen. You may see smoke coming from the top.
4. You can tell the ice of a glacier or icecap by its white color in the satellite photo.
5. A satellite photo of a river shows how it winds through the land.
6. The unique shape of Florida is easy to see in its satellite photo.

Think About It!

What are some uses for digital three-dimensional maps?

_____

_____

_____

Name _____

ESSENTIAL **QUESTION**

How Does Earth Move in Space?

Materials

beach ball
table-tennis ball
softball

EXPLORE

Let's travel through space! In this activity, you will investigate how Earth, the sun, and the moon form a system in space.

Before You Begin—Preview the Steps

1. Work in a group of four to model Earth, the sun, and the moon in space. One person holds the beach ball to represent the sun. Another person holds the softball to represent Earth. A third person holds the table-tennis ball to represent the moon. A fourth person observes and takes notes for the group.

2. The person holding the sun stands far away from Earth and the moon and does not move. The person holding Earth moves around the sun in an almost circular path. At the same time, Earth should also be spinning.

3. The person holding the moon moves around Earth in a circle. At the same time, the moon should spin slowly as it completes each revolution.

Set a Purpose

What do you think you will learn from this experiment?

Think About the Procedure

Why do you think you are using different balls as models to represent the sun, Earth, and the moon?

Why do you think the balls in this investigation are different sizes?

Name _____

Record Your Data

In the space below, make a chart to record what you observed.

Draw Conclusions

Think about the movements you made during the activity. How do these model the way Earth moves in space?

_____

_____

_____

Claims • Evidence • Reasoning

1. What movement represented a year? Explain your reasoning.

2. How is the movement of the moon similar to that of Earth? Explain your reasoning.

3. Write a claim about how the rotation of the moon and Earth compare. Cite evidence that supports your claim and explain why it supports the claim.

4. Could you use only these three balls to model day and night or Earth's seasons? Give evidence to support your claim.

ESSENTIAL **QUESTION**

What Are Moon Phases?

Engage Your Brain

Find the answer to the following question in this lesson and record it here.

What do you observe about the moon in the night sky?

_____

_____

_____

_____

ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____

_____

_____

_____

Cause and Effect

Many ideas in this lesson are connected by a sequence, or order, that describes the steps in a process. Active readers stay focused on sequence when they mark the transition from one step in a process to another.

Our Moon

Neil Armstrong was the first person to walk on Earth's moon. He said of the moon, "The surface is fine and powdery. I can pick it up with my toe."

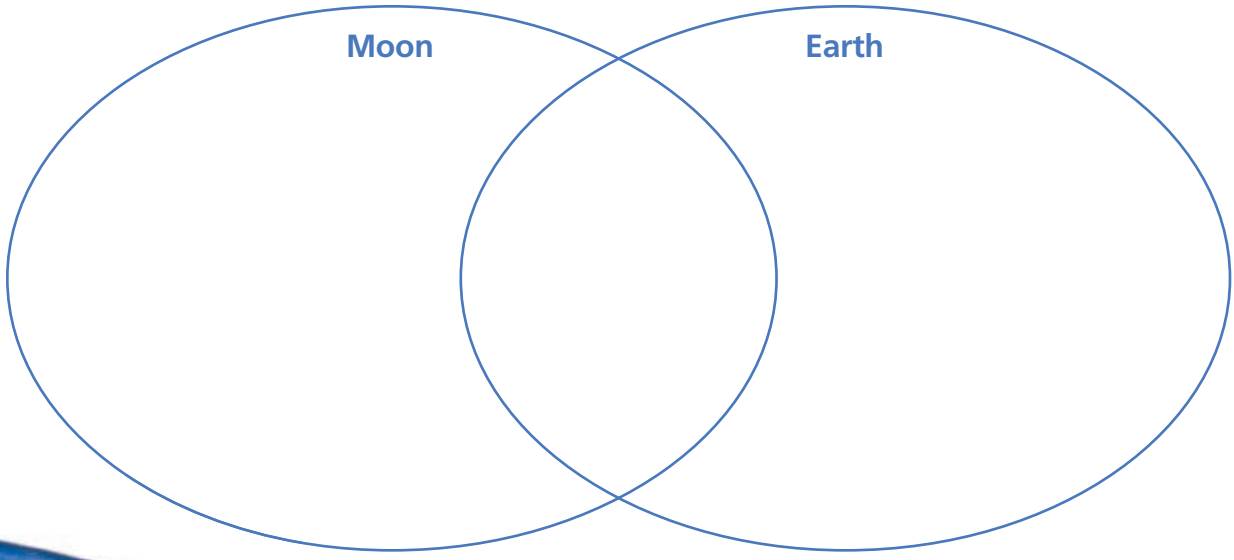
The moon is Earth's satellite. A satellite is an object that moves around another larger object in space. Earth's moon is the largest and brightest object in the night sky. It looks large because it is close to Earth. But the moon is small compared to Earth. It is only about one-fourth the size of Earth. The moon has no air, wind, or liquid water. We see the moon because light from the sun reflects from it and back to Earth.

The pull of Earth's gravity keeps the moon in its orbit around Earth. We see only one side of the moon from Earth. That is because the moon takes the same amount of time to rotate once as it does to orbit Earth once.

We can see the moon at night (small photo) and sometimes during the day.

Moon and Earth

Compare the moon and Earth. How are they alike? How are they different? Complete the Venn diagram below.



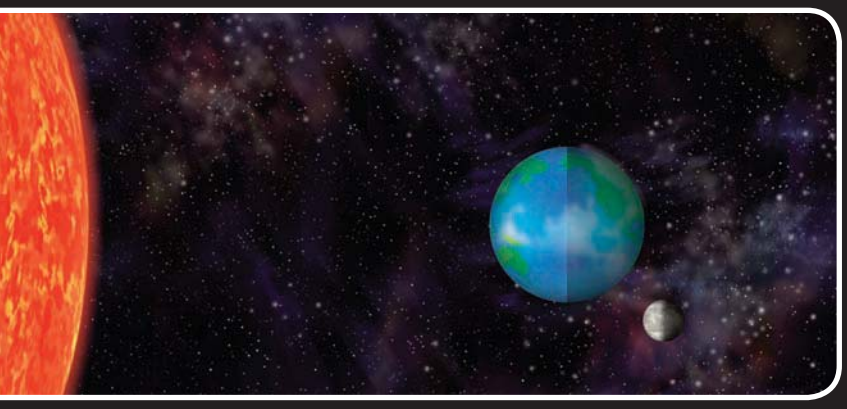
Rocks and chunks of debris from space slammed into the moon and formed its many craters. Craters, or pits in the ground, cover the moon's rocky surface.

There are mountains and large, flat plains. The plains on the moon's surface are called *maria* [mah•REE•uh], a Latin word meaning "seas."

