Birth of Modern Astronomy

Sidereal year vs. tropical year

- Sidereal year- 365.256363004 days. Astronomical significance, used in Astronomy.
- Tropical, or solar, year- 365.242190402 days. Correlates with seasons, most noticeable to us on Earth, used for everything else.
- 365.242190402 days is the magic number.

Calendars — Lunisolar calendar

- Developed independently by the Mesopotamia, Indian subcontinent, China, Americas, to name a few (360° in a circle).
- The solar year was roughly 12 lunar cycles.
- 12 lunar cycles x 29.5306 days per lunar cycle = 354.3672 days in a lunar year.
- Tropical year was 365.242190402 days long.
- Years are off by 10.875 days, or 0.36826 lunar cycle.
- Add 7 “leap months” every 19 lunar years.
- 12 +7/19 lunar months = 365.246894 days, close!
    - 1 less day every 212 lunisolar years.

Calendars — Julian calendar

- Old Roman Calendar divided 355 days into 12 months with a 22–23 day leap month (similar to lunisolar calendar with leap months).
- Leap month was not standardized.
  - Corrupt leaders added spurious leap months to extend their rule.
- Revamped by Julius Caeser.
- 365 days split over 12 months.
  - Leap year with extra day every four years.
- 365 +¼ = 365.25 days per Julian year.
- 365.242190402 days in tropical year.
  - 1 less day every 128 years.
- Easier calibration than lunisolar calendar.

Calendars — Gregorian calendar

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

- Very similar to Julian calendar.
- 97 leap years (366 day years) every 400 (365 day) years.
- 1 Gregorian year = 365 +97/400 days = 365.2425 days/ Gregorian years
- 365.242190402 days in tropical year.
- 1 extra day every 3229.995 Gregorian years!
- Standard calendar used by majority of the world.
- Used by the majority of the world, some accepting it as late as 2016.

Astrology vs. Astronomy

- Astronomy developed from the need to develop a calendar.
- Ancient cultures also designated the wandering stars as Gods and attributed certain characteristics to them.

Astrology vs. Astronomy

ASTROLOGY.COM

HOROSCOPES PSYCHICS GAMES TAROT BIRTH CHART SHOP

LEARN | PLANETS | MARS

MARS

Mars: The Planet of Passion

Mars is the action planet of the zodiac. The 'Red Planet,' after all, should be pretty fiery, and Mars does not disappoint. Energy, passion, drive and determination are all right up Mars's alley. This planet commands you (and yes, Mars does rule the military) to stand up, be noticed and get things done — sitting on the sidelines belongs somewhere else in the heavens. Simply put, Mars speaks to the power and confident expression of the individual.

Astrology vs. Astronomy

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

ASTROLOGY.COM

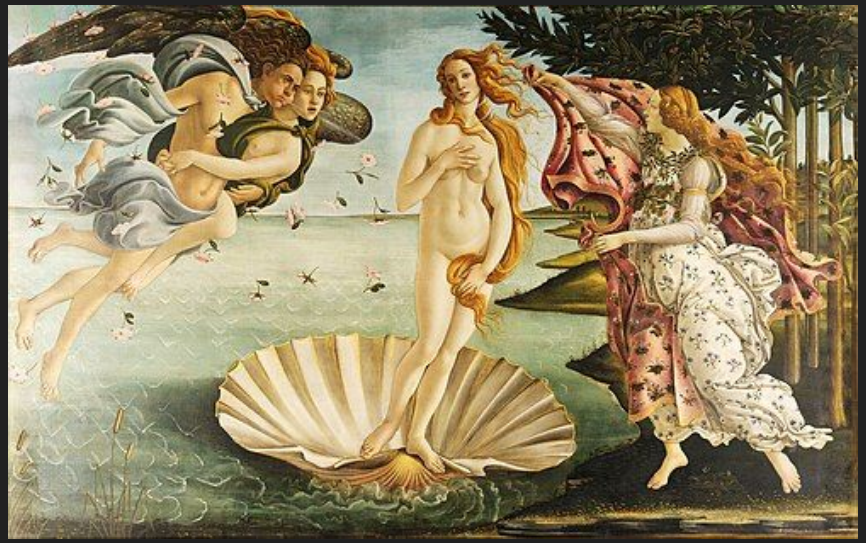
HOROSCOPES PSYCHICS GAMES TAROT BIRTH CHART SHOP

LEARN | PLANETS | VENUS

VENUS

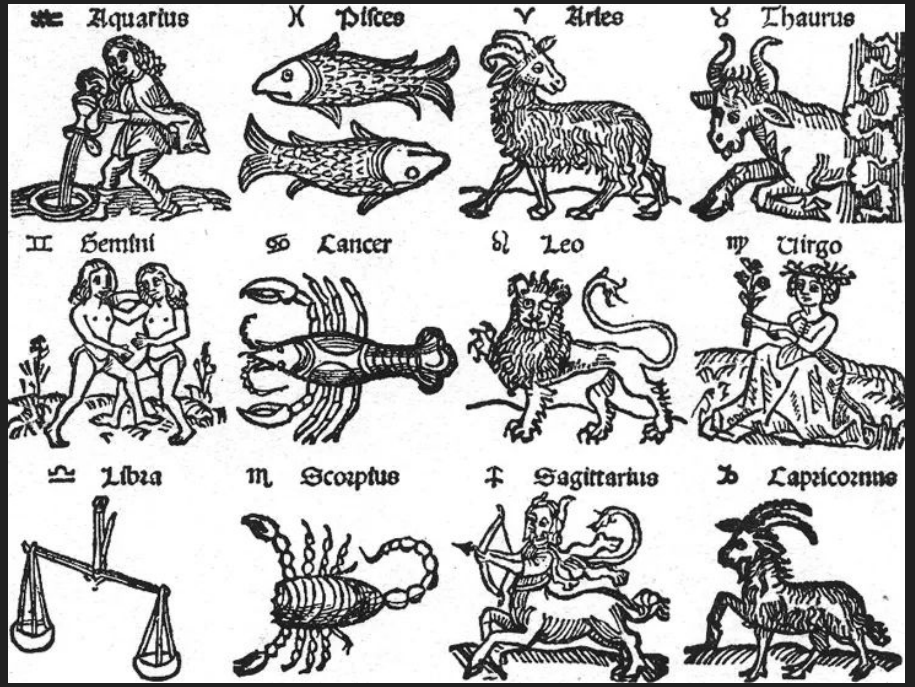
Venus: The Planet of Love and Money

Venus is all about pleasure, especially pleasure shared with someone else. This planet concerns itself with love, romance and harmony in our emotional attachments, marriages, friendships and other unions (like business partnerships). Venus is content to spread happiness and tenderness, all the while teaching us how to love and appreciate others and the things that we possess.



