SPACE SCIENCE

K - 8 Science Unit Study

THE GOOD AND THE BEAUTIFUL

SPACE SCIENCE

CREATED BY THE GOOD AND THE BEAUTIFUL TEAM

Table of Contents

UNIT INFORMATION

Science Journal

All The Good and the Beautiful science units include activities for a science journal. For each child, prepare a 1–2-in. 3-ring binder to function as his or her science journal. Tabbed divider pages can be used to separate the different units. Also, have wide-ruled paper and blank white paper on hand for journal activities. All completed journal activities are to be kept in the science binder. If desired, have the child create a cover and insert it under the clear cover of the binder.

Science Wall

All science units include vocabulary words to be placed on your science wall, which is a wall or three-fold presentation board in your learning area to which you can attach the vocabulary words and other images. **Cut out the vocabulary word cards at the beginning of the unit.** The course will indicate when to place them on the wall.

Lesson Preparation

All science units include easy-to-follow lesson preparation directions at the beginning of each lesson.

Lesson Mini Books

Some lessons in this unit incorporate science mini books. If you bought the PDF download only, print the pages single-sided. To assemble the mini books, cut them in half along the dotted lines, stack the pages together with the page numbers in the correct order, and staple twice along the left side.

Video Recordings

Go to **goodandbeautiful.com/sciencevideos** and scroll down to the *Space Science* section to see videos that are integrated with the course.

Activities and Experiments

Many of The Good and the Beautiful science lessons involve hands-on activities. The *Space Science* unit features activities that involve potentially messy and/or harmful materials.

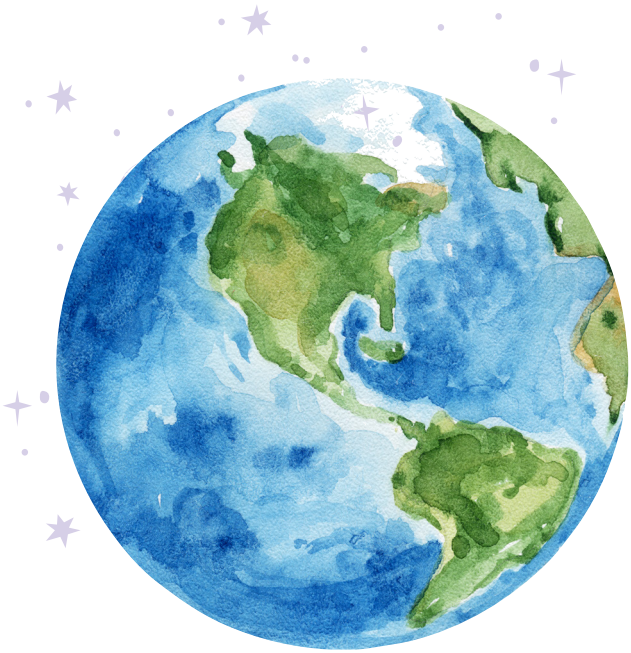
An adult should always closely supervise children as they participate in the activities to ensure they are following all necessary safety procedures.

Older Children and Younger Children

Some lessons include extra content that is more applicable for older children (grades 5–8). Parents or teachers may choose to skip this content if instructing only younger children.

Worldview

The unit takes a general Christian worldview that supports Creationism. The unit does not attempt to define how long it took God to make items in the universe, thus allowing for use by both those who believe in a young earth theory and those who believe in an old earth theory. If parents want to get into more detail on dates and time periods of the universe, they can include the doctrines specific to their own beliefs.



READ-ALOUD BOOK PACK

The two books below are optional read-aloud books that complement this unit. These books can be purchased as a book pack by going to **goodandbeautiful.com/science** and clicking on the *Space Science* unit link.

Mars Exploration: 1960–2016
by Megan Noel

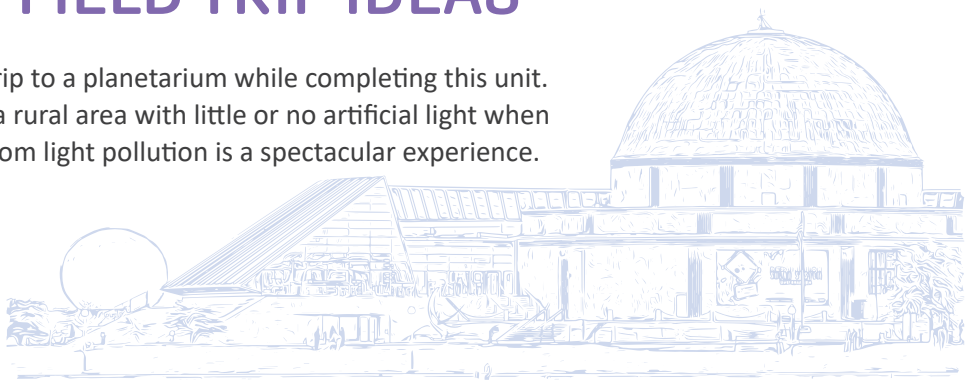
The Story of Mae Jemison
by Amy Drorbaugh

CORRELATED BOOKS

The Good and the Beautiful Library has several books that correlate well with the *Space Science* unit. It can be a wonderful experience for children to read books on their levels related to the subjects they are learning in science. The library includes both fiction and nonfiction books that are organized according to reading level. Find these correlated books by going to **goodandbeautiful.com/science** and clicking on the *Space Science* science unit product page.

FIELD TRIP IDEAS

If possible, consider taking a field trip to a planetarium while completing this unit. Also, consider taking a field trip to a rural area with little or no artificial light when it is dark. Seeing the night sky far from light pollution is a spectacular experience.



GRADES 7–8

LESSON EXTENSIONS

How the Extensions Work

Each lesson has an optional lesson extension for children in grades 7–8. Complete the lesson with all the children, and then have the older children complete the self-directed lesson extension. These extensions are generally located at the end of the lesson, though some are combined on a page, and you will need to turn back to them.

Answer Key

The answer key for the lesson extensions can be found by going to **goodandbeautiful.com/science** and clicking on the *Space Science* unit link.

Flexibility

The amount of time it will take to complete each lesson extension will vary for each child. The average time is about 10–15 minutes per extension. Parents/teachers and children may choose to omit parts of the lesson extension if desired. Encourage the children to stretch their capabilities, but also reduce work if needed.

Science Journal

The extension pages are nonconsumable. The children will do their work on separate sheets of paper and insert them into their science journal binders along with any science journal pages done during the lessons.

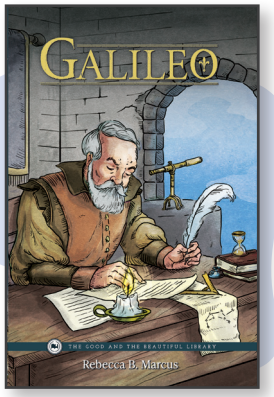
Children are encouraged to take ownership of their science journals and put forth effort to make the journals visually appealing. The journals will be something the children can treasure. The children should use color and illustrations where possible. Have the children view the sample pages below.

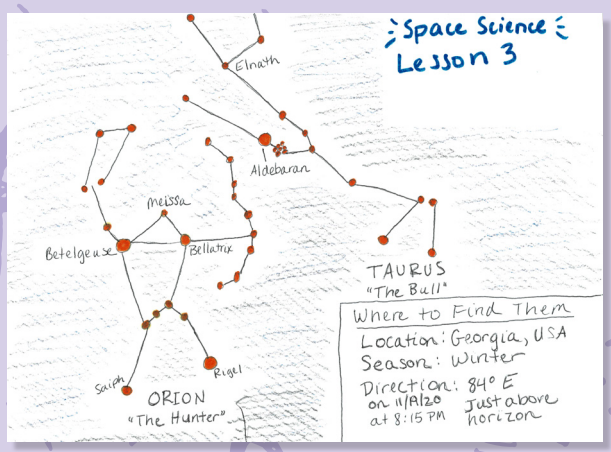
Taking Notes

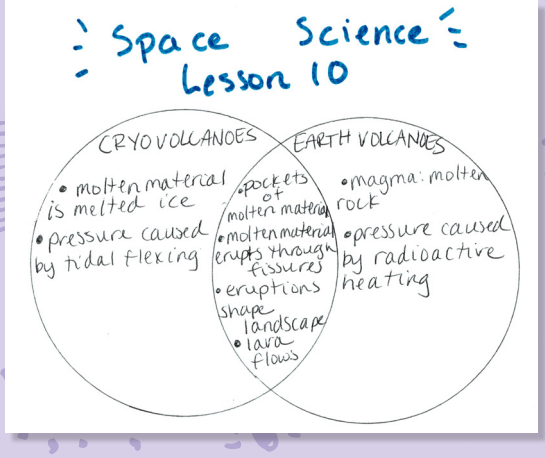
Some of the grades 7–8 lesson extensions have the children summarize the material they have read. Teach the children to look for key information and summarize the most important points. Students can also add notes with their thoughts and the facts that are most interesting to them.

Optional Grades 7–8 Reading Book

We recommend *Galileo* by Rebecca B. Marcus as extra reading for students in grades 7–8. This book can be purchased by going to **goodandbeautiful.com/science** and clicking on the *Space Science* unit link.







SUPPLIES NEEDED

You will need the following supplies for activities. There are no experiments in this unit.

Lesson 1

- MILKY WAY® bar for each child (optional)
- Standard dice

Lesson 2

- 1 piece of chalk
- Stopwatch or timer
- 1 roll of toilet paper (optional)
- 9 small objects such as pebbles (optional)
- 1 medium object (tennis ball-sized rock) (optional)

Lesson 3

- 8 marshmallows for each child (regular- or mini-sized) or substitute small balls of play dough
- 7 toothpicks for each child
- 1 empty paper towel tube for each child (or 2 toilet paper tubes taped together) (optional)
- 1 piece of black tissue paper for each child (optional)
- 1 safety pin or pushpin (optional)
- Black or dark blue paint
- Paintbrush (optional)
- 1 rubber band for each child (optional)
- Small star stickers (optional)

Lesson 4

- 1 foam or paper cup for each child
- 1 blank sheet of paper for each child
- 1 pencil for each child
- 1 sheet of cardstock or construction paper for each child

Lesson 5

- None

Lesson 6

- 2 c Kinetic Sand® or 2 balls of play dough (same color)
- Small pebbles or rocks
- A round metal cake pan or pie tin

Lesson 7

- 8 OREO® cookies or generic brand chocolate cookies with white cream filling for each child (or substitute black and white play dough) (optional)

Lesson 8

- A pillow (any size)
- Basketball (extension)
- Tennis ball (extension)
- Lamp (extension)

Lesson 9

- None

Lesson 10

- ½ c milk (any kind)
- Red and yellow food coloring
- Dish soap
- Small bowl

Lesson 11

- 64 dried beans (any kind)
- Red, blue, and green food coloring
- 2 c shaving cream (foam, not gel)
- 1 c white glue

Lesson 12

- Plastic sheet protector for each child (optional)
- Dry-erase marker for each child (optional)
- An orange or other similar-sized piece of fruit or small ball

Lesson 13

- Medium or large ball (basketballs or soccer balls work best)
- 90–150 cm (35–59 in) of rope
- Plastic grocery bag with handles
- 1 small coin or pebble

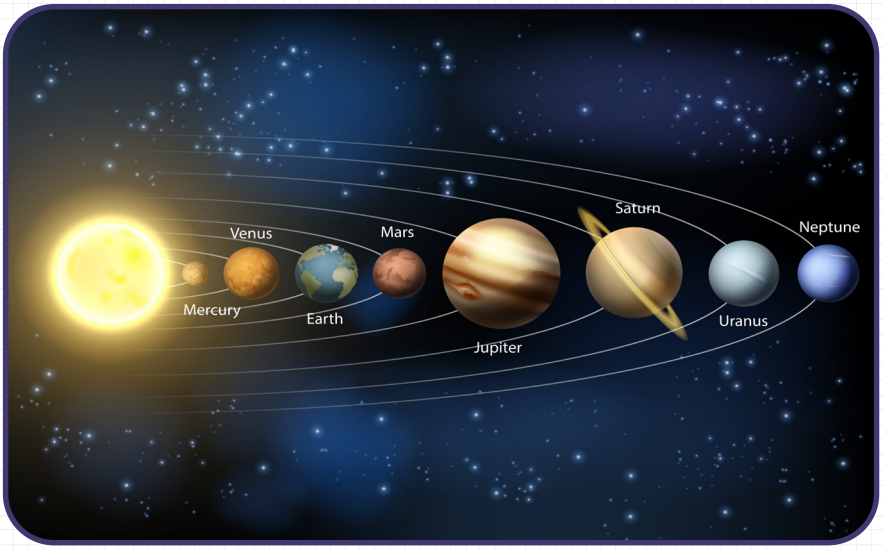
Lessons 14 & 15

- None

VOCABULARY

Instructions: Cut out the vocabulary cards in this section. Place them on your science wall when prompted to do so in the lessons. Review the vocabulary words several times during this unit and, if desired, at various times throughout the school year.

