



Young Astronomers

Moving Moon

Classroom Activity – After visiting the Observatory

Overview

Age Range: 7-10 years

Lesson Time: 1h 45 min

Cost per activity: Low

Includes the use of: NO TELESCOPE NEEDED!

-Moon phase spotting: Internet, pen and paper, scissors, (optional: free Stellarium software or online version)

-Moon lollipop: paper pulp ball, stick (eg. grill stick), source of light (eg. desktop light), (optional: paints to colour the paper pulp ball)

-Where is the Moon: compass/phone's compass application, pen and paper

Outline

Become a space researcher by studying a very familiar object in the sky! Our Moon orbits the Earth and always looks different: its shape and position vary at different times over the month.

How does the Moon change its shape? Count all of the phases of the Moon in the Stellarium software, or in the sky if you prefer! You can also use the "Moon lollipop" to see what causes these different phases.

Additionally, you can track the movements of the Moon in the sky. Can you see how quickly the Moon moves?

Pupils will Learn:

- The Moon goes around the Earth once a month. Because of this rotation, the Moon changes position in relation to the stars.
- The motion of the Moon around the Earth also causes the different shapes, or phases, of the Moon. The phases of the Moon are the result of light hitting different areas of its surface at different times of the month as viewed from the Earth.
- The Moon does not generate light of its own, it just reflects the light of the Sun.

The online observatory collaboration consists of the following partners:

Baldone Observatory, Brorfelde Observatory, Cardiff University, Harestua Solar Observatory, Helsinki Observatory



Lesson Plan:

Description	Time	Notes
Introduction to the subject	15 min	
Activity 1: Moon phase spotting	about 1 month	<p>You will follow the phases of the Moon over one month ("MovingMoon ObservationSheet.pptx"). After making your observations, you will be able to study the order of the phases using the cards depicting the phases of the Moon ("MovingMoon PhasesInOrder.pptx").</p> <p>Alternatively you can use the Stellarium software (https://stellarium.org/ or online version https://stellarium-web.org/)</p> <p>You can also use a simulator to explain your observations: https://ccnmtl.github.io/astro-simulations/lunar-phase-simulator/</p>
Assessment	5 min	
Activity 2: Moon lollipop	30 min	In this assignment we will learn why the Moon changes its shape.
Assessment	15 min	
Moon lollipop/Further activities	15 min	
Activity 3: Where is the Moon? A) Let's play Earth and Moon B) Follow the real Moon in the sky	10 min about 2 weeks	<p>We will study the movements of the Moon in the sky over a month. The movement will be visible in about a week of observations. The winter is the best time to observe the Moon. The observations are written down on the form ("MovingMoon CompassSheet.pptx").</p> <p>Alternatively you can use the Stellarium software (https://stellarium.org/ or online version https://stellarium-web.org/)</p>
Assessment	15 min	



Introduction to the subject:

Activate the pupils' existing knowledge and determine their knowledge level by discussing the following questions:

- You can start by talking about what goes around what: the Moon and the Earth, and the Earth and the Sun.
- Does the Moon always look the same? What kinds of shapes have you seen the Moon take in the sky? [The Moon can be seen in different shapes, including full moon, crescent (or gibbous moon) and half moon. Sometimes the Moon disappears (new moon) so that it is difficult to see in the sky.]
- Have you noticed that the Moon isn't always at the same point in the sky? [Sometimes the Moon can seem to be behind your house, sometimes it's over a field, etc.]
- Do you know where the Moon's light comes from? Does the Moon shine? [The Moon generates no light; its light comes from the Sun! The light of the Moon is actually just sunlight reflected from the surface of the Moon.]

When making observations in the sky, make sure the sky is clear! In Finland, the autumn tends to be cloudier than the spring. Statistically, the largest number of clear days fall in May and June, with the cloudiest time being November and December.

To save time, the observations for activities 1 and 3 may be done at the same time.

Activity 1: Moon phase spotting

Spot the different phases of the Moon! The teacher will check the current phase of the Moon beforehand and instruct the pupils. Afterwards, the group will see how the phases of the Moon follow each other.