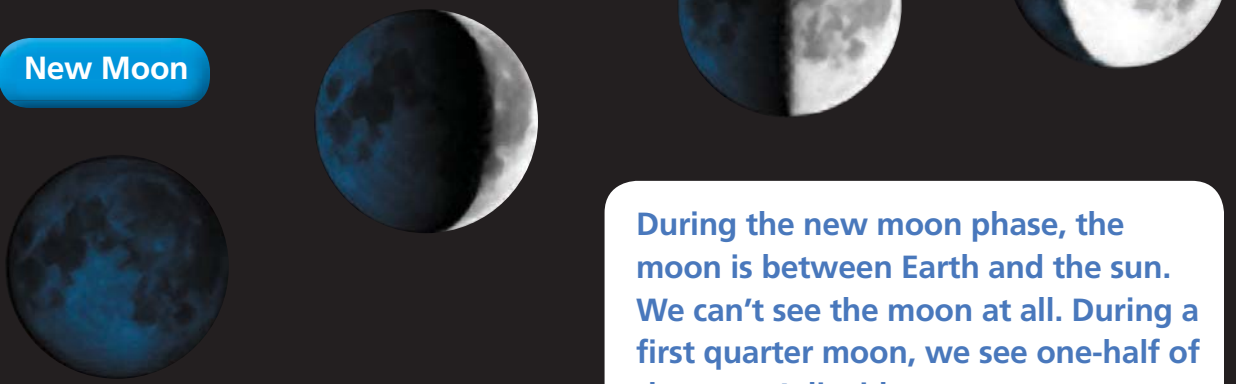
Moon Phases

One night, you might look at the moon and see a tiny sliver in the sky. A few nights later, you might see a bright, round circle. What makes the moon look so different?

ACTIVE READING As you read the last paragraph, write numbers next to the sentences to show the sequence of moon phases.



As Earth orbits the sun, the moon also orbits Earth. The moon reflects light from the sun. That is the light we see from Earth. As the moon travels in its orbit, different amounts of the moon's lit side can be seen from Earth.



During the new moon phase, the moon is between Earth and the sun. We can't see the moon at all. During a first quarter moon, we see one-half of the moon's lit side.

The moon's shape does not change. The changes in the appearance of the moon's shape are known as **moon phases**.

You know that sunlight reflects from the moon to Earth. Yet the sun lights only half of the moon at any time. The motions of Earth and the moon are responsible for the phases you see. As the moon revolves around Earth, the amount of the lit part that we see from Earth changes. These different amounts of the moon's lighted side are the different phases of the moon.

Each phase of the moon has a different shape. It takes about 1 month for the moon to complete all of its phases. Then the cycle repeats.

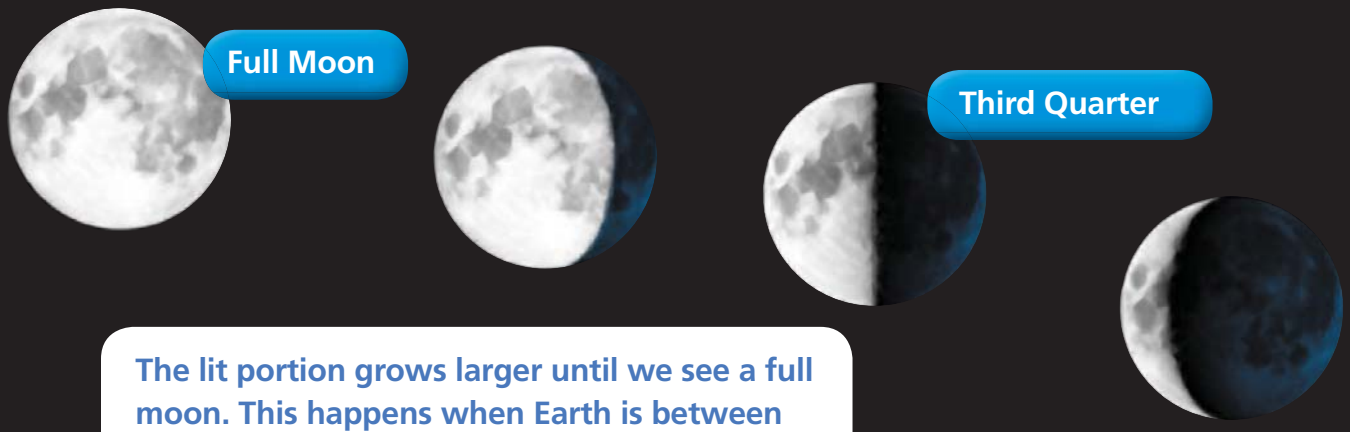
During the new moon phase, we can't see the moon. That is because the lit part of the moon faces away from Earth. As the moon moves in its orbit around Earth, we see more of the moon's lit part. We see a full moon when all of the lit part of the moon faces Earth. Then we see less and less of the lit part again.

DO THE MATH

Estimate Fractions and Percentages

What fraction and percent of the moon's lit side is seen during each phase? Complete the table.

	Full moon	First quarter	New moon	Third quarter
Fraction		$\frac{1}{2}$		
Percent		50%		



The lit portion grows larger until we see a full moon. This happens when Earth is between the moon and the sun. As the moon continues in its orbit, we see less of its lit portion. When it is half lit again, it is a third quarter moon.

Why It Matters

Lunar and Solar Calendars

For thousands of years, people used the phases of the moon to make calendars and track time. These are called lunar calendars. Earth's orbit around the sun also has been used to make calendars and track time. These are called solar calendars.

The Chinese Zodiac Calendar

The Chinese zodiac calendar is based in part on the phases of the moon. Twelve animals stand for cycles of time on the calendar. Some of these animals are the tiger, rabbit, dragon, and snake. Each year is also given an animal name. For example, in 2026, it will be the "Year of the Horse." The year 2027 will be the "Year of the Sheep".

Chinese New Year comes sometime between late January and early February. It is celebrated with fancy dragon costumes.

The Aztec calendar is based on Earth's orbit around the sun. Each part of the calendar has colorful animals or symbols. These symbols marked important times of the year, such as when to plant crops.

