a place of mind

FACULTY OF EDUCATION

Department of
Curriculum and Pedagogy

Physical Sciences Astronomy: Phases of the Moon 1

Science and Mathematics Education Research Group

Supported by UBC Teaching and Learning Enhancement Fund 2012-2014

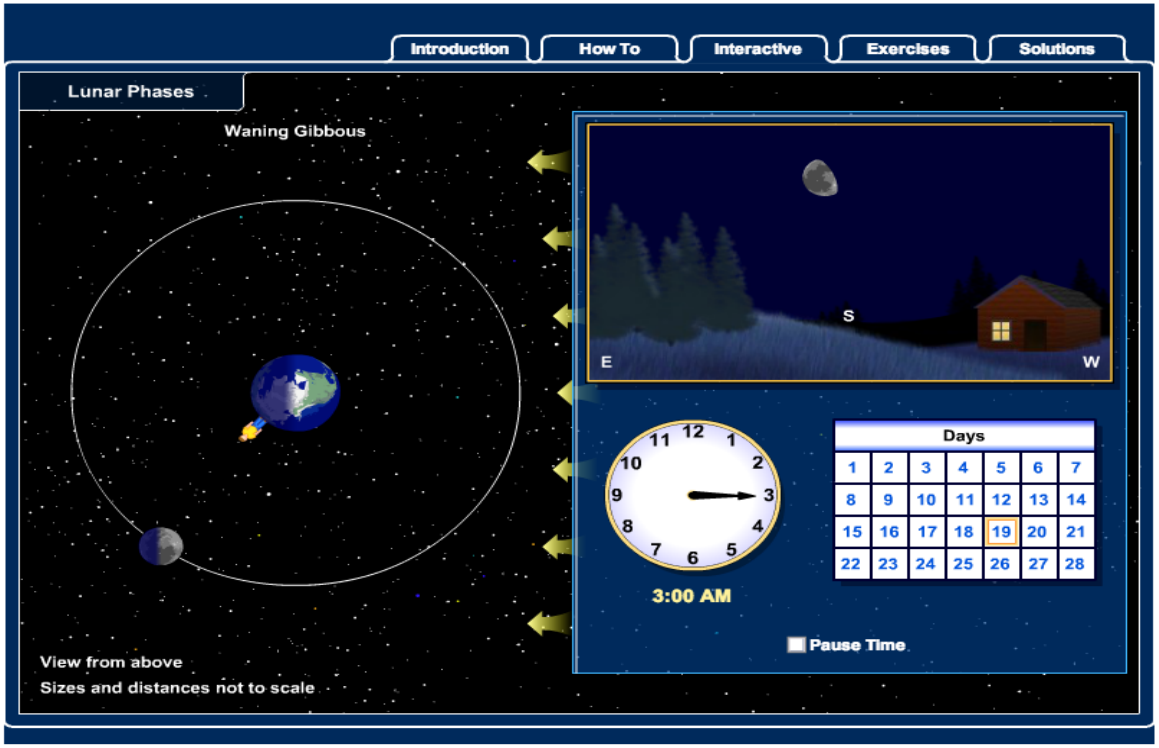
Phases of the Moon: Part I

Extend Your Learning: Video

Title: Bill Nye – Phases of the Moon

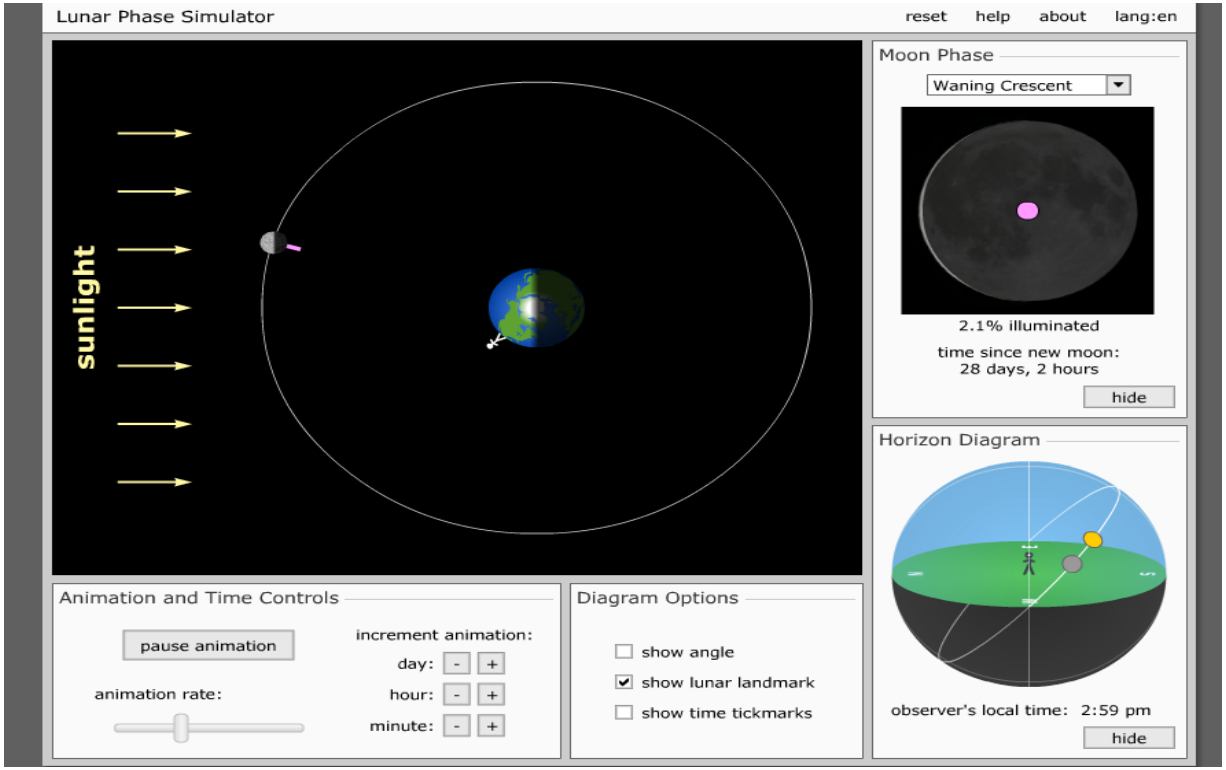
Extend Your Learning: Simulation

Title: Phases of the Moon



Extend Your Learning: Simulation

Title: Phases of the Moon



GIF

Phases of the Moon I

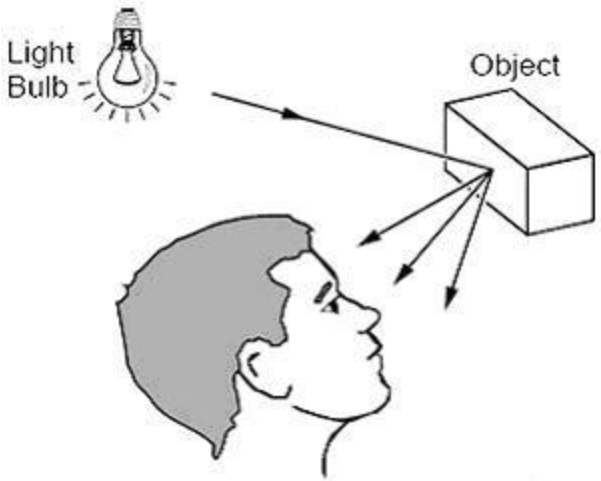
Why does the Moon glow in the night sky?

A. The Moon reflects light from the Sun, which we see
B. Nuclear reactions on the Moon's surface produce light
C. Phosphorescent stones on the Moon's surface emit light
D. The temperature of the Moon's surface is so high that it glows
E. All of the above

Solution

Answer: A

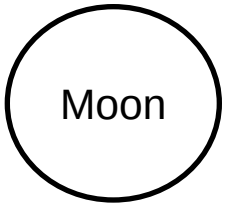
Justification: The Moon is not a source of visible light. Therefore, in order to see the Moon, it must be illuminated by a light source. The only major source of visible light in our solar system is the Sun. The sunlight reflects off of the surface of the Moon to the Earth, allowing us to see the Moon.



