

Science and Superstition

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I have worked on this topic with the teachers and students of grades 5 to 12 in different schools. In the lower classes we talked about students' knowledge of the solar system, planets, stars, celestial bodies, constellations, phases of Moon, eclipses, with which many superstitions are associated and are present everywhere in society. Generally, astronomy is seen as another branch of science, but my experiments with teaching science through it have got positive results.

We find during classroom teaching that science is considered to be a very difficult subject and almost all the teachers feel that teaching it is challenging without teaching aids. Since Space is a simple and commonly available resource adhering to nature and natural processes, it can be used as the basis of principles of science.

The first thing I did with teachers and students through astronomy was to observe the events happening around them and to know the reason for their occurrence. Related ideas were demonstrated through various activities and discussed, as scientific observation of the environment contributes a lot in understanding daily events- we only have to make connections. There are some topics which are an integral part of our daily life, such as day and night, changing seasons, the Earth's atmosphere. Apart from this, an understanding of the celestial bodies and their motion helps us with various applications of science like installing satellites. During the discussion some general assumptions related to them surfaced, such as: the Sun is the biggest planet in the universe, the Pole Star is the brightest, seeing Mars-Saturn-Rahu-Ketu is inauspicious, the Earth stands on the back of a turtle (or the horn of a bull) and so on, although some associated stories, such as *Dhruv tara* (Pole Star) having the highest position, the contribution of stars in the development of civilisations, planets having names of the deities, were quite interesting.

Although discussions have been had and presentations made on other topics, our recent focus has been on the Moon and its orbital motion. The lunar eclipse of 30th January 2018 was a great

opportunity when we observed and discussed concepts related to the motion of the Moon at the Azim Premji School, Tonk. Deliberations were had, experiments and observations were done on this topic by different groups, which helped in understanding various phenomena related to the Moon.

The Moon's motion and superstition

This theme has been discussed several times with different groups and the lunar eclipse which occurred on January 30, 2018 was special because on this day there were three celestial events happening together, namely, Blood Moon, Super Moon and Blue Moon. We planned to watch this amazing celestial event, when the Moon enters the orbit of the Earth, with the children using a telescope. We first gathered the children at one place and talked about their assumptions and local beliefs about an eclipse and the reasons behind those popular misconceptions. The children were influenced by events and beliefs around them and whatever they had heard from their family members. Normally, we regularly attempt to rectify misconceptions that arise by giving correct information, but this is not so easy. It is necessary for us to work continuously and give everyone the opportunity to check their knowledge which is based on the information that they receive and then to be able to identify the scientific ones.

After the discussion, the children were told about the Earth, the motion of the Moon and solar and lunar eclipses through a model and a live broadcast from NASA. By now the children had got the answers to most of the questions related to the eclipse and were ready to witness it. We showed them the eclipse with two telescopes in groups of five as well as a live telecast by NASA through the projector, talking simultaneously about other related things: the discovery of bright stars, planets and constellations, the colour of stars, stories related to different stars etc. It was clear that, even though the children did not know the definitions, their knowledge about these things was above average.

Subject analysis

There are some common beliefs or superstitions that came forth during our discussions with teachers and students of different classes. The reasons behind many superstitious beliefs are - to create fear, to bring in some socio-practical regularities, to follow some health-related practices etc. But there are some other ideas which are far too deep and which cannot be explained away. Some of these are:

- pregnant women should not watch a lunar eclipse
- whatever one eats, donates or does at the time of eclipse becomes evil (power of asura)
- eclipse causes blindness
- new moon and souls
- married women are not allowed to wash their hair
- bathing clears dark shadows or bad effects of eclipse
- ban on shaving, haircut, cutting of nails etc.
- starting any new work is prohibited
- reducing/getting rid of its wrath by worshipping/giving alms
- sprinkling basil (*tulasi*) leaves and Ganga water on clothes and household articles

Many other questions also came up during the discussions which were examined scientifically. Some of the issues were:

Was the Moon illumined by its own light or some other source?

Does the Moon also move on its own axis, like the Earth?

If the Moon moves (rotation and revolution) then why does it always look same?

Are the phases of the Moon formed due to the shadow of the Earth?

If the eclipse occurs because the Earth, which comes between the Moon and the Sun, why does it not happen every day or every month?

Does the Moon contribute in any way to life on Earth?

The answers can be explored in two steps- first, understanding the reasons behind their occurrence and second, examining various opinions/beliefs/superstitions on the basis of this understanding. The presence and utility of the Moon in daily life is evident in our almanac, which is made on the basis

of the motion and sighting of the Moon (*Krishna Paksha-Shukla Paksha*). In addition, days of fasting in the Indian year/almanac (like *Karva Chauth*, *Ramzan*), festivals (*Deepawali*, *Janmashtami*), worshipping, astrology (place in horoscope, head of the zodiac sign) etc. are also determined on the basis of Moon's motion and visibility. Our literature connects the Moon and its phases with various idioms, analogies, examples, stories, relationships, traditions etc. All this is fine, but the moment we talk about eclipse, many unscientific practices, beliefs, processes, superstitions based on oral traditions are evidenced which are difficult to question or reject and become the basis for many deep-rooted superstitions.