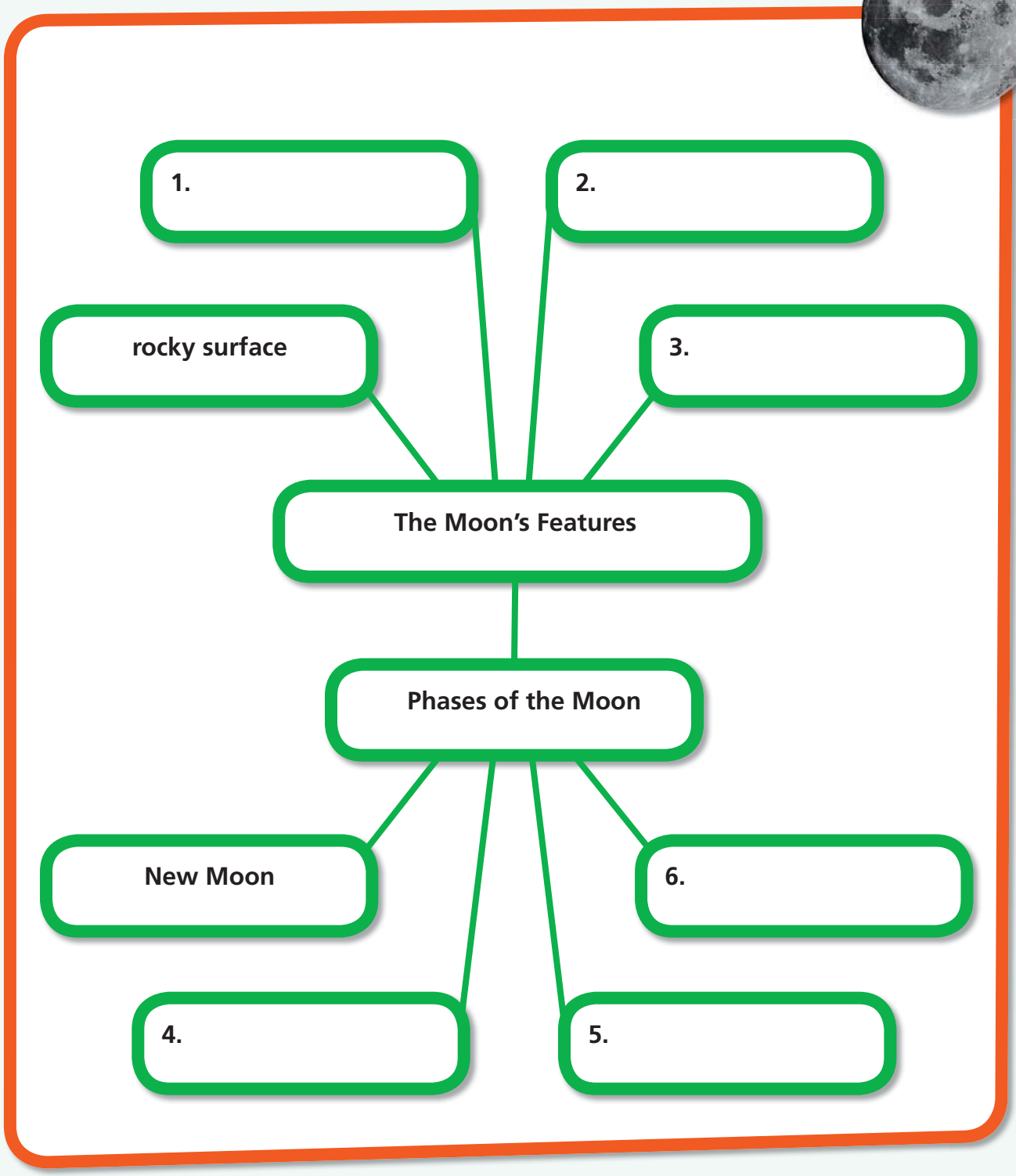
New Year's Day

In the United States, New Year's Day is always January 1. In China, it is on the day of the new moon. Why do you think New Year's Day always falls on a different day each year in China?

Our modern calendar is based on Earth's orbit around the sun. Each month is based roughly on the moon's phases. Once in a while, there are two full moons in one month.

Sum It Up »

The idea web below summarizes the lesson. Complete the web.



Brain Check

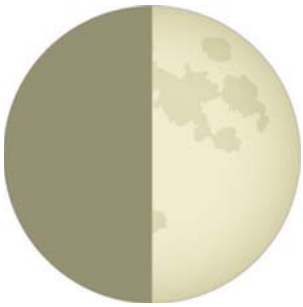
LESSON 3

Name _____

Vocabulary Review

1 **Look at the picture and word clues. Write the answer to each clue on the blanks.**

1.



The picture shows a first
_ (1) _ (2) _ _ _ moon.

2.

People use this to track time.
_ _ (3) _ (4) _ _ _

3.

These are pictures of some moon _ _ _ _ (5)(6).

4.

An object that moves around another object in space is a
_ (7)(8) _ _ _ _ _ _.

Look at the letters in circles. Match the letter with the number below each space to solve the riddle.

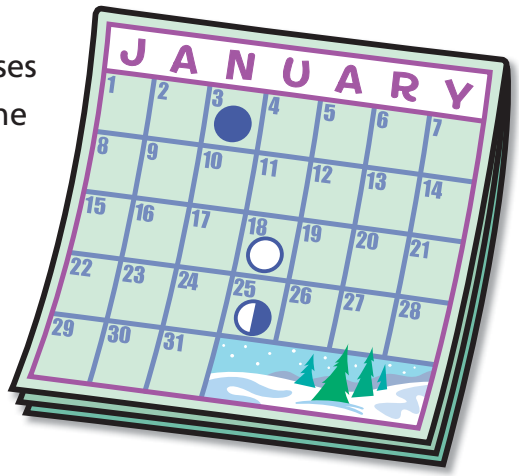
What kind of cartoons does the moon watch?

_	_	_	_	_	_	_	_	_	_
3	1	4	7	2	8	1	4	5	6

Apply Concepts

2 Draw a picture of the sun and the moon. Add lines to show light rays from the sun. Shade the part of the moon that is dark.

3 Look at the calendar. One of the moon's phases is missing for January 10th. Draw and label the missing moon phase in the space below.



4 Explain why you drew the moon the way you did in Question 3.

_____

_____

_____

Take It Home!

With an adult, use a pair of binoculars to observe the moon. Can you see craters? Draw a picture of what you see.

ESSENTIAL **QUESTION**

How Does Technology Help Us Learn About Space?

Engage Your Brain

Find the answer to the following question in this lesson and record it here.

What do you think it would be like to work in space? Explain.

_____

_____

_____

_____

_____

ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____

_____

_____

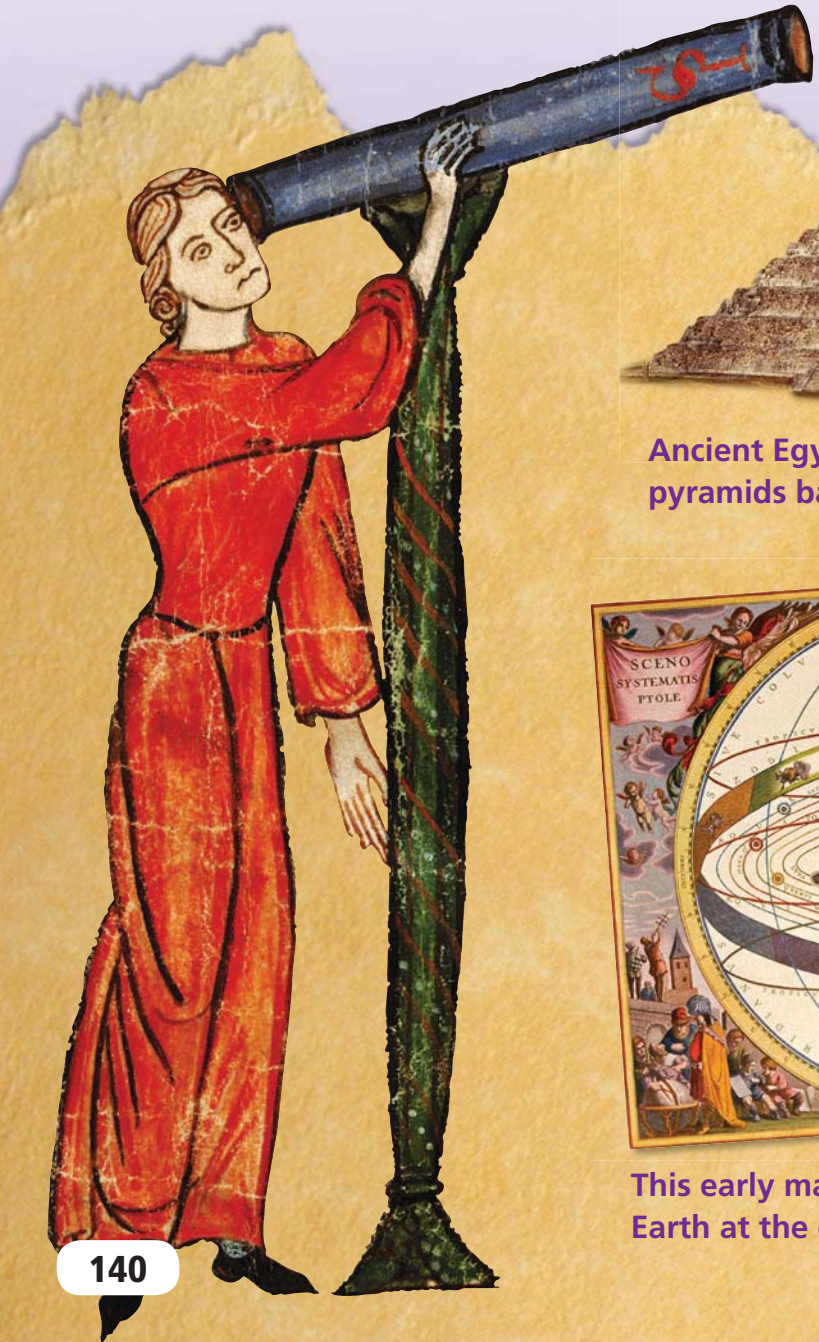
Signal Words: Details

Active readers remember what they read because they are alert to signal words that identify examples and facts about a topic. Signal words show connections between ideas. *For example* and *for instance* signal examples of an idea. *Also* and *in fact* signal added facts.