Solar System



the sun and all the planets, asteroids, moons, and other objects that revolve around it

Galaxy

a system of stars, gas, and dust held together by gravitational attraction

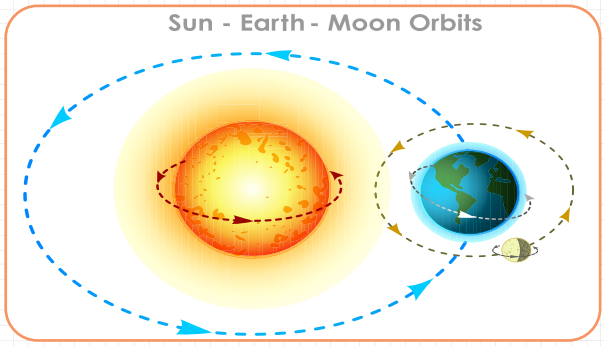
Milky Way

the galaxy that contains our solar system

Constellation

a group of stars that forms a picture in the sky by connecting the stars

Orbit

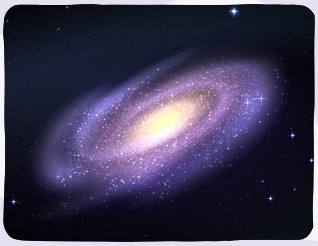


the path followed by an object revolving around another object, caused by gravity

INTRODUCTION TO SPACE

Objective

Help the children feel the wonder of the universe and understand the basic terminology of space science.



Preparation:

- ☐ Cut out the "Milky Way Fact Cards."

Activity Supplies:

- MILKY WAY® bar for each child (optional)
- Standard dice
- Planet Cards Set #1

☐ Opening Activity

In the Bible we read,

> "O Lord our Lord, how excellent is thy name in all the earth! . . . When I consider thy heavens, the work of thy fingers, the moon and the stars, which thou hast ordained" (Psalm 8:1, 3).

What things does this scripture teach us that God made? [the heavens, moon, and stars]

In this unit we are going to learn about our universe. The *universe* is all of space and everything in it: planetary systems, stars, galaxies, and more. These are all God's creations. God created all things, both small and large—from tiny ladybugs to massive stars.

1. **Have the children observe the photo included in this lesson titled "A Photograph Captured by the Hubble Space Telescope." Discuss the grandeur of God, who can create such majestic things. (You will use this photo again in the next lesson.)**
2. **Have the children observe the photo included in this lesson titled "Rose." Discuss the grandeur of God that is displayed in something as tiny as this spider inside the delicate, velvety, perfumed petals of a single rose.**

☐ Read to the Children

As we study about space in this unit, I hope we will feel the majesty of God, as is stated in Psalm 104:1:

> "O Lord my God, thou art very great; thou art clothed with honour and majesty."

☐ Science Wall: Vocabulary Word

Place the vocabulary card SOLAR SYSTEM on your science wall. Read and discuss the word and definition.

Solar System

Our ***solar system*** is the sun and all the planets, asteroids, moons, and other objects that revolve around it. Look at the illustration on the vocabulary card titled "Solar System" to answer these questions:

1. What is the center of the solar system? [the sun]
2. How many planets revolve around the sun, and what are their names? [There are eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.]

All the planets except for Mercury and Venus have at least one moon.

Science Journal

Have the children write SOLAR SYSTEM in their science journals and draw a picture of the solar system. Have older children write the definition.

Planet Cards Activity

Lay out the Planet Cards Set #1 and have the children practice putting them in order, starting with the closest planet to the sun. [Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune] You can use this mnemonic device to remember the order: My Very Enthusiastic Mother Just Served Us Noodles. (Each word represents the first letter of a planet's name.)

Science Wall: Vocabulary Word

Place the vocabulary card GALAXY on your science wall. Read and discuss the word and definition.

Galaxy

Scientists used to think that the universe was made of just one huge group of stars. In 1924 scientists realized that there were actually many large groups of stars in the universe. Each group became known as a galaxy.

A ***galaxy*** is a system of stars, gas, dust, and other matter held together by gravity. Scientists think there are billions of galaxies of all shapes and sizes in the universe.

Science Journal

Have younger children make an illustration of a GALAXY in their science journals. Have older children write the definition and illustrate it.

Science Wall: Vocabulary Word

Place the vocabulary card MILKY WAY on your science wall. Read and discuss the word and definition.

Milky Way

Read to the children: Earth's galaxy is known as the ***Milky Way***. Our solar system, made up of the sun and everything that orbits around it, including planets, moons, asteroids, comets, and meteoroids, is only a tiny part of the Milky Way.

The Milky Way Galaxy has a barred, spiral shape. It is also huge. Just how big is our galaxy? Imagine this: if you were to travel at the speed of light, 299,792 km per second (186,282 mi per second), it would take 100,000 years to travel across the galaxy.

Milky Way Facts Activity

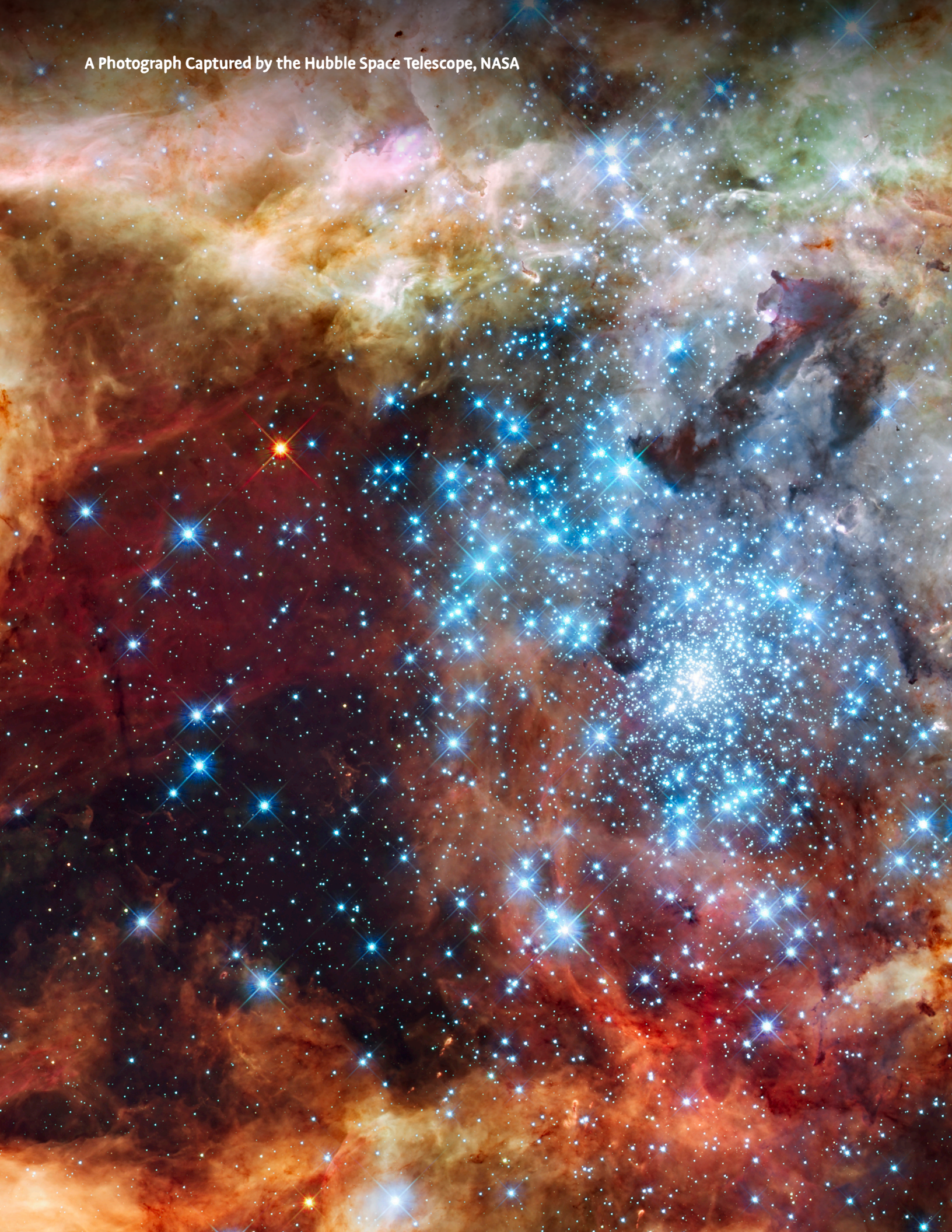
1. **Lay the cutout "Milky Way Fact Cards" on the table along with the "Milky Way Facts" page.**
2. **Have the children take turns rolling the dice, reading the fact on the matching number card, then placing the card on one of the spots (any of them) on the "Milky Way Facts" page.**
3. **If the child rolls a number that has already been completed, read the card with the asterisk (*) on it or review that number.**
4. **Optional: Give the children MILKY WAY® bars.**

Activity: It's Quiet Up There!

Read to the children: Let's imagine what it's like far, far up in space. **Have each child do something to make noise (sing, clap, bang a pot, etc.).** If you made that noise up in space, no one would be able to hear it. Noise cannot be made in space. Sound waves cannot travel without air or some other medium, and there is no air in space. It's quiet up there!

It's Dark Up There!

Read to the children: We can see the light that comes from the sun and the stars. They shine in space, so why is it dark in space? We can see light only when it hits an object and bounces off. God designed our planet to be bright because light bounces off tiny particles in our atmosphere. There are hardly any of those particles in space, so there isn't much for light to bounce off. When you imagined space before, what was it like? How do you think it would feel to be in outer space?



A Photograph Captured by the Hubble Space Telescope, NASA

EXTENSION

Instructions:

Lesson 3: With permission, use an app (such as SkyView® or Night Sky) or a reputable website to find out which stars are visible in your area during the current season. In your science journal, sketch two constellations visible in the night sky, label them, and write where to find them.

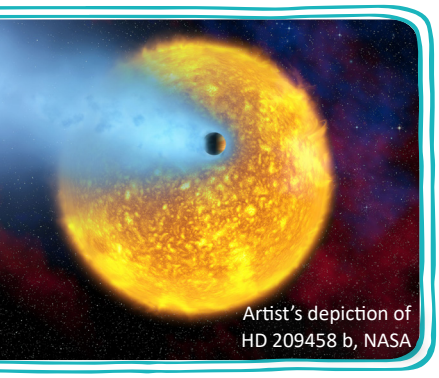
Lesson 4: Read the information below. In your science journal, write at least two characteristics of a "hot Jupiter" exoplanet. How does it differ from planets in our solar system?

Exoplanets: Planets Around Other Stars

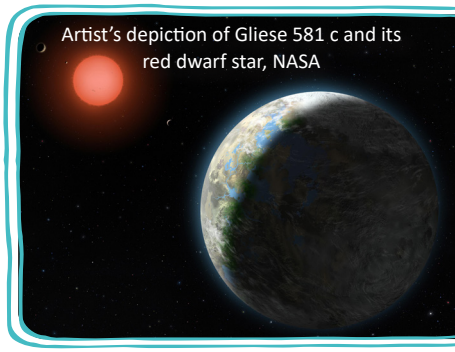
Astronomers have long wondered if our solar system is unique in the universe. Are other stars, like our sun, orbited by planets? Yes! Other stars are very far away, however, and detecting those planets, called ***exoplanets***, is difficult. (The Greek prefix *exo-* means "outside.") The first exoplanets were discovered in 1992. Those exoplanets astounded scientists because they were found orbiting the remnant of a dead star, called a ***pulsar***, rather than a sunlike star. Since that time thousands of other exoplanets have been discovered orbiting a variety of different types of stars, including stars much like our own sun.

When astronomers first started searching for exoplanets, they had expected to find planetary systems like ours. Instead, they discovered that many exoplanets are very different from anything found in our solar system. For example, exoplanets like HD 20782 b have extremely eccentric orbits—they are more stretched out than those of planets in our solar system. This means part of their orbit is very close to their sun, while the other part is far away from it. What do you think happens to the temperature on those planets as they travel around their orbits?

