

The Magnitude of the Solar System
Activity
Astronomy
Lesson 9

Sometimes it can be extremely challenging for students to understand the magnitude of the solar system, even with scaled diagrams. So, I find this activity to be extremely useful in helping students wrap their heads around the magnitude of the solar system.

This activity requires the use of a large field, I use the public park next to our school, or any other long stretch of land/sidewalk/pavement/etc. as well as some model magic/play-dough/other modeling clay. You and your students will literally walk across the solar system examining to-scale spheres that represent each of the planets. I also like to throw in some tiny spheres to represent the Asteroid Belt and the Kuiper Belt.

I create small model-magic balls—preferably out of colors that represent the planets (e.g., grey for Mercury, blue and green for Earth, red for Mars, white (for the cloud cover) for Venus, orange and white striped for Jupiter, yellow for Saturn, aqua for Uranus, and blue for Neptune)—and use these “planets” for the Solar System Walk. As an extension, I have students determine the diameters of the scaled planets in a math lesson. This also helps us determine the scale for the walk.

This activity was modeled after the “Scales of the Universe” exhibit at the Rose Center for Earth and Space, American Museum of Natural History.
(<http://www.amnh.org/rose/scales.html>)

[Note: the distances and diameters of each planet can be found through *Windows to the Universe* –
http://www.windows.ucar.edu/tour/link=/our_solar_system/planets.html]

The Scale

	Real	Model
Earth’s diameter	7,953 miles ≈ 8,000 miles in diameter	8/100 inch in diameter
Sun’s diameter	864,900 miles (we’ll round down for an easier scale) ≈ 800,000 miles in diameter	8 inches in diameter
Scale is:	100,000 miles	1 inch
Miles to inches	3,600,000 miles	36 inches
Sun-Earth distance	93,000,000 miles	930 inches == 26 yards

Distances

$$\frac{100,000 \text{ miles}}{\text{inch}} = \frac{\text{Dist(miles)}}{x \text{ Inches}}$$

Distance from...	Real (approx. miles)	Scaled to model (inches)
Sun to Mercury	36,000,000	360 inches == 10 yards
Mercury to Venus	31,000,000	310 inches == 9 yards
Venus to Earth	26,000,000	260 inches == 7 yards
Earth to Mars	49,000,000	490 inches == 14 yards
Mars to Jupiter	342,000,000	3420 inches == 95 yards
Jupiter to Saturn	403,000,000	4,030 inches == 112 yards
Saturn to Uranus	897,000,000	8,970 inches == 249 yards
Uranus to Neptune	1,011,000,000	10,100 inches == 281 yards

Diameters

$$\frac{100,000 \text{ miles}}{\text{inch}} = \frac{\text{Diameter(miles)}}{x \text{ Scaled Diameter(inches)}}$$

Object	Real Diameter (miles)	Diameter Scaled to model (inches rounded to the nearest hundredth)
Sun	800,000	8.0
Mercury	3,031 ≈ 3,000	0.03
Venus	7,521 ≈ 8,000	0.08
Earth	7,926 ≈ 8,000	0.08
Mars	4,222 ≈ 4,000	0.04
Jupiter	88,729 ≈ 89,000	0.89
Saturn	74,600 ≈ 75,000	0.75
Uranus	32,600 ≈ 33,000	0.33
Neptune	30,200 ≈ 30,000	0.30

Create the Sun and planets:

- Sun – 8 inches in diameter
- Mercury – 0.03 inches in diameter
- Venus – 0.08 inches in diameter
- Earth – 0.08 inches in diameter
- Mars – 0.04 inches in diameter
- Jupiter – 0.89 inches in diameter
- Saturn – 0.75 inches in diameter
- Uranus – 0.33 inches in diameter
- Neptune – 0.30 inches in diameter

I like to place my solar system objects out prior to the lesson. Remember, you'll need a large field, lot, strip of pavement, etc. to set this up accurately.

I approximate one **LARGE** step (roughly 3 feet for each yard) so that I don't have to take my tape measure with me, but feel free to be more precise than I am!

For the actual lesson I take my students out and read them the following introduction:

You have seen diagrams of the Sun and the planets in our lessons. The fact that the planets are very small compared to the enormous distances between them is hard to comprehend. In order to try and wrap our heads around the scale of the solar system, we're going to take a ramble through a scale model of the solar system.

If you've opted to have them do the conversion calculations for the scale, then they should know the rough distances, however I find that students still have difficulty visualizing what the solar system looks like.

So, off we start, I try to make our ramble a bit dramatic, and ask students hypotheses they can make about the planets based on what we've learned so far (e.g., how hot do you imagine Mercury to be since it is so "close" to the Sun? How fast do you think it's orbit would be compared to Jupiter's? Would you expect to see Jupiter retrograde like Mars since we also overtake Jupiter in orbit? Etc...) I find that asking students questions preps them for the planetary lessons that are soon to follow, and also makes that information more intuitive.

Finally, once we've walked the entire length to Neptune (by the way, the students are **shocked** at how far we have to walk and how tiny the planets are) I have one student stand next to each planet and we take a picture of the solar system with our student markers.

When we get back to the classroom, I like to set out our planet models and print out the picture of the students in the solar system to hang above them so that the students have a visual reminder of the vastness of the solar system over the coming lessons.