

## Family Space Day Overview

Family Space Day is a three hour event. The activities are set up so that children and parents can select the order in which they undertake activities. Parents and children are encouraged to learn, play, and explore *together*.

Several Family Space Days, one after the other, explored the different planets. The first planetary Family Space Day concentrated on the definition of a planet and on Mercury, closest planet to the Sun.

### Objectives of the Day

Children will:

- learn the characteristics of planets.
- learn about the surface and interior of Mercury.
- learn about what it would be like to live on Mercury.

### Activities

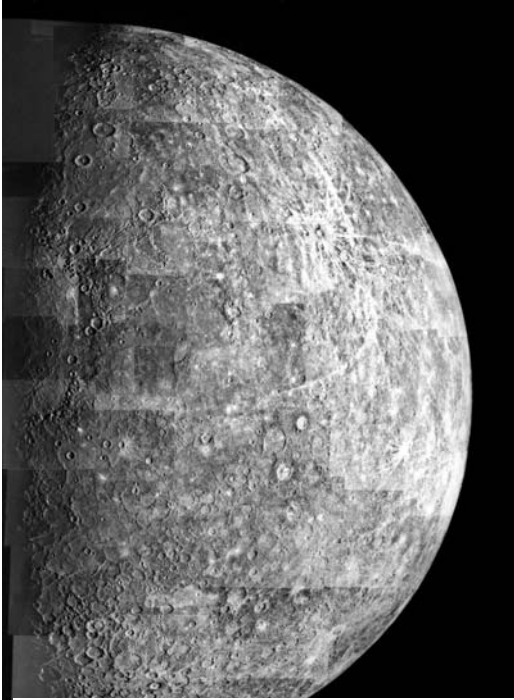
- **Station 1: What's a Planet?**  
Children and their parents explore 6 boxes to learn the characteristics of planets. The children answer questions related to each box and put their answers on their answer sheet.
- **Station 2: Mercury on a String**  
Children and their parents create a mobile of Mercury to add to their current solar system mobile made from other Family Space Day events or have it be the first of a series of planet mobiles.
- **Station 3: Impact Craters!**  
Children explore how Mercury got covered with circular depressions. The process of cratering is one of the most important geologic processes in our solar system – as Mercury displays for us!
- **Station 4: Living on Mercury Book**  
Children answer questions about what it would be like to live on Mercury and then use different craft items to decorate their book.
- **Station 5: Coloring Sheets and Games**  
Children can relax and color and play simple games related to Mercury.
- **Station 6: Reading Room**  
Children and their parents can browse and read a selection of books about Mercury (refer to book list for suggested reading).

### Other Materials

- *Facilitator Information* – Mercury
- *Explore Mercury* – Book and Website References
- *All About Mercury* – A Mercury Fact Sheet

## Facilitator Information

(All you need to know about Mercury to survive the day)



Surface of Mercury revealed by several images collected by the Mariner spacecraft. Image courtesy of NASA/JPL.

### Mercury the Messenger

Mercury is the closest planet to the Sun and is named for the Roman god, Mercury, who was messenger to the other gods. Mercury's surface temperature ranges from 300 degrees below zero Fahrenheit on the side facing away from the Sun and up to above 800 degrees Fahrenheit on the side that is toward the Sun. The low surface gravity and high temperatures have caused any atmospheric gases this planet had to escape.

Mercury is the smallest of the eight planets; Jupiter and Saturn actually have moons that are larger than Mercury! Because of its small size and proximity to the Sun, most of Mercury's properties have only been determined in the last few decades. NASA's new mission to Mercury – the MESSENGER Mission – is helping to reveal many of Mercury's mysteries!

### What is Mercury's orbit like?

Now that Pluto is no longer classified as a planet, Mercury is the planet with the most eccentric orbit and the most tilted with respect to the ecliptic (the plane traced by Earth's orbit around the Sun). Mercury takes 88 days to orbit the Sun. Birthdays on Mercury would come with alarming frequency!