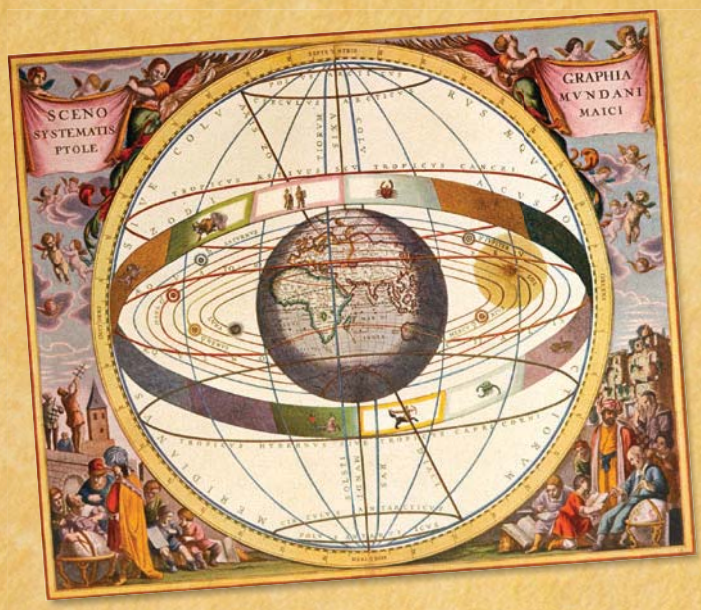
EARLY ASTRONOMERS

People have always looked at the night sky. Early people built monuments based on what they saw in the sky. When writing was developed, people began to record their observations.

ACTIVE **READING** As you read these pages, circle two clue words or phrases that signal a detail such as an example or a fact.



Ancient Egyptians, Aztecs, and Mayans built pyramids based on their observations of the sky.



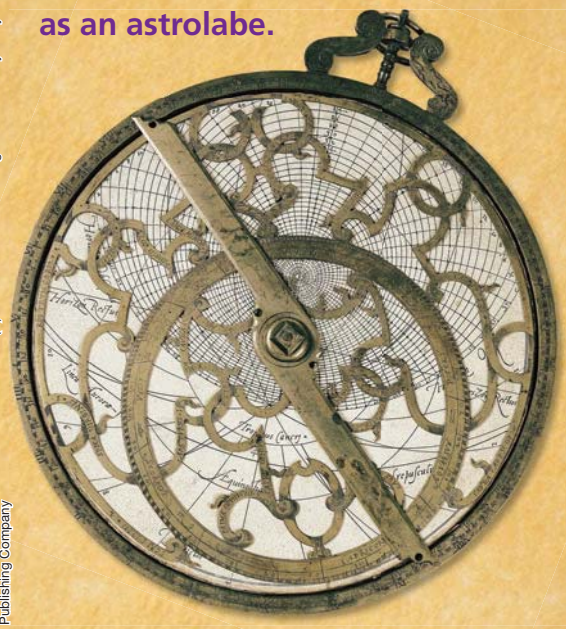
This early map of the solar system shows Earth at the center of the universe.

Early Aztec and Egyptian astronomers were limited to observing space with just their eyes. They observed several planets using just their eyes. Early astronomers also believed that Earth was the center of the universe.

Then, in the 1600s, the telescope was invented. A **telescope** is a tool that uses lenses to make faraway objects appear closer and larger. Galileo was one of the first astronomers to study space by using a telescope. The telescope led to many new observations about space. For example, Galileo observed four of Jupiter's moons by using a telescope.

By the early 1600s, astronomers knew that Earth revolved around the sun. However, they still believed that the sun was the center of the universe.

▶ **By the 1600s, scientists knew that the sun was the center of the solar system. They had also observed five other planets with telescopes. Draw a diagram of an early solar system.**



This early model of the solar system is known as an astrolabe.

Galileo was the first astronomer to use a telescope to study objects in space.

HUMANS ON THE MOON!

The launch of *Sputnik* was the beginning of the Space Age.

"That's one small step for [a] man, one giant leap for mankind." Neil Armstrong spoke those words from the moon's surface in July 1969. He was the first person ever to be there!

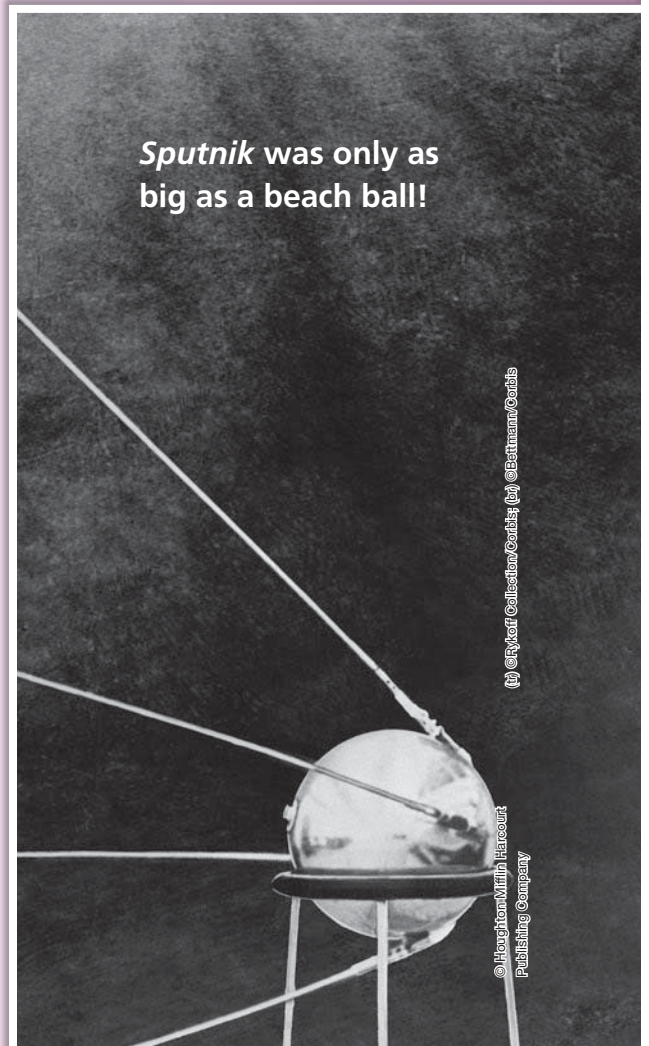
ACTIVE READING As you read these pages, draw circles around clue words or phrases that signal a sequence of events.