Phases of the Moon II

Imagine that the Moon was a source of light.

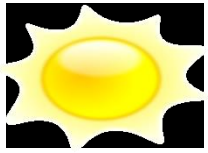
How would the Moon appear in the night sky?



A. 

B. 

C. 

D. 

Solution

Answer: D

Justification: If the Moon was the source of its own light then the entire observable side of the moon would always be visible.

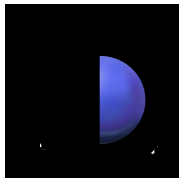
If the light we observe is not bouncing off the Moon, but rather being emitted by the Moon we would not be able to see the level of surface detail on the Moon that we see today.

This means the Moon would look like a second Sun.

Phases of the Moon III

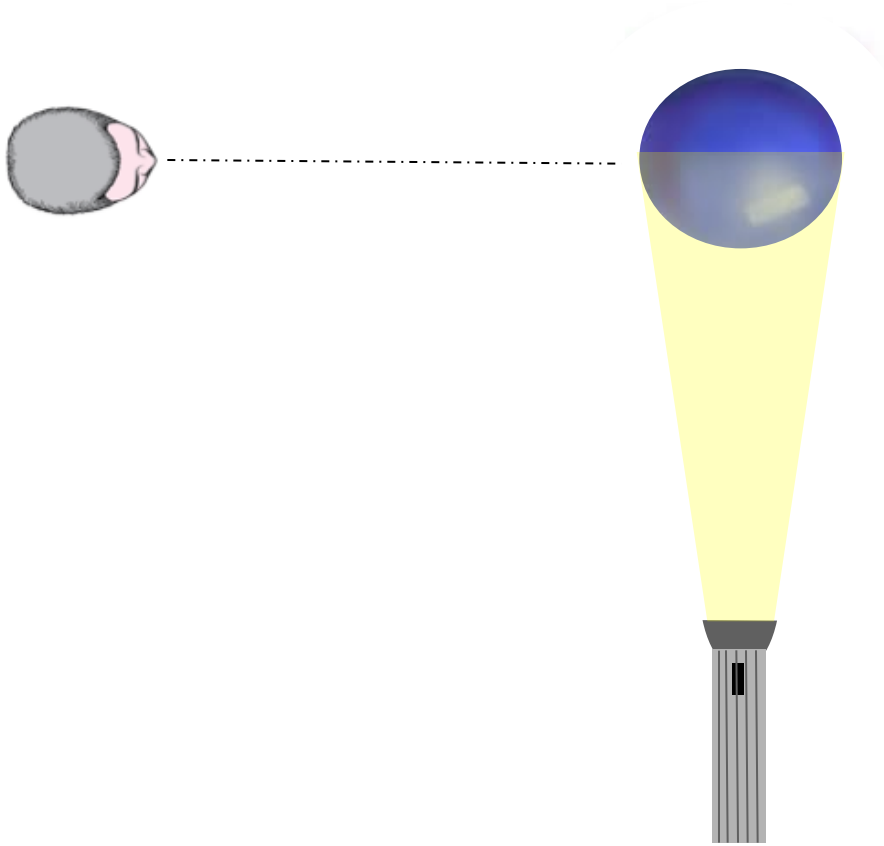
If the only source of light in the diagram is the flashlight, what shape does the observer see?

A. 

B. 

C. 

D. 

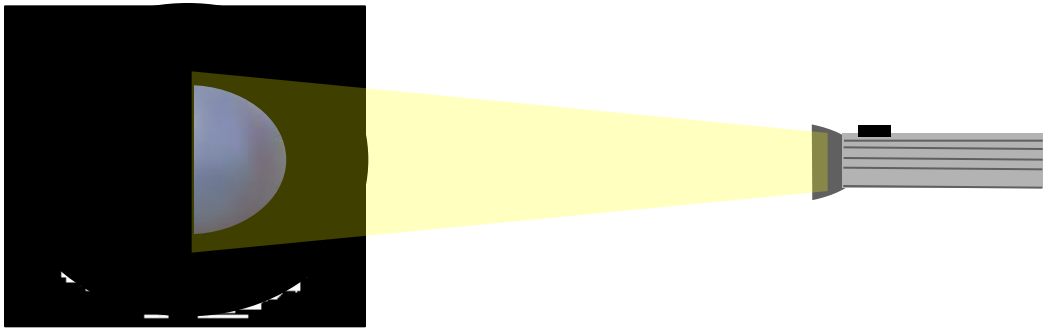


Solution

Answer: B

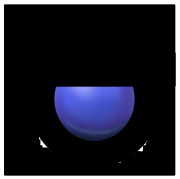
Justification: Imagine now that you are the observer in the previous diagram – the image below is what you would observe in that diagram. The light rays illuminate what you would be able to see.

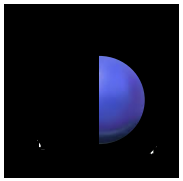
The flashlight illuminates half of the sphere, however, because we are observing the illuminated portion of the sphere at a 90 degree angle from the flashlight, we can only see half of the potentially visible side of the ball.



Phases of the Moon IV

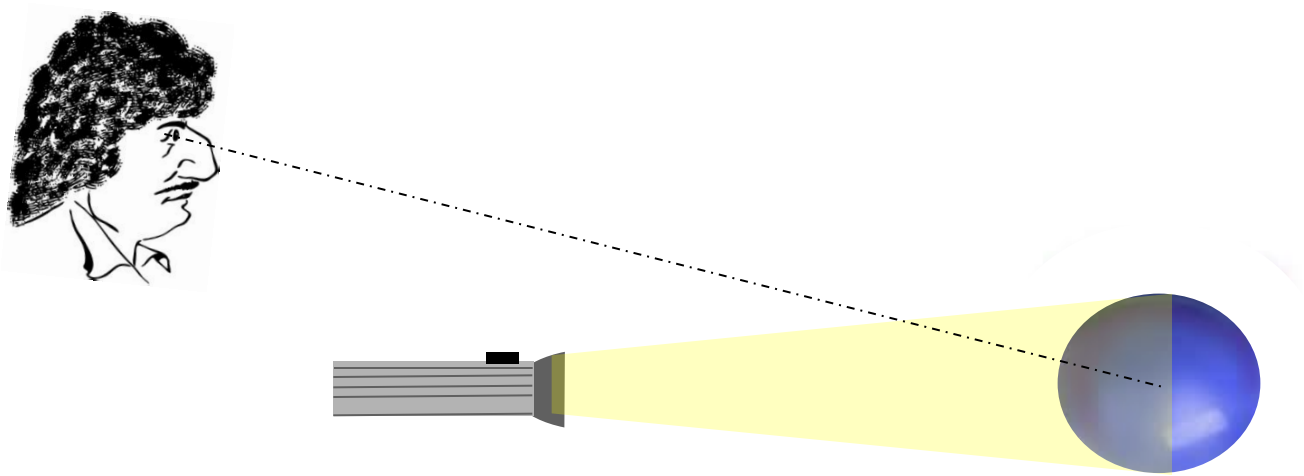
You are the observer, holding a flashlight that is illuminating a sphere. If the only source of light in the diagram is the flashlight, what shape do you see?

A. 

B. 

C. 

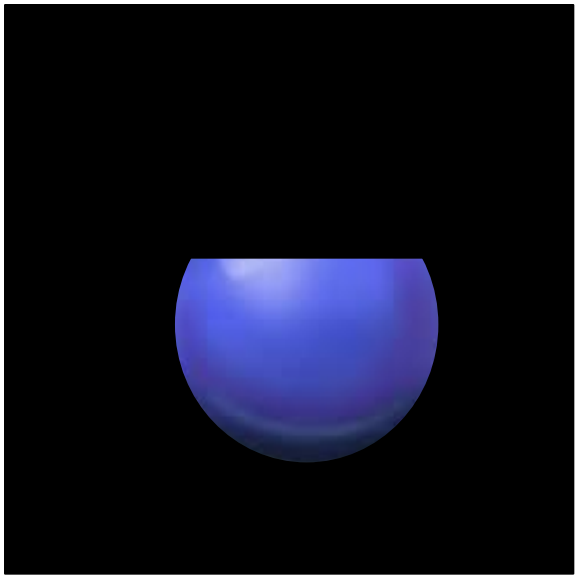
D. 



