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Playdough Planets with a Side of Moon

Overview

In this activity, students create a scaled Moon, Earth, and Mars using playdough. After creating their models, they will determine the correct distance to place them apart to be the correct scale for their size.

What's the point?

The furthest we have gone into space is the moon, and the last time we sent humans to the moon was in 1972! More recently, humans have occupied the International Space Station (ISS), but that is not even above Earth's atmosphere. In this activity, students will learn how far humans have gone into space in the past, present, and future!

Learning goals

After doing this activity, students will be able to:

- Demonstrate a basic distance model of the Earth, Moon, and Mars
- Describe how far humans have gone into space
- Describe and define a scale model

Time

45 minutes

Recommended Age

8-11

Materials

Materials per student

- One ruler
- One sharpened pencil
- Two or three sheets of scratch paper
- A calculator (can be phone or computer)
- A plastic knife

Materials to share:

- Several rolls of masking tape
- One measuring tape with both English and metric units
- One 3lb tub of playdough for every 3-5 students (available from art supply stores or online)
- Access to computer and Internet
- Projector
- *Max Goes to Mars: A Science Adventure with Max the Dog* (Science Adventures with Max the Dog series) by Jeffrey Bennett (Author), Alan Okamoto (Illustrator)

Preparation

- Gather materials
- Print student sheets: Playdough Planets with a side of Moon
- Pre-load GoogleMaps in an Internet browser: http://www.googlemaps.com
- Explore measuring distance in GoogleMaps by right-clicking on the map, and selecting "Measure distance" from the menu. A circle will appear where you right-clicked on the map. Click on another part of the map to see the distance to that position. A line will appear. Click and drag either spot on the map to alter the line and see a new distance. To clear the distance, right click again and select "Clear measurement."

Alternate ideas

- Create home-made playdough using a recipe such as: http://www.pbs.org/parents/crafts-for-kids/no-bake-play-dough/
- Younger students who have not learned about halves and quarters may have difficulty with portions of this activity. We recommend that you have a younger group follow your instruction, and everyone will make the same sized spheres. Leave out the more difficult math, but pre-measure all of the distances to reveal the true answers to the scaled distances after students have made their guesses.
- Explore the planet Mars and exploration of Mars on the NASA website: http://solarsystem.nasa.gov/planets/mars
- Use a Solar System Scale Model Online Calculator such as: http://thinkzone.wlonk.com/SS/SolarSystemModel.php

Procedure

1. Pass out materials to each student.
2. Explain: Today we are going to make a scale model of Earth, the Moon, and Mars. What is a scale model?
3. If students are not familiar with scale models, use the example of a Hot Wheel as a scale model car. Follow with the idea of a map being a scale model to help us find where we are going (note: this can be a map on a computer or phone as well, but when you zoom out on a map, you are also changing the scale). We can also make a scale model of the Solar System.
4. Ask: Who can tell me what the definition of the diameter of a circle is? (Ans: The diameter is the distance of the center of a circle from one side to the other. If students are having trouble, they can draw a diagram to help them).
5. Explain: The diameter of Mars is about half of Earth's, and the diameter of the Moon is about one quarter the size of Earth's. This is not exact, and we are estimating.
6. Students will roll their Earth, Mars, and Moon by following the student directions, and measure the diameter of each in centimeters.
7. While students are working, it may be good to tell the group that it isn't important for their playdough globes to be exactly spherical and cutting the playdough does not have to be exact.
8. For the comparison to Earth's diameter, the students are not likely to get exactly Earth's diameter by multiplying by two for Mars and four for the Moon, so point out that they "guesstimated" when they cut their playdough, so if they have even come close, that is pretty amazing.
9. Once they have three globes, students will guess how far away to place the scaled Moon and Mars from the Earth. Students may choose to mark their guessed distances using masking tape. Encourage conversation with other students at this time.
10. Reveal that the Moon is, on average, about thirty Earth diameters away from the Earth.
11. Students can "eyeball" this by placing the model Earth side by side thirty times, or calculate it. Use the measuring tape to help students find the exact distance. *A 5.5 centimeter diameter multiplied by 30 is 165 centimeters (or 1 meter and 65 centimeters).*
12. Explain: The furthest humans have ever traveled into space is the Moon. The Moon isn't very far, just 385,000 kilometers (240,000 miles) away! The last time humans went to the Moon was in the early 1970s. Today, humans live on the International Space Station (ISS), which is only 400 kilometers (about 250 miles) above Earth's surface.

