



SCIENCE DISSECTED

The Phases of our Moon Model-Evidence Link Diagram (MEL)

Other than the sun the moon is the most notable object in our sky. The moon is something that everyone has been aware of, heard of and talked about since they were small children. The term moon phase refers to the lit portion of the moon that's visible from Earth. Half of the moon is always lit just like our planet but because we usually only see a portion of that lit area, due to the relative position of the moon, Earth and sun, we see different phases.

A common misconception among students and adults is that the shaded part of the moon is a result of the Earth's shadow. In addition to the use of a physical model demonstrating the reason for phase changes, this activity allows students to use critical thinking skills to determine appropriate evidence to support the correct reason for moon phases.

Model A: *The phases of the moon are caused by the shadow of the earth on the moon.*

Model B: *The phases of the moon are caused by the relative position of the sun, moon and Earth.*

Evidence #1: The phases the Moon goes through are caused by two things: 1) the Moon revolving around the Earth, and 2) the Moon reflecting sunlight towards the Earth.

Evidence #2: The rotational period of the moon is exactly the same as its orbital period therefore the same portion of the Moon's sphere is always facing the Earth.

Evidence #3: The part of the Moon that is illuminated is the part that is facing the Sun. From the Earth we cannot always see that same half instead; we see only the part facing us.

The following is a suggestion for using this MEL with students:





1. Hand out the Phases of the Moon Model Evidence Link Diagram (page 1). Instruct students to read the directions, descriptions of Model A and Model B, and the four evidence texts presented.
2. Handout the four evidence text pages (pages 3-5).
3. Instruct students to carefully review the Evidence #1 text page (page 3), then construct two lines from Evidence #1; one to Model A and one to Model B. Remind students that the shape of the arrow they draw indicates their plausibility judgment (potential truthfulness) connection to the model.
4. Repeat for Evidence #2-3 (pages 4-5).
5. Handout page 2 for the students to critically evaluate their links and construct understanding.

Once students have completed page 2, they can then engage in collaborative argumentation as they compare their links and explanations with that of their peers. Students should be given the opportunity to revise the link weighting during the collaborative argumentation exercise. If time permits, have students reflect on their understanding of phases of the moon and create questions that they might explore in the future.

Name: _____ Period: _____

Directions: draw two arrows from each evidence box. One to each model. You will draw a total of 6 arrows.

Key:

	The evidence supports the model
	The evidence STRONGLY supports the model
	The evidence contradicts the model (shows its wrong)
	The evidence has nothing to do with the model

Standard: E.8.B.7

Evidence #1
The phases the Moon goes through are caused by two things: 1) the Moon revolving around the Earth, and 2) the Moon reflecting sunlight towards the Earth.

Model A
The phases of the moon are caused by the shadow of the earth on the moon.

Evidence #2
The rotational period of the moon is exactly the same as its orbital period therefore the same portion of the Moon's sphere is always facing the Earth.

Model B
The phases of the moon are caused by the relative position of the sun, moon and Earth.

Evidence #3
The part of the Moon that is illuminated is the part that is facing the Sun. From the Earth we cannot always see that same half instead; we see only the part facing us.

Provide a reason for three of the arrows you have drawn. **Write your reasons for the three most interesting or important arrows.**

- A. Write the number of the evidence you are writing about.
- B. Circle the appropriate descriptor (**strongly supports** | **supports** | **contradicts** | **has nothing to do with**).
- C. Write the letter of the model you are writing about.
- D. Then write your reason.

1. Evidence # ____ **strongly supports** | **supports** | **contradicts** | **has nothing to do with** Model ____ because:

2. Evidence # ____ **strongly supports** | **supports** | **contradicts** | **has nothing to do with** Model ____ because:

3. Evidence # ____ **strongly supports** | **supports** | **contradicts** | **has nothing to do with** Model ____ because:

4. Circle the plausibility of each model. [Make two circles. One for each model.]

	Greatly implausible (or even impossible)										Highly Plausible
Model A	1	2	3	4	5	6	7	8	9	10	
Model B	1	2	3	4	5	6	7	8	9	10	

5. Circle the model which you think is correct. [Only circle one choice below.]

Very certain that Model A is correct	Somewhat certain that Model A is correct	Uncertain if Model A or B is correct	Somewhat certain that Model B is correct	Very certain that Model B is correct
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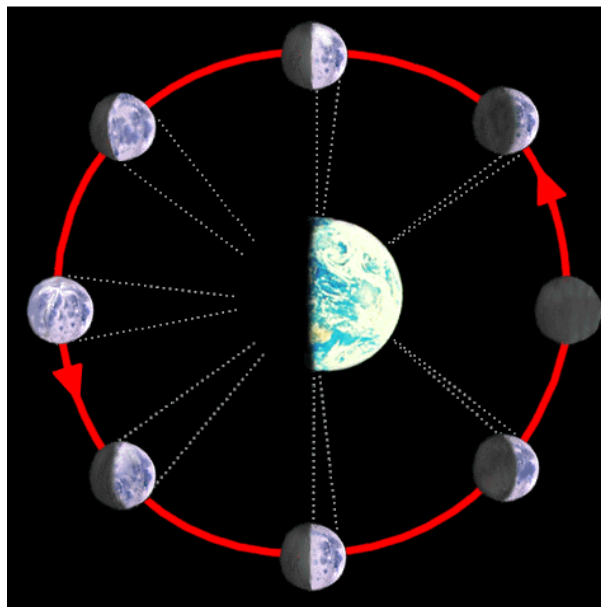
Evidence #1: The phases the Moon goes through are caused by two things: 1) the Moon revolving around the Earth, and 2) the Moon reflecting sunlight towards the Earth.