Solution

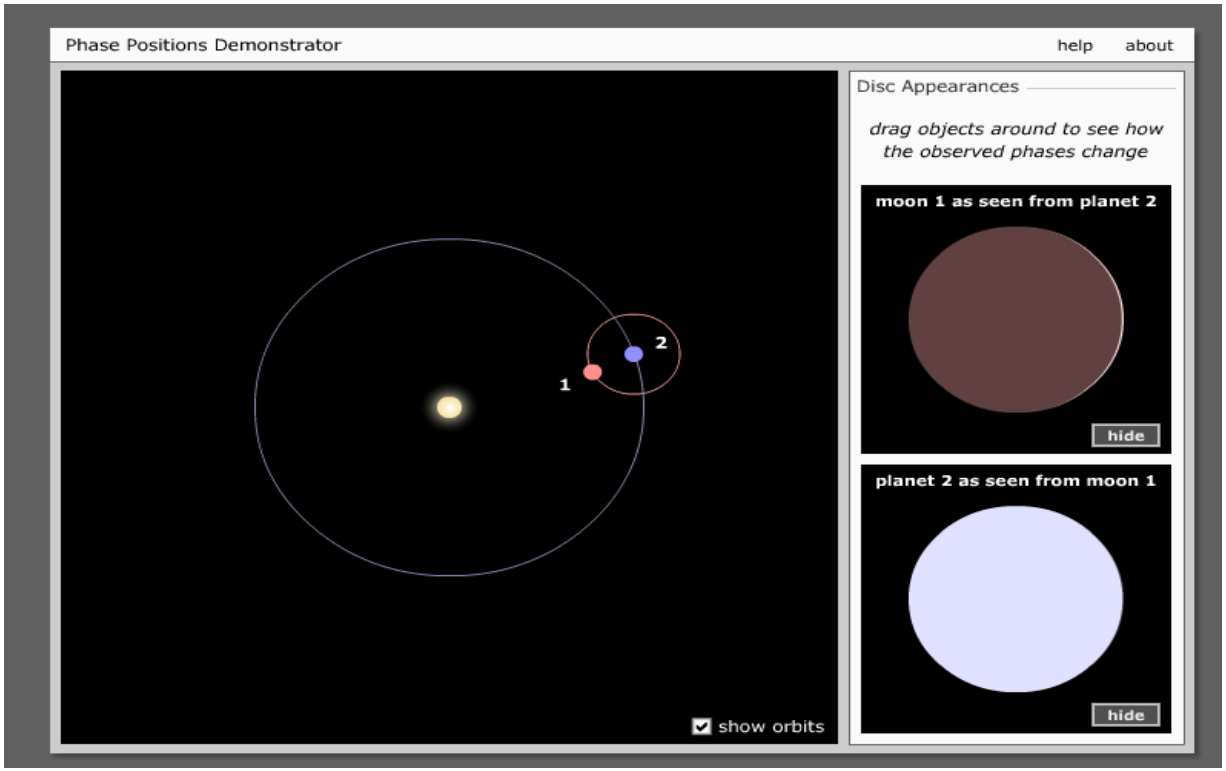
Answer: A

Justification: This time nearly the entire observable side of the sphere is illuminated by the flashlight, and therefore can be seen by the observer, who is standing above and behind the flashlight.



Extend Your Learning: Simulation

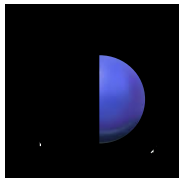
Title: Phases in a 3 Body System – General



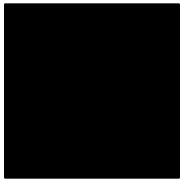
Phases of the Moon V

If the only source of light in the diagram is the flashlight, what shape does the observer see?

A. 

B. 

C. 

D. 

Solution

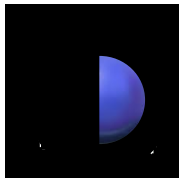
Answer: D

Justification: The observers head is blocking all of the incoming light. There is no light reflecting off of the ball and into the observers eyes, therefore the observer will see nothing.

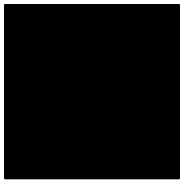
Phases of the Moon VI

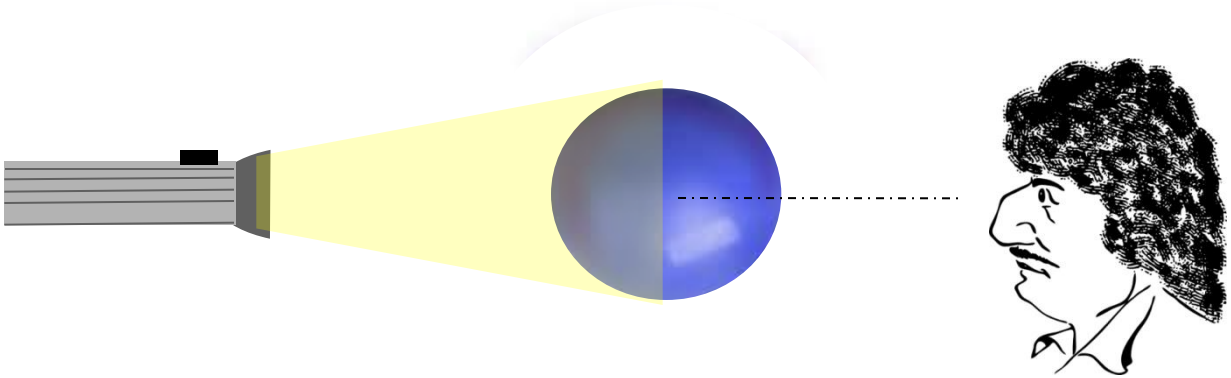
If the only source of light in the diagram is the flashlight, what shape does the observer see?

A. 

B. 

C. 

D. 



Solution

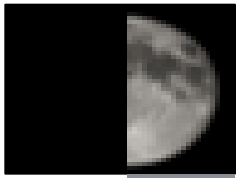
Answer: D

Justification: The object is blocking all of the incoming light. If no light is reaching the observer, no image will be observed.