Textbooks talk about the Moon and theories/information related to it such as phases of the Moon, astronauts who went to the Moon, the relation of the Moon to the Earth, tides, the rotation of the Moon on its axis, but not about removing social beliefs and superstitions. However, they can be a good starting point to work on superstitious beliefs because they are used by students of different levels who are in the process of building their knowledge. Logical analysis can be helpful in preventing misconceptions from growing.

The questions raised above have links with both textbooks and daily life. While textbooks affirm scientific and logical study, much of our daily behaviour is full of superstitious beliefs, misconceptions and illogical analyses/beliefs. They are passed on from one generation to the other in the same form, are never questioned and are accepted the way they are. In an attempt to get more information in order to break this cycle of superstition we found that they exist in all religions and geographies. The above questions can be divided into the following steps to facilitate analysis and understanding:

- the same side of the Moon always faces the Earth (one side of the Moon is always dark)
- the formation of the phases of Moon (observational activity)
- understanding the process of eclipse (position from the source of light, obstruction, plane, tilt, partial and total eclipses).

Based on the information above, it was important to verify the truth behind superstitious beliefs. A solar eclipse is considered to be of four *prahar-s* (one *prahar* equals three hours) and lunar eclipse of three *prahar-s*. A scientific analysis can be made

by understanding their motion and the type of motion.

It is very important to know here whether the Moon is moving or not. The Moon revolves around the Earth in an *elliptical orbit* once in 27.3 days and takes about the same time to rotate once on its axis. This is called *synchronous rotation* or *tidal locking* in space science and is why only one side of the Moon is visible from Earth. It is difficult to determine whether the Moon rotates on its axis or not, but if we look at only the axial rotation of the Moon without its revolution around Earth then we know that it is moving. It is also difficult to understand and demonstrate both the movements simultaneously. I did a simple activity where the numbers 1, 2, 3, and 4 were written at a distance on a white ball representing the moon. The ball was rotated around the globe, (the Earth and centre of motion). The ball was revolved around the globe in two positions, once while keeping it steady and the second time while rotating it on its axis.

In the first case it was noticed that when the ball had different positions around the globe then different numbers face towards the centre, that is, different surfaces of the Moon are visible from the Earth. In the second position, it was revolved around the globe while rotating it on its axis. We tried to make sure that it would complete one revolution around the globe at the same time as it rotates on its axis. Here we saw that the same number was seen around the globe in different positions. This activity was helpful in explaining the scientific cause behind why we only see one side of the Moon.

The surface of the Moon visible from the Earth is considered to be denser and the gravity of the Earth causes the Moon to keep the denser side always facing the Earth. This analysis confirms that the Moon is a moving body and this information helps us to investigate other questions related to eclipses.

Moon phase activity

Why do the phases of moon occur? What causes it? Many people believe that the shadow of the Earth falls on the Moon. The following activities and presentations were done to learn the correct reasons.

The most effective way to understand the phases of the Moon is through direct experience. A light bulb represented the Sun, a white sphere or a ball, the Moon and a student participant represented the Earth (Picture 2). The aim of this activity was

to show that the Moon has no light of its own. It can only reflect light from the Sun. Only the side of the Moon which faces the Sun can reflect this light and can appear bright, the other side appears dark. As the Moon orbits the Earth, we can see different parts of it illuminated by the Sun. Thus, it appears to change its shape. The varying shapes of the bright part of the Moon seen during a month are called phases of the Moon.



Picture 1



Picture 2

To demonstrate this, a student participant was asked to turn a full circle with the Moon (white sphere or ball) in his hand and observe the lit portion of the ball in different positions. A full Moon is the lunar phase seen when the whole of the moon's lit side is facing Earth. This phase happens when Earth is between the Moon and the Sun (the Moon is on the opposite side of the Earth from the Sun), we see the entire illuminated portion. When it was between the Sun and Earth (luminous part of the Moon towards the Sun) we only see the dark portion (new Moon). Another advantage of this experiment was that it changed

the perception of the participants that a part of the Moon is always dark, called the dark side of the Moon. The participants saw that the 'dark' side is completely illuminated with the Sun's light even during new Moon.



The second attempt to develop an understanding on the phases of the Moon was with the help of pictures where there is a source of light on one side and the Earth is placed at the centre. The picture demonstrates that the Moon's phases are created by changing angles (relative positions) of the Earth, the Moon and the Sun, as the Moon orbits the Earth. From both these explanations, it becomes clear that phases of the Moon have nothing to do with the shadow of the Earth. The phases are the illuminated part of the Moon depending upon its position and not as a result of the Earth's shadow cast upon the Moon by the Sun.

