

Space Bits:

# Outer Space Objects

5<sup>th</sup>  
Grade



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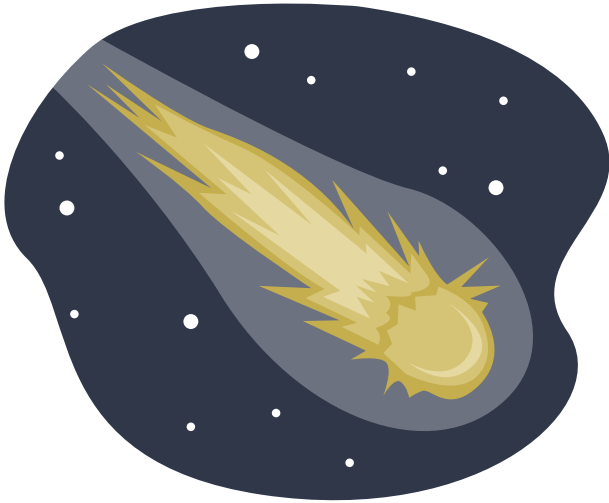
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# Comet vs. Asteroid



A **comet** is a *small solar system body*. They can be as small as 100 meters or as big as 40 kilometers across. They have such low mass that they do not become spherical, or round. Most comets have *elliptical orbits* around the sun. Some comets have 200-year orbits, and others take millions of years to complete one orbit.

Comets are distinguished by their *coma* and their *tail*. A *coma* is a thin, fuzzy atmosphere that surrounds the center of the comet. Like comets, comas are made up of ice and dust.

They form when a comet passes close to the sun. A *tail* is the trails of gas and dust that a comet leaves behind as it passes through the solar system. These trails usually leave behind solid debris or dust particles.

## Comet Vocabulary

**small solar system body:** an object in the solar system that is not a planet, dwarf planet or satellite of a planet or dwarf planet.

**coma:** a thin, fuzzy atmosphere that surrounds the center of the comet.

**tail:** the trails of gas and dust that a comet leaves behind as it passes through the solar system.

An asteroid is a small rocky body that orbits the sun. Asteroids are sometimes referred to as minor planets. Asteroids are made up of carbon, rocks, and metals. Most asteroids in our solar system have orbits that lie between Mars and Jupiter. Unlike comets, asteroids do not have a coma or a tail.

The biggest recorded asteroid is called Ceres. Ceres is 1,000 kilometers across and roughly a quarter the size of our moon.



## Asteroid Vocabulary

**minor planet:** a celestial body that moves around the sun and is not considered large enough to be a planet.

**celestial body:** a natural object that is visible in the sky.

# Reading Comprehension

1. What is the main idea of the passage in page 1?

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2. What are the differences between a comet and an asteroid? What are the similarities?

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3. In outer space there is no air resistance; all objects in motion will stay in motion. With that in mind, what do you think causes comets and asteroids to move?

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**True or False?** For questions that you mark false, re-write the statement so that it is true.

1. An asteroid has a tail. .... **True**  **False**

2. A comet has an orbit. .... **True**  **False**

3. The coma is just an optical illusion. .... **True**  **False**

4. Some asteroids can be as big as our moon. .... **True**  **False**

5. A small solar system body is not a planet. .... **True**  **False**

6. Comets are not round. .... **True**  **False**

# Meteoroid vs. Meteor vs. Meteorite



A Leonid meteor

A **meteoroid** is a small body made up of dust or debris that travels through the *space vacuum*. The space vacuum is more commonly referred to as outer space. It is the space between celestial bodies that is most empty of matter. Meteoroids are not very big - they can be as small as a speck of dust.

A **meteor** is the visible path of a meteoroid that enters the earth's atmosphere. Meteors occur when the path of a meteoroid and the path of the earth's orbit around the sun collide. Meteors are often referred to as falling stars because they light up as they burn through the earth's atmosphere.

**DID YOU KNOW?** Millions of meteors occur in the Earth's atmosphere every day.

A *meteor shower* is made up of a large number of meteors that come from a particular region in the sky. Meteor showers occur when the earth passes through a region of space debris, such as dust particles left from a comet's trail.



A bright meteor



Meteorite

A **meteorite** is a former meteoroid that survives its fiery passage through the atmosphere to hit the earth's surface. Most meteors burn away to nothing in the earth's atmosphere.



# Crazy Craters Around The World



Craters are bowl-shaped depressions in the ground caused by the high velocity impact of a meteorite or asteroid. Here are some of the most well-known craters all over the world:

## Lake Bosumtwi crater

- Located in Kumasi, Ghana
- The impact of the meteorite opened up a crater that slowly filled with water, creating Ghana's only natural lake.
- Lake Bosumtwi crater is 10.5 kilometers across.



Lake Bosumtwi crater



Kumasi  
Ghana



## Barringer crater

- Located in the state of Arizona, USA
- Best preserved impact center
- Also known as Meteor Crater, Coon Butte and Canyon Diablo
- Barringer Crater is relatively small. It measures only 1.2 kilometers in diameter.