13. Pick a representative student's Earth, and pick up a ruler. For most students, that should be less than 6 centimeters across, but you can choose one about that size.

14. If you like, use the diameter of a student's Earth in millimeters and multiply by 0.03 to get the exact distance to the ISS. *For example, 6 centimeters is 60 millimeters. Multiply by 0.03 to get about 2 millimeters.*

15. Explain: The ISS is orbiting at just over _____ millimeters (under 2 millimeters for most students) above the surface of this scaled Earth. This is still inside of Earth's atmosphere, so it's not even really in outer space. That's as far as people ever go these days. Now, the goal is to send people to Mars in the next fifteen to twenty years. How much further into space will we have to go?

16. Explain: One of NASA's goals is to prepare for human exploration of Mars in the future. But Mars is really far away!

17. Explain: If Mars and Earth were lined up in their orbits, there would be about 6400 Earth diameters between them! This is an estimated distance. Can you calculate that using your calculators? Multiply 6400 by the diameter of your Earth. Note: This is an idealized distance since Earth and Mars travel in their orbits and rarely line up (see Image 3). Mars can be nearly five times the distance if it is on the other side of its orbit from Earth.

18. Students will get measurements in centimeters. Students can convert to meters by dividing by 100 (100 cm = 1 m). *For example, in a 5.5 centimeter Earth, multiplying by 6400 gives 35200 centimeters. This is 352 meters. Since this is just an estimate, it's okay for students to round down to 350 meters.*

19. Using the projector, display GoogleMaps and find your location on the map (if this does not automatically load, enter the address under "Search Google Maps").

20. Right-click on your location and select "Measure distance" from the menu (See Image 2).

21. Using the mouse, click anyplace on the map. A line will appear along with the distance in both feet and meters. Drag the dot until the distance matches any calculated distance for Mars for any of the student models. Place the marker in a spot students could walk to safely (not in the middle of a building or between streets) (See Image 2).

22. Show where you would have to drop a few of the students' Mars' for the different models to be accurate. In general, this will probably be at least a block away, and in some cases more than two (unless you have particularly long blocks). Since most students will have guessed that Mars would be in the room or building, this will be a surprise.

23. Explain: Traveling to Mars takes about 9 months. Today, we send robots like the Curiosity Rover, and MAVEN orbiter to Mars instead of people. Discuss: What do you know about Mars? What things would you need to bring with you if you went to Mars?
24. Read the book, "Max Goes to Mars." Discuss: What things would you need to bring with you if you went to Mars?
25. If time allows, pick one of the measurements and take a walk with a Mars to its accurate location. Leave the Earth at the entrance of your building.

Notes about the Activity

- This activity models the volume of planets using the volume equation: Volume is equal to 4/3 times pi times the radius of the sphere cubed: $V=4/3\ \pi\ r^3$
- The model will not be exact. Mars is a little bit bigger than half the radius of Earth, so Mars in our model is just a bit too small. The Moon is a little bigger than a quarter of the radius of Earth, so our model of the Moon will also be a bit too small. The point of this activity is to give students a feel for distance and the vastness of space, and not to get a perfect model.

Image 1: Earth, far left, is twice the diameter of Mars, center, and four times the diameter of the Moon on the far right.

