



a place of mind

FACULTY OF EDUCATION

Department of
Curriculum and Pedagogy

Physical Science Astronomy: Eclipses

Science and Mathematics
Education Research Group

Eclipses



Eclipses I

An eclipse occurs when one celestial body moves _____ another, partially or fully obscuring it from view.

- A. next to
- B. in front of
- C. into the shadow of
- D. further away from the Sun than



Solution

Answer: C

Justification: An eclipse occurs when one celestial body is obscured by another celestial body.

Having one celestial body move in front of another does not guarantee an eclipse, because determining whether the shadow of one object will fall on another depends on: the distance between the objects, the size of the objects, and the size of the light source.

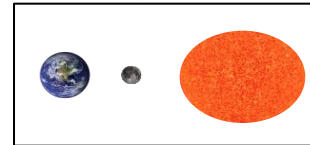
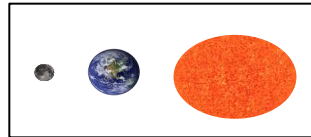
Eclipses II

Which option shows the correct order of the Sun, Moon and Earth during the solar and lunar eclipses?

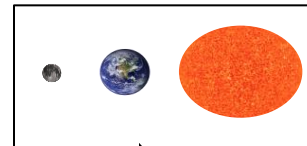
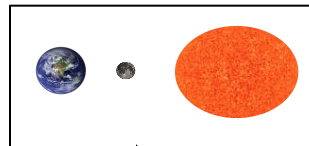
Solar Eclipse

Lunar Eclipse

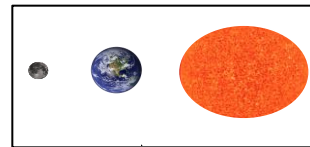
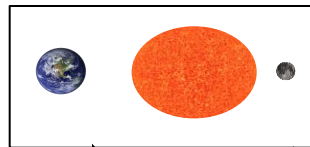
A.



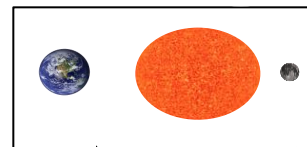
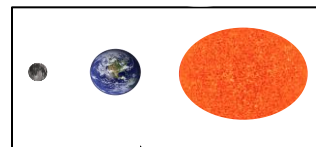
B.



C.



D.



Solution

Answer: B

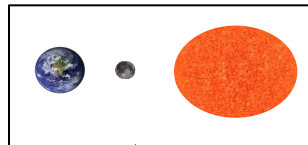
Justification: The name of an eclipse is given by the celestial body that is being obstructed from Earth's view. During a solar eclipse the Sun's light must be blocked by the Moon. During a lunar eclipse the light that would have reflected off of the Moon must be blocked by the Earth.

It follows that:

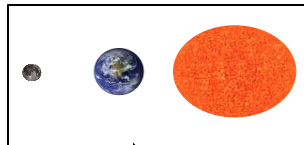
A solar eclipse must have the order Earth, Moon the Sun.

A lunar eclipse must have the order Moon, Earth then Sun.

Solar Eclipse



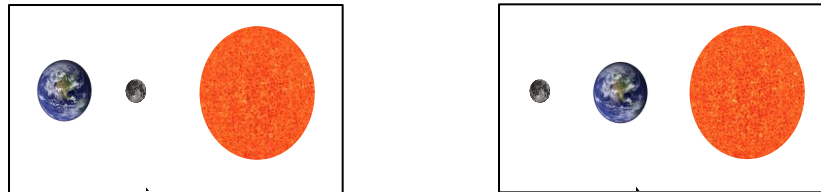
Lunar Eclipse



Extend Your Learning: Thought Experiment

How we categorize eclipses is based on where you are observing the system from. We usually consider eclipses from our position on Earth. But it is possible to think of and name eclipses from other perspectives.

For example, if you consider this diagram from the previous question but imagine you are on the Moon...



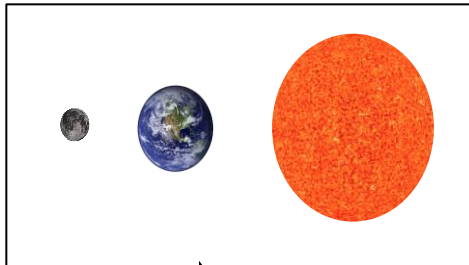
Now how would you name these eclipses?

