# MOON PHASES
## Session 1: The Four Steps

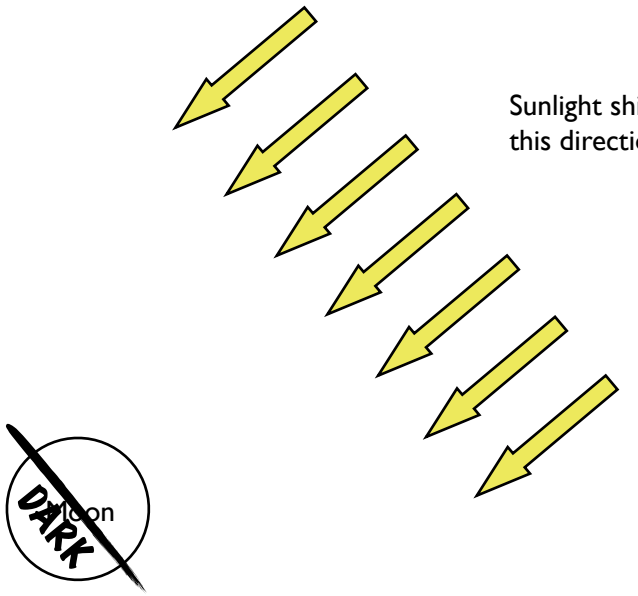
Note: Wait for instructions before you start answering the questions here!

### 1. How is the Moon lit up?

a. What do you think lights up the Moon? **the Sun**

b. The diagram below shows an overhead view of the Moon. **Shade the part of the Moon** that you think will be dark (leave the lit part of the Moon white/unshaded).

**overhead perspective**
(space-based perspective)

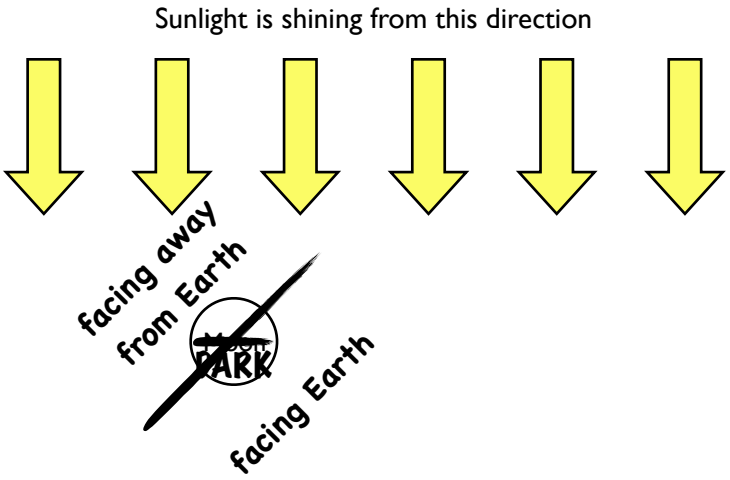



c. How much of the Moon is lit at any time **half**
< write as a fraction >

d. Why is the dark part of the Moon dark? (respond below)

The dark part of the Moon is dark because all of the Moon's light comes from the Sun, and this is the side that faces away from the Sun

## 2. Follow 4 STEPS to figure out the Moon's phase




**Overhead perspective**
NOT to scale


| **Overhead Perspective** (space-based perspective) | |
|---|---|
| **Step 1** | **Shade** the part of the Moon (and Earth) that appears dark from overhead. |
| **Step 2** | **Draw** a line that divides the Moon into the halves facing Earth and facing away from Earth.<br>**Label** the two sides of the Moon ("facing Earth" / "facing away from Earth"). |
| **Step 3** | **Describe** the side of the Moon facing Earth. *Circle one of the five choice below*<br>ALL DARK **MOSTLY DARK** HALF-LIT/HALF-DARK MOSTLY LIT ALL LIT |
| **Earth-Based Perspective** | |
| **Step 4** | Use the overhead view above to imagine what the Moon looks like from Earth.<br>**Predict** if the light is on the Moon's left or right (when viewed from Earth's Northern Hemisphere). *Circle one of the two choice below*<br>LEFT **RIGHT** |

## Earth-Based Perspective:

In the box to the right, **draw** what you think the Moon looks like from Earth (in the Northern Hemisphere).

