# mage result for night skyPurpose

Another object we see in the sky is the Moon. In this activity, we will examine how and why the position and appearance of the Moon change and why.

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|  | What changes in the Moon can we observe over the course of a month and how can we understand them? |

# Initial Ideas

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| The Moon is a familiar sight in the night sky. Consider these questions about it.  icon_predict Briefly explain what you think causes us to see the Moon? | mage result for crescent moon |
| icon_predict Do you think you can ever see the Moon while it is daylight? Briefly explain your answer. | |

 Participate in a short class discussion about everyone’s ideas.

# Collecting and Interpreting Evidence

You will need:

 Bright light bulb to represent the Sun (shared with whole class)

Ball on a stick to represent the Moon.



 No. 2 and yellow colored pencils

## Exploration #1: How does the appearance of the Moon change?

***Each person in your group should take a turn as the ‘Earth’   
person in each of the following steps.***

**STEP 1:** The real Moon orbits around the Earth about once a month. We will use our light bulb-Sun and a ball to represent the Moon. The Earth will be represent by a person's head!

Face the Sun and hold the Moon out in front of you at arm’s length. (Each member of your group should try this.)

The diagram below shows a ***SIDE VIEW*** of this arrangement. The shading on the ‘Moon’ is intended to show that only approximately half the ‘Moon’ is lit by the ‘Sun’ and not what the ‘Earth person’ behind the Moon should see.



**Earth Moon Sun**

 In this arrangement, how much of the ***sunlit half*** of the Moon can you (and hence anyone on Earth) see, all of it, some of it, or essentially none of it?

Because the light from the ‘Sun’ is bouncing off the walls, floor, and ceiling, you can still probably see the ‘dark’ side of the ‘Moon’. However, in the real Earth-Moon-Sun system, there are no other light sources to illuminate or objects to reflect light on the ‘dark’ side of the Moon. In this real life arrangement, you would not see the Moon at all, even though it is actually in the sky.

**STEP 2:** You should now turn left a little, keeping the Moon straight out in front of you. A ***TOP-DOWN VIEW*** of this arrangement is shown here. This represents the arrangement of the Sun-Moon- Earth system, 3-4 days later.

Face this way

**Earth Moon Sun**

Note that exactly half the moon is still lit by the Sun (the half that is facing toward it.)

 How much of the ***sunlit half*** of the Moon can you (and hence anyone on Earth) see? All or most of it, half of it, only a small part of it, or none of it?

 To illustrate what you can see, shade this circle to show what the Moon looks like from the Earth person’s viewpoint.

***Shade the dark part in gray and the lit part in yellow***.

 Describe the shape of the ***lit part*** of the Moon that can be seen from Earth in this arrangement.

 As you are looking toward the Moon in this position, can you also see the Sun at the same time?

 What does your answer to the previous question imply about whether the real Moon can sometimes be seen during daylight or not? Explain your thinking.

**STEP 3:** Now repeat STEP 2 as you move the Moon through several different positions in its 28-day orbit around the Earth. The positions you should investigate are shown as **TOP VIEWS** in the table on the next page. In each case, the appropriate halves of the Moon are shown as being lit and dark.

For each position, you should:

* Have each person in the group take a turn as the Earth person, holding the Moon, looking toward it, and describing the shape of the lit part of the Moon they can see.
* Shade in the circle in the third column of the table to show what the Moon looks like ***from the Earth***. (Shade the dark part grey and the lit part yellow.)
* As you look directly at the Moon check whether you can you also see the Sun, even if it is only out of the corner of your eye. If so then anyone on the Earth could see the Sun and Moon in the sky at the same time.

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| When | System Arrangement (Top View) | Moon appearance | Sun visible too? (Y/N) |
| ~7 days |  |  |  |
| 10-11 days |  |  |  |
| ~14 days | *Note: In this arrangement, make sure the Moon is* ***NOT*** *in the Earth’s shadow, by raising it up a little. This is NOT an eclipse.* |  |  |
| 17-18 days |  |  |  |
| ~21 days |  |  |  |
| 24-25 days |  |  |  |
| ~28 days |  |  |  |

# Moon Phase Names

As you may be aware, the shapes of the phases that the Moon passes through have specific names.

