ASTRONOMY from the GROUND UP
An Educational Collaboration of ASP, NOAO & ASTC
Funded by the National Science Foundation

Sizing Up the Moon
Activity Guide

Originally developed by Dennis Schatz (Pacific Science Center) for Family ASTRO

Adapted by Anna Hurst

390 Ashton Ave., San Francisco, CA 94112 • www.astrosociety.org/education.html

Type of Activity:	Classroom or drop-in station; facilitated
Set up Time:	5 minutes
Time to Do:	20 minutes
Audience age:	8 years and older
Group size:	variable, in groups of 2 - 4

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 (one per group, see page 6); or 2 sheets scrap paper
- Three-inch diameter ball of playdough (approximately 1 pound) for each group and one ball for the facilitator
- 5 plastic knives
- Cutting board or sheet of wax paper for each group of 2-4
- A piece of string 7.5 feet long, which represents the distance between the Earth and Moon at the scale used in this activity (3" x 30 Earth diameters = 90" or 7.5 feet)

Setting Up the Activity

You will need some space on a **table** or other surface for each group to work with their playdough 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 **playdough** balls on each table with the two half-page **location sheets** (page 6), a **plastic knife** and a cutting board or sheet of **wax paper**.

Suggestions for Introducing the Activity

For any of these 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. For a more thorough exploration of this concept with ideas of how to introduce and discuss it, see the introduction to the Saturn Project.

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

The first step for participants is to make a prediction regarding how much of the playdough 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 the correct 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. You will need 5 volunteers. Divide your playdough ball into 5 equal pieces (this is the facilitator's ball). Give each volunteer one piece and a plastic knife and ask them to cut it into 10 equal pieces. When they are done, have them bring back their pieces.

Ask for another volunteer to help you pick an "average" size piece out of the 50 that are now in front of you. Set the "average" piece aside. Point out how many are left. Have yet another volunteer roll the 49 pieces back together. 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

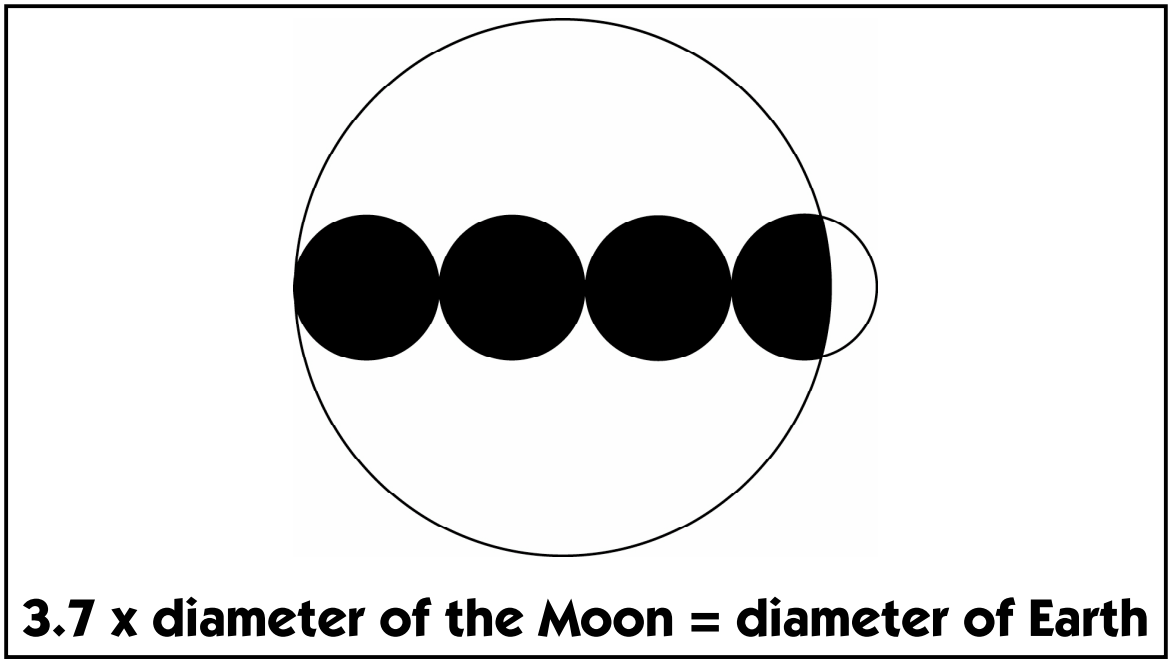
volunteers to help determine the correct distance to the Moon. It is 30 Earth diameters away. In other words, 30 Earths would fit between the Earth and the Moon. One volunteer holds the accurate model Moon, while the other person takes one end of the string. You hold one end of the string at the model 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 3" ball of playdough and a 90" 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.