Understanding the process of eclipse

A lunar eclipse is an astronomical event that occurs when the Moon passes directly behind Earth and into its shadow. This can occur only when the Sun, Earth, and Moon are exactly or very closely aligned with Earth between the other two.

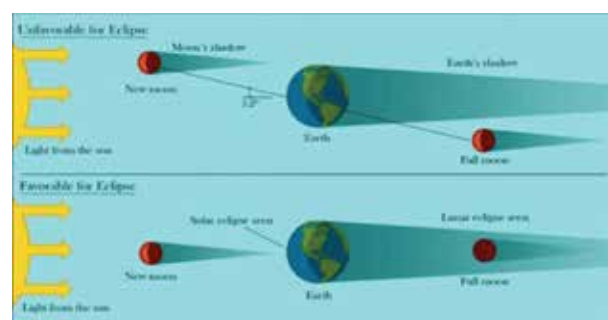
Due to this geometrical restriction, a lunar eclipse can occur only on the night of a full Moon. The type and length of a lunar eclipse depends on the Moon's



proximity to either node of its orbit. Generally, there are two types of eclipses- total and partial. A total lunar eclipse occurs when the Moon passes through the darkest part of the Earth's shadow. In such a situation, the Earth completely blocks the Sun's light from falling on the Moon. A partial lunar eclipse happens when only a part of the Moon enters Earth's shadow. An initial explanation is illustrated on the blackboard, followed by an activity using a light source, globe and white sphere or ball. The light source and the Earth (bulb, white ball and globe) are kept stationary and different positions are created to show the Moon's rotation and to help students learn the natural causes of eclipses.

During this entire process and discussions significant learnings happened: first, the observation was that a lunar eclipse can occur only on the night of a full Moon and second, the connection between phases of the Moon and the eclipse.

Now, an important question was raised. Why does an eclipse not occur on every full Moon?

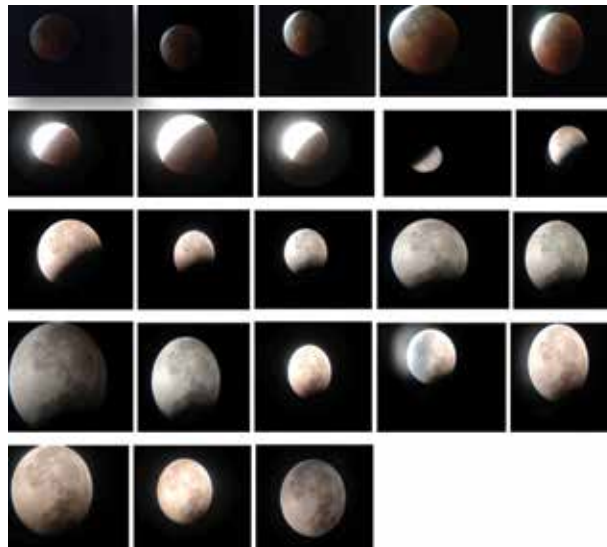


This question gave me an opportunity to learn something new because the search for the answer led me to look at the path of the moon orbiting the Earth, which was somewhat different from the Sun and the Earth's plane. If we consider that the Sun

and the Earth are in the same plane, then the orbit of the Moon is inclined by about 5.2° to the orbital plane of the Earth, in other words, the Moon's plane round the Earth is at an angle of 5.2 degrees. A lunar eclipse occurs when the Sun, Earth and moon are exactly or very closely aligned in a straight line. Because the Moon's path round the Earth is tilted at an angle compared to the Earth's orbit around the Sun, an eclipse does not occur every full Moon night. With the help of models used in the above activity, children were able to observe the shadows at different surfaces which contributed significantly in understanding eclipses.

Sometimes a scientific theory is made simple in an attempt to make it easy for the student to understand and this helps in the practical understanding of scientific phenomena. An example - our planet's changing distance from the Sun causes the change in the seasons. Also, some questions are based on the experiences of the students and cannot be cleared with the theories given in the book. For example, if the Earth rotates around its axis and

revolves around the Sun, why do we not actually feel the movements? If the Moon revolves around the Earth then why is there no eclipse every month? if the Earth is round, then why does it look flat to us? Scientific discussions on such topics can help to break deep-rooted false beliefs.



References

Module: The Moon (Azim Premji Foundation: Social Science Team)

Book: *Akash Darshan ka Anand* - Rakesh Popli (Vigyan Prasar)

Article – *Grahan Yatharth*: Narayan Chandra Rana

Article – *Rahu Ketu ki Khoj* -Rakesh Popoli

Article – *Akash ki Or*

Organising Report - *Chandra Grahan*: Azim Premji Vidyalaya

Images: Photos taken online and clicked by self in the schools

Links for observing the moon's motion:

https://www.school-for-champions.com/astronomy/moon_motion.htm#.WzRZCaczblU

https://en.wikipedia.org/wiki/Tidal_locking#/media/File:Tidal_locking_of_the_Moon_with_the_Earth.gif

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