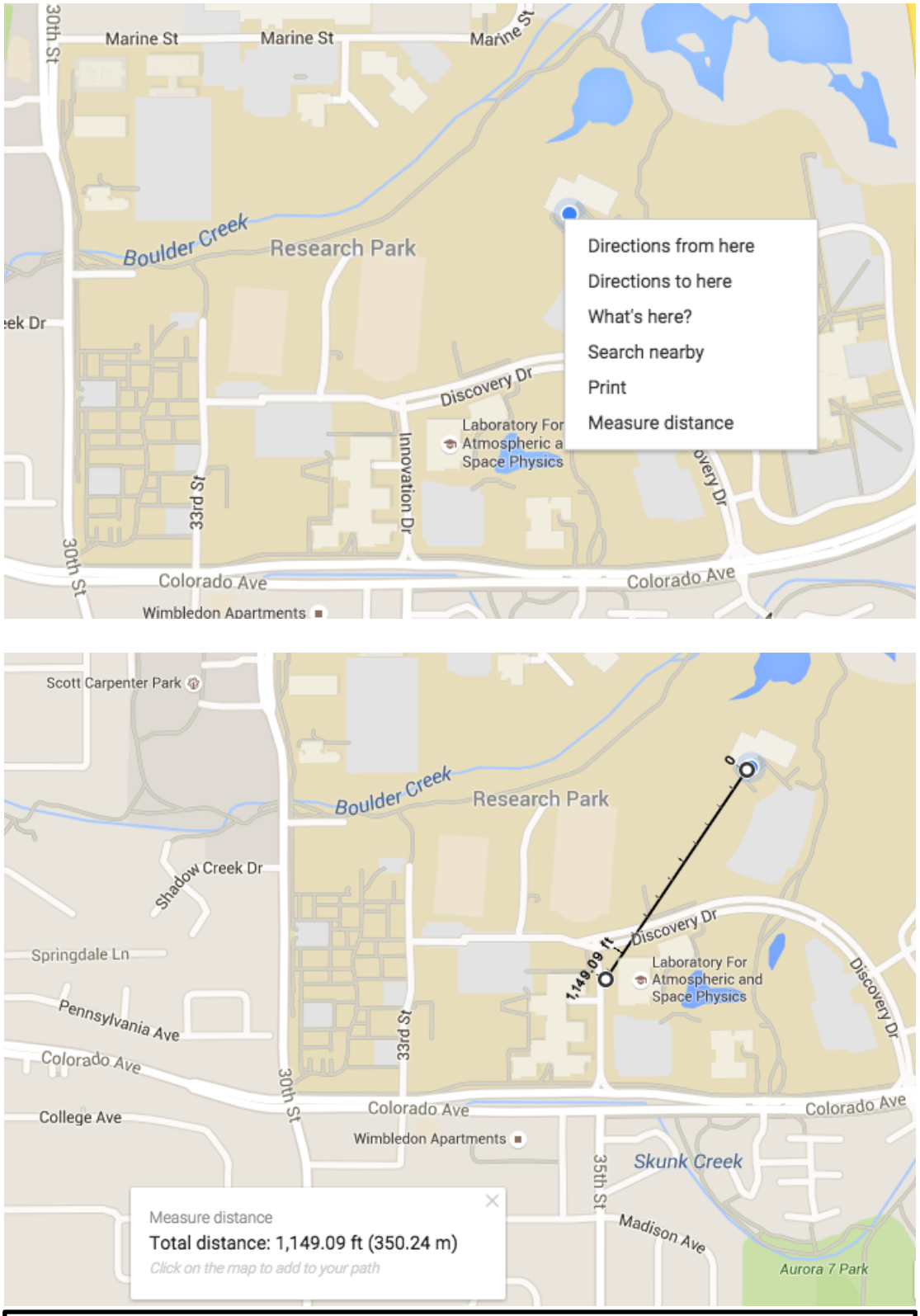
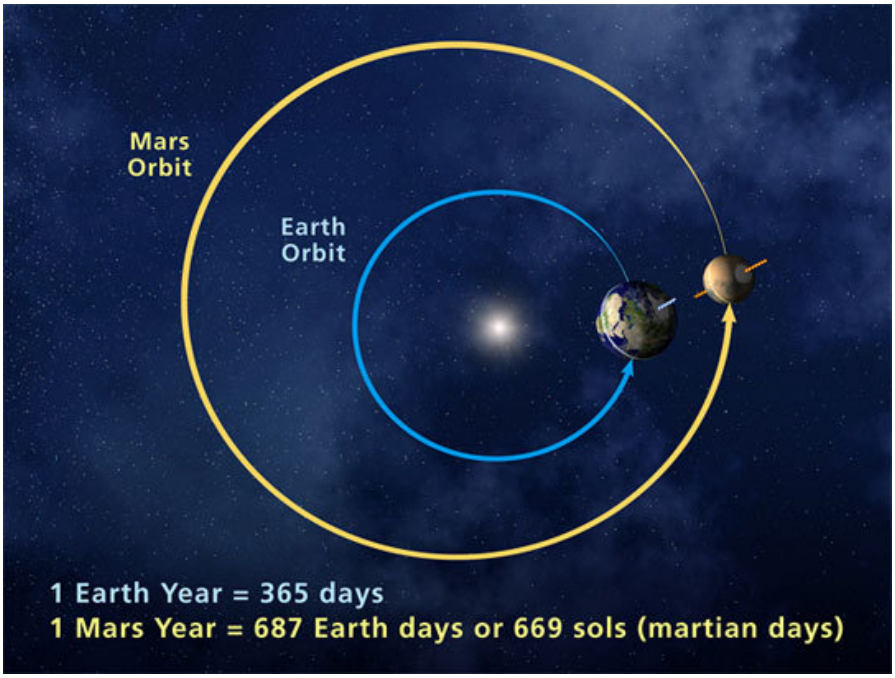