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# MOON PHASES
# Session 2: The Missions

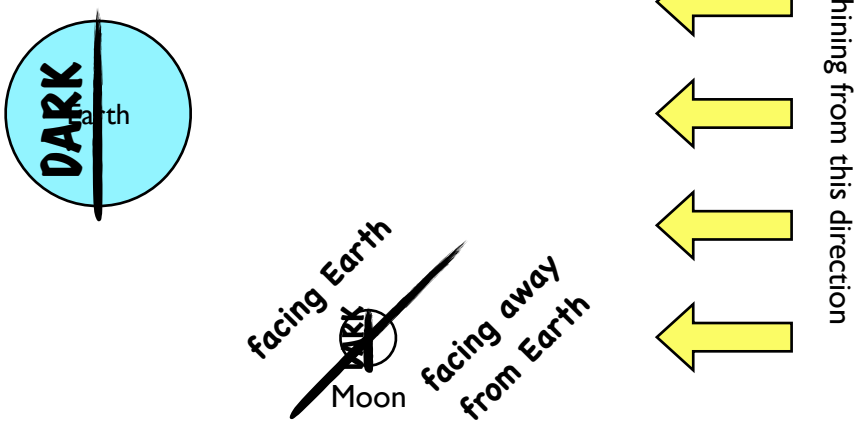
## Mission 1

**Figure out** what the Moon in diagram A below looks like from Earth's Northern Hemisphere.

**Diagram A**

**Overhead Perspective**

NOT to scale




| **Overhead Perspective** (space-based perspective) | |
|---|---|
| **Step 1** | **Shade** the part of the Moon (and Earth) that appears dark from overhead. |
| **Step 2** | **Draw** a line that divides the Moon into the halves facing Earth and facing away from Earth.<br>**Label** the two sides of the Moon ("facing Earth" / "facing away from Earth"). |
| **Step 3** | **Describe** the side of the Moon facing Earth. *Circle one of the five choice below*<br>ALL DARK MOSTLY DARK HALF-LIT/HALF-DARK MOSTLY LIT ALL LIT |
| **Earth-Based Perspective** | |
| **Step 4** | Use the overhead view above to imagine what the Moon looks like from Earth.<br>**Predict** if the light is on the Moon's left or right (when viewed from Earth's Northern Hemisphere). *Circle one of the two choice below*<br>LEFT RIGHT |

