## PART I: Earth and Moon

Astronomers often deal with large numbers for distances, masses, and other quantities. They often use ratios to get a better sense of how big or small these quantities are. This can be useful in our daily life as well. For example, we may not have a good sense for the length of a 40-meter-long commercial jet, but saying that the jet is 8 times longer than a car may be more meaningful to us.

Distances like the following can be hard to conceptualize:

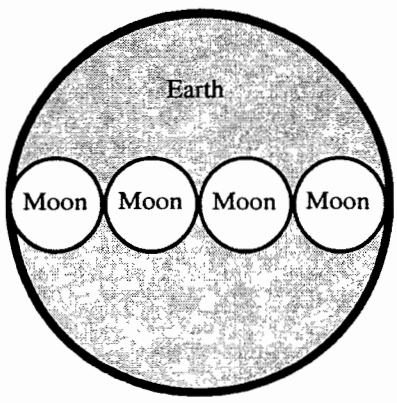
Moon's diameter: 3,476 km
Earth's diameter: 12,756 km

But we can think about these sizes in terms of one another so that we can create a scale model of Earth and the Moon in our minds. If we say, "Earth is (some number) times bigger than the Moon," we can determine that number by dividing Earth's diameter by the Moon's diameter. The result is roughly 4 (12,756/3476 ≈ 4). This means it would take about four Moons to stretch across the diameter of Earth (as shown below).

1) Which of the following pairs of objects would make a good scale model of Earth and the Moon?

   a) A basketball and a soccer ball
   b) A basketball and a softball
   c) A basketball and a ping pong ball
   d) A basketball and a pea
   e) A basketball and a grain of sand

2) Could any combination of the "second" objects (soccer ball, softball, ping pong ball, pea, grain of sand) also be used to make a scale model of Earth and the Moon?




The distance between Earth and the Moon is much larger than either the Moon or Earth – but how much larger? If we divide the Earth-Moon distance (384,000 km) by Earth's diameter, we get 384,400/12,756 ≈ 30. This means you could fit about 30 Earths between Earth and the Moon.

3) To make a scale model of the Earth-Moon orbital system, you not only need to pick appropriately sized objects to represent Earth and the Moon; you also need to place them the right distance apart. Let's say you use a 12-inch (1 foot) basketball and a 3-inch orange as your Earth and Moon respectively. About how far apart must they be to have an accurate scale model of the Earth-Moon orbital system? (circle your answer below) Why?

   a) 1 foot
   b) 4 feet
   c) 10 feet
   d) 30 feet
   e) 300 feet

## PART II: The Sun

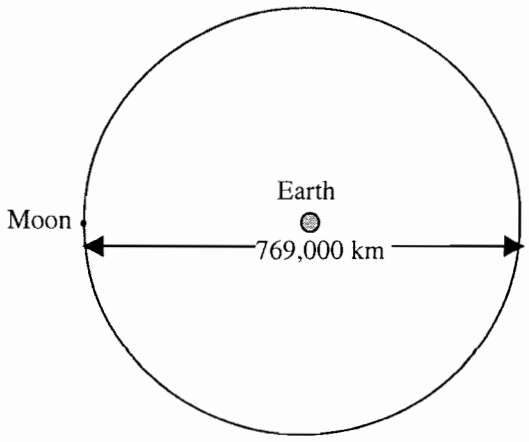
Compared to the size of Earth, the Sun (with diameter 1,392,000 km) is about 110 times bigger than Earth.

4) Can any combinations of the following items be used to make accurate scale models of Earth and the Sun? If so, which two would you choose and why? If not, why not?

- basketball
- soccer ball
- softball
- ping pong ball
- pea
- grain of sand

Now let's compare the Sun's diameter to the size of the Moon's orbit around Earth. The diameter of the Moon's orbit is about 769,000 km across. So, the ratio of the Sun's diameter to the Moon's orbital diameter is roughly 2. (1,392,000 / 769,000 ≈ 2)

5) Does this mean that two Suns placed side by side would fit inside the Moon's orbit or that the two Moon orbits placed side by side would fit across the Sun? Explain your answer.



The distance from Earth to the Sun is about 150,000,000 km. This makes the Sun-Earth distance about 110 times larger than the size of the Sun (150,000,000/1,392,000 ≈ 110).

6) If we used a 12-inch (1 foot) basketball to represent the Sun, how far would it have to be from Earth to be an accurate scale model?
   a) 1 foot
   b) 10 feet
   c) 30 feet
   d) 110 feet
   e) 300 feet

7) If we used a basketball to represent the Sun and a ping-pong ball to represent Earth, and separated them by the distance you answered in question 6, would we have an accurate scale model of the Sun-Earth system? Explain your answer.

8) How many Moons would fit across the diameter of the Sun?