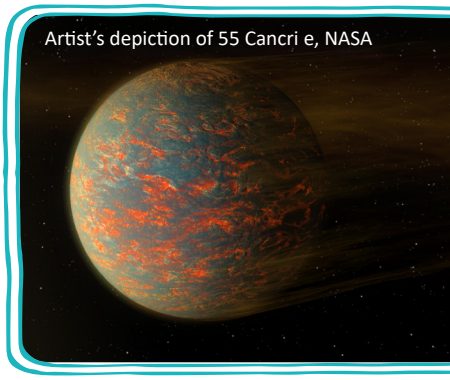
Some planets orbit much closer to their star than Mercury does to our sun. One exoplanet called HD 209458 b is so close to its sun that the planet itself is evaporating away, leaving a long comet-like tail behind it. This planet is made mostly of gas, like Jupiter, but it is much hotter. These so-called "hot Jupiters" came as a surprise to astronomers because their theories of how the solar system formed said that gas giants could not form that close to a star. As a result of this new discovery, scientists had to modify their theories. If HD 209458 b continues to lose gases into space, eventually its entire atmosphere will be blown away. All that will be left is a baked rocky core called a Chthonian [THON–ee–un] planet.


Artist's depiction of HD 209458 b, NASA

Similar to the planets in our solar system, exoplanets can be small rocky terrestrial planets or large gas giants. Some terrestrial planets are much smaller than Earth, while others are called "super-Earths" because they are so massive. These super-Earths have high gravity and are often covered by thick atmospheres. The largest ones have air that is so thick and dense that they are hard to distinguish from giant gaseous planets like Neptune. Other terrestrial planets are thought to be water worlds, their surfaces completely covered by ocean. It's difficult to say for sure which planets have liquid water on their surfaces because they are so far away, and the observations are prone to error. The planet Gliese 581c was once thought to be a water world, but later observations showed that it likely is not. Scientists are very interested in discovering liquid water on exoplanets because life as we know it relies on the existence of water.


Artist's depiction of Gliese 581 c and its red dwarf star, NASA

The exoplanet 55 Cancri e orbits so close to its sun that astronomers believe its surface may be covered with molten lava. Other exoplanets are freezing cold because they are too far from the warmth of their suns. The region around the sun-star where a planet receives enough heat for liquid water to exist on its surface is called the star's "habitable zone." A planet that lies within its star's habitable zone is sometimes called a Goldilocks planet because its temperature is just right. It's possible to have more than one exoplanet orbiting within its star's habitable zone.


Artist's depiction of 55 Cancri e, NASA

Could humans survive on the other planets? Scientists don't have enough information to answer that question yet, but they are fascinated by the possibility.

OUR SOLAR SYSTEM AND THE SUN

Objective

Help the children gain a general overview of and appreciation for the solar system, focusing on our sun.

Preparation:

- ☐ Assemble the mini book *The Sun*.
- ☐ Make a copy of the sheet titled "The Planets Envelope" for each child.
- ☐ Print FOUR COPIES of either the sheet titled "Planet Fact Cards for Older Children" or the sheet titled "Planet Fact Cards for Younger Children" for each child. *(Note: You can print the sheets on either regular copy paper or on cardstock.)*

Activity Supplies:

- 1 foam or paper cup for each child
- 1 blank sheet of paper for each child
- 1 pencil for each child
- 1 sheet of cardstock or construction paper for each child
- Planet Cards Set #1

☐ Read to the Children

If you look into the sky at night, what things might you see? You would see the moon, the stars, and other planets. The moon and the other planets do not glow or give off light; they simply reflect light from the sun. Planets can look like stars because of the light they reflect, but they are not stars.

What contains one star, eight major planets, over two hundred moons, hundreds of thousands of asteroids, and billions of comets? [It's our solar system.]

☐ Science Wall: Vocabulary Word

Review the card SOLAR SYSTEM, which you put on your science wall previously. Place the vocabulary card ORBIT on your science wall. Read and discuss the word and definition.

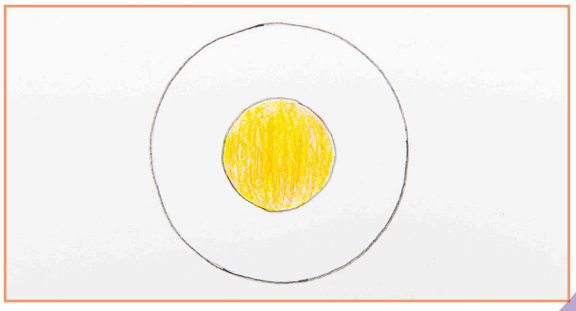
Orbit

Read to the children: Hundreds of years ago, most people believed the earth stood still and the sun, moon, and stars all orbited around the earth. A scientist named Copernicus was the first man to promote the idea that the sun is in the center of a system of planets that orbit around the sun. He was right! The path followed by an object, such as a planet, revolving around another object, such as a sun, caused by gravity, is called an ***orbit***.

☐ Elliptical Orbits Activity

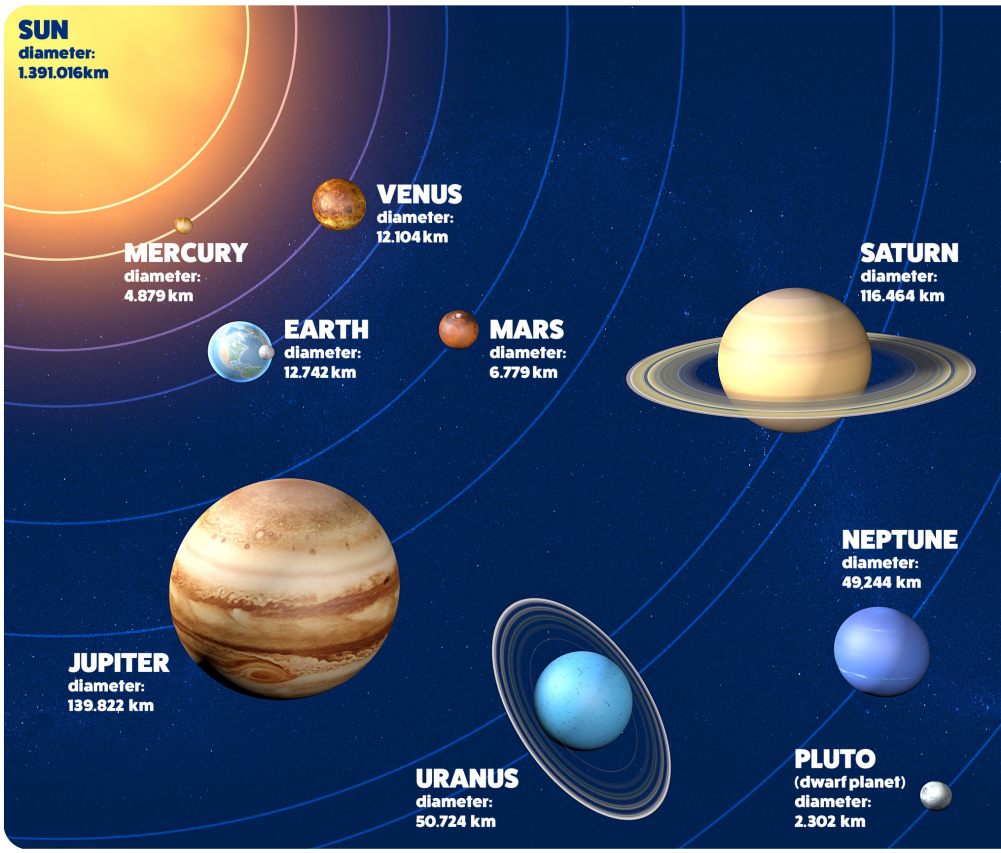
Read to the children: Copernicus believed the planets moved around the sun in a circle. Let's draw an example:

1. Draw a small sun about the size of a quarter in the middle of your paper.
2. Place a foam or paper cup upside down on the paper, with the sun underneath in the middle, and trace around its edge to make a circle around the sun.



It must also be massive enough for its own gravity to make it nearly round and capable of "clearing the neighborhood" of smaller objects around its orbit. That means it has the gravitational power to move objects out of its orbital path. That last rule is why asteroids and moons cannot be called planets.

Let's review the names of the eight planets.



❑ Planet Cards Activity

Lay out the Planet Cards Set #1 and have the children put them in order, starting with the closest planet to the sun [Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune]. Review the mnemonic device to help them remember the order of planets: My Very Enthusiastic Mother Just Served Us Noodles.

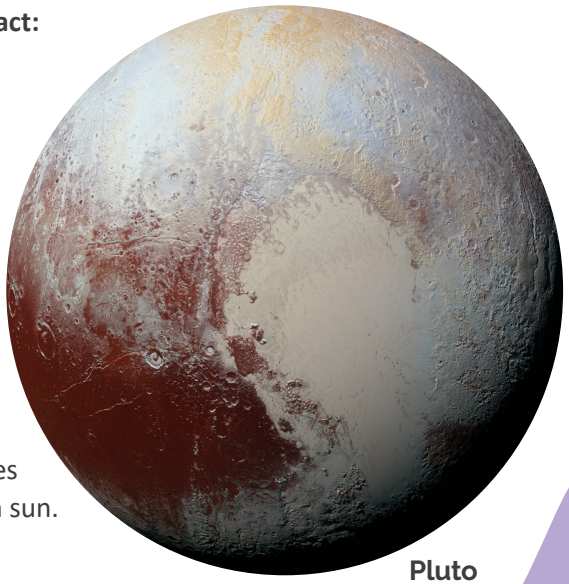
Why do you think the planets orbit the sun? The sun is the center of the solar system because of its high mass. *Mass* is a measurement of how much matter is in an object. The sun contains 99.8% of the mass of all the objects in the solar system.

All objects exert gravitational force on all other objects. The earth is more massive than we are, so when we jump in the air, the earth's gravity causes us to be pulled back toward the surface. Similarly, the sun is so much more massive than the planets that its gravity pulls the planets toward it and causes them to move in orbit around it. Gravitational pull is why the planets, asteroids, and comets all orbit the sun.

Why do you think gravity doesn't pull the planets into the sun as we are pulled to the ground? [Though gravity pulls objects to the center, planets also have a forward motion, so they continue to orbit rather than crash into the sun.]

Some celestial bodies orbiting the sun have been classified as planets for a time but have later been reclassified as dwarf planets. Such was the case with Pluto. Discovered in 1930, Pluto was initially classified as a regular planet. However, it is estimated to have only 1/6 the mass of Earth and is only half as wide as the United States. Later, other celestial bodies in the Kuiper Belt (the region beyond Neptune where Pluto orbits) were discovered to be more massive than Pluto. In 2006, it was determined that Pluto fell into the category of a "dwarf planet," and it was no longer considered one of the main planets of our solar system.

Interesting Fact: Since the early 1990s, astronomers have discovered other planetary systems with planets orbiting stars like Earth does with our own sun.

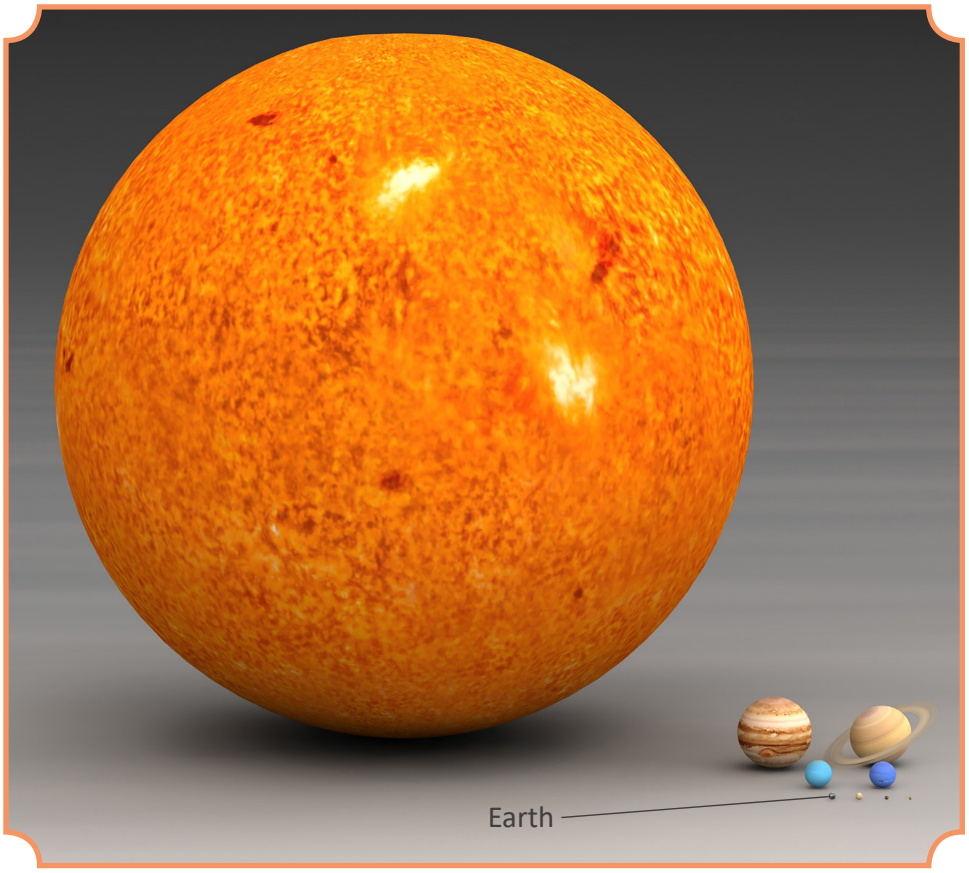


Pluto

The Sun

You see the sun every day, but have you ever really thought about what a blessing it is? As we read this book, we will not only learn interesting facts about the sun but we will also learn how much God has blessed us by creating the sun.

