



EARTH/MOON COMPARISONS, Part 2

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Students will understand: the use of models to understand relationships; comparative sizes and distances of the Earth and the Moon; the concepts of diameter, distance, and volume.

Students will be able to: work with group members to arrive at a prediction; explain relative sizes and distance of the Earth and Moon.

Note to teachers: The following activity can be done on a long whiteboard or a wall. You will need about 4 meters (13 feet) in order to get the distance from the Earth to the Moon. In most classes we have taped the Earth to the edge of a whiteboard, had the students draw their estimates of the size of the Moon on the board, and then tape a circle to the wall to get their estimated distance from the Earth to the Moon. In our teacher workshops, our whiteboard is just long enough to do the distance on the board itself (see image on Page 3).

1. Diameters

- a) Review the definition of diameter.
- b) Using construction paper, make a circle with a 12.8 cm diameter** and draw a diameter line across it; label it “Earth.”
- c) Put the circle on the board or the wall; say to students, “If this circle represents the diameter of the Earth, how big would a circle representing the Moon be?”
- d) Give the students some time to discuss this in their groups of three or four.
- e) Have one member from each group draw a circle on the board to represent their prediction of the Moon (or have them cut one out of construction paper and tape it on the board or wall).
- f) When all predictions are on the board or wall, observe and discuss them.
- g) Then show the students a 3.5cm circle labeled “Moon.” Show how the Moon fits across the Earth’s diameter about four times. The ratio is approximately 4 to 1—it takes about four Moon diameters to equal one Earth diameter.

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**Scale: 1 cm = 1,000 km; 1:100,000,000

2. Distance

- a) Refer back to the circle representing the Earth on the board.
- b) Say to the students, "If this shows Earth's position in space, how far away is the Moon?"
- c) Have students make group predictions; one student from each group draws or tapes up their Moon on the board or wall.
- d) Observe and discuss the predictions.
- e) Using a meter stick, measure 383 cm away from the Earth and draw or tape up the Moon circle at that point (or, move the Earth circle 30 times away from its original position). The Moon is almost exactly 30 Earth diameters away from the Earth.
- f) As an extension, as another way to visualize the Earth-Moon distance, you can string together 30 Styrofoam[®] balls. Two-inch balls are an ideal size, but any size will do. A single ball represents the Earth and the entire string represents the Earth-Moon distance. You can also add a small bead at the one end to represent the Moon.
- g) It should be noted, that, since these models are to scale, if you look from the Earth toward the Moon or from the Moon toward the Earth, the circle or ball will look to correct size from your viewing position.

3. Volume

- a) Review the concept of volume.
- b) Give each group a quantity of Play-Doh[®] (one can per group, or two cans for some groups) and have them form 50 spheres of equal size, using all of their clay. No matter how much clay each group works with, the ratio will be the same.
- c) Ask students to decide how to model the volumes of the Earth and the Moon; how many spheres of the 50 would represent the Earth and how many the Moon? They must use all 50 spheres.
- d) Have the students loosely clump together the spheres of their models.
- e) Have each group display their models on one table.
- f) Observe and discuss the models.
- g) Show the correct relationship; one sphere of clay represents the Moon's volume and the other 49 represent the Earth's.
- h) **Note:** in large venues, pre-make the spheres, divide the spheres into separate piles of 25/25, 35/15, 40/10, 45/5, 49/1, etc. and have the participants guess which one is correct (a container is helpful to keep the spheres together).

Evaluation: Review the three relationships studied. Have students copy and complete the following:

1. The Earth's diameter is _____ times greater than the Moon's.
2. The distance between the Earth and the Moon is equal to _____.
3. Earth's volume is _____ times greater than the Moon's.

SIZE AND DISTANCE: EARTH AND MOON STATISTICS

DIAMETER	Earth is about 4 times the diameter of the Moon (actually 3.67 times larger) (12,756 km vs. 3,475 km)
VOLUME	Earth is about 50 times the volume of the Moon (actually 49.5 times) ($1.09 \times 10^{12} \text{ km}^3$ vs. $2.20 \times 10^{10} \text{ km}^3$)
DISTANCE	Earth is about 30 Earth diameters from the Moon (384,400 km, mean distance) (actually 30.1)

If you have an interest in gravity:

1. Gravity is proportional to mass and falls off as $1/r^2$
2. When standing on a planet/moon, r = the radius of the object
3. Mass is density times volume (proportional to r^3)
4. Therefore, gravity is proportional to radius and density (proportional to r^3 times $1/r^2$ times density)
5. Therefore, if the Earth and the Moon had the same density, the Earth should have a gravity that is 3.67 times the Moon's. However, as we know the Earth's gravity is actually about 6 times (very close), so the Earth must be made of heavier "stuff" than the Moon. In fact, while the Earth is 49.5 times the volume of the Moon, it is 81.2 times the Moon's mass.



