

## Chapter Twenty: The Sun-Earth-Moon System

### Lesson 3: Eclipses and Tides

A shadow results when one object blocks the light that another object emits or reflects.

**Umbra:** the central, darker part of a shadow where light is totally blocked

- If you stand here, you see no light

**Penumbra:** the lighter part of a shadow where light is partially blocked

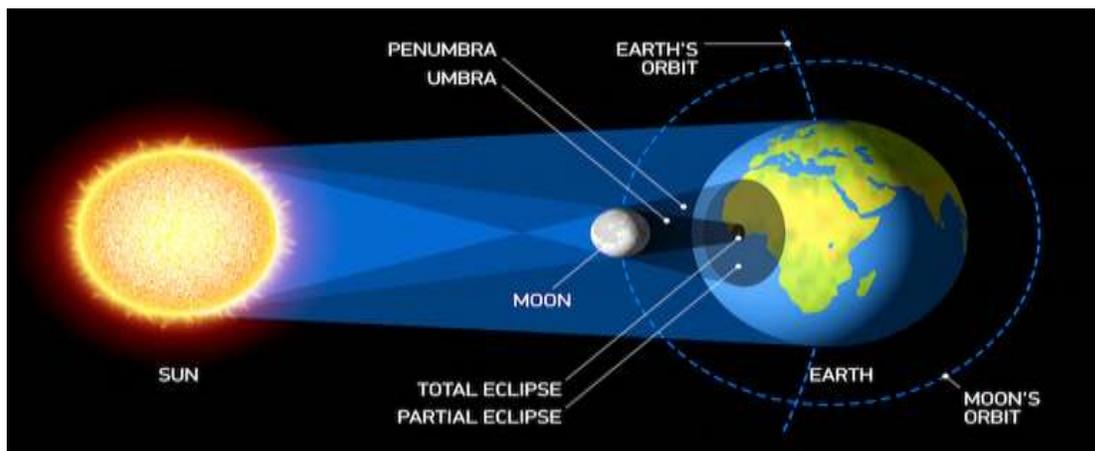
- If you are standing here, you would see part of the light

As the Sun shines on the Moon, the Moon casts a shadow that extends out into space.

- Sometimes the Moon passes between the Earth and its shadow is cast onto Earth.
- This occurs during the new moon phase – during the day
- **Solar eclipse:** when the Moon's shadow appears on Earth's surface
  - Total solar eclipse – this occurs when you are in the Moon's umbra
  - Sky becomes dark enough that you could see the stars.
  - Lasts about 7 minutes
- If you are outside the penumbra, you will not see the eclipse at all.

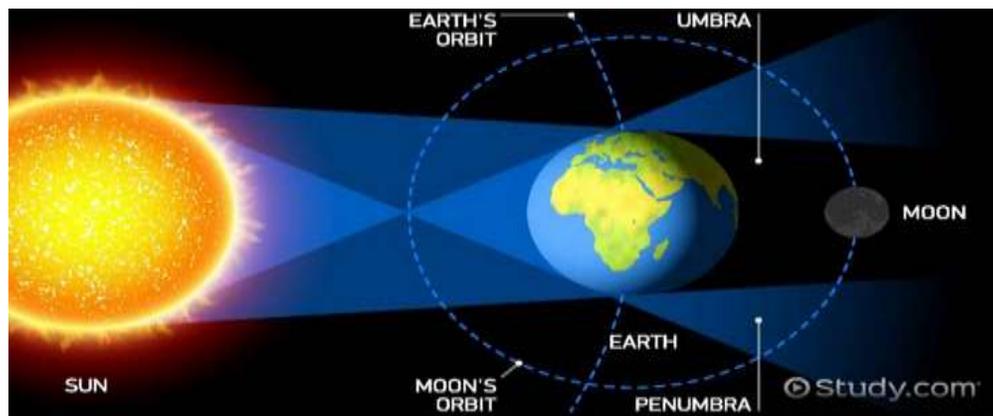
Solar eclipses only occur during a new moon but don't occur every new moon because the Moon's orbit is tilted slightly compared to Earth's orbit.

- Everything has to be lined up (Moon-Earth-Sun) to see the shadow.



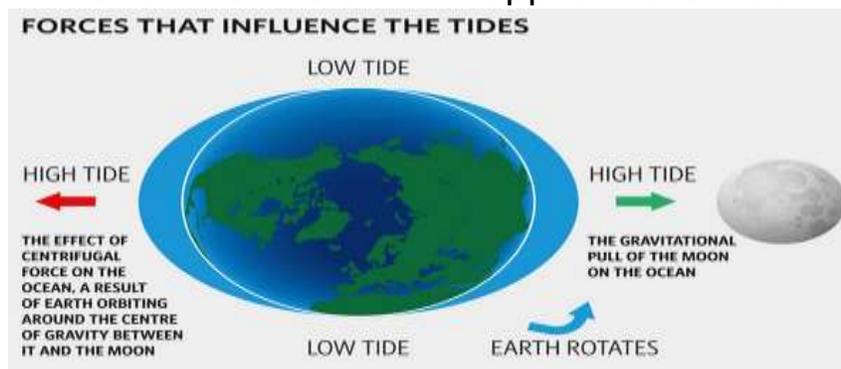
Earth also casts a shadow out into space. If the Moon crosses that shadow, a lunar eclipse occurs.

- **Lunar eclipse:** occurs when the Moon moves into Earth's shadow
  - Can occur only during the full moon phase – during the night
  - Total lunar eclipse occurs when the Moon moves through Earth's umbra
    - Although all light is blocked, some of the light is deflected and the Moon appears reddish in color.
  - Partial lunar eclipse occurs when part of the Moon moves through Earth's umbra
  - Lunar eclipses don't occur every full moon because of the tilt of the Moon compared to Earth's tilt.



**Tides:** the daily rise and fall of the sea level

- Primarily the Moon's gravity that causes Earth's ocean to rise and fall twice each day.
- The Moon's gravity is slightly stronger on the side of Earth closer to the Moon and weaker on the side of Earth opposite the Moon



Spring tides – produce higher high tides and lower low tides

Neap tides – produce lower high tides and higher low tides