# Scale Earth and Moon Model to demonstrate a Lunar Eclipse

**Aim**: use scaling techniques to appreciate the unusual occurrence of a lunar eclipse

**Materials**: tennis ball or sphere of similar size, piece of prestick or dough for a 2cm sphere
if possible: extra tennis balls and prestick for each group of learners to have a model
2m tape measure

**Introduction**:

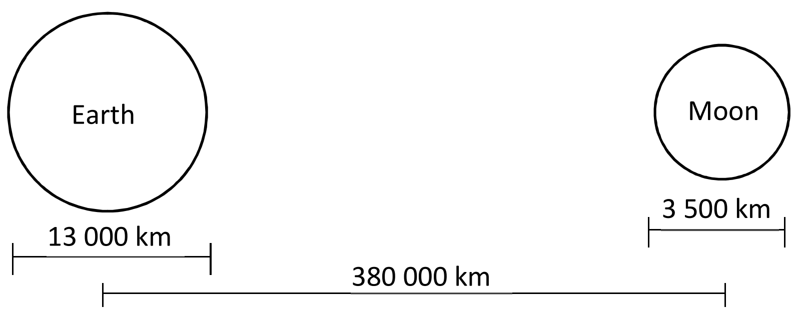
Remind the learners:

- that there are two types of eclipses: eclipses of the Sun and of the Moon
- how eclipses happen:
    - for an eclipse of the Sun, the Sun, Moon and Earth are lined up, and the Moon blocks our view of the Sun;
    - for an eclipse of the Moon, the Sun, Earth and Moon are lined up, and the Moon darkens as it goes through the shadow of the Earth.

This can be done using two volunteer learners – the head of one is the Earth, of the other is the Moon.

**Scale Model**:

1) Draw sketches of the Earth and Moon on the board. Don't try making them the correct scale, just have the Moon a bit smaller than the Earth.
2) Add the sizes underneath, as well as the distance between them:




3) Tell the learners that we will model the Earth-Moon system. The tennis ball (7cm diameter) will represent the Earth. How big should the Moon be? Let them try and work this out themselves first.

   There are at least two ways of doing this:

   a. The difficult way:

      We shrunk the Earth by a factor of

      $\frac{13\ 000\text{km}}{7\text{cm}} = \frac{13\times10^8\text{cm}}{7\text{cm}}$ = $1{,}9 \times 10^8$ times [or roughly 200 million times]

      So, we must shrink the Moon by the same factor:

      3 500 km ÷ ($1{,}9 \times 10^8$) = $3{,}5 \times 10^8$cm ÷ ($1{,}9 \times 10^8$) = 1,8 cm

      This is tricky because:

a) it involves big numbers, and
b) you must be careful not to divide km by cm – convert to the same units first

b. The easy way:

If the real Moon is $\frac{3\ 500\ \text{km}}{13\ 000\ \text{km}}$ = 0,27 times the size of the real Earth (or, roughly ¼ the size of Earth), then our scale Moon must be 0,27 times (or ¼) the size of the scale Earth:

0,27 x 7 cm = 1,9 cm or ¼ of 7cm = 1,8 cm

We can use a 2cm ball of prestick or similar, to represent the Moon.

4) Now we scale the distance between the Earth and the Moon. Either:

a. The difficult way:

380 000 km ÷ (1,9 x $10^8$) = 3,8 x $10^8$ m ÷ (1,9 x $10^8$) = 2 m

b. The easy way:

The real Moon is $\frac{380\ 000\ \text{km}}{13\ 000\ \text{km}}$ = 29 real-Earth-diameters from the real Earth.

So the scale Moon must be 29 scale-Earth-diameters from the scale Earth:

29 x 7 cm = 203 cm which is roughly 2m.

So, if we scale the Earth to a tennis ball, the Moon would be a 2cm ball, 2m from the tennis ball.

**Wrap it Up**:

For an eclipse to happen, the Moon must go through the shadow of the Earth.

You can take your scale model outside into the sunlight – try and position the scale "Moon" in the shadow of the tennis ball, while holding the scale Moon 2m from the tennis ball – it's not easy! Stick your Moon on the end of a pencil so the shadow of your hand doesn't get in the way.

This is why we don't have eclipses every month – normally the Moon passes above or below the Earth's shadow, and we see an un-eclipsed full Moon.

**More Info for Educators**:

An eclipse of the Sun happens when the shadow of the Moon falls on the Earth. Only people in the shadow path see the eclipse. You can use the same scale model to demonstrate this.

**The Earth, Moon and shadow of the Earth to scale**:

a) twice a year – possible lunar eclipse at full mooon

b) most months – no eclipse at full moon

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