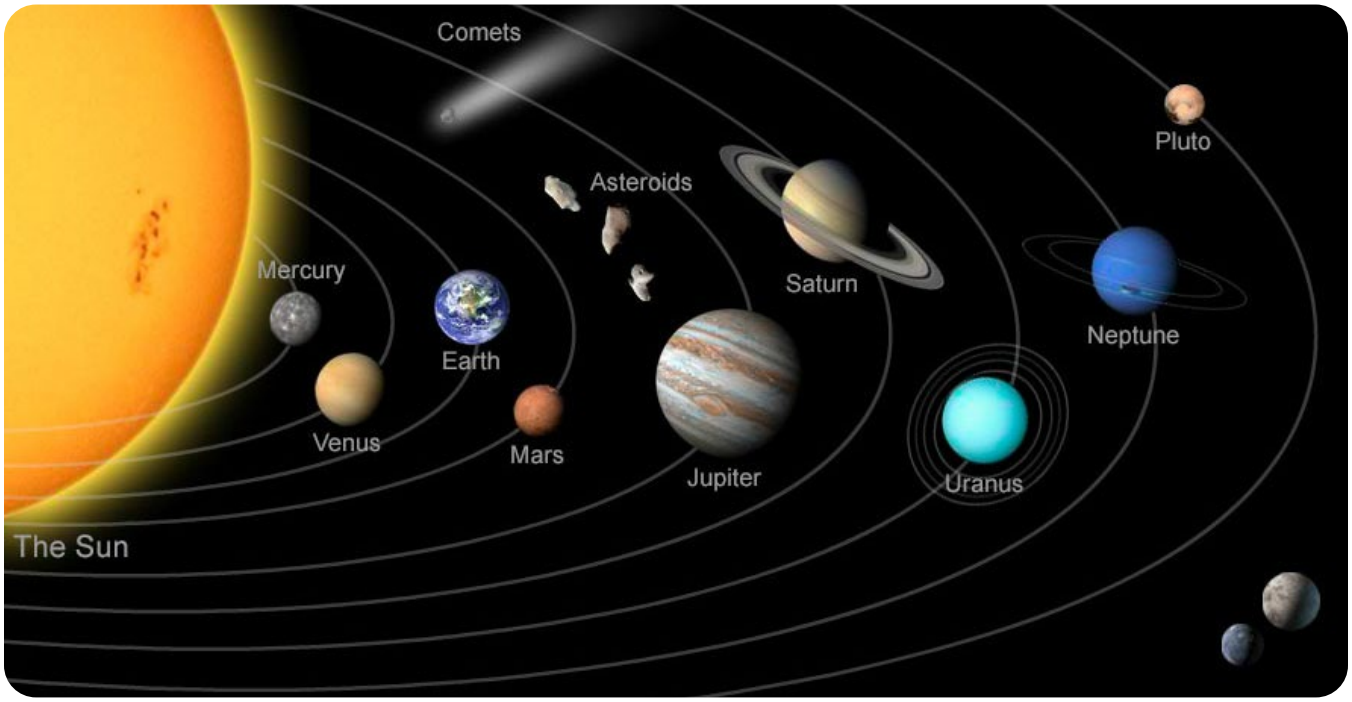
Solar System Model — Distance

Introduction

Our solar system is the Sun and everything that travels around it. Traveling around the Sun are eight official planets, at least five dwarf planets, nearly 200 moons (or natural satellites of the planets), and a large number of comets and asteroids.



Supplies

- Tape measure
- Rolls of toilet paper
- Index cards or paper
- Markers
- Tape
- Solar System Statistics cards (See printable cards after page 6. The cards are set up to print double-sided.)

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Get kids thinking

Our solar system is BIG! The sizes of the planets vary greatly as do the distances between planets and their distance from the Sun. Start by asking about distances kids have traveled.

- How many miles is it from home to school? How much time does the trip take?
- How long would it take and how many miles would you have to travel from where you live to get to London, England, or to La Paz, Bolivia? What about to Mars?

Let's get started!

Mars is relatively close to Earth, while the Sun and other planets even farther away. Talk about scale and how good a way to show the vast distances among the planets is to make a scale model that is smaller than the actual size of the solar system.

Talk about the planets with the kids.

STEP 1: IDENTIFY THE PLANETS

ASK KIDS: Can they can name all the planets in the solar system?

- As you **NAME THEM** together, have kids **WRITE EACH PLANET NAME** down on its own index card or small piece of paper along with the average distance (in miles) of each planet from the Sun. These are big numbers, so share the distance chart on page 4 to help.
- Instead of writing, kids can cut out and use the Solar System Statistics cards. (See printable cards after page 6. The cards are set up to print double-sided.)
- Once you have cards for each planet, have kids put them in order from nearest the Sun to farthest.

