MOON PHASES
Session 1: The Four Steps

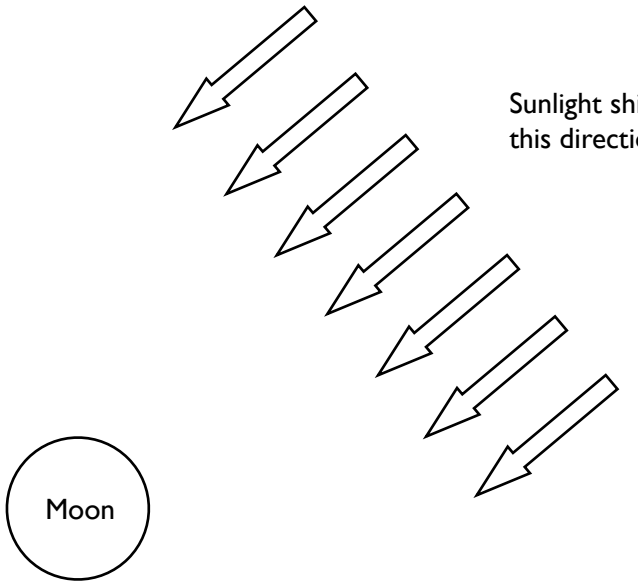
Note: Wait for instructions before you start answering the questions here!

1. How is the Moon lit up?

a. What do you think lights up the Moon? _____

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)



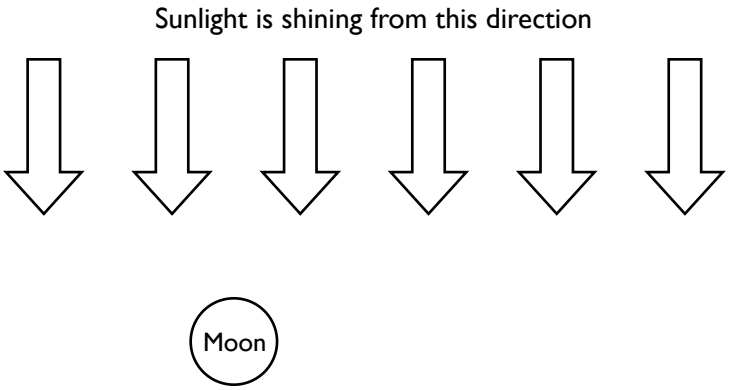
c. How much of the Moon is lit at any time _____
< write as a fraction >

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

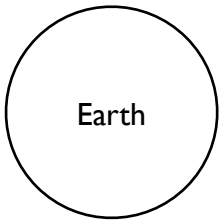
_____

_____

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



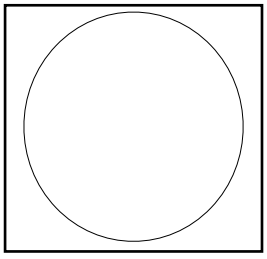
Overhead perspective
NOT to scale



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. **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* 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. **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* 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).



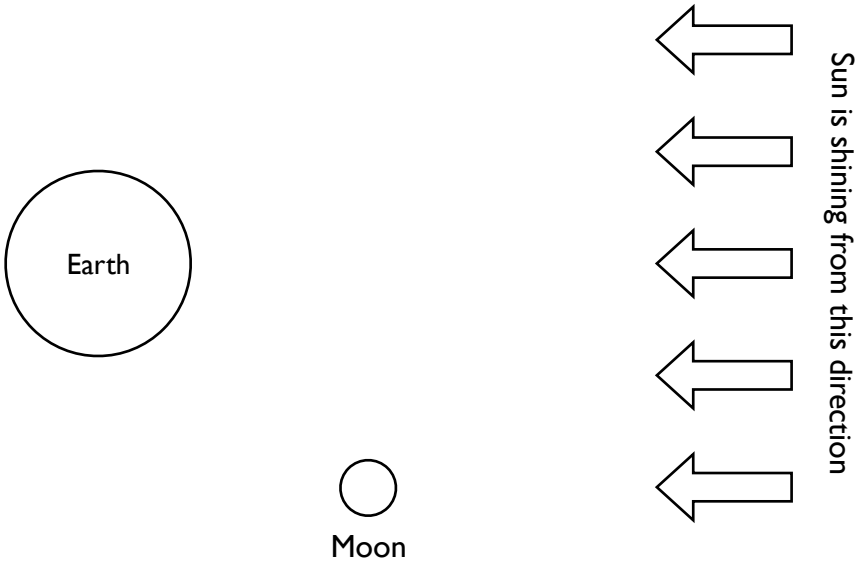
MOON PHASES
Session 2: The Missions

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. **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* 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. **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* 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.

