

A Toilet Paper Solar System Scale Model

Activity D2

Grade Level: 3–8



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What’s This Activity About?

Distances in space are difficult for students and audiences to imagine. Even the distances between planets boggle the imagination. In this activity, students unroll roll of toilet paper (with a teacher’s permission; talk about a hoot!) to build a scale model of distances in the solar system.

What Will Students Do?

Using toilet paper squares as a standard measuring unit, students create a scale model of our solar system.

Tips and Suggestions

- Consider starting the activity by getting students to predict where planets will be in the model.
- Using toilet paper outside on a breezy day can be a problem. In this case, have students pace off the distances and mark them with chalk.
- See Activity D3 for an extension to planetary systems around other stars

What Will Students Learn?

Concepts

- The relative spacing of the planets and their sizes

Inquiry Skills

- Modeling
- Measuring
- Ordering
- Comparing

Big Ideas

- Models and Simulations
- Scale

LEADER INSTRUCTIONS

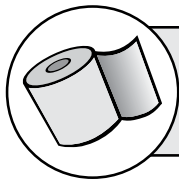
TOILET PAPER SOLAR SYSTEM

ADAPTED BY SUZANNE GURTON

Based on an idea by the late Gerald Mallon, a planetarium educator who spent his life helping students understand the Universe.

**An Activity for the Whole Family from Project ASTRO**

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- **Type of Activity:** Facilitated
- **Time to Do:** 20 minutes
- **Set-up Time:** 3 minutes

WHAT'S THIS ABOUT?

Even in our own “cosmic neighborhood,” distances in space are so vast that they are difficult to imagine. In this activity, participants will build a scale model of the distances in the solar system using a roll of toilet paper. This is a great follow-up to the “Worlds in Comparison” activity, where families get a sense of the relative *sizes* of the planets.

MATERIALS INCLUDED

- Family instructions masters. Use **either** the:
200-Sheet Model (requires 84 feet of working space for each family to do the full solar system); or the
100-Sheet Model (requires 42 feet of working space for each family)
- Planet stickers, with enough sets for 8 family groups (plus a master to copy more)

MATERIALS YOU'LL NEED TO GET

- One roll of 2-ply toilet paper per family (201 sheets or more)*
- A roll of clear tape (for repairs), one for each family

***Toilet Paper Tips:** Cheap, flat toilet paper generally works best. Textured paper is okay, but toilet paper with printed graphics can be distracting.

SETTING UP THE ACTIVITY

After selecting either the 200-Sheet or 100-Sheet Model, provide for each family:

- a copy of the family instructions handout;
- a roll of toilet paper;
- a set of planet labels; and
- a roll of clear tape.

SUGGESTIONS FOR INTRODUCING THE ACTIVITY

Although there are many scale models of the solar system out there, this model **only shows** the relative distances between the planets (and not their relative sizes). At the scale used here, Jupiter would be the size of a grain of salt. Thus, if you have already completed the Worlds in Comparison activity with your families before starting this one, you'll want to mention that the scales on the two activities are **very different**.

You can also remind your families that the planetary orbits are ellipses, so the numbers here represent their average distances from the Sun. For example, the planet with the most extreme elliptical orbit is Pluto. At its furthest point away from the Sun, Pluto is 7.4 billion kilometers out. However, when Pluto is at its closest point to the Sun (at 4.3 billion kilometers), it is actually closer to the Sun than Neptune ever gets (i.e., its orbit takes it closer to the Sun than Neptune's orbit). Finally, it's also important to point out that the planets are never all in a straight line going out from the Sun as they are represented in this model.

DOING THE ACTIVITY

Make sure everyone is in a starting place with enough room to make their toilet paper solar system. Now, instruct families to use their planet labels and table of distances (provided in their handout) to mark the distances of each planet on their roll of toilet paper. The number in the table is the number of sheets of toilet paper needed to reach the orbit of each planet. It is important to tell participants that the counts in the table are **starting from the Sun**, not from the previous planet. (Thus, after you get to Mercury, you need 1.7 more sheets to get to Venus.) This also means that the beginning of the roll (the leading edge) represents the Sun.

The appropriate planet sticker should be affixed on the toilet paper at the distance (by sheets) indicated in the table of distances for that planet. Ceres, the largest asteroid, is used to represent the asteroid belt.

If you don't have the time or space to complete the whole model, try to at least get to Jupiter and note that Saturn would nearly double that distance. The same is true of going from Saturn to Uranus. When finished, families can take their models home with them if they wish. Otherwise, please RECYCLE the toilet paper models when cleaning up.