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STEP 2: DECIDE ON THE SCALE FOR YOUR MODEL

Toilet paper sheets are going to represent the distances of planets from the Sun in this model. What's fun about making this model is deciding the scale. If you have a lot of space , consider a scale of 10,000,000 (10 million) miles equals 1 square of toilet paper. That will put Neptune about 1,100 sheets or 94 feet away from your "Sun." (See the **EXPANDED DISTANCE TABLE** on the following page if you plan to use this scale.)

- As you think about your scale, ask kids to estimate space available for the model.
- Have them measure a square of toilet paper and predict if their model will fit into the available space.
- Provide kids with a copy of the **EXPANDED DISTANCE TABLE**. The table is for this scale: **10,000,000 MILES = 1 SQUARE OF TOILET PAPER** (95 feet of floor or outdoor space needed)

ALTERNATIVE SCALE OPTIONS

If you do not have access to 95 feet of room, you can calculate the numbers for a scale that requires only about 20 feet of space. This is a good math challenge for kids who like to do calculations! 50,000,000 miles = 1 square of toilet paper (19 feet of floor or outdoor space needed)

FOR YOUNGER KIDS, you can use this simplified chart below:

Planet	Squares	Average distance from Sun
Mercury	2.0	36 million miles
Venus	3.7	67 million miles
Earth	5.1	93 million miles
Mars	7.7	142 million miles
Jupiter	26.4	484 million miles
Saturn	48.4	888 million miles
Uranus	97.3	1.8 billion miles
Neptune	152.5	2.8 billion miles

Expanded Distance Table **10,000,000 miles = 1 square of toilet paper** (95 feet of floor or outdoor space needed)

PLANET	True Average Distance to the Sun in Miles	Rounded Average Distance to Sun in Miles	Distance to Sun in Sheets* (10,000,000 miles/ sheet) * 4-inch toilet paper squares	Distance to Sun in Inches	Distance to Sun in Feet	Distance Between Each Planet in Sheets
MERCURY	35,983,610	36,000,000	3.6	14.4	1.2	
VENUS	67,232,360	67,000,000	6.7	26.8	2.3	
EARTH	92,957,100	93,000,000	9.3	37.2	3.1	
MARS	141,635,300	142,000,000	14.2	56.8	4.7	
JUPITER	483,632,000	484,000,000	48.4	193.6	16.2	
SATURN	888,188,000	888,200,000	88.8	352.2	29.6	
URANUS	1,783,950,000	1,800,000,000	180	720	60	
NEPTUNE	2,798,842,000	2,800,000,000	280	1,120	93.3	

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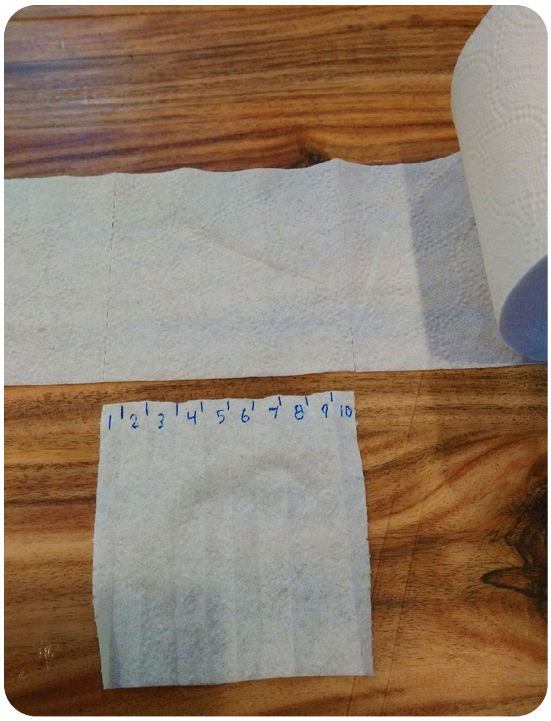
STEP 3: MAKE YOUR MODEL

- Make an index card for the Sun (or a construction paper Sun) and secure it on the ground (with tape if you are inside, set a rock on top of it if you are outside).
- Attach the toilet paper to the index card with tape.
- Lay the toilet paper down, slowly walk and unroll the toilet paper. (If you are outside and it is even a little windy, get some rocks to hold the toilet paper in place.)
- As you unroll, count the number of squares.
- When you reach Mercury (3.6 sheets on a 10,000,000 mile scale), use a marker to make a dot on the toilet paper and secure the Mercury card next to that square.
- If you want to be precise about where to put the dot, turn a square of toilet paper into a tool that can help. (See photo on the right)
- Continue unrolling the toilet paper and placing the planet cards until you get all the way to Neptune! Far out, right?