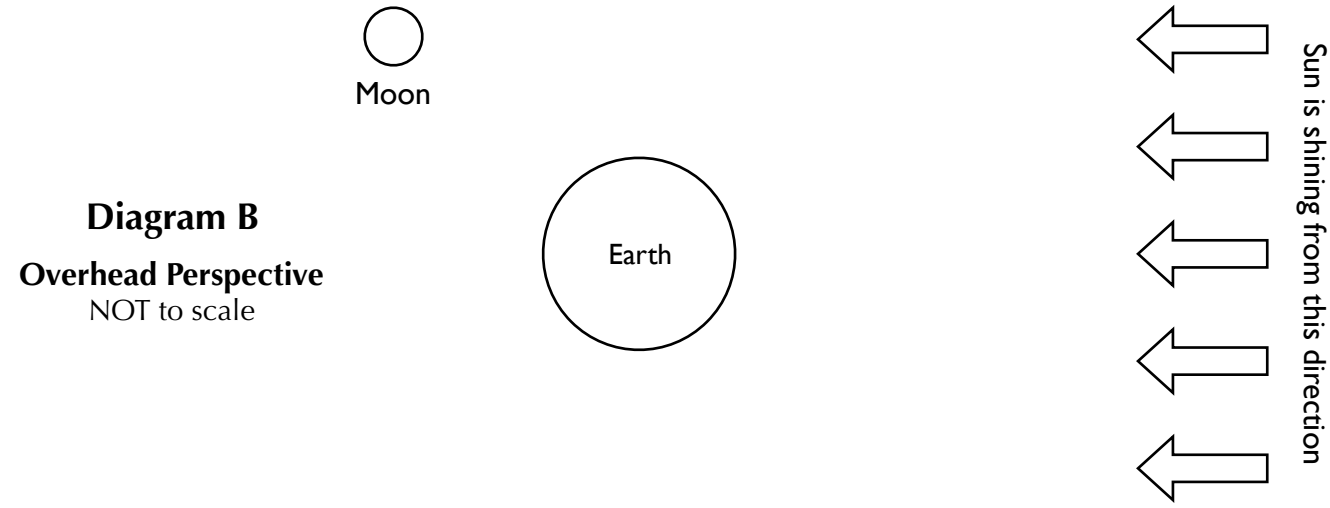


Diagram B

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. **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* 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. **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* 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?

_____

_____

_____

_____

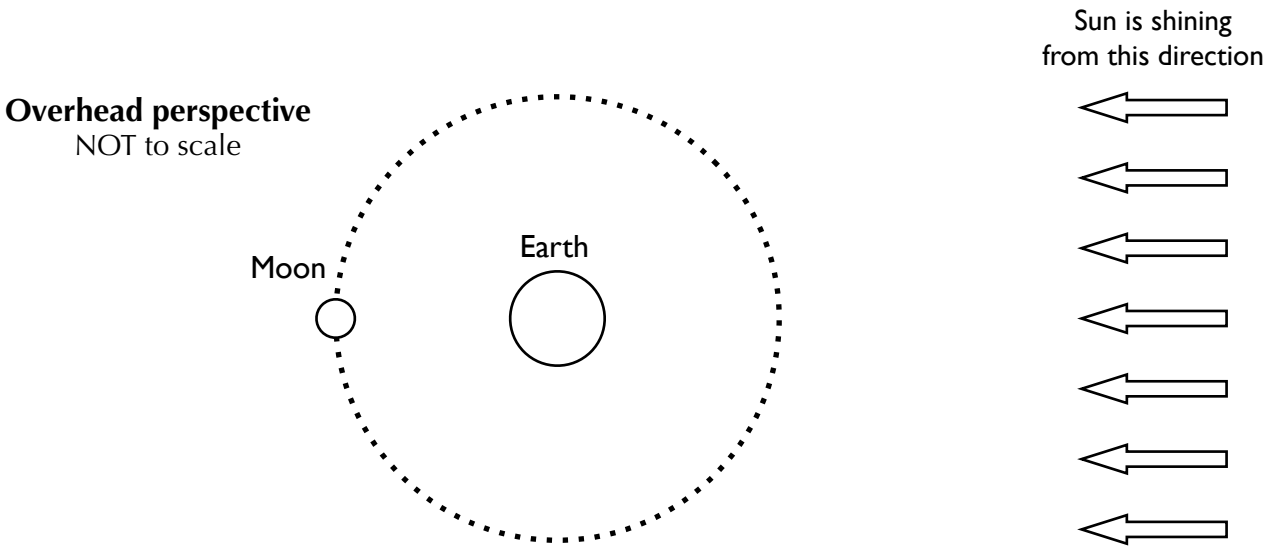
_____

_____

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?