Astrology vs. Astronomy

- Astrology was developed about 2,500 years ago by the Babylonians
- Greeks believed the positions of the planets, Sun, and Moon at birth shaped personalities
- Horoscope, from Greek *hora skopos*, time keeper.
- Split the paths the Sun, Moon, and planets travel in (i.e. the ecliptic) into 12 areas called signs.



Astrology vs. Astronomy

Astrology vs. Astronomy

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

What constellation was the Sun in on your birthday?

These dates are correct for people alive today, but as the Earth wobbles, the dates will continue to change, as they always have.

Constellation	Dates
Aries	April 19 – May 14
Taurus	May 15 – June 20
Gemini	June 21 – July 20
Cancer	July 21 – August 10
Leo	August 11 – September 16
Virgo	September 17 – October 31
Libra	November 1 – November 24
Scorpio*	November 25 – December 17
Sagittarius	December 18 – January 19
Capricorn	January 20 – February 16
Aquarius	February 17 – March 11
Pisces	March 12 – April 18

**Scorpio is combined here with the constellation, Ophiuchus, through which the Sun passes between November 30 and December 17. (It is not part of the Zodiac, however.)*

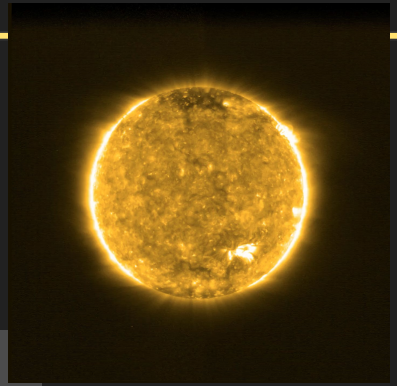
Eratosthenes

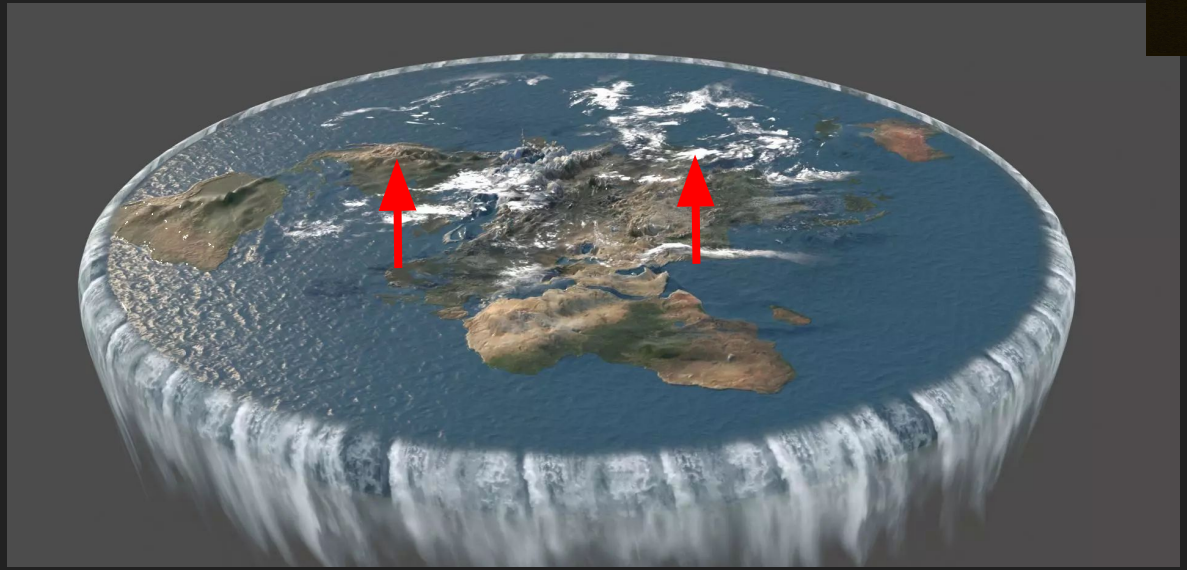
Cosmos video

http://physics.uwyo.edu/~nikhil/Courses/ASTR1050/files/cosmos.mp4

Evidence for the round Earth- shadows

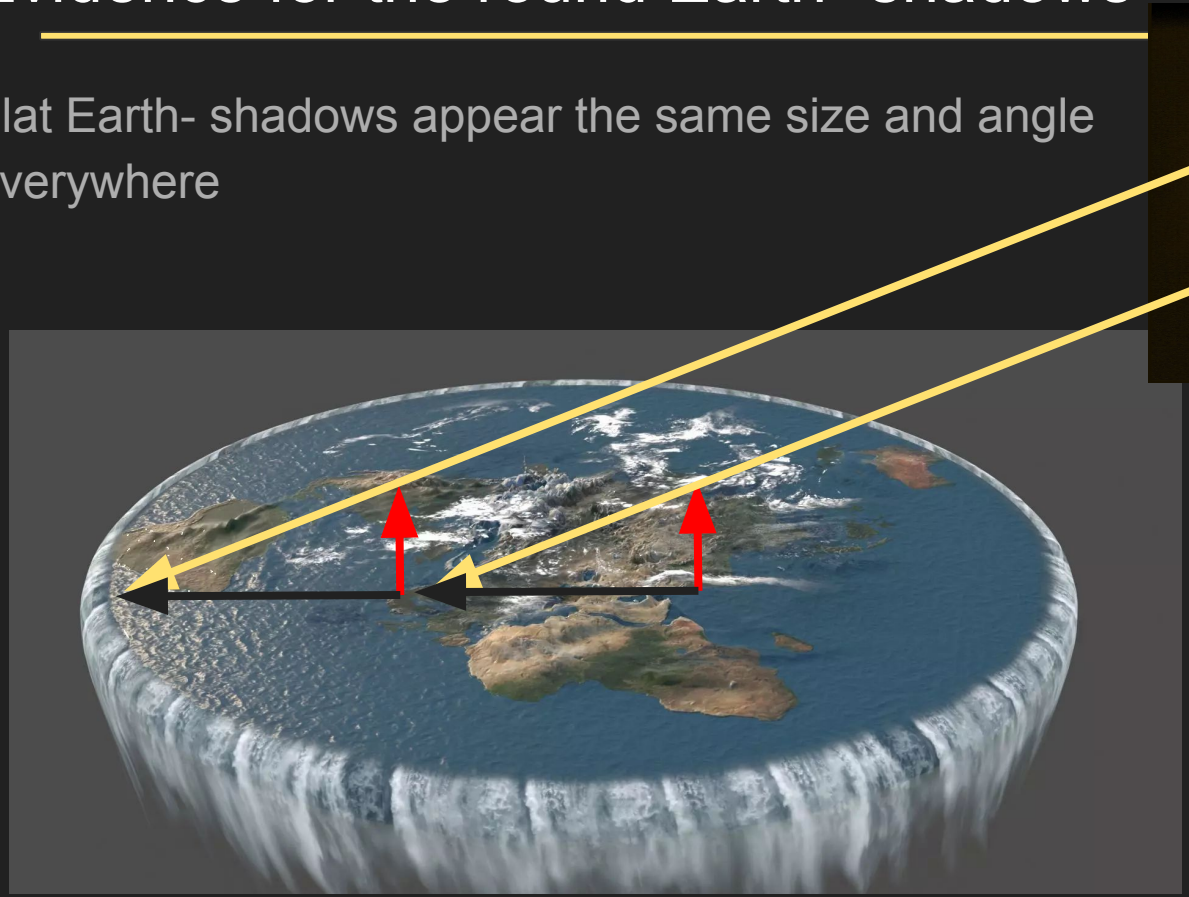
Flat Earth- shadows appear the same size and angle everywhere





Evidence for the round Earth- shadows

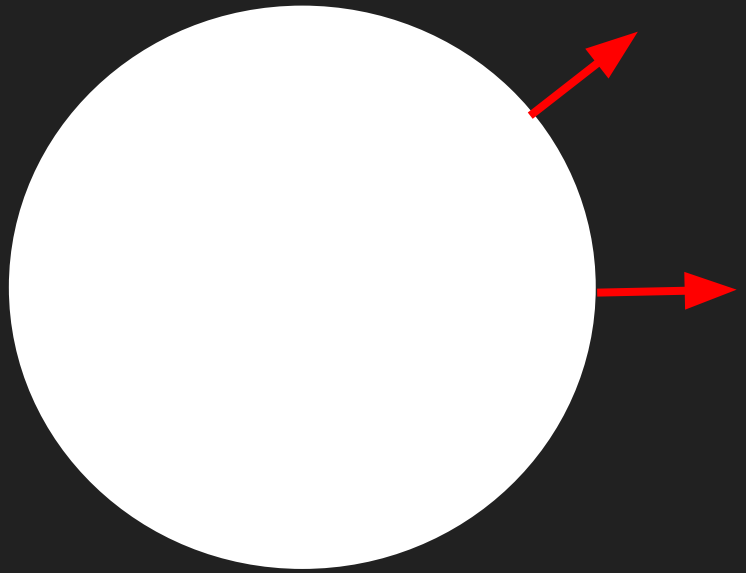
Flat Earth- shadows appear the same size and angle everywhere