* ***New*** - when the Moon is in the sky, but cannot be seen
* ***Crescent*** - when less than half the lit part can be seen
* ***Quarter*** - when exactly half the lit part can be seen
* ***Gibbous*** - when more than half, but not all, of the lit part can be seen
* ***Full*** - when all of the lit part can be seen

Further, the full lunar cycle is divided into two halves.

* ***Waxing*** - when the visible lit part is growing, as it goes from New to Full Moon.
* ***Waning*** - when the visible lit part is shrinking, as it goes from Full to New Moon.

Thus, the full cycle of moon phases passes through a succession of named phases as shown below.



## Exploration #2: What happens when there is an eclipse?

**STEP 1:** As you have seen, the Moon orbits round the Earth once a month. No matter where it is in its orbit, half of the Moon is always lit by the Sun, but the way we view it causes us to see it pass through different phases.

 However, when the Moon is in its 'new' phase, we do not usually see it block the Sun. In addition, when the Moon is in its 'full' phase, we do not see it pass into the Earth's shadow. Why do you think this is?

Work with your group to determine how the Moon could be positioned such that we see it in its 'new' phase, yet we do not see it block the Sun.

 On the ***side-view diagram*** below, sketch one or two positions of the Moon that would allow us to see it in its ***'new'*** phase, yet we do **not** see it block the Sun.

**Earth Sun**

Now work with your group to determine how the Moon could be positioned such that we see it in its 'full' phase, yet we do not see it pass into the Earth's shadow.

 On the ***side-view diagram*** below, sketch one or two positions of the Moon that would allow us to see it in its ***'full'*** phase, yet we do **not** see it pass into the Earth's shadow.

**Earth Sun**

**STEP 2:** Occasionally however, we do see the Moon block the Sun. This is what causes a ***solar eclipse***.

 On the ***side-view diagram*** below, sketch the position of the Moon that would allow us to see it block the Sun.

**Earth Sun**

Sometimes we also see the Moon pass into the Earth's shadow. This is what causes a ***lunar eclipse***.

 On the ***side-view diagram*** below, sketch the position of the Moon that would allow us to see it pass into the shadow of the Earth.

**Earth Sun**

# Summarizing Questions

**S1:** It is a common idea that we see the Moon in its crescent phases every month because the Earth blocks sunlight from reaching some of it. Do your findings in this activity support or refute this idea? Explain your thinking.

**S2:** As the Moon orbits the Earth, it keeps the same side toward us. (Thus, nobody knew what the far side of the Moon looked like, until the Soviet Luna 3 probe sent back the first pictures in 1959.) Sometimes the side we never see is also called the ‘dark-side’ of the Moon. Explain why this is not a good name for it. During what phase of the Moon (as seen from Earth) is the far side truly also the dark side?

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| **S3:** Here is an illustration taken from a children’s book. What is misleading about it? |  |

# Common Misconceptions *(for teachers only!)*

Quite a lot of research has been done on common ideas children (and some adults) have about the topics addressed by this activity. Many are based on common experience that is simply misapplied to these situations. You may encounter some these in your classes.

***The Moon makes its own light.***

* Since we see the Moon shine brightly at night, and cannot see the Sun at the same time, it is easy to assume that the Moon is making its own light. In fact, we see it because light from the Sun is reflecting from it back to us here on Earth.

***The Moon can only be seen at night.***

* It is much easier to see the Moon at night, so people are naturally more aware of it. However, most phases of the Moon can also be seen while it is daylight. It's just much less noticeable.

***It is the shadow of the Earth (or clouds) that causes the phases of the Moon.***

* People are used to seeing an object in shadow when another object blocks light from reaching it. When it is apparent that light is not reaching part of the Moon, they naturally attribute this to something else blocking it.

***Eclipses happen every month.***

* People usually have a mental model (or physical model) in which the Sun, Earth, and Moon always lie in the same plane. In such a model, you would indeed see eclipses every month. However, the Moon's orbit is tilted by about 5° and so the alignment necessary for an eclipse does not happen very often.

***The far side of the Moon is always dark.***

* Since we never see it from Earth, it is easy to assume that the far side of the Moon is always dark. In fact, it receives just as much light as the side we see - it's just like day and night on the Earth.