## Mission Completion | Earth-Based Perspective:

**Choose** what you think the Moon looks like from Earth (in the Northern Hemisphere)

# Mission 2

**Figure out** what this Moon in diagram B looks like from Earth's Northern Hemisphere.

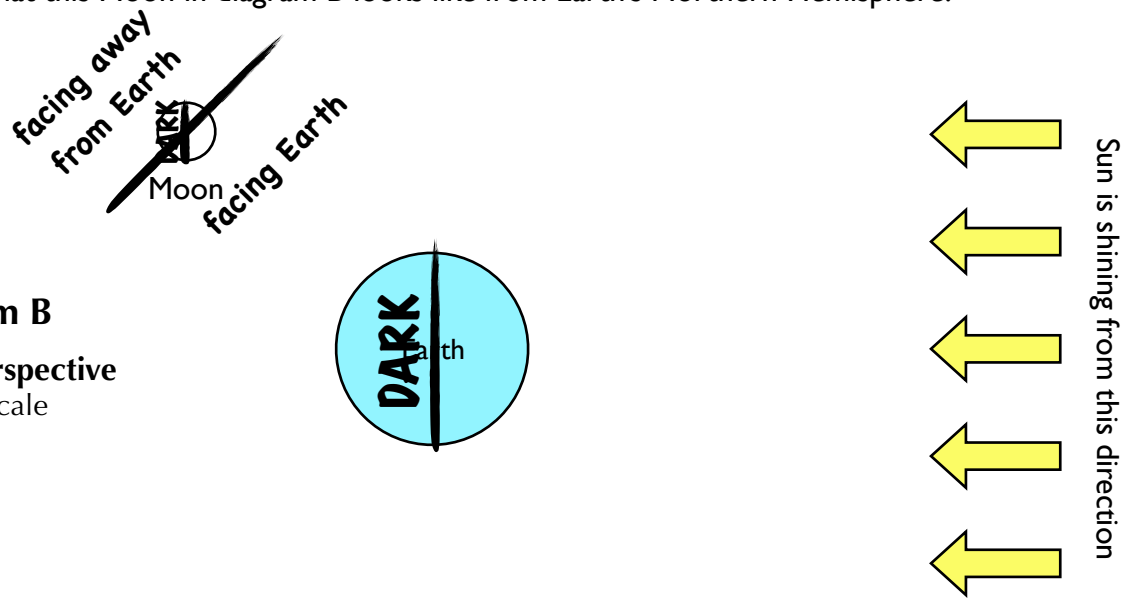



**Diagram B**

**Overhead Perspective**
NOT to scale

| **Overhead Perspective** (space-based perspective) | |
|---|---|
| **Step 1** | **Shade** the part of the Moon (and Earth) that appears dark from overhead. |
| **Step 2** | **Draw** a line that divides the Moon into the halves facing Earth and facing away from Earth.<br>**Label** the two sides of the Moon ("facing Earth" / "facing away from Earth"). |
| **Step 3** | **Describe** the side of the Moon facing Earth. *Circle one of the five choice below*<br>ALL DARK MOSTLY DARK HALF-LIT/HALF-DARK **MOSTLY LIT** ALL LIT |
| **Earth-Based Perspective** | |
| **Step 4** | Use the overhead view above to imagine what the Moon looks like from Earth.<br>**Predict** if the light is on the Moon's left or right (when viewed from Earth's Northern Hemisphere). *Circle one of the two choice below*<br>LEFT **RIGHT** |

## Mission Completion | Earth-Based Perspective

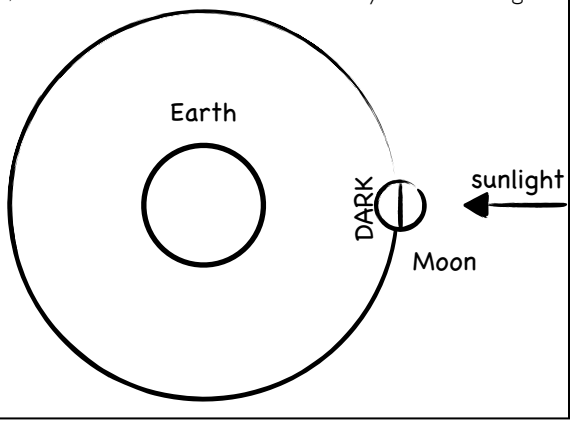
**Choose** what you think the Moon looks like from Earth (in the Northern Hemisphere)

## Question 3

**Explain** how we experience a New Moon. How is it that a half-lit Moon could appear completely dark to someone on Earth?

A New Moon occurs when the Moon is directly between Earth and the Sun. Even though half of the Moon is always lit by the Sun, all the light is on the far side of the Moon from Earth, so it appears completely dark.

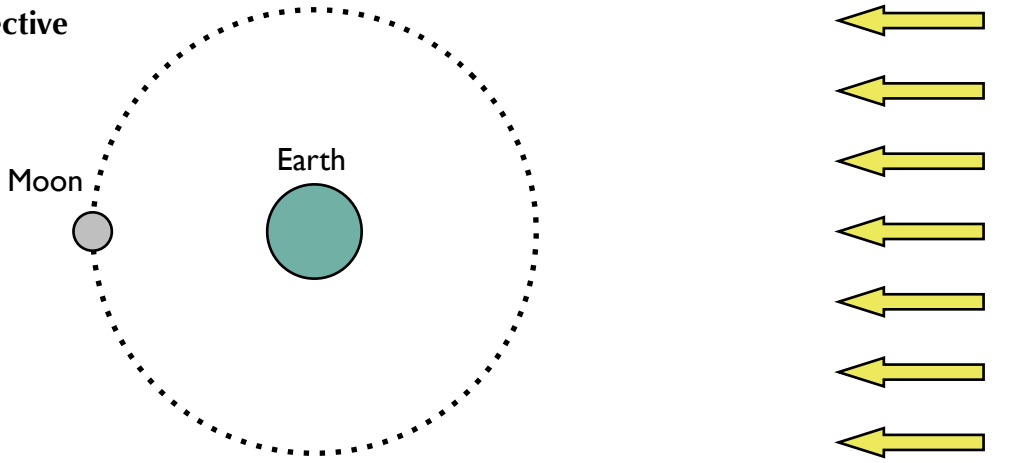
Sketch and label a diagram of an overhead view of the Sun, Earth and Moon to demonstrate your reasoning.