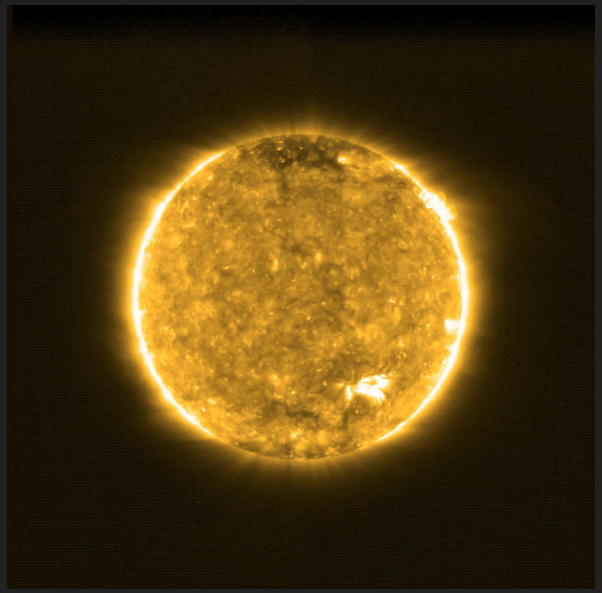


Evidence for the round Earth- shadows

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

Round Earth- shadows appear at different angles at far enough distances

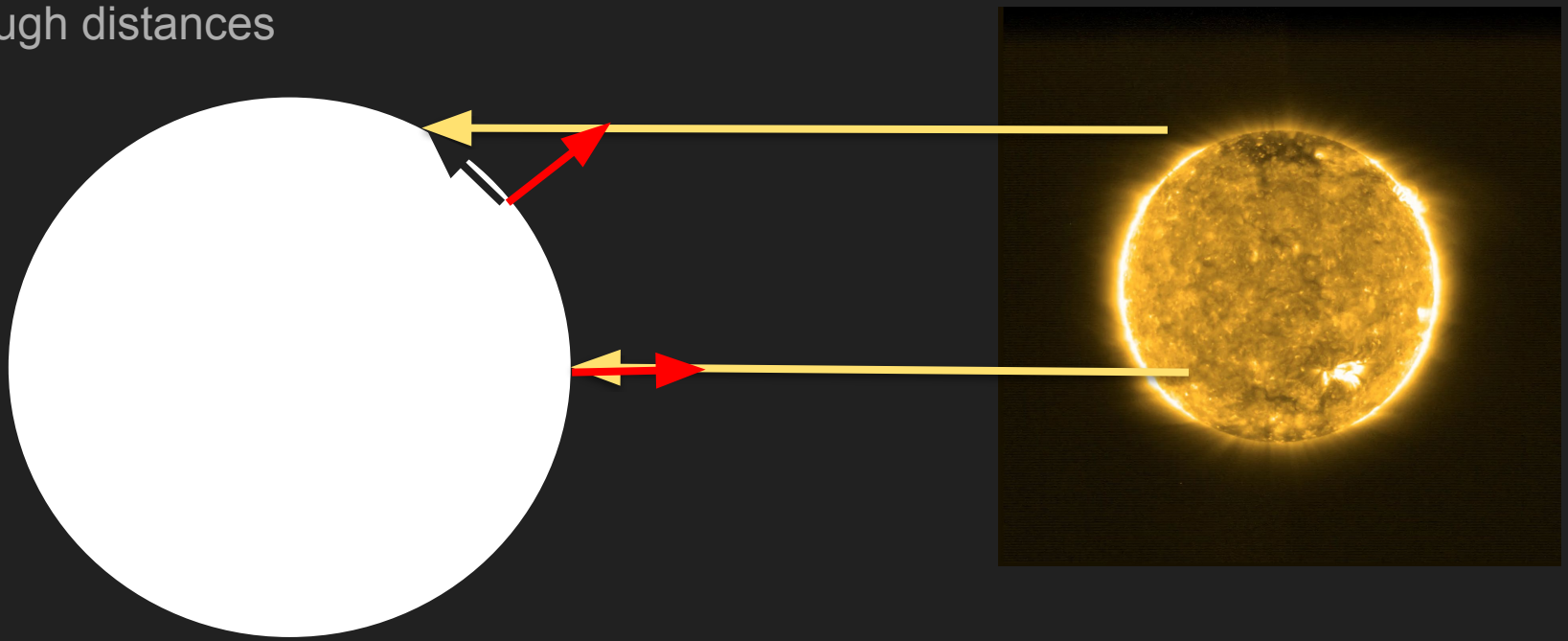




Evidence for the round Earth- shadows

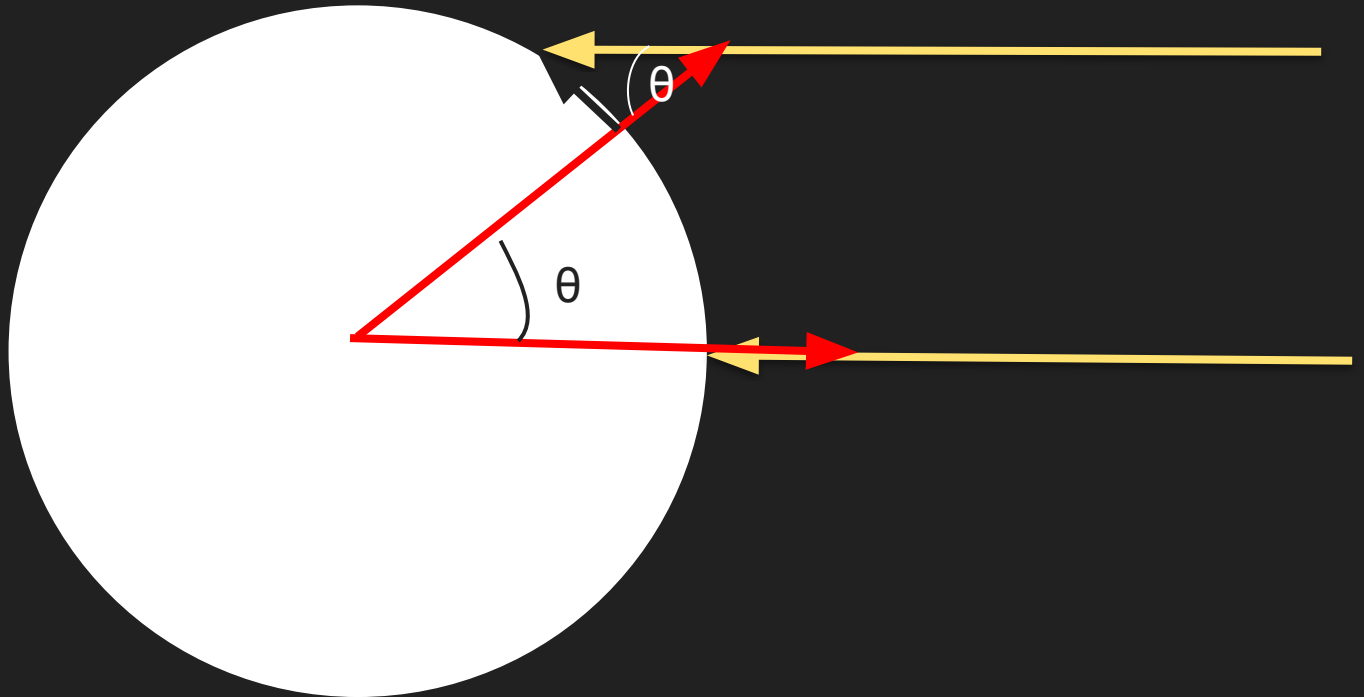
University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

