STATEWIDE STAR PARTY

SIZING UP THE MOON

Activity Instructions

http://www.ncsciencefestival.org/starparty/

OBJECTIVE

Create a model of the relative sizes of Earth and the Moon and the distance between them.

SUGGESTED AGE RANGE

Ages 8 and up (works well with families or groups of 2-4 people each

ACTIVITY DURATION

Up to 20 minutes

SETTING

Indoor drop-in station or classroom

CREDIT

This activity has been modified from an activity that was developed by Dennis Schatz and adapted by Anna Hurst as part of the Family ASTRO and Astronomy from the Ground Up programs from the Astronomical Society of the Pacific, www.astrosociety.org

PREPARATION

1. You'll need 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 (at least ten feet of free space for all groups to lay out their models).
2. Place the **Play-Doh** cans on each table with the two half-page **location sheets**, a **plastic knife**, and a sheet of **wax paper**.

MATERIALS

- Earth/Moon location sheets, cut in half (one per group); or 2 sheets scrap paper
- 1 four-ounce can of Play-Doh for each group + 1 can for the facilitator
- Plastic knives
- Sheet of wax paper for each group; or cutting boards
- Piece of string 67½ inches long

PROCEDURE

1. Introduce the activity by exploring the notion of models, such as by referring to playthings like dolls or toy cars. Tell your participants they'll be making a model of Earth and the Moon and exploring their relative sizes and distance from each other.

2. Ask who has seen the 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 you can estimate their size if you know the distance. In this case, we're going to have you make a guess about the Moon's size and distance.

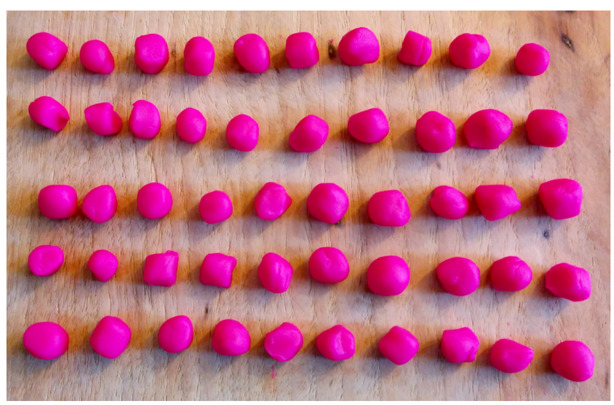
3. Have each group take the Play-Doh from their can and form it into a ball.

4. Invite your participants to make predictions: About how much of the Play-Doh ball would go into producing a model of Earth? How much would go into a model of the Moon (at the same scale)? How far apart should the model Earth and model Moon be?

5. Have each group create their model Earth and model Moon out of their Play-Doh ball and place them on the location sheets at what they think is the correct relative distance from each other. (If you have more than one group, each group can put their names on the sheets.)

6. After all participants have made their predictions, discuss the differences and similarities in their predictions. For example, 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.

7. Tell them you are now going to make a model together that shows the accurate comparison of sizes and distance. You can do this with the help of 5 volunteers. First, divide your Play-Doh ball into 5 equal pieces (this is the facilitator's ball). Then, 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.



8. Ask for another volunteer to help you pick an "average" size piece out of the 50 pieces that are now in front of you. Set the "average" piece aside. Point out how many are left (49).

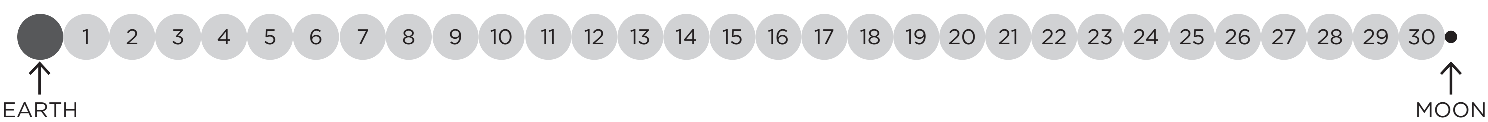
9. Have another volunteer roll the 49 pieces back together. Now you have accurate Earth (larger ball) and Moon (smaller ball) scale models. Ask them for any comments they care to make about their predicted sizes versus the actual relative sizes.

