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ARTICLE-A-DAY™

Getting to Know the Planets

9 Articles

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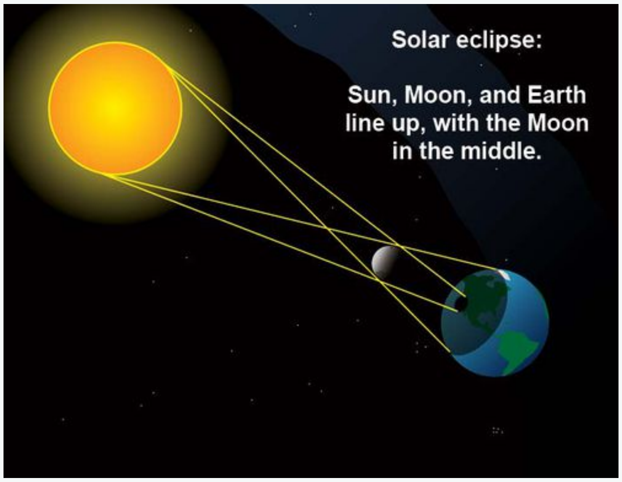
Venus Crosses the Sun

The text and images are from NASA Space Place.

Astronomers love eclipses. And this has been a great year for them!

An eclipse happens when one object in space gets right in front of another object in space. Seeing that happen is awesome! And it is a chance to learn more about one or both of the objects.

Depending on what gets in front of what, we have different names for the eclipse.

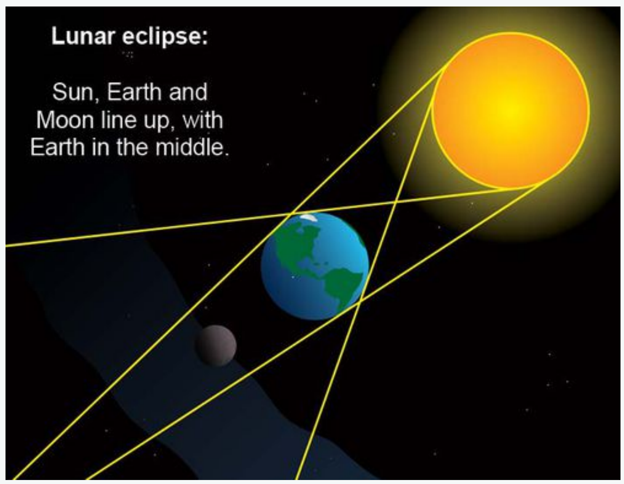


When the Moon passes between us and the Sun, we call it a solar eclipse. It is the Sun that is being "eclipsed" (meaning hidden or blocked from sight).

To form an eclipse, the two objects and the observer must be located along a straight line.

These are the most notable eclipses we see on Earth. During a solar eclipse, daylight gets dimmer for a few minutes, then returns to normal. During a lunar eclipse, the Moon may look like an orange ball. We can still see it because it reflects some sunlight that has grazed Earth's atmosphere, becoming reddened and scattered by the atmosphere as if at sunset.

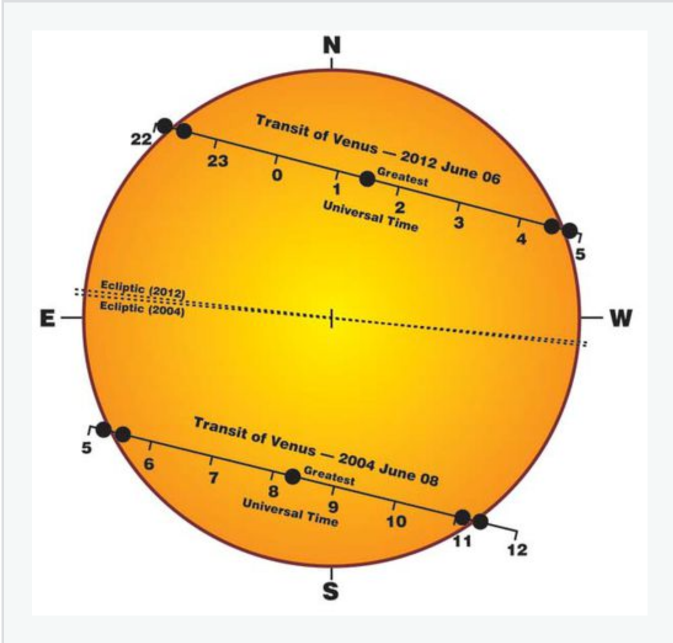
There is one other very rare eclipse that we can also see happening before our very SHIELDED eyes. That one is called a "Venus transit." Venus orbits closer to the Sun than Earth does. Sometimes Venus passes between Earth and the Sun. When things are lined up just right, we can see Venus as a small black dot moving across the face of the Sun.



When Earth passes right between the Sun and the Moon, we get a lunar eclipse.

How often can we see a Venus transit?

The answer is—not often! If you are more than 8 years old, you have been very lucky, because there have already been two Venus transits during your life. One occurred June 5 and 6, 2012. The previous one occurred in June 2004.



But after 2012, the next one will not occur until 2117! You will have wait until way past your 100th birthday to see the next one. . . .

Since the invention of the telescope, Venus transits have occurred in:

- 1631 (not witnessed) & 1639
- 1761 & 1769
- 1874 & 1882
- 2004 & 2012

How Long Is One Day on Other Planets?

The text and images are from NASA Space Place.

One day is the time it takes a planet to spin around and make one full rotation. Here on Earth that takes 24 hours. How long are days on other planets in our solar system? And what is the best way to show the answer to this question?

Let's look at a few options.

Option 1: A Paragraph

We can write a paragraph about how long days last on other planets.

On Mercury a day lasts 1,408 hours, and on Venus it lasts 5,832 hours. On Earth and Mars it's very similar. Earth takes 24 hours to complete one spin, and Mars takes 25 hours. The gas giants rotate really fast. Jupiter takes just 10 hours to complete one rotation. Saturn takes 11 hours, Uranus takes 17 hours, and Neptune takes 16 hours.

Reading that paragraph took a while, and it's hard to find all the numbers. Let's see how it looks if we put it in a table.