Image 2: In Google Maps, select "Measure distance" from the drop down menu (top) and click anywhere on the map to display the distance (bottom). Drag the circle at either end of the line to change the distance.



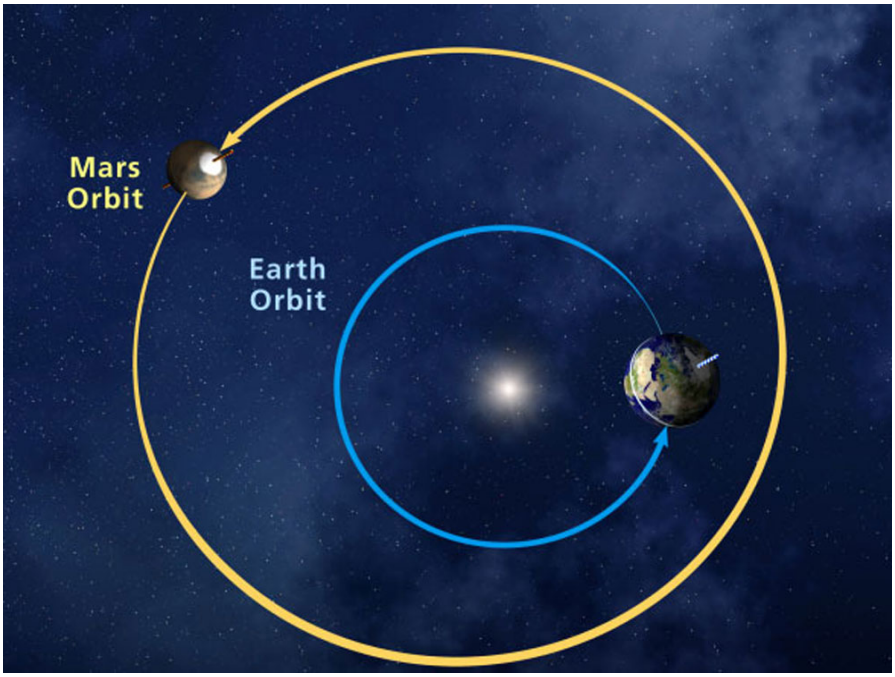


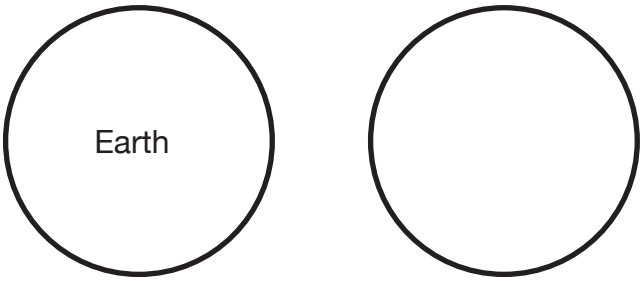
Image 3: At top, Mars and Earth are very close together in their orbits. On the bottom, Mars is nearly on the opposite side of the Sun from Earth, hence much further away. As the planets move in their orbits the distance between them changes. The sizes of the planets are not to scale in this image. Credit: NASA JPL

Inspiration/Credits for this activity:

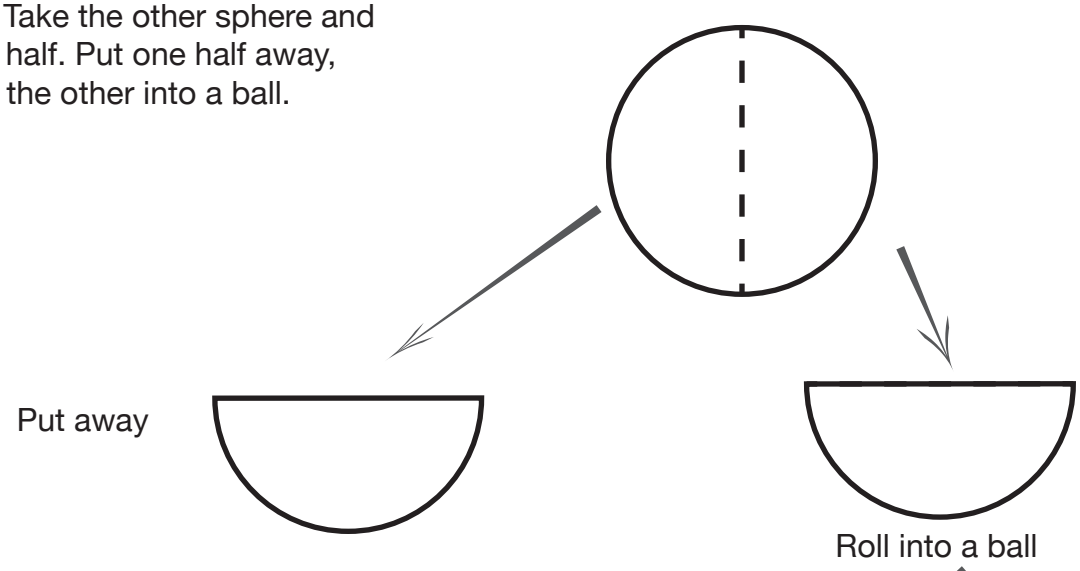
Inspiration for the activity provided by Worlds in Comparison from the Astronomical Society of the Pacific's Astronomy from the Ground Up.
http://mintaka.sdsu.edu/projectastro/resources/WorldsInComparison.pdf

Playdough Planets with a Side of Moon

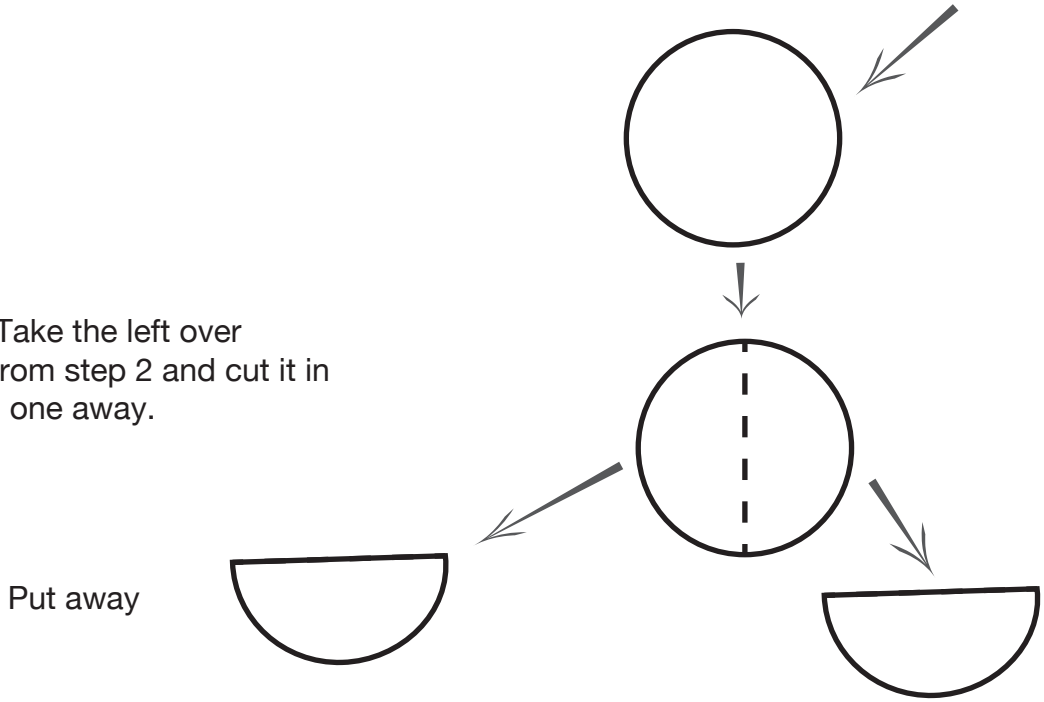
Step 1: With your playdough, make two spheres of exactly the same size. How big you make them is up to you. One sphere is your Earth.