Mercury's rotational and orbital period are connected to each other. The rotation of Mercury (its period of spin on its axis) is exactly 2/3 of its orbital period (revolution around the Sun, or its year), about 59 days. This means that it completes one whole turn on its axis when it has moved 2/3 of the way around the Sun. After another half rotation, it completes an orbit around the Sun. If you lived on Mercury, you would need to wait for two complete orbits around the Sun (two of Mercury's years) to watch from one sunrise to the next.

### What is Mercury like on the inside?

Mercury's interior is deduced from its small size and high density (5.43 g/cm<sup>3</sup>, almost as high as Earth's density), which together require a large metallic core. It is estimated that more than half of Mercury's interior is an iron core, and new evidence indicates that the core is molten. Surrounding the core is a layer of rocky material, the mantle. Mercury has a crust, but the thickness is not known. The MESSENGER Mission will help scientists understand more about Mercury's interior.

### What is on the surface of Mercury?

Much of Mercury's surface is covered by impact craters, caused by asteroids and comets smashing into the surface. Some of these craters have smooth floors, which may be caused by lava flows infilling the crater depression. The Caloris Basin, the largest impact basin on Mercury, measures 1300 kilometers across.

Mercury's surface shows long cliffs, called scarps, that are 20 to 500 kilometers long and a few hundred meters to a kilometer high. Scientists propose that these formed as the planet cooled and shrank – the surface buckled up into these scarps.

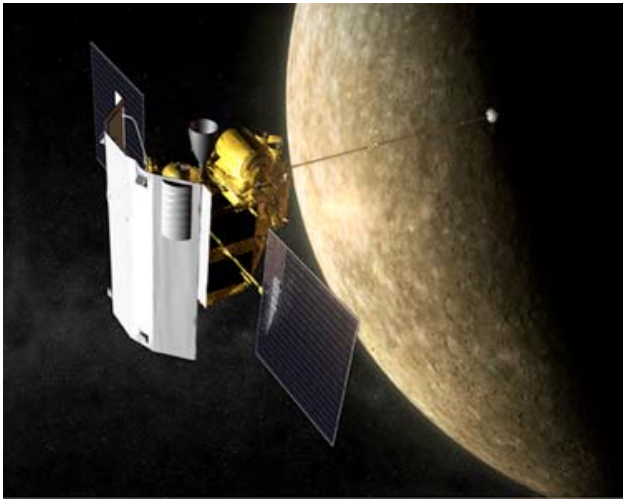
Mercury may have polar ice caps! Earlier missions collected radar images of the polar regions that suggest ice at the poles. MESSENGER will help scientists answer this question.



Imaging from the Mariner spacecraft of the surface of Mercury showing the circular depressions of impact craters. Image courtesy of NASA/JPL/Northwestern University.

### How did Mercury form?

Mercury formed when the Sun and all the planets in our solar system formed – about four and a half *billion* years ago! Not enough is known about Mercury at this time to create a detailed picture of its formation and evolution. Like the other rocky, terrestrial planets in our solar system, Mercury formed by accretion (small pieces of rocky material smashing into each other, with some sticking together, gradually growing into a planet). Like Earth, Venus, and Mars, the interior of Mercury probably differentiated early in its history, causing the separation of the materials that make up the iron-rich core, the rocky middle layer of the mantle, and the rocky outer crust. During its first half a million years, Mercury and the other bodies of the solar system were bombarded by big and small asteroids, creating much of the cratered landscape we see today. **One** theory to explain Mercury's relatively large core is that a giant asteroid smashed into the planet and blew off a large amount of the mantle and crust, leaving behind the core. Today Mercury is geologically inactive, except for infrequent and small asteroid and comet impacts.