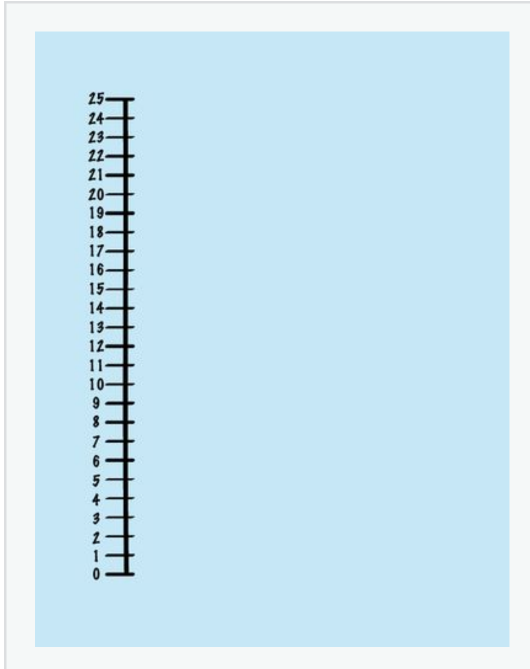
Option 2: A Table

Planet	Day Length
Mercury	1,408 hours
Venus	5,832 hours
Earth	24 hours
Mars	25 hours
Jupiter	10 hours
Saturn	11 hours
Uranus	17 hours
Neptune	16 hours

That's a little bit better. We can look up and down at the numbers and can compare them more easily. But wouldn't it be nice if we could see how big those differences are?

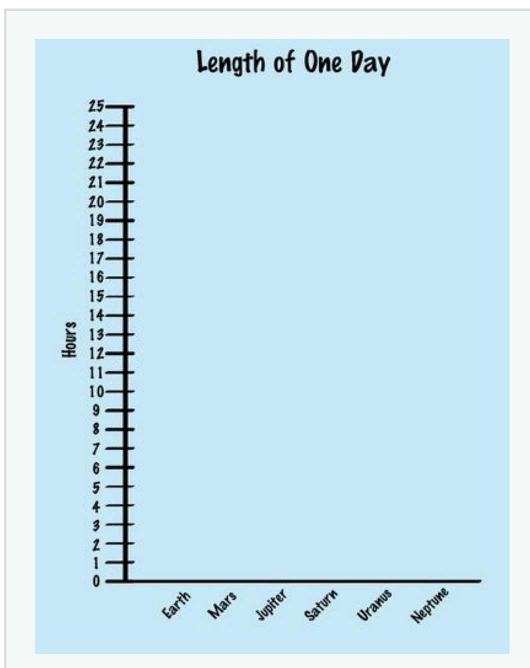
Let's make a graph with these numbers!

Option 3: A Graph



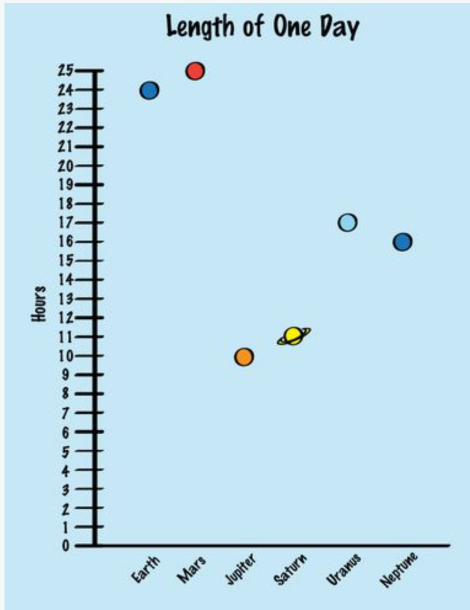
To start, make a number line that starts at 0 and goes to the highest number you need to include. This first graph will only have Earth, Mars, Jupiter, Saturn, Uranus, and Neptune on it. We'll save Mercury and Venus for later. You'll see why in a minute.

The longest day among those planets is 25 hours. That means our number line will go up to 25.



Label the number line so you remember it represents hours. And write what information the graph will have at the top.

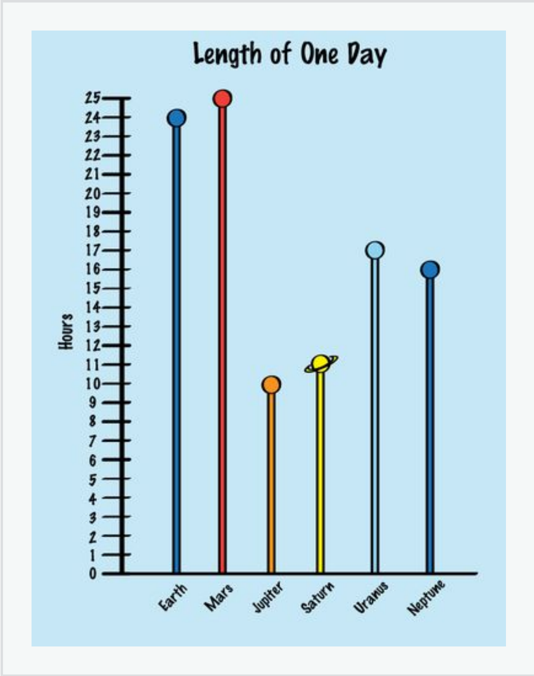
Along the bottom, write the names of the planets.



Make a dot above the name of the planet next to the number of hours its day takes.

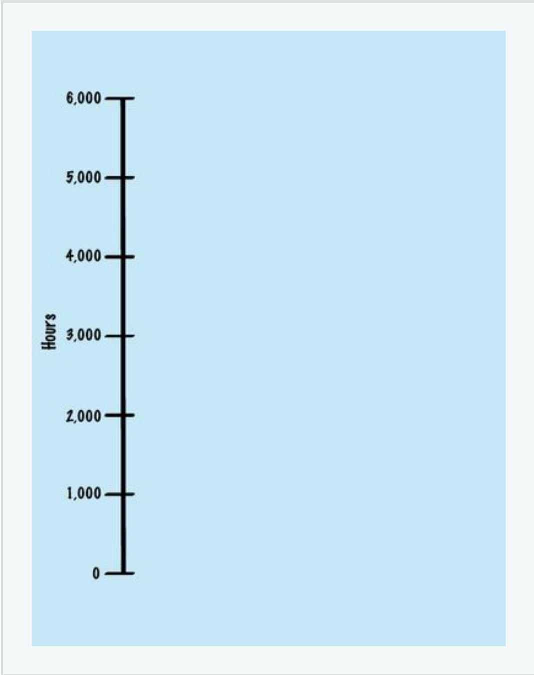
Our graph is coming together!

What do we do now? Color in the area below the dot to make a bar graph.

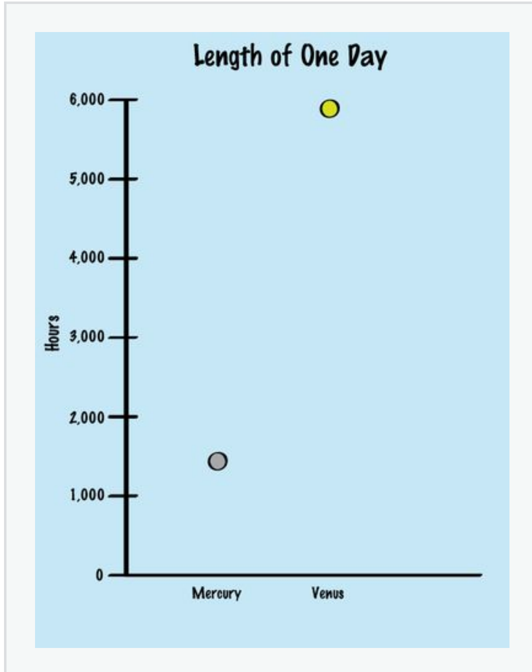


Now we can easily see which planet has the longest day, the shortest day, and everything in between. This is much easier that reading a list of numbers, don't you think?