FOR AN ADDED CHALLENGE

ASK KIDS if they have a plan for keeping track of their mileage.

For example, Venus is 6.7 sheets from the Sun, but only 3.1 sheets from Mercury. Will they count sheets from the Sun for each planet? See if they can calculate the number of sheets between each planet and add that information to their distance chart. Or, find out if they have another idea to keep their model accurate.

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STEP 4: TALK ABOUT YOUR MODEL

Now that kids have an idea of the relative distance between planets, what do they think?

ASK KIDS:

- Why is it important to know these distances?
- Who is it important to?
- How do the distances between planets get measured?
- What units are the best units for measuring these distances?

As you discuss, be sure to explain to kids that the distances they used to create their model represent the planets *average distances* from the Sun.

- Planetary orbits are elliptical and not circular, so the distances change depending on the planet's orbit.
- Also, be sure to point out that orbiting planets are never all in a straight line going out from the Sun as they are represented in this toilet paper model.
- And worth sharing: astronomers measure distances in the solar system in "astronomical units" or AU. 1 AU = 93 million miles, the distance from the Sun to the Earth.
- Talk about what a solar system model that demonstrates the relative average distances between the planets and the Sun and the relative sizes of the planets would look like.

Save your Solar System Statistics cards for future activities.

More model solar system activities

SCALE MODEL OF OUR SOLAR SYSTEM (UNIVERSITY OF MANITOBA)
umanitoba.ca/observatory/outreach/solarsystem/

THE THOUSAND-YARD MODEL OR, THE EARTH AS A PEPPERCORN (NATIONAL OPTICAL ASTRONOMY OBSERVATORY)
noao.edu/education/peppercorn/pcmain.html

SOLAR SYSTEM BEAD ACTIVITY (NASA)
jpl.nasa.gov/edu/teach/activity/solar-system-bead-activity/

Sun

The sun is a massive ball of gas and the largest body in the solar system.

Diameter	863,400 miles (1,390,000 km)
Surface Temperature	10,800° F (6,000° C)
Interior Temperature	27,000,000° F (15,000,000° C)
Rotational Period	25–36 days
Estimated Age	4.5 billion years
Primary Chemical Component	Hydrogen

Mercury

Mercury is the closest planet to the sun and the smallest in the solar system.

Diameter	3,031 miles (4,880 km)
Natural Satellites	0
Distance from the Sun	35,974,272 miles (57,910,000 km)
Rotational Period	58.65 days
Orbital Period	87.97 days
Surface Temperature	354° F (179° C)
Main Atmospheric Component	Helium

Venus

The second planet from the sun, cloud-covered Venus rotates from east to west.

Diameter	7,518 miles (12,103 km)
Natural Satellites	0
Distance from the Sun	67,214,920 miles (108,200,000 km)
Rotational Period	243.0 days
Orbital Period	224.7 days
Surface Temperature	899° F (482° C)
Main Atmospheric Component	Carbon Dioxide

Earth

The only planet with liquid water on its surface, it is the only planet to support life.

Diameter	7,924 miles (12,756 km)
Natural Satellites	1
Distance from the Sun	92,933,000 miles (149,600,000 km)
Rotational Period	23 hours, 56 mins
Orbital Period	365.2 days
Surface Temperature	354° F (179° C)
Main Atmospheric Component	Nitrogen

Mars

The fourth planet from the sun is a barren, rocky, rusty red world.

Diameter	4,220 miles (6,794 km)
Natural Satellites	2
Distance from the Sun	141,050,000 miles (227,940,000 km)
Rotational Period	24.62 hours
Orbital Period	687 days
Surface Temperature	-81° F (-63° C)
Main Atmospheric Component	Carbon Dioxide