Artist's drawing of MESSENGER spacecraft orbiting Mercury. Image courtesy of NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

## Missions to Mercury

Until Mariner 10, little was known about Mercury. Even the best telescopic views from Earth showed Mercury as an indistinct object lacking any surface detail. The planet is so close to the Sun that it is usually lost in solar glare. When the planet is visible on Earth's horizon just after Sunset or before dawn, it is obscured by the haze and dust in our atmosphere. Only radar telescopes gave any hint of Mercury's surface conditions prior to the voyage of Mariner 10. But in 1974 the first close-up views of Mercury were obtained by the Mariner 10 spacecraft.

Today, the MESSENGER (MERcury Surface, Space ENVIRONMENT, GEOchemistry, and RANGing) spacecraft is poised to go into orbit

around Mercury in March 2011. MESSENGER will study Mercury from orbit for about one year.

MESSENGER will measure the planet's gravity and its magnetic field, which will help us learn more about Mercury's interior. MESSENGER will also explore the composition of the materials on Mercury's surface, which will help us understand the formation and history of this small planet. Strange as it may seem, some scientists think there may be ice on Mercury, hiding from the intense heat of the nearby Sun in the forever shaded bottoms of large craters near the planet's poles. MESSENGER's instruments will tell us whether water ice is really to be found in this most unlikely location.

MESSENGER is following a roundabout route on its trip to Mercury. In order to save fuel (and to keep the cost of the mission low), the spacecraft will have flown past Earth once, past Venus twice, and past Mercury itself three times before beginning its orbit around Mercury in 2011.

## What's a Planet?

The definition of a “planet” is being debated by the planetary science community, in part, because of newly discovered celestial bodies in the outer parts of our solar system and celestial bodies in orbit around distant stars.

In 2006 the International Astronomical Union defined a planet as “a celestial body that: (a) **is in orbit around the Sun**; (b) has sufficient mass for its gravity to overcome rigid body forces so that it **has a nearly round shape**; and (c) **has cleared the neighborhood around its orbit** (there are no other bodies of similar size in its orbit).

Upsetting to many small children the world over, the new definition caused Pluto to be booted out of the planet category and into the category of “dwarf planet.” It also resulted in further debate among planetary scientists. Stay tuned, the definition is being revisited!

In the mean time, this activity will familiarize your child with what makes a planet a planet!

### What You Need:

- 6 cardboard boxes with lids (shoeboxes will work for small groups of children, Xerox paper boxes are appropriate for larger groups)
- Scissors
- Paper or foil to cover boxes (optional)
- Tape
- Index cards
- Markers
  
- Box 1: 1 4 to 8 inch rubber ball or other seamless ball
- Box 2: thin smooth string or fishing line, one large yellow pom-pom or a cut out of the Sun, two small, dark-colored pom-poms or other representatives of smaller planets, two 2-inch pieces of drinking straw
- Box 3: strong flashlight, thin string or fishing line, dark-colored pom-pom
- Box 4: tennis-ball sized lump of modeling clay (the stiffer the better)
- Box 5: soft-ball sized lump of modeling clay.
- Box 6: cardboard plate, 2-3 cans of play-doh or modeling clay
- Box 7: flashlight, thin string or fishing line, dark-colored pom-pom, one 2-inch piece of drinking straw



## Preparation:

Cut a three-sided flap in the side of each box that is large enough for an adult hand to easily pass through. Alternatively, cut a square or circle large enough for an adult hand to pass through

If you wish, cover the boxes in foil or paper to give them a uniform look.

