

## Observing Our Moon

### Overview

Changes in shape and the size of the moon over the period of a month has always been an intriguing topic for kids. Students learn that it's not the moon which is changing but it is actually an effect seen from earth and happens due to change in sun-earth-moon angle, as moon rotates around the earth. In this learning unit students will learn about the phases of moon, by analyzing the data given in the form of pictures, time and date. They will also learn about different terminologies related to phases of moon and try to draw their own conclusions by answering questions asked in different tasks.

**Minimum Time Required:** 2 sessions of 60 minutes.

### Type of Learning Unit

This learning unit **consists of two tasks**, in **Task-I** students will be doing a role play activity to depict the motion of moon around earth and in **Task-II** individual student has to fill the table and answer the questions **on the basis of information given in the data table**.

### Learning Objectives

1. To study the Phases of Moon as we see from Earth.
2. Visualization of motion and orbit of moon around the earth.

### Links to Curriculum

NCERT Class 8 Science textbook; Chapter 17: Stars and the Solar system,  
NCERT Class 8 Science textbook; Chapter 16: Light (Concept of light path and shadows)

### Motivation

Today we shall discuss some ideas related to the phases of moon by writing answers to all the questions in the sheet. It's not necessary to write full sentences. At any point, if you think you should change your answer to any of the earlier questions, feel free to do so. After you have finished writing the answers, we will discuss all the questions together and try reaching to the best answer by combining all your answers.

**Materials Required:** Paper, pencil, eraser, etc.

### Task 1: Role Playing Activity

Below is the Image of Sun, Earth and Moon and the orientations of their Orbits as seen by a distant observer.

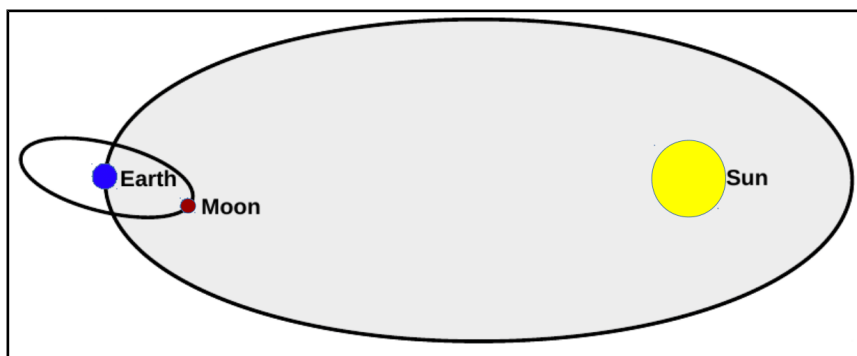


Figure 1: Illustration of Sun-earth-moon orbit

The plane of orbit of Moon is tilted to the plane of Earth's orbit around Sun at approximately  $5^\circ$  angle.

Let's play a game which help us to understand different positions of moon during different phases in between sun and earth

### Instructions

- Three students from the class will play roles of the Sun, Earth and Moon.
- Earth person's head represents planet Earth and his/her nose is an imaginary person on the Earth's surface. Other students who are not part of the role play, observe the activity from a few feet away.
- Student who is playing moon's role will draw a circle around Earth, to represent the moon's orbit around Earth (not absolutely essential but it would help).
- Keep in mind that moon moves around Earth in an anti-clockwise direction, which is also the same direction in which Earth rotates as well as revolves around sun.
- The student playing earth's role should stand stationary. Fix the position of the person playing sun's role for direction of sunlight.
- Person playing Earth's role need not to go around the sun as here we are mainly focusing on phases of moon. Now make the moon go around in its orbit. To begin with, let the moon be between Earth and Sun.

Now, guess which part of the moon's head would be illuminated, which part of the moon would be dark due to absence of sunlight.

- Now make the moon take a position such that earth is in between moon and sun and all the three become aligned.

Now lets discuss which part of the moon is illuminated, which part is not illuminated.

- Now make the moon to take various position in its path. Let students guess which part of the moon is illuminated and which part is not illuminated.

### Full moon & New moon

At which position of the moon in orbit a person on earth (who is at position of nose of student playing earth's role) will see full moon (or new moon)?