Round Earth- shadows appear at different angles at far enough distances



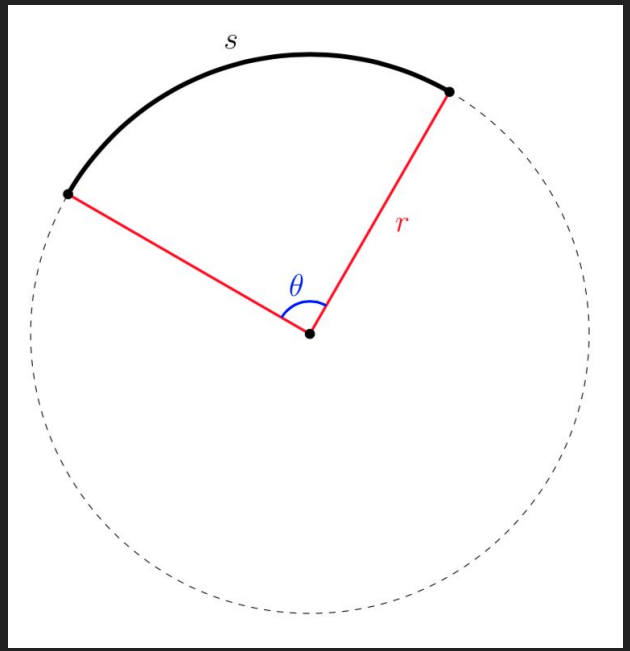
Evidence for the round Earth- shadows

Round Earth- shadows appear at different angles at far enough distances



Geometry review

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy



$$\theta\ (\text{radians}) = \frac{s\ (\text{m})}{r\ (\text{m})}$$

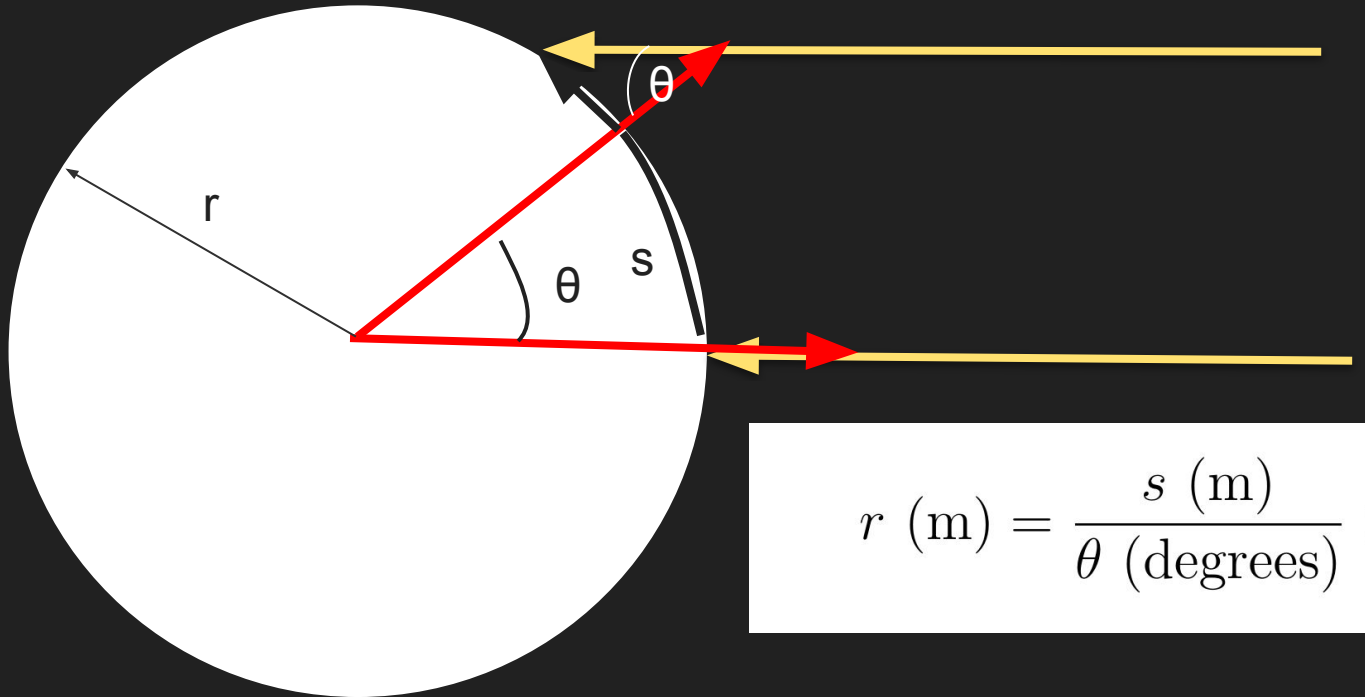
$$s\ (\text{m}) = r\ (\text{m}) \cdot \theta\ (\text{degrees}) \times \frac{\pi}{180}$$

$$r\ (\text{m}) = \frac{s\ (\text{m})}{\theta\ (\text{degrees})} \times \frac{180}{\pi}$$

Evidence for the round Earth- shadows

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

Round Earth- shadows appear at different angles at far enough distances



$$r\ (\mathrm{m}) = \frac{s\ (\mathrm{m})}{\theta\ (\mathrm{degrees})} \times \frac{180}{\pi}$$

Poll everywhere

1. If the distance between Alexandria and Syene is 800 km, and an object at Alexandria casts a 7° shadow at the same time the Sun is directly overhead at Syene, calculate the radius of the Earth Eratosthenes measured.

a. 7,780 km b. 114 km c. 6,550 km d. 9,800 km

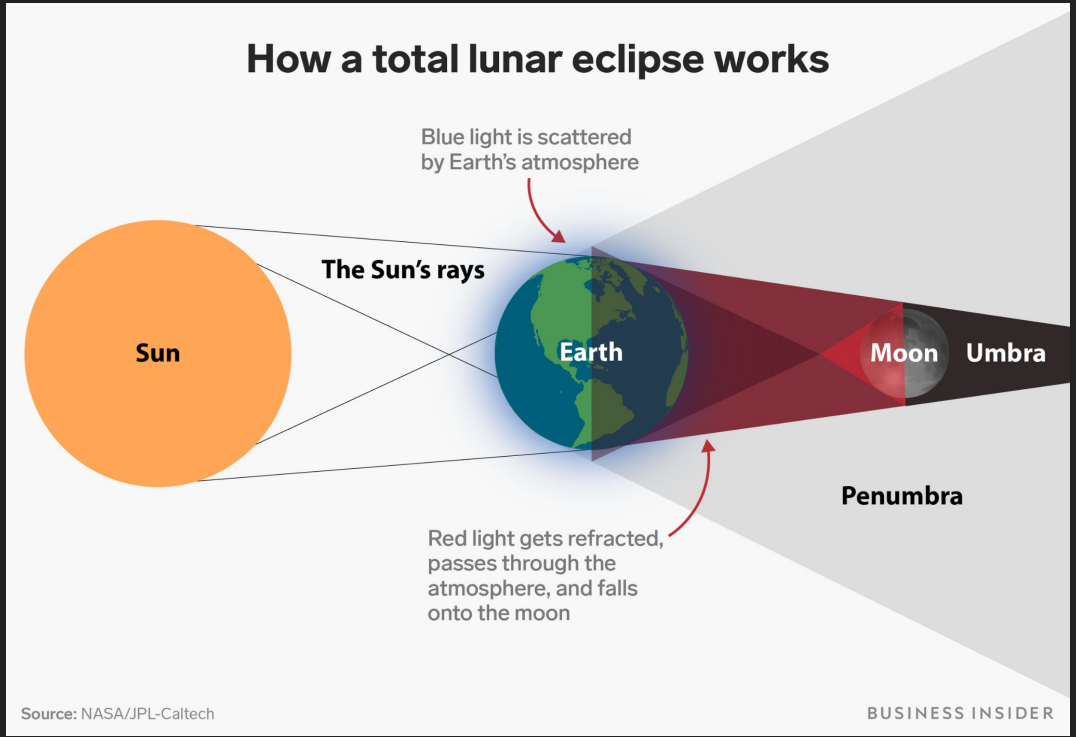
Poll everywhere

Solution on course website and Wyocourses

http://physics.uwyo.edu/~nikhil/Courses/ASTR1050/lecture_notes/week_02/Friday/notes.pdf