Phases of the Moon XI

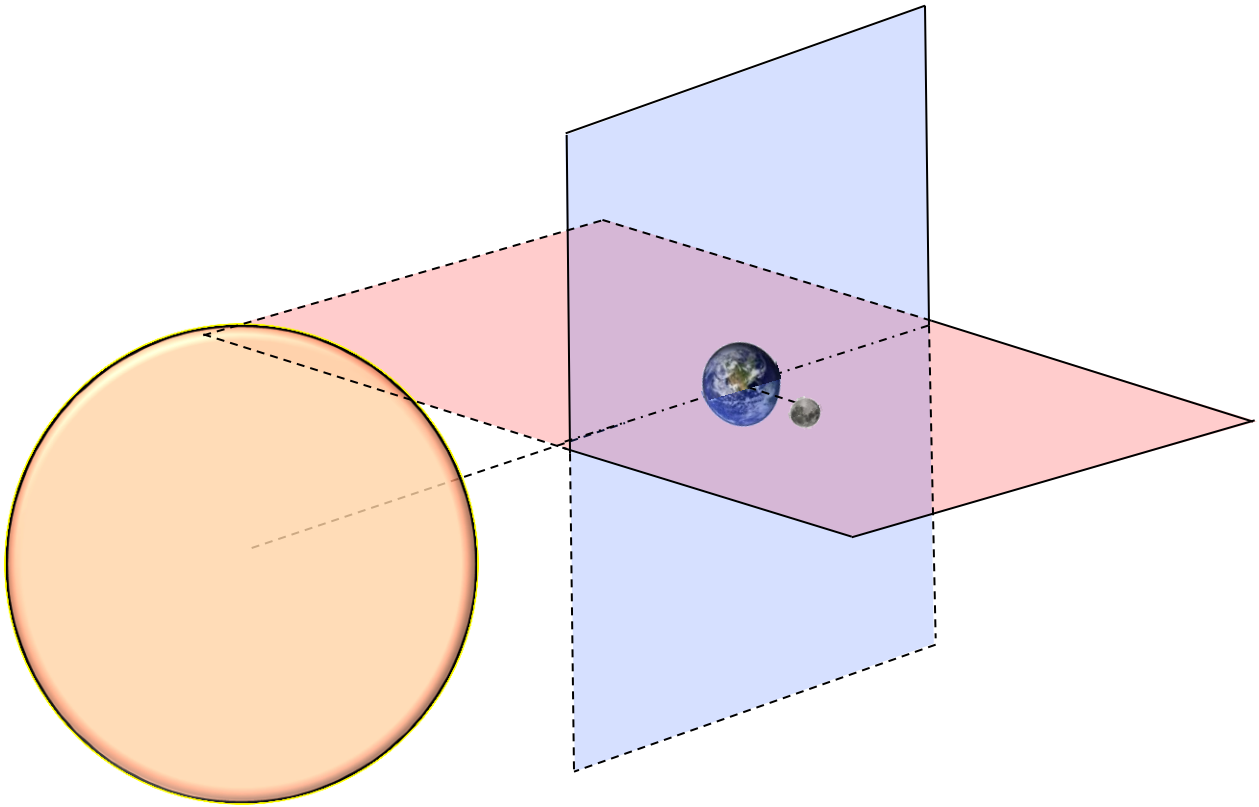
What portion of the Moon is visible from Earth in the following diagram?

A. 

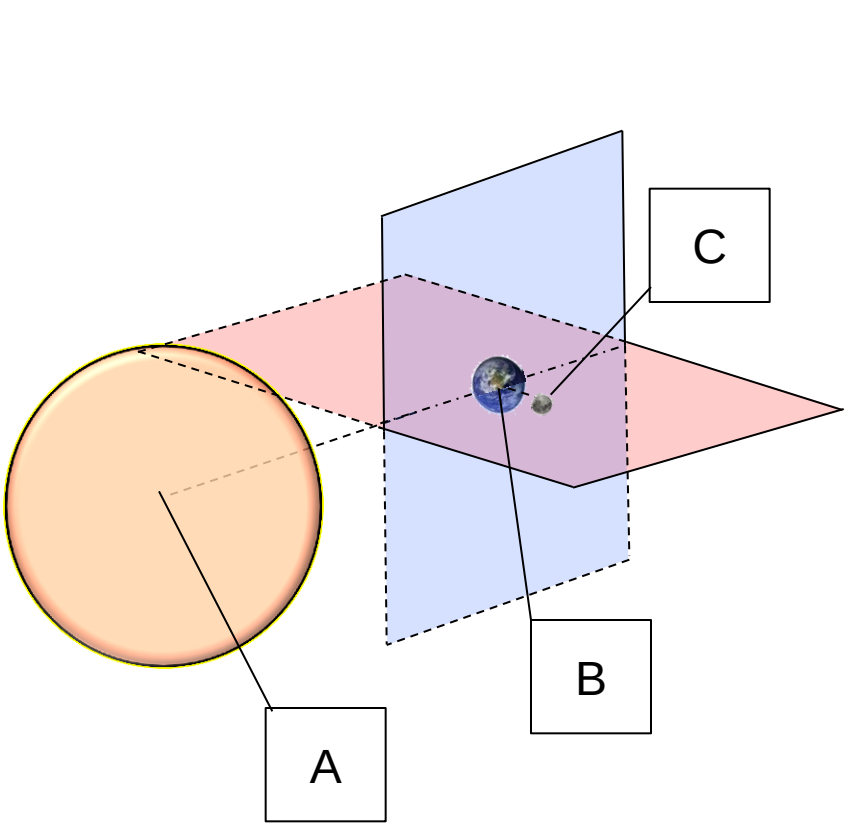
B. 

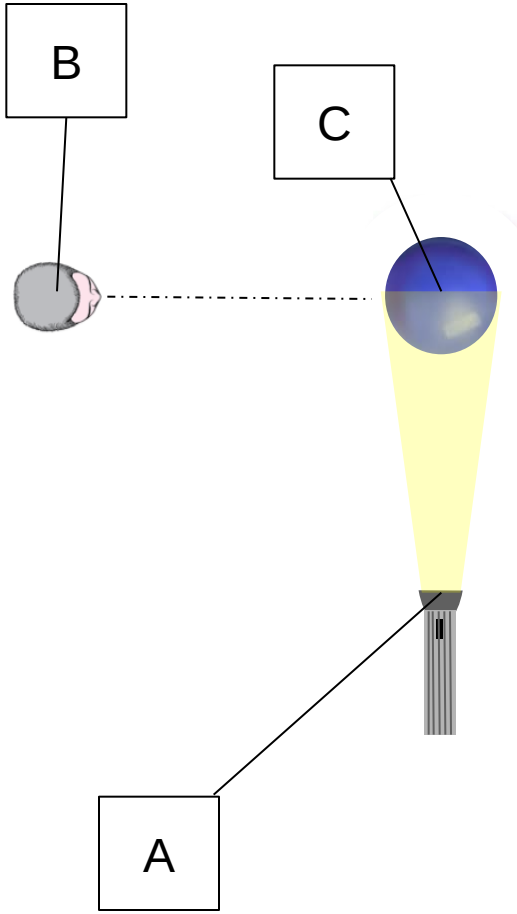
C. 

D. 



Did You Notice?