The sun is an enormous ball of scorching hot, burning gas. It is the nearest star to Earth and is by far the largest object in our solar system. You could fit 1.3 million Earths in the sun.

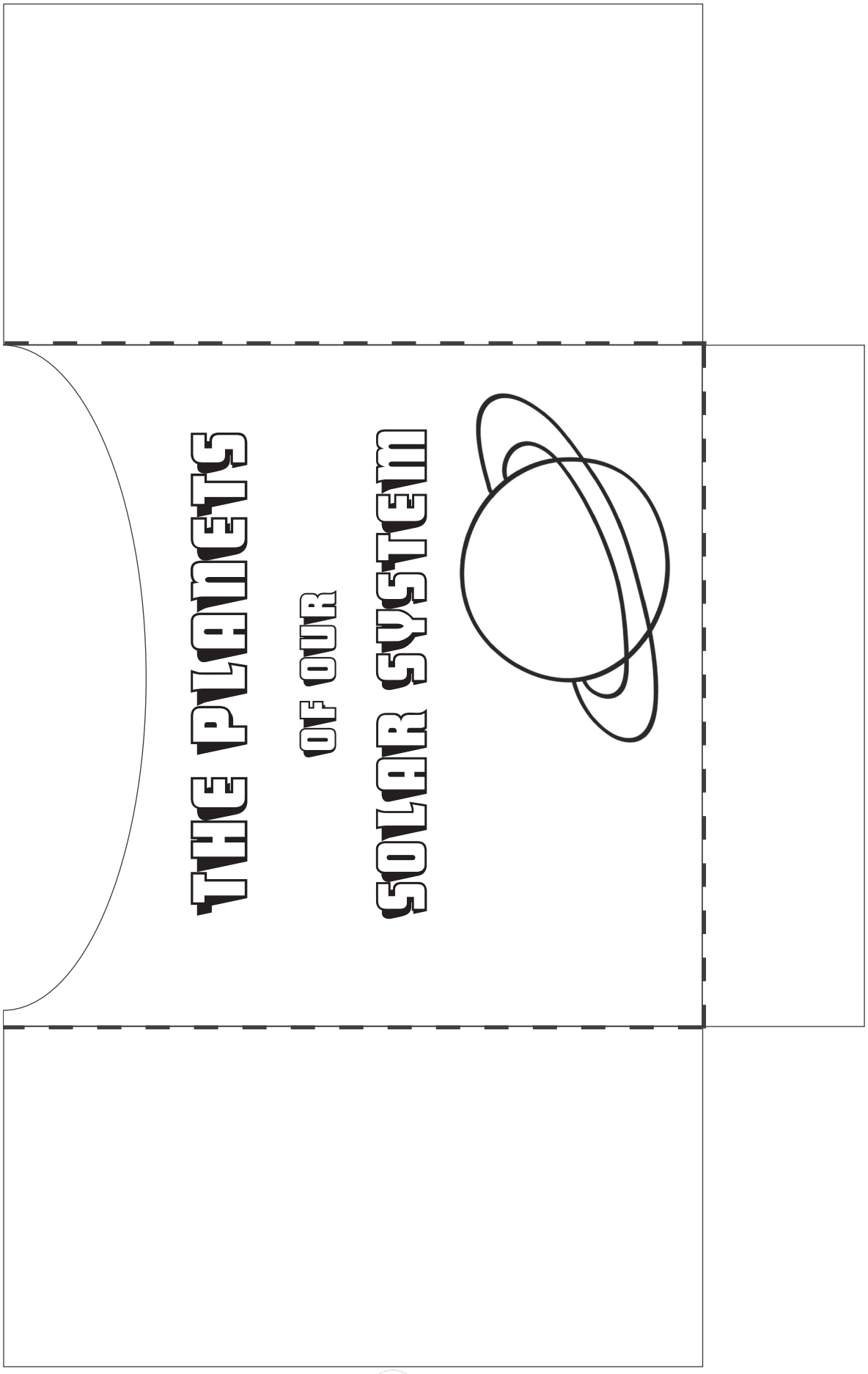


Planets and sun size comparison

If you were in the scene shown on this page, it may look as if the sun were rising from behind the mountain. The sun does not actually rise and set each day. In fact, the sun is not moving. Instead, the earth spins on its axis in a circle every 24 hours, making it look as if the sun rises and sets.

"Landscape with a Ferryman" by Adolf Chwala (1836–1900), unknown

Not only does the sun bring light, heat, and energy to our world but it also brings beauty. For example, look at the beauty of sunlight that is portrayed in this painting. As you go about life, try to recognize and feel grateful for the blessings of the sun as you feel its warmth and see its beauty.



Planet Name

Illustration of Planet

Facts

Ordinal position from the sun: _____

Number of known moons: _____

Size compared to Earth: _____

Time to orbit the sun: _____

Length of day/time to complete a rotation: _____

Unique physical features:

Interesting facts:

Planet Name

Illustration of Planet

Facts

Ordinal position from the sun: _____

Number of known moons: _____

Size compared to Earth: _____

Time to orbit the sun: _____

Length of day/time to complete a rotation: _____

Unique physical features:

Interesting facts:

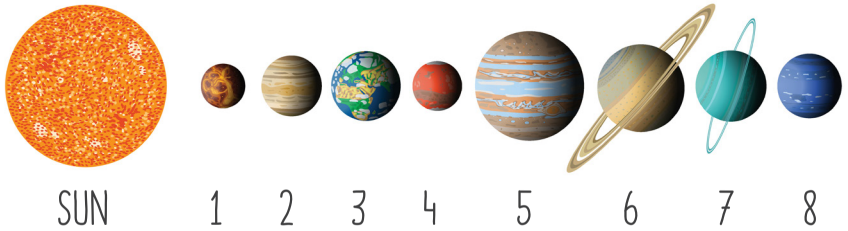
Planet Name

Illustration of Planet

Facts

Circle the best answer:

What ordinal position is it from the sun?



Is it BIGGER or SMALLER than Earth?

Is it HOTTER or COLDER than Earth?

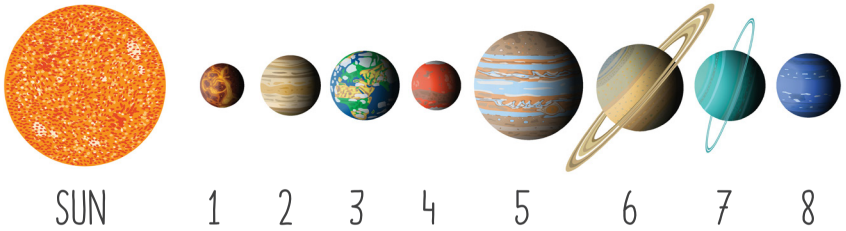
Planet Name

Illustration of Planet

Facts

Circle the best answer:

What ordinal position is it from the sun?



Is it BIGGER or SMALLER than Earth?

Is it HOTTER or COLDER than Earth?

Mercury AND Venus

PLANET: Mercury

NAMED FOR: Roman god of travel—travels quickly across the sky

ORDINAL POSITION FROM THE SUN: first

NUMBER OF KNOWN MOONS: none

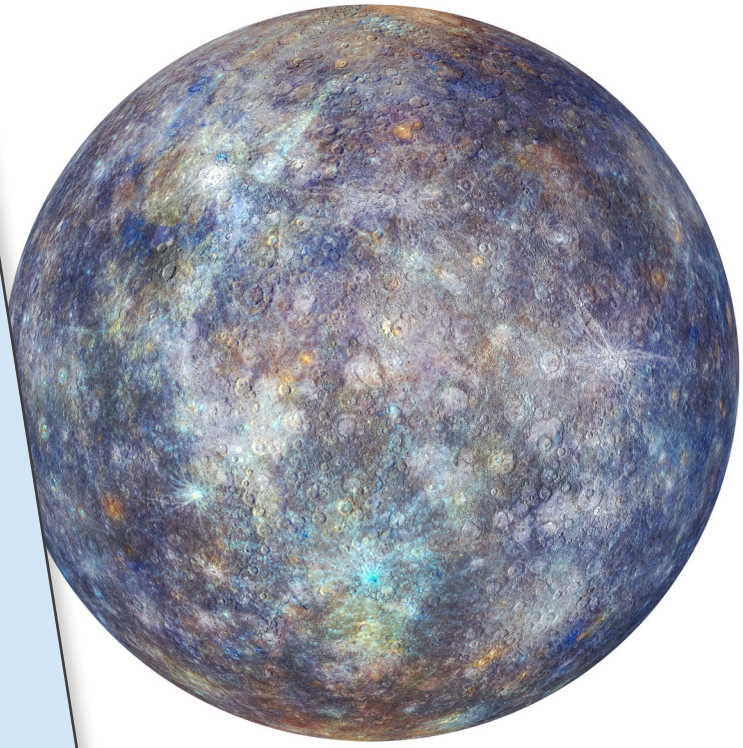
SIZE COMPARED TO EARTH: two-fifths of the earth; the smallest planet

LENGTH OF YEAR/TIME TO ORBIT SUN: 88 days

LENGTH OF DAY/TIME TO COMPLETE A ROTATION ON ITS AXIS: 58 days

UNIQUE PHYSICAL FEATURE: heavily cratered surface

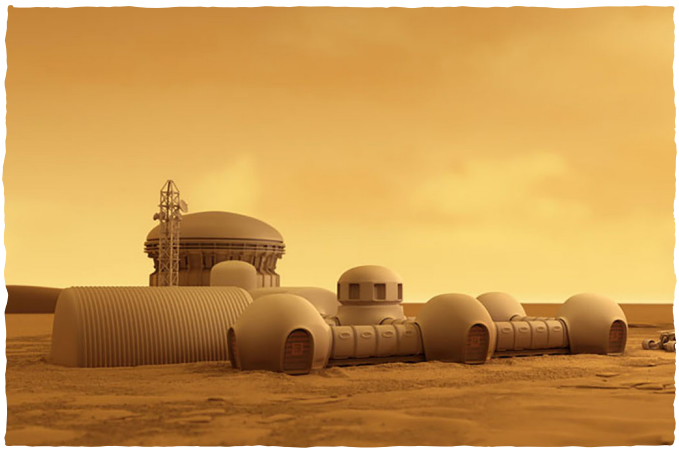
INTERESTING FACTS: greatest temperature variation; almost no atmosphere



❑ Planets Envelope & Fact Cards

Have the children complete Planet Fact Cards for Earth and Mars, using the information from the mini book *Earth and Mars*. (These are the cards that were included in Lesson 4 and go in the envelope titled "The Planets of Our Solar System." The other cards will be completed in future lessons.)

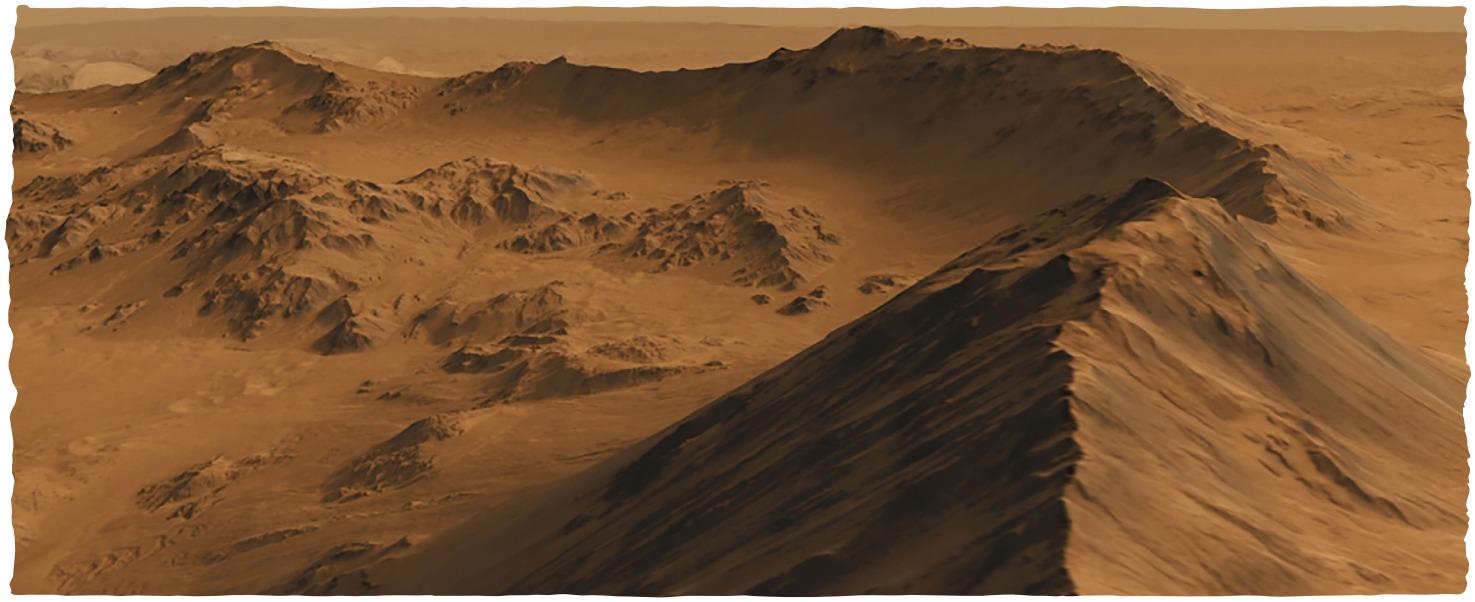
Optional: Listen to the "Mars" movement from *The Planets* by Gustav Holst while the children work on their cards. You might hear some sections that remind you of famous music from movie soundtracks. Composer John Williams, who wrote the music for *Star Wars*, says that he drew inspiration for his score from this movement by Gustav Holst.



