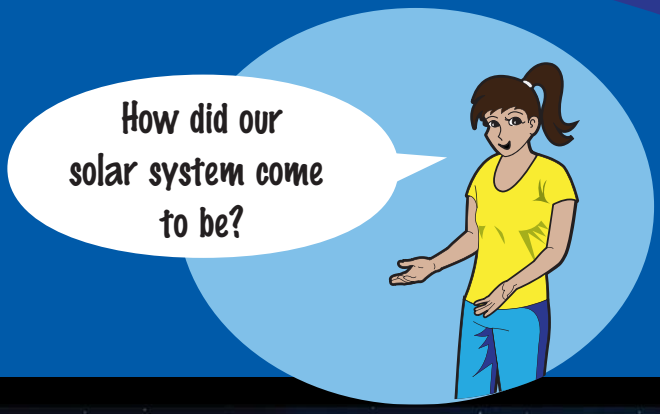
National Aeronautics and Space Administration

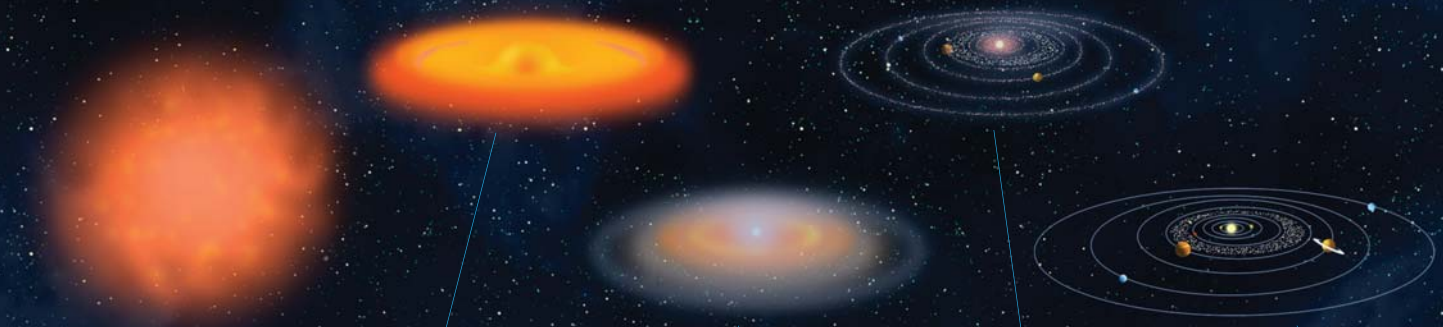
NASA

small Worlds Big Discoveries!

Our solar system was born from a wispy cloud of gas and dust. Some researchers believe that a shockwave from a nearby supernova explosion caused the cloud to compress and collapse in on itself, pulling enough material toward its center to create a star. Our sun gobbled up 99.8% of all of this matter. As the sun began to heat up, only nearby rocky objects survived while icy objects formed further away. The inner planets were created from this rocky material. The icy material (and some rocky material) further away clumped together into large enough objects that their gravity pulled gases or ices toward their center. This process formed the larger gas and ice giants. The material left over became asteroids, comets, moons or even dwarf planets.



How did it all begin?



Presolar Nebula

Approximately 4.6 billion years ago, a massive cloud of gas and dust collapsed under its own gravity, perhaps due to a nearby supernova explosion.

Protoplanetary Disk

Gravitational forces slowly pulled material toward the cloud's center, forming a flat spinning disk.

Star Formation

The material at the center of the disk became so dense and hot that nuclear fusion, an atomic process that releases lots of energy, began. This was the birth of our sun.

Planetary Material Collects

The material leftover from the sun's formation began to collide and clump together. As the clumps grew and their gravity increased, they began to collide with each other, forming still larger rocky or icy objects.

Planets Form

After several millions years, these objects grew so large that their gravity was strong enough to form spherical objects – planets. Moons sometimes formed from leftover material circling these planets. When finished, some of the leftover materials became small rocky, icy bodies that continue to wander our solar system today.

