



Smithsonian

The EXTREME Universe

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TCM

Teacher
Created
Materials

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Looking Out

Planet Earth can surprise us with intense weather and natural disasters. At times, it can seem like events and conditions on Earth are extreme. But when you zoom out, you'll see that Earth is a very special place. Humans have everything they need to thrive: water, sunlight, clean air, shelter, and food. It's not too hot, not too cold, not too poisonous...it's just right! And as far as we know, ours is the only planet with life on it.

For Review Only

When you look out into the solar system and beyond, you quickly see that Earth is surrounded by unique **phenomena**. Other planets exist outside of our solar system, orbiting their own stars. Far out in space, stars explode and collapse in on themselves. Invisible dark matter lurks in between. Scientists have discovered all these things—and more.

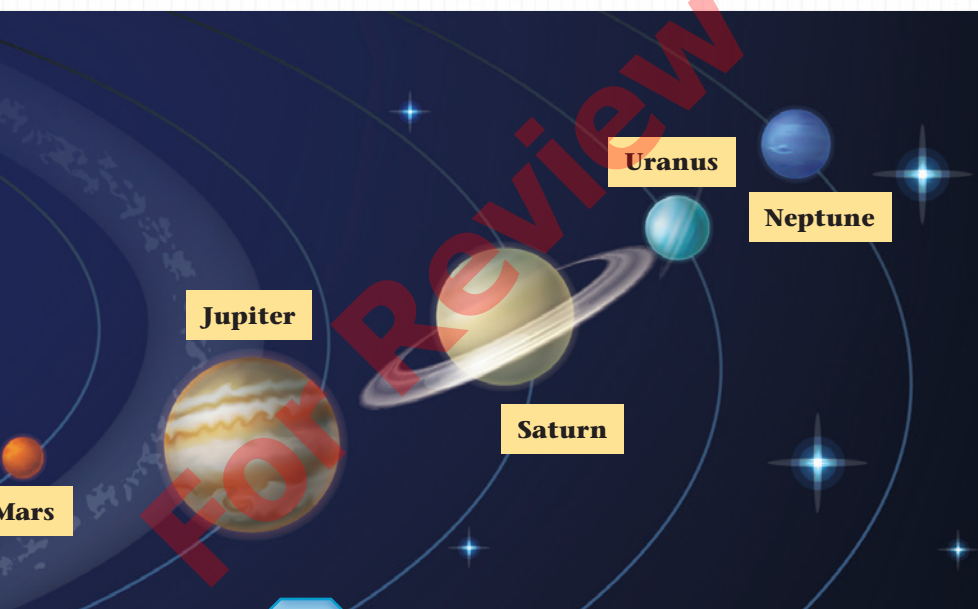
The universe is so **vast** and mysterious that we may never see or understand all of it, but that doesn't mean we **aren't** trying. Scientists have built powerful tools that **allow** them to examine and explore space. They started **by** studying our solar system, then the rest of the galaxy, **all the way** to the edge of the universe. Scientists are just **starting** to answer some of our biggest questions, such as "What holds us together?" Exploring our knowledge **of the** universe leads to some extreme events and places.

The Solar System

Before zooming out to the far reaches of the universe, let's take a look at where we are in space. Earth is one planet in the solar system. The solar system includes the sun, which is a large star, and everything that orbits around it. The planets Mercury, Venus, Mars, Jupiter, Saturn, Uranus, and Neptune orbit the sun just like Earth does. The solar system includes dwarf planets and hundreds of moons. Millions of smaller objects, such as **asteroids** and **comets**, float in between. A ring of asteroids called the *Kuiper Belt* lies at the outer part of the solar system. Beyond that is the Oort Cloud, a cloud of icy objects. The farthest edge of the Oort Cloud is considered the edge of the solar system.



Scientists think that the solar system was formed about 4.7 billion years ago. It started as a cloud of dust and gas. Then, the force of **gravity** affected the cloud. It pulled the dust and gas together into clumps. Over millions of years, these clumps became the planets and the sun we know today. Gravity has a large impact on the solar system—and the entire universe. The sun's gravity pulls large objects toward it. That's why the planets orbit around the sun. Earth completes one orbit in 365 days. Mercury completes one orbit in 88 days, making it the fastest planet in our solar system.