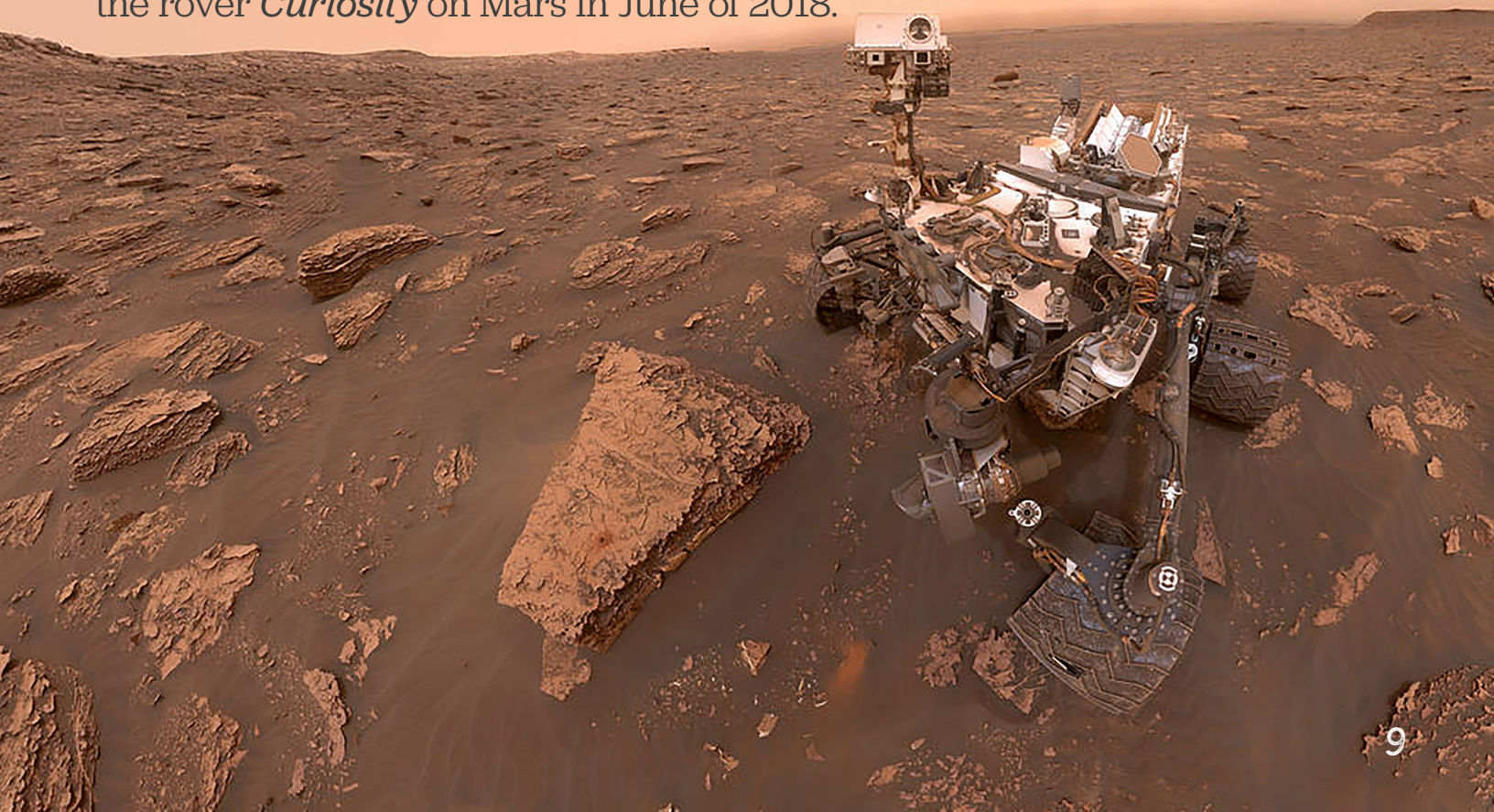
"CHALLENGES OF LIVING ON MARS" WORD STRIPS

No Food or Water	Low Oxygen
Cold Temperatures	Meteorites
Thin Atmosphere	Far from Earth

Evidence gathered from several missions to Mars has led scientists to believe that the atmosphere on Mars used to be much denser than it is now and that water likely existed on the surface. In fact, it is believed that water is still there—it is just trapped underground and frozen. Mars is typically dusty and windy, but particularly so when Mars is closest to the sun and large dust storms ensue that sometimes encompass the entire planet!



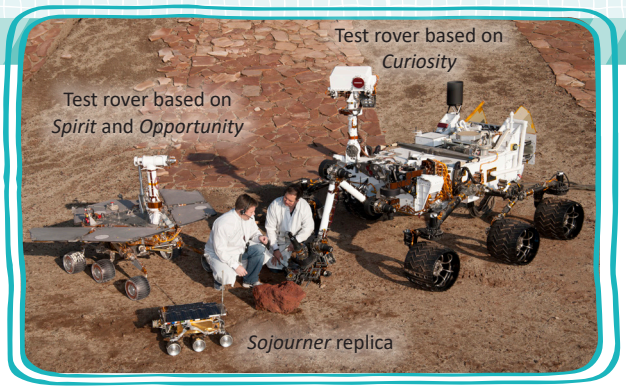
Mars has been explored since 1965. There are often rovers on the surface and international missions orbiting the red planet. This image is a "selfie" taken by the rover *Curiosity* on Mars in June of 2018.



EXTENSION

Instructions:

1. Read the information below.
2. NASA likes to give its rovers fanciful names like *Spirit* and *Opportunity* in order to give people a sense of wonder about the probes. Why do you think they do this? With that in mind, come up with your own name for the next rover to go to Mars. In your journal, briefly explain why you chose that name.



Our Favorite Martians

Ever since astronomers in the 1800s thought they saw canals on Mars, people have been fascinated with learning about the surface of the red planet. The astronomers were incorrect, of course, and there are no canals on Mars. But what is the surface really like, then?

1962 From the 1960s to 1970s, NASA sent several *Mariner* probes to fly by Mars and send back pictures and other data. The last of them, *Mariner 9*, became the first space probe to orbit Mars. These probes gathered information about the planet and allowed scientists to take the next step: landing on Mars.

1976 A spacecraft called *Viking 1* became the first probe to land successfully on Mars and send pictures from the surface. *Viking 2* followed the next year. These landers were stationary, meaning they were unable to move from their positions, but they still managed to make plenty of discoveries. They found a cold world with an atmosphere made of carbon dioxide. They took soil samples and analyzed them for signs of life. But perhaps most intriguingly, they saw signs that Mars once had liquid water on its surface.

1997 Landers like the *Viking* probes were limited to exploring only the places where they touched down, but scientists really wanted to explore the planet with rovers, which are robotic vehicles that can drive around and explore large areas. The first rover landed in 1997 with the *Pathfinder* lander. The *Pathfinder* mission included a rover called *Sojourner* that drove around the landing site and sent back a tremendous amount of data about the surface conditions. *Sojourner* operated for 83 (Mars) days and wandered no more than 12 m (40 ft) from the landing site. The panoramic pictures it sent back from Mars caught the public's attention. People were excited about little *Sojourner*'s adventures on Mars!

2003 NASA sent a pair of rovers, *Spirit* and *Opportunity*, to explore the surface of Mars. The rovers, which landed in 2004, were designed to explore much larger areas than *Sojourner*. These rovers wandered over several kilometers of the Martian landscape and once again captured the public's imagination. People enjoyed thinking about the rovers as though they had their own personalities. When *Opportunity*'s battery was almost dead, it sent back a final message about its condition that people interpreted as, "My battery is low and it's getting dark." The probe was a simple machine, of course, and not capable of poetic thoughts, but people enjoyed personifying it. The two spacecrafts provided a wealth of information about Mars. Perhaps the most important discovery is that Mars was once a wet planet that could have supported life.

2012 A more advanced rover called *Curiosity* landed on Mars. *Curiosity* was much larger than the previous rovers and required NASA scientists to develop a specialized landing apparatus called a sky crane in order to land it safely. Designed with a wide array of scientific instruments, *Curiosity*'s mission was to determine if Mars might have had microbial life at one time. Although the rover was intended to last only two years, as of 2020, *Curiosity* was still actively exploring Mars. These vehicles are designed with durability in mind since there are no garages to do repairs on Mars! *Curiosity* is extremely heavy and has features that help it avoid getting stuck or tipping over. Whenever a rover wears out, it remains with its fellow probes on Mars.

Did you know?

More missions to Mars are constantly being planned. When you read this, there may well be more rovers rolling around on the red planet.

THE PHASES OF THE MOON

Objective

Help the children gain a general overview of and appreciation for Earth's moon and its phases.

Preparation:

- ☐ Make a copy of the sheet titled "Moon Phases" for each child.

Activity Supplies:

- 8 OREO® cookies or generic brand chocolate cookies with white cream filling for each child (or substitute black and white play dough) (optional)

☐ Moons Video Activity

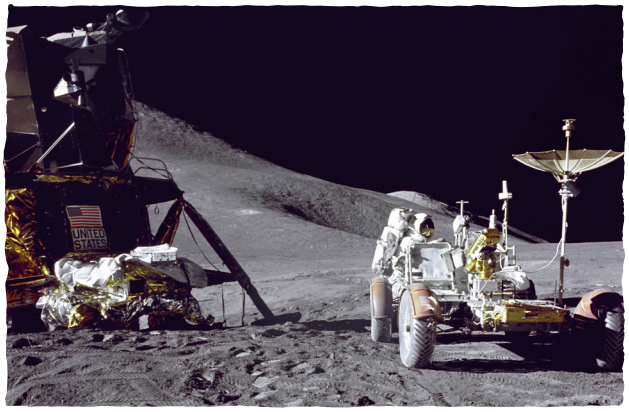
Read to the children: A *moon* is a celestial body that makes an orbit around a planet. As we have learned, not all planets have a moon. Which two planets in our solar system do not have a moon? [Mercury and Venus] Earth has one moon, and Mars has two. But the planets beyond the main asteroid belt have many moons. Both Jupiter and Saturn have more than 70 moons, with new ones still being discovered. The ice giants, Uranus and Neptune, have more than 10 moons each. Overall, there are hundreds of moons in our solar system. There are even some asteroids that have moons! What do you think it would be like to have more than one moon orbiting Earth?

WATCH ONLINE

Watch the video titled "The Moon" at goodandbeautiful.com/sciencevideos.

Let's discover more about Earth's moon.

- Whenever we see the moon, it most often appears to be shining like a big white or yellow light in the sky, but sometimes it appears red. The moon does not make its own light—it reflects the light from the sun. The earth reflects sunlight too. You can see this when looking at the crescent moon. The dark part of the moon is visible with a very slight glow. The glow comes from Earth's reflected light.



- Earth's moon is the fifth-largest moon in our solar system.
- The moon's surface is covered with a thin layer of dust. Because there is no atmosphere on the moon, the moon does not have any weather. There is no wind or rain. This means that the footprints left by astronauts years ago will stay unchanged.
- Astronauts first visited the moon in 1969 on NASA's *Apollo 11* mission. Neil Armstrong was the first person to set foot on the moon.
- Only one side of the moon is visible from Earth because the moon rotates around its axis at the same rate that it orbits the earth.
- The moon is full of craters. These craters were made when asteroids and meteorites hit the moon.