Barringer crater



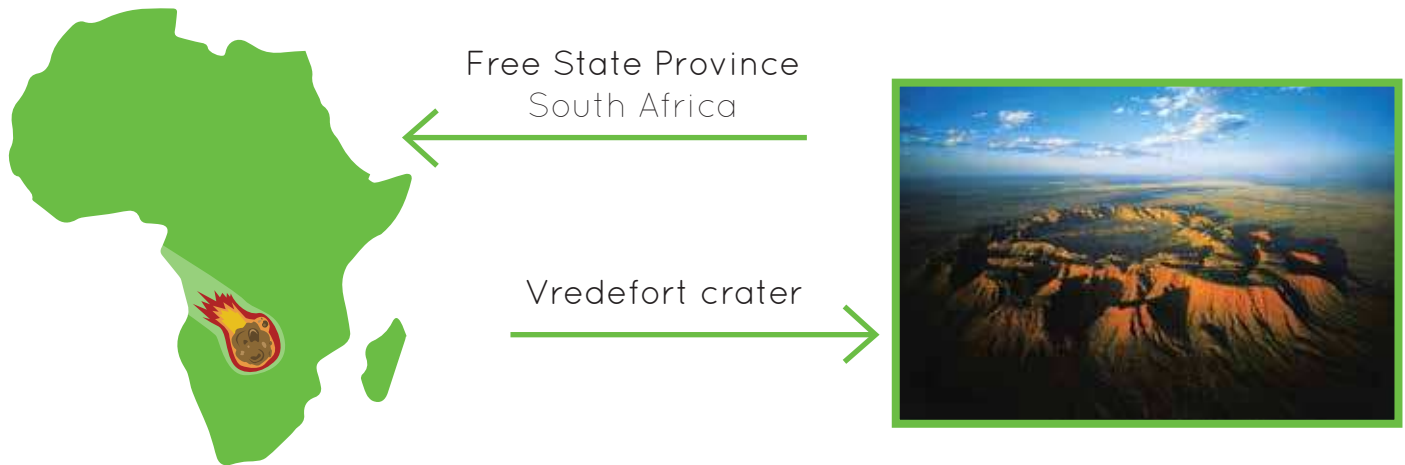
Arizona  
USA



# Vredefort crater

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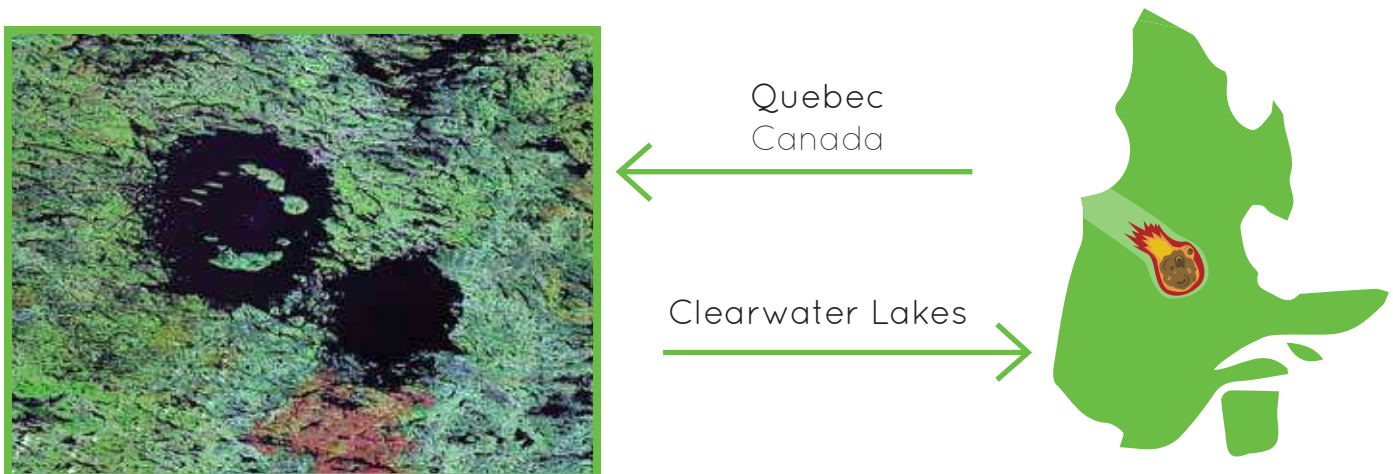
- Located in the Free State Province of South Africa and named after the town of Vredefort, which is situated near its center.
- Largest verified impact crater on Earth
- Scientists estimate that Vredefort crater was created by an asteroid roughly 5-10 kilometers in diameter.
- Vredefort crater is about 300 kilometers wide, and more than 2 billion years old!



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# Clearwater Lakes

- Located in Quebec, Canada
- These two lake craters were caused by a pair of asteroids that crashed into Earth simultaneously
- West Clearwater Lake has a 32 kilometer diameter, and East Clearwater Lake has a 22 kilometer diameter.



# Reading Comprehension

Craters are created by meteorites that hit the earth at great speeds. This impact creates lakes, canyons and other landforms. What other natural processes affect the shape of the land?

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## Finding Volume

Let's do a math review! Imagine we live in a world where craters are rectangular in shape. Find the volume of the craters using the formula below.

$$\text{volume} = \text{length} \times \text{width} \times \text{height}$$

If the Vredefort crater is 300 kilometers wide, 250 kilometers long and 10 kilometers deep, what is its volume?

If the western Clearwater Lake is 32 kilometers wide, 26 kilometers long and 1.5 kilometers deep, what is its volume?

If Lake Bosumtwi crater is about 8 kilometers wide, 8 kilometers long and 1 kilometer deep, what is its volume?

# Halley's Comet



**Halley's Comet** is a *periodical comet* with an *orbital period* of 75-76 years. It is the most well-known periodical comet.

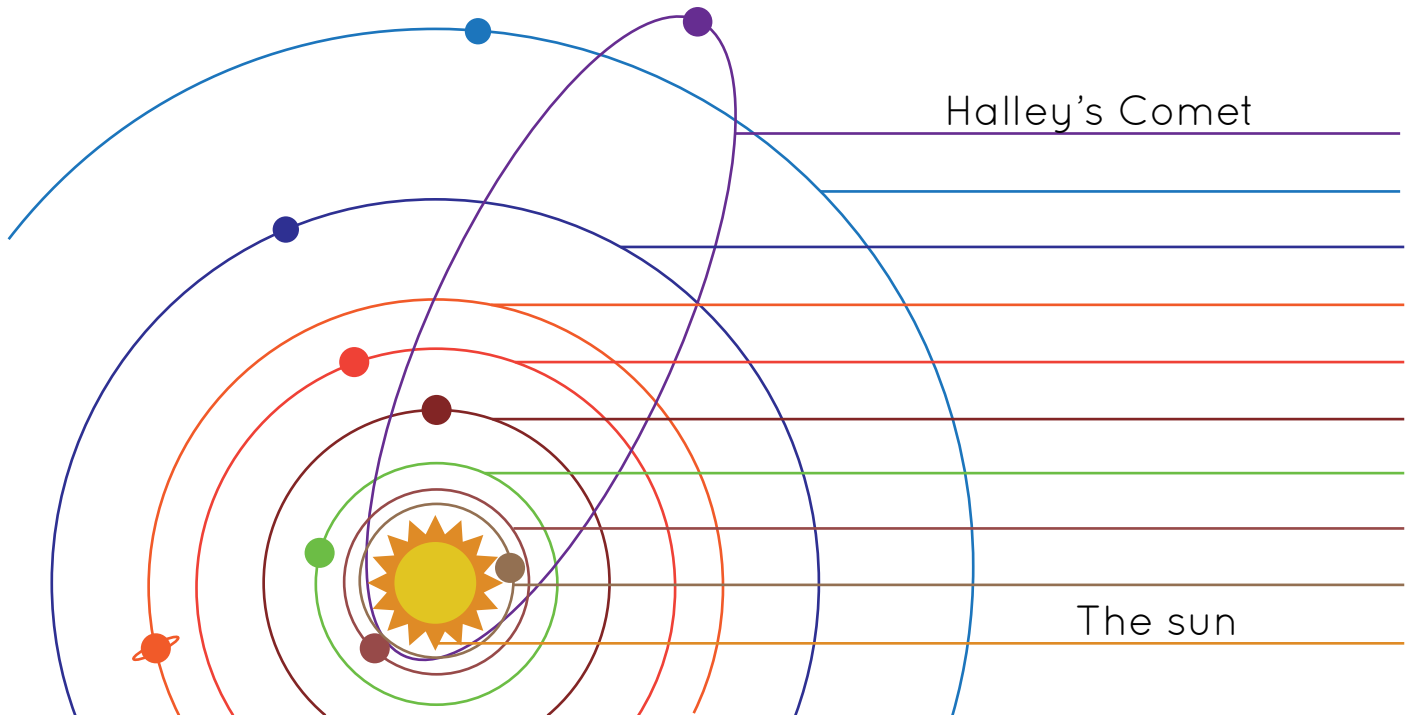
A periodical comet is a comet that has an orbital period of less than 200 years. An orbital period is the amount of time an object takes to make a complete orbit around another object. In this case, Halley's Comet takes 75-76 years to orbit around earth.

Halley's Comet was named after English astronomer Edmond Halley who first calculated the comet's orbital period in 1705. Halley's Comet last appeared in 1986, and its next predicted return is in 2061.