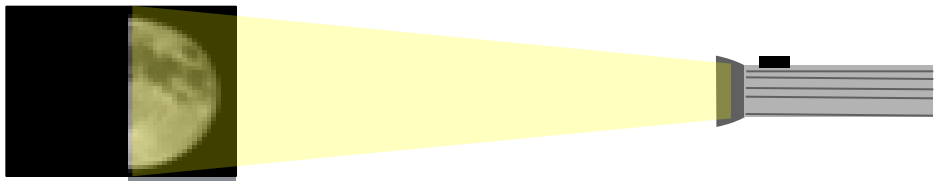


Solution

Answer: B

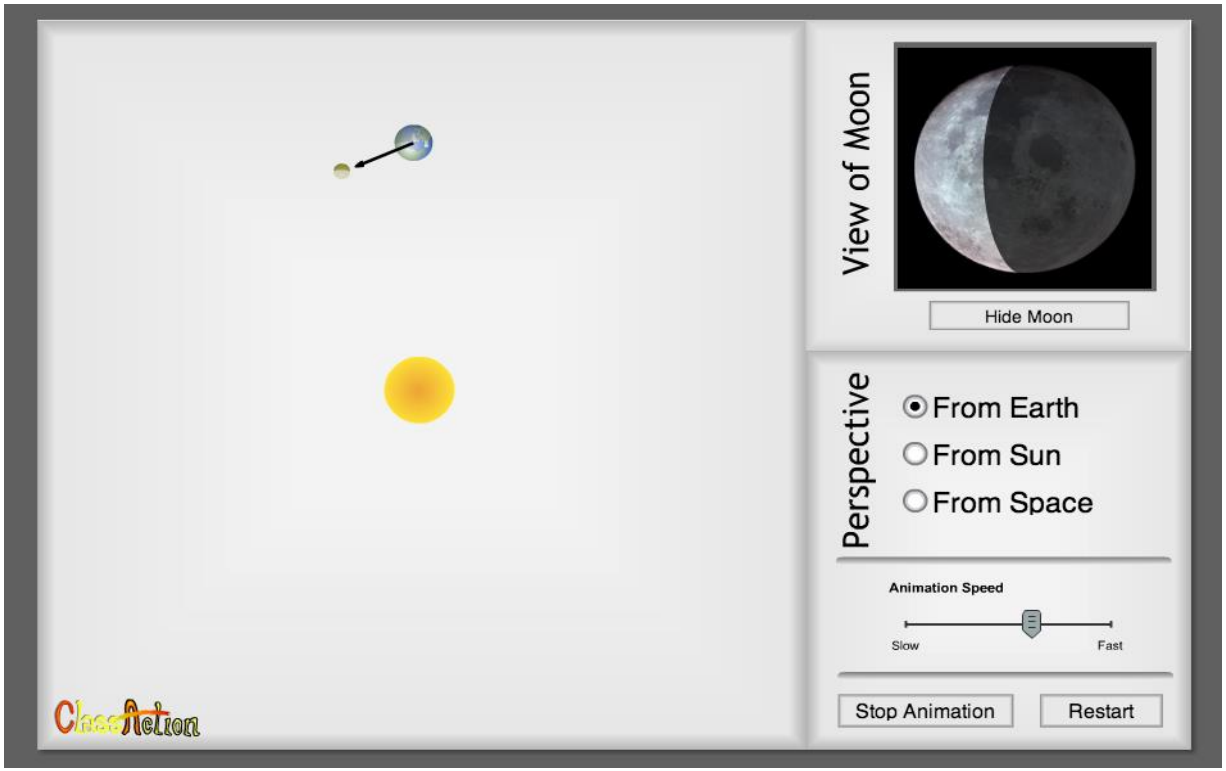
Justification: Imagine now that you are the observer in the previous diagram – the image below is what you would observe in that diagram.

The sunlight illuminates half of the Moon. However, because we are observing the illuminated portion of the moon from the side, we can only see half of the potentially visible side of the Moon's surface.



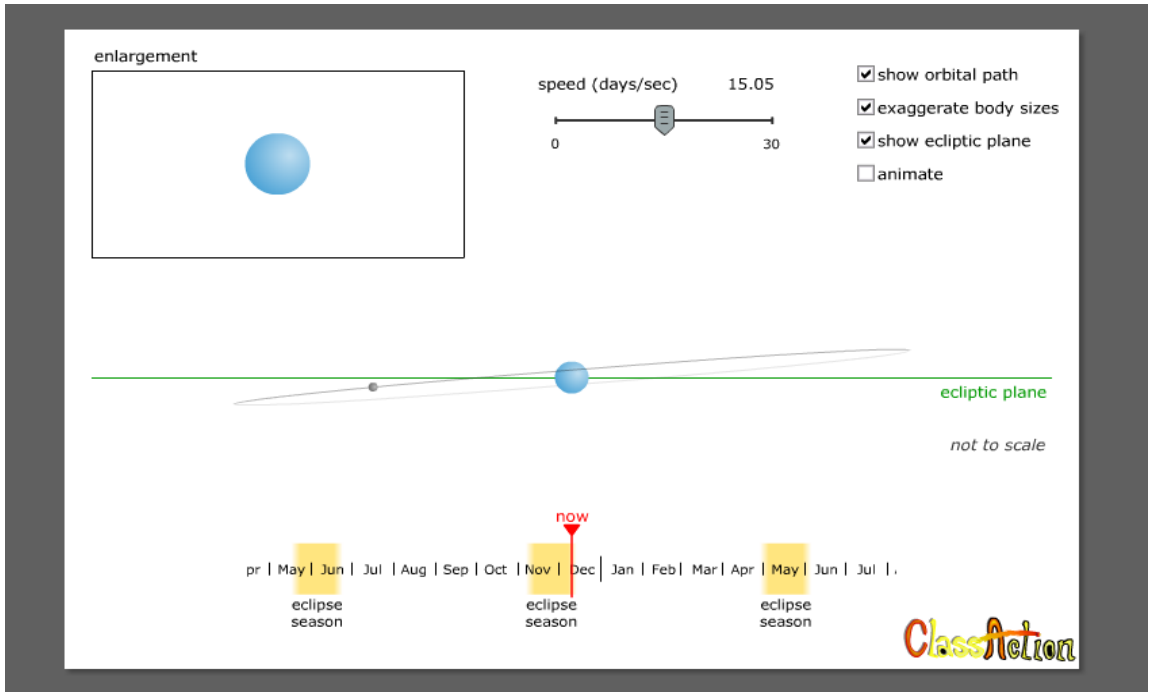
Extend Your Learning: Simulation

Title: Our Solar System – Phases in a 3 Body System



Extend Your Learning: Simulation

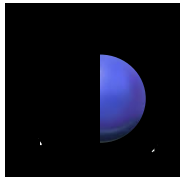
This simulation will help you to understand the ideas in the following questions. Please pay close attention to how the Moon orbits the Earth, and how the lunar orbit is orientated relative to the ecliptic plane. Try to form a clear mental "GIF" of this simulation .



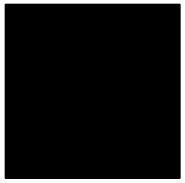
Phases of the Moon VIII

If the only source of light in the diagram is the flashlight, what shape does the observer see?

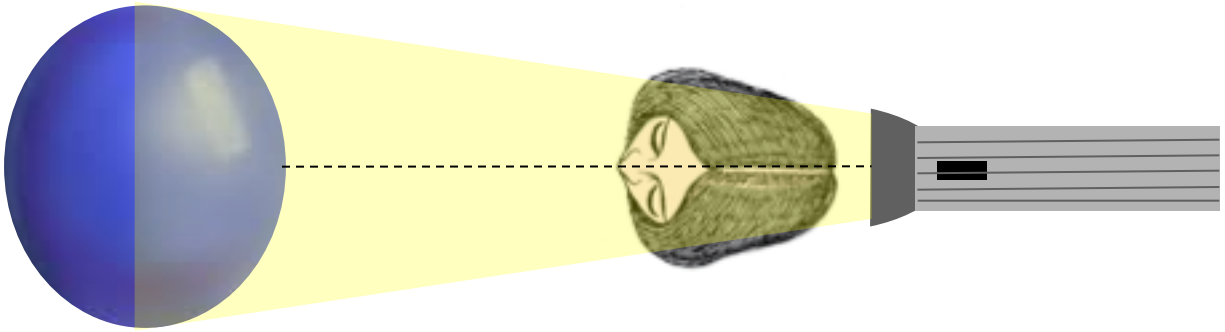
A. 

B. 

C. 

D. 

Assume that the diagram below is accurate and true.

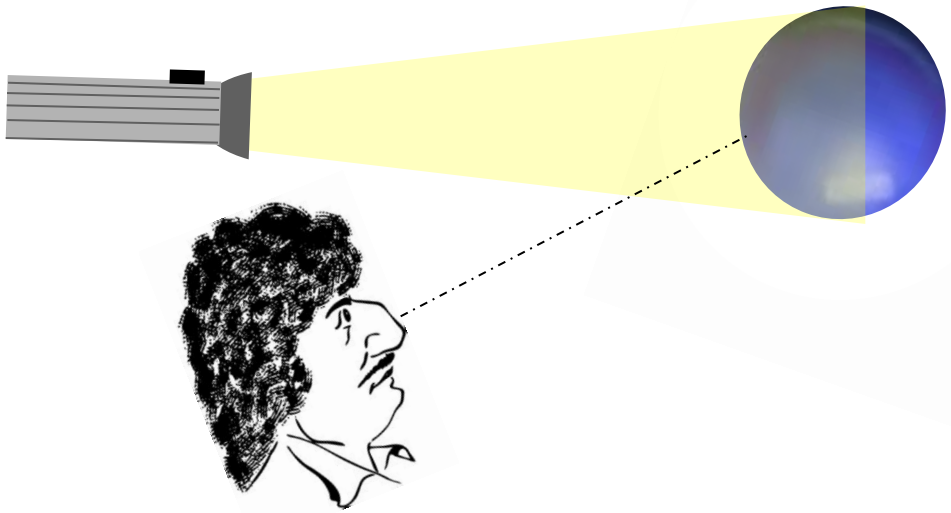


Solution

Answer: A

Justification: The light rays below illuminate what you would be able to see.