MOON PHASES

EXTENSION

Instructions:

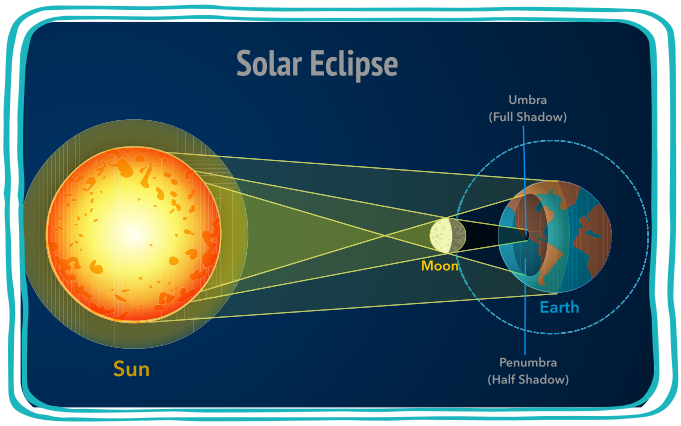
Lesson 7: Read the information below. With permission from a parent, go to **www.timeanddate.com/eclipse** to find out when the next lunar or solar eclipses will occur in your area. Write down the dates in your journal. How old will you be when the next solar eclipse occurs in your country?

Lesson 8: Follow the instructions on the next page to complete the activity. In your journal, discuss the results of your experiment. How does the activity show what is happening during a solar eclipse and a lunar eclipse? Why can you see a lunar eclipse more often than a solar eclipse?

Solar Eclipses

A solar eclipse is an exciting, dramatic event. In the middle of the day the sky goes dark, temperatures drop, and winds slow down and change direction. Some stars might even be visible! At its height the sun's disk is completely blocked out, allowing you to see the glowing ***corona*** (Latin for "crown") surrounding it. What causes this spectacular display of nature?

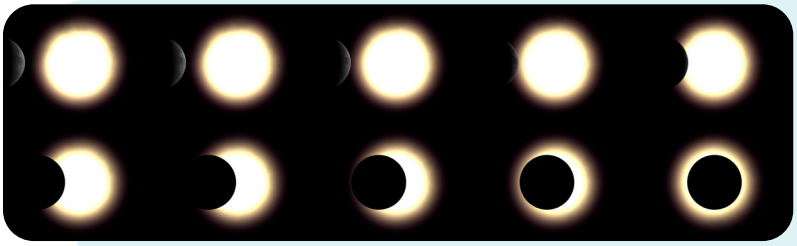
As the moon orbits the earth, it occasionally passes directly between the sun and the earth. When that happens, the moon's shadow falls on the surface of the earth. Since the moon is much smaller than the earth, the shadow covers only a small region. As the shadow passes across the earth, people on the surface see the moon passing in front of the sun. This is a ***solar eclipse***.



If you were watching the event happen, first you'd see the moon's shadow taking a tiny bite out of the edge of the sun. Then, as the moon advances, more and more of the sun vanishes until you're left with a crescent sun. Daylight becomes dimmer and dimmer as the amount of sunlight diminishes. But be careful! Even though much of the sun is covered, even a small sliver of the sun is bright enough to damage your eyes if you look at it. You should never look at an eclipse directly; it's just as dangerous as looking at the sun any other time. Finally, when the moon's shadow completely covers the sun, you have a total solar eclipse.

The moon's shadow has two components, the dark ***umbra*** and the lighter ***penumbra*** surrounding it. Within the umbra

the eclipse is total; that is, the moon completely covers the sun. Within the penumbra the eclipse is partial, meaning that it never reaches totality. Did you ever notice that the sun and the moon appear to be roughly the same size in the sky? The moon is really much smaller than the sun, of course, but it is much closer. It's an amazing fact of nature that the moon is just the right distance away to appear around the same size as the sun in the sky, which allows beautiful solar eclipses to happen. If the moon were farther away, it would appear smaller and never completely block out the sun. Since the moon's orbit is an ellipse rather than a perfect circle, sometimes it is a little farther away than normal and thus appears a bit smaller during an eclipse. At these times a ring of sunlight is visible around the moon's shadow. These are called ***annular eclipses***.



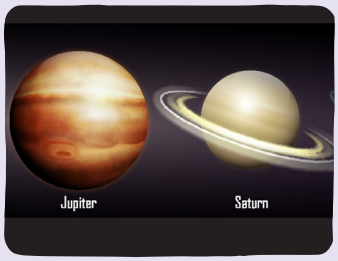
Lunar Eclipses

When the moon passes behind the earth, Earth's shadow falls on its surface, making it dark. This is a ***lunar eclipse***. Since the earth is bigger than the moon, its shadow covers the entire lunar surface. As you watch, you'll see an edge of the full moon go dark. As the earth's shadow advances, more

THE GAS GIANTS: JUPITER AND SATURN

Objective

Give the children an overview of the Jovian planets and an opportunity to explore Jupiter and Saturn.



Preparation:

- ☐ Assemble the mini book *Jupiter and Saturn*.

Activity Supplies:

- Planet Cards Set #2
- ½ c milk (any kind)
- Red and yellow food coloring
- Dish soap
- Small bowl

☐ Matching Activity

Lay out the Planet Cards Set #2 and have the children practice matching the names to the images. Optionally, turn the cards facedown and play a memory game. When you finish, show Jupiter, Saturn, Uranus, and Neptune to the children.

Read to the children: Jupiter, Saturn, Uranus, and Neptune are sometimes called the *gas giants* because they are mostly made of gas, and they are massive in size compared to the other four planets. These four planets farthest from the sun account for 99% of the total mass of all celestial bodies that orbit the sun. Jupiter, Saturn, Uranus, and Neptune are also known as the outer planets because they lie outside the asteroid belt.

☐ Mini Book

Read the mini book *Jupiter and Saturn* included in this lesson.

☐ Planets Envelope & Fact Cards

Have the children complete Planet Fact Cards for Jupiter and Saturn using the information from the mini book *Jupiter and Saturn*.

Optional: While the children fill out their Planet Fact Cards, have them listen to the "Jupiter" and "Saturn" movements from Gustav Holst's *The Planets*.

☐ Jupiter Storm Activity

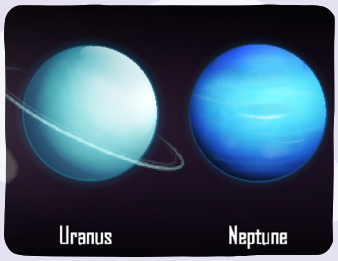
This activity can be done as a group, or each child can do the activity individually.

1. Pour ½ cup milk into a small bowl.
2. Add one drop of yellow food coloring and one drop of red food coloring.
3. Put a drop of dish soap in the middle of each color.
4. Pick up the bowl and gently swirl it around a few times, and you have something that looks like a storm on Jupiter!

THE GAS GIANTS: URANUS AND NEPTUNE

Objective

Give the children an opportunity to explore Uranus and Neptune.



Preparation:

- ☐ Assemble the mini book *Uranus and Neptune*.
- ☐ Make a copy of the sheet titled "Neptune's Moon Triton" for each child.

Activity Supplies:

- 64 dried beans (any kind)
- Red, blue, and green food coloring
- 2 c shaving cream (foam, not gel)
- 1 c white glue

☐ Opening Activity

Read to the children: Do you remember the names of the planets that are farthest from the sun? [Uranus and Neptune] To get an idea of how large these gas giants are, let's do an activity.

1. **Place one dried bean on the table. Tell the children it represents Earth.**
2. **Have the children use 58 beans to create another circle as shown here:**

3. **Compare the single bean, which represents Earth, to the circle made with 58 beans, which represents Neptune. Explain that if Neptune were hollow, nearly 58 Earths would fit inside of Neptune. This gives us an idea of how large Neptune is compared to Earth.**
4. **Add five more beans to your circle, for a total of 63 beans. Explain to the children that if Uranus were hollow, 63 Earths would fit inside of it. This gives us an idea of how large Uranus is compared to Earth and Neptune.**

☐ Mini Book

Read the mini book *Uranus and Neptune* included in this lesson.

☐ Planets Envelope & Fact Cards

Have the children complete Planet Fact Cards for Uranus and Neptune, using the information from the mini book *Uranus and Neptune*.

Optional: Listen to the "Uranus" and "Neptune" movements from Gustav Holst's *The Planets* while the children fill out their Planet Fact Cards. The movement for Neptune is very soft and mysterious sounding to reflect how distant and unknown Neptune was at the time the piece was composed in 1915.

THE HISTORY OF ASTRONOMY

Objective

Help the children understand how the ideas of astronomy have developed throughout history and learn about the influence of key astronomers.

Preparation:

- ☐ Assemble the mini book *Once Upon a Starry Night: The Story of Astronomy.*
- ☐ Make a copy of the "History of Astronomy Timeline" for each child.
- ☐ Make a copy of the sheet titled "Space Vocabulary Bingo" for each child.

Activity Supplies:

- Plastic sheet protector for each child (optional)
- Dry erase marker for each child (optional)
- An orange or other similar-sized piece of fruit or small ball
- Planet Cards Set #2

☐ Science Wall: Vocabulary Word

Place the vocabulary card ASTRONOMY on your science wall. Read and discuss the word and definition.

Astronomy

☐ Read to the Children

We live in a time with amazing technology that allows us not only to see deep into space but also to send probes to the far reaches of our universe to collect information. For most of history, it has not been this easy to study astronomy. Let's go back in time to learn how early astronomers viewed the universe and see how it was different from what we know and do now.

☐ Mini Book

Read the mini book *Once Upon a Starry Night: The Story of Astronomy* included in this lesson.

☐ Space Vocabulary Bingo Optional Review Activity

Play the Space Vocabulary Bingo review game while sitting in front of your Science Wall.

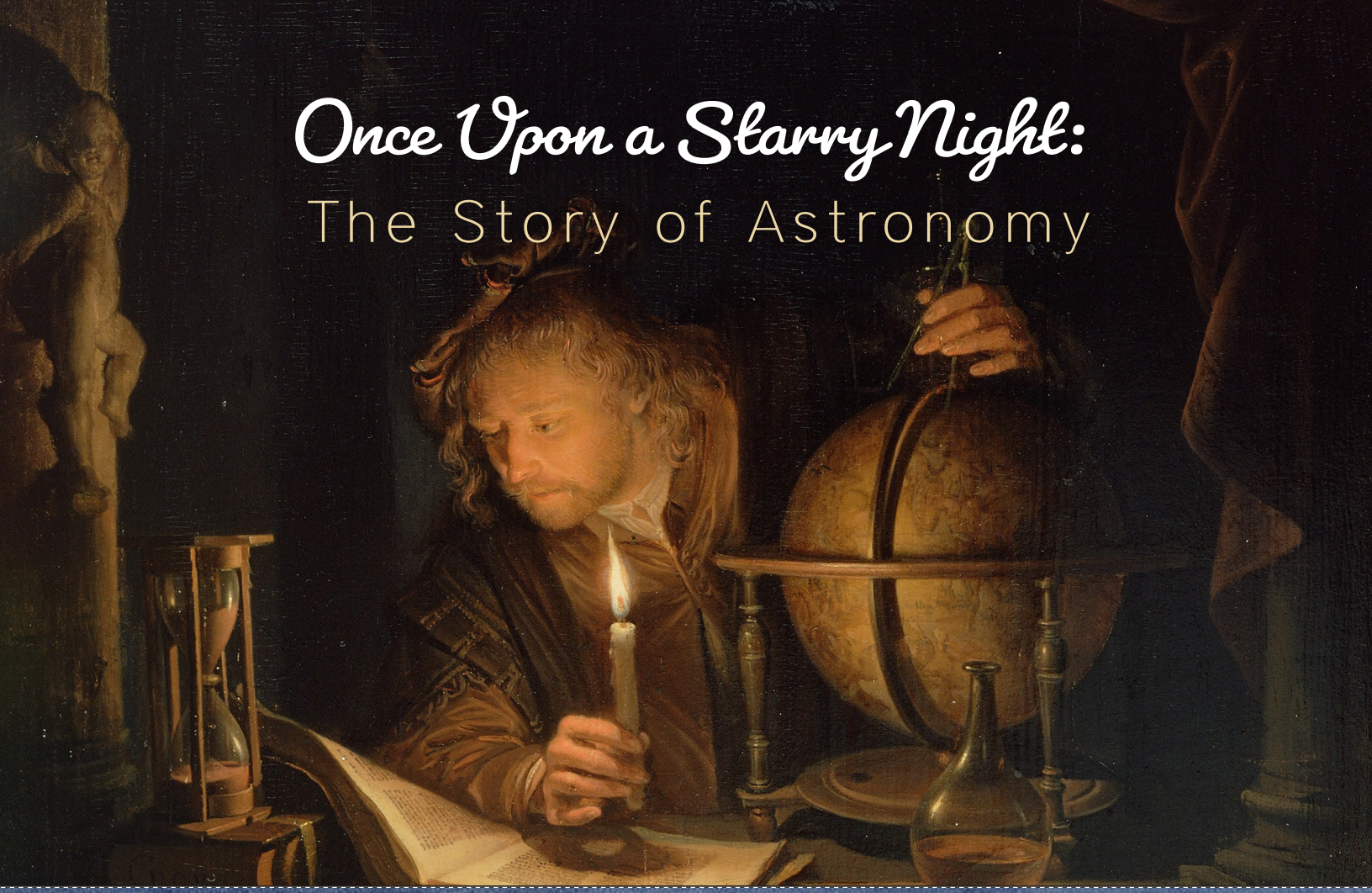
1. Give each child a copy of the sheet titled "Space Vocabulary Bingo." Have the children write in each square of his or her BINGO card a different vocabulary word from this unit.
2. Place each "Space Vocabulary Bingo" sheet into a clear plastic sheet protector. With a dry-erase marker, have the children place an "X" in each of the "Free" squares on the Bingo card.
3. Begin calling out the definitions for vocabulary words from your Science Wall in random order. Between each definition pause for long enough to allow the children to find the matching vocabulary word and mark the square with an "X." Assist the children with finding the answer when needed.
4. Have the first child to create a horizontal, vertical, or diagonal row of five "X"s call out "Space!" He or she is the winner.