Evidence for the round Earth- lunar eclipse

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy



Evidence for the round Earth- lunar eclipse

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

Round Earth- shadow of the Earth is circular, never flat

Galileo Galilei

- Copernican (Heliocentric) and Ptolemaic (Geocentric) models still debated.
  - Insistence to maintain the Geocentric model.
- Studied motion.
- He found that all objects accelerate at the same rate!
  - It was common knowledge at the time that heavier objects fall faster than light objects, despite this contradiction.

Apollo experiment

Do lighter objects, in fact, fall at the same rate as heavier objects?

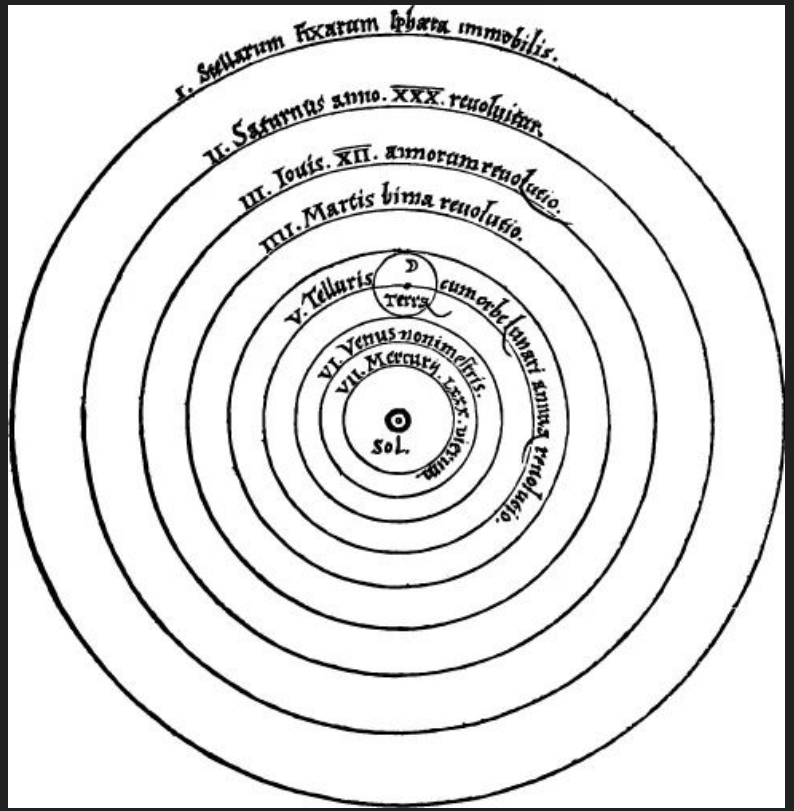
http://physics.uwyo.edu/~nikhil/Courses/ASTR1050/files/apollo.mp4

Galileo Galilei

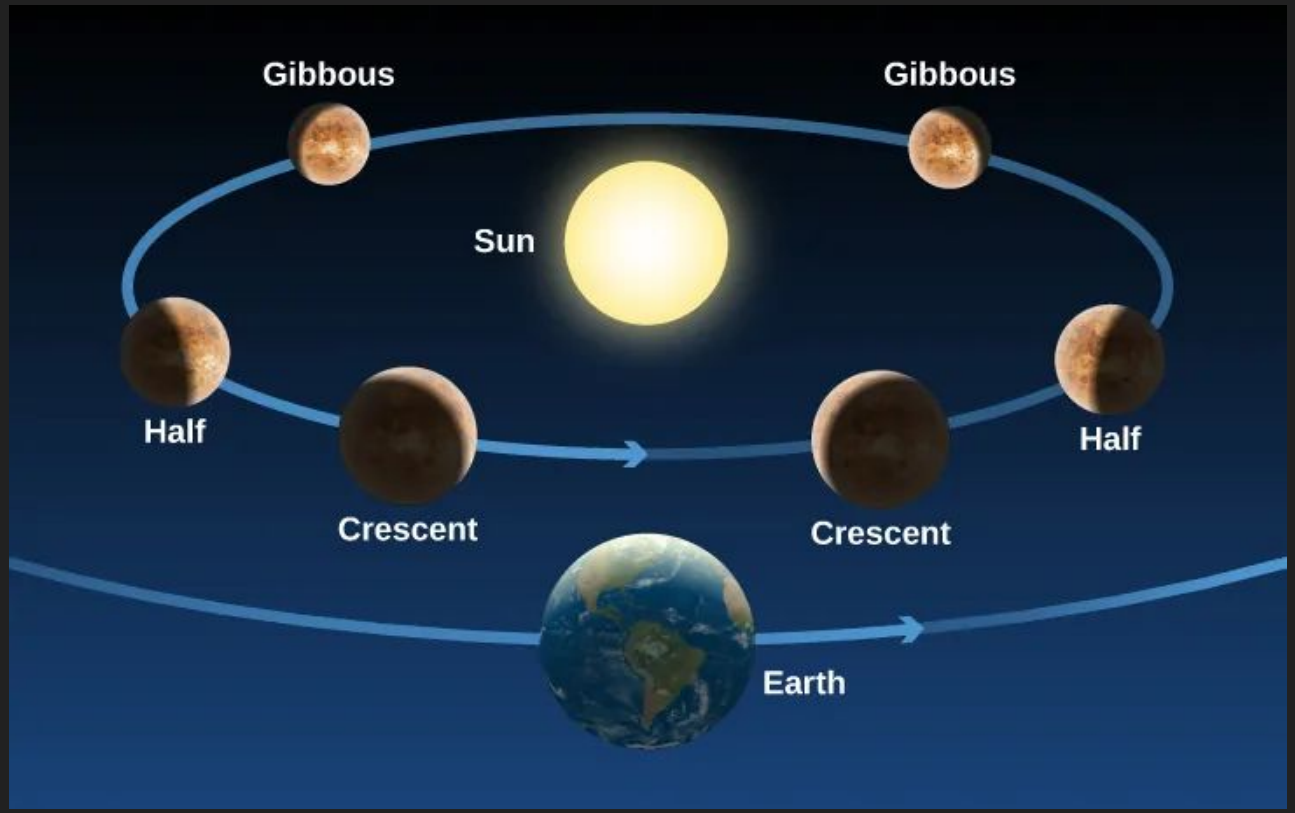
- Galileo is credited as the first to turn the spyglass to the heavens.
- He made observations that could not be explained by the Ptolemaic cosmology.