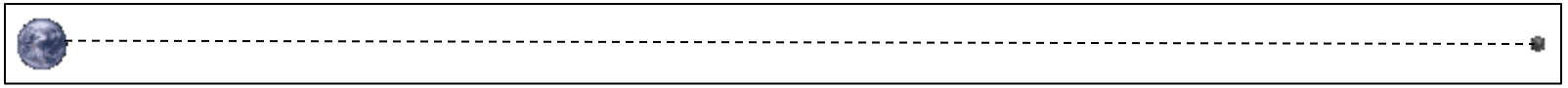
The flashlight illuminates half of the sphere and because the observer is not blocking the light source, he can see almost the entire half of the sphere.



Extend Your Learning: Thought Experiment

It is important to keep in mind how large the astronomical scale truly is. Due to the extreme nature of the sizes and distances involved in astronomy, the diagrams used to explain concepts and questions, are usually not to scale in order to allow the diagram to fit on one page.

For example, here is a graphic of the Earth and Moon to scale:



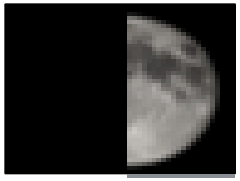
Each pixel in the above diagram represents more than 500km^2 of space!

If we where to try to include the Sun in this diagram, the Moon would be invisible because it would take up less than one pixel of space.

Phases of the Moon IX

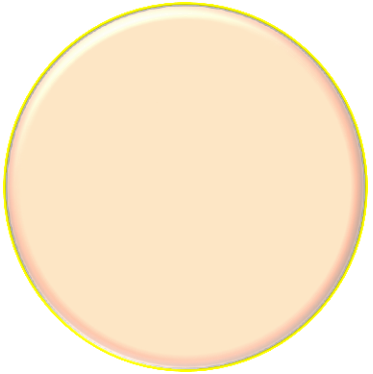
What portion of the Moon is visible from Earth if the following image is viewed from the **top down**?

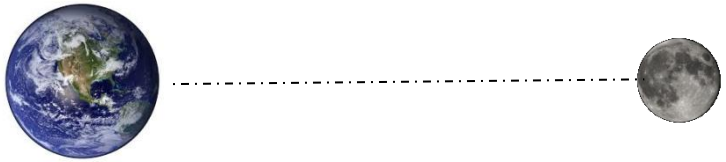
A. 

B. 

C. A or D

D. 

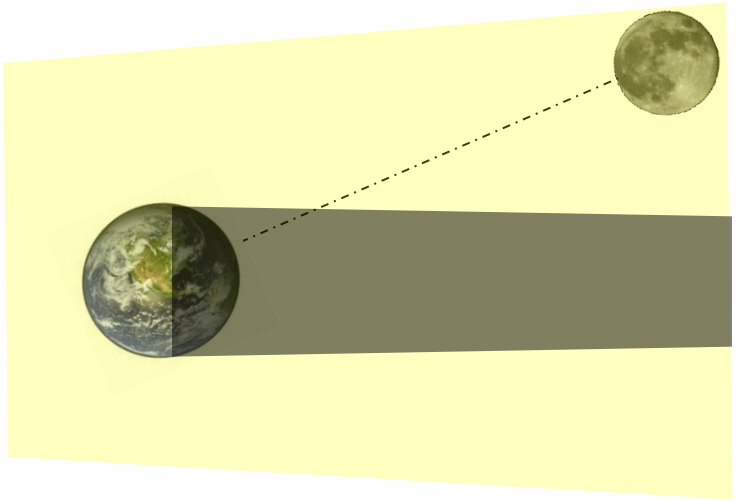


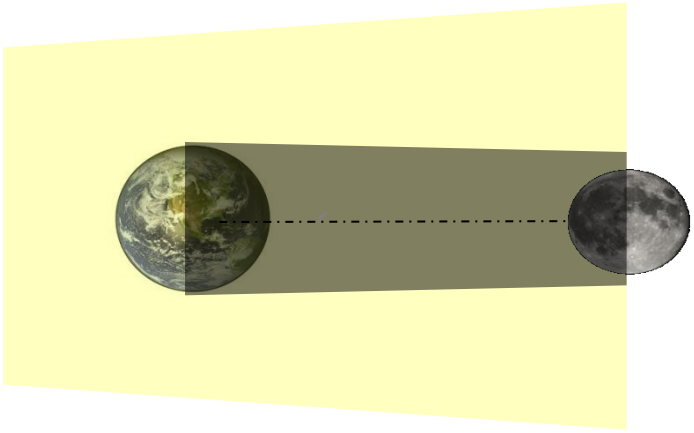


Solution

Answer: C

Justification: The observer will see either a Full Moon or no Moon at all depending on where the Moon is relative to the Ecliptic plane. These diagrams below are being viewed **from the side instead of from the top.** Both of these options are possible.

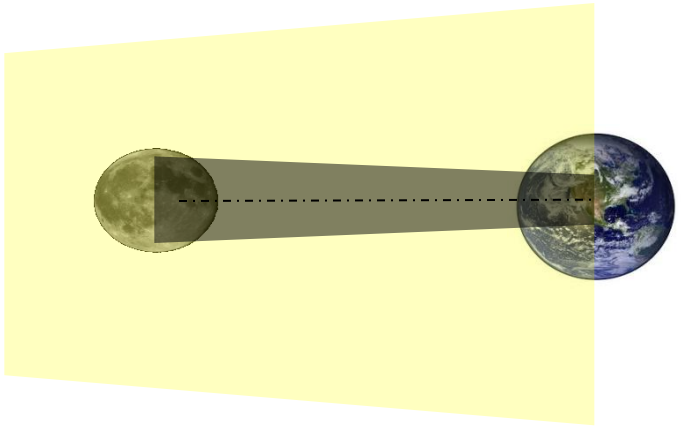




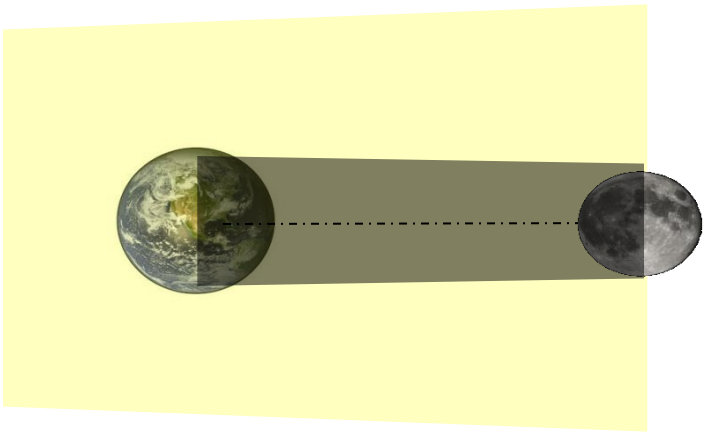
Extend Your Learning

When one celestial body's shadow obstructs the observer's view of a different celestial body the event is called an **eclipse**. The name of the eclipse will be given by the name of the celestial body being obstructed.