**DID YOU KNOW?** Halley's Comet is the only short-periodical comet that is clearly visible to the naked eye.

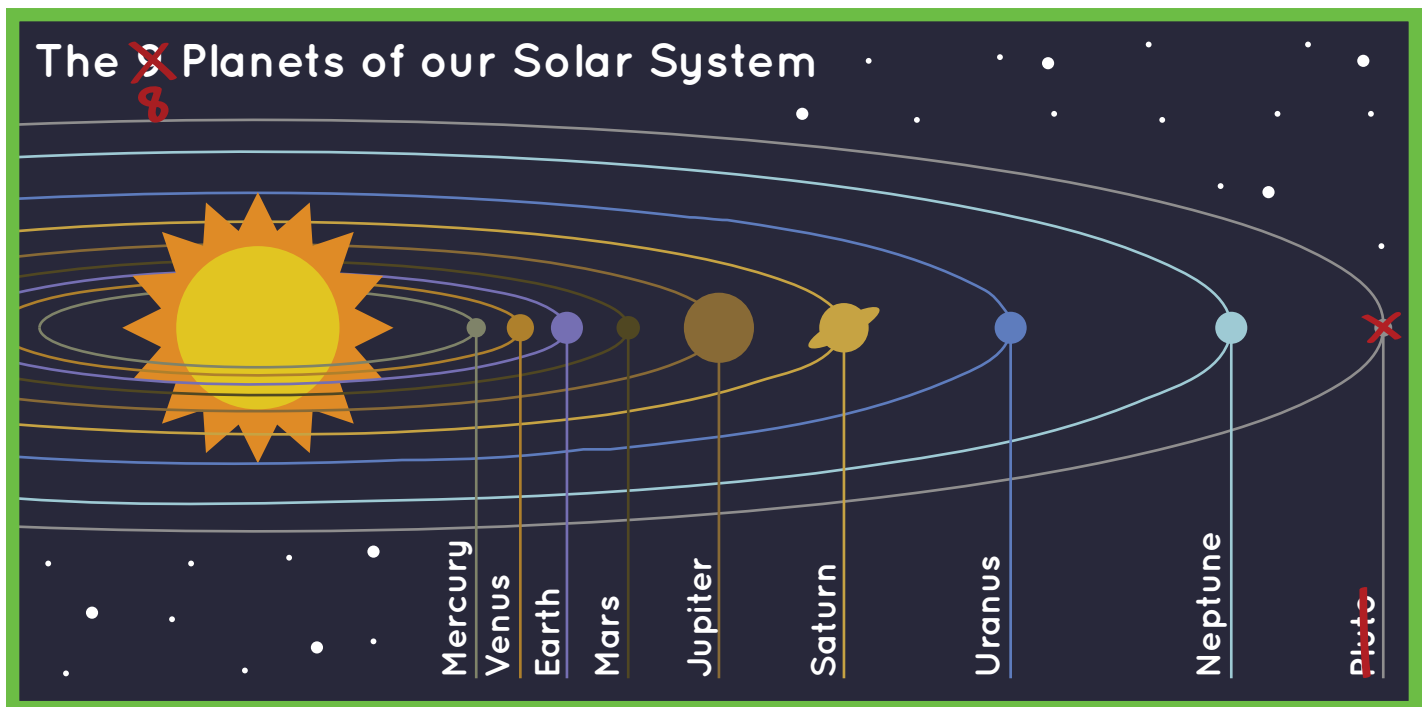
## Orbital Path of Halley's Comet

Label each planet in our solar system.



# What is Pluto?

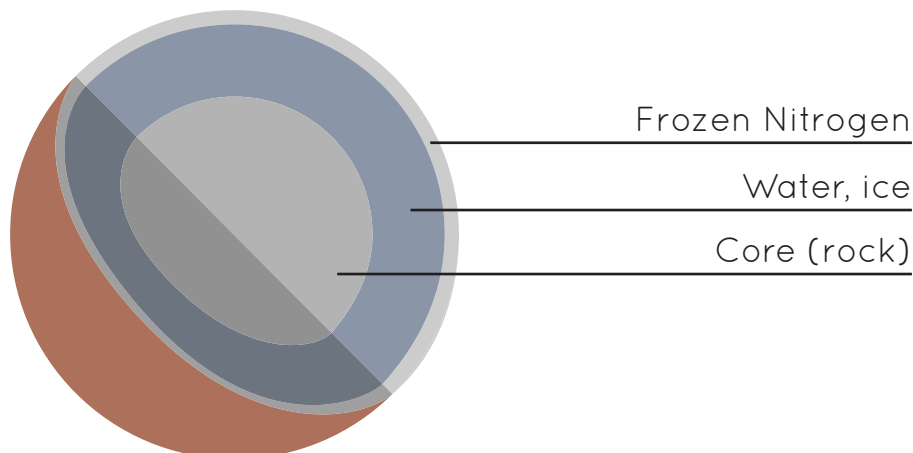
What constitutes a “planet” by our definition?



Pluto is a dwarf planet that used to be considered as one of the nine planets of our solar system. A dwarf planet is a celestial body that is big enough to have its own gravitational field, making it round like the planets. However, a dwarf planet is not able to sweep up or expel debris from its orbital path, like normal planets do.

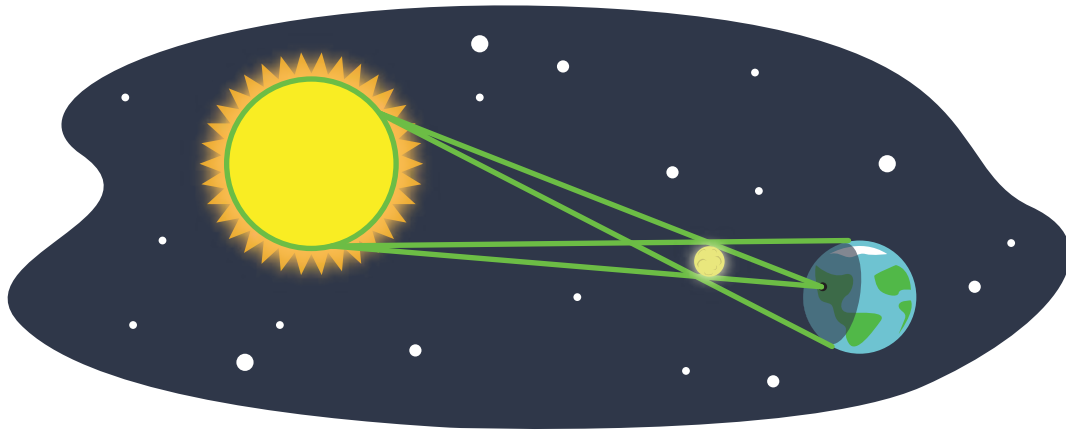
In 2006, Pluto was downgraded from a planet to a dwarf planet because it could not sufficiently sweep up or expel debris. This new ruling has met lots of controversy. Some astronomers believe that Pluto and a few other more massive and distant dwarf planets should be classified as “planets” instead.

