STARS RESOURCES

Tracking the Moon

ACTIVITY

Observe the Moon's orbit across the sky to see how its position changes over time.

Note: This activity takes about a month of data collection to complete. You can do this activity with the naked eye but it is fun to observe the Moon through a telescope.

BACKGROUND INFORMATION

The Moon orbits the Earth once every 27.3 days. One side of the Moon permanently faces the Earth; this is known as tidal lock.

In this activity, we explore the geometric relation between the Earth, Moon and Sun that result in phases of the Moon.



The Earth orbits the Sun on an imaginary plane called the 'ecliptic'. The path we see the Sun take through the sky over one year also follows the ecliptic. In the diagram below, the ecliptic is shown as a pale grey box. The Earth orbits the Sun on the green line across the imaginary plane.

The Moon travels on its own plane (dark grey box), which is tilted about 5 degrees from the ecliptic (shown in the diagram below).



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BACKGROUND INFORMATION cont'd

Because the Moon's path is slightly deviated from the ecliptic, from Earth we will see it following the same path as the Sun, but sometimes 5 degrees above it, or sometimes 5 degrees below it.

You'll notice that the Moon will move 12 - 13 degrees east every day. This is because it is, of course, orbiting the Earth. Each day the Earth has to rotate for a little bit longer to catch up to the Moon, which is why moonrise is 50 minutes later each day.

DID YOU KNOW?

You can measure an object's position on the sky using your fist.

Hold your fist up to the sky at arm's length.

Have the back of your hand facing you.

The width of your fist is 10 degrees on the sky.



To find out more, take a look at:

- 'Does the Moon follow the same path across the sky as the Sun?', Astronomy.com, <u>https://astronomy.com/magazine/ask-astro/2006/11/does-the-moon-follow-the-same-path-across-the-sky-as-the-sun</u> (1 November 2006), Accessed 8/3/2022.
- 'The Moon's Orbit', NASA Science video (4:53 mins), <u>https://moon.nasa.gov/</u> resources/429/the-moons-orbit/ (10 May 2021), Accessed 8/3/2022.

EQUIPMENT

You will need the following to complete this activity.

- The telescope provided by your school (or you can make observations without a telescope
- A pen or pencil
- A print-out of the sky chart
- A clipboard
- A clock/watch and a calendar
- The Internet (optional)

NOTE: You will need relatively clear skies for your observations, so keep an eye on the weather and cloud cover.



OBSERVATIONS

1. Select a day to begin your observations.

Using a website such as Time and Date, <u>https://www.timeanddate.com</u>, look up the timing of the Moon phases and start your observing during a 'new' Moon.

Each night, observe the Moon at the same time. It is important that you go out roughly the same time every night. Moon rise or the 6:30 - 8pm window is optimal. In this way you will get a sense of the path of the Moon as it crosses the sky.

2. Select an open location.

You will need a good, clear view from low in the western horizon and across to the eastern horizon. At the very beginning of the observing period the Moon will be towards the west and low in the sky (or already set if you wait until 8pm). Close to the full moon phase the Moon will be low over the eastern horizon.

So, identify where north, south, east and west are. You can do this with a compass, or you can use the stars of the Southern Cross and of the Pointers to identify south (as explained here: 'Beginner's Guide to the Night Sky', ABC website, <u>http://www.abc.net.au/science/articles/2009/07/27/3169018.htm</u>.

3. Locate the Moon.

This can be done by angling the telescope tube towards the Moon and locating the Moon through the finderscope.

NOTE: When you look at the Moon in the eyepiece, some telescopes may show you a "flipped" version of what you see when you look at the Moon with just your eyes. Make sure you draw what you see with your eyes and use the telescope as a guide only to help with the shape of the Moon.

Within a few minutes the Moon will disappear from the view in the telescope. Manually adjust the telescope to ensure you stay fixed on the Moon as the Earth rotates.

4. Commence your observations.

Look at the sky chart on page 5. The chart consists of a circle, the area of which represents the dome of the sky above your head. The perimeter of the circle represents the horizon around you. On this circle the four cardinal points (north, south, east and west) are marked. NOTE: Unlike Earth maps, sky maps have the east direction to the left of the north direction. This is because you are looking up, not down. Think of it as looking at map from the reverse side.



OBSERVATIONS - cont'd

Now that you have found the Moon at step 3, determine which direction the Moon is in. If the Moon appears near the horizon between the west and north direction then we say that the direction is north-west.

5. On the sky chart, mark the location of the Moon in the sky.

Draw the outline of the Moon with the proper phase at the correct position on the chart. (The size of the Moon does not need to be to scale). Note the date, time, and angle above the horizon next to each drawing of the Moon. You should have identified in which direction the Moon is, as well as how high above the horizon it is. If it is very close to the horizon then you will place it very close to the edge of the circle on the chart (in the correct direction). If it is overhead, then you will place it in the middle of the circle.

If you would like an easy technique for measuring the vertical position (i.e. elevation) of the Moon with respect to the horizon, use your fist. See 'Did you know' box on page 2.

6. Continue nightly observations of the Moon until it becomes a full moon (around two weeks).

EXTENSION:

While you are at it, you should take the time to look around the sky. A chart can be found on the Powerhouse Museum - Sydney Observatory webpage, 'Observations - Monthly Sky Guides: <u>https://maas.museum/observations/category/monthly-sky-guides/</u>, and there are plenty of interactive apps you can download too (e.g. Stellarium).

See if you can spot the Southern Cross, the Pointers, and, virtually overhead, the constellation Scorpius.







RESULTS

Once you have completed your observations, have a close look at your sky chart.

You will find that each night the Moon slightly changes its position in the sky, creating an arc on the page.

Use your diagram to answer a few questions about the Moon cycle over the period of your observations.

FOLLOW-UP QUESTIONS

1. Describe the changes in the Moon's appearance over the course of your observations.

2. Imagine that you are now standing on the Moon looking back at the Earth.

a) How would the Earth change over the course of 24 hours?

b) If you stayed on the Moon in the same spot for a week, would the Earth's position in the Moon's sky change?

Explain your reasoning.



FOLLOW-UP QUESTIONS

EXTENSION QUESTION

1. How might your observations have been different if you had conducted this experiment further north, say at the equator, over the same dates?

FURTHER RESOURCES

Phases and motion of the Moon:

'Top 4 keys to understanding moon phases', EarthSky website, <u>https://earthsky.org/moon-phases/understandingmoonphases/</u> (January 2021).

Animations of the Moon:

'Lunar Eclipses and the Moon's Orbit', NASA Scientific Visualisation Studio, multiple animations, <u>https://svs.gsfc.nasa.gov/4158</u> (10 April 2014).

A video demonstration of how eclipses occur:

'Eclipses 2: Eclipse Seasons', UNL Astronomy from University of Nebraska (5:24 mins), <u>https://youtu.be/-kw6pW46sal?t=138</u> (28 Feb 2020).

All websites accessed 8/3/2022.