Before 1960, scientists had already developed the technology to send rockets and people into space. Russia sent the satellite *Sputnik* into space in 1957.

Then, in May 1961, President John F. Kennedy challenged NASA. He wanted the United States to be the first country to put a human on the moon. The space race was on! During the late 1960s and early 1970s, the United States sent nine *Apollo* spacecrafts to the moon. Six of those spacecrafts landed on the moon's surface.

Both the United States and Russia launched space probes. **Space probes** are vehicles that move through space, but are controlled from Earth. They take photos of faraway objects, and send the data back to Earth.

By the early 1960s, large observatories had been built all over the world. These are buildings where huge telescopes are kept. The telescopes are powerful enough to observe distant stars.



Sputnik was only as big as a beach ball!

This *Gemini 7* space capsule took two astronauts on a 14-day orbit around Earth.

▶ Imagine you are an early NASA astronaut. Write a journal entry about one of your experiences in space.

Not only has Buzz Aldrin walked on the moon, he even played a round of golf!

TECHNOLOGY IN SPACE!

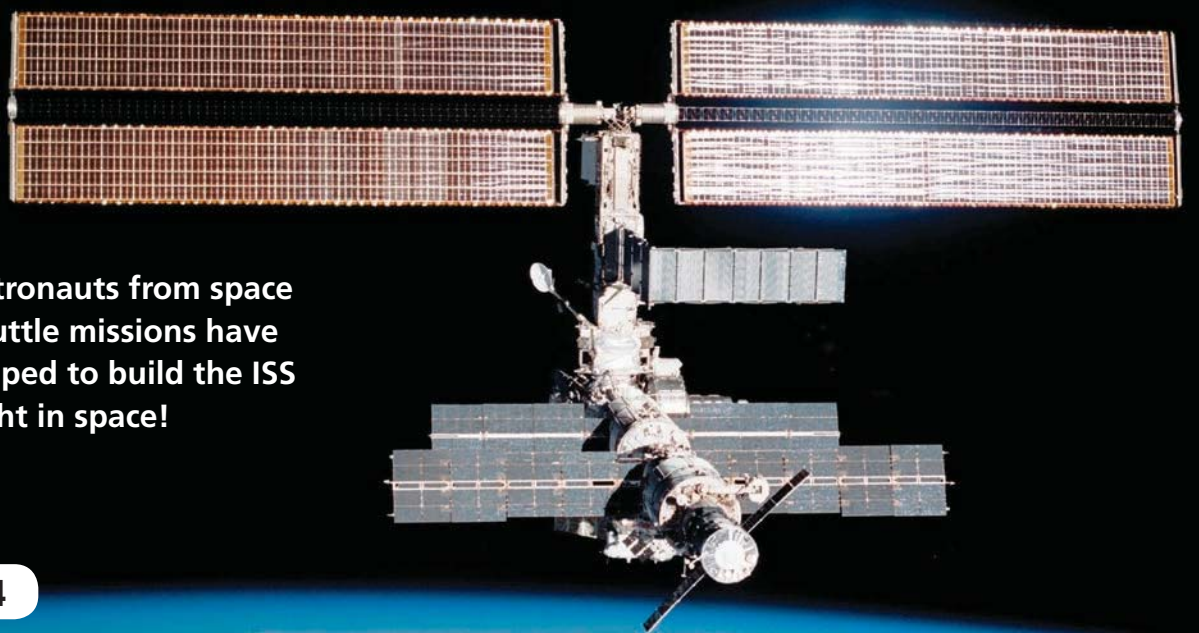
Today, a few astronauts live on the International Space Station (ISS). They travel there on the Space Shuttle. Scientists study space from both of these places.

The International Space Station is a giant space lab that orbits Earth. There, astronauts from 16 countries live, conduct experiments, and gather data. Astronauts orbit Earth in the Space Shuttle, too.

Another example of technology orbits in space. It is the Hubble Space Telescope. It takes pictures of space that are not possible to get from Earth.

People have not traveled any farther than the moon. But space probes have travelled past the edge of our solar system. The first space probes visited nearby planets such as Mars and Venus. Most space probes just fly by planets. They take pictures and send them back to Earth. *Viking I* was the first space probe to successfully land on Mars in 1976. Since then, other space probes have landed on Mars' surface.

▶ **The International Space Station is covered with solar panels. What do you think they are used for?**



Astronauts from space shuttle missions have helped to build the ISS right in space!

The Hubble Space Telescope takes pictures of faraway galaxies. Here are just a few of Hubble's amazing pictures.

(l) ©Scott Camazine/Alamy; (r, t) ©NASA; (b) ©Dorling Kindersley/Getty Images

▶ Think about what astronomers could view with early telescopes. How does it compare with what can be viewed with the Hubble Space Telescope? Give three examples.