How Big?

Our solar system is so big that it can be hard to fathom. For example, the distance between Earth and the sun is 150 million kilometers (93 million miles). It would take an airplane 20 years to fly that distance! The entire solar system extends for trillions of kilometers into space.

Exploring the Solar System

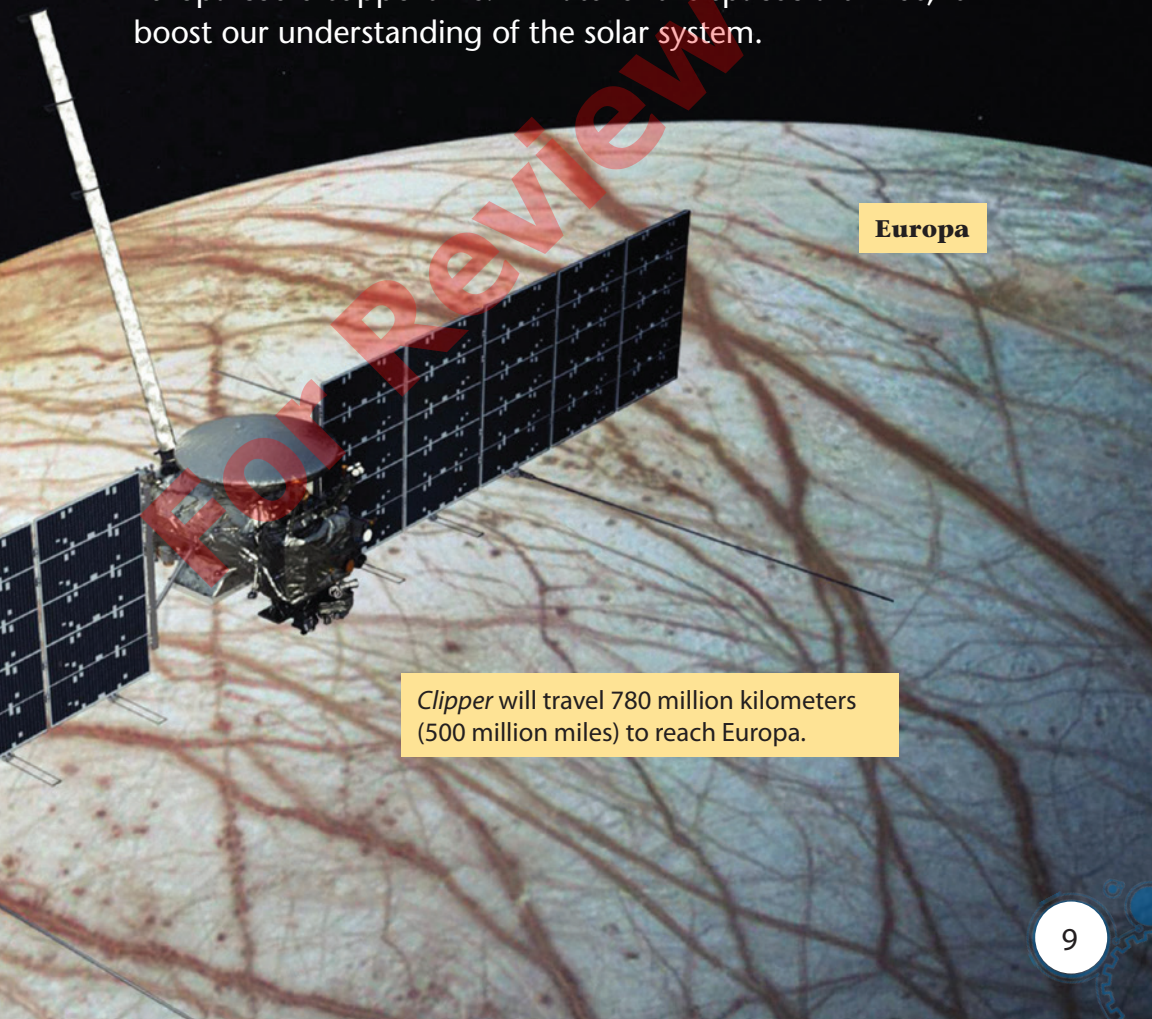
Beyond Earth, the only place humans have set foot on is the moon. However, scientists have hopes of visiting Mars, Earth's neighbor. Scientists have learned a lot about Mars with telescopes and tools on Earth. But there's more scientists want to learn by observing Mars directly.

