UNIT OVERVIEW

Our solar system is home to Earth and seven other planets. Each planet rotates on its axis while revolving around the Sun. Each planet has unique characteristics and qualities that set it apart from the others. The Sun keeps this complex arrangement in order. The Solar System unit reveals detailed facts about our Sun and the planets. It also addresses other components of our solar system, including dwarf planets, moons, asteroids, and comets.

Certain reading resources are provided at three reading levels within the unit to support differentiated instruction. Other resources are provided as a set, with different titles offered at each reading level. Dots on student resources indicate the reading level as follows:

- low reading level
- middle reading level
- high reading level

THE BIG IDEA

Learning about our solar system can give students a sense of wonder and perspective. They can ponder and appreciate Earth's crucial position in our solar system, which makes this planet such an ideal place for us to live. Students may also consider how small our entire world is compared to some of our fellow planets, the Sun, and the vastness of space. For some students, this perspective might provide a sense of scale for their own panoramas and concerns. It may also help students understand why many people are excited about the prospects of discovering and exploring new solar systems, both within our galaxy and beyond.

Other topics

This unit also addresses topics such as: the exploration of Mars, the asteroid belt, the outer solar system, Galileo's moons, and the discovery and reclassification of Pluto.

SPARK

The spark is designed to get students thinking about the unit's topics and to generate curiosity and discussion.

Materials

- variety of round objects (for example, tennis ball, golf ball, Ping Pong ball, bowling ball, beach ball, orange, marble, dried pea)
- smooth, flat surface

Activity

Ask students to share what they know about the planets in our solar system. Explain that this fun activity will help them understand that planets are round, they come in different sizes, they are made of different materials, and they spin at different speeds. Hold up a small object (not the smallest in your set) and tell students that it represents Earth, the planet on which we all live. Ask a volunteer to spin the object in slow circles on top of a table or desk. Then have the student spin it in fast circles. Discuss which speed seems more like the spin, or rotation, of Earth.

Now invite more volunteers to each pick one of the remaining round objects and take a turn at spinning it, first slowly and then quickly. Ask the class to observe any similarities or differences between the objects' rotations. Then invite new volunteers to spin all the objects at once. It may be fun to hold contests to see who can make their object spin the longest without causing it to fall off the table. As an extension, you might let students design their own planet on one of the disposable round objects (such as a tennis ball, golf ball, or orange) and observe how their design appears as their object spins.

Below are questions to spark discussion.

Did the size of the object make a difference in how smoothly or how long it spun? What made the biggest difference?

If we wanted to represent the real planets in our solar system, how many objects would we need, and what kinds of objects should we choose?

How are real planets similar to and different from the objects we used in this activity?

Do you think real planets spin in the same way these objects spun? Do planets spin in a perfectly upright position, or do you think they spin at a tilt, or even on their side?

Do you think real planets spin in one place, or do they move around? If they move around, where do they go?

In the real solar system, do the planets bump into one another as the objects (likely) did in our activity? Why or why not?

Use this activity to begin an introductory discussion about planets and how they move. Throughout the unit, students will learn more about the rotation, revolution, size, mass, composition, special features, and position of each of the planets.

Many of the unit's vocabulary terms are related to the spark activity and can be introduced during the spark. For vocabulary work, see the Vocabulary section in this *Unit Guide*.

PRIOR KNOWLEDGE

Invite students to explain their understanding of the solar system and any facts about the Sun or individual planets that they may have learned about previously.

Probing Questions to Think About

Use the following questions to have students begin thinking of what they know about our solar system.

- Why does the Sun move across the sky? Does the Sun move around Earth, or does Earth move around the Sun?
- If the Sun is a star, why don't we see it at night?
- How are the other planets in our solar system similar to Earth, and how are they different?
- Can you see any planets from Earth with just your eyes? Can you see any planets with binoculars or a telescope? Why might some planets be harder to see than others?
- Is the Moon considered a planet? Why or why not?
- Do any other planets have moons? If so, do you think their moons are similar to our Moon?
- Do you think all planets move in the same way and at the same speed?
- What are Saturn's rings made of? How many rings does it have?
- What else does our solar system have besides a star and planets?
- Is Pluto a planet? Why or why not?
- How are comets and asteroids alike? Where do they come from?
- What is an *atmosphere?* Would you want to live on a planet with no atmosphere? Why or why not?
- What does Earth have that makes it different from other planets (besides humans)? Could we still live on this planet if it were closer to or farther away from the Sun? Why or why not?

