Astro 301/ Fall 2006

(50405)

Introduction to Astronomy

http://www.as.utexas.edu/~sj/a301-fa06

Instructor: Professor Shardha Jogee

TAs: Biqing For, Candace Gray, Irina Marinova

Lecture 8: Tu Sep 26

Announcements (Lec 8)

See current Announcements on class website
http://www.as.utexas.edu/~sj/a301-fa06/

à **Hwk1 and quiz 2**

Recent and upcoming topics in class

--- Explaining Natural Phenomena

- Spin and Orbtital Motion of Earth
  Day/ Night, Length of a year

-- Why do we have seasons?
  Why do they occur in different months in N and S hemisphere?

-- Precession of the Earth's tilted axis.

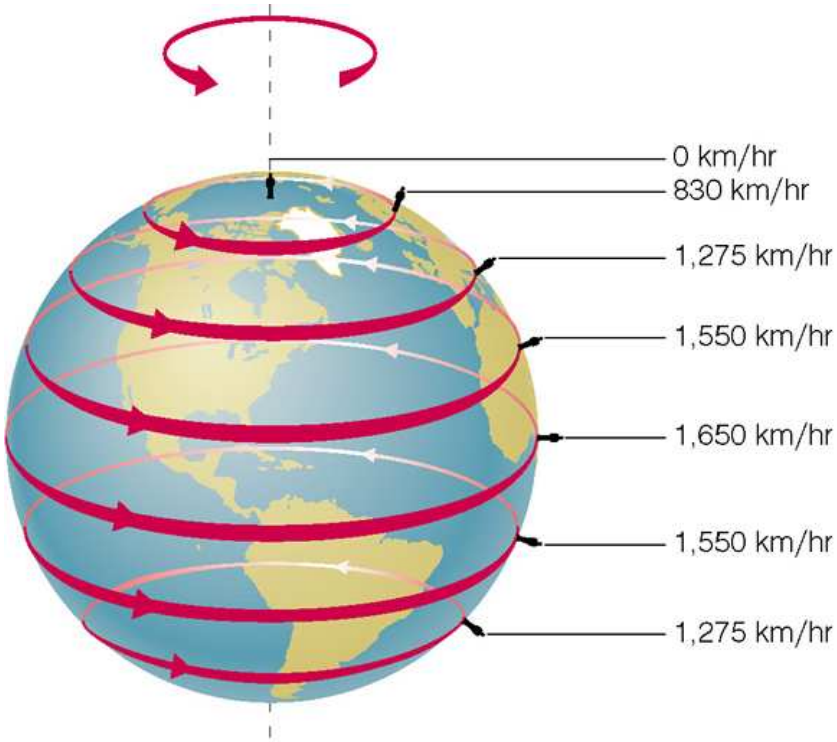
-- Lunar phases

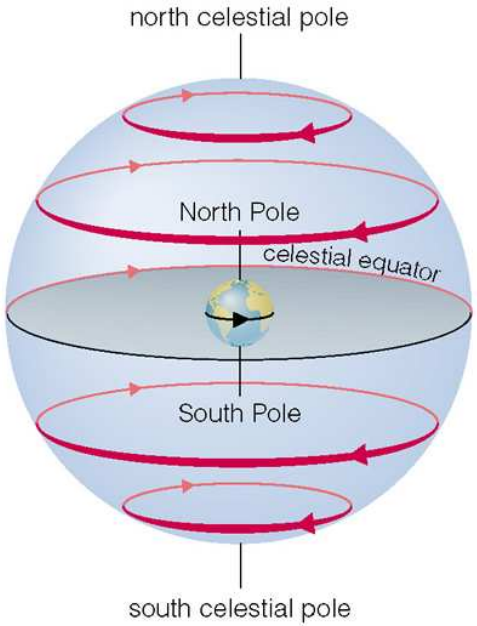
Spin and Orbtital Motion of Earth.

Tilted Axis of Earth

Day/Night, Seasons

Spin of Earth about its axis