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)



This is also a time when you might discuss the time it takes light to travel to the Moon from Earth, or how long it took the Apollo spacecraft to take the astronauts to the Moon. Light takes 1.3 seconds to get to the Moon from Earth and another 1.3 seconds to get back. That's why there was a slight delay between questions and responses when astronauts on the Moon communicated with Earth. It took the Apollo 11 astronauts about 73 hours and 27 minutes to travel from Earth's orbit to an orbit around the Moon. To put it in perspective, you might ask how long they think it would take them to drive to the Moon in their family car. If they could maintain a highway speed of 70 miles/hour that would be 239,000 miles/70 miles/hour = 3,414 hours = 142 days = almost five months -- and that's DRIVING NONSTOP, with no bathroom or sleeping breaks!

Complimentary Activities:

Scale model activities

- Birdseed Galaxy
- Earth As a Peppercorn
- Worlds in Comparison
- Saturn Project
- Sizing Up the Stars

Moon activities

- Daytime Moon
- Moon Clock
- Creating Craters

Materials sources:

Playdough:

Three pound tubs of Play-Doh, Crayola Dough or other similar modeling clay can be purchased from many craft suppliers. As of this writing, Dick Blick sells 3 lb. tubs of Crayola Dough for $7.49 each (www.dickblick.com or (800) 828-4548).

Alternatively you can make your own dough using the recipe below. The only drawback is that this can grow moldy, so if you plan to do this activity often, it is recommended that you invest in the commercial product.

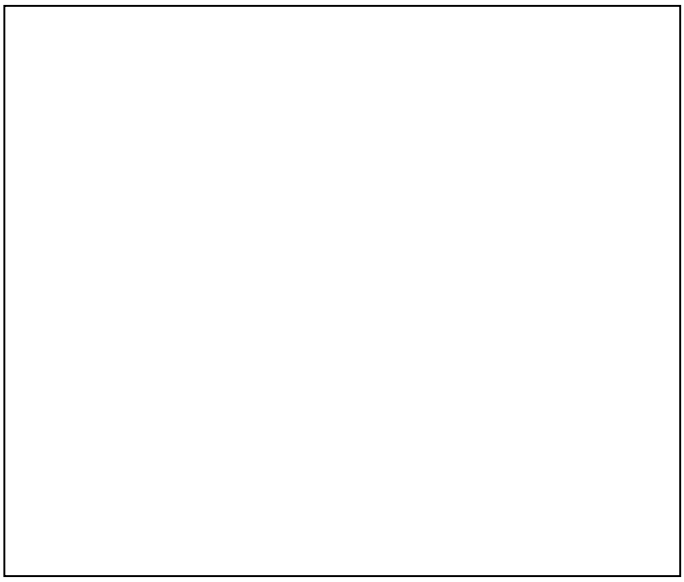
Kool-Aid™ Playdough Recipe

This recipe makes three pounds of colorful, scented playdough:

5 cups of flour
1 cup salt
4 packages dry unsweetened Kool-Aid™
4 cups boiling water
6 tablespoons vegetable oil

Mix the dry ingredients together in a bowl. Mix the liquids together and pour them over the dry ingredients. Stir the mixture until it forms a ball (this may take a while — keep stirring). As the mixture cools, it will become less sticky. After the mixture has cooled to room temperature, take it out of the bowl and knead it until it is smooth. Store in ziplock bags in the refrigerator until ready to use.

Location of Model Earth



Location of Model Moon