GIF

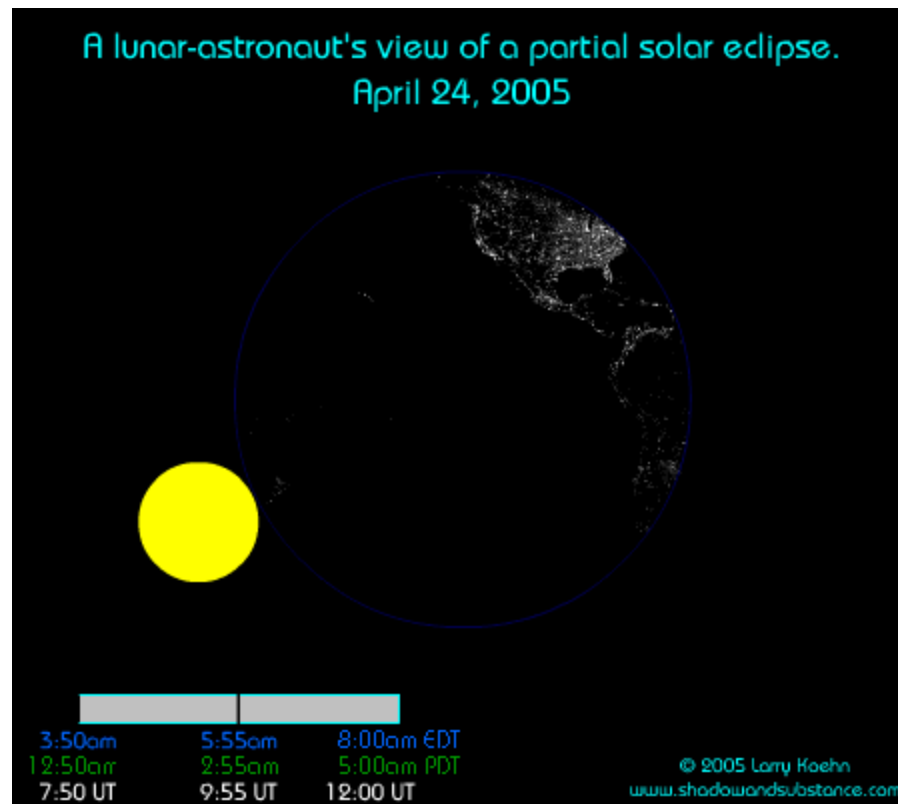
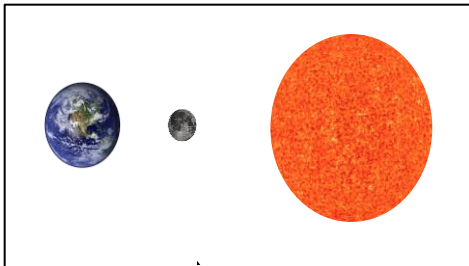
Extend Your Learning: Thought Experiment

A partial solar eclipse seen from the moon

Solar Eclipse



Terran Eclipse



Eclipses III

Which phenomenon does the following statement describe?

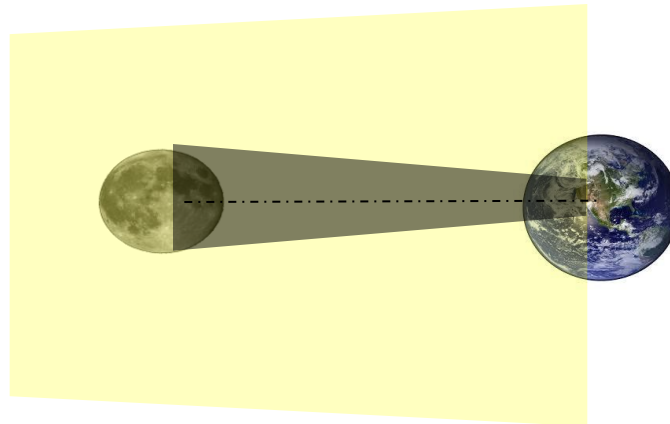
The Moon travels between the Sun and the Earth, blocking the Sun's light, briefly blacking the sky in the middle of the day.

- A. Lunar Eclipse
- B. Solar Eclipse
- C. Neither

Solution

Answer: B

Justification: When one celestial body moves in front of another, the event is called an eclipse. The type of eclipse depends on the celestial body that is obscured from view. In this case, because the Moon has moved in front of the Sun, obscuring it from view on Earth, we call it a Solar eclipse.



Eclipses IV

Which phenomenon does the following statement describe?

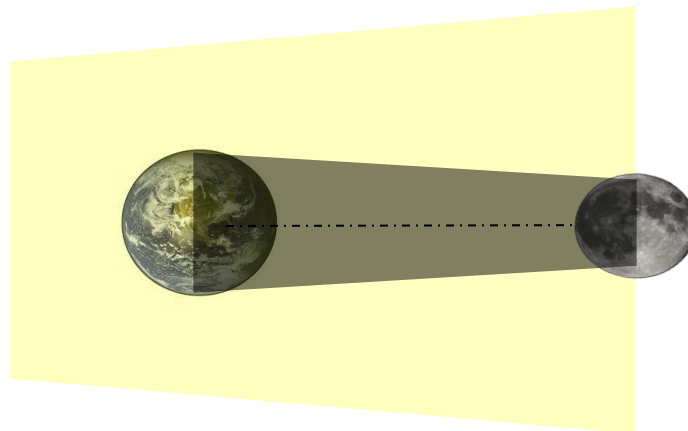
The Moon moves between the Sun and the Earth resulting in a moonless night.

- A. Lunar Eclipse
- B. Solar Eclipse
- C. Neither

Solution

Answer: C

Justification: This scenario describes the new moon, not a lunar eclipse. A lunar eclipse does not result in a moonless night. During a lunar eclipse the Moon moves through the Earth's shadow, re-emerging on the other side. Additionally, the order of the planets in the scenario does not describe a lunar eclipse. If the Moon is to move through the Earth's shadow, the Moon cannot possibly be between the Earth and the Sun.



Eclipses V

Which phenomenon does the following statement describe?

The Moon moves into the shadow of the Earth, briefly blocking the Sun's light from reaching the Moon.