1. Find the current phase of the Moon in the calendar or on the web (e.g., the website Heavens Above features the phases of the Moon: <https://www.heavens-above.com/moon.aspx?lat=51.4934&lng=0.0098&loc=Greenwich&alt=0&tz=GMT>). The best times for seeing the phases of the Moon (the times when the Moon is at its highest):
 - **WANING CRESCENT** (left side illuminated) -> Morning (the smaller the crescent, the closer it is to the Sun.)
 - (The **NEW MOON** is harder to see, as it is always close to the Sun.)
 - **WAXING CRESCENT** (right side illuminated) -> Evening or afternoon (the smaller the crescent, the closer it is to the Sun.)
 - **FULL MOON** -> Night
2. You can enter one of the above times of day into the Heavens Above star chart (<https://www.heavens-above.com/skychart2.aspx?lat=51.4934&lng=0.0098&loc=Greenwich&alt=0&tz=GMT>) along with a suitable date. Give your pupils a homework assignment to observe the Moon by looking at the sky at roughly the right time in roughly the right direction. Repeat this before every observation you want them to make. Remember to check the weather to make sure the Moon is visible!
3. Ask the pupils to draw or take a photo to show what kind of Moon they see at each observation. Add the date to each image. You can use the form in "MovingMoon ObservationSheet.pptx" to write down the observations.
4. You can also use the Stellarium software to track the phases of the Moon. Use the time menu to change the dates and times of day.
5. When all observations have been made, hand out the Moon cards printed from page 2 of the file named "MovingMoon PhasesInOrder.pptx". Each pupil will have a set of eight Moon cards. Cut out the cards.
6. Ask the pupils to look at their own images in the observation form in chronological order, and use them to determine the right order of the cards (the phases of the Moon). Please note that any card can be first, but the sequence of the phases is important. The pupils can also compare their results, and if they are different, try to find the right solution together.
7. You can now look at page 3 of "MovingMoon PhasesInOrder.pptx", which features both the correct sequence of lunar phases and their names. Please note that there are two kinds of crescent, gibbous and half moons, waning (left side illuminated) and waxing (right side illuminated).
8. You can also show an animation of the phases of the Moon: <https://ccnmtl.github.io/astro-simulations/lunar-phase-simulator/>. In the animation, the "Moon Phase" window shows the phases of the Moon in the correct order over a month's time. (You can later use the main animation window in activity 2 (The Moon lollipop) to think about the reasons for the phases of the Moon.)

Assessment:

- Did you notice how long it took for the Moon to go through all of the phases? If you were to follow the Moon for another month, what would happen?

The online observatory collaboration consists of the following partners:

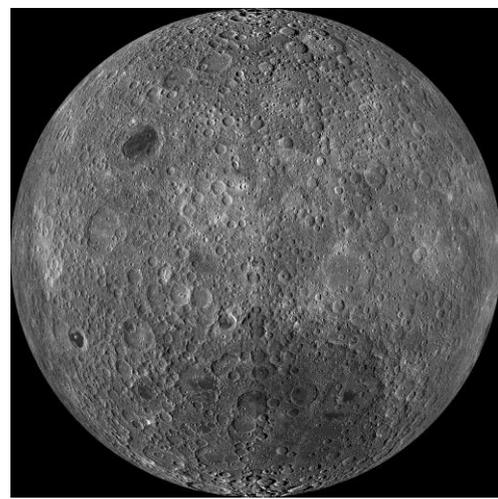
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Activity 2: The Moon lollipop