- Box 1 Place a seamless ball such as child's rubber ball. Place a card on the outside of the box that says *No Peeking! Use your hands to feel the shape of the object inside.*
- Box 2.
  - Attach a large yellow pom-pom or a cut out of the Sun to a five inch string. Attach the other end with tape to the center of the top of the box, so that the Sun hangs down into the box when the lid is closed.
  - Cut a thin almost-complete circle, about 5 inches in diameter into the top of the box. The circle should be centered around the hanging yellow pom-pom. Leave the last three inches uncut so that the cardboard circle is firmly attached to the box. Repeat for a ~7 inch diameter circle (diameters can vary depending on the box size). The cuts need to be fairly smooth.
  - Attach a small dark pom-pom to the end of a 5 inch string. Repeat with a second pom-pom. Stick the opposite end of one of the strings through the 5 inch diameter "circle" and knot it around one of the straws at the box top so that the string does not pull through when tugged on from the inside of the lid. Repeat with the other string and straw for the second "circle." When the lid is placed on the box, the pom-poms should hang down in the box, at about the same level as the Sun. They should be able to be pulled along the circle from the top, simulating planets going around the Sun when looking into the box. You may need to adjust the size of the cuts or the attachment of the string.
  - Place a card on the outside of the box that says *Look in here! What do you see?*
- Box 3. Cut a hole on the side of the box opposite the viewing flap that will tightly fit the lighted end of the flashlight. Suspend a dark pom-pom on a string from the center of the top of the box. Place a card on the outside of the box that says *Look in here! What do you see?*
- Box 4 set-up: Shape the modeling clay into a very irregularly shaped asteroid. Place a card on the outside of the box that says *No Peeking! Use your hands to feel the shape of the object inside.*
- Box 5 set-up: Shape the modeling clay into a relatively smooth sphere. Make a second shape, using about a quarter-sized amount of modeling clay, into a smaller irregularly shaped asteroid. Place a card on the outside of the box that says *No Peeking! Use your hands to feel the shape of the object inside.*

- Box 6 set-up: Place a half-inch layer of clay on the plate. With your fingers, create a “Mercury” landscape of large and small craters that are obvious enough for a child to recognize by touch. Place a card on the outside of the box that says *No Peeking! Use your hands to feel the shape of the object inside.*
- Box 7 set-up: Cut a hole on the side of the box opposite the viewing flap that will tightly fit the lighted end of the flashlight.
  - Cut a thin semi-circle, about 6 to 8 inches in diameter into the top of the box, leaving the uncut part on the side *closest to the flashlight.* (Diameters can vary depending on box size.)
  - Attach a small dark pom-pom to the end of a string. Stick the opposite end of one of the string through the semi-circle cut and knot it around a straw at the box top so that the string does not pull through when tugged on from the inside of the lid. When the lid is placed on the box, the pom-pom should hang down in the box in front of the flashlight. It should be able to be pulled along the semi-circle from the top, simulating partial orbit of a planet when looking into the box. You may need to adjust the size of the cut or the attachment of the string. Suspend a dark pom-pom on a string from the center of the top of the box. Place a card on the outside of the box that says *Look in here! What do you see?*

### What to Do:

- Invite your child to imagine they are in a spacecraft adventuring far, far, from our own solar system. Suddenly they see a something in their spacecraft window. Is it a planet?

*Ask your child What makes a planet a planet?*

*What do you think the characteristics of a planet are? (Answers will vary, but you can prompt discussion by asking them to name some planets, or by asking how a planet and a moon and a star are different.)*

- Invite your child to explore the mystery boxes with you to unravel the characteristics of planets. At each station, help your child to follow the directions to either look inside or to not look, but feel the shape of what is inside.
- At each station, answer the questions on the “What’s a Planet?” sheet.
- After you have visited all of the boxes, invite your child to share what they have learned.

*What makes a planet a planet?*

*What is its shape?*

*Does it make light?*

*How is a planet different from an asteroid?*

# Parent Guide - What's a Planet? - Parent Guide

Explore each of the boxes around the room with your child. Each box has instructions to follow. Have your child write their response on their card – or write their answer below. The answer to each question is beside the question in parentheses.

## Box #1

Reach into the box. What shape is the object that you feel? In general, planets are also this shape.

Planets tend to be \_\_\_\_\_ in shape (spherical or round).

## Box #2

Looking into the box – what is the name of the object that the planets are circling or orbiting?

To be a planet, it must orbit a \_\_\_\_\_ (star).