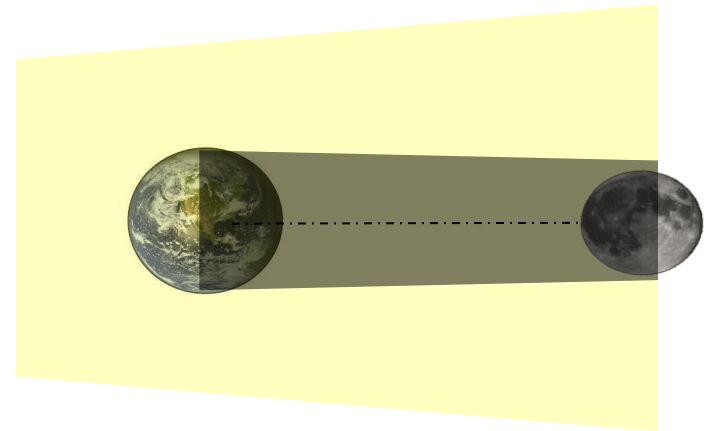
- A. Lunar Eclipse
- B. Solar Eclipse
- C. Neither

Solution

Answer: A

Justification: In this case, the Moon has moved into the shadow of the Earth, causing the Moon to be obstructed from our view.

The name of an eclipse is given by the name of the of the object that is blocked from our view, in this case the Moon. Therefore, the scenario in question describes a lunar eclipse.



Extend Your Learning: Video

Title: Solar Eclipse



Extend Your Learning: Video

Title: Lunar Eclipse



Extend Your Learning: Video

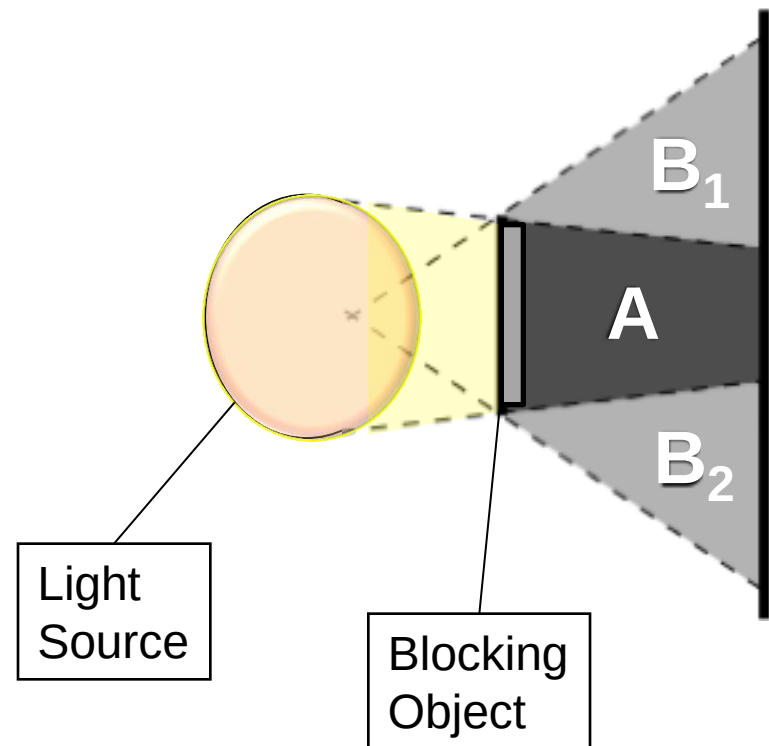
Title: Turning the Moon Red - NASA



Eclipses VI

Given that in Latin the word umbra means “shadow” and paene means “almost, nearly”, correctly identify the umbra and the penumbra on the diagram below.

- A. Umbra = B_2 Penumbra = B_1
- B. Umbra = B_1, B_2 , Penumbra = A
- C. Umbra = A, Penumbra = $B_1 B_2$
- D. Umbra = B_1 , Penumbra = B_2