Tell students they will learn more about these topics soon.

UNIT MATERIALS

Each unit provides a wide variety of resources related to the unit topic. Students may read books and other passages, work in groups to complete hands-on experiments and investigations, discuss science ideas as a class, watch videos, complete writing tasks, and take assessments.

Resources are available for printing or projecting, and many student resources are also available for students to access digitally on Kids A–Z.

Selected unit resources are available in more than one language.

For a complete list of materials provided with the unit, see the Solar System unit page on the Science A–Z website.

VOCABULARY

Use the terms below for vocabulary development throughout the unit. They can be found in boldface in the *Nonfiction Book*, the *Quick Reads*, and/or other unit resources. These terms and definitions are available on *Vocabulary Cards* for student practice. Additional vocabulary lists are provided in the teaching tips for *Investigation Packs* and *FOCUS Books*.

Core Science Terms

These terms are crucial to understanding the unit.

asteroid	an irregularly shaped rock that orbits a star
comet	a space object made of ice and dust that orbits a star and develops a long, bright tail as it nears its star
core	the center of an object
crater	a hole in the ground caused by the impact of an object from space
dwarf planet	a nearly round object that orbits a star, is smaller than a planet, and is not a satellite of another object
gas giant	a large planet that is mainly made up of gases
gravity	the force that pulls all objects toward each other
moon	a solid object that travels around a planet; a natural satellite
orbit	to revolve around another object
planet	a very large object that orbits a star
satellite	a natural or human-made object that orbits Earth or another object in space
solar system	a group of objects in space that orbit a star
star	a body in outer space, made of hot gases, that shines in the night sky
terrestrial	like Earth; describes planets that are rocky and Earthlike in size

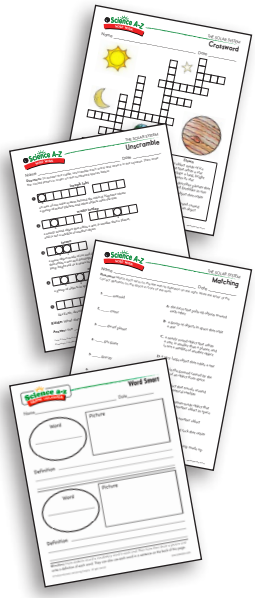
Other Key Science Terms

The following vocabulary is not essential for comprehending the unit but may enrich students' vocabulary.

asteroid belt	the area in space between Mars and Jupiter where most asteroids orbit
atmosphere	a layer of gases surrounding a planet, star, or moon
Earth	the third planet from the Sun; the planet we live on

gas	a substance with no fixed volume or shape that can expand freely
helium	the second lightest chemical element; often a gas
hydrogen	the lightest chemical element; often a gas
Jupiter	the largest planet in our solar system and the fifth from the Sun; a gas giant
Kuiper Belt	an area of our solar system beyond the orbit of Neptune where a group of minor planets and other objects orbit the Sun
Mars	a small reddish planet that is fourth from the Sun; a terrestrial planet
mass	the measure of the amount of matter in an object
matter	anything that takes up space and has weight
Mercury	the smallest planet in our solar system and the closest to the Sun; a terrestrial planet
methane	a colorless, odorless, flammable gas commonly called "natural gas"
Moon	Earth's only natural satellite
Neptune	a large blue planet that is eighth from the Sun; a gas giant
nucleus	the center of a comet, made of small particles of ice and frozen gas that can turn to vapor and form a tail as the comet nears a star
oxygen	a gas that has no color, taste, or smell, and which people need to live
Pluto	a dwarf planet discovered in 1930 that was once considered a planet
plutoid	a dwarf planet that orbits the Sun beyond Neptune
revolution	a single journey along an orbital path
rotation	a single turn of something around an axis or a fixed point; spinning
Saturn	a planet with large rings around it that is sixth from the Sun; a gas giant
tail	the bright, vaporized part of a comet that points away from the Sun
Uranus	a large blue-green planet that is seventh from the Sun; a gas giant
Venus	a small planet that is second from the Sun; a terrestrial planet