## Box #3

Looking at what is in the box, do you think that a planet makes its own light?

What provides light to a planet? A \_\_\_\_\_! (star)

Our star, the \_\_\_\_\_ gives our planet Earth its light (Sun). *No planet makes its own visible light.*

## Box #4

Reach into the box what shape is the object you're feeling? – Would this represent an asteroid or a planet? Why?

Unlike planets, asteroids have a shape that is \_\_\_\_\_ (irregular / not round). *While there is not formally part of the definition of a planet, planets tend to be large and round and asteroids tend to be small and irregular.*

## Box #5

Feel both objects in the box, which one might best represent a planet (small and slightly irregular or the larger, round object)

Planets tend to be \_\_\_\_\_ and \_\_\_\_\_. (large and round). *While not part of the definition of a planet, this describes the planets in our solar system.*

## Box #6

Feel the surface in the box. It is a model of the surface of Mercury. Describe the features you feel – what is the surface of Mercury like? \_\_\_\_\_

\_\_\_\_\_ (children may mention rocky, round, craters, bumpy....)

## Box #7

How have scientists found planets orbiting other stars? \_\_\_\_\_

*Sometimes planets are found when they move between our telescopes on Earth (and in space!) and the star they are orbiting. The light from the star dims just a bit – and scientists detect this light change. (Most astronomers detect planets by observing very small “wobbles” in stars caused by the gravitational pull of planets as the whole system moves around a common center of gravity).*



# What's a Planet?

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What provides light to a planet? A \_\_\_\_\_!

Our star, the \_\_\_\_\_ gives our planet Earth its light.

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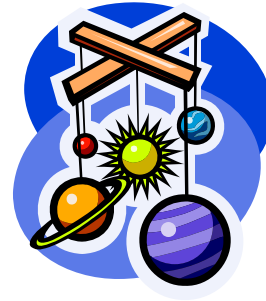
How have scientists found planets orbiting other stars? \_\_\_\_\_

## Mercury on a String

In this activity, you and your child will make a Mercury disk that can be hung in his or her room - or it can be part of a growing mobile of the planets in our solar system (added during other Family Space Day events).

### What You Need:

- CD with small hole drilled in top and bottom
- Image of Mercury
- Mercury Poem on cardstock
- String or fishing line
- Scissors
- Glue



### What to Do:

- Help your child cut out the image of Mercury
- Glue the image on the printed side of the CD.

*Why is there not an image of the "other side" of Mercury? Mercury is a mystery! Only one spacecraft has ever visited Mercury and it sent images back to Earth of a little less than half of Mercury's surface. Because of Mercury's unique orbit and spin, we only see one side from Earth. So there is much to learn about this small planet. Never fear! We will be able to see and learn much more about Mercury from the MESSENGER mission! While it is not yet orbiting Mercury, it has flown by and has already given us images from the "unknown" areas on Mercury..*

- Help your child cut out the Mercury poem .
- Loop a piece of string through the small hole in the CD at the top of Mercury and tie it off in a knot. This will be the hanger Mercury.
- Loop a second piece of string through the bottom hole in the CD. Before tying a knot, attach the Mercury Poem through its hole
- Your child now has a Mercury mobile!

### Parent Prompts:

As you and your child are creating the Mercury mobile, ask them:

*What do you think the other side of Mercury looks like?*

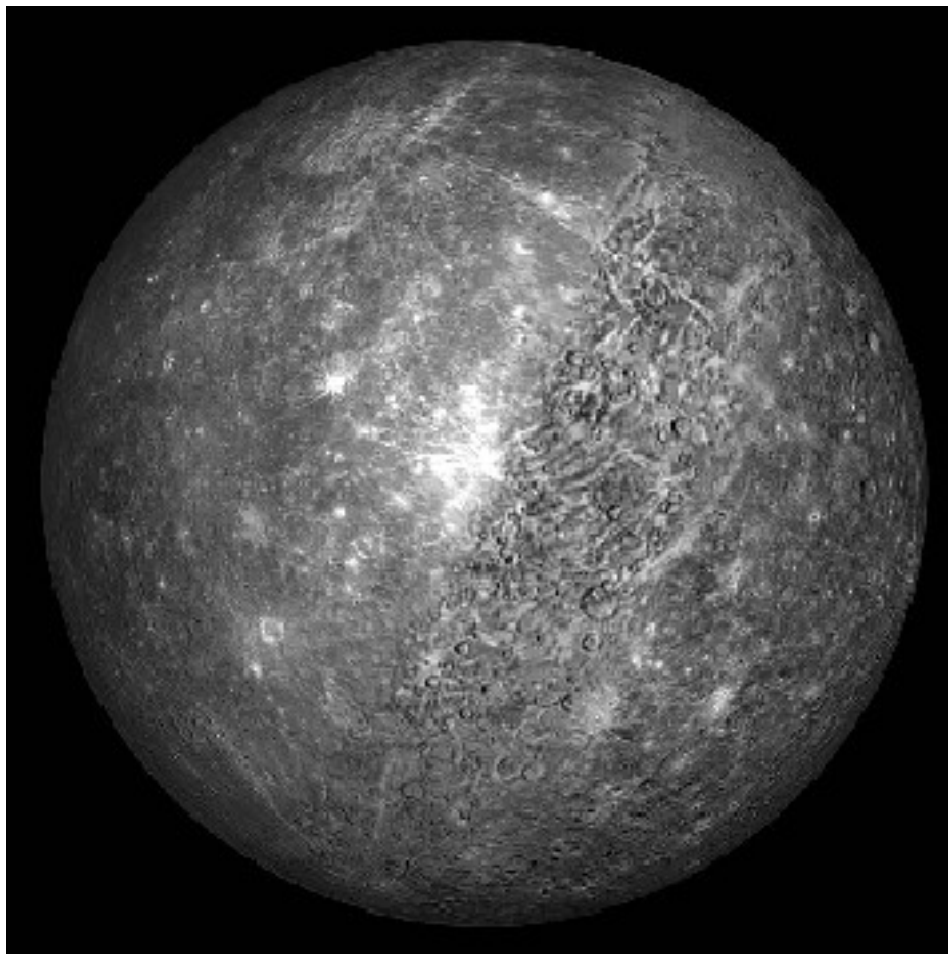
*How will we find out what the other side looks like?*

*What are the circular features that are all over Mercury's surface? How did they form?*

Mercury

I am M E R C U R Y  
C L O S E S T Planet to the Sun  
Now that Pluto's out,  
No one's smaller no, not one!

MERCURY IMAGE for CD



# Impact Cratering

Impact craters are caused when an impactor collides with a planet. A crater's size and features depend on the mass, velocity, and incoming angle of the impactor. Impact craters provide insights into the age and geology of a planet's surface.

In this activity, you and your child will create impact craters like the ones on Mercury. Use different impactors and drop them at different speeds and angles to find out if the different variables form different size/shaped craters.

## What You Need:

- A large pan or box such as a dish pan, aluminum baking pan, or copy paper box lid, (larger pans allow children to drop more impactors before having to re-smooth or resurface)
- Enough sand, sugar, rice, or oatmeal to fill the pan about 4 inches
- Enough flour to make a 1" to 2" deep layer
- Enough powdered cocoa to cover the surface by about an 1/8 of an inch
- A sifter
- A large trash bag or piece of cloth or plastic to place under the crater box
- Several objects that can be used as impactors, such as large and small marbles, golf balls, rocks, bouncy balls, and ball bearings. Use your imagination!
- Ruler
- Paper and pencil
- Images of craters on Mercury
  - [http://www.nasa.gov/images/content/208907main\\_phone\\_crater.jpg](http://www.nasa.gov/images/content/208907main_phone_crater.jpg)
  - <http://btc.montana.edu/ceres/MESSENGER/instruments/mla.html>
  - <http://www.astro.washington.edu/courses/labs/clearinghouse/labs/Craters/crater.html>
- Safety glasses