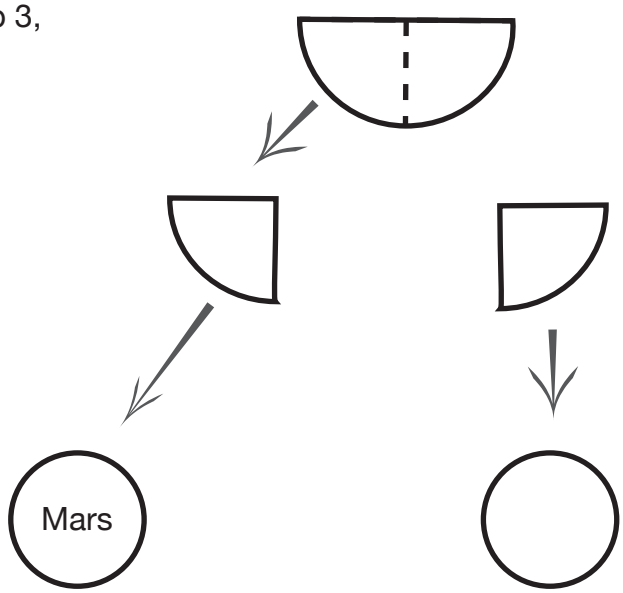
Step 2: Take the other sphere and cut it in half. Put one half away, and roll the other into a ball.



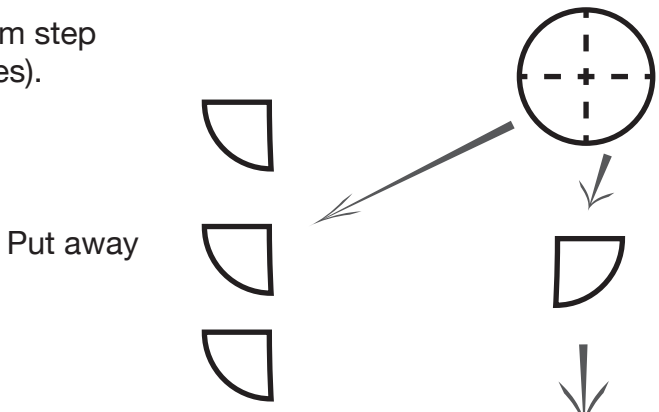
Step 3: Take the left over sphere from step 2 and cut it in half. Put one away.



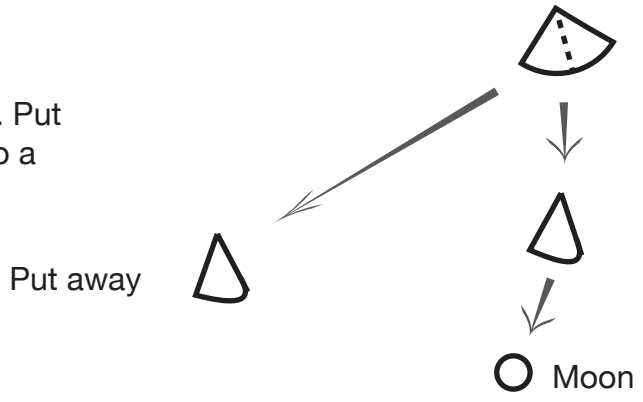
Step 4: Take the half sphere from step 3, and cut it in half. Roll each half into a sphere. One of these spheres is your Mars!



Step 5: Take the leftover sphere from step 4 and cut it into quarters (four pieces). Put three of them away.



Step 6: Cut the leftover piece in half. Put one half away. Roll the other half into a sphere. This is your Moon!



RECORD YOUR RESULTS

Planetary body	Diameter (centimeters)	Comparison with Earth's diameter (centimeters)
Earth		
Mars		x 2 =
Moon		x 4 =

THINGS TO THINK ABOUT

How far from Earth *do you think* you need to put the Moon in your scale model?

How far away *do you think* your model Mars should be from your model Earth?