Solution

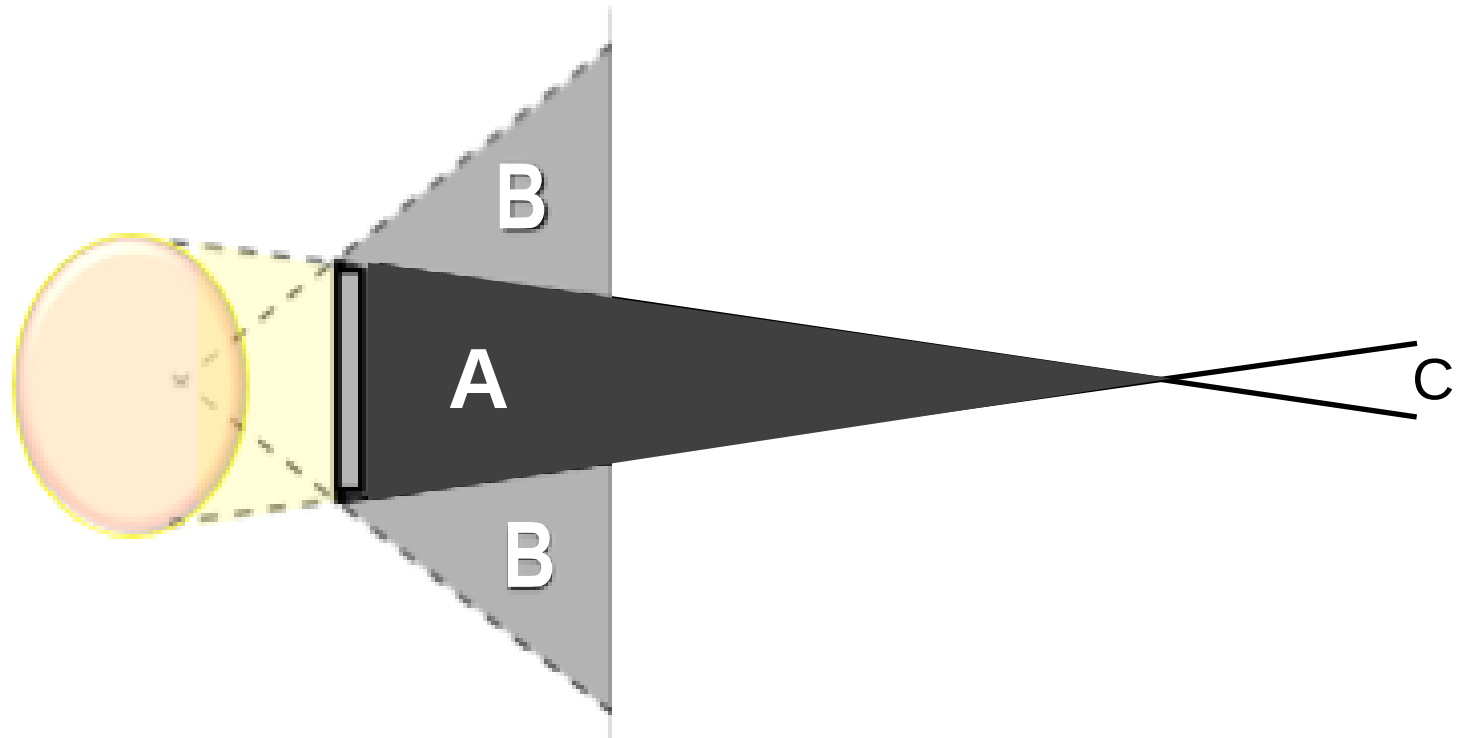
Answer: C

Justification: The umbra refers to the “shadow” or an area where no light from the source exists. In the diagram area A refers to the Umbra.

The penumbra refers to the “almost shadow”, or an area where not all of the light from the source is blocked. In the diagram areas B_1 and B_2 are the Penumbra.

Eclipses VII

How would an observer see the light source if they were located at point C?

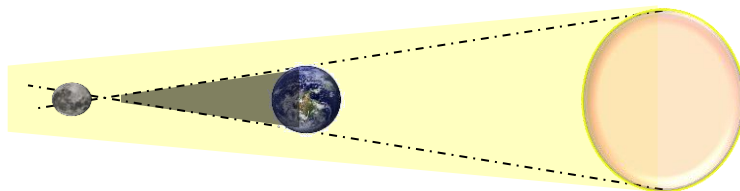


- A.
- B.
- C.
- D.

Solution

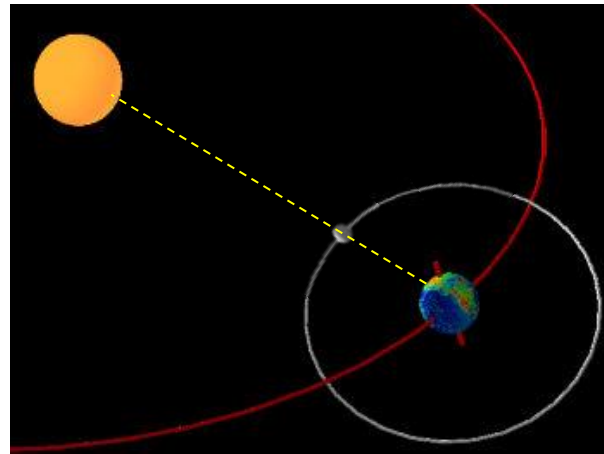
Answer: A

Justification: The observer at point C is not within the shadow of the object, however the object does block a large portion of the light emitted from the source, from reaching the observer. All of the light from the interior of the circle is blocked but the outside edges will still appear, this sort of eclipse is called an annular eclipse.



Eclipses VIII (Difficult)

Which of the following changes could increase the frequency of “total solar eclipses”?

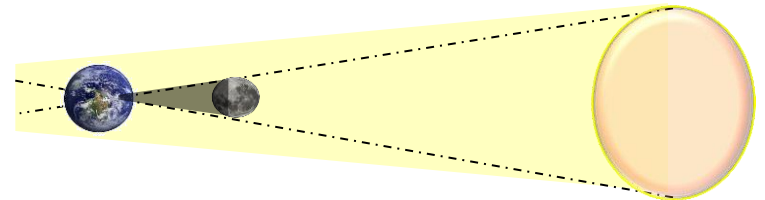
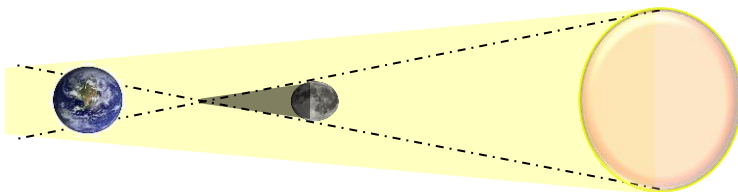