Where the moon should be so that it is full moon (or new moon) for a person at the back of the head of student playing earth's role. (What is important here is the orientation of the Moon).

It should be clearly noted that irrespective of where the nose is facing, if it is full moon, it is full moon! That is moon has to be oriented with respect to the Sun in a particular way. As the Earth rotates each and every part of the Earth will experience full moon (or new moon)

Someone who knows a little bit more will say that when Moon is between Earth and Sun it is eclipse time. You can avoid such a situation by choosing two students who have different height. So you can say that though moon is in the same direction as that of the sun, it is not exactly in the straight line. Also tell the class that you will discuss why then eclipses occurs later with a separate model/ picture.

### Half moon



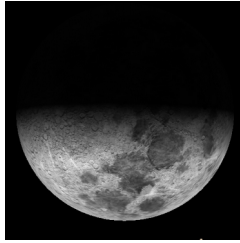




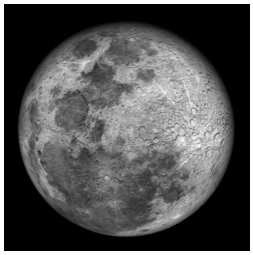

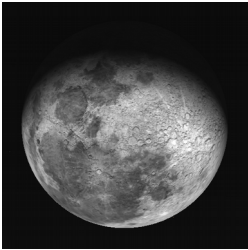


Guess at which position there would be a half moon and discuss it among your group.

The angle between sun-earth-moon is 90 degree at two positions of moon in its orbit around earth and at these two positions it will be half moon. Notice that this time, for everyone on the surface of earth, it is half moon.

Discuss that during motion of moon in its orbit the bright portion of moon which is seen from earth increases for sometime and then decreases for sometime. When bright portion of moon as seen from earth is increasing it is called as Waxing of moon and when it is decreasing it is called as Waning of moon. Now, guess in which half of the moon's orbit it would be waxing and in which half it would be waning. Explain by role play. Notice that when

the moon is going from full moon to new moon it is waning and when it is going from new moon to full moon, it is waxing (Krishna paksha and Shukla paksha).

### Task 2: Analyzing data table

Sr. No.	01	02	03	04
Image of Moon				
Date	18/02/2018	20/02/2018	23/02/2018	24/02/2018
Rise Time	08:02	10:01	12:15	13:07
Set Time	20:00	22:39	00:31	01:31
Sr. No.	05	06	07	08
Image of Moon				
Date	26/02/2018	28/02/2018	01/03/2018	02/03/2018
Rise Time	15:04	17:10	18:12	19:12
Set Time	03:32	05:27	06:19	07:08
Sr. No.	09	10	11	12
Image of Moon				
Date	04/03/2018	05/03/2018	07/03/2018	09/03/2018
Rise Time	21:06	22:01	00:13	01:54
Set Time	08:36	09:18	12:06	13:29

1) Fill the following table by using information given above.

Date	Moon-rise time	Moon-set time	Moon shape (crescent / half / more than half (gibbous) / full / absent)	Boundary of Bright and Dark region of Moon is (convex / concave)
18/02/2018	08:02	20:00	crescent	concave
20/02/2018	10:01	22:39	crescent	concave
23/02/2018	12:15	00:31	Half moon	convex
24/02/2018	13:07	01:31	More than half	convex
26/02/2018	15:04	03:32	More than half	convex
28/02/2018	17:10	05:27	More than half	convex
01/03/2018	18:12	06:19	Full moon	-
02/03/2018	19:12	07:08	More than half	convex
04/03/2018	21:06	08:36	More than half	convex
05/03/2018	22:01	09:18	More than half	convex
07/03/2018	00:13	12:06	More than half	convex
09/03/2018	01:54	13:29	Half moon	convex

2) Observe the table and state if the following statements are true or false.