## Possible structure of Pluto

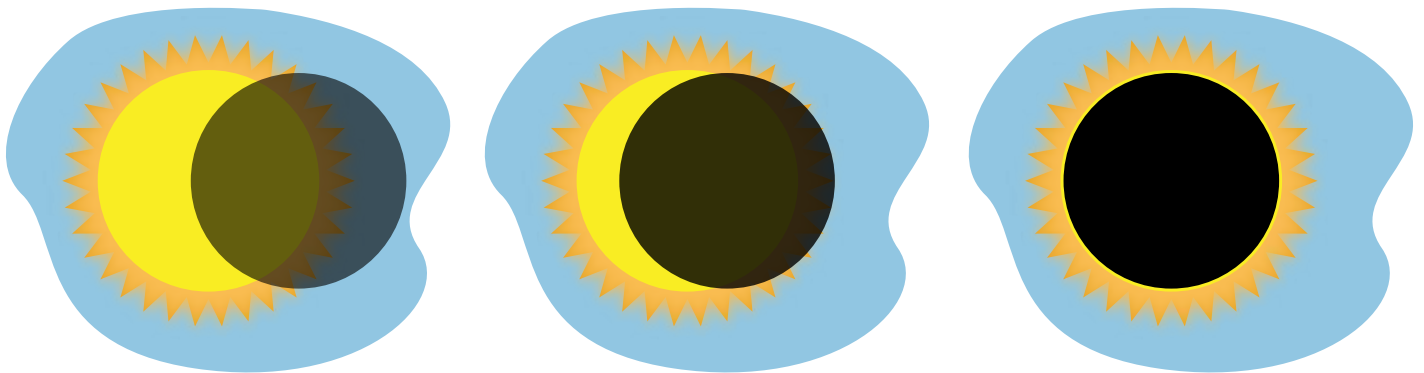




# Solar Eclipse vs. Lunar Eclipse

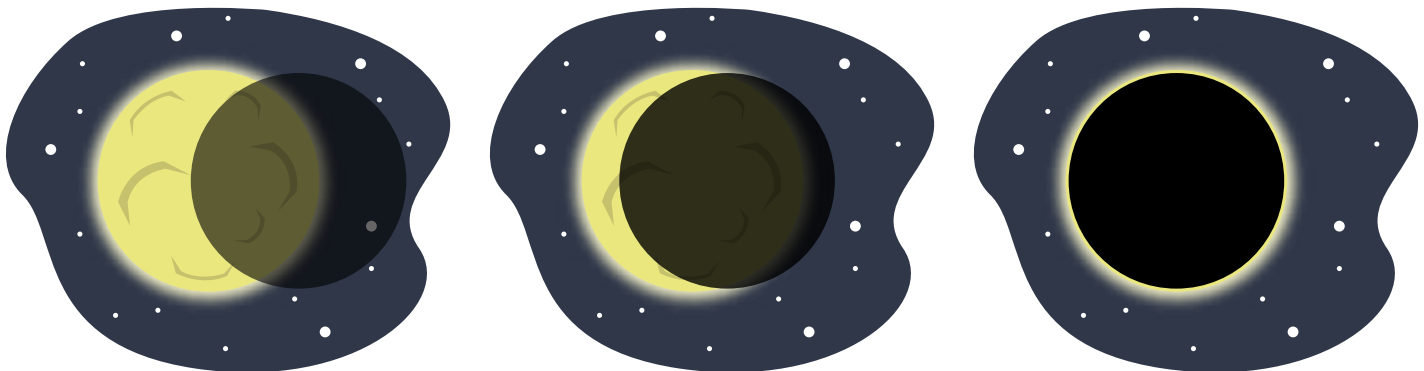


An *eclipse* is an obscuring of light caused by the passage of one object between a source of light and another object.



## Solar Eclipse

A *solar eclipse* occurs when the moon moves between the sun and the earth, partially or fully blocking the sun. There are two to five solar eclipses every year.



## Lunar Eclipse

A *lunar eclipse* occurs when the earth moves between the sun and the moon. There are at least two lunar eclipses every year.

# Reading Comprehension

## Think About It!

During a solar eclipse the shadow of the moon covers up the sun. Do you think that when it happens the whole earth will be in darkness? Why or why not?

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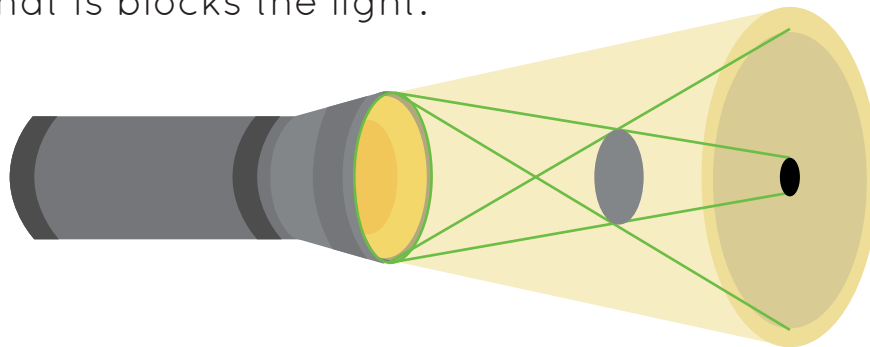
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## Try This!

Demonstrate what's happening during a solar eclipse on a smaller scale. All you need is a flashlight, a quarter and a partner. Aim the flashlight at your partner's face. Then have your partner hold up the quarter so that it blocks the light.



What happened? Which of these items represents the sun, the moon, and the earth?

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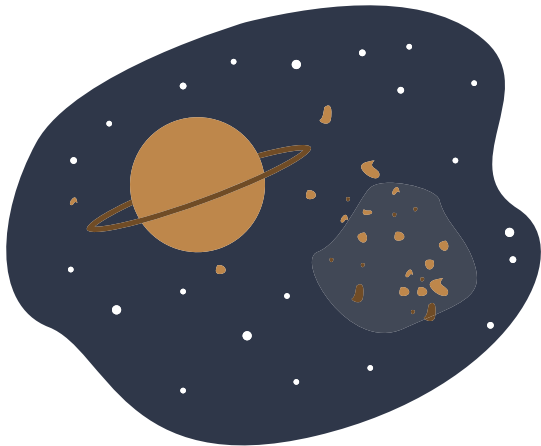
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# How Do Moons Form?

Moons are solid objects that orbit around a larger body. Moons can form in three different ways:

## 1. A moon forms from the “left-overs” of a planet.

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Often when a planet forms, some dust and gas particles don't get drawn into the gravitational pull of the rest of the new planet. Instead, the remaining matter gathers, effectively creating its own gravity. More and more particles are drawn towards it, and this forms a moon.

## 2. An asteroid becomes a moon.

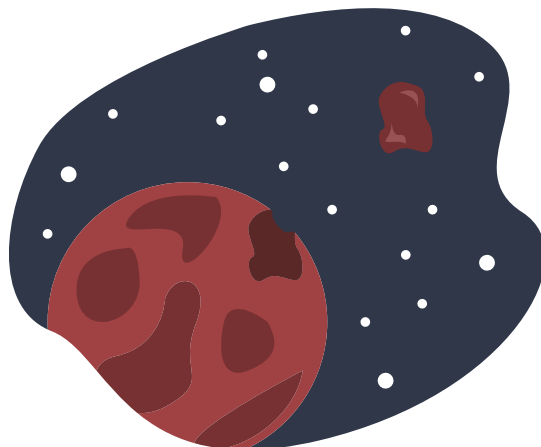
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Sometimes asteroids get pulled in by a planet's gravitational pull. In these cases, the asteroid can either enter the planet's atmosphere or begin orbiting the planet.

## 3. Parts of a planet break off and form a moon.

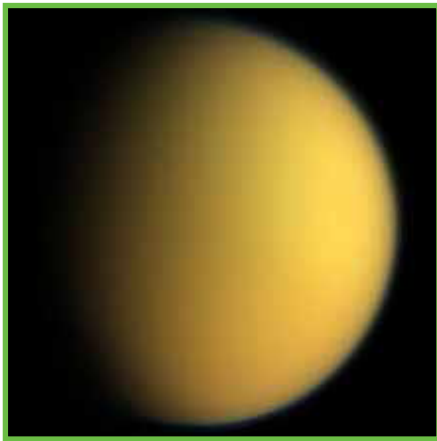
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Earth's moon was likely formed in this way. Scientists theorize that a Mars-shaped object hit our planet, causing chunks of rock to break off from Earth. These chunks gathered together and began orbiting Earth.

# Moon Match

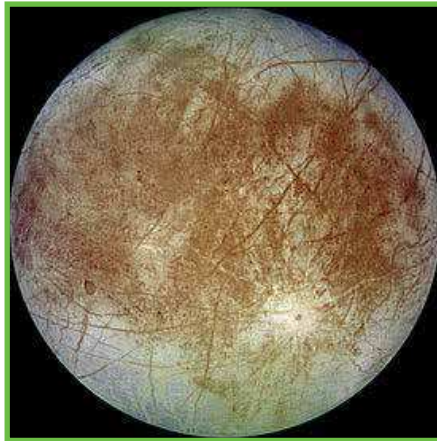
Do research to identify each image of the moons below.



