Activity: Toilet Paper Solar System

LEVEL
Ages: general audiences

RATIONALE
A graphic demonstration of the varied and enormous distances in space.

LENGTH
Half an hour, in advance, to prepare the roll.
10-15 minutes for demonstration, plus 10 minutes or so to re-roll.

OBJECTIVES
Describe the relative distances of planets from our sun. In the advanced version, describe the eccentricity of orbits in terms of the varying distance from the sun.

MATERIALS

- One roll of toilet paper, 201 sheets or more (251 sheets or more for the advanced version).
- Felt-tip marker(s) or fluid writing utensil(s), preferably 10 colors.
- Clear tape for repairs.

PREPARATION

1. On a flat, protected surface, unroll the first sheet or so of the roll. Test the marker(s) for clarity and bleedthrough. Change markers or gear your writing based on the test. For the simple version, you will be making X's and writing the names of planets. For the advanced version, you will also be making dotted or dashed lines, some across many sheets. Discard the test sheet(s).
2. Draw a small dot, about half the diameter of a standard pencil eraser, near the perforations between the (new) first and second sheet. This is the size of the Sun, approximately to scale. The other objects in our solar system are too small to draw on this scale; we will use large X's to represent their placement.
3. Write "SUN" near the dot.
4. Using the perforations between sheets as a ruler (the first is zero), mark the placement and names of the planets as listed in the table below. If you are doing the advanced version, also mark the innermost and outermost position of each planet.
5. Re-roll the toilet paper. If it tears, repair with tape.

PROCEDURE

Starting at one end of a long hallway, unroll the toilet paper until you reach the end. Note the varying distances.

If you made the advanced version, note the variation in the orbits of Mercury, Mars, and Pluto. Note especially that Pluto is sometimes closer to the Sun than Neptune. (Pluto becomes further from the Sun than Neptune in March 1999.)

Re-roll the model to use again (repair with tape if necessary).

SPACING

Standard version:

Object	Location
Sun	0.0
Mercury	2.0
Venus	3.7
Earth	5.1
Mars	7.7
Jupiter	26.4
Saturn	48.4
Uranus	97.3
Neptune	152.4
Pluto	200.0

Advanced version:

Object	Location (sheets)
Sun	***0.0***
Mercury - min	1.5
Mercury - avg	***2.0***
Mercury - max	2.4
Venus - min	3.6
Venus - avg	***3.7***
Venus - max	3.7
Earth - min	5.0

Earth - avg	***5.1***
Earth - max	5.2
Mars - min	7.0
Mars - avg	***7.7***
Mars - max	8.4
Asteroids -min	9
Asteroids - avg	***14***
Asteroids - max	22
Jupiter - min	25.1
Jupiter - avg	***26.4***
Jupiter - max	27.7
Saturn - min	45.7
Saturn - avg	***48.4***
Saturn - max	51.1
Uranus - min	92.7
Uranus - avg	***97.3***
Uranus - max	101.8
Neptune - min	151.1
Neptune - avg	***152.4***
Neptune - max	153.8
Pluto/Charon - min	150.0
Pluto/Charon - avg	***200.0***
Pluto/Charon - max	250.0

ALTERNATIVES AND OTHER DETAILS:

Cheap, flat toilet paper generally works best.
Textured paper is okay; printed paper can be distracting.

I usually use gel or fluid pens rather than felt-tip. Pens that are very pointy or wet can tear the paper.

In the advanced version, I include the asteroid belt (the edges are approximate). I also refer to the Pluto/Charon system, rather than the planet Pluto, because the two bodies are essentially a double planet. The Kuiper Belt of comets starts approximately at Neptune's orbit. (I may someday figure out how much more paper would be needed to model the whole Kuiper Belt. Don't ask me to model the Oort Cloud of comets; it would go to about 4000 times the average distance to Pluto.)

Uranus is pronounced YOO-rah-nus. Charon can be pronounced several ways, but planetary scientists tend to pronounce it SHA-ron.

Credits:
Other people have used toilet paper to make scale models of the solar system, but I did the calculations for this version using generally accepted orbital parameters.

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