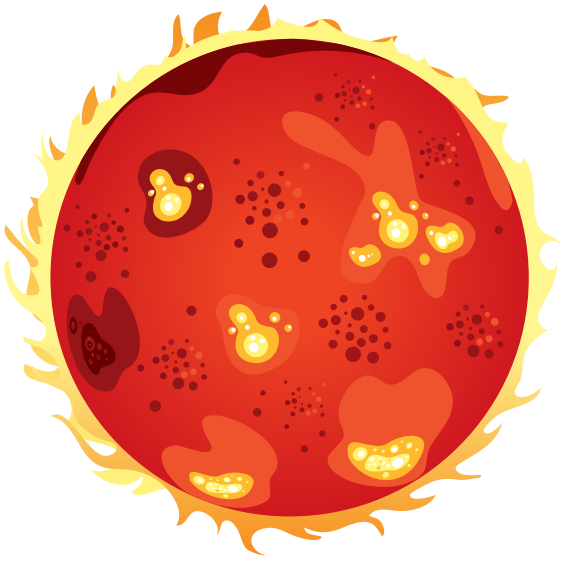
Asteroids and Comets

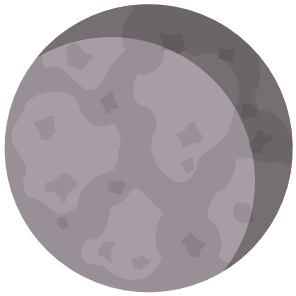
Asteroids are big space rocks left over from when the solar system formed about 4.6 billion years ago. Most asteroids orbit the sun within the main asteroid belt between Mars and Jupiter.

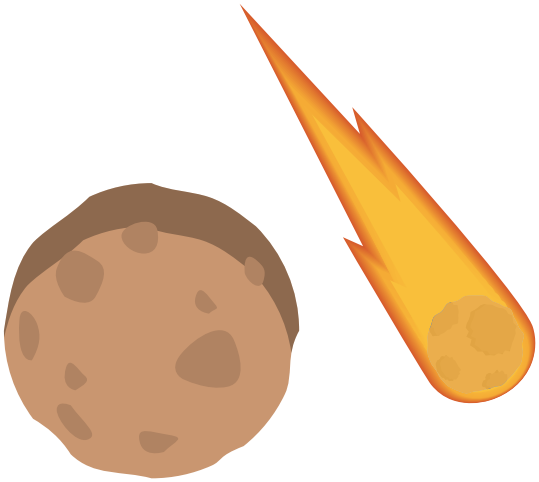
Number of known asteroids: 794,770

Comets are the oldest, most primitive bodies in the Solar System. They are huge snowballs of frozen gases, rock, and dust that orbit the sun. When close to the sun, a comet heats up, and its dust and gases form a tail that stretches for millions of miles.

Number of known comets: 3,570







Jupiter

Almost twice the size of all of the other planets combined and has a giant red spot.

Diameter	88,823 miles (142,984 km)
Natural Satellites	64 known
Distance from the Sun	482,546,000 miles (778,330,000 km)
Rotational Period	9.84 hours
Orbital Period	4333 days
Cloud Temperature	-185° F (-121° C)
Main Atmospheric Component	Hydrogen

Saturn

Saturn, a gas giant with three main bands of rings, is called the jewel of the solar system.

Diameter	74,565 miles (120,536 km)
Natural Satellites	62
Distance from the Sun	884,740,000 miles (1,429,400,000 km)
Rotational Period	10.25 days
Orbital Period	29.46 years
Cloud Temperature	-193° F (-125° C)
Main Atmospheric Component	Hydrogen

Uranus

The only planet that rotates on its side, Uranus is a featureless blue-green sphere.

Diameter	31,755 miles (51,118 km)
Natural Satellites	27
Distance from the Sun	1,783,487,000miles (2,870,990,000 km)
Rotational Period	17.3 hours
Orbital Period	84 years
Cloud Temperature	-315° F (-193° C)
Main Atmospheric Component	Hydrogen

Neptune

A giant blue sphere with unusual cloud features and a thin, dark system of rings.

Diameter	30,744 miles (49,492 km)
Natural Satellites	13
Distance from the Sun	2,798,116,000miles (4,504,300,000 km)
Rotational Period	15.8 hours
Orbital Period	165 years
Cloud Temperature	-315° F (-193° C)
Main Atmospheric Component	Hydrogen

Pluto

Pluto is officially classified as a dwarf planet and has an oval and tilted orbit.

Diameter	1,473 miles (2,370 km)
Natural Satellites	5
Distance from the Sun	3,673,537,000miles (5,913,520,000 km)
Rotational Period	6.3 days
Orbital Period	248 years
Surface Temperature	-382° F (-230° C)
Main Atmospheric Component	Methane

Moon

Our moon is the 5th largest of the 190+ moons orbiting planets in the solar system.

Diameter	2,160 miles (3,476 km)
Natural Satellites	0
Distance from the Earth	238,800 miles (384,400 km)
Rotational Period	27.32 days
Orbital Period	27.32 days
Surface Temperature	0° F (-17° C)
Main Atmospheric Component	Hydrogen