Pocket Solar System

Building scale models of the solar system is a challenge because of the vast distances and huge size differences involved. This is a simple little model to give you an overview of the distances between the orbits of the planets and other objects in our solar system. (It is also a good tool for reviewing fractions.)

Materials needed:

- At least 1 meter of paper tape per person, such as adding machine paper
- Pen or pencil each

Just to review, the order of the planets and large objects going out from the Sun and their average distances are:		
Object	**Distance in kilometers**	**Distance in AU①**
Mercury	58 million	0.39
Venus	108 million	0.72
Earth	150 million	1
Mars	228 million	1.52
Asteroid Belt (including Ceres ②)	416 million	2.77
Jupiter	778 million	5.2
Saturn	1,427 million	9.54
Uranus	2,870 million	19.2
Neptune	4,497 million	30.1
Pluto ② and the inner edge of the Kuiper belt	5,850 million	39.5
Eris②	10,200 million	67.8

①AU stands for Astronomical Unit and is defined as the average distance between the Sun and the Earth (about 93 million miles or 150 million kilometers).
②The International Astronomical Union (IAU), the organization in charge of naming celestial objects, classified these objects as "dwarf planets" in 2006.

Making Your Pocket Solar System

Make sure everyone has a strip of register tape at least a meter long and at most, the length of the person's body. Cut or fold over the ends so they are straight. Label one end "Sun" and the other end "Pluto/Kuiper Belt".

Next, fold the tape in half, crease it, open it up again and place a mark at the half-way point. Many will be surprised that this is Uranus.

Now fold the tape back in half, then in half again. Unfold and lay it flat. Now you have the tape divided into quarters with the Sun at one end, Pluto on the other and Uranus in the middle. Place a mark at the quarter mark and 3/4 mark and label as Saturn (closer to the Sun) and Neptune (closer to Pluto), respectively.

Stop and admire your work. Which part of the solar system has filled 3/4 of your tape? That's right, you've only been mapping out the places for the 3 most distant planets and Pluto. That means that you've still got 5 plus the asteroid belt to fit into the quarter between the Sun and Saturn! Let's keep going to see how this will work.

Fold the Sun up to Saturn and crease it. Unfold and lay flat again. Place a mark for Jupiter at the 1/8 mark (between the Sun and Saturn), and label it.

If you take a look, you've got the 4 gas giants and Pluto all on there. For the remaining bodies in the Solar System, you'll only need 1/2 of the first 1/8th! That's the inner 1/16th of your tape length! Fold the Sun out to meet Jupiter to mark the 1/16th spot. A planet does not go here, but the Asteroid Belt does. (See picture below)

At this point, things start getting a little crowded and folding is tough to get precise distances. Fold the Sun to the Asteroid Belt mark and crease it. Place a mark for Mars on this fold (between the Sun and Asteroid Belt) and label it.

How many more planets do we need to place? Three. Fold the Sun up to meet the line for Mars. Leave it folded and fold that section in half. Unfold the tape and you should have three creases. Mark Earth on the crease nearest Mars, Venus on the middle crease and Mercury on the crease closest to the Sun.

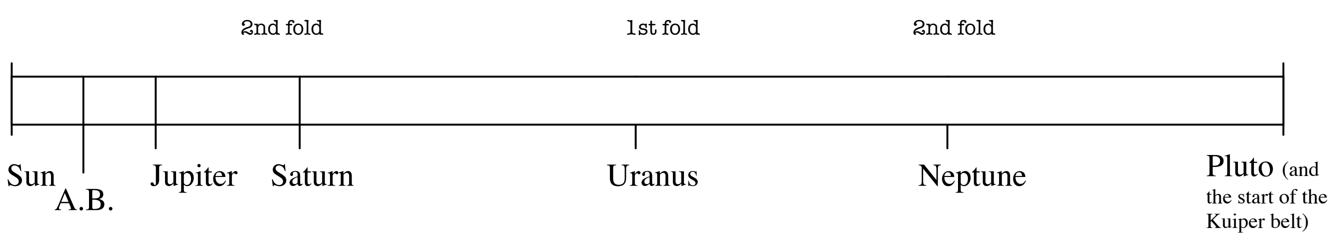
Smooth out your model and admire your work. Are there any surprises when you look at the distances between the planets this way? Many people are unaware of how empty the outer solar system is (there is a reason they call it space!) and how crowded the inner solar system is (relatively speaking).

<u>Here are some questions to consider while admiring your work:</u>

1. Can you estimate where Eris, will be at the same scale as your model? It travels in a very eccentric orbit, from 38 AU at its closet approach all the way out to 97 AU from the sun at its farthest.
2. If your model were 1 meter, where would the nearest star be? (1m = 40 AUs, Proxima Centauri is 4. 3 light years from the Sun, and 1 light year = 65,000 AUs)
3. How big would the Sun and planets be if your model were one meter long?

<u>Answers:</u>

1. At 97 AUs it would more than double the size of the model, you'd need to add another one and a half meters to the model. This is within the region called the Kuiper belt, a thick disk of comets, dwarf planets and icy objects.
2. The nearest star would be about 7 kilometers or 4.2 miles away.
3. The Sun would be smaller than a grain of sand. You couldn't see any of the planets without a magnifying glass on this scale!



Fold Sun to Asteroid Belt, mark "Mars" on fold.
Fold Sun to Mars and then fold in half again. You should have 3 marks for the three planets closest to the Sun.
The Sun is smaller than a grain of sand – 100 Suns must fit between Sun and Earth.
It's easy to remember Uranus is in the middle: If you make the strip as long as you are tall, "Uranus" is right over (your behind), right in the middle of your body.