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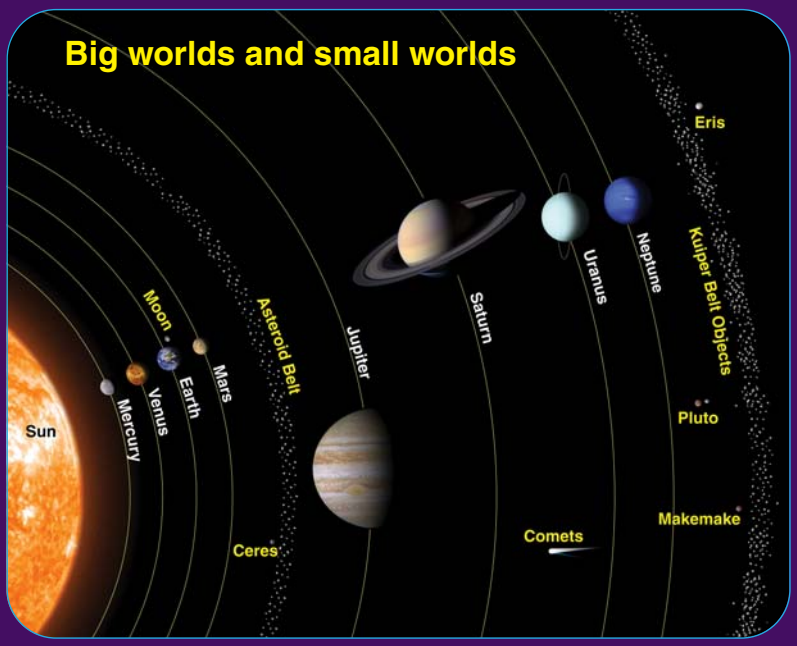
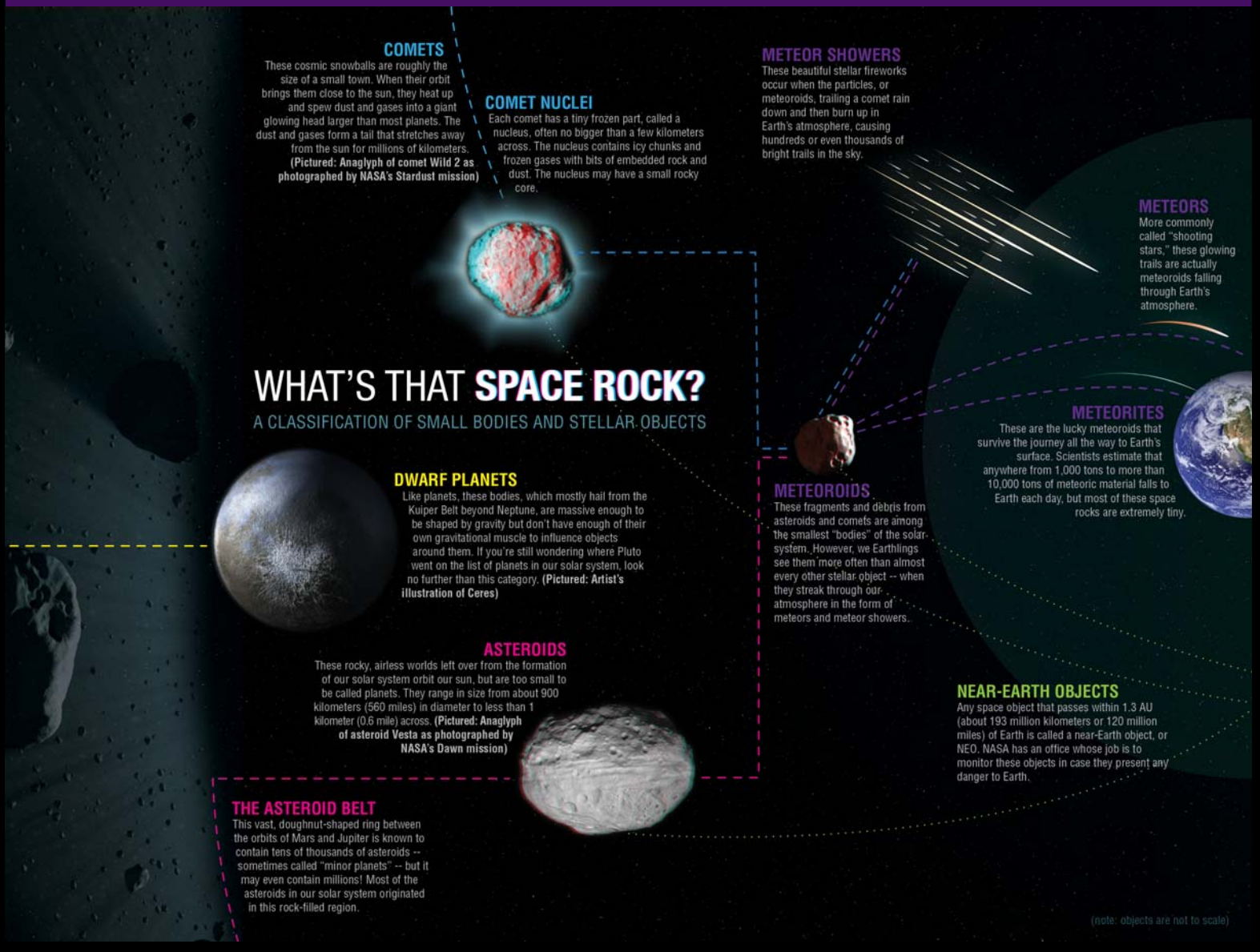
What can we learn from small bodies?