In the past several decades, scientists have worked on many space missions. They have built **spacecraft** and technology to learn more about planets in our solar system. Some probes and telescopes sent into the solar system are also looking for places where life could exist.

Jupiter

One example of these missions involves spacecraft created by NASA. *Europa Clipper* is designed to study one of Jupiter's moons, Europa. *Clipper* is solar powered, and it has 24 engines to help it make its long journey. It can withstand intense temperatures. It can also handle **meteorites** and **radiation**.

Clipper's arrival into Jupiter's orbit is set for 2030. When it gets there, it will make 50 passes over Europa. *Clipper* will scan and map as much of the planet's icy surface as it can. Scientists hypothesize that an ocean may be beneath the surface! *Clipper* has special tools on board to find out what's going on beneath the surface, and scientists hope to find out how deep the ocean is. *Clipper's* ultimate goal is to determine whether conditions on Europa could support life. Whatever the spacecraft finds, it will boost our understanding of the solar system.



Europa

Clipper will travel 780 million kilometers (500 million miles) to reach Europa.

STEAM CHALLENGE

Define the Problem

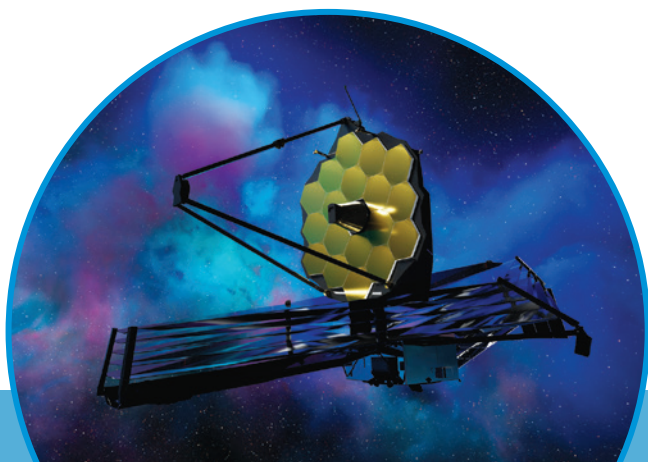
Telescopes have come a long way since their invention in the 1600s. Today, scientists use them to discover cosmic objects in the universe that are far from our solar system. Astronomers are continually looking for new design concepts for telescopes. They have asked for your help in creating a compact telescope that can someday be launched into space.



Constraints: You may only use the materials that have been provided to you.



Criteria: Your telescope must measure no larger than 46 centimeters (18 inches) long by 13 centimeters (5 inches) tall and include an eyepiece. It must allow for the last row of an eye chart to be read clearly from a distance.



CAREER ADVICE

from Smithsonian

Do you want to be an astronomer?

**Here are some tips to keep in mind
for the future.**

"Keep an eye out for astronomy in the news: we're learning more about our solar system and universe every day."

– *Matt Shindell, Curator,
Planetary Science and Exploration, National Air and Space Museum*

"Look for the stars you can see from your neighborhood. Track how they move each night and during the year."

– *Samantha M. Thompson, Phoebe Waterman Haas Astronomy
Curator, National Air and Space Museum*



Read and Respond

1. Describe what our solar system is made up of.
2. What is the Milky Way Galaxy, and what is inside it?
3. What kinds of tools help scientists study the universe?
4. How does gravity affect the orbits of planets?
5. Why is it important to explore the universe?
6. Will scientists ever solve the mysteries of dark energy and dark matter? Explain your thinking.