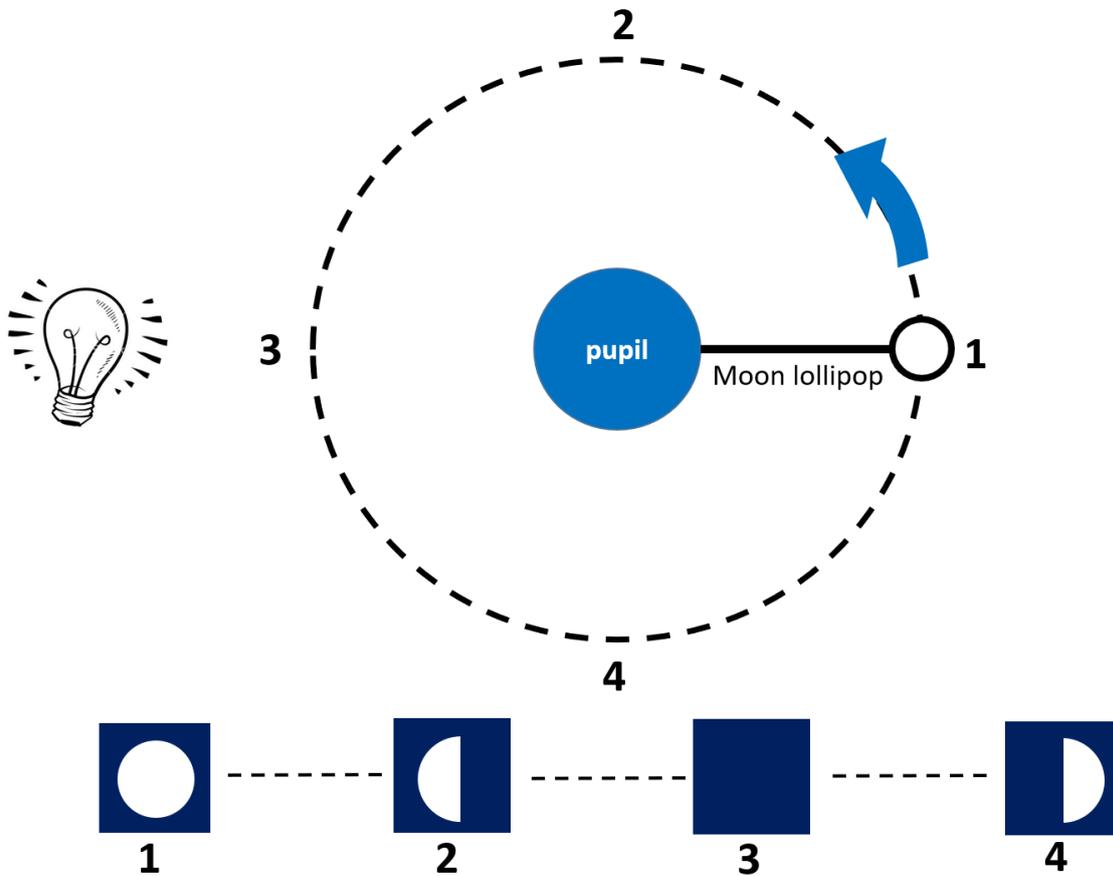
Use the Moon lollipop to find out why the Moon changes its shape. Make your own Moon lollipop by attaching a papier-mâché ball (paper pulp ball) to a stick. The pupil will be the Earth, and a lamp will be the Sun. By changing the positions of the “Earth”, “Sun” and “Moon”, the pupil will see how the phases of the Moon happen.

- Ask your pupils if they have any idea why the Moon has phases.
- Hand out the balls and sticks. The bigger the balls, the easier it will be to see the different lunar phases. If you want, you can also paint lunar topography onto the balls. Please note that there are almost no seas on the far side of the Moon. This side is never visible from the Earth. The side that can be seen from the Earth is covered with darker areas, the maria, or “seas” of the Moon.



Activity 2: The near and far sides of the Moon (for painting). Credit: Gregory H. Revera [CC BY-SA 3.0], NASA/GSFC/Arizona State University [Public domain].

1. Tell the pupil to attach their Moon ball to the stick. (If you painted the Moon, attach the stick on the side of the ball that will be visible from the Earth.) Tell the pupil to hold the Moon above their heads (to avoid any lunar and solar eclipses).
2. Use a bright lamp as the Sun. If you can make the room dark, it will be easier to see the shadows.
3. Ask the pupil to stand with the “Sun” lamp behind their back. The pupil should now be able to see a full moon, the side of the Moon fully illuminated by the Sun. Ask the pupil to calmly turn counter-clockwise – this means they will be moving the Moon around the Earth. See how the shape of the illuminated area of the Moon changes, creating the phases of the Moon as it orbits the Earth. See the image below.



4. You can also observe how the phases of the Moon are created in the animation: <https://ccnmtl.github.io/astro-simulations/lunar-phase-simulator/> . The “Moon Phase” image shows the phase that is visible from the Earth at a given time. The main window shows the Earth-Moon-Sun position. (Please note that the “Horizon Diagram” image shows the view from the Earth as days pass. The motion of the image is caused by the Earth rotating on its axis, which makes the Sun and Moon seem to move along the sky over the course of a day and night.)



Assessment:

- In what order are the phases of the Moon created? [See the page 3 of “MovingMoon PhasesInOrder.pptx”]
- From Earth, it seems that the area of the Moon which is illuminated changes through the month. But what would we see actually happening if we could observe the Moon from different points in space? How much of the area of the Moon is always illuminated? [Half of the Moon is always illuminated, except during a lunar eclipse.]
- Where does the light of the Moon come from? [The light comes from the Sun, not the Moon. This means that the Moon produces no light, it just reflects sunlight.]

The Moon lollipop/Further activities:

Lunar eclipses are often confused with the phases of the Moon, but they are the result of different processes. Try to make a lunar and solar eclipse with the Moon lollipop!

Many think that the reason for the phases of the Moon is the shadow of the Earth. This is not the case. When the Moon is in the Earth’s shadow, we say that a lunar eclipse is happening. So an eclipse does not cause the phases of the Moon. You can try making a lunar eclipse with the Moon lollipop by asking a pupil to stand between the lamp and the “Moon”. Make sure that the Moon is precisely in the shadow of the “Earth” pupil. (The lollipop should be held lower this time!) Do you see that a lunar eclipse can only happen during a full moon? Why isn’t there a lunar eclipse every month? [The Moon’s orbit is slightly tilted. This means that the Moon does not fall in the shadow of the Earth on every orbit.]

You can also check how a solar eclipse happens: the pupil should turn so that the Moon and the light source are in the same direction. Try to get the “Moon” to cover the light source completely from the perspective of the pupil – the Sun is eclipsed!

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Activity 3: Where is the Moon?

Have you noticed that the Moon seems to move around the sky? In this activity, we will learn about the movements of the Moon, which are different e.g. from the monthly movements of the Sun in our sky. The Moon is much lighter than the Earth and orbits it as a satellite. It's easy to see the movement of the Moon: it moves approximately 13 degrees, or 26 Moon-widths, along the sky every day.

- A) Let's play Earth and Moon: The class can now observe the movements of the Moon in relation to a background.
1. Use the Moon lollipop from the previous activity as the Moon, with a pupil representing Earth. Alternatively, this can be a pair assignment with one pupil representing the Moon and the other one, the Earth. In that case, assign the roles beforehand. (You can also designate a lamp to be the Sun, but make sure it is significantly further away from the pupils.)
 2. The pupil representing the Earth stands still and notes what they see in different directions (objects, furniture, etc.). Then the Moon moves slowly around the Earth (the Moon's speed is about one rotation per month!). If you are doing this as a pair activity, the pupil playing the Earth can also keep turning around (actually the Earth turns on its axis about 30 times every month) to see the Moon in different directions.
 3. The Earth pupil will observe how the Moon appears in relation to the environment. Sometimes the Moon will be seen by the blackboard, sometimes by the door.
- B) Follow the real Moon in the sky
1. Track the movements of the Moon in the sky for several days or nights at the same time. You can start making the observations at any time of the month. The best time for observations is during the winter months, when the Moon is relatively high. Tip: The Moon is best visible at a convenient time for school nights (early evening) about a week before and after a waxing half moon (right side illuminated).
 2. You can now look in the calendar for e.g. the next waxing half moon and then check the Heavens Above star map (<https://www.heavens-above.com/skychart2.aspx?lat=51.4934&lng=0.0098&loc=Greenwich&alt=0&tz=GMT>) to find out which direction the Moon will be in.
 3. You could, for example, give your pupils a homework assignment to observe the Moon by looking at the sky at roughly the right time in roughly the right direction. The point of observation doesn't have to be exactly the same each night, but all observations should be made in the same general area, e.g., near your home. Remember to check the weather to make sure the Moon is visible!



4. Instruct the pupils to make observations about the position of the Moon in the sky for several days (e.g., one or two weeks), always at the same time of day. In principle, the observations should be documented by marking the position of the Moon on a star map each time. However, during such a short observation period, the constellations will be approximately in the same direction every day at the same time, so the best way to see the movements of the Moon is by observing its change in position at the same time each day.
5. Tell the pupils to mark the position of the Moon once every day (at the same time) in the observation form of "MovingMoon CompassSheet.pptx". Use a compass or a compass app to see the direction of the Moon. For each observation, mark the direction of the Moon and the date on the form.
6. If you want, you can also observe the same phenomenon in the Stellarium software. Use the time menu to change the dates and times of day.



Activity 3: Models for observing the directions of the Moon (screen shots from a mobile compass app)

Assessment:

- Look at your observations: Has the Moon moved between your observation days? In which direction? [Because of the rotation of the Moon around the Earth, the direction of the Moon between the observation days will be counter-clockwise. (Compare: The movement of celestial bodies will appear to be clockwise due to the rotation of the Earth.)]
- Why has the Moon moved? [The Moon changes its position in relation to the Earth from day to day. The Moon goes around the Earth once in a month. Compare this to the "Let's play Earth and Moon" game!]

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Background Material/Knowledge:

- Telling time
- Cardinal directions, using a compass or a mobile compass app