This is the second largest moon in our solar system! It is also the only moon that is known to have a dense atmosphere, and actually resembles Earth in many ways.

Orbits the planet: .....

Moon: .....



This Galilean moon has an icy crust, and many scientists believe it houses a giant ocean underneath, one that could possibly support life!

Orbits the planet: .....

Moon: .....



This is one of Jupiter's four Galilean moons. It is covered in volcanoes, sulfur pits and radiation.

Moon: .....



This moon is the only large moon in the solar system with a retrograde orbit, which means it orbits in the opposite direction of its planet's rotation.

Orbits the planet: .....

Moon: .....



These two tiny moons of Saturn are shaped like flying saucers.

Moons: .....

.....

## Word Bank

Titan

Io

Saturn

Europa

Jupiter

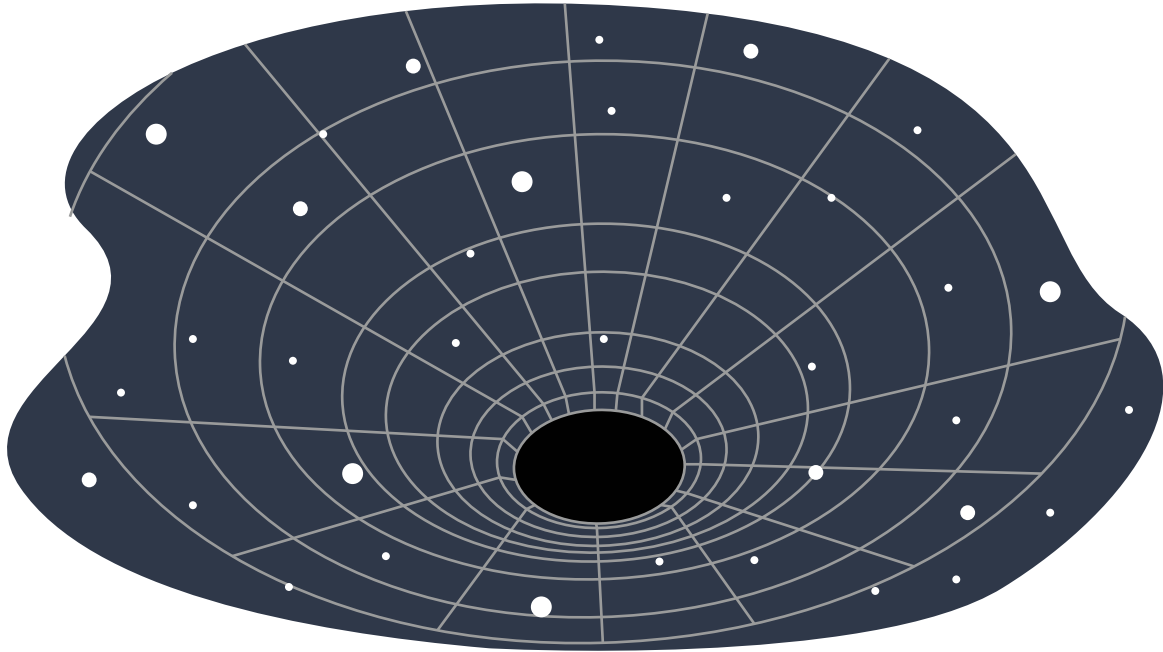
Pan

Atlas

Triton

Neptune

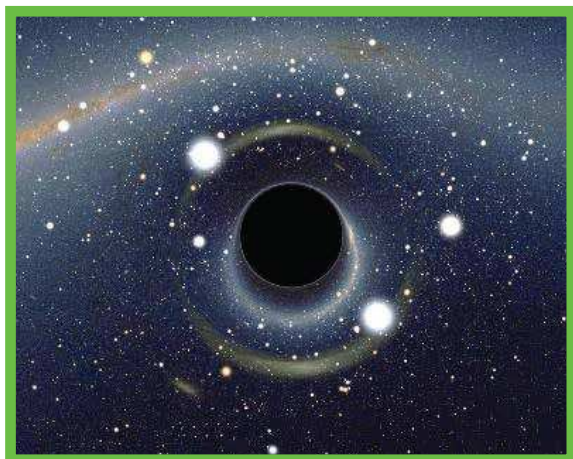
# Black Holes



A black hole is a region of space with an extremely strong *gravitational pull*. Gravitational pull is the attraction one object has for another object based on the natural force of gravity. No matter, radiation or light can escape the pull of a black hole.

Black holes are often considered invisible because the lack of light makes them nearly impossible to see without a special telescope (hence the name black hole).

Scientists estimate that black holes can be as tiny as a single atom and as big as 20 of our suns put together. Stellar black holes, the largest of the observed black holes are created when a star collapses.

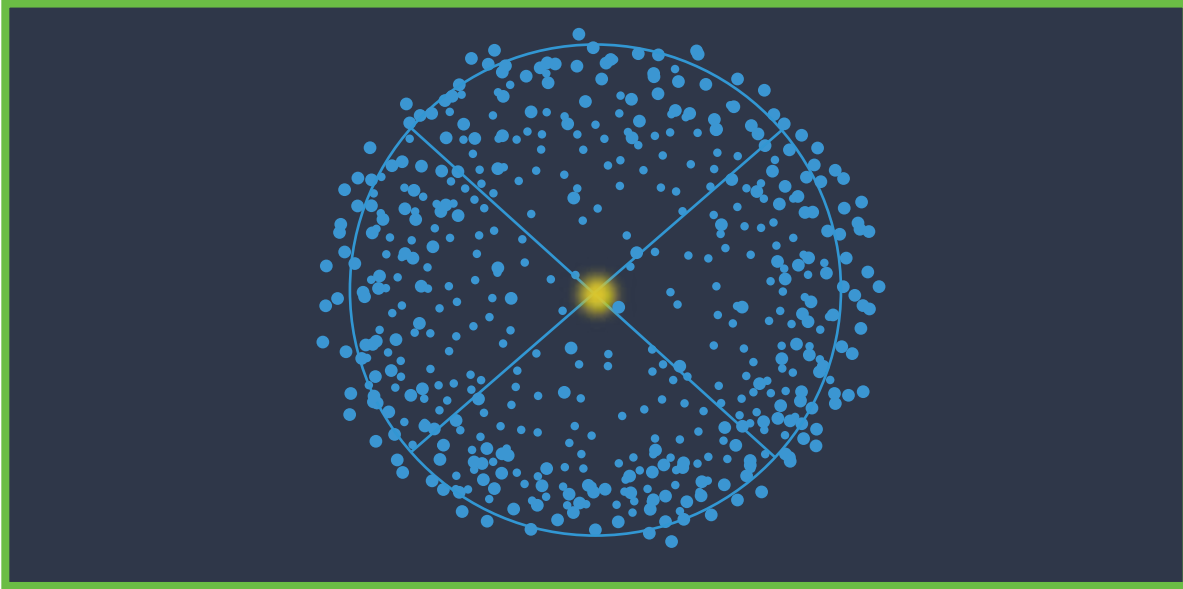


Computer simulated images of black holes



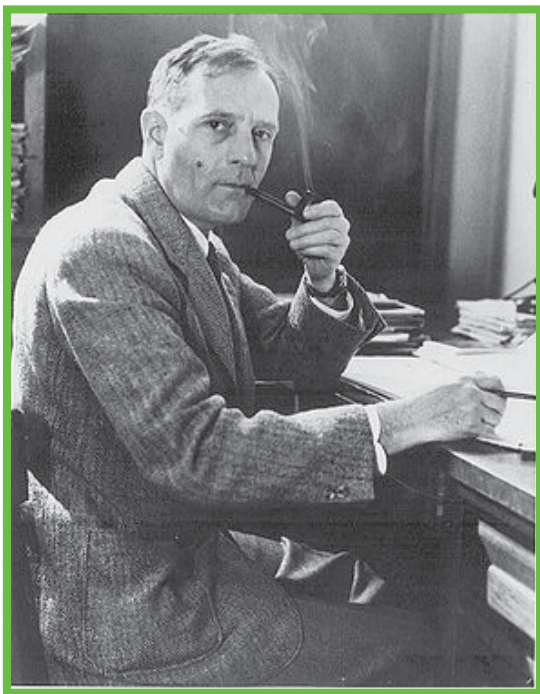
# The Big Bang Theory

The Big Bang theory is the theory that our universe began from an expansion event.