a) The bright part of the moon is always towards the sun. \_\_\_\_\_

| True

b) The boundary of dark and bright part of the moon is always concave. \_\_\_\_\_

| False [inside edge of crescent is concave while as for gibbous it is convex]

c) Moon does not rise at same time everyday. \_\_\_\_\_

| True [It rises approximately 50 minutes late every day because of its own motion around earth]

d) Moon does not rise on a new Moon day. \_\_\_\_\_

| False [moon does rise, but since it rises with sun and its side which faces earth does not receive sun light and due to sunshine we can not see it]

e) On day after the full Moon, we expect moon to rise around 1 hour after sunset. \_\_\_\_\_

| True [on full Moon the moon rise happens at sunset, hence one day after full Moon the moon rise will happen nearly 50 minutes late]

f) On day before the new Moon, we expect moon to rise around 1 hour before sunrise. \_\_\_\_\_

| True [on new Moon the moon rise happens at sunrise, hence one day before new Moon the moon rise will happen nearly 50 minutes early]

g) In waxing fortnight (शुक्ल पक्ष / bright fortnight), moon is already in the sky at sunset. \_\_\_\_\_

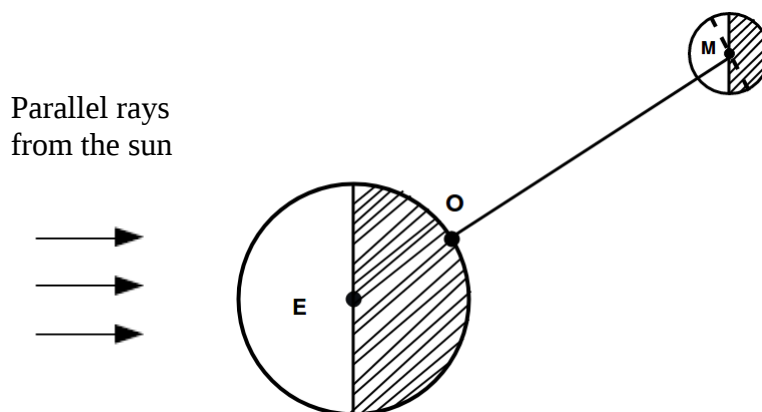
| True [The fortnight from new Moon to full Moon is called as waxing fortnight, on new Moon day moon sets with the Sun and after that everyday it sets 50 minutes late which is why during waxing fortnight moon will be present in the sky for sometime even after sunset]

h) In waning fortnight (कृष्ण पक्ष / dark fortnight), moon is already in the sky at sunrise. \_\_\_\_\_

| True [The fortnight from full Moon to new Moon is called as waning fortnight, on full Moon

day moon sets when sun is rising and after that everyday it sets 50 minutes late that is why during waning fortnight moon will be present in the sky at the time of sun rise.]

- 3) Let us imagine that we are astronauts and have gone in space above the plane of our solar system and we are observing the Earth and the Moon from the top. Rays of the Sun are falling on the Earth and Moon from the left of the page and are parallel to the bottom edge. In the figure below draw appropriate diameters of earth and moon, to separate the part **receiving** sunlight and part **not** receiving sun light. Shade the dark part with your pencil. Next, you can see a tiny observer "O" on the surface of earth exactly along the line connecting the centers of earth and moon. Draw an appropriate diameter of moon to show which part of moon will be visible to this observer.



- 4) Based on your drawing, answer the following:

a) Is the observer in the lighted part or dark part?

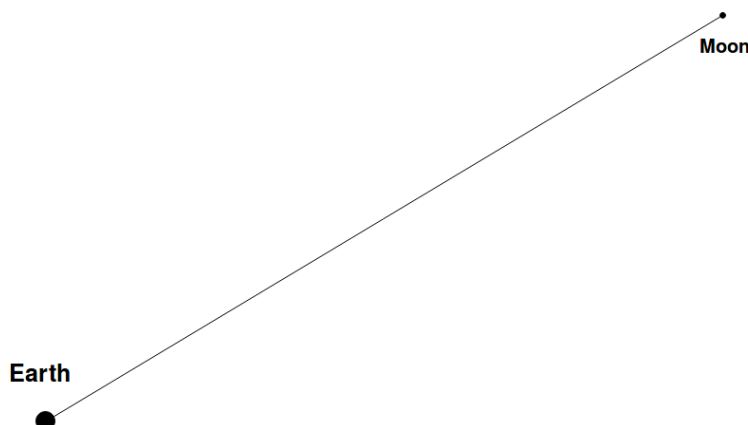
Ans.- The observer is in dark part

b) As seen by this observer, how much part of moon's disk is bright (less than half / more than half)?