- A. Increase the angle of inclination between the ecliptic plane and the Moon's orbit
- B. Decrease the radius of the Moon's orbit
- C. Increase the size of the Sun
- D. Decrease the size of the Earth

Solution

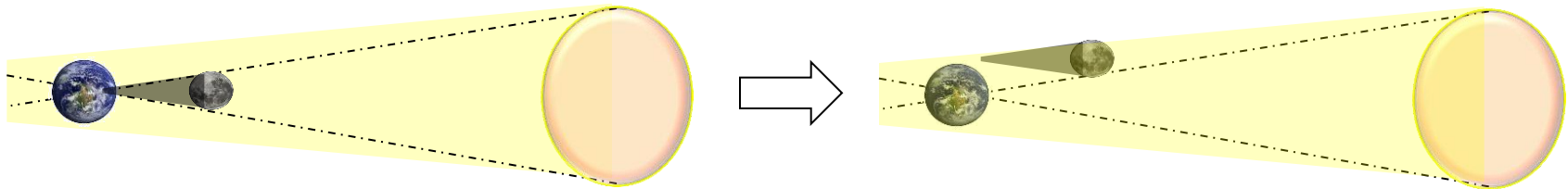
Answer: B

Justification: In order for you to experience a total solar eclipse, the place where you are located on the Earth's surface must be entirely in the shadow of the Moon. By decreasing the radius of the Moon's orbit we are increasing the size of the shadow of the Moon, available to the Earth. This increases the chances that the Moon's shadow will lie fully on the surface of the Earth.

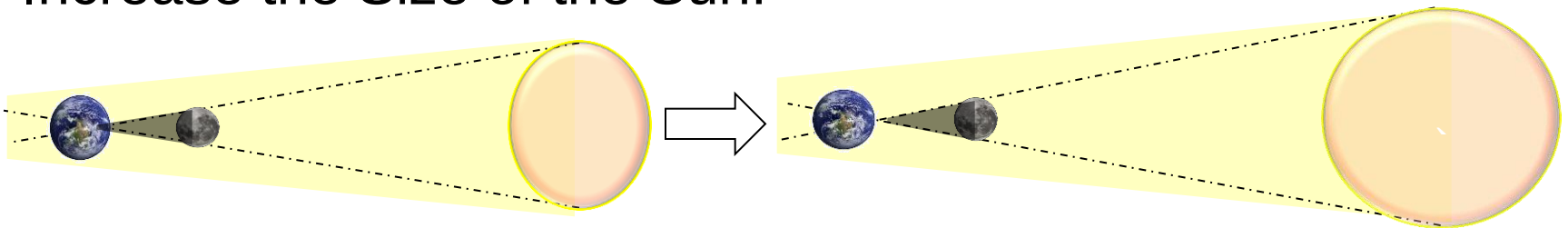


Solution

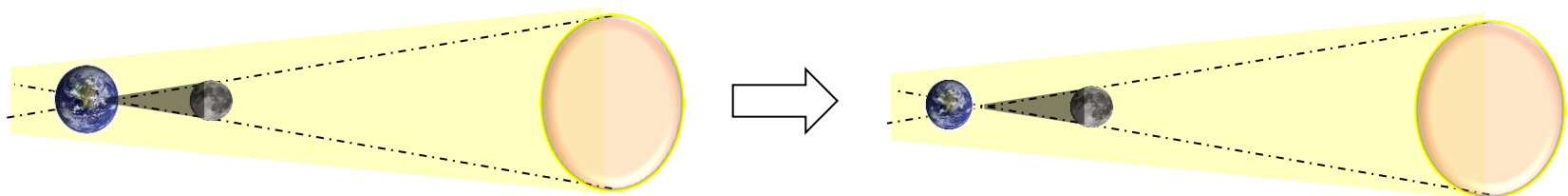
Increase the angle of inclination:



Increase the Size of the Sun:

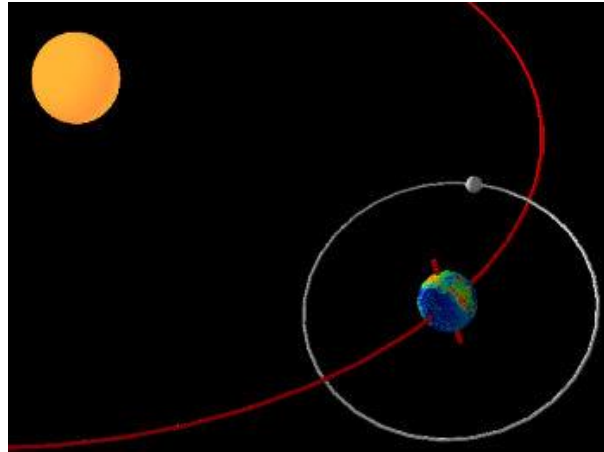


Decrease the Size of the Earth:



Eclipses IX (Difficult)

Which of the following changes could decrease the frequency of “total lunar eclipses”?

