Division Of Geological Survey
HANDS ON EARTH SCIENCE
No. 10

TWO SCALE MODELS OF THE EARTH-MOON SYSTEM

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Given the diameters of the Earth and the Moon and the distance between the two bodies, students can construct a scale model of the Earth-Moon system which will prove very useful in their classroom. The following activity is written in an inquiry mode and should be presented to students as a set of activities and questions. Answers for the instructors are provided in italics in brackets.

Diameter of the Earth	=	12,800 km
Diameter of the Moon	=	3,500 km
Mean distance from Earth to Moon	=	385,000 km

MODEL I

First, calculate to the nearest whole number how many times as large as the Earth (its linear diameter) the Moon is. [4]

If we choose a basketball (diameter of approximately 25 cm) to represent the Earth, what size ball would represent the Moon? [~6 cm, a tennis ball. For any scale model, the Earth must be four times as large as the Moon.]

We now have our system to scale with respect to size. Next we scale for distance. To the nearest whole number, how many Earths can fit between the Earth and the Moon? [30] This is a fascinating answer. Does it surprise you? Did you think it should be smaller or greater?

According to our scale above, how many basketballs must fit between the Earth and the Moon? [30. For any scale model, the Moon must be 30 “Earths” from the Earth.]

Now obtain a long piece of heavy string. Using our scale, how long should the string be to represent the distance between the Earth and the Moon? [30 x 25 cm = 750 cm = 7.5 meters]

With masking tape, attach one end of the string to the “Earth” and the other end to the “Moon.” You now have a very flexible Earth-Moon model which is to scale for both size and distance—the Earth and Moon in your classroom!

With this model, how far away would the sun be, in units of our Earth-Moon distance? Hint: the Earth-Sun distance is 150,000,000 km. [400] If we took our model outside into the street, how far away would the sun be in meters? [400 x 7.5 meters = 3,000 meters = 3 km] This exercise should provide the students some food for thought as to the immense size and vast emptiness of our solar system!

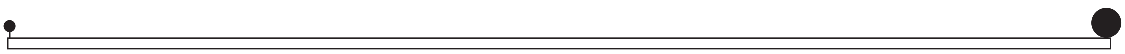
MODEL II

The second model is less flexible than the one above but has the advantage of clearly simulating both solar and lunar eclipses.

Let the Earth be represented by a 10-cm styrofoam ball. What size styrofoam ball should represent the Moon? [2.5 cm. Remember, our scaling factor for size is 4.]

What is the Earth-to-Moon distance with our new scale? [30 x 10 cm = 300 cm = 3 meters. Remember, our scaling factor for distance is 30.] Go to your local lumber yard and have them cut an inexpensive 1-inch x 1-inch board whose length correctly represents this Earth-Moon distance.

Attach the larger ball (the Earth) to one end of the board with glue or large rubber bands. Place the smaller ball (the Moon) at the other end. However, in order to keep the shadow of the Moon distinct from the shadow of the board, raise the smaller ball above the surface of the board by attaching it to a nail or a stiff wire. A bent paper clip works well.



Scale diagram showing the styrofoam balls and board for model II.

Armed with this model (and it is an armful), take your class outside on a sunny day and demonstrate eclipses. It really works! You will discover that the “Moon” will be completely covered by the “Earth’s” umbra as you simulate a lunar eclipse just as in the actual event, but during your “solar” eclipse only a portion of the “Earth’s” surface will fall into the “Moon’s” total shadow. Again, this is what actually happens. Our model illustrates nicely why one must live within that narrow zone of totality in order to experience a total solar eclipse! The strip of totality is generally about 241 km wide, which explains why most people have never seen a total solar eclipse.