Ans.- More than half

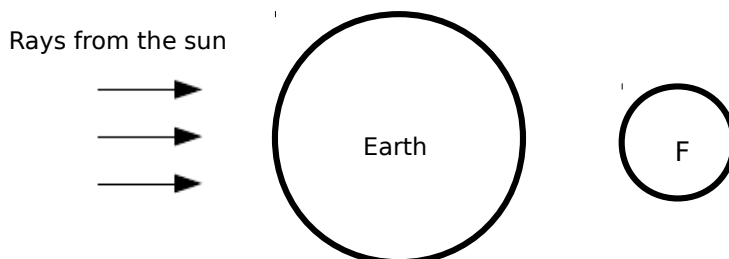
- c) Let's assume the diameter of moon is 2mm then diameter of the earth will be approximately 7mm. In this scale, the distance between Earth and moon will be about 23cm. Draw diagram of relative sizes and distance between earth and moon. By looking at the diagram it is possible to conclude that observers at any location on the earth will see proximately the same phase of moon. Do you agree?

Ans.-Yes. Due to extremely small size of earth and moon as compared to the distance between them, observers at any location on the earth will see proximately the same phase of moon.



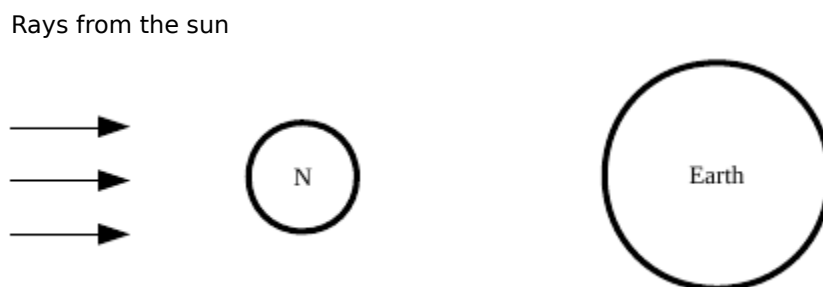
d) Where will the moon be on the full Moon day? Mark the position in the diagram with a circle and mark it as F.

Ans.-



e) Where will the moon be on the new moon day? Mark the position in the diagram with a circle and mark it as N.

Ans.-



f) Will shadow of earth fall on moon on new moon day?

Ans.- No, on new moon day moon is between sun and earth, therefore earth's shadow cannot fall on moon.

g) As seen by astronauts, earth rotates anticlockwise. In question no. 3, now place second observer on surface of the earth on upper edge of the dark part. Is this second observer seeing sunrise or sunset?

Ans.- We have assumed that sun is on the left side of diagram and from this angle earth appears to rotate anti-clockwise, Thus second observer is moving from darker region into bright region seeing sunrise. Hence second observer must be seeing sunrise.

h) As seen by astronauts, direction of moon's revolution is also anti-clockwise. Is this waxing fortnight or waning fortnight?

Ans.- Direction of moon's revolution is also anticlockwise, hence moon is moving towards the same side as that of sun in sky with respect to earth, therefore it is waxing fortnight.

i) Can you guess this?

(i) During a lunar eclipse, the Sun, Earth and Moon get aligned as you can see in the image you made in the answer (e) i.e. Full Moon. But we don't see lunar eclipse on every Full Moon. What do you think will be reason for this?

(ii) Do we see solar eclipse on every New Moon day? Give reason.

### Further Reading / Resources

1. A youtube video demonstrating phases of moon:  
<https://www.youtube.com/watch?v=wz01pTvuMa0&feature=youtu.be>
2. Timetable of phases of moon for year 2018-19:  
<https://www.timeanddate.com/moon/phases/>
3. A youtube video can be used as an activity:  
<https://www.youtube.com/watch?v=HD4v9m-9us8>
4. Brief introduction to the different terms of phases of moon:  
<https://astrosociety.org/edu/publications/tnl/12/12.html>