## Earth-Moon Model

The image below is a scene from the film, Apollo 13 and a link to a 2 m 25 s You Tube video is here:
https://youtu.be/gmLgi5mdTVo

https://s.aolcdn.com/hss/storage/midas/1e380013a19e4dd345eb5bfb6101a457/202211902/ED_HARRIS_2.jpg
The sketch on the blackboard is showing NASA's plan to slingshot the Apollo 13 capsule around the moon to return to Earth.

But how realistic is that diagram?
Are the sizes of the Earth and Moon in the correct proportion and how far apart are they?
So, the STEM activity arising from this stimulus is:
You want to build a scale model of our part of the solar system. If the earth is a tennis ball, where is the moon and how big is it?

## PROCESS

Students will have to:

- research/measure the radius/diameter of a tennis ball
- research the radius/diameter of both the earth and the moon (in metric or imperial units)
- research the distance between the earth and the moon (in metric or imperial units)


## RATIONALE

The solution to this activity requires approximation and rounding at the outset of the working, rather than with the 'final answer'.
Many students incur rounding errors in Maths by rounding too soon, or by rounding at each stage through a multi-step calculation, and thus their final answer is 'wrong'.
In Mathematics, we often have to encourage students to be accurate at all stages, only rounding in their final step.
In STEM Mathematics, rounding from the outset and then throughout may often be considered acceptable or even necessary!

## POSSIBLE SOLUTION

Tennis ball radius is 2.7 inches, or 6.8 cm
Earth radius is 3950 miles or 6371 km
Moon radius is 1100 miles or 1700 km
Distance from Earth to Moon is 238,850 miles or $384,400 \mathrm{~km}$
So, the Moon is about a quarter of the radius of the Earth, so in our model it's $1.75 \mathrm{~cm}=$ about the size of a table-tennis ball (which has a real radius of 2 cm )

Look at scale of tennis ball radius (cm) : earth radius (km) and it's roughly $1 \mathrm{~cm}: 1000 \mathrm{~km}$ So the distance from the Earth to the Moon is roughly $1 / 1000^{\text {th }}$ of the real distance $=384 \mathrm{~cm}$

We conclude that if the Earth is a Tennis Ball then the Moon is roughly a Table-Tennis ball that's about 4 metres away!

## EXTENSION

How are the 'real' dimensions of the earth and moon even known?
And what about the distance between the earth and the moon .... and is it constant? (ie does the moon have a circular orbit around the earth?)
How were they worked out?

## JUSTIFICATION

This activity is considered a STEM activity, as it...

- provides a motivational starting point, from a Science perspective
- prompts student discussion about what information is required to solve it
- has a graphical/diagrammatic element
- requires students to deal with approximation and uncertainty.
- has contextualized mathematics of scale factors and units of measurement

There are some more suggestions for 'Preparing Students for STEM', here: https://nrich.maths.org/7308

In particular, scroll down to Part 2 where it says....

## - "Inability to make estimates or approximations

- Mathematical contexts in real applications are rarely simple. In order to apply mathematics predictively, approximations will need to be made. To make approximations requires the student to really understand the meaning and structure of the mathematics."

And then try this activity: http://nrich.maths.org/6505
There are also some related activities on the TI Science Nspired website:
Earth Science: Space - Scale Properties
https://education.ti.com/en/tisciencenspired/us/earth-science/space?m=CtuqxI4ph02YIZprwTz8Lg
Earth Science: Space - Lunar Phases
https://education.ti.com/en/tisciencenspired/us/earth-science/space?m=fkNibOo_nk-odsLQOxYZlw