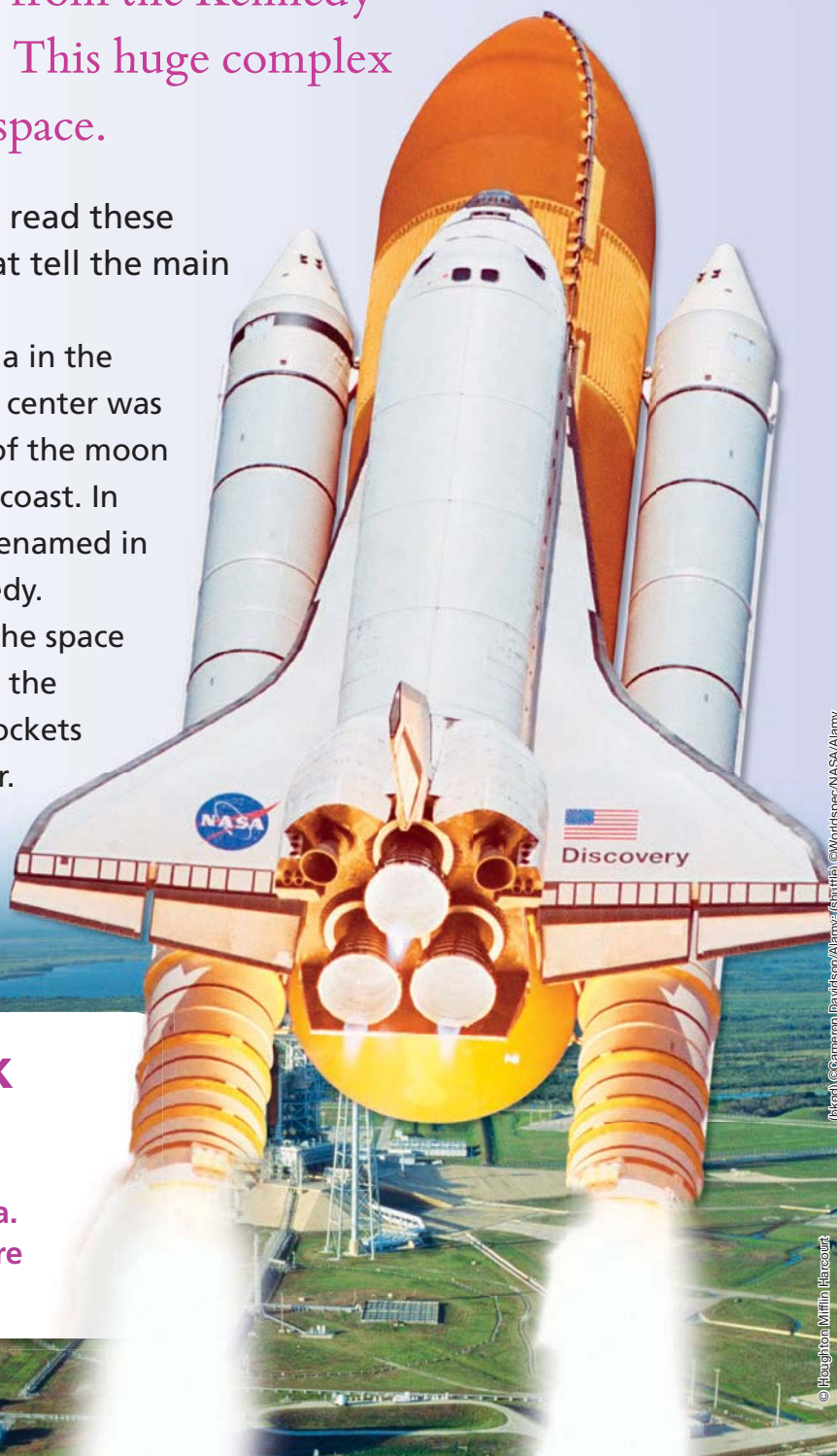
FLORIDA'S ROLE IN SPACE

Powerful rockets launch from the Kennedy Space Center in Florida. This huge complex is America's gateway to space.

ACTIVE READING As you read these pages, underline sentences that tell the main ideas.

The Space Age began in Florida in the early 1960s. Then, Florida's space center was known as Cape Canaveral. Each of the moon missions launched from Florida's coast. In 1963, NASA's headquarters was renamed in honor of President John F. Kennedy.

Florida is a good location for the space center. Why? Florida has some of the fairest weather in the country. Rockets can't be launched in bad weather.



[bkgd.] ©Cameron Davidson/Alamy; [shuttle] ©Worldspec/NASA/Alamy

Beyond the Book

Research ways that space exploration has affected the economy and culture of Florida. Develop a presentation to share with your class.

One of the most important buildings at the Kennedy Space Center is the Vehicle Assembly Building. Construction on this giant building began in 1963. Many people came to Florida to help with its construction. Since then, hundreds of rockets have been built here.

Many people work at Kennedy Space Center. Engineers design and build rockets. Scientists study data brought back by astronauts and space probes.

Every year, visitors come to Florida to visit the space center. It's an important tourist attraction.

DO THE MATH

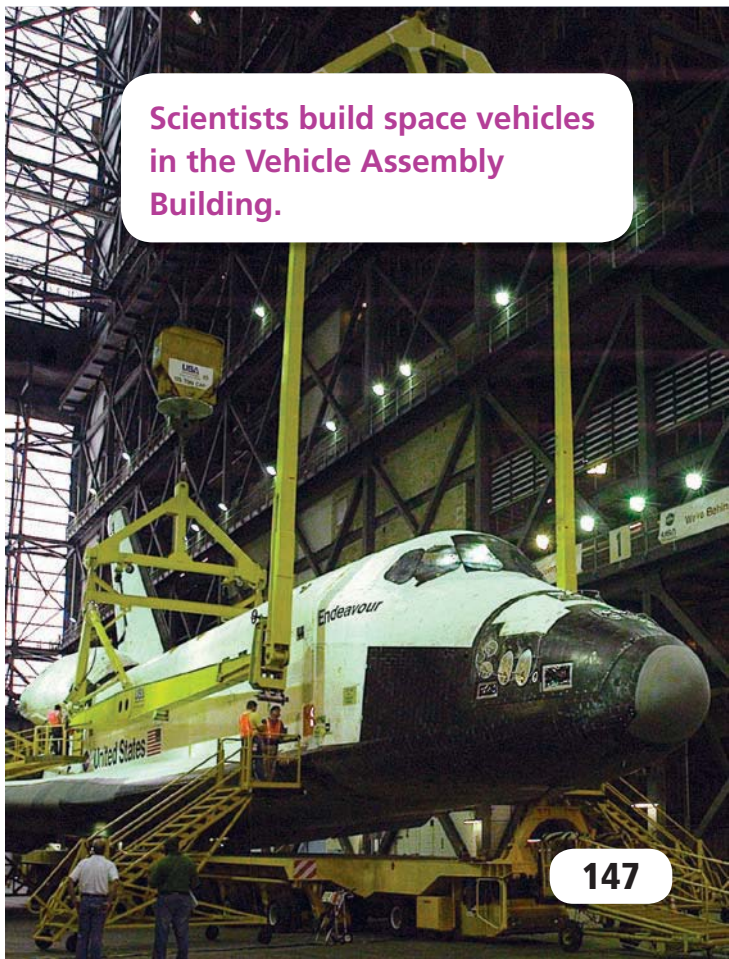
Solve a Two-Step Problem

It takes the shuttle about 90 min to make one trip around Earth. About how many trips can it make in 24 hr? (Hint: 1 hr = 60 min)

_____

_____

The Atlas V rocket launches a spacecraft at the Kennedy Space Center.



Scientists build space vehicles in the Vehicle Assembly Building.

The Kennedy Space Center welcomes visitors from all over the world.

SPACE TECHNOLOGY IN EVERY HOME

Much of the technology used in our homes comes from the space program. These technologies are known as space "spin-offs."

Astronauts on the moon needed tools to do many tasks. So scientists developed cordless power tools. Today, we use cordless power tools in our homes.

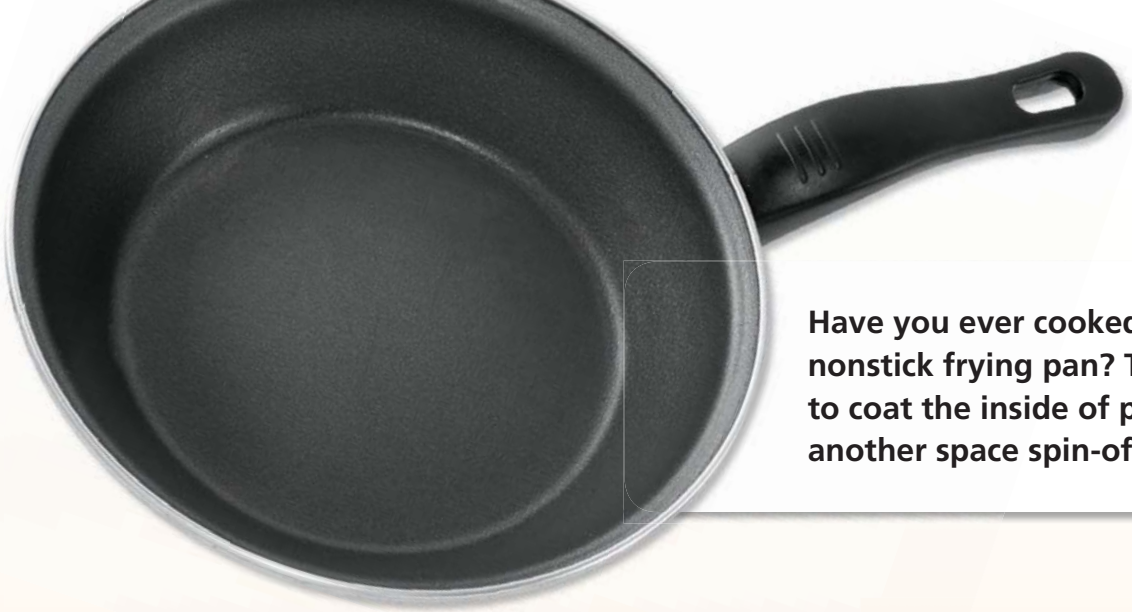
▶ **Why do you think astronauts cannot use a drill with a cord in space?**

_____

_____

_____

Did you know that the design of the athletic shoes you wear is a space spin-off? Astronauts needed boots to stay on the surface of the moon where there is no gravity. With the boots, they could walk and jump around on the moon. The soles of today's athletic shoes are based on these moon boots. The soles improve how you jump and run.



