Sizing Up the Moon

Originally developed by Dennis Schatz (Pacific Science Center) for Family ASTRO. Adapted by Anna Hurst for **Astronomy from the Ground Up**, a program of the Astronomical Society of the Pacific, and modified slightly by SJS staff.

What's This Activity About?

This activity starts by asking for participants' ideas about the relative sizes and separation between the Earth and Moon. It builds from these initial thoughts to help them produce a model of the Earth and Moon that provides the accurate relative sizes, as well as the appropriate distance between them.

Materials

- Earth/Moon location sheets, cut in half or 2 sheets scrap paper
- One 3 oz. container of play-doh for each group and one ball for the facilitator
- Plastic knives
- **Optional:** Cutting board or sheet of wax paper for each group of 2-4
- **Optiona**l: a piece of string 5 feet long, which represents the distance between the Earth and Moon at the scale used in this activity (2" x 30 Earth diameters = 60" or 5 feet)

Setting Up the Activity

You will need some space on a table or other surface for each group to work with their play-doh and enough space on the floor to set up the models. There should be at least ten feet of free space with enough space for all the groups to lay out their models. Place the play-doh balls on each table with the two half-page location sheets, a plastic knife and a cutting board or sheet of wax paper.

Introducing the Activity

For any scale model activities, it is useful to start by exploring the notion of models. Referring to playthings, such as dolls or toy cars, can be a useful reference for talking about scale models.

To introduce this activity about the Moon, ask how many participants have seen the full Moon in the sky. How did it look? Could you tell how big it is or how far away? Not really. When looking at familiar objects, you can estimate their distance from you by how big or small they appear and their size if you know the distance. In this case, we're going to have you make a guess about the Moon.

Doing the Activity

Give each team a container of play-doh. Ask them to predict how much of the play-doh ball would go into producing a model of the Earth and how much would go into a model of the Moon (at the same scale). Then ask them how far apart the model Earth and model Moon would be. Tell them where you want them to put their Earth models so there is also room to place the Moon models at their predicted scaled distance. Be sure they put their names on both the Moon and Earth location sheets.

After all participants have made their predictions, you are now ready to start discussing the differences and similarities in their predictions. Ask who is willing to share why they chose the sizes and distance in their model Earth and Moon. Conclude the discussion by asking if anyone now wants to modify a prediction. If there is time, you can let them physically make the changes. Otherwise, just accept the verbal description of what changes they would make.

Tell them that you are now going to make a model together that shows the accurate comparison of sizes and distance. Each team divides their play-doh ball into 50 roughly equal pieces (this is the

facilitator's ball. When they are done, have them pick an "average" size piece out of the 50. Set the "average" piece aside. Point out how many are left. They can roll the 49 remaining pieces back together. Listen to the groans!! Now you have accurate Earth (larger ball) and Moon (smaller ball) scale models. Ask them for any comments that they care to make about their predictions versus the actual relative sizes.

Now place your model Earth next to the other Earth models in the front of the room. Ask two volunteers to help determine the correct distance to the Moon. Tell them It is 30 Earth diameters away. In other words, 30 Earths would fit between the Earth and the Moon.

One volunteer holds the accurate model Moon, while the other person takes one end of the string. You hold one end of the string at the model Earth while the two of them walk away from the Earth. When they reach the end of the string, they should hold the model Moon up in the air at the end of the string. If you won't always have a 2" ball of play-doh and a 60" string, you can use the following method to estimate the distance between the model Earth and model Moon. The circumference of a circle or sphere is Pi x diameter. Pi is about 3, so ten times around the Earth ball is about 30 diameters. The beauty of this method is that it works for any size Earth.

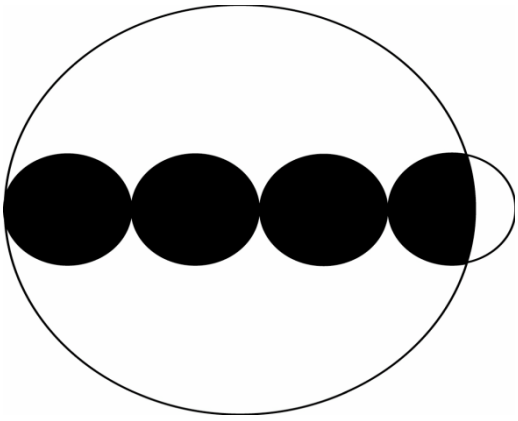
Alternatively, just tell participants that 30 Earths would fit in between the Earth and Moon, and challenge **them** to come up with a way to estimate the scale distance.

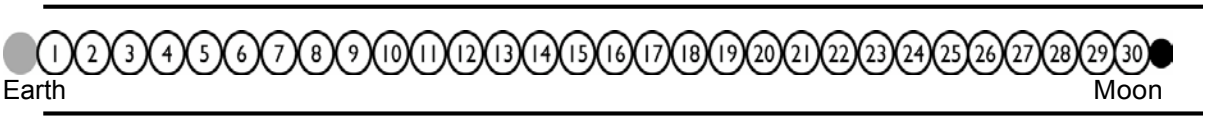
The participants can now compare the correct scale distance to the model Moon to their various predictions. Ask them for any comments that they wish to make about their predictions vs. the actual distance in the scale model.

Wrap-up

This is now a good time to talk about the real sizes for the Earth and Moon, and how far apart they are:

- Earth's Diameter = 12,756 km (7,926 mi)
- Moon's Diameter = 3,476 km (2,160 mi)
- Distance from Earth to Moon = 384,000 km (239,000 mi)
- 3.7 x diameter of the Moon = diameter of Earth





Math extension: the volume of a sphere increases by the cube of its radius. The Earth's radius is 3.7 times bigger than the moon's (same as the ratio of diameters). Cube that: 3.7 x 3.7 x 3.7 and you get about 50! It takes 50 moons to fill the Earth's volume.

On this scale (earth diameter = 2 inches), the sun's radius would be 110 inches, or 9 feet!! That's 110 times bigger. How many earth sized balls of play-doh would you need to fill the sun model? Cube it! That's a lot of play-doh!

Resource: an interactive website to help you calculate different solar system model scales: http://www.exploratorium.edu/ronh/solar_system/