Galileo’s observations: Phases of Venus

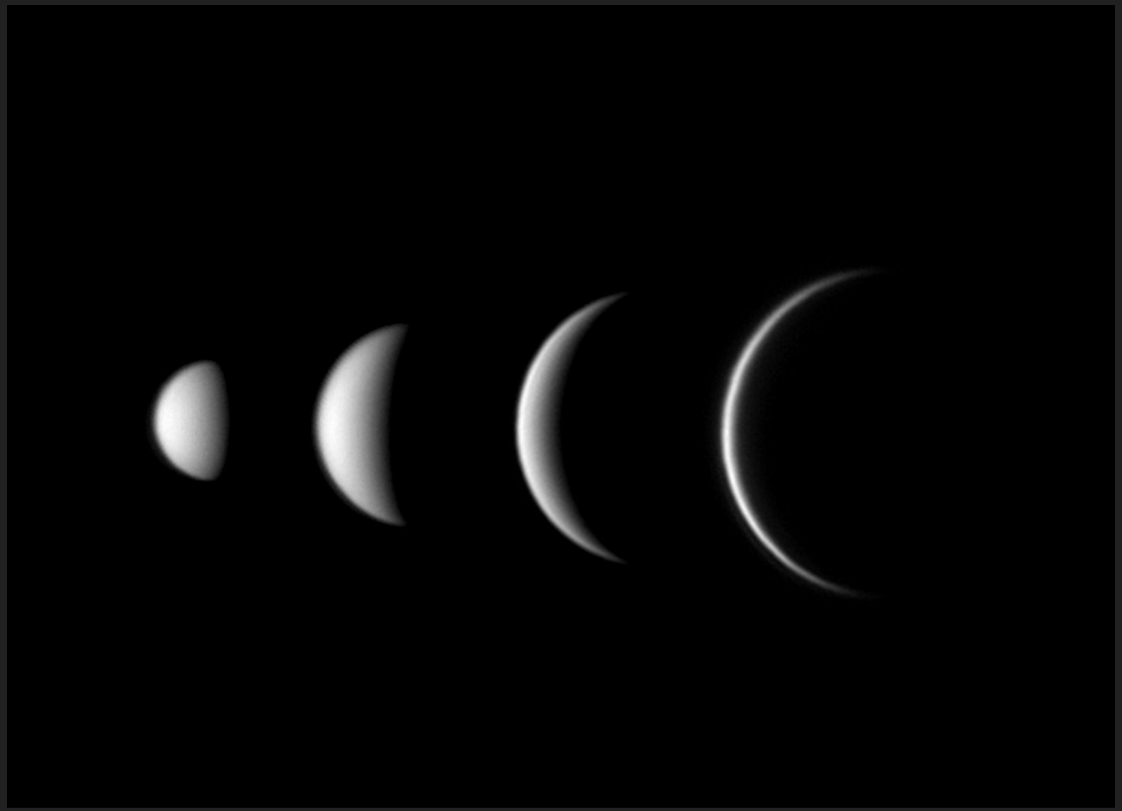
- If the Sun were the center of the universe, than we should observe the inner planets go through phases, like the Moon.
- We can never observe a “full” Venus



Galileo's observations: Phases of Venus



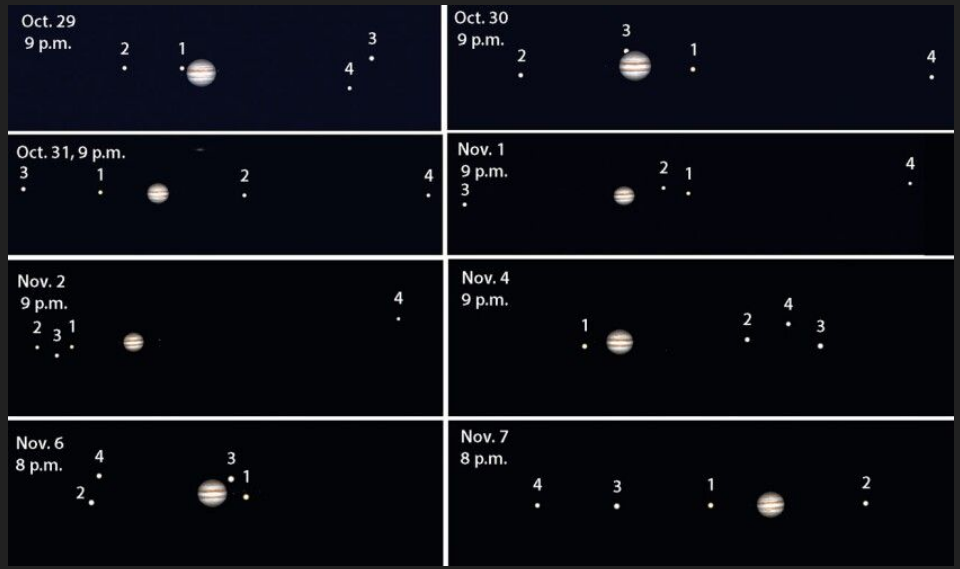
Galileo’s observations: Phases of Venus



Galileo’s observations: moons of Jupiter

University of Wyoming
College of Engineering and Physical Sciences
Physics and Astronomy

- Telescope reveals moons orbiting Jupiter.
- If moons can orbit other bodies, than maybe the Earth is unexceptional.