The Phases of the Moon

The phases the Moon goes through are caused by two things: 1) the Moon revolving around the Earth, and 2) the Moon reflecting sunlight towards the Earth. Half of the Moon is always lit, not just the portion we see: however, sometimes we only see a profile of the lit portion of the Moon. Certain phases of the Moon result depending on its orbit, and the Moon's orbit is responsible for the phase changes we see.

Since we only see the lit portion of the Moon that is facing Earth, we see a Moon phase. There are eight phases that the moon goes through and they always occur in the same order. The Sun's light seems to move from right to left across the surface of the Moon. The phases of the Moon are: 1) New Moon, 2) Waxing Crescent, 3) First Quarter, 4) Waxing Gibbous, 5) Full Moon, 6) Waning Gibbous, 7) Last Quarter, 8) Waning Crescent, and back to the New Moon.

The diagram below shows the lit part of the moon that we see from the Earth while the entire half of the moon, including the unlit part, is also facing us.



<http://coldwater.k12.mi.us/lms/Grades/Science/olympiad/starry-night/lunar-phases.html>

Evidence #2: The rotational period of the moon is exactly the same as its orbital period therefore the same portion of the Moon's sphere is always facing the Earth.

Why Do We Only See One Side of the Moon?

You may have heard references made to the "dark side" of the Moon. This popular, although somewhat inaccurate term refers to the fact that only one face of the Moon, the "near side", is visible to us. The dark side or far side is permanently rotated away from our planet.

Why is this the case? We all know that the Earth rotates on its own axis, so theoretically, the Moon should also do the same, allowing us to get a full picture of the planetoid. Why are we limited to seeing only 50 percent? It turns out that the speed at which the Moon rotates has led to this particular phenomenon. Millions of years ago, the Moon spun at a much faster pace than it does now. However, the gravitational influence of the Earth has gradually acted upon the Moon to slow its rotation down, in the same way that the much smaller gravitational influence of the Moon acts upon the Earth to create tides. This influence slowed the rotational period of the Moon to match that of its orbit – about 29.5 days – and it is now "locked in" to this period.

If the Moon didn't spin at all, then eventually it would show its far side to the Earth while moving around our planet in orbit. However, since the rotational period is exactly the same as the orbital period, the same portion of the Moon's sphere is always facing the Earth.

Finally, the reason that the far side of the Moon is frequently referred to as the "dark side" is because many people mistakenly think that it never sees any light from the sun. In fact, since the Moon is constantly rotating on its own axis, there is no area which is in permanent darkness, and the far side of the Moon is only completely devoid of sunlight during a Full Moon – when the Sun is facing the Moon with the Earth in between.

<http://www.moonconnection.com/moon-same-side.phtml>

Evidence #3: The part of the Moon that is illuminated is the part that is facing the Sun. From the Earth we cannot always see that same half instead; we see only the part facing us.

Understanding Moon Phases

The Moon is the most noticeable object in the night sky, and it is then no wonder that it has fascinated mankind since antiquity. If you observe it for several days, you will no doubt notice that its appearance changes: most of the time only part of it is illuminated, and this part seems to grow until it covers the whole moon (*full moon*) and then decrease until nothing is illuminated (*new moon*), and then grow again, in a cycle that repeats about every month.

One possible explanation that comes to mind is that the dark part we see on the Moon is the shadow that the Earth casts on it. But there are problems with this explanation. If the Moon passes through the Earth's shadow every month, then when it is at the opposite side of its orbit it should get directly in between the Sun and the Earth, producing a [solar eclipse](#) much more often than it actually happens.

Why does the Moon have phases, then? The Moon does not emit light on its own; all the moonlight we see is actually light coming from the sun that is reflected on the moon surface. The part of the Moon that is illuminated is the half that is facing the Sun. But from here, the Earth, we cannot always see that same half; instead, we see only the half facing us. The parts of the Moon that are on both halves (the illuminated one, and the half facing Earth) are the parts that we can actually see from here.

Sometimes, when the Moon is almost new, it is possible to dimly see its darkened disk. The light from the Sun cannot reach this part of the Moon directly; but at this time the Earth (as viewed from the Moon) is at its full and very bright, and what we see is light reflected from the Earth, that then bounces back at us from the Moon. It's a long trip for this light: from the Sun to the Earth, to the Moon, and back to the Earth. No wonder it's not enough to really illuminate the Moon!

<http://www.scienceu.com/observatory/articles/phases/phases.html>