SPACE VOCABULARY BINGO

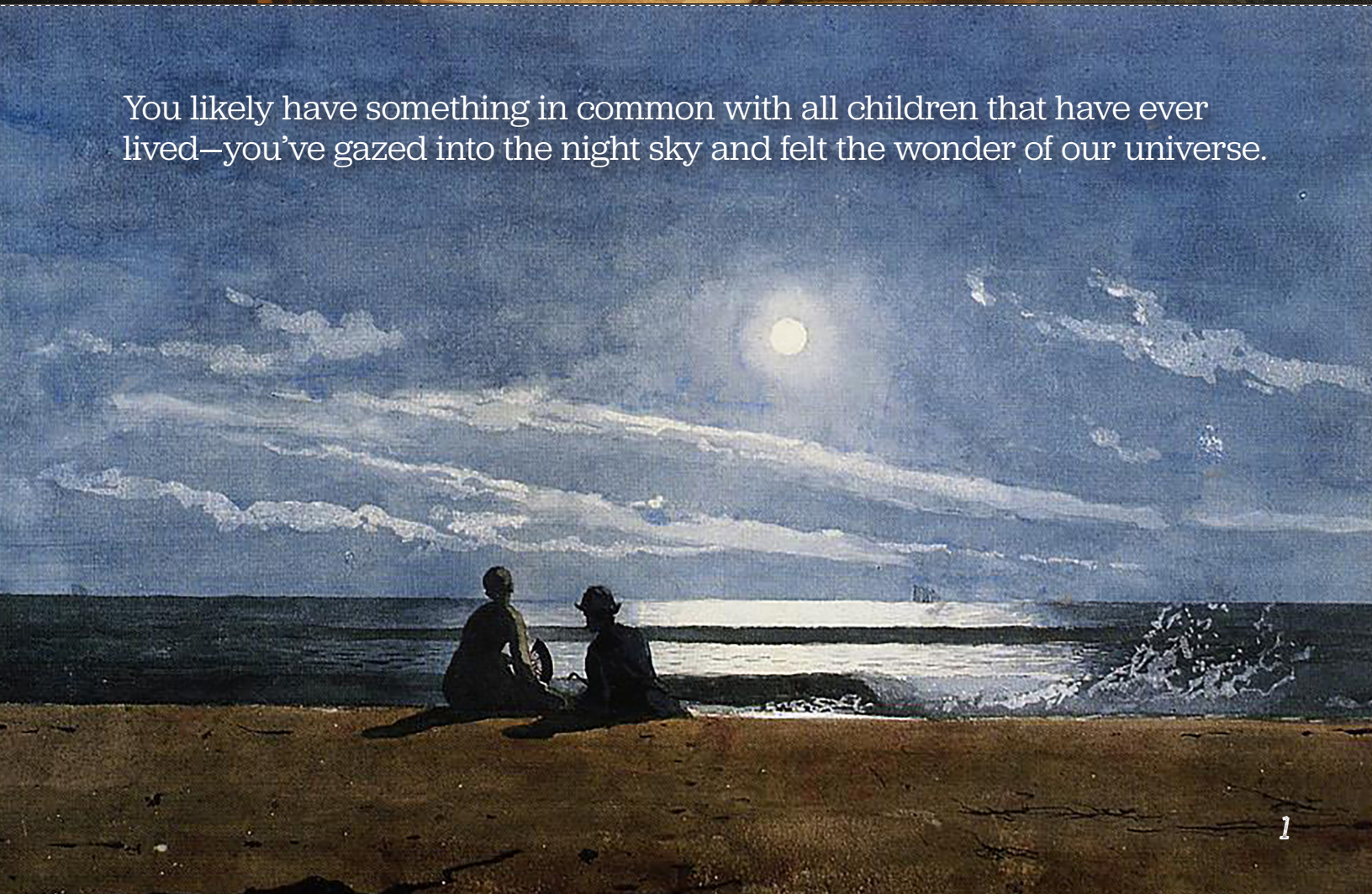
S	P	A	C	E
FREE			FREE	
		FREE		

S	P	A	C	E
FREE				
		FREE		
				FREE

Once Upon a Starry Night:
The Story of Astronomy



You likely have something in common with all children that have ever lived—you've gazed into the night sky and felt the wonder of our universe.



EXTENSION

Instructions:

1. Read the information below.
2. In your science journal, write 1–2 sentences about each of the following prompts:
   a. Describe some of the life challenges that Henrietta Swan Leavitt had to overcome.
   b. How did Henrietta Swan Leavitt's discoveries impact the study of astronomy?
   c. What inspired you the most about Henrietta Swan Leavitt?

Astronomer Henrietta Swan Leavitt

Have you ever heard of someone being called a forerunner? A forerunner is a person who precedes or leads the way for someone else. Henrietta Swan Leavitt was certainly a forerunner in astronomy: her discoveries influenced the work of famous astronomers who came after her. Despite humble beginnings, prejudices against women, and multiple health challenges, Henrietta Swan Leavitt beat the odds to make far-reaching contributions to astronomy.

Born on July 4, 1868, in Lancaster, Massachusetts, Henrietta was the eldest of seven children. Due to her father's work as a minister, her family moved regularly. One of those moves took them to Cleveland, Ohio, where Henrietta attended Oberlin College, beginning at age 17. During her early college years, Henrietta studied music, which she enjoyed, but she had not yet found a subject of study that fully captured her interest.

After her third year of study, the Leavitt family moved back to Massachusetts, where Henrietta hoped to continue her education. However, Harvard University did not admit women at that time. Instead, Henrietta enrolled at the Harvard Annex (later called Radcliffe College). There she shifted her studies to mathematics and, during her final year, stumbled into the field of astronomy. Instantly, she was fascinated by the vastness of space and the limitless discoveries to be made.

Upon graduating at age 23, Leavitt volunteered as a research assistant at Harvard's observatory. As one of the human computers at the observatory, Leavitt measured and cataloged the brightness of stars as they appeared on photographic plates. But Leavitt's aspirations of becoming an astronomer soon came to a halt when ongoing health problems confined her to home for two years. As her illness advanced, she became aware of a horrifying side effect: she was losing her hearing! Over a short period of time, Leavitt became increasingly deaf. At first the realization weighed heavily on her heart, but taking courage and placing her faith in God, Henrietta Swan Leavitt pressed forward toward her goal.

In 1902, with her health finally improving, Leavitt returned to the Harvard College Observatory, this time as an employee. Variable stars remained her central focus. Leavitt worked diligently to discover the relationship between the overall brightness of stars and the time it took them to change from bright to dim and back again (called a ***pulse rate***).

After carefully observing these ***Cepheid variable stars***, she made her breakthrough discovery: the brightness of these stars was directly related to pulse rate! Brighter stars have longer pulse rates, while dimmer stars have shorter pulse rates. Why was this so important? It provided a standard for measuring distances outside our solar system and determining a galaxy's size. She established 17 magnitudes of brightness that were used for decades to order stars by their brightness.

Additionally, Leavitt's discovery advanced the work of other astronomers, such as Harlow Shapley, who proved that our sun was not at the center of the galaxy. Astronomer Edwin Hubble also relied on the ***Leavitt law***, as it came to be known, to establish his theory that the universe is expanding. And when Hubble found Cepheid stars in other galaxies, Leavitt's law helped prove that galaxies existed outside the Milky Way and that our galaxy was not the center of the universe.

Henrietta Swan Leavitt's work was so pivotal to the field of astronomy that she was nominated for a Nobel Prize in 1926. Sadly, she could not win because the prize cannot be awarded posthumously (after a person dies). After years of ill health, Leavitt had succumbed to stomach cancer in December of 1921 at the age of 53. Despite significant social and health-related challenges, Henrietta Leavitt retained a positive attitude and made invaluable discoveries in astronomy. As a forerunner to the many great scientists who built upon her discoveries, she truly paved the way for those who came after her.

Pendulums Activity

With the children, create a pendulum to demonstrate what Galileo observed.

1. Place a large ball inside a plastic bag and tie the handles together in as tight a knot as possible.

2. Tie one end of the rope through the handles and throw the other end of the rope over a bar or tree branch. (Any place where the rope can hang and the ball can swing back and forth will work.) Tie off the rope securely.

3. Pull the ball pendulum out to one side and let it go. Watch it swing back and forth.

Read to the Children

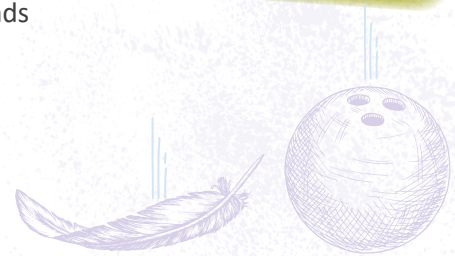
A Test on a Tower: The father of Galileo hoped that his son would become a physician. However, the young man liked to study mathematics, and his father permitted him to follow his interests.

When not quite 25, Galileo was made a professor of physics. He taught his classes about pumps and machinery, why smoke rises in the air, why birds' wings enable them to fly, and why fish's fins send them through the water.

Nobody in Europe at that time knew much about such matters. People knew very little about such things as gravity. Even learned men thought that two pounds of lead would fall twice as fast as one pound, one hundred pounds one hundred times as fast, and so on.


Leaning Tower of Pisa

One day Galileo asked some of his friends to climb the Leaning Tower of Pisa with him. This tall tower is one of the famous buildings of Europe. The odd thing about it is that it does not stand up straight like the tower or spire of a church but leans over, as some trees do.



Some of Galileo's friends stayed at the foot of the tower; some went to the top. They carried heavy and light things up and dropped them from the summit of the tower. One pound of iron reached the ground at the same instant as a piece that weighed ten pounds.