Solar Eclipse



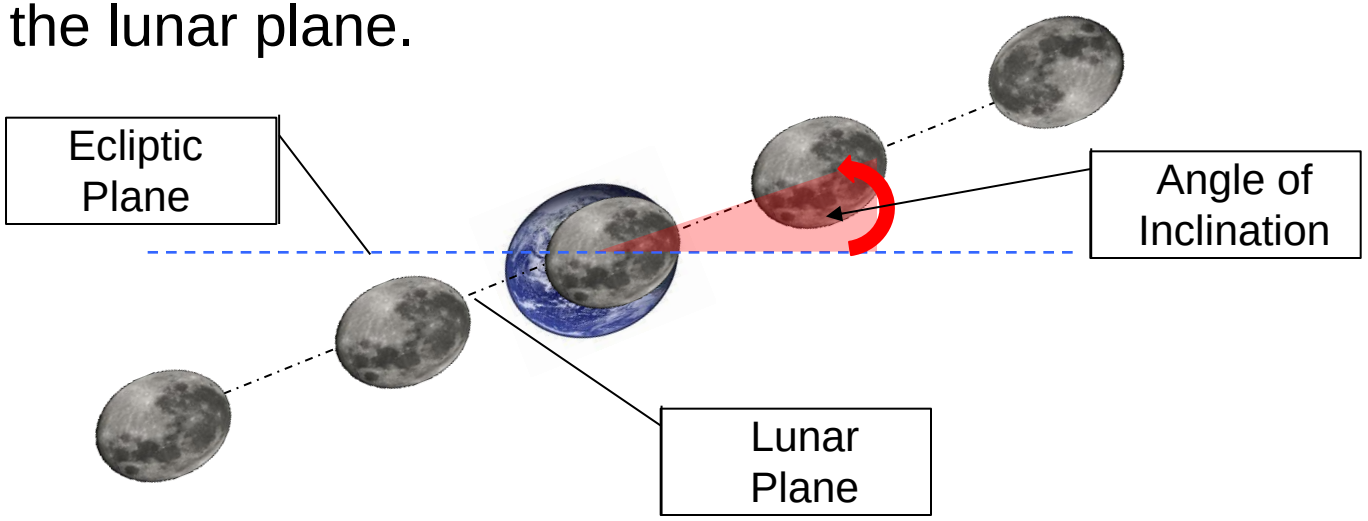
Lunar Eclipse



Extend Your Learning

Ecliptic Period:

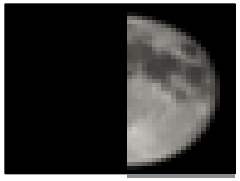
There is an average of four eclipses per year, two solar and two lunar. One solar and one lunar eclipse will happen within the same month, and then the second pair will occur approximately six months later. The reason why we don't experience a solar and a lunar eclipse every month is because of the angle of inclination between the ecliptic plane and the lunar plane.



Phases of the Moon X

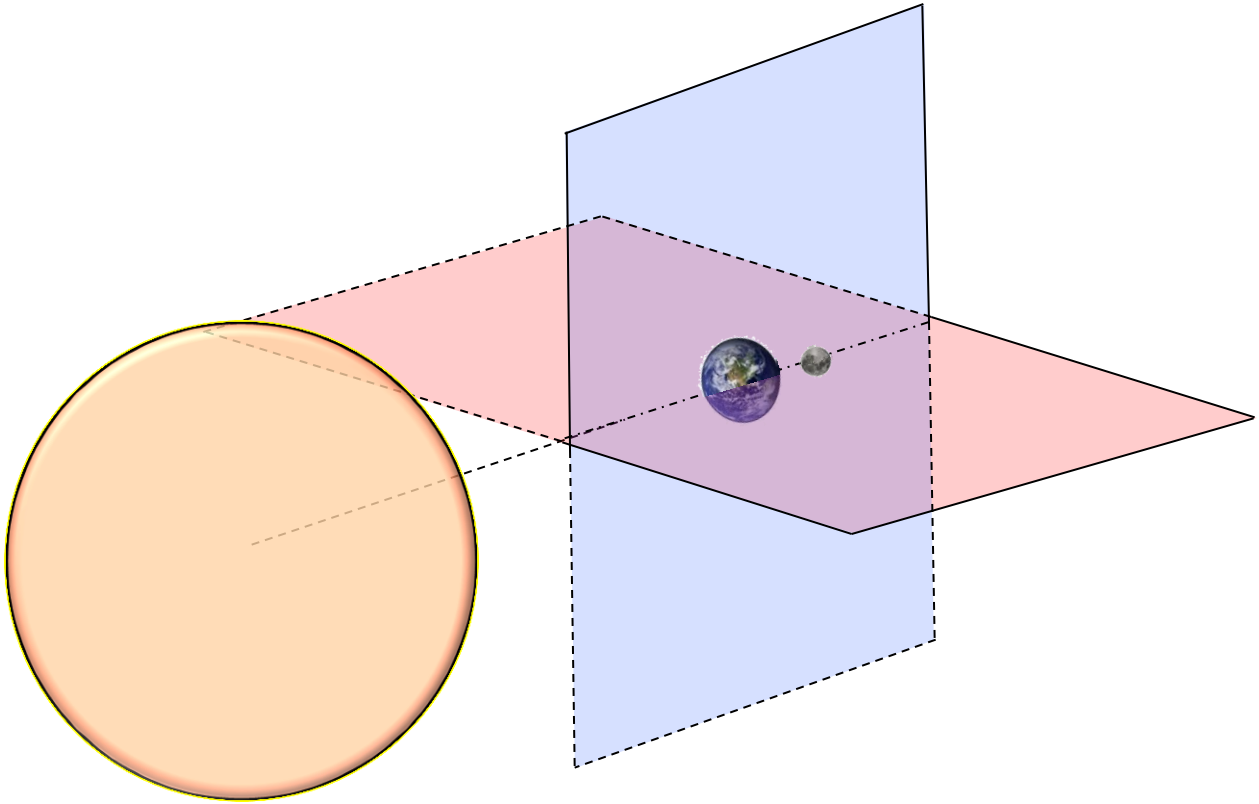
What portion of the Moon is visible from Earth if the following objects are in the same horizontal and vertical planes?

A. 

B. 

C. 

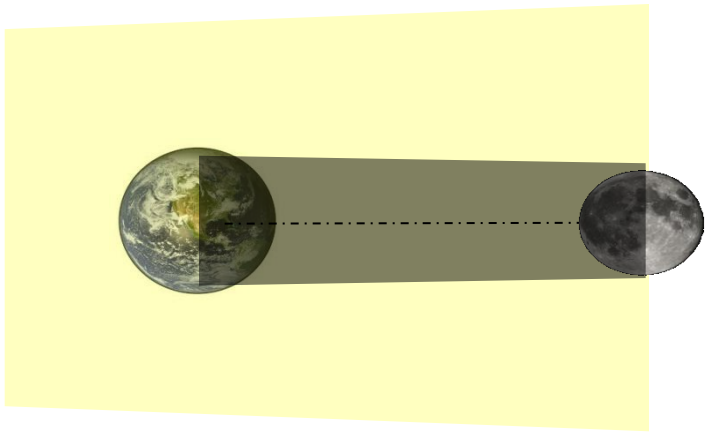
D. 



Solution

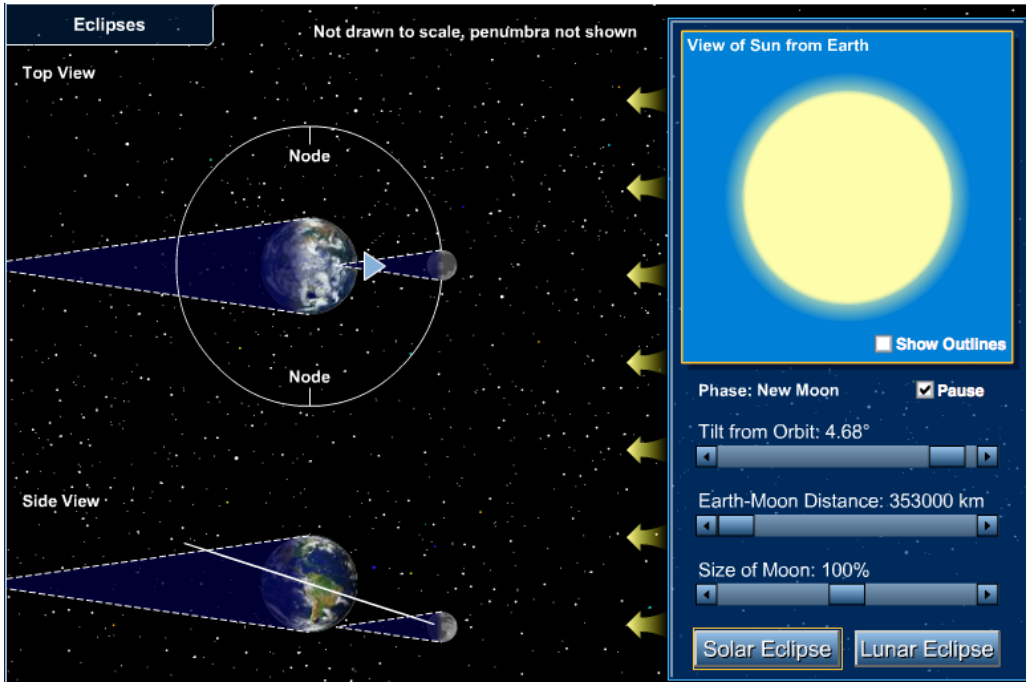
Answer: D

Justification: If the Earth, the Moon, and the Sun are in the same horizontal and vertical plane, then the Earth will block the sunlight from reaching the Moon. This event is known as a Lunar eclipse. Although this is true for the case of our Sun, Moon and Earth, if the sizes of the objects, or the distances between them were altered this event might never happen.