Have you ever cooked something in a nonstick frying pan? The material used to coat the inside of pots and pans is another space spin-off.

The beverage cooler you take on picnics is based on a space cooling system. Astronauts also need a way to keep food in space, so along came freeze-dried foods. Just add water and you've got a meal. Perhaps you have some freeze-dried fruit in your cereal!

Under a racecar driver's uniform is a "cool suit." The suit keeps the driver cool using water that runs through tubes in the suit. Cool-suit technology came from space suits that astronauts wore. The uniform also protects the driver from fire.

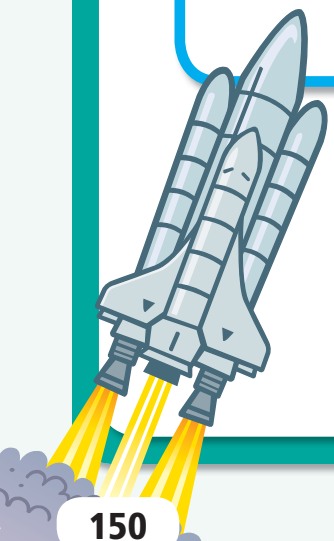
Sum It Up »

Read the summary. Write the numbers from the list below the summary into the correct box at the bottom of the page.

Travel to space and space technology have changed our lives. Early astronomers began to study space with telescopes. Later, technologies put people in space and on the moon. Today, the space program has affected our lives in many ways.

1. athletic shoes
2. the Hubble Space Telescope
3. missions to the moon
4. jobs in the space program
5. Galileo
6. space probes
7. freeze-dried foods
8. International Space Station
9. Space Shuttle

Astronomy	Space Travel	Space in Our Lives



Brain Check

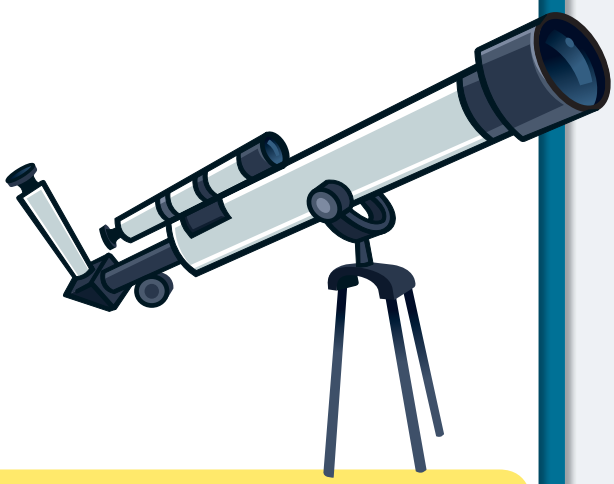
LESSON 4

Name _____

Vocabulary Review

1 Use the words in the box to complete each sentence.

1. A person who studies space is an _____.
2. _____ was an early astronomer.
3. A cordless power tool is an example of a _____.
4. The first satellite in space was _____.
5. The _____ is a large telescope that orbits in space.
6. A _____ is a vehicle that moves through space but is controlled from Earth.
7. A tool used to make objects appear larger is a _____.
8. The _____ space center is in Florida.



telescope	**space probe**	**Kennedy**	**Sputnik**
Hubble	**Galileo**	**astronomer**	**spin-off**

*** Key Lesson Vocabulary**

Apply Concepts

2 Draw stars you might see with your eyes. Then draw stars that an astronomer might see with the Hubble Space Telescope.

Your Eyes

The Hubble

3 All of the pictures below show space spin-offs. Tell how each one has affected your life.

_____ _____ _____

_____ _____ _____

4 Imagine that it's 1969. You are the first astronaut to land on the moon. What would your first words be? Write them below.

_____

_____

Take It Home! Interview an older relative about what Central Florida was like before NASA and the Kennedy Space Center. How has the area changed? Compare what you learn to what Central Florida is like today.

SC.4.N.3.1 Explain that models can be three dimensional, two dimensional, an explanation in your mind, or a computer model.

S.T.E.M.

ENGINEERING & TECHNOLOGY

Space Exploration

Typically, engineering design problems have many solutions. An engineer often needs to find a balance among many trade-offs to get the best solution. A *trade-off* is the giving up of one design feature to make another design feature better. The charts below show trade-off analyses for spacecraft with and without crew. The benefits and drawbacks of some major design features of each kind of mission are shown. You decide which one should blast off.

Spacecraft with Crew

Design Feature	Benefit	Drawback
living space for crew	people onboard to fix problems and run difficult science experiments	greater cost to build and to fuel; increased weight during liftoff (must store air, food, and water)
heat shield for reentry to Earth's atmosphere	safe return of crew; reusable ship	more fuel needed; less space for everything else

Spacecraft without Crew

Design Feature	Benefit	Drawback
smaller, lighter	less fuel needed; costs less to launch	less room for instruments
no living space for crew	no need to store air, food, water	no one to fix problems or watch experiments
large energy supply to last many years in space	can learn about faraway objects	spacecraft doesn't return to Earth; it cannot be reused

YOU **DECIDE**

Which type of spacecraft works best for space exploration? Use information from the chart to explain your answer.

S.T.E.M. continued

Analyze Trade-offs

Engineers think about trade-offs before designing a spacecraft. Sometimes, the trade-offs lead them to conclude that a particular solution is not worth trying.

Suppose a crew wants new space suits. Use the features and trade-offs of the old and new space suits to answer the questions below.

Old Space Suit		New Space Suit	
Design Feature	**Trade-off**	**Design Feature**	**Trade-off**
thick space suit protects astronaut against extreme temperatures and debris	hard to move around in	thinner space suit lighter and easier to move around in	may not protect as well as the old suit against extreme temperatures or debris
sturdy material and strong joints	difficult to put on quickly	has newer technologies built in	all technologies may not have been tested in space

What is the most important feature of a space suit?

_____

_____

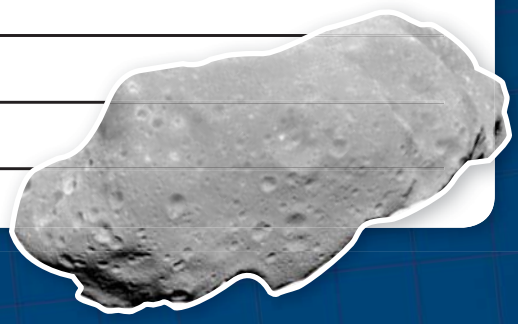
Do you think the benefits of the new space suit outweigh its trade-offs? Why or why not?

_____

_____

_____

_____



ENGINEERING DESIGN CHALLENGE

Design It:
Build a Sundial

What time is it? Most likely, you'll find the answer by looking at a watch or another electronic device. However, thousands of years ago, people used the sun to tell time.