## What to Do:

- Fill a pan 4 inches deep with sand, sugar, rice, or oatmeal
- Add a 1 to 2 inch layer of flour
- With the sifter, sprinkle a thin layer of powdered cocoa on top of the flour
- Provide several impactors and a ruler
- Have your child drop one impactor at a time into the pan.
- Change the types of impactors and the heights from which the impactor is dropped.
- Discuss the differences in the size and depth of the craters the different impactors make.

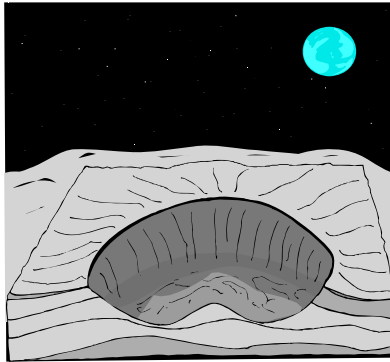
Parent Prompts:

What did your child observe?

How did the weight of objects affect the size and depth of the crater you created?

How did the size of the object affect the size and depth of the crater?

How did dropping or throwing the impactors from different heights affect the size and depth of the craters they formed?





## Living on Mercury Book

Living on the planet Mercury would be a ... challenge! If one could, what might it be like? With its extreme temperatures, little atmosphere, no water, the surface covered with impact craters and mile-high cliffs, and Sunlight six-and-a-half times as intense as it is on Earth, the mission would be difficult.

In this activity, you and your child will imagine what it would be like to live on Mercury. Then your child will draw images based on the information provided at the bottom of each page.

### What You Need:

- Craft items
- Crayons
- 1 double sided copy of the [Mercury Coloring Book](#)
- 1 piece of construction paper for the book cover
- Scissors
- Stapler



### What to Do:

On each of the pages of your child's coloring book, use craft items and crayons to color and decorate according to the stated caption.

Have your child use their imagination to illustrate the Mercury concept for that page. Once complete, staple the pages together at the top to create the book.

### Parent Prompts:

As you and your child are creating the coloring book, ask him or her:

*What would the weather be like on Mercury?*

*How long is a day on Mercury?*

*Is it hot or cold or both?*

## Coloring Sheets and Games

Enchanted Learning

<http://www.enchantedlearning.com/subjects/astronomy/activities/coloring/Mercury.shtml>

Windows to the Universe

[http://www.windows.ucar.edu/tour/link=/coloring\\_book/index\\_java.html](http://www.windows.ucar.edu/tour/link=/coloring_book/index_java.html)

Enchanted Learning

<http://www.enchantedlearning.com/subjects/astronomy/activities/findit/qmercury.shtml>

Enchanted Learning

<http://www.enchantedlearning.com/subjects/astronomy/cloze/mercury/>

EdHelper.com – Mercury Word Find

<http://edhelper.com/SolarSystem1061.htm>

## Explore Mercury!

### Websites

<http://messenger.jhuapl.edu/index.html>

NASA's MESSENGER site shares the 2011 planned spacecraft visit to Mercury and offers information for all age groups about our solar system's innermost planet. Of special interest to kids is the 'just for students' section offering Mercury fast facts, related websites, MESSENGER animations, MESSENGER movies and a frequently asked questions piece.

<http://www.enchantedlearning.com/subjects/astronomy/planets/mercury/>

Check out Enchanted Learning's exploration of Mercury, look inside the planet, and learn about why it has such long days. Find a coloring page, puzzle, and more!

<http://seds.lpl.arizona.edu/nineplanets/nineplanets/mercury.html>

Older children and adults will enjoy viewing the nine planets website for a comprehensive look at planet Mercury. Along with a thorough information section, the site presents Mariner details, Mercury imagery, the latest studies, links and an open issues section with the latest Mercury topics.

<http://www.astrosociety.org/education/publications/tnl/59/planetdefine.html>

Is the definition of the word "planet" impossible? Parents can check out the arguments here!

<http://www.windows.ucar.edu/tour/link=/mercury/mercury.html> Learn all about Mercury whether you're a beginning explorer or advanced. Windows to the Universe offers information, games, and resources about the great Red Planet.

[http://starchild.gsfc.nasa.gov/docs/StarChild/solar\\_system\\_level1/mercury.html](http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level1/mercury.html)

Nasa's Starchild is great for ages 4 and up. It provides information about Mercury as well as games and other resources.

## *Explore Mercury!*

### Books

Mercury. Goldstein Margaret, Lerner Publications Company, 2003, ISBN: 0822546485.

A first reader book appropriate for ages 5-7. The book provides an introduction to Mercury, describing its place in the solar system, its physical characteristics, its movement in space, and other facts about the planet.

The Solar System: Mercury. Asimov Isaac, Gareth Stevens Publishing, 2002, ISBN: 083683237X.

A book suitable for 7-10 year old readers. Asimov covers the physical characteristics of the planet Mercury, along with such topics as past and future missions to Mercury, its history and telescopic viewing of the planet.

Mercury. Simon, Seymour, Morrow Junior Books, 1992, ISBN: 0688105440. This children's book describes what is known about Mercury from the photographs taken by project Mariner. Diagrams and artist depictions help to make this book an attractive read. Desirable for ages 6-10.

Mercury (The Galaxy). Steven L. Kipp, Capstone Press, 2000, ISBN-10: 0736805184, ISBN-13: 978-0736805186.

This book discusses the orbit, surface features, exploration, and other aspects of the planet Mercury. Great introductory book for ages 4-8.

Mercury. Thomas K. Adamson, Capstone Press, 2003, ISBN-10: 0736821147, ISBN-13: 978-0736821148.

The simple text and photographs describe the planet Mercury and is great for young children.

## All About Mercury

- Mercury is the closest planet to the Sun and smallest in our solar system.
- The planet is named for Mercury, the Roman messenger of the gods.
- Mercury spins once on its axis each 59 days and orbits the Sun once every 88 days (1 Mercury year). So Mercury rotates three times in two (Mercury) years, making the length of one day and night 176 Earth days long!
- Mercury has no moon.
- We know very little about Mercury. Only the Mariner 10 spacecraft has visited (1974), taking ~10,000 images – but we've still never even seen half of the surface!
- In general, Mercury's surface resembles that of the Earth's Moon.
- Over half of Mercury's surface is covered with impact craters.
- Mercury has one of the largest impact basins in our solar system - Caloris Basin! It is a huge circular basin about 1300 kilometers (810 miles) in diameter that formed when an asteroid struck Mercury.
- Scientists think Mercury actually shrank as it cooled internally. Long scarps, or cliffs, occur on the surface, interpreted as layers that crumpled and broke and rode over each other as the planet shrank.
- Mercury has an internal magnetic field, similar to but weaker than Earth's. The cause is a mystery – is it because Mercury has such a huge iron core? Because it has a partially molten core?
- Mercury's gravity is about one-third of the Earth's gravity. Everyone would weigh less on Mercury! ☺
- Mercury's atmosphere is so thin that it is barely detectable; any atmosphere is lost from the planet because of solar activity.
- The side of the planet Mercury that faces the Sun gets very hot (greater than +800° F), and the side that faces away from the Sun gets very cold (nearly 300° F below zero!). Its temperature range is so extreme, in part, because there is no atmosphere to help moderate it.
- Sunlight on Mercury's surface is 6.5 times as intense as it is on Earth.
- The MESSENGER spacecraft that left Earth in August of 2004 will go into orbit around Mercury in 2011. It will study the planet and take new pictures from space. MESSENGER will help us learn more about Mercury's formation and geologic history.