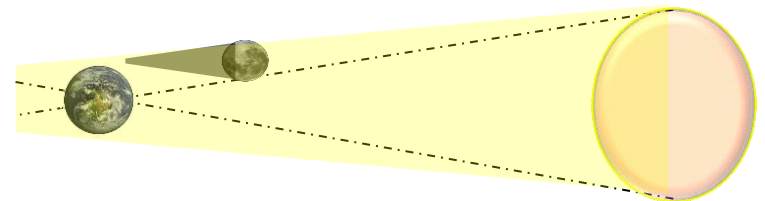
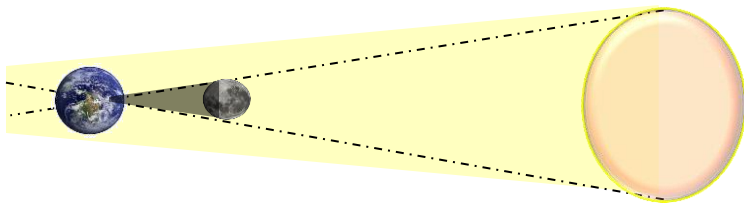


- A. Increase the angle of inclination between the ecliptic plane and the Moon's orbit
- B. Decrease the radius of the Moon's Orbit
- C. Decrease the size of the Sun
- D. Increase tilt of the Earth's axis

Solution

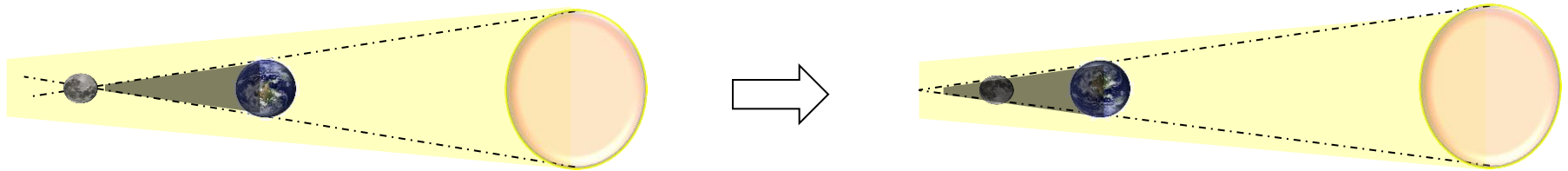
Answer: A

Justification: In order for you to experience a total lunar eclipse, the Moon must be positioned inside the shadow of the Earth. By increasing the angle of inclination between the ecliptic plane and the lunar orbit we decrease the amount of time the Moon spends in line with the ecliptic plane. This decreases the chances of a lunar eclipse occurring.

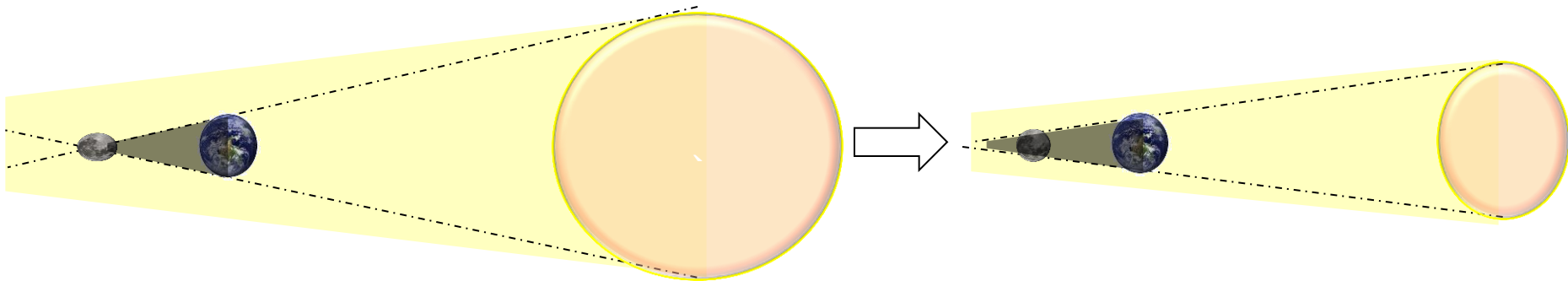


Solution

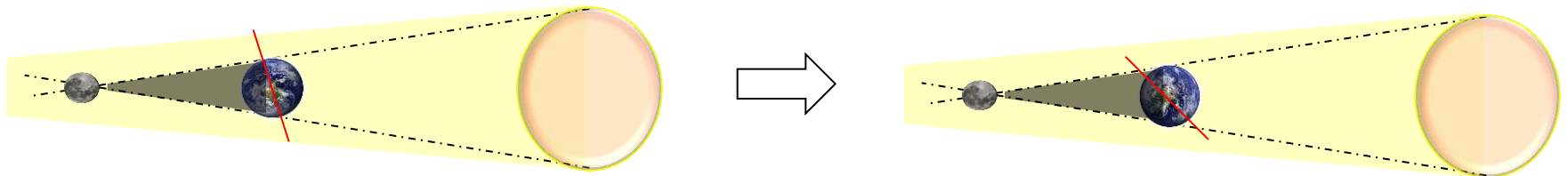
Decrease the Radius of the Moon's orbit:



Decrease the Size of the Sun:



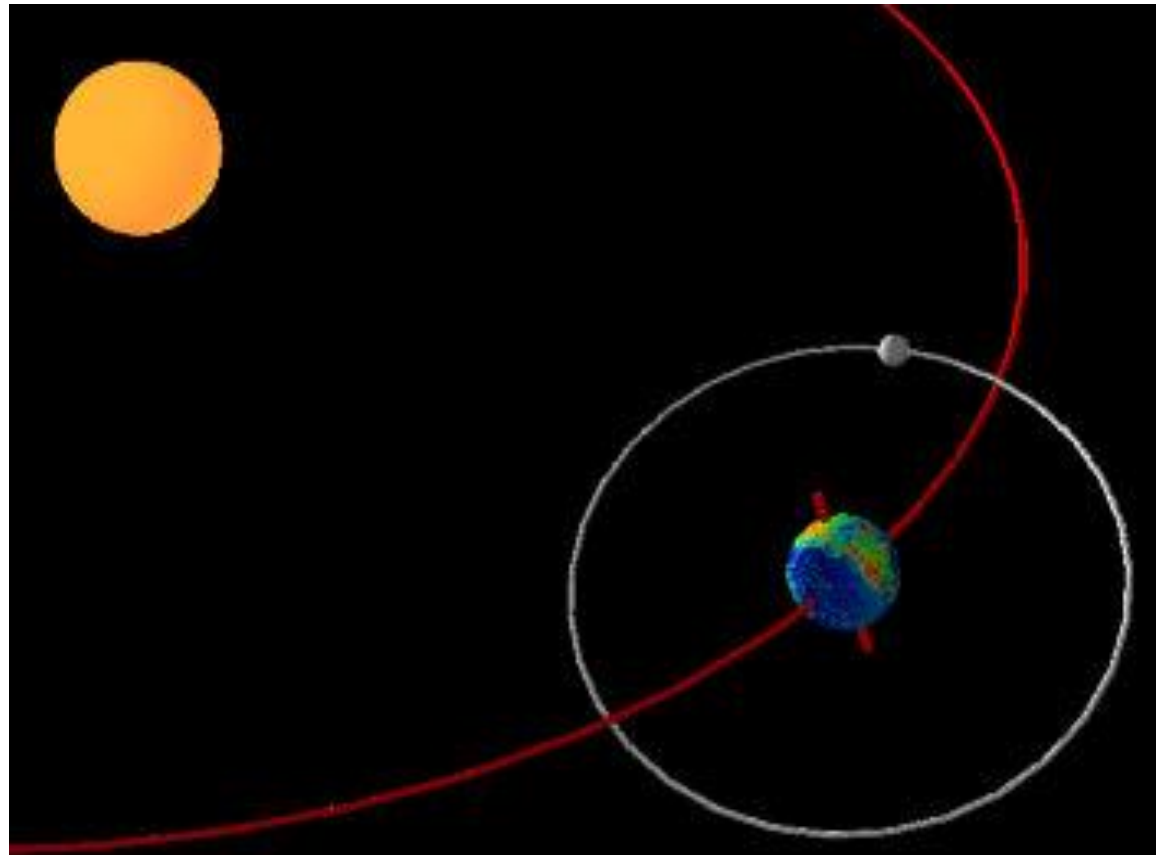
Increase tilt of the Earth's axis



Eclipses IX

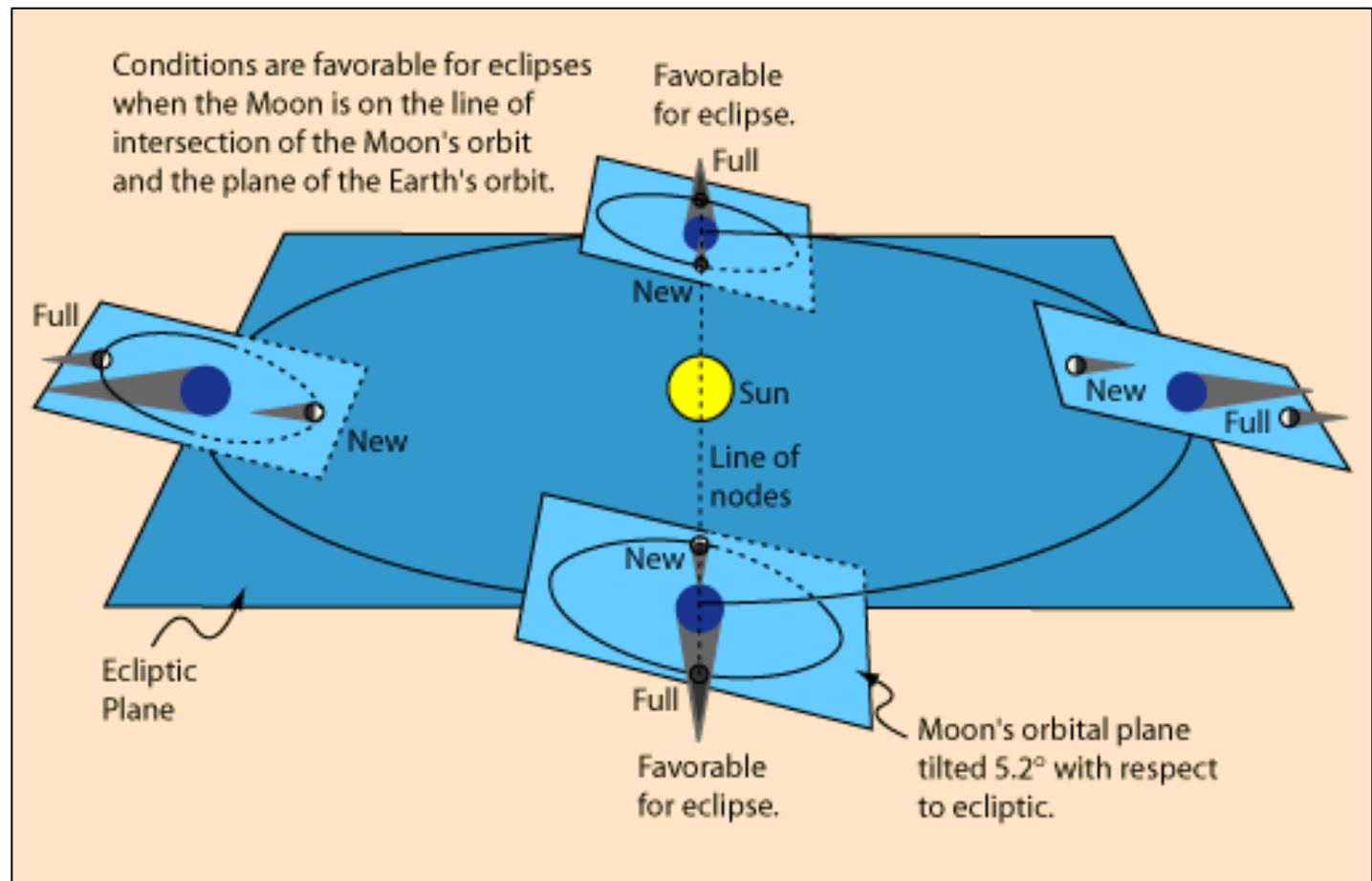
Given that for an eclipse to occur, the Moon must be in line with the ecliptic, approximately how many eclipses happen per year?