A sundial is a device that uses the position of the sun to tell time. It has an upright rod that casts a shadow onto a number scale that identifies the time of day.

Now that you know about sundials, can you build one, too? Think about how a sundial is used. What materials would work best? A good sundial design should be accurate to within a half hour of the actual time.

Sundial

Image credit text needed

What to Do:

1. Research sundials to learn how they use Earth's motion to tell time.
2. Identify everyday materials you could use to build your sundial.
3. Identify the design criteria your sundial must meet.
4. Draw a diagram of your design.
5. Build and test your design.
6. Use an electronic clock to test the accuracy of your sundial. How can you improve the sundial's performance?
7. If needed, redesign your sundial until it meets your design criteria.
8. Place your sundial outside and use it to tell time.
9. Keep a record of your work in your Science Notebook.

UNIT 3 Benchmark Review

Name _____

Vocabulary Review

Use the terms in the box to complete the sentences.

axis
constellation
moon phase
orbit
rotate

1. A change in the appearance of the moon's shape is known as a(n) _____.
2. When things turn like a top, they _____.
3. Earth turns around an imaginary line called a(n) _____.
4. The path that one object takes around another object in space is its _____.
5. A group of stars that seems to form a pattern in the night sky is a(n) _____.

Science Concepts

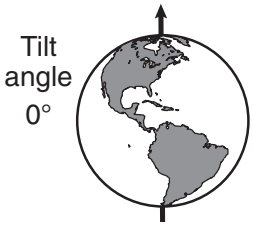
Fill in the letter of the choice that best answers the question.

6. One kind of modern calendar is a solar calendar. What is a solar calendar based on?
   - (A) daily pattern of the sun
   - (B) yearly pattern of the sun
   - (C) weekly pattern of the sun
   - (D) monthly pattern of the sun

7. A fourth-grader in Florida is doing an experiment in her science class. At the same time, a fourth-grader in China is getting a good night's sleep. What is responsible for it being daytime in Florida while it is nighttime in China?
   - (F) Earth's rotation
   - (G) Earth's revolution
   - (H) moon's revolution
   - (I) Earth's path as it orbits the sun

8. As Earth rotates, it is tilted on its axis. Which model correctly shows how much Earth tilts on its axis?

Ⓐ



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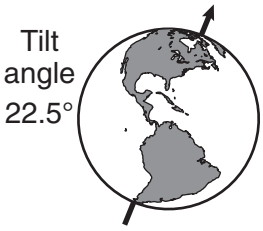

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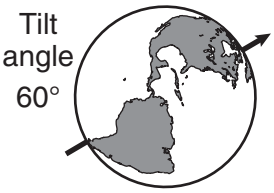

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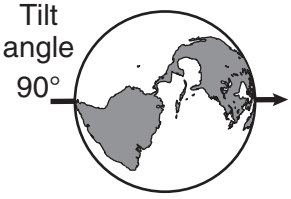


9. One day on Earth is 24 hours. Some planets have shorter days. Other planets have longer days. What determines the length of a planet's day?

Ⓕ moons
Ⓖ revolution
Ⓗ rotation
Ⓘ tilt

10. The data table shows how long it takes each planet to make one complete rotation and revolution. The numbers are in Earth days.

Planet	Time needed to make one complete rotation (Earth days)	Time needed to make one complete revolution (Earth days)
Mercury	58.6	87.96
Venus	243	224.7
Earth	1	365.26
Mars	1.02	687

According to the data table, which is correct?

Ⓐ Earth takes less time to orbit the sun than Mars.

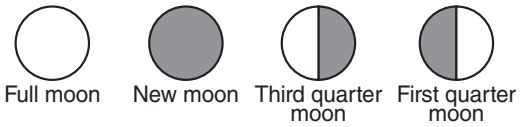
Ⓑ Venus takes more time to orbit the sun than Mars.

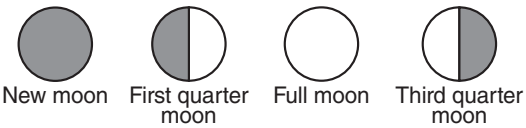
Ⓒ Venus takes less time to orbit the sun than Mercury.

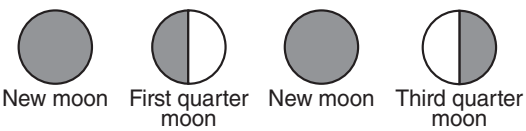
Ⓓ Mercury takes more time to orbit the sun than Earth.

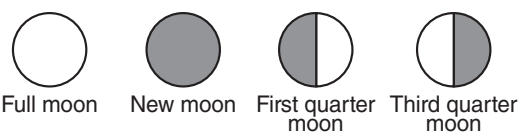
Name _____

11. Ashley notices changes in the moon over the course of a month. Which of the following sequences could Ashley have seen?

Ⓕ 

Ⓖ 

Ⓗ 

Ⓘ 

12. A modern Earth solar calendar year has 365 days divided into 12 months. Each month is about 30 days. On an imaginary moon of planet X, a month is 3 days shorter than an Earth month. About how many planet X lunar months will fit into an Earth calendar?

Ⓐ about 12.5
Ⓑ about 13.5
Ⓒ about 14.5
Ⓓ about 15.5

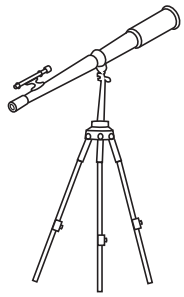
13. Sheena makes a list of different jobs people have in Florida. Which of these types of jobs probably increased the most when the space program was located in Florida?

Ⓕ school teaching
Ⓖ deep-sea fishing
Ⓗ citrus fruit farming
Ⓘ aircraft engineering

14. Technology developed for use in space can help us in other ways. Which type of technology on Earth is a spin-off of technology originally developed for space exploration?

Ⓐ radio
Ⓑ cordless drill
Ⓒ automobiles
Ⓓ light bulb

15. The illustration below shows an instrument used by many scientists. It was first used in the Netherlands in about 1608.



What types of objects can be seen with this instrument?

Ⓕ objects that are far away
Ⓖ objects that produce sound
Ⓗ objects that are very small
Ⓘ objects that move very fast

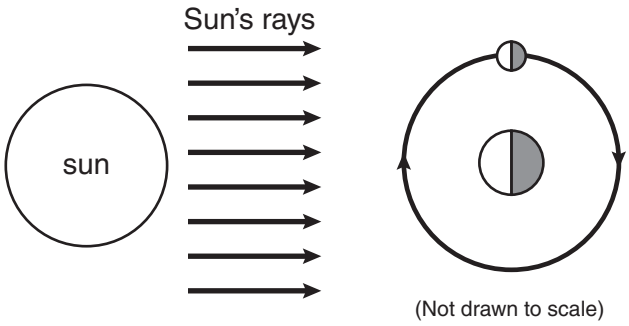
16. Some constellations are visible from different places on Earth only during part of the year. Why are certain constellations not visible everywhere on Earth all year long?

Ⓐ sun's rotation
Ⓑ Earth's rotation
Ⓒ sun's revolution
Ⓓ Earth's revolution

Apply Inquiry and Review the Big Idea

Write the answers to these questions.

17. The diagram below shows Earth, the moon, and the sun. This diagram is not drawn to scale.



Use the diagram to explain why you can see the moon from Earth.

18. In the United States, how does the temperature on an August day and a January day usually compare? State a claim and explain your claim with reasoning.