## Question 4

**Predict:** How will the Moon appear to a viewer on Earth when the Moon is in this position?

**Overhead perspective**
NOT to scale




Hint: The Moon's orbit has a slight tilt, so the Moon is almost always slightly above or below Earth compared to the Sun. When the Moon is above or below, sunlight does not get blocked by Earth.

In this position, a viewer on Earth will see the Moon as all lit .
< all dark / mostly dark / half lit-half dark / mostly lit / all lit >

This is known as a full moon.
< new / crescent / half / gibbous / full >

# MOON PHASES
# Session 3: Eclipses

**Instructions:** You and your partner should **discuss your responses** to each question, then write your answers in your own packet.

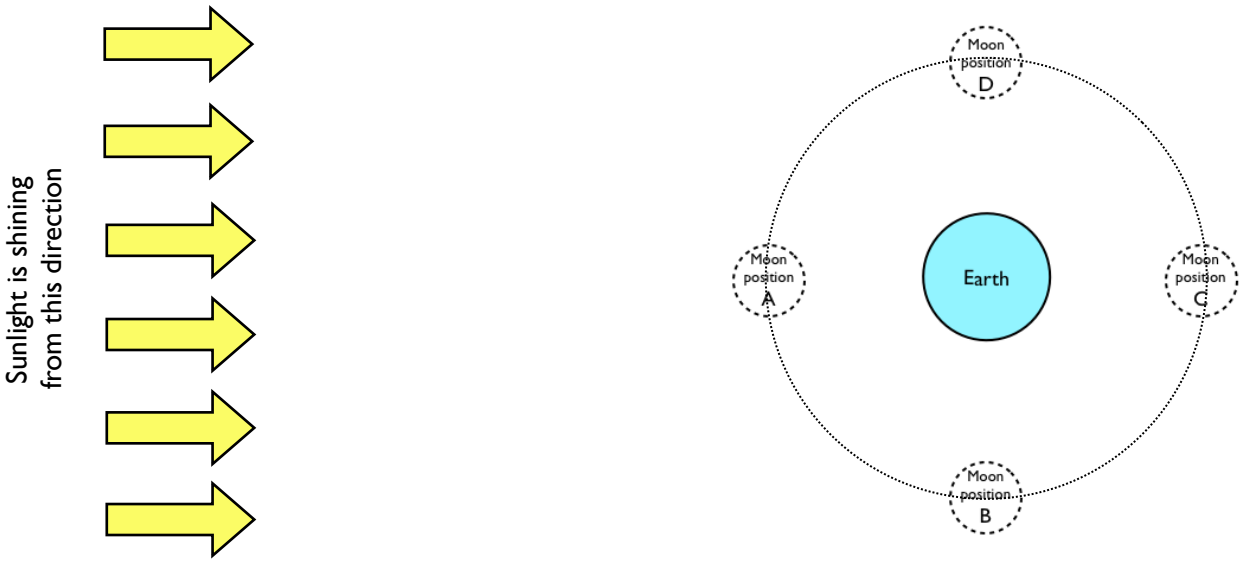
## 1. Lunar or Solar Eclipse?

a. During a **lunar eclipse**, something is blocking the **Moon** .
< Sun / Moon >

b. During a **solar eclipse**, something is blocking the **Sun** .
< Sun / Moon >

## 2. Which positions?

This diagram shows an **overhead view** of the sunlight and Earth, with the Moon drawn at 4 possible positions. *NOTE: The diagram is not to scale!*




a. Choose the Moon position that goes with a Solar Eclipse: (A) B C D

b. Choose the Moon position that goes with a Lunar Eclipse: A B (C) D

c. What is the phase of the Moon when it is at the position you chose in part a?

At this position, the phase of the Moon is **New** .
< new / crescent / half / gibbous / full >

d. What is the phase of the Moon when it is at the position you chose in part b?

