



national science week 2020

Moon and Sun

The Rabbit in the Moon

Try this: Next time you **watch a movie or TV** show set in Australia or NZ and it shows the Sun or Moon, see if the producers got lazy and just bought film footage from the northern hemisphere.

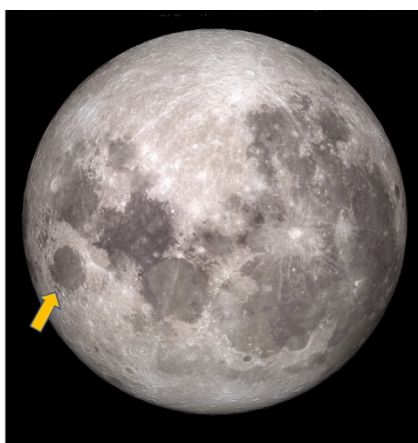
For us to see the Sun or Moon in the sky the camera is pointing north, so both rise on the right of the screen (East) and set on the left (West). Northerners must be facing south and so see them rise on the left and set on the right. Also, the Moon is upside down for northerners.



The Moon as seen from the northern hemisphere. Do you see a large *Man In The Moon* shape?

Mare Crisium is the dark circle on the right.

Credit: NASA Goddard/Lunar Reconnaissance Orbiter



The Moon as seen by us from the southern hemisphere. Do you see a rabbit or another animal?

Mare Crisium is the dark circle on the left. Apollo 11 landed at the dark area midway between there and the centre.

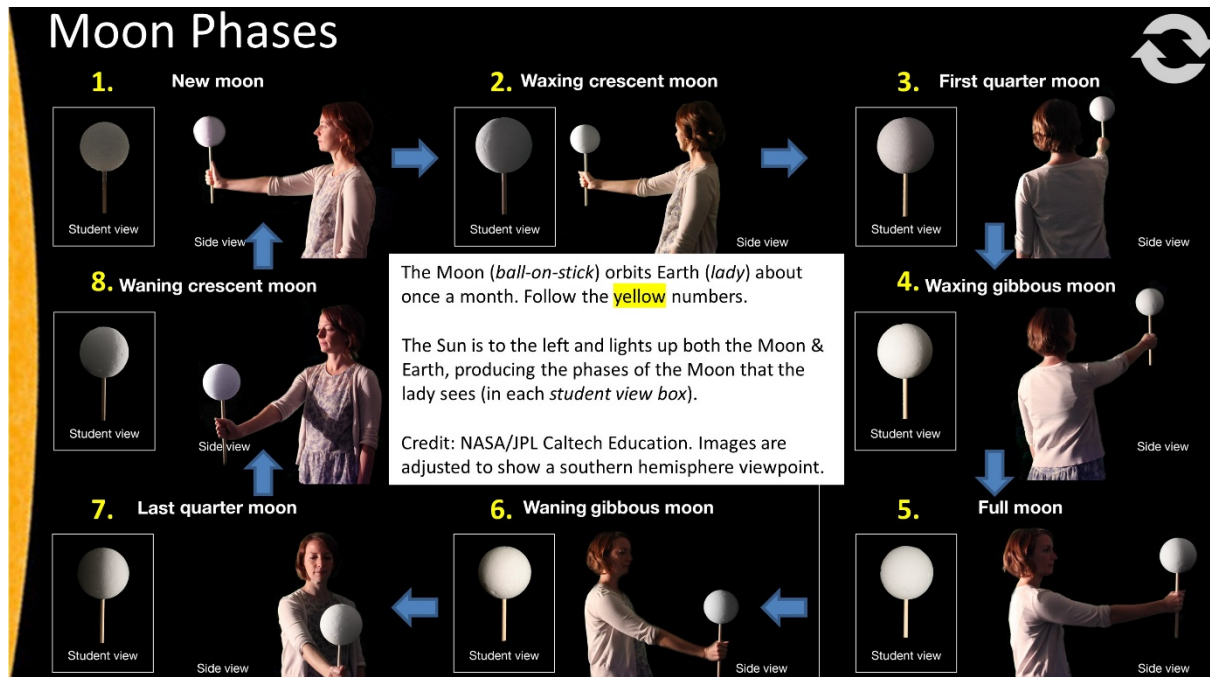
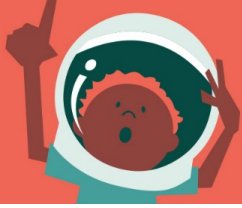
In the north they see the dark lunar features look like a *Man in the Moon* face, whereas we're more likely to imagine an animal like a rabbit. There's also a dark circular feature called *Mare Crisium* near the bottom and left of the Moon for us, but it's near the top and right for northerners.

Phases of the Moon

The appearance of the Moon changes daily as it orbits the Earth about once a month (or *moonth*). Sometimes it's a fully lit Moon during the night, sometimes a crescent or half Moon shape during the day or night, and other times you don't see it at all. It all depends on the angle of the Sun and Moon and what sunlight gets reflected off the Moon to reach your eyes.

Try this: With your phone, zoom in and take a **photo of the Moon** each day or night for a month so you can record the different phases. You can also **sketch** it instead. Compare with the predictions from the links below. It rises later from day to day, so some will be evening and some morning views.

You can see what's happening from NASA's ball-and-stick experiment, where it's adjusted for our southern hemisphere view. The lady's head represents the Earth and she's holding a white ball on a stick to represent the Moon. The Sun is on the left. She turns around clockwise once a month, for one orbit of the Moon following the numbers. What she sees at each step is shown inside the small student's view box.