Vocabulary Activities



You may choose to introduce all the terms that will be encountered in the unit before assigning any of the reading components. *Vocabulary Cards* with the key science terms and definitions are provided. Dots on the cards indicate the reading levels of the *Nonfiction Book* or the *Quick Reads* in which each term can be found. If all level dots appear, the term may come from another resource in the unit. Students can use these cards to review and practice the terms in small groups or pairs. The cards can also be used for center activity games such as Concentration.

The *Word Work* activity sheets offer fun puzzles and practice with key vocabulary terms from the unit. For further vocabulary practice and reinforcement, you can choose from the vocabulary *Graphic Organizers*. To build customized vocabulary lessons with terms related to the topic, see Vocabulary A-Z.

Students can use the *Word Smart* vocabulary *Graphic Organizer* to organize information on the science terms. You may want to assign each student one to three words to share his or her *Word Smart* knowledge with classmates. Students who have the same word should first compare their *Word Smart* sheets with each other and then report to the larger group.

The science terms can be used in oral practice. Have students use each term in a spoken sentence.

As students read, encourage them to create a science dictionary by recording new vocabulary terms and definitions in their *SAZ Journal*.

BACKGROUND AND MISCONCEPTIONS

Use this section as a resource for more background knowledge on unit content and to clarify the content for students if misconceptions arise. Refer to Using the Internet below for more ways to extend the learning.

Q: *Are the stars we see in the sky part of our solar system?*

A: No. The Sun is the only star in our solar system. Our solar system is located on the outer edge of the Milky Way galaxy. The stars we see are located in our galaxy, but they are much farther away than our solar system. The closest stars to our solar system are part of a triple-star system (Centauri A, B, and C). At 9.5 trillion kilometers (5.9 trillion miles) away, it takes over four years for the light they emit to reach Earth! Our Sun is about 149 million kilometers (93 million miles) away from Earth, and its light reaches us in only eight minutes. That's because light travels about 300 million kilometers (186,000 miles) per second!

Q: *Is our solar system the largest part of the universe?*

A: No, not at all! Our solar system is just a speck of the Milky Way galaxy, which itself is only a tiny part of the universe. If each person on Earth had 60 galaxies (each containing 100–200 billion stars), the total would roughly represent the number of galaxies estimated to exist in the universe. Yes, our solar system is enormous, but it is like a drop of water in the ocean compared to the universe—or even our own galaxy!

Q: *Does the Milky Way galaxy have anything to do with milk?*

A: Yes—strangely enough, it does. The word *galaxy* is derived from the Greek and Latin words for "milk." The Latin derivation of *galaxy* is *via lactea* ("milky road" or "milky way"). Interestingly, the Milky Way was named long before anyone knew what it was. Myths described milk being spilled across the sky. Later, in the 1600s, Galileo determined that the "milky" band across the night sky was actually made up of many individual stars.

Q: *Why don't we feel dizzy from Earth's rotation?*

A: When motion is basically constant, it is not detected. But if an object slows down, speeds up, or collides with something, the motion will be felt. Think of a plane ride. We feel the motion intensely when taking off or landing, but in flight there appears to be no motion. This situation is similar to what happens as Earth rotates, and it explains why we do not feel the planet spinning at 1,600 kilometers (1,000 miles) per hour or feel it traveling around the Sun at a rate of 108,000 kilometers (67,000 miles) per hour!