An illustration of how the Big Bang is suggested to look.

According to the theory, our universe was previously very hot and dense. The “Big Bang” caused a rapid expansion of this dense matter. This expansion turned the hot, dense universe into the spread out, cool place that we are now familiar with.



Edwin Hubble

The Big Bang was not actually an explosion, as the name seems to suggest. Instead, the Big Bang was simply a very rapid expansion of particles through space. It is worth noting that while widely accepted, the Big Bang theory is still a work-in-progress. What existed before the Big Bang and what exactly caused the Big Bang have not been fully agreed upon. Scientists estimate that the Big Bang occurred about 13 billion years ago. The universe has not stopped expanding since the Big Bang.

In 1929, Edwin Hubble observed that far off galaxies were increasing in distance from our own. Since the universe is always expanding, it is always in a constant state of change.



# The End of the Universe?

Scientists have given a series of fun names to theories about the universe's end - none of which are thought to occur for hundreds and hundreds of years.

## The Big Freeze

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As our universe continues to expand, it will continue to cool. Eventually, this could potentially lead to the universe becoming too cold to sustain life.

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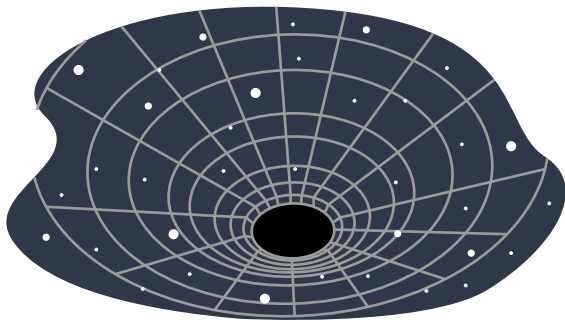
## The Big Rip

The expanding universe could cause all matter to be torn apart once the force of the expansion becomes too great.



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## The Big Crunch



Constant expansion will eventually lead the universe to collapse, ending in a single black hole.

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## The Big Bounce

This theory combines the Big Bang with the Big Crunch. According to it, our universe continues to “bounce” back and forth between a Big Bang and a Big Crunch. After this universe collapses, ending all life, expansion will help bring about a new cycle of life.

# Creative Writing

It's one million years in the future, and the universe is about to end. What's happening? Why is the universe ending? What will happen to everyone? Be creative and descriptive.

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If you knew the universe was going to end soon, what THREE things would you want to do before it all ended, and why? Pretend money is not an issue.

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You're in a spaceship traveling toward the edge of the universe. When you finally reach the edge, what is there? Tell a story about your travels to the end of the universe and what you found there.

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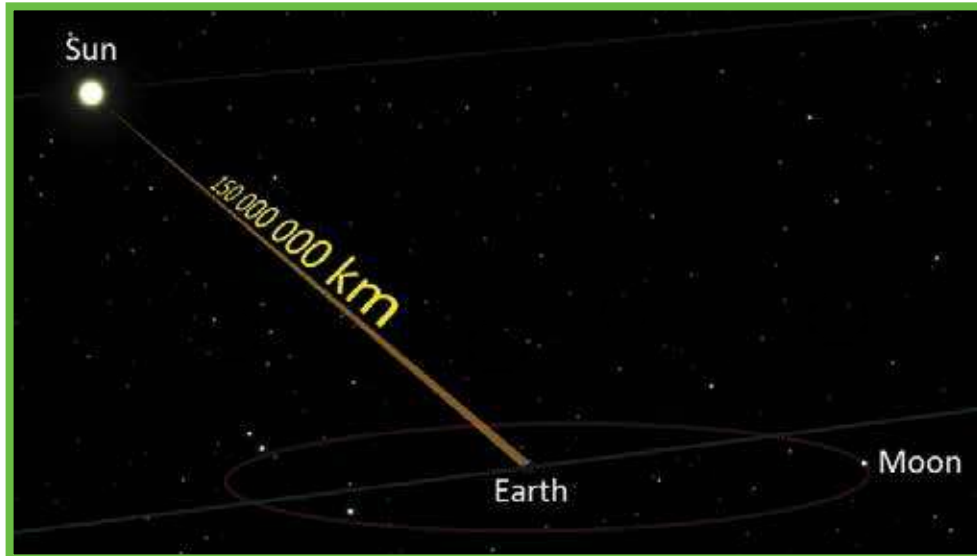
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# Light Speed

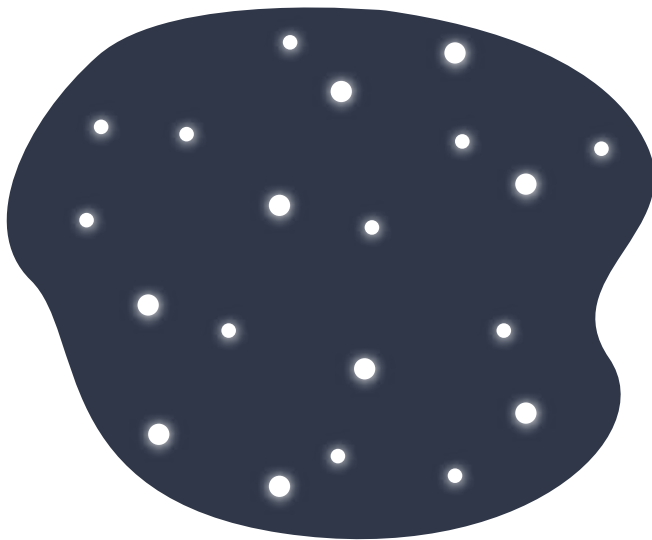
There is almost nothing in our universe that can travel faster than the speed of light!



The distance light has to travel from the Sun to Earth

*Light speed* is the speed at which light travels through a vacuum. Light travels at 186,000 miles per second through the space vacuum! When we see stars, we are seeing the light that has traveled many miles through the space vacuum to Earth.

The lights we call “stars” are actually light beams that are hundreds to millions of years old. Even our closest star, the Sun, is about 93 million miles away from Earth. It takes light from the Sun, traveling at 186,000 miles a second, a little over eight minutes to make it to Earth. That means that all the light we see from the Sun is eight minutes old!



Imagine if the Sun was suddenly destroyed. It would take roughly eight minutes before the Sun’s light would no longer be visible on Earth.

# Light Speed Math

A light year is a common unit of measurement in astronomy. It is how far light can travel over a year. Using what you know about the speed of light per second, find the measurement of a light year.