See how the Moon is invisible at New Moon when it's close to the Sun, but then a few days later as it "waxes" we see a crescent appear, and this grows into a First Quarter Moon (1/4 of the orbit) which has its left half lit, then a gibbous Moon, then a Full Moon (1/2 of the orbit). The Moon then begins to "wane" and a gibbous shape returns before Third Quarter Moon (3/4 of the orbit) which has its right half lit, then a crescent and back to New Moon again.

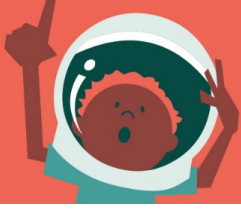
You can do this **experiment** yourself in a dark room if you have a torch or light that you fit inside an empty toilet roll or cling wrap roll. Cover around it so that stray torch light doesn't bounce off the walls and ceiling and only reaches your Moon ball through the roll opening. With your other hand, hold your phone by your face and take a video of the Moon phases as you turn around.

Outdoors, line up the front leading edge of the Moon with something near to you, like a tree. Time how long it takes for the trailing edge to pass the same spot. The Moon moves its own diameter surprisingly fast. If you did this when it was just rising in the East, to your eye it will look much larger than if the Moon was high in the sky. This is an optical illusion that tricks the brain.

The Moon also moves through the sky slower than the stars, due to its own motion in orbit. If you're lucky, you might notice a star catches up with, and goes behind, the Moon and then overtakes it and reappears later out the other side. If it's bright enough, because this looks like something slowly launching off the Moon, it has sometimes been reported as a **UFO**.

Why do I see the Sun move in the sky? The Moon goes around Earth, but the Sun doesn't.

Try this: It all depends on your **viewpoint**. Imagine your head is the Sun and the Earth is your phone camera. Hold your phone in your outstretched arm and video your head as you slowly turn around in an anti-clockwise direction. When you replay the video, did you notice the background appeared to move clockwise, yet your background wasn't really moving? In the same way, because the Earth



spins around in space once every 24 hours, this causes the Sun to appear to move in the opposite direction.

For those living in Earth's southern hemisphere, the Sun rises in the east, sweeps across the sky to be north at the middle of the day and continues its journey until setting in the west. For those living in northern countries, they see the midday Sun to the south instead. If you face north and hold out both arms like aircraft wings, Earth is turning such that your right arm is dropping while your left arm is rising. This causes the Sun to seem to rise from your right side and then set on your left side. That's why Western Australia has its sunrise and sunset a couple of hours later than the eastern states because it takes the Earth that long to turn around in space.

Finding the Time

If the sky is clear during the day you can easily make an equatorial sundial to read the time.

Try this: Use the link below to print a **Sundial** onto paper. Take care your printer doesn't stretch or distort it. Hold it up against a window and with a pencil trace the hourly marks onto the back of the paper.

Assemble it as shown with scissors, tape, and a pencil. The angle to use is your *latitude* - if you live at Uluru, Google for "Latitude of Uluru" to find out what it is for you. The pencil needs to point up towards the south, so use your phone's compass app to find that.

Due to Earth's tilt, for our summer months the Sun casts the pencil's shadow onto the top of the printed sundial. But during our winter months it casts the shadow underneath the paper instead, so you'll need to read the hour markers through the paper or from where you traced underneath.

If your location has an hour added for daylight savings during the year, then for those months remember to add an hour.



Credit: Peter Skilton

A garden equatorial Sundial in Victoria. The arrow points upwards to south, and the Sun is on the right. Time is read from the arrow's shadow cast onto the Roman numerals on the curved band. For the paper sundial, the pencil replaces the arrow, and the time is read from its shadow either falling above the paper dial (October to March) or below (April to September).

Why are solar panels mounted at an angle?

Earth doesn't have its South and North Poles straight up and down in space. The Earth is thought to have been tilted over in a collision with a smaller planet called Theia early in its existence. That collision mixed the two bodies together, knocked our new Earth over and ripped out a chunk into orbit that formed the Moon. Moon rocks returned by the Apollo astronauts showed it's made of identical minerals to Earth. If you own a globe of Earth at home, notice it indeed has the poles leaning over. This tilt angle makes the seasons of Spring, Summer, Autumn and Winter.



Try this: **Solar panels** make electricity most efficiently if they point directly at the Sun. So ideally, they need a motor to track the Sun from east to west across the sky each day.

To keep costs down, often they're simply fixed to face north to best catch the Sun around midday. Use your phone's compass app to find north. This is usually slightly different from the north found by a magnetic compass needle. Earth's tilt complicates things because it means the Sun is high in the sky in Summer, but low in the sky in Winter. So, you'd need a second motor to move the panels up and down from day to day. Imagine if Earth had a ring around its equator like Saturn does. From the ground you'd see it stretching across the sky, and this would be the midpoint path for the Sun. So, the cheap compromise is for solar panels also to point to where that ring would be in the sky, and that angle depends on your *latitude*.

Search for your latitude as mentioned above in the Sundial activity, and then visit the solar panel links below to work out the optimal angle to mount your panels. If you're lucky, your roof might be at the right angle and facing north already.

Resources

Solar panel angle: www.solarcalculator.com.au/solar-panel-angle/ and www.solarelectricityhandbook.com/solar-angle-calculator.html

Sundial: www.skyandtelescope.org/observing/how-to-make-a-sundial/ and www.skyandtelescope.org/wp-content/uploads/sundial_s-1.pdf

Sun & Moon predictions: www.timeanddate.com and use the *Sun & Moon* tab for your town.

Moon calendar: www.moonphases.co.uk/moon-calendar/2020/8/1

Apps: Those on timeanddate.com, The Moon, Day & Night, Skyview Lite.