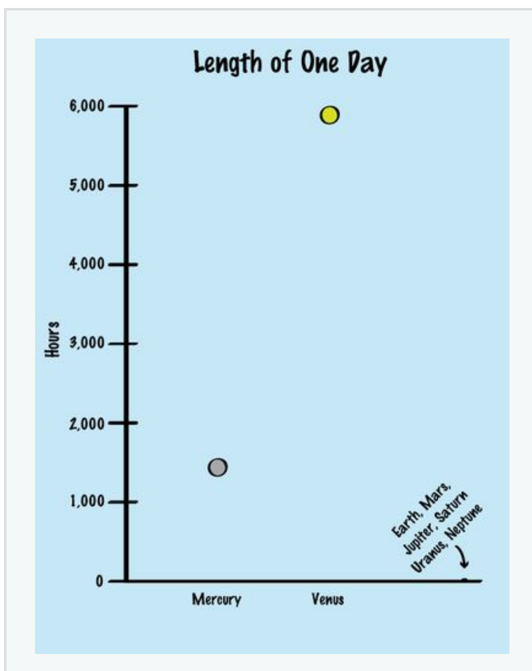
But what do we do about Mercury and Venus? Their days are *thousands* of hours long. How do we make a graph for those?



We make a number line, but instead of numbers 1, 2, *3 . . . we will use 1,000, 2,000, 3,000 . . .*



Make a number line that goes all the way up to 6,000. Along the bottom, write Mercury and Venus. Above Mercury, mark a dot a little less than halfway between 1,000 and 2,000. It's not going to be perfect, but that's okay. Now make a dot a little under 6,000 for Venus.



Do you think we can include Earth, Mars, Jupiter, Saturn, Uranus, and Neptune on here? Their dots would be so close to 0 it would be hard to tell the difference between them. Graphs work best when the *numbers are similar in size, usually with the same number of digits.*

Now that you know how to make a graph, you can show all kinds of information this way. You can graph the time it takes to get to school each day, the number of pieces of pizza your friends can eat, and how many people like the color blue or green. Go on and get graphing!

Peculiar Pluto

This text is from NASA Space Place.

Which sentence best describes Pluto?

NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

One of the final images taken before New Horizons made its closest approach to Pluto on 14 July 2015.

a. Pluto is actually closer to the sun than Neptune for about 8% of its orbit.

b. Pluto is just one of many icy objects in a distant area of our solar system.

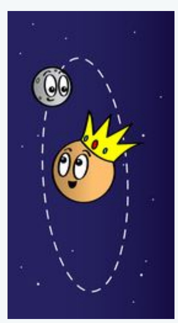
c. Pluto and its large, orbiting companion object Charon, are tipped on their sides.

d. All of the above.

Well, just pick the answer you like best, because they are all true!

Pluto is a dwarf planet that lies in the Kuiper Belt. It's an area full of icy bodies and other dwarf planets at the edge of our solar system. Because Pluto is the biggest object in this region, some call it "*King of the Kuiper Belt*."

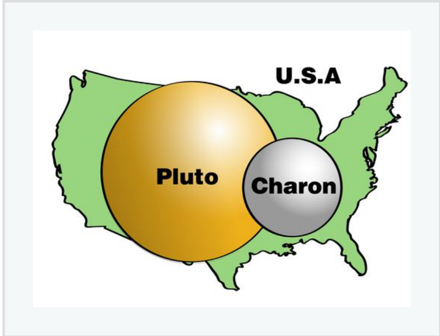
One thing is certain. Pluto and its neighborhood are very peculiar. If scientists could unravel some of their mysteries, we would know more about how our solar system formed.



NASA

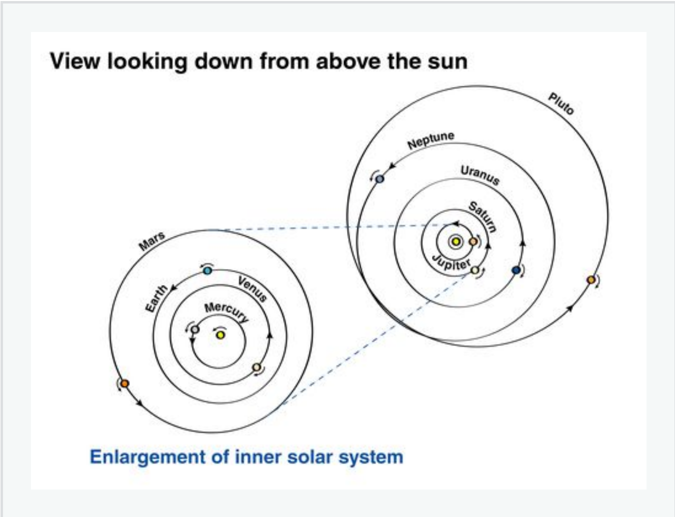
More Fun Facts About Pluto:

- Pluto is only about half the width of the United States. Charon is about half the size of Pluto. Charon is the largest moon compared to the body it orbits (whether planet or dwarf planet) of any moon in the solar system.



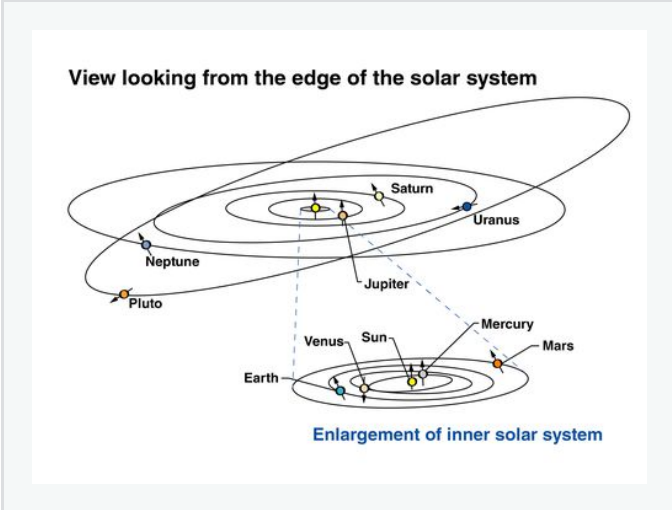
NASA

- Almost all the planets travel around the sun in nearly perfect circles. But Pluto does not. It takes an oval-shaped path with the sun nowhere near its center. What's more, its path is quite tilted from the nice, orderly plane where all the planets orbit. (*Mercury has a slightly lop-sided orbit, although not nearly so much as Pluto's.*)