At this position, the phase of the Moon is **Full** .
< new / crescent / half / gibbous / full >

### 3. How often do eclipses occur?

On October 27, 2004 (when the Red Sox won the World Series!), there was a lunar eclipse. Two friends at the game wondered how often lunar eclipses happen.

*Jade said:*
"Lunar eclipses must happen every month, when Earth is between the Sun and the Moon."

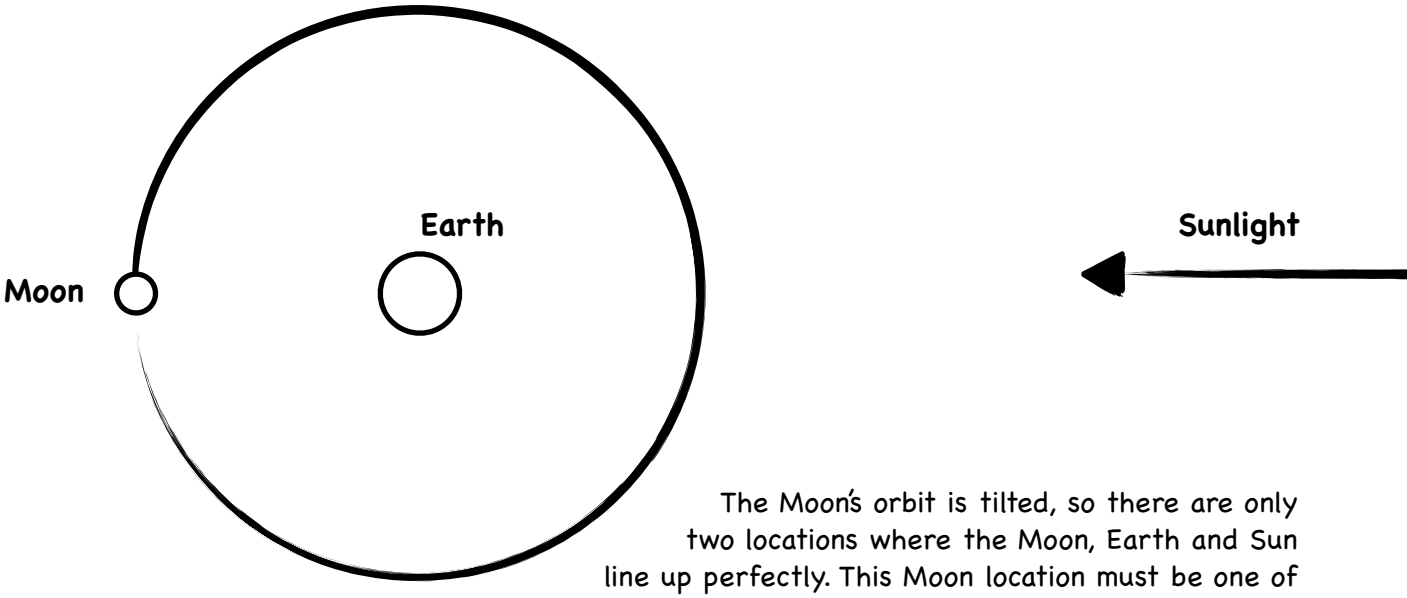
*Ruby responded:*
"I don't think lunar eclipses happen every month. Otherwise why would the news make a big deal out of this eclipse?"

Which friend do you agree with? Explain why.

a. I agree with **Ruby** , (< Jade / Ruby >)

because the Moon's orbit is tilted, so most of the time the Moon is above or below the Earth relative to the Sun, and Sunlight hitting the Moon does not get blocked by the Earth. Lunar Eclipses only happen when the Moon is at a location in its orbit where all three objects line up.

b. **Sketch and label** a diagram of the Sun, Earth, and Moon during a Lunar Eclipse. Include information in your diagram about the shape of the Moon's orbit, to help us understand your answer.




The Moon's orbit is tilted, so there are only two locations where the Moon, Earth and Sun line up perfectly. This Moon location must be one of the places where it is neither above nor below Earth, relative to the Sun. If the Moon is directly behind Earth from the perspective of the Sun, sunlight is blocked by the Earth and never reaches the Moon, and we have a Lunar Eclipse.