ASTR 105
Intro Astronomy:
The Solar System
Video taken from the University of Colorado at Boulder (by Prof. Phil Armitage)

https://www.youtube.com/watch?v=wz01pTvuMa0&spfreload=10
Which direction was Prof. Armitage facing when taking the video?

• A) North
• B) East
• C) West
• D) South
• E) Impossible to tell
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- A) North
- B) East
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Next: The Moon, Our Constant Companion

Learning Goals:

• Why do we see phases of the Moon?

• How can we tell time by the phase and position of the moon?
The changing phases of the Moon originally inspired the concept of the *month*.
Watch Movie at:
http://antwrp.gsfc.nasa.gov/apod/image/9911/lunation_ajc.gif
Phases of the Moon (29 & ½ days)

- **new**
- **waxing crescent**
- **first quarter**
- **waxing gibbous**
- **full**
- **waning gibbous**
- **last quarter**
- **waning crescent**
- **new**

### Waxing
- Gets “fuller” and rises later each day.
- Moon visible in afternoon/evening.

### Waning
- Gets “smaller” and sets later each day.
- Moon visible in late night/morning.
If the Moon was in the new phase today, how many of the Moon phases shown above would the Moon go through during the next 14 days?

A. Only one
B. Two
C. Three
D. More than three
E. None
If the Moon was in the new phase today, how many of the Moon phases shown above would the Moon go through during the next 14 days?

A. Only one
B. Two
C. Three
D. More than three
E. None
Clicker Question

Which ones?

A. (1) and then (2)
B. (2) and then (1)
C. (4) and then (3)
D. (2) and then (4)
E. (3) and then (5)
Clicker Question

Which ones?

A. (1) and then (2)
B. (2) and then (1)
C. (4) and then (3)
D. (2) and then (4)
E. (3) and then (5)
What is that causes the phases of the Moon?

- A) The Earth’s shadow falling on the Moon
- B) We see different portions of the day and night sides of the Moon as it orbits around the Earth
- C) The rotation of the Earth around the Sun
- D) The rotation of the Moon around its axis
Let’s understand the REAL reason for the phases of the Moon
Although the Moon is **always** ½ lit by the Sun, we see different amounts of the lit portion from Earth depending on where the Moon is located in its orbit.
Phases of Moon

- Moon is illuminated (always $\frac{1}{2}$) by Sun.
- We see a changing combination of the bright and dark faces as Moon orbits the Earth.

See this demonstration: https://www.youtube.com/watch?v=MA2LON2QAA4
The Power of Moon Phases

- Time
- Moon Phase
- Moon Position in the sky

If you know any two, you can figure out the third!
Understanding this picture is key to being able to tell time by moon phases.
At what time does a first quarter Moon is at the highest?

A. 6am
B. Noon
C. 3pm
D. 6pm
E. 9pm
At what time does a first quarter Moon is at the highest?

A. 6am
B. Noon
C. 3pm
D. 6pm
E. 9pm
What time does a first quarter Moon rise?

A. 6am  
B. Noon  
C. 3pm  
D. 6pm  
E. 9pm
What time does a first quarter Moon rise?

A. 6am
B. Noon
A. 3pm
B. 6pm
C. 9pm
Why do we see always the same face of the Moon?
Synchronous rotation

Spin period of Moon = Orbital period around Earth

Not a coincidence.....
The gravitational force from Earth is to blame....

Useful clip to visualize:
https://www.youtube.com/watch?v=OZIB_leg75Q
Solar and Lunar eclipses

Eclipses are created when the Sun, Earth and Moon fall into a straight line, hence casting shadows.

Two types:

- **Lunar eclipse**: Earth’s shadow falls on Moon
- **Solar eclipse**: Moon’s shadow falls on Earth
Lunar Eclipse

The Earth lies directly between the Sun and the Moon
What must be the phase of the Moon for a total lunar eclipse?

A. New Moon
B. First Quarter
C. Waning Gibbous
D. Full Moon
E. Waxing Crescent
What must be the phase of the Moon for a total lunar eclipse?

A. New Moon
B. First Quarter
C. Waning Gibbous
D. Full Moon
E. Waxing Crescent
Total Lunar Eclipse
The Moon lies directly between the Sun and the Earth.
What must be the phase of the Moon for a total Solar eclipse?

A. New Moon
B. First Quarter
C. Waning Gibbous
D. Full Moon
E. Waxing Crescent
What must be the phase of the Moon for a total Solar eclipse?

A. New Moon
B. First Quarter
C. Waning Gibbous
D. Full Moon
E. Waxing Crescent
Total Solar eclipse
Why don’t we see an eclipse every month?

The orbit of the Moon is misaligned by 5 deg with respect to the ecliptic. It crosses the ecliptic at the nodes.

Eclipses can only occur at the nodes, with the Moon either in a full Phase (lunar eclipse) or in a new phase (solar eclipse).