NASA

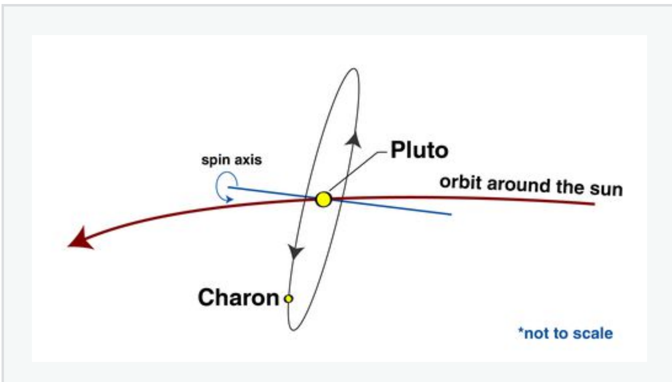
In the picture above, the arrows show the direction the planets and Pluto rotate. Notice Pluto's spin goes the opposite direction of all the others except Venus and Uranus.



NASA

In the picture above, the arrows show which direction the planets' and Pluto's axes of rotation point. Notice Pluto's and Uranus' point along the same plane as their orbits, instead of more or less "up and down."

- Compared to most of the planets and their moons, the whole Pluto-Charon system is tipped on its side. Like the planets, Pluto's spin axis stays pointed in the same direction as it orbits the sun. But unlike all planets except Uranus, Pluto is tipped on its side. The planets' axes of rotation stand more or less upright from the plane of their orbits.

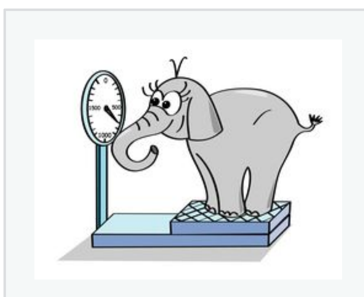


NASA

- If you lived on Pluto, you'd have to live 248 Earth years to celebrate your first birthday in Pluto-years.

NASA

- If you lived on Pluto, you would see Charon from only one side of the planet. Charon's orbit around Pluto takes about six and one-half Earth days. Pluto's day (that is, one complete rotation) takes exactly the same amount of time. So, Charon always "hovers" over the same spot on Pluto's surface, and the same side of Charon always faces Pluto.
- At Pluto's current distance from the sun, the temperature on its surface is about 400 degrees below zero Fahrenheit! It will get even colder as it moves farther from the sun. From Pluto, the sun looks like just a bright dot in the sky, the brightest star visible. The light from the sun is as bright on Pluto as the light from the full Moon is on Earth.
- If you weigh 100 pounds on Earth, you would weigh only 7 pounds on Pluto!

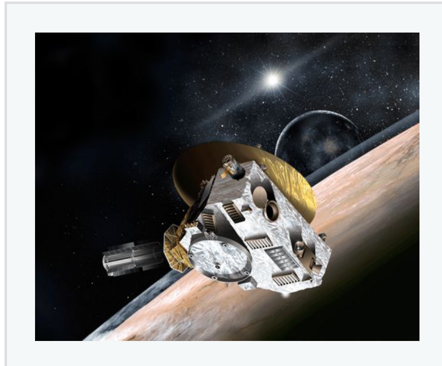


NASA

- Pluto orbits in a far-out region of the solar system called the Kuiper (rhymes with viper) Belt. There are lots of icy, rocky objects out there. But they are so far from the sun they are really hard to see, even with powerful telescopes.

Let's Go There!

We finally got to visit Pluto, Charon, and the Kuiper Belt! On January 19, 2006, NASA launched a robot spacecraft on the long journey. This mission is called New Horizons. The spacecraft arrived at Pluto in July 2015, and will continue to study other objects in the Kuiper Belt from about 2018 to 2022.



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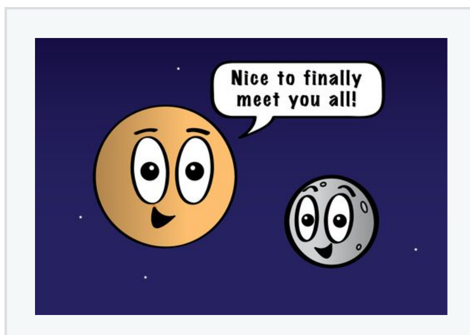
With New Horizons, we will visit and learn about the objects at the very edge of our solar system. They may help us understand how our solar system formed.



NASA

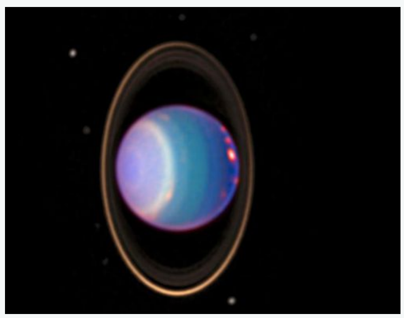
Why Did It Take So Long to Discover Uranus?

This text is from NASA Space Place.

Right in Plain Sight

If you know where to look, and your eyes are strong enough, you might be able to see Uranus without a telescope or binoculars. It's not very bright and barely large enough, but it does sometimes appear in our night sky.

In spite of this, Uranus wasn't officially discovered until 1781. Ancient Babylonians knew about all of the planets from Mercury to Saturn long before that. Why did it take so long for people to find lonely Uranus?



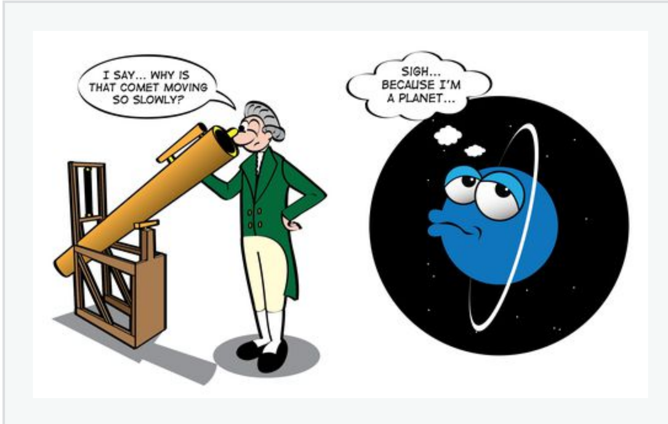
NASA/JPL/STScI

Hubble telescope image of Uranus

What to Call It?