Most planets have changed significantly since they first formed. Powerful geologic forces, raging winds and other agents of change have significantly altered their surfaces. Little is left on these objects that record what conditions were like in the early solar system.

Luckily for us, the solar system is full of objects that have not been subject to the same forces. Many smaller rocky and icy bodies have changed very little since our solar system's early days.

Each of these smaller, more "primitive" worlds offers valuable information about what the early solar system was like. Small bodies have provided scientists with information ranging from the age of the solar system (and of the Earth) to the possibility that a supernova might have been responsible for creating our solar system in the first place.





What's so special about being round?

Planets and dwarf planets are, by definition, spheres. Comets and most asteroids are not.

If an object is large enough, its gravity will be strong enough to reshape the material from which it was made. If the objects are smaller, like asteroids and comets, the gravity will not be able to mold it into a sphere.

The material that makes up the objects matters, too. Rocky objects are harder to reshape than icy objects, which are softer and more flexible.

What are the orbits of small bodies like?

The orbits of the planets are slightly elliptical—which means oval-shaped—but they are very close to being true circles. Many small bodies, on the other hand, have extremely elliptical orbits. Why is this?

The orbits of small bodies are often formed when gravitational forces from large planets or even other stars disturb their stable orbits. This can send them hurling toward our sun from far away.

Comets, for example, often have orbits that extend from the Kuiper Belt or Oort Cloud on one end of our solar system to very close to the sun on the other.

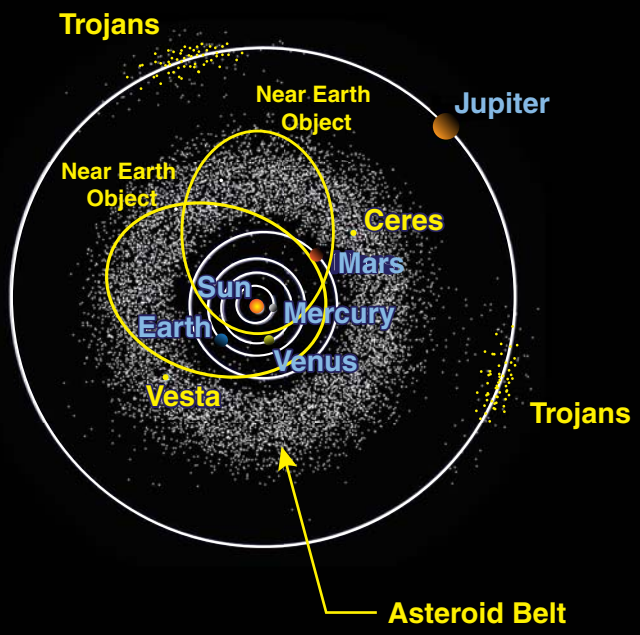
Similarly, asteroids can be flung out of the asteroid belt and hurled toward the sun or even toward Earth, becoming near-Earth objects. Scientists continually monitor the sky to search for any that might be headed our way.

Small bodies don't always develop such funky orbits, though. Some asteroids, named trojans, follow the orbital path of planets. Other small bodies, trapped by the gravity of larger planets, can become moons.