Extend Your Learning: Simulation

There are a number of factors that will determine if an eclipse will occur. These include the size of the Sun, the size of the Moon, and the distance between the Earth and the Moon. Please use the following simulator to explore how the factors effect the likely hood of an eclipse occurring.



Phases of the Moon XII

How would the phases of the Moon and ecliptic cycle differ if the Moon's orbital inclination was changed from the five degrees (which happens in real life), to zero degrees?

A. There would be a lunar eclipse every new moon and a solar eclipse every full moon.
B. There would be a lunar eclipse every full moon and a lunar eclipse every new moon.
C. There would be a solar eclipse every new moon and a lunar eclipse every full moon.
D. There would be a solar eclipse every full moon and a solar eclipse every new moon.

Solution

Answer: C

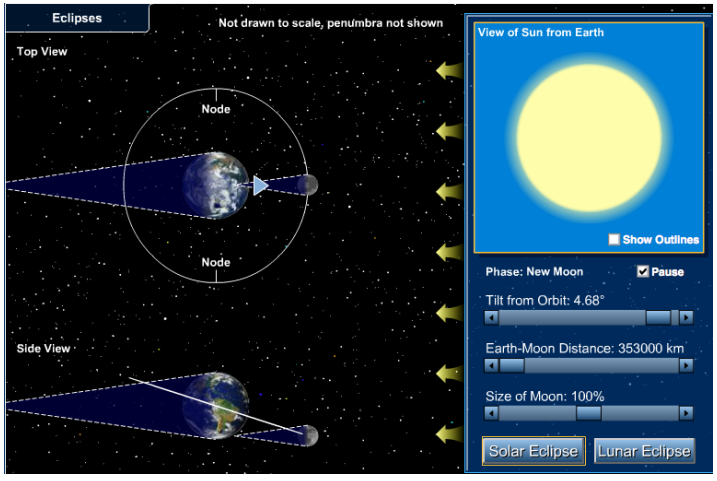
Justification: Without the inclination of the lunar orbit we would experience a solar eclipse every new moon and a lunar eclipse every full moon.

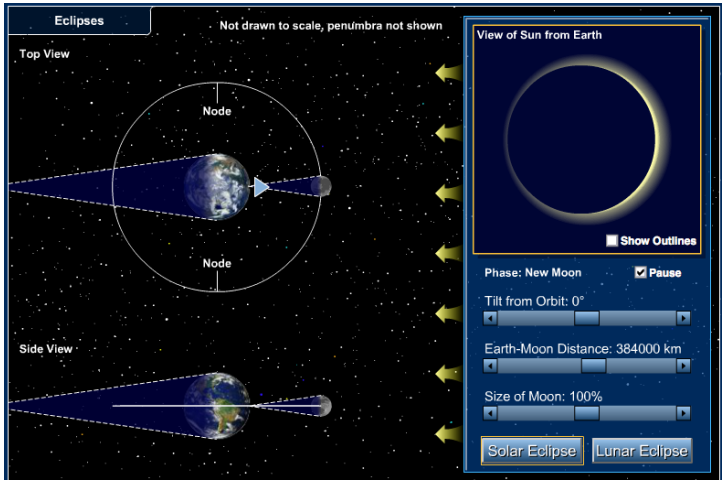
It is because of the angle of inclination of the Moon in relation to the ecliptic plane that eclipses do not occur every lunar period. Over the two slides we will look at the relationships between the New Moon and the Solar eclipse, and the Full Moon and the Lunar Eclipse.

Extend Your Learning: New Moon and Solar Eclipse

New Moon vs. Solar Eclipse

When the Moon's orbit is inclined with respect to the ecliptic plane the simulation shows that we do not observe a solar eclipse during the new moon. Because the Moon is below the Earth, its shadow does not fall on the Earth's surface. If the Moon's orbit is not inclined, we can see that where we had originally observed a new moon, we now observe a solar eclipse. As we can see from the lower right hand diagram, the Moon's shadow lies directly on the surface of the Earth, eclipsing the sun.

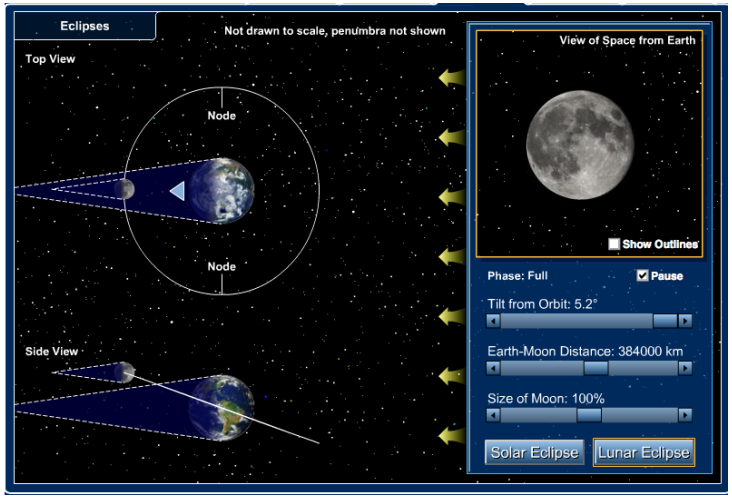


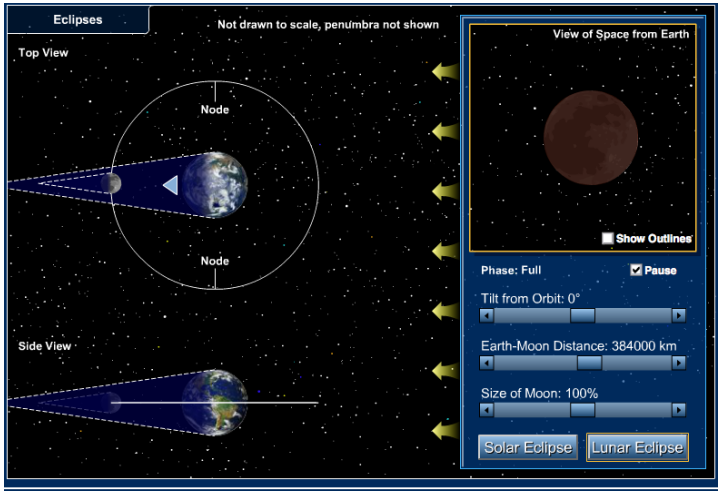


Extend Your Learning: Full Moon and Lunar Eclipse

Full Moon vs. Lunar Eclipse

If the lunar orbit is inclined, we observe a full moon because the Moon is not in the same plane as the ecliptic, and is completely unobstructed by the Earth's shadow. Without the inclination the Earth's shadow falls on the Moon and we observe a Lunar Eclipse instead of a full Moon





Extend Your Learning: Simulation

Title: Eclipses of the Moon and Earth