PROCEDURE (CONTINUED)

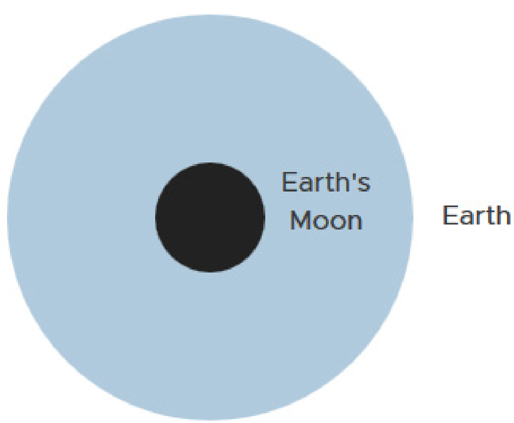
10. Place your model Earth next to the other Earth models in front of the room. Ask 2 volunteers to help determine the correct distance to the Moon. It is 30 Earth diameters away, that is, 30 Earths would fit between Earth and the Moon. One volunteer holds the accurate model Moon, while the other person takes one end of the string. You hold one end of the string at the model Earth while the two volunteers walk away from 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.

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

12. Discuss the real sizes of Earth and the Moon, and how far apart they are:
    - Earth's diameter = 12,756 km (7,926 miles)
    - Moon's diameter = 3,476 km (2,160 miles)
    - Almost 4 Moons could be lined up across the face of Earth.
    - The Moon's volume is only about 2% (1/50th) the volume of Earth.
    - Average distance from Earth to Moon = 384,000 km (239,000 miles)



Earth's Moon is 3.7x smaller across than Earth.



Modified from an image at https://solarsystem.nasa.gov/moons/earths-moon/by-the-numbers/

PROCEDURE (CONTINUED)

13. You can also discuss the time it takes light to travel between Earth and the Moon, or how long it took the Apollo spacecraft to take the astronauts from Earth 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 (3 days) 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!

ABOUT THE SCALE

A 4-ounce can of Play-Doh produces a model with an Earth ball about 2¼ inches in diameter ball and a Moon ball about 5/8 inch in diameter. The two objects need to be approximately 67.5 inches apart (roughly the arm span or height of an adult).

If you won't always have this size of Play-Doh and string, you can estimate the correct relative distance between Earth and the Moon by wrapping a string 10 times around the Earth ball. This works for any size Earth. That's because the circumference of a circle or sphere is pi times its diameter, and pi is ~3, so 10 times around the Earth ball is ~30 diameters.

ALSO TRY THIS!

Simpler Version

This version of the activity takes as little as 2 minutes, works with young kids, and can be done in virtually any setting. It uses the same scale as the Play-Doh version.

MATERIALS

- Ball about 2 1/4 inches in diameter ("Earth"), such as a racquetball
- Marble about 5/8 inch in diameter ("Moon")
- Piece of string 67½ inches long (or use an adult's arm span)
- Optional: A bin of extra balls of various sizes

PROCEDURE (SIMPLER VERSION)

1. Hold up the ball with a diameter of 2¼ inches, and explain that it represents Earth.
2. How big would the Moon be on this same scale? Invite your participants to guess. They might show you their guess by holding their fingers apart. Or if you have a bin of balls of varying sizes, have them select a ball that best represents their guess.
3. Reveal the Moon ball (marble with a diameter of 5/8 inch). Discuss the relative sizes, e.g., you could fit nearly 4 Moons across the face of the Earth.
4. How far apart would the Moon and Earth be on this scale? Invite your participants to demonstrate their best guess. For example, they might hold their hands apart. Or you might hold up the Earth ball and have them hold the marble at what they think is the correct distance.
5. Ask 2 volunteers to help measure the correct distance to the Moon (30 Earth diameters away). You can use the 67.5-inch string to measure this distance.
6. Alternatively, you can demonstrate the correct distance yourself: Hold the Earth ball in one hand and the Moon ball in the other hand, then stretch out your arms; the relative distance between Earth and the Moon on this scale is about 67.5 inches—or roughly the arm span of an adult.

ADDITIONAL NOTES

- You may be able to find a short video of the simpler version of the activity at https://www.wral.com/weather/page/1611657/ (starts partway through the "Observe the Moon Night" video).
- If you have enough space, you can create a larger model using a basketball for Earth (~9.4 inches in diameter) and a tennis ball for the Moon (~2.6 inches in diameter). On this scale, the distance between Earth and the Moon is about 23½ feet (roughly 8 large paces).

NORTH CAROLINA SPACE GRANT

The Statewide Star Party is made possible by the generous grant support of the North Carolina Space Grant.

LOCATION OF MODEL EARTH

LOCATION OF MODEL MOON