FAMILY CHALLENGE

Astronomers believe there is a vast cloud of frozen comets called the Oort Cloud that surrounds our solar system. It lies roughly 50,000 times farther from the Sun than the Earth is. Ask families how many squares of toilet paper you would need to put the cloud on the longer scale model? (Answer: $50,000 \times 5.1 = 255,000$ squares)

TOILET PAPER SOLAR SYSTEM TABLE OF NUMBERS: LEADER'S VERSION

PLANET	DISTANCE FROM SUN (KM)	SQUARES OF TOILET PAPER OUT TO PLANET'S ORBIT (short version)	SQUARES OF TOILET PAPER OUT TO PLANET'S ORBIT (long version)
Mercury	57,910,000 km	1.0	2.0
Venus	108,200,000 km	1.8	3.7
Earth	149,600,000 km	2.5	5.1
Mars	227,940,000 km	3.8	7.7
Ceres	414,436,363 km	7.0	14.0
Jupiter	778,330,000 km	13.2	26.4
Saturn	1,429,400,000 km	24.2	48.4
Uranus	2,870,990,000 km	48.6	97.3
Neptune	4,504,000,000 km	76.3	152.5
Pluto	5,913,520,000 km	100.0	200.0

Family Instructions

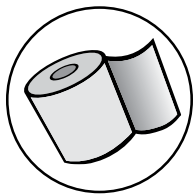
Toilet Paper Solar System



200-Sheet Model

BY SUZANNE GURTON (based on an idea by the late Gerald Mallon, a planetarium educator who spent his life helping students understand the Universe)

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What's This About?

Even in our own “cosmic neighborhood,” distances in space are so vast that they are difficult to imagine. In this activity, we will build a scale model of the solar system using a roll of toilet paper.

Materials

- Roll of toilet paper
- One set of planet stickers

What to Do

Use the table of distances (attached or on the reverse side of this sheet) to find the distances to each of the planets in our solar system. The number in the table is the number of sheets of toilet paper needed to reach the orbit of each planet from the Sun, so keep a running count as you go along. In other words, counts in the table **start from the Sun**, not from the previous planet. Thus, after you get to Mercury, you only need 1.7 more sheets to get to Venus (and not 3.7). This also means that the beginning of the roll (the leading edge) represents the Sun.

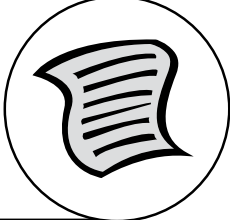
For each planet, affix the appropriate planet sticker on the toilet paper at the distance indicated. Ceres is the largest asteroid; use this sticker to represent the asteroid belt.

Family Challenge

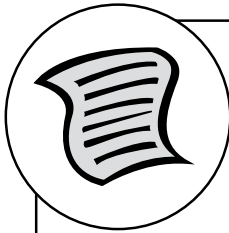
Astronomers believe there is a vast cloud of frozen comets called the Oort Cloud that surrounds our solar system. It lies roughly 50,000 times farther from the Sun than the Earth is. How many squares of toilet paper would you need to put the cloud on your model?

Toilet Paper Solar System Table of Distances: Family Version (200-Sheet Model)

Note: Keep a running count as you work. Each distance represented in the table below is from your starting point, i.e., the Sun, and not from the previous planet.



PLANET	SQUARES OF TOILET PAPER FROM THE SUN
Mercury	2.0
Venus	3.7
Earth	5.1
Mars	7.7
Ceres	14.0
Jupiter	26.4
Saturn	48.4
Uranus	97.3
Neptune	152.5
Pluto	200.0



Note: 200 sheets of toilet paper stretch out to nearly 84 feet. Make sure you have room for your model before you start, or agree on which outer planets you will leave out.

Family Instructions

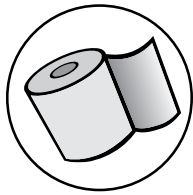
Toilet Paper Solar System



100-Sheet Model

BY SUZANNE GURTON *(based on an idea by the late Gerald Mallon, a planetarium educator who spent his life helping students understand the Universe)*

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What's This About?

Even in our own “cosmic neighborhood,” distances in space are so vast that they are difficult to imagine. In this activity, we will build a scale model of the solar system using a roll of toilet paper.

Materials

- Roll of toilet paper
- One set of planet stickers

What to Do

Use the table of distances (attached or on the reverse side of this sheet) to find the distances to each of the planets in our solar system. The number in the table is the number of sheets of toilet paper needed to reach the orbit of each planet from the Sun, so keep a running count as you go along. In other words, counts in the table **start from the Sun**, not from the previous planet. Thus, after you get to Mercury, you only need 0.8 more sheets to get to Venus (and not 1.8). This also means that the beginning of the roll (the leading edge) represents the Sun.

For each planet, affix the appropriate planet sticker on the toilet paper at the distance indicated. Ceres is the largest asteroid; use this sticker to represent the asteroid belt.

Family Challenge

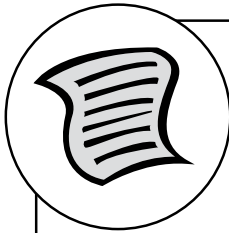
Astronomers believe there is a vast cloud of frozen comets called the Oort Cloud that surrounds our solar system. It lies roughly 50,000 times farther from the Sun than the Earth is. How many squares of toilet paper would you need to put the cloud on your model?

Toilet Paper Solar System Table of Distances: Family Version (100-Sheet Model)

Note: Keep a running count as you work. Each distance represented in the table below is from your starting point, i.e., the Sun, and not from the previous planet.



PLANET	SQUARES OF TOILET PAPER FROM THE SUN
Mercury	1.0
Venus	1.8
Earth	2.5
Mars	3.8
Ceres	7.0
Jupiter	13.2
Saturn	24.2
Uranus	48.6
Neptune	76.3
Pluto	100.0



Note: 100 sheets of toilet paper stretch out to nearly 42 feet. Make sure you have room for your model before you start, or agree on which outer planets you will leave out.