Gravity Activity

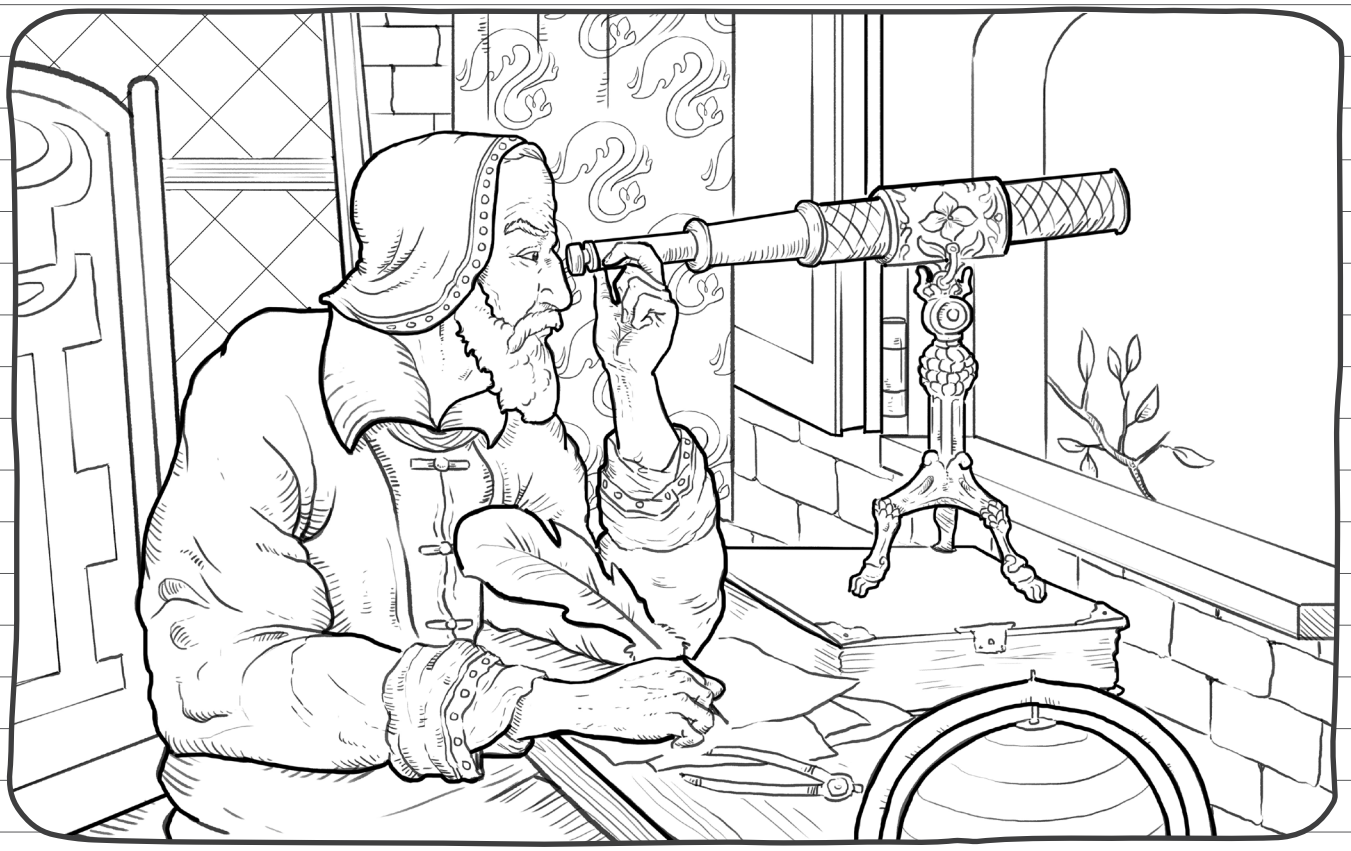
Let's re-create Galileo's experiment and see how fast objects fall to the earth.

1. Find a place (outside is suggested) where you can drop two items from at least 2 m (6 ft), but the higher the better.

2. Drop the large ball and coin or tiny pebble at the exact same time. Have the children observe when the objects hit the ground. If desired, experiment with different sizes and types of objects.

Note: Due to the atmosphere and air resistance, some objects appear to fall slower than others, such as a feather, which seems to float down. Astronauts proved Galileo's theory of gravity by dropping a feather and bowling ball on the surface of the moon where there is no atmosphere. In that environment the feather and bowling ball fell at the same rate.

→GALILEO←



Major Scientific Accomplishments:

1. Invented the _____ and thermometer
2. Helped lead to the invention of _____
3. Greatly improved the _____
4. Discovered moons around _____
5. Discovered craters on the _____ and _____ on the sun
6. Helped prove that the planets orbit the ___

Have other people ever questioned your beliefs? What can you learn from the example of Galileo?

SPACE EXPLORATION

Objective

Help the children understand some of the challenges that need to be resolved as mankind attempts to further explore the universe.

Preparation:

- ☐ Cut out the puzzle pieces on the page titled "Facts About the International Space Station" and put them in a bowl.
- ☐ Make a copy of the "Parts of a Space Shuttle" page for each child.

Activity Supplies:

None

☐ Read to the Children

What do you think it would be like to travel into space? Would you ever want to travel into space? Why or why not?

Early space missions crammed astronauts into a tiny capsule and launched them into space atop a powerful rocket. That all changed on April 12, 1981, when the first *space shuttle* took off.

☐ Science Journal: Parts of a Space Shuttle

Give each child a copy of the page "Parts of a Space Shuttle" and allow him or her to color the picture while you read aloud. As you read, help the children label the parts of the space shuttle. Place the page in the child's science journal.

NASA's space shuttles were the first partially reusable space-shuttle spacecrafts. Previous space capsules splashed down into the ocean and were not used again. The new space shuttles were the size of a commercial jetliner and designed with wings so that they could glide back to Earth and land on a runway. Exploring space became much more comfortable!

However, launching the shuttle into orbit required a lot of power. The shuttle itself had three *main engines* that burned liquid hydrogen and liquid oxygen. **Help the children find the main engines.** To provide enough fuel, the shuttle was strapped to a large fuel tank. **Help the children find the fuel tank and point to the orange tank in the image at the left.** To provide even more thrust, two *solid rocket boosters* were attached to the fuel tank. **Help the children find the solid rocket boosters.** The solid rocket boosters gave the shuttle a powerful boost when it launched. When their fuel was used up, the

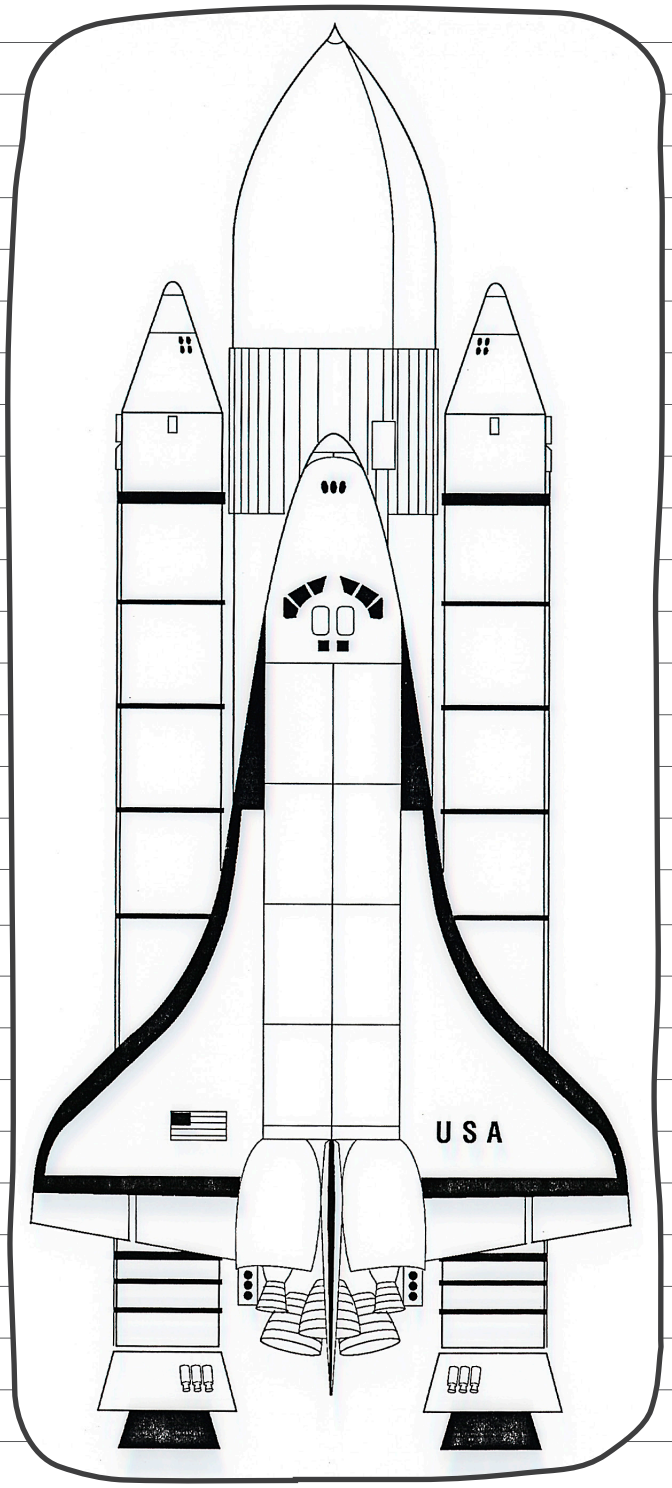
The first piece of the ISS was launched on November 20, 1998. More pieces were added over the next several years. It is Russian built and American funded and took the help of 15 countries to create. It is a great representation of the world working together to further space exploration. The purpose of the ISS is to create a laboratory for testing experiments while actually in space. This is something that can't be replicated on Earth.

ISS Puzzle Activity

Show the cut-out puzzle pieces in the bowl to the children. Have them take turns choosing a puzzle piece from the bowl and reading it aloud. Discuss the information where applicable. Ask the children to imagine life on a space station as they put the puzzle together.

PARTS OF A SPACE SHUTTLE

Label the parts of the Space Shuttle and color the picture.



FACTS ABOUT THE INTERNATIONAL SPACE STATION PUZZLE

It is fast! It orbits the earth every 90 minutes. That means it travels at 25,000 kph (15,000 mph).

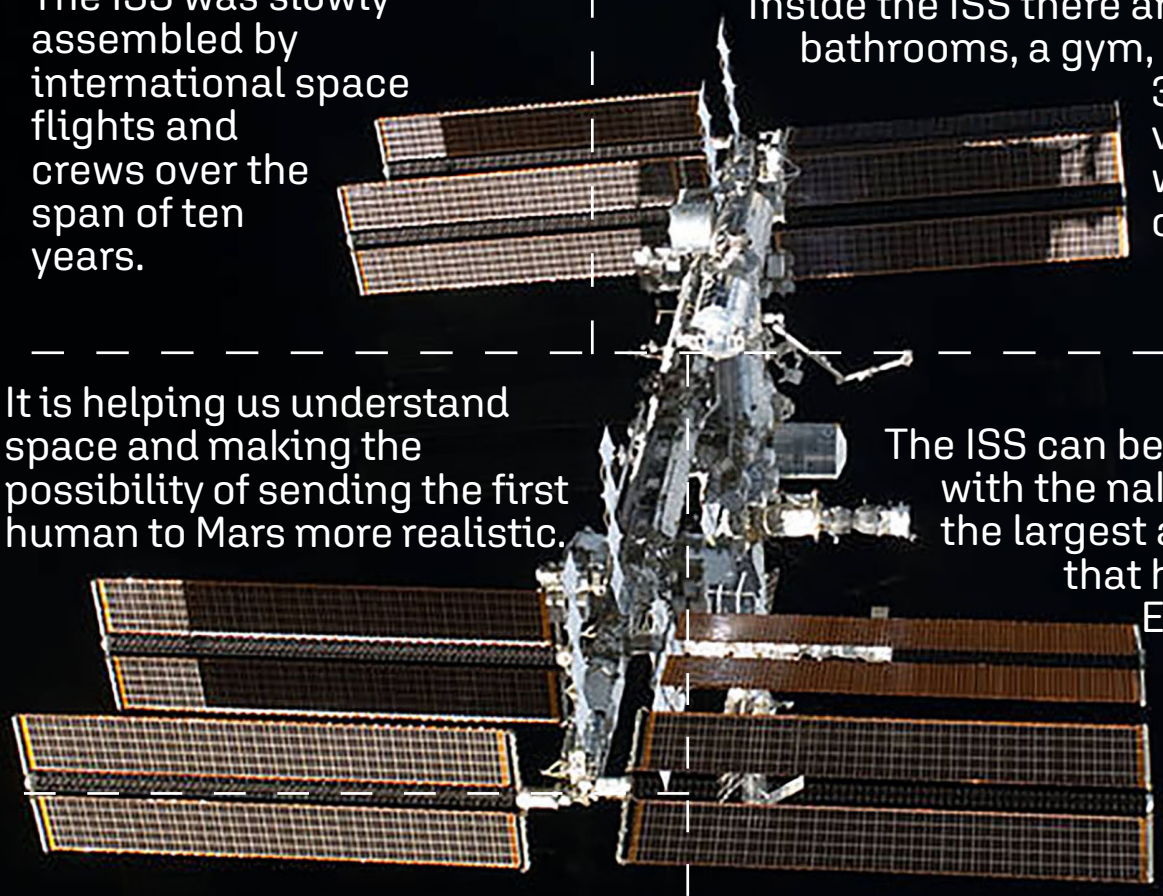
The ISS is a home in space. People have lived in the space station continuously since the year 2000.

It is big enough to cover an entire football field!

Expeditions have included male and female crew members from many nations.

The ISS was slowly assembled by international space flights and crews over the span of ten years.

Inside the ISS there are two bathrooms, a gym, and a 360-degree-view bay window, among other rooms.



It is helping us understand space and making the possibility of sending the first human to Mars more realistic.

The ISS can be seen from Earth with the naked eye, and it is the largest artificial satellite that has ever orbited Earth. To find when you can see the ISS, visit **spotthestation.nasa.gov.**

It is made to support a crew of six people, plus visitors.

Because the human body tends to lose muscle and bone mass in zero-gravity environments, all astronauts aboard the ISS must work out for at least two hours a day to combat these effects.

Over 200 different people have lived there over the years.