Montage of planets. Not to Scale.

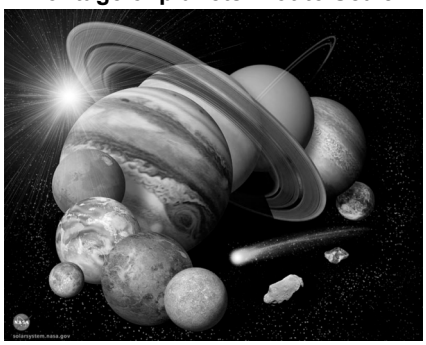

Image credit: NASA/JPL

In this Exploration, find out

- How the sizes of the planets compare to each other?
- How far apart are the planets?
- What is a scale model?
- What is the solar system mainly composed of?

Scale Model Solar System

Purpose:

Today you will make a *scale model* solar system. Every step you take in our model is like walking **10 billion** steps in the real solar system. Our **scale factor** for the model solar system is then **1 to 10 billion** (like the scale on a map). The positions of the model planets are based on each planet's **average distance** from the Sun. The sizes of the planets have the same **scale factor** of 1 to 10 billion as the distances between the planets. It doesn't matter what unit of measure you use. You can use inches, feet, meters, steps, or anything you want.

- *Example:* If you measure the size of the model planets in inches, then multiply your measured number in inches by 10 billion, and you'll get the real size of the planet in inches!

For our scale model solar system, we will use *millimeters, meters,* and *steps* as the **units.**

Materials:

Size of Sun and Planets Table
Diameter of Sun and Planets Table
Various household objects to represent the Sun and planets
Meter stick
Ruler

Part 1: Scaled Sizes

1. Write the name of each planet on an index card. (The Sun doesn't require an index card.)
2. Convert the diameters of the Sun and the planets on the SIZE TABLE to the scaled diameter size.

Background: Why Use Scale Models?

- Scientists use models everyday. Models can be conceptual (ex: an atomic nucleus surrounded by orbiting electrons), mathematical (ex: population increase), and scale (ex: model airplanes).
- Scale models are a concept that you are already familiar with in the context of model toys (cars, planes, houses, etc.), maps, and globes.
- Scale models allow us to explore systems with scales from the microscopic to the astronomical that are beyond the realm of normal human experience.
- Scale models of the solar system aid in understanding the relative sizes and distances of objects in the solar system, an important foundation for studying other topics in astronomy.

3. Using the "scaled diameters" of the Sun and planets from the size table and your ruler, select objects that are approximately the same size as the scaled size for each planet and the Sun.
4. Attach the object you have selected for each planet to an index card.
5. Compare the objects you have selected for the Sun and the planets to the object you have selected for the Earth.

Part 2: Scaled Distances

Now make a scaled distance solar system using your scaled size Sun and planets objects/cards to illustrate the scale of the entire solar system (size and distance).

1. Convert the distances from the Sun to the planets on the DISTANCE TABLE to the scaled distance size.
2. Using a meter stick, practice making a step 1 meter long. Try this a few times until you are comfortable repeating 1 meter steps or very close.
3. The class will construct our scale model solar system from the scale model Sun to at least as far as Jupiter. How many meters of space do we need for Jupiter? How many to Neptune? *(Hint: look at the table of real and scaled distances.)*
4. With your teacher locate a place to make the scale model solar system, place the object representing the scale model Sun at one end.
5. Look at the DISTANCE TABLE, and find the column labeled STEPS. The first planet from the Sun is Mercury, and the number of steps is 6. Walk 6 steps (about 1 meter each) from the model Sun.
6. Stop when you reach 6 steps and place the card for Mercury on the ground or taped to a wall at this distance.
7. Look on the DISTANCE TABLE for the number of steps to the next planet. This number of steps is **from Mercury to the next planet** out from the Sun, **not** the total number of steps from the Sun to the next planet.
8. Walk to the next planet counting the correct number of steps and repeat the procedure you used for Mercury with the index card. Try to keep your path as straight a line as possible.
9. Continue counting steps and placing index cards for each planet up to (and including) Jupiter.
10. After Jupiter, if room and time allows, continue counting steps and placing cards all the way to Neptune.

Things to think about:

1. How does the size of the object for Earth compare to Mars? Jupiter? Sun?

2. The Moon in this model is about 4 centimeters (38 millimeters) away from the scale model Earth (and 1/4 the diameter of the scale model Earth).

    a) How does this compare to the distances between the Earth and Venus?

    b) the Earth and Mars?

3. How do the distances **between planets** in the real solar system change as they orbit the Sun?

4. Which does the solar system have more of matter (the Sun, planets, asteroids, etc.) or empty space?

5. Light takes about 8 minutes to travel from the Sun to the Earth. What is the speed of light? (Speed = distance/time)