- A. 1
- B. 2
- C. 4
- D. Less than one



Solution

Take a moment to explore this diagram before reading further for the explanation.

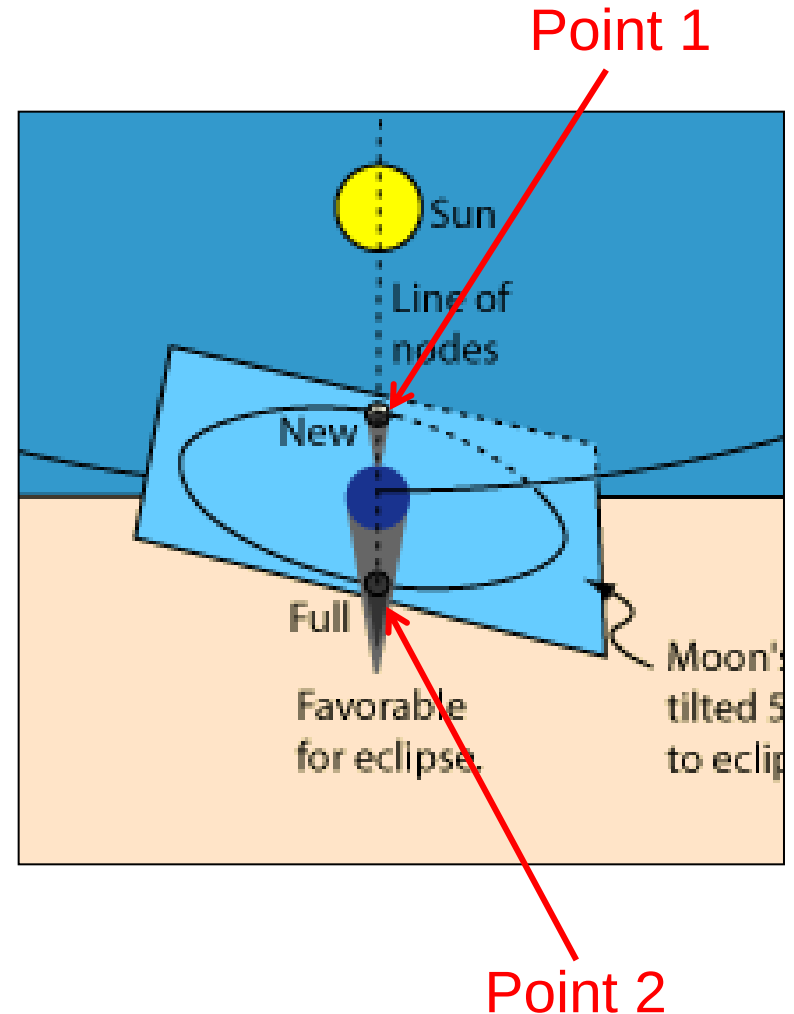


Solution

Answer: C

Justification: The Sun and the Earth are in the same plane (the ecliptic plane). Because the Moon orbits around the Earth, its trajectory will intersect the ecliptic in two places.

When the points of intersection are such that Earth Moon and Sun can be connected with a straight line, an eclipse can occur.



Solution

The Moon orbits around the Earth, and the Earth orbits around the Sun, so the Moon's orbit is also in orbit about the sun. This means the points where the Moon's orbit intersects the ecliptic plane in the correct way for the eclipses to occur happens twice every Earth year.

How many eclipses occur during each year?

Each opportunity for eclipse results in one lunar and one solar eclipse. Because a year is much longer than a month, the Moon has time to complete the Earth while in the zone favourable for eclipses, resulting in four eclipses per year.