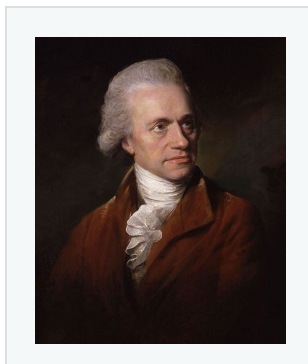
Actually, it wasn't a matter of finding it. It was a matter of knowing that it was a planet. The story of Uranus's discovery is full of people not realizing what they were seeing. People may have seen Uranus as early as 128 B.C. but, each time they saw it, they said it was a star.

In fact, the man who we credit with discovering the planet got it wrong too! Sure, he knew it wasn't a star, but he didn't think it was a planet either. On March 13, 1781, William Herschel—an amateur astronomer—located an object in the night sky. After measuring it, he determined that this object moved too quickly to be a star. It had to be a comet, he thought.



NASA

A Great Debate



NASA

Sir William Herschel

Herschel told other astronomers about the new "comet." They were confused. The problem was that a comet as bright as this object would have to be pretty close to the sun, but a comet that close to the sun would have to be moving through the sky much faster than this thing was moving. It also didn't have a coma or a tail like comets have.

These other astronomers began to study the object too. They figured out that its orbit was pretty close to circular—just like the orbit of a planet. That was enough for most of them to call it a planet. By 1783, Herschel also accepted that it must be a planet. After he tried to name it after King George III, the planet was named Uranus, after the Greek god of the sky.

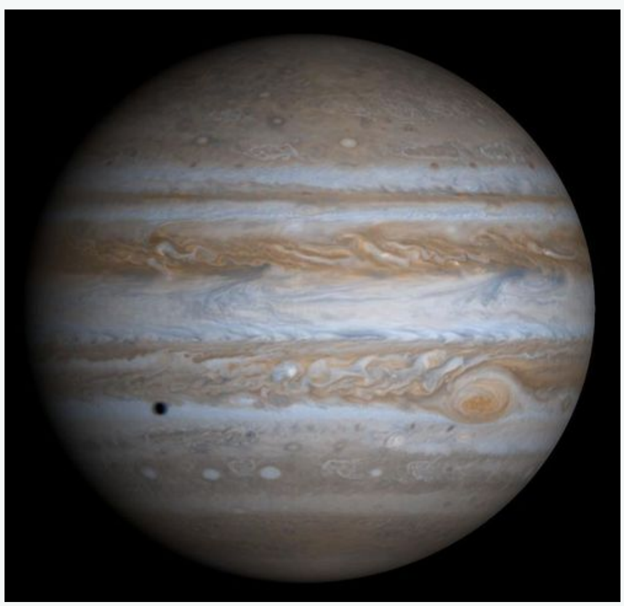
What's It Like Inside Jupiter?

This text is from NASA Space Place.

Under Pressure . . .

If you have ever spent any time at the bottom of the deep end of a pool, you probably noticed that everything around you seemed heavier. Your ears might have hurt a bit and you might have felt your goggles press harder against your face. This is because the deeper you go, the more water there is on top of you. All that water presses against you and you experience more pressure.

If you notice this effect in a relatively shallow swimming pool, imagine how much pressure you would feel at the bottom of the deepest part of the ocean. At the bottom of the Pacific Ocean, you would feel as if there were over 16,000 pounds of force pressing on every square inch of your body! That's like having the weight of three cars pressing against every square inch of your body. Obviously no human could survive under such conditions—that's why we've had to build incredibly strong submarines to go that deep.



NASA/JPL/Univ. of Arizona

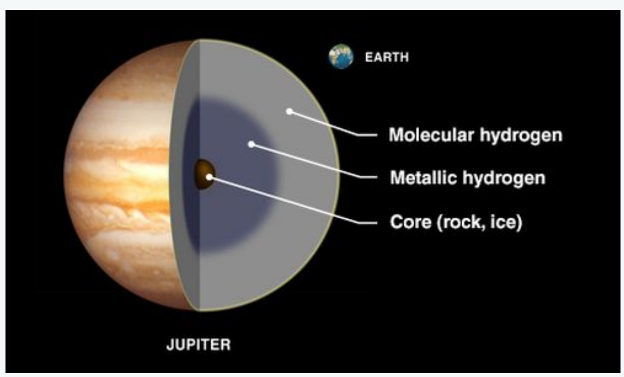
Jupiter

But that kind of pressure is nothing compared to what would be found at the center of the Earth. Think of everything that would be on top of you—oceans, mountains, millions of tons of molten material, an iron core... In theory, you would experience about 53 million pounds (or around 10,000 cars) of pressure on every square inch of your body at that depth.

But as powerful as that may sound, the pressure at the center of Earth is child's play compared to the pressure at the center of Jupiter. How much weight would each square inch of your body experience there? Potentially over 650 million pounds! That's nearly 130,000 cars! If you were to stack up all those cars they would rise up 117 miles above Earth—and if you can imagine it, there would be one stack like that for each square inch of your body!

What Happens Under That Much Pressure?

It turns out some pretty crazy things happen under that kind of immense pressure. Jupiter is made up almost entirely of hydrogen. When you think of hydrogen, you probably think of a common, colorless, odorless gas. But under the millions of pounds of pressure found inside Jupiter, the hydrogen gas is compressed so much that it actually changes into a liquid! Even deeper, the pressure is so great that the liquid hydrogen acts like a metal. Scientists call it liquid metallic hydrogen.



NASA

Here's what we think it looks like inside of Jupiter. Earth is shown for scale.

At least we are pretty sure that's what is going on inside Jupiter. The conditions on Jupiter are so extreme that they can't really be recreated here on Earth. Scientists have been trying for years to create liquid metallic hydrogen. But it is nearly impossible to mimic the interior of Jupiter on Earth for more than a couple millionths of a second.

The Largest Ocean in the Solar System

NASA

Jupiter's Great Red Spot. The spot is a hurricane-like storm that has been raging on the planet's gaseous exterior for hundreds of years. But what's happening inside may just be even crazier than that!

Despite how hard it is to create these conditions here on Earth, Jupiter is so extremely massive that it probably has an entire ocean of liquid metallic hydrogen deep underneath its cloudy exterior. Incredibly, if scientists are right, it would be the largest ocean in our solar system.

An entire ocean of something we can barely produce here on Earth! Turns out pretty crazy things happen when something is surrounded by the weight of 130,000 cars in every direction!

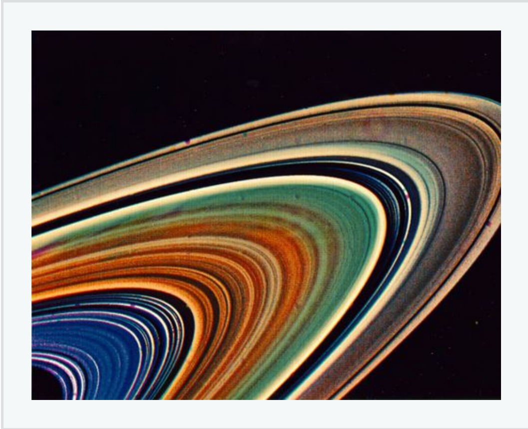
Why Does Saturn Have Rings?

The text and images are from NASA Space Place.

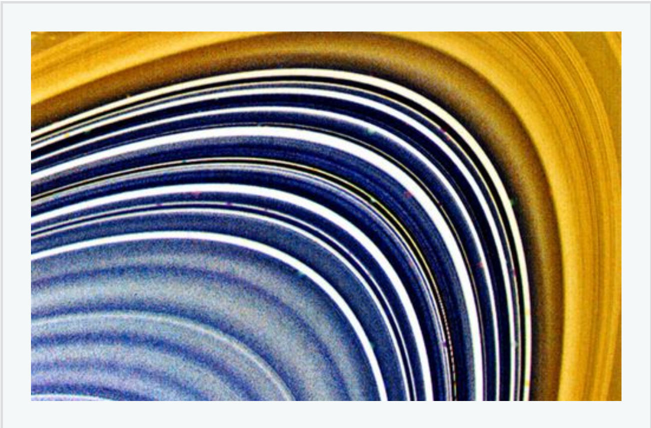
Scientists have ideas about why Saturn has rings, but no one knows for sure.

What are Saturn's rings made of?

Are they solid like the CD you used to make your model? Or are they made of many particles dancing in formation around the planet? Four robotic spacecraft from Earth have visited Saturn—Pioneer 11, Voyager 1, Voyager 2, and Cassini. They have revealed many surprising things about Saturn's rings.



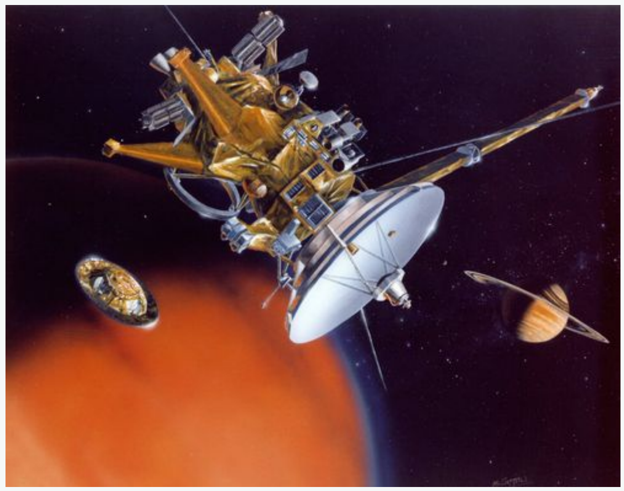
The small color differences in Saturn's rings have been enhanced in this picture from Voyager 2 data.



Over 60 bright and dark ringlets show up in this color enhanced image from Voyager 2 data.

The rings are about 400,000 kilometers (240,000 miles) wide. That's the distance from the Earth to the Moon! But the rings are as little as 100 meters (330 feet) thick. They range from particles too tiny to see to "particles" the size of a bus. Scientists think they are icy snowballs or ice covered rocks.

There are actually many rings—maybe 500 to 1000. There are also gaps in the rings. (That's why we put some black rings on our model Saturns.)



The Cassini spacecraft arrived at Saturn in July 2004 and is still there. It is studying Saturn, its rings, and its moons much more thoroughly than the earlier spacecraft could.

Cassini also carried a probe, called Huygens (HOY-guns), that parachuted into the atmosphere of Saturn's giant moon Titan. Huygens sent back amazing information and images from this strange world whose surface we have never seen.

Cassini and Huygens have made exciting new discoveries.

One Way to Find a Planet

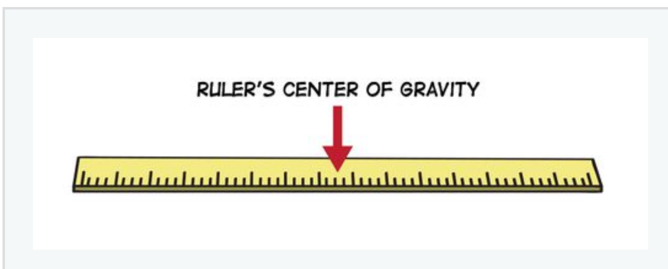
The text and images are from NASA Space Place.

We say that planets orbit stars, but that's not the whole truth. Planets and stars actually orbit around their common center of mass. This common center of mass is called the barycenter. Barycenters also help astronomers search for planets beyond our solar system!

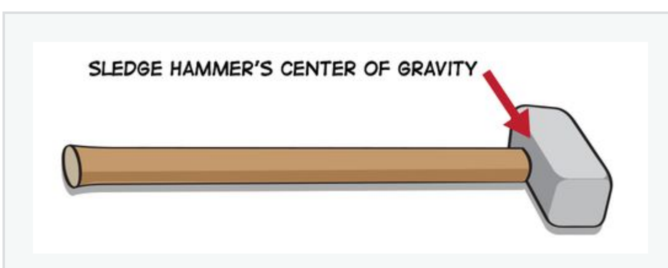
What is a center of mass?

Every object has a center of mass. It is the exact center of all the material an object is made of. An object's center of mass is the point at which it can be balanced.

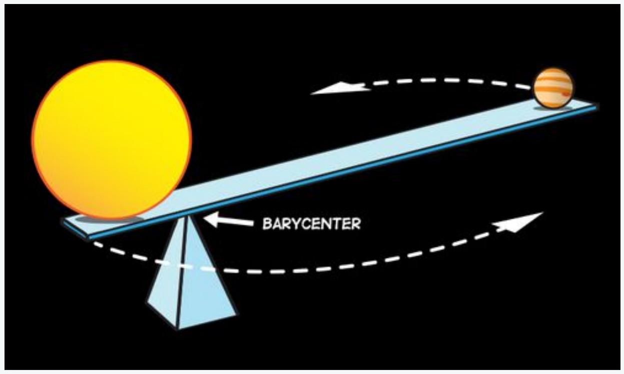
Sometimes the center of mass is directly in the center of an object. For example, you can easily find the center of mass of a ruler. Try holding your finger under the middle of a ruler in a few different spots. You'll find a spot where you can balance the whole ruler on just one fingertip. That's the ruler's center of mass. The center of mass is also called the center of gravity.



But sometimes the center of mass is not in the center of the object. Some parts of an object may have more mass than other parts. A sledge hammer, for example, has most of its mass on one end, so its center of mass is much closer its heavy end.



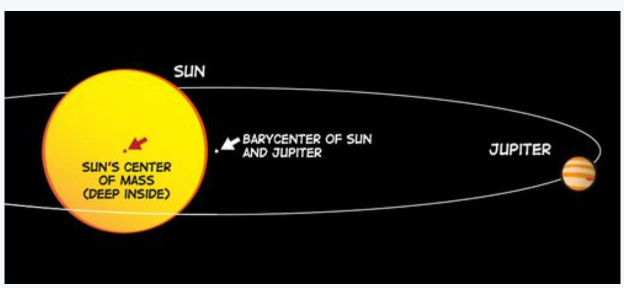
In space, two or more objects orbiting each other also have a center of mass. It is the point around which the objects orbit. This point is the barycenter of the objects. The barycenter is usually closest to the object with the most mass.



Barycenters in Our Solar System

Where is the barycenter between Earth and the sun? Well, the sun has lots of mass. In comparison, Earth's mass is very small. That means the sun is like the head of the sledgehammer. So, the barycenter between Earth and the sun is very close to the center of the sun.

Jupiter is a lot larger than Earth. It has 318 times more mass. As a result, the barycenter of Jupiter and the sun isn't in the center of the sun. It's actually just outside the sun's surface!



Our entire solar system also has a barycenter. The sun, Earth, and all of the planets in the solar system orbit around this barycenter. It is the center of mass of every object in the solar system combined.

Our solar system's barycenter constantly changes position. Its position depends on where the planets are in their orbits. The solar system's barycenter can range from being near the center of the sun to being outside the surface of the sun. As the sun orbits this moving barycenter, it wobbles around.

How do barycenters help us find other planets?

If a star has planets, the star orbits around a barycenter that is not at its very center. This causes the star to look like it's wobbling.

Planets around other stars—called exoplanets—are very hard to see directly. They are hidden by the bright glare of the stars they orbit. Detecting a star's wobble is one way to find out if there are planets orbiting it. By studying barycenters—and using several other techniques—astronomers have detected many planets around other stars!

Jumping the Tallest Cliff in the Solar System

The text and images are from NASA Space Place.

Mount Thor (in Nunavut, Canada) has the tallest cliff face on Earth.

Let's talk extreme sports. What's more extreme than jumping off a cliff with a parachute? Jumping off the highest cliff known to humankind, that's what!

Here's the thing: This super-high cliff is not here on Earth. It's a whole lot taller than what we've got on our planet.

The Tallest Cliff on Earth

To get a good comparison, we would first have to take a trip to the remote and rugged mountains of northern Canada to see the tallest cliff on Earth.

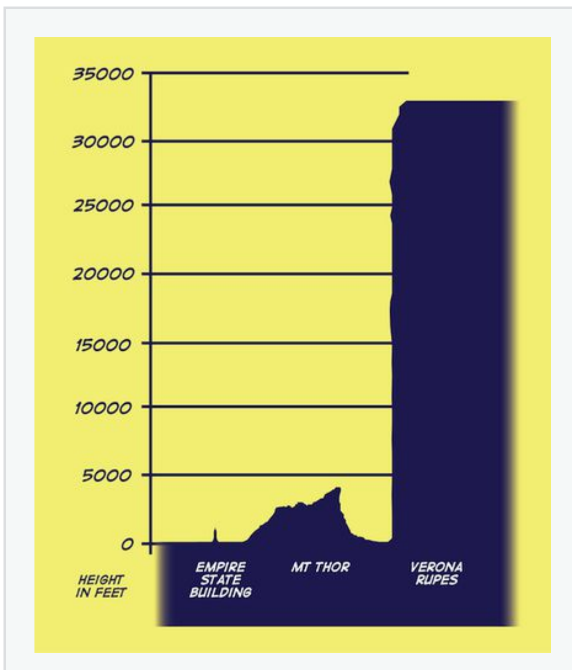
There, we would find ourselves at the base of Mount Thor. We'd also be in front of a massive cliff. The cliff is 4,100 feet tall—without any breaks.

If we were to drop a bowling ball from the top (something you should never ever do), it would take almost 20 seconds for it to hit the ground. Count that out in your head: 1 . . . 2 . . . 3 . . . 4 . . . . That's a lot of falling! By the time it reaches the ground, the ball would be traveling over 150 miles per hour! That would be a pretty extreme fall for a professional cliff jumper.

The Tallest Cliff Known to Humans!

Not impressed? Fine. But the tallest cliff known to us is in a place even more remote than northern Canada. We would have to take a long journey to find it.

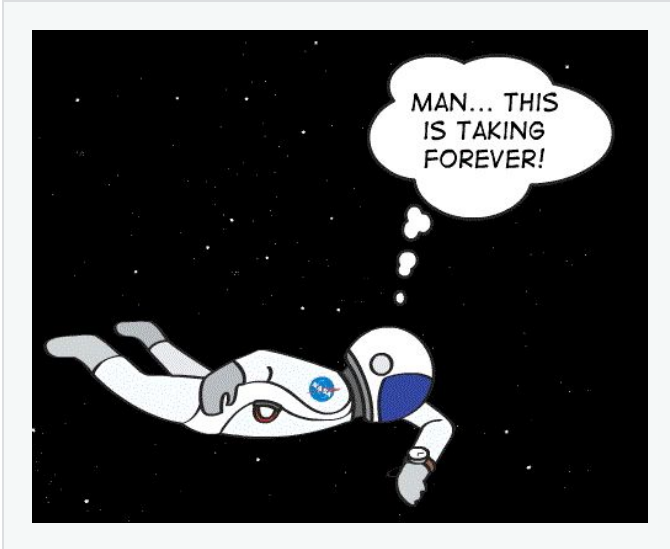
It's on a moon named Miranda in orbit around Uranus. That's right near the far edge of our solar system. It's estimated that this cliff—named Verona Rupes—is over six miles high. It's nearly 33,000 feet tall. That's five times the depth of the Grand Canyon and taller than Mount Everest!



This figure is to scale.

Extreme Space Jump or Leisurely Tumble?

So what would happen if our trained professional/extreme astronaut jumped from something that high? You probably wouldn't be too surprised to hear that it would take a long time to fall.



But what might shock you is how long it would take. The fall would last a full eight minutes. You might also be surprised to learn that the jumper would be going much slower by the time he or she reached the ground. The jumper would max out at around only 90 miles per hour and might even be able to land safely with some sort of futuristic airbag!

The fall would take so much more time because Miranda is much smaller than Earth. That means it has less gravity. In fact, the gravity is only 0.008 times as strong there as compared to Earth.

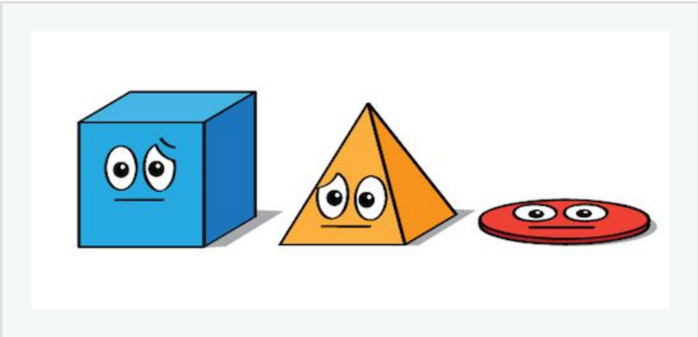
So maybe our super long space jump wouldn't be that extreme after all?

Why Are Planets Round?

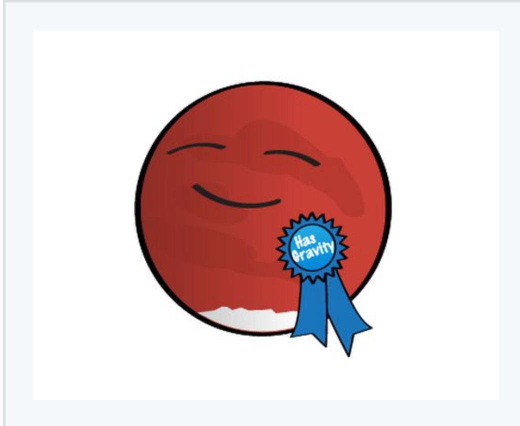
The text and images are from NASA Space Place.

Big, Small, But All Round

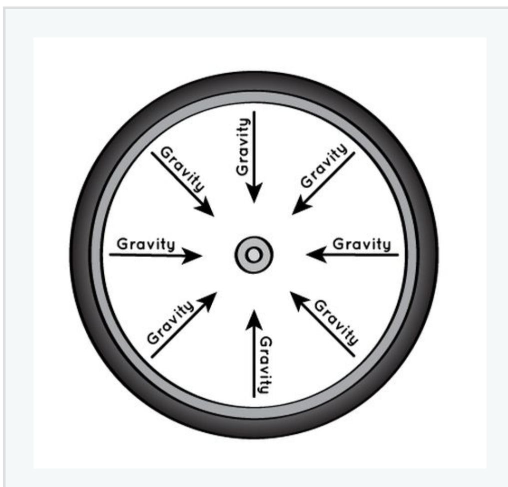
The eight planets in our solar system differ in lots of ways. They are different sizes. They are different distances from the sun. Some are small and rocky, and others are big and gassy. But they're all nice and round. Why is that? Why aren't they shaped like cubes, pyramids, or discs?



Planets form when material in space starts to bump and clump together. After a while it has enough stuff to have a good amount of gravity. That's the force that holds stuff together in space. When a forming planet is big enough, it starts to clear its path around the star it orbits. It uses its gravity to snag bits of space stuff.



A planet's gravity pulls equally from all sides. Gravity pulls from the center to the edges like the spokes of a bicycle wheel. This makes the overall shape of a planet a sphere, which is a three-dimensional circle.

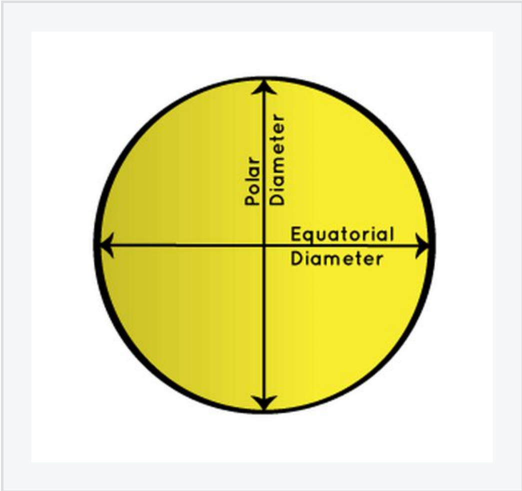


Are they all perfect, though?

While all the planets in our solar system are nice and round, some are rounder than others. Mercury and Venus are the roundest of all. They are nearly perfect spheres, like marbles.

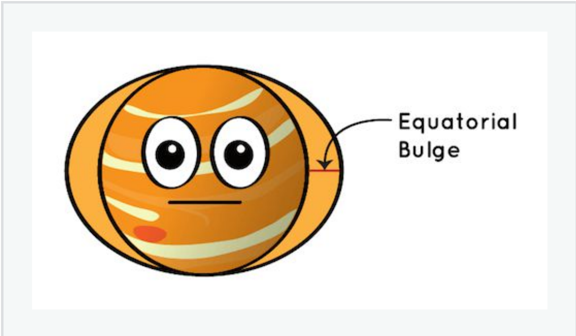
But some planets aren't quite so perfectly round.

Saturn and Jupiter are bit thicker in the middle. As they spin around, they bulge out along the equator. Why does that happen? When something spins, like a planet as it rotates, things on the outer edge have to move faster than things on the inside to keep up. This is true for anything that spins, like a wheel, a DVD, or a fan. Things along the edge have to travel the farthest and fastest.



Along the equator of a planet, a circle half way between the north and south poles, gravity is holding the edges in but, as it spins, stuff wants to spin out like mud flying off a tire. Saturn and Jupiter are really big and spinning really fast but gravity still manages to hold them together. That's why they bulge in the middle. We call the extra width the equatorial bulge.

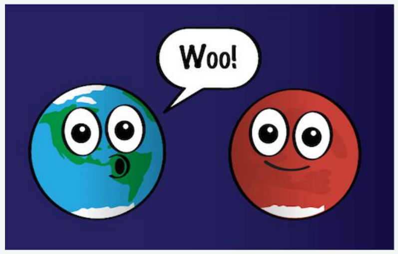
Saturn bulges the most of all the planets in our solar system. If you compare the diameter from pole to pole to the diameter along the equator, it's not the same. Saturn is 10.7% thicker around the middle. Jupiter is 6.9% thicker around the middle.



Instead of being perfectly round like marbles, they are like basketballs squished down while someone sits on them.

What about the other planets?

Earth and Mars are small and don't spin around as fast as the gas giants. They aren't perfect spheres, but they are rounder than Saturn and Jupiter. Earth is 0.3% thicker in the middle, and Mars is 0.6% thicker in the middle. Since they're not even one whole percentage point thicker in the middle, it's safe to say they're very round.



As for Uranus and Neptune, they're in between. Uranus is 2.3% thicker in the middle. Neptune is 1.7% thicker. They're not perfectly round, but they're pretty close.

Feel the forces from spinning

Do you want to know what it's like to be a spinning planet? You can feel it when you spin around in place. First, make sure there are no obstacles around that you might bump into. Then either while standing, or in a spinner chair, spin around in circles. Hold your arms close to your body, then extend your arms out. Move your arms in and out and feel the difference. When your arms are outstretched, your hands have to move faster than your shoulders to keep up, so you'll feel more force on them.