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 _____ .

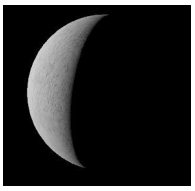
< all dark / mostly dark / half lit-half dark / mostly lit / all lit >

This is known as a _____ moon.

< new / crescent / half / gibbous / full >

Optional Bonus 1: What does the Moon look like in the Southern Hemisphere?

You go outside in Massachusetts and see a crescent moon lit on the left hand side.



You have a friend who lives in Santiago, Chile, in the Southern Hemisphere. Your friend looks at the Moon at the same time you do. What does the Moon look like to your friend? Sketch the Moon below, and explain your reasoning.

Your friend in Chile sees:

Bonus 2: When can you see a crescent moon lit on the left hand side in MA?

What time do you think it was when you were looking at the crescent Moon pictured above?

To figure this out, sketch an overhead view of the Sun, Earth, and Moon when you can see a waning crescent Moon in MA.

Are the people who can see this Moon on the daytime or nighttime side of Earth? At what time of day is it possible to see a waning crescent Moon?

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.

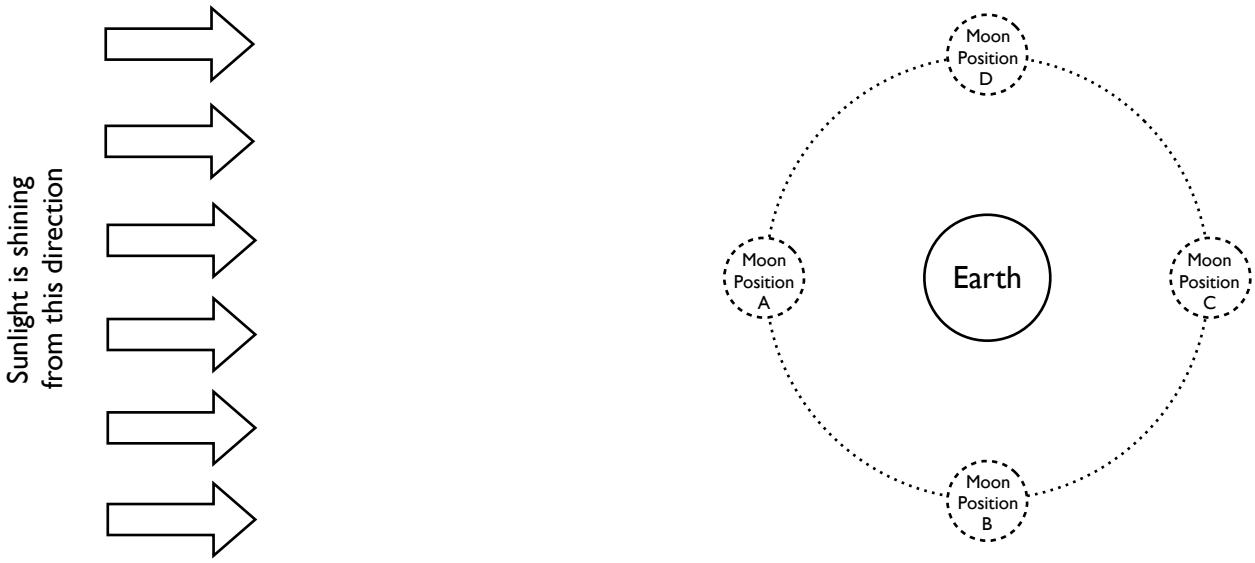
1. Lunar or Solar Eclipse?

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

b. During a **solar eclipse**, something is blocking the _____ .
< 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. 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 / crescent / half / gibbous / full >

c. Choose the Moon position that goes with a **Lunar Eclipse**: A B C D

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

At this position, the phase of the Moon is _____ .
< 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 _____ ,
< Jade / Ruby >

because _____

_____

_____

_____

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.

Optional Eclipse Bonus Questions

a. Explain why eclipses happen roughly around the same time of year from year to year. Sketch (and label) a diagram to help us understand your answer.

b. Do you have any idea why total solar eclipses have been seen by fewer people than total lunar eclipses? (Another way of saying this is, why do people often have to travel to faraway locations to view a solar eclipse?) Explain your thinking

MOON PHASES
Extension Questions

For each of these questions, sketch a diagram to help us understand your thinking.

1. What time does a new moon rise and set? How does that compare with when the Sun rises and sets?
2. You are on vacation at the beach and notice that high tide times occur about 1 hour later each day. Based on what you know about the Moon, can you explain why this happens?
3. Explain why the Moon takes 27.3 days to orbit around Earth, but a complete Lunar Cycle takes 29.5 days.