Now, using your knowledge of the speed of light per second, calculate the distances between each item in the diagram.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

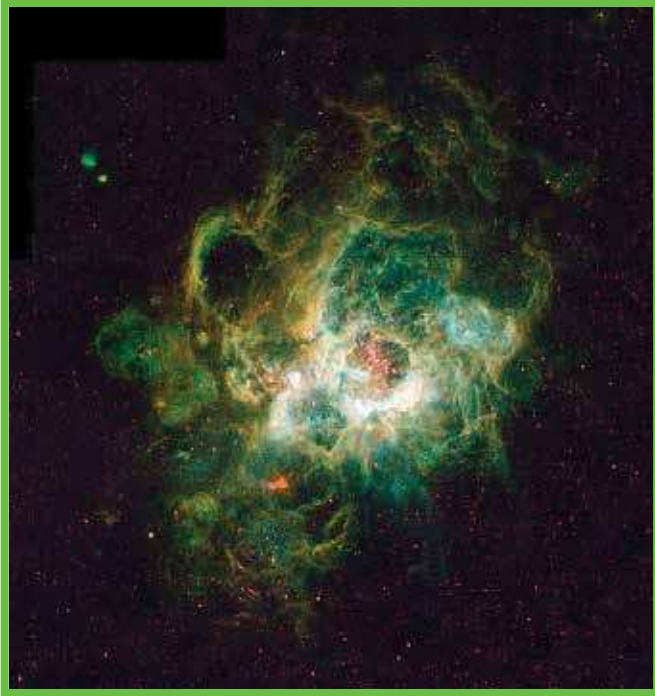


Note: This diagram shows rough estimates.

**Fun Fact:** Did you know that light from the closest star besides the Sun takes 4.3 years to reach Earth?

# Nebula

A nebula is a cloud of gas and dust in space.



The Triangulum Emission Garren Nebula



The Flame Nebula

Nebulae (the plural form of nebula) are formed from the collapse of gases or supernova explosions, and can be trillions of miles across. Nebulae often get their names from their shapes. Some examples are Horsehead Nebula and Crab Nebula. Stars, which are spheres of plasma bounded together by gravity, are formed inside nebulae.

## Types of Nebulae



Emission Nebula



Dark Nebula



Supernova Remnant



Protoplanetary Nebula



Planetary Nebula

# Reading Comprehension

Guess the name of each nebula based on its shape.



## Nebula Bank

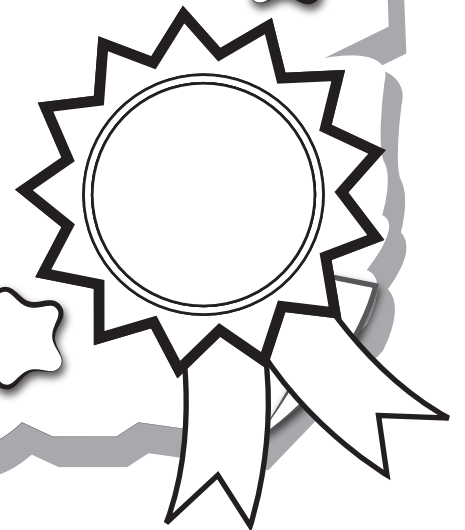
- Omega Nebula
- Horsehead Nebula
- Crab Nebula
- Cat's Eye Nebula
- Red Rectangle Nebula

Draw your own nebula.

Great job!

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# Answer Sheets

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## **Space Bits: Outer Space Objects**

Comet vs. Asteroid  
Crazy Craters Around the World  
Halley's Comet  
Solar Eclipse vs. Lunar Eclipse  
How Do Moons Form?  
Light Speed  
Nebula

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# Answer Sheet

## Reading Comprehension

1. What is the main idea of the passage in page 1?

The main idea of the passage is to define what a comet is and what and asteroid is, especially noting the differences between the two.

2. What are the differences between a comet and an asteroid? What are the similarities?

The main difference between comets and asteroids is that comets have a coma and tail, and asteroids do not.

Both comets and asteroids are rocky outer space bodies. They both orbit the sun, and they both are too small to become round and spherical like planets.

3. In outer space there is no air resistance; all objects in motion will stay in motion. With that in mind, what do you think causes comets and asteroids to move?

Comets and asteroids start to move when they are first formed; they can be formed from other big space objects colliding, or from the collapse of space giants. Eventually, gravity from the sun pulls them into orbit and they continue that way until they hit something.

**True or False?** For questions that you mark false, re-write the statement so that it is true.

1. An asteroid has a tail. Asteroids do not have tails. True  False
2. A comet has an orbit. True  False
3. The coma is just an optical illusion. True  False   
The coma is a thin atmosphere around a comet.
4. Some asteroids can be as big as our moon. True  False   
The largest known asteroid is 1/4 the size of the moon.
5. A small solar system body is not a planet. True  False
6. Comets are not round. True  False

# Answer Sheet

## Reading Comprehension

Craters are created by meteorites that hit the earth at great speeds. This impact creates lakes, canyons and other landforms. What other natural processes affect the shape of the land?

*Nature has many different ways of shaping the earth. It is called weathering. Volcanoes, earthquakes (movement of tectonic plates), floods, rainfall, snow, ice, wind, and chemical reactions in the soil are just some of the many types of weathering that shape the earth. Even gravity has an affect on the earth's shape! The earth would not be round if it weren't for gravity.*

## Finding Volume

Let's do a math review! Imagine we live in a world where craters are rectangular in shape. Find the volume of the craters using the formula below.

$$\text{volume} = \text{length} \times \text{width} \times \text{height}$$

If the Vredefort crater is 300 kilometers wide, 250 kilometers long and 10 kilometers deep, what is its volume?

$$300 \times 250 \times 10 = 750,000 \text{ km}^2$$

If the western Clearwater Lake is 32 kilometers wide, 26 kilometers long and 1.5 kilometers deep, what is its volume?

$$32 \times 26 \times 1.5 = 1,248 \text{ km}^2$$

If Lake Bosumtwi crater is about 8 kilometers wide, 8 kilometers long and 1 kilometer deep, what is its volume?

$$8 \times 8 \times 1 = 64 \text{ km}^2$$

# Answer Sheet

## Halley's Comet



**Halley's Comet** is a *periodical comet* with an *orbital period* of 75-76 years. It is the most well-known periodical comet.

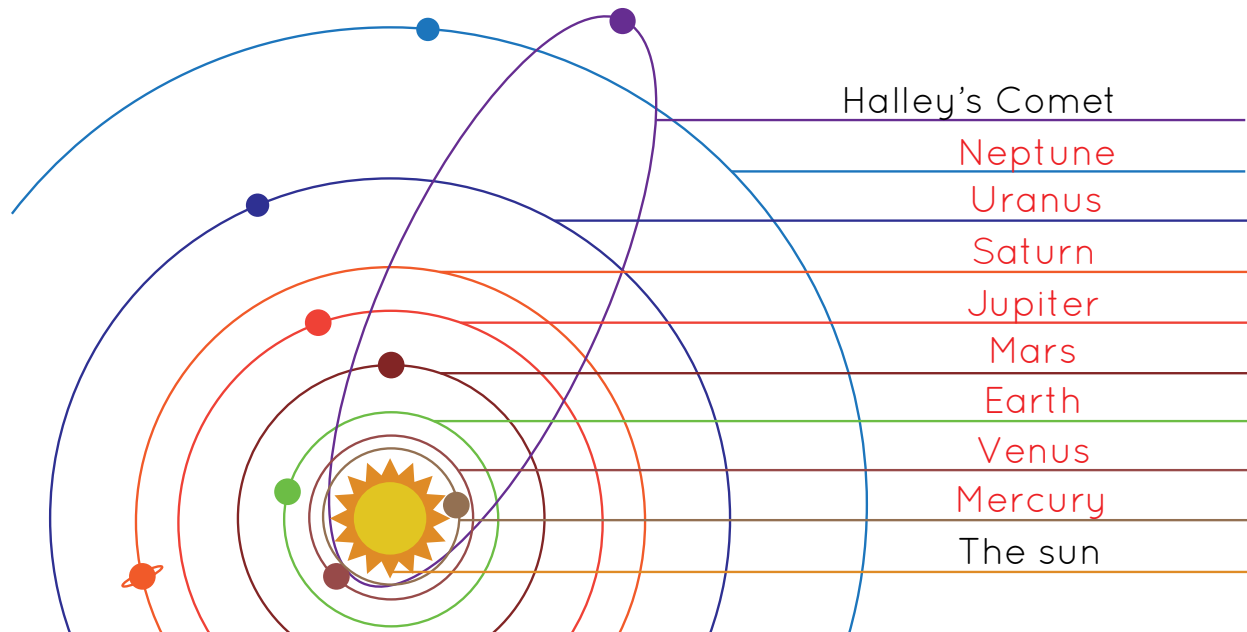
A periodical comet is a comet that has an orbital period of less than 200 years. An orbital period is the amount of time an object takes to make a complete orbit around another object. In this case, Halley's Comet takes 75-76 years to orbit around earth.