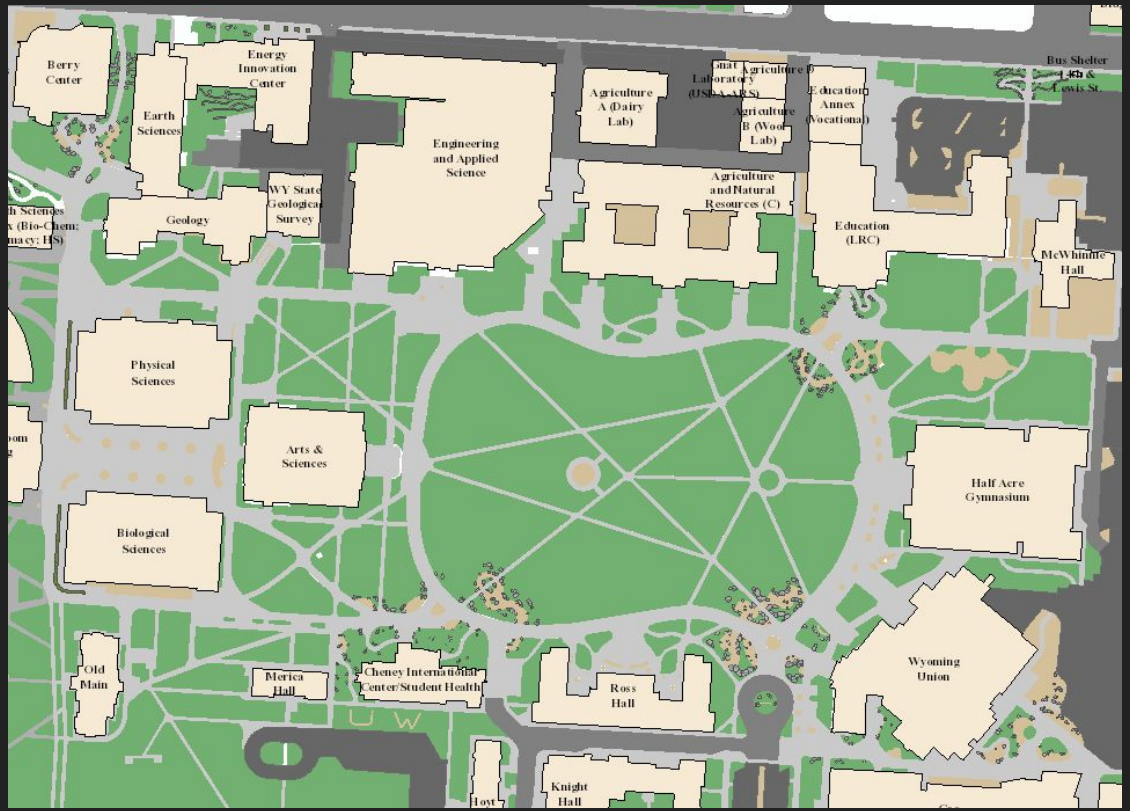
Galileo’s observations: land features on Moon

- Telescope reveals diverse landscape on the Moon.
- The Moon has dark patches, which Galileo referred to as “mare” or oceans.
- If other bodies can have complicated geography like the Earth, than maybe the Earth is unexceptional (again).

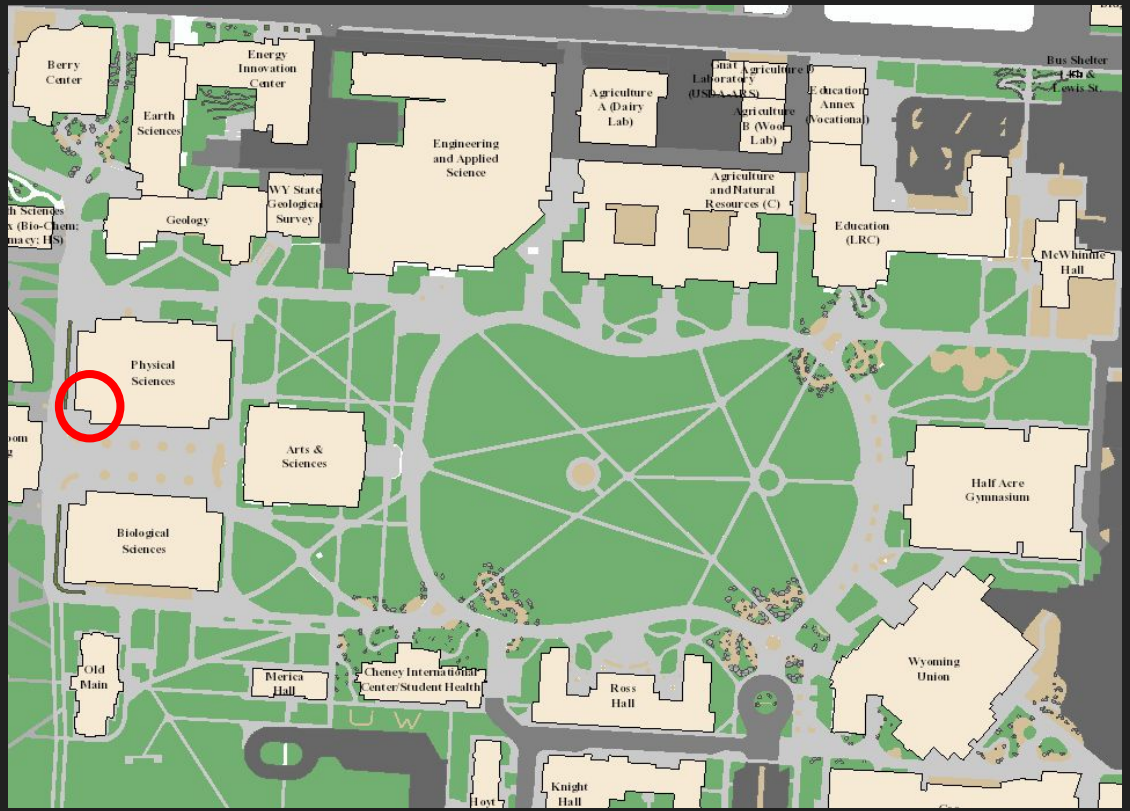
Announcements

- First homework due today.
- First lab next week, meet in planetarium.

Announcements



Announcements



Next time

- The Sky Above