Q: *Do all the planets rotate and revolve at the same speed?*

A: No. Each planet rotates on its axis at a different speed and revolves around the Sun at a different rate as well. The time it takes a planet to circle the Sun is known as its *revolution,* with one revolution being considered a year. One *rotation* on an object's axis is considered a day. Revolutions and rotations can be stated in terms of Earth hours, days, or years. Planets closer to the Sun have years that are shorter than Earth's because their trip around the Sun is shorter. Planets beyond Earth have longer years because their trip around the Sun is longer. For example, Saturn's year is 29.4 times longer than Earth's because it is much farther from the Sun than Earth is. (That's about 353 Earth months in a year!) But unlike rate of revolution, rate of rotation is not related to distance from the Sun. Saturn's day lasts only 10.7 Earth hours! It spins on its own axis more than twice as fast as Earth does.

Q: *Is Pluto no longer considered a planet because of its size?*

A: Pluto's small mass has a lot to do with its reclassification. But another reason is that Pluto does not stand out from its neighborhood of smaller objects, while the other eight planets do. Still, Pluto is of interest to scientists. NASA's New Horizons spacecraft was launched in 2006, and one of its tasks is to bring back images to help us understand this curious dwarf planet.

Q: *Will more planets ever be discovered in our solar system? Will any current planets be downgraded, as Pluto was?*

A: It is difficult to predict the future when it comes to astronomical inquiry and exploration. Scientists constantly search space to learn more about our solar system and beyond, and may decide that a known or newly discovered object should be classified as a planet. Some people in the scientific community already consider there to be more than eight planets, while some haven't given up on calling Pluto a planet. This is due to there being some gray area, both in defining a planet and in identifying where the boundary of our solar system lies. So it would seem that anything is possible, including the reclassification of the current planets.

EXTENSION ACTIVITIES

Using the Internet

Most search engines will yield many results when the term *solar system* is entered. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- planet photographs
- temperature of Venus
- compare Mercury and the Moon
- Which planet rotates sideways?
- solar system model
- Saturn's rings
- Is there life on Mars?
- Will an asteroid hit Earth?

Projects and Activities

- **Project:** Secretly assign each student a planet, the Sun, or another feature of our solar system. Provide research resources (such as books, websites, magazines) and have students research and then present information collected without identifying their planet or other object. After observing each presentation, see if classmates can guess what the student researched and described.
- **Arts:** Provide students with a variety of magazines and large pieces of construction paper. Have them cut out pictures of items that can be traced back to the Sun and create a Sun collage. (For example, a colored T-shirt is made of cotton, which comes from the cotton plant, which needs sunlight to grow.)

- **Math:** Have students calculate how many Earth months make up a year on each of the other planets. Multiply the number of Earth years it takes each planet to complete one of its years by 12. For weeks, multiply by 52 instead.
- **Math:** Have students make a bar graph with the planets listed on the x-axis (in order from the Sun) and selected data from the nonfiction book *The Solar System* on the y-axis. For example, students might use the graph to compare periods of rotation, planet diameters, or number of moons.
- **Project/Home Connection:** Invite students and their families to monitor the cycle of the Moon for one month. A journal can be kept to record observations (for example, apparent size of the Moon, location, color, and phase).
- **Guest:** Invite an astronomer or a professor from a local college or university to speak to the class about current projects being researched in the field of astronomy. You might also ask this visitor to address career opportunities and educational requirements.
- **Field Trip:** Bring students to a planetarium or science center to learn about the tools of space exploration and view displays on features in space.
- **Project/Technology:** Encourage students to monitor newspapers and selected websites for current news related to our solar system and space exploration. Then have groups of students each create a newscast of real and/or invented space news, including weather, sports, and human-interest stories.
- **Research/Careers:** Have students work in groups to research the sorts of career opportunities that are available in the field of astronomy/planetary science. What sort of education is required? What are the pros and cons? Allow each group a few minutes to present its findings. Check to be sure different areas of job interests are represented.
- **Research:** Students can create a biographical report describing a notable scientist, including significant work and contributions to the field of astronomy. See Writing A-Z for extensive writing instruction.
- **Research/Home Connection:** Students can conduct research as a family/home project or in the library/media center to extend the learning about a topic in one of the *Quick Reads* or other unit resources.