Halley's Comet was named after English astronomer Edmond Halley who first calculated the comet's orbital period in 1705. Halley's Comet last appeared in 1986, and its next predicted return is in 2061.

**DID YOU KNOW?** Halley's Comet is the only short-periodical comet that is clearly visible to the naked eye.

### Orbital Path of Halley's Comet

Label each planet in our solar system.



# Answer Sheet

## Reading Comprehension

### Think About It!

During a solar eclipse the shadow of the moon covers up the sun. Do you think that when it happens the whole earth will be in darkness? Why or why not?

*The earth will NOT be in total darkness due to a solar eclipse. Only a small area of the earth will even be able to see the eclipse. From outer space it would just look like a teeny shadow on the big earth. And for those who can see it, the sky will grow somewhat dimmer, but not completely dark.*

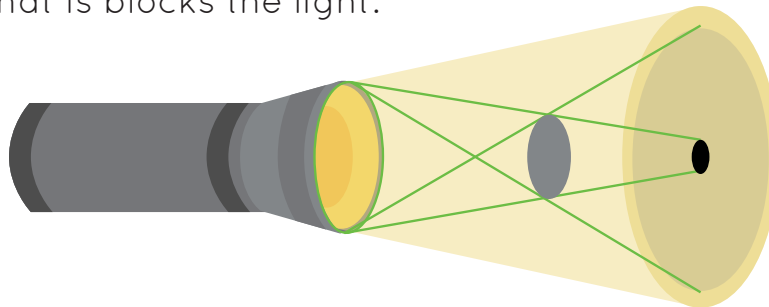
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### Try This!

Demonstrate what's happening during a solar eclipse on a smaller scale. All you need is a flashlight, a quarter and a partner. Aim the flashlight at your partner's face. Then have your partner hold up the quarter do that is blocks the light.



What happened? Which of these items represents the sun, the moon, and the earth?

*In this experiment the flashlight represents the sun, the quarter represents the moon and your partner's face represents the earth.*

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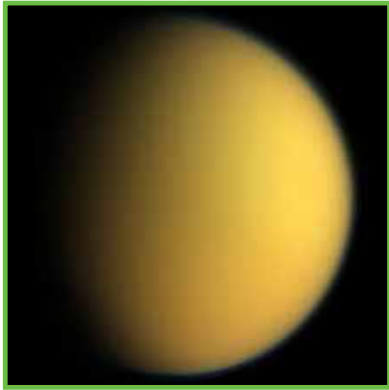
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# Answer Sheet

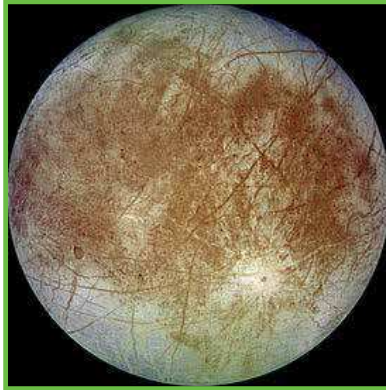
## Moon Match

Do research to identify each image of the moons below.



This is the second largest moon in our solar system! It is also the only moon that is known to have a dense atmosphere, and actually resembles Earth in many ways.

Orbits the planet: Saturn  
Moon: Titan



This Galilean moon has an icy crust, and many scientists believe it houses a giant ocean underneath, one that could possibly support life!

Orbits the planet: Jupiter  
Moon: Europa



This is one of Jupiter's four Galilean moons. It is covered in volcanoes, sulfur pits and radiation.

Moon: Io



This moon is the only large moon in the solar system with a retrograde orbit, which means it orbits in the opposite direction of its planet's rotation.

Orbits the planet: Neptune  
Moon: Triton



These two tiny moons of Saturn are shaped like flying saucers.

Moons: Pan  
Atlas

### Word Bank

Titan      Io      Saturn      Europa      Jupiter  
Pan      Atlas      Triton      Neptune

# Answer Sheet

## Light Speed Math

A light year is a common unit of measurement in astronomy. It is how far light can travel over a year. Using what you know about the speed of light per second, find the measurement of a light year.

$$186,000 \text{ miles/sec} \times 60 \text{ seconds} \times 60 \text{ minutes} \times 24 \text{ hours} \times 365 \text{ days} = 5,865,696,000,000$$

**One light year is roughly 5.8 trillion miles**

Now, using your knowledge of the speed of light per second, calculate the distances between each item in the diagram.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$



Note: This diagram shows rough estimates.

**(Multiply speed of light by the time in seconds)**

$$\text{Moon to Earth: } 186,000 \text{ mps} \times 1.2 \text{ sec} = 223,200 \text{ miles}$$

$$\text{Earth to Sun: } 186,000 \text{ mps} \times 510 \text{ sec} = 94,860,000 \text{ miles}$$

$$\text{Sun to Pluto: } 186,000 \text{ mps} \times 20,400 = 3,794,400,000 \text{ miles}$$

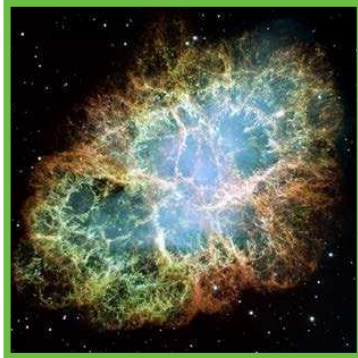
$$\text{Pluto to nearest star: } 186,000 \text{ mps} \times 22,075,200 = 4,105,987,200,000 \text{ miles}$$

**Fun Fact:** Did you know that light from the closest star besides the Sun takes 4.3 years to reach Earth?

# Answer Sheet

## Reading Comprehension

Guess the name of each nebula based on its shape.



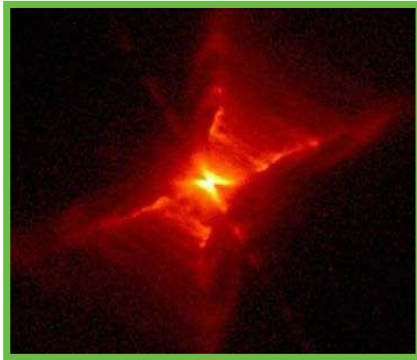
Crab Nebula



Horsehead Nebula



Cat's Eye Nebula



Red Rectangle Nebula



Omega Nebula

Draw your own nebula.

### Nebula Bank

Omega Nebula  
Horsehead Nebula  
Crab Nebula  
Cat's Eye Nebula  
Red Rectangle Nebula