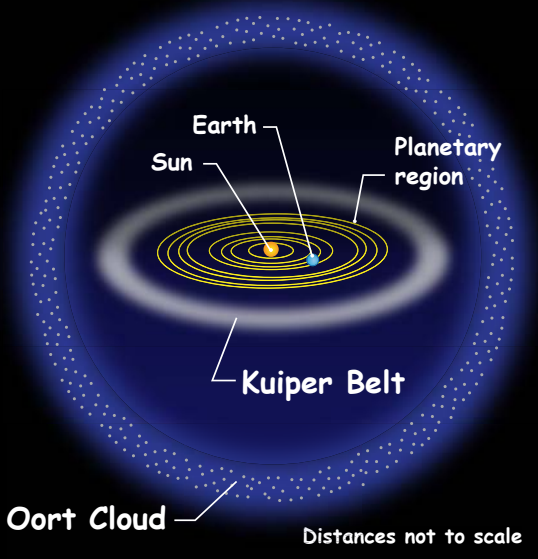
Where can these small worlds be found?

Small worlds exist in many different places. Some are relatively close to Earth, while others reside in the furthest outer reaches of our solar system.

Most of the rocky bodies are found in the asteroid belt between the orbits of Mars and Jupiter. Many icy bodies, including the dwarf planets Pluto and Eris, reside in a region known as the Kuiper Belt beyond the orbit of Neptune. Both the Kuiper Belt and the asteroid belt may be left over bits of the protoplanetary disk that never quite had enough mass to form a planet.



Way beyond even Pluto and Eris is the Oort Cloud. It is more than 50 times further from the sun than Earth. It may even extend halfway to the next nearest star. Scientists think that it could be home to trillions of icy objects, including many comets.



What about moons?

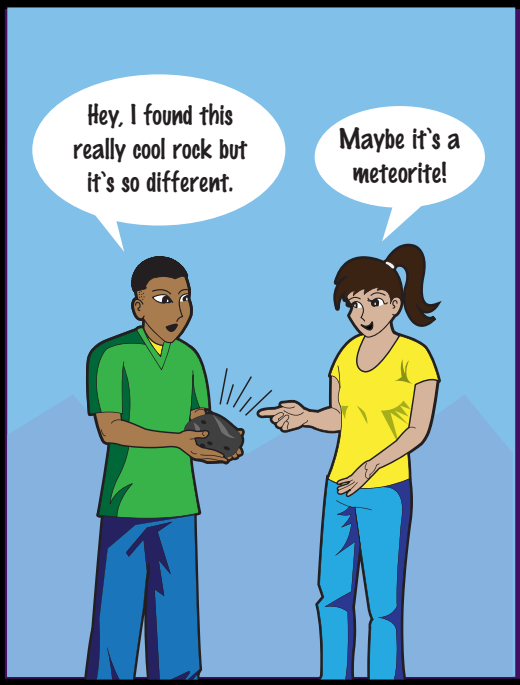
Moons can be found in many shapes and sizes and in many locations throughout our solar system. There are moons orbiting planets, dwarf planets and even asteroids.

Nineteen moons are large enough to be spherical. Others are small and irregular shaped or warped by the strong gravity of their parent planet. Some have geologic activity, like earthquakes, plate movements and volcanoes. A few even have atmospheres and weather.

Jupiter's moon Io, for example, has a massive volcano whose erupting plume of lava and gas can be seen from space. Saturn's moon Titan has large lakes of methane or ethane—it may even rain methane and ethane there.

We know of at least 146 moons orbiting other planets in our solar system, but there are very likely many more to be found.

Scientists believe that most of these moons formed from disks of gas and dust circling around planets in the early solar system. Earth's moon, on the other hand, may have formed when a Mars-sized object collided with the young Earth some 4.5 billion years ago. The debris that was ejected into space clumped together into the object we know as the Moon.



Is that a rock? No! It's a meteorite!

Comets and asteroids can tell us a lot about our solar system. But how can we get our hands on these important objects if they are floating around in space? One way is to wait for bits of them to fall down to Earth. That's where meteorites come in.

Meteorites are meteors that have made it through Earth's atmosphere and landed on the ground. Meteors are most often tiny broken bits of asteroids and comets. When these objects get pulled into Earth's atmosphere, they burn up and emit a bright light. You may know these as "shooting stars," even though they have nothing to do with stars.

Meteorites are rocky or metallic and can range in size from tiny pebbles to as large as boulders. Most contain small round particles known as chondrules, which are formed when molten droplets solidify in space. Chondrules may be the oldest solid objects in our solar system and may record the conditions during the solar system's formation.

Next time you see an odd looking rock on the ground you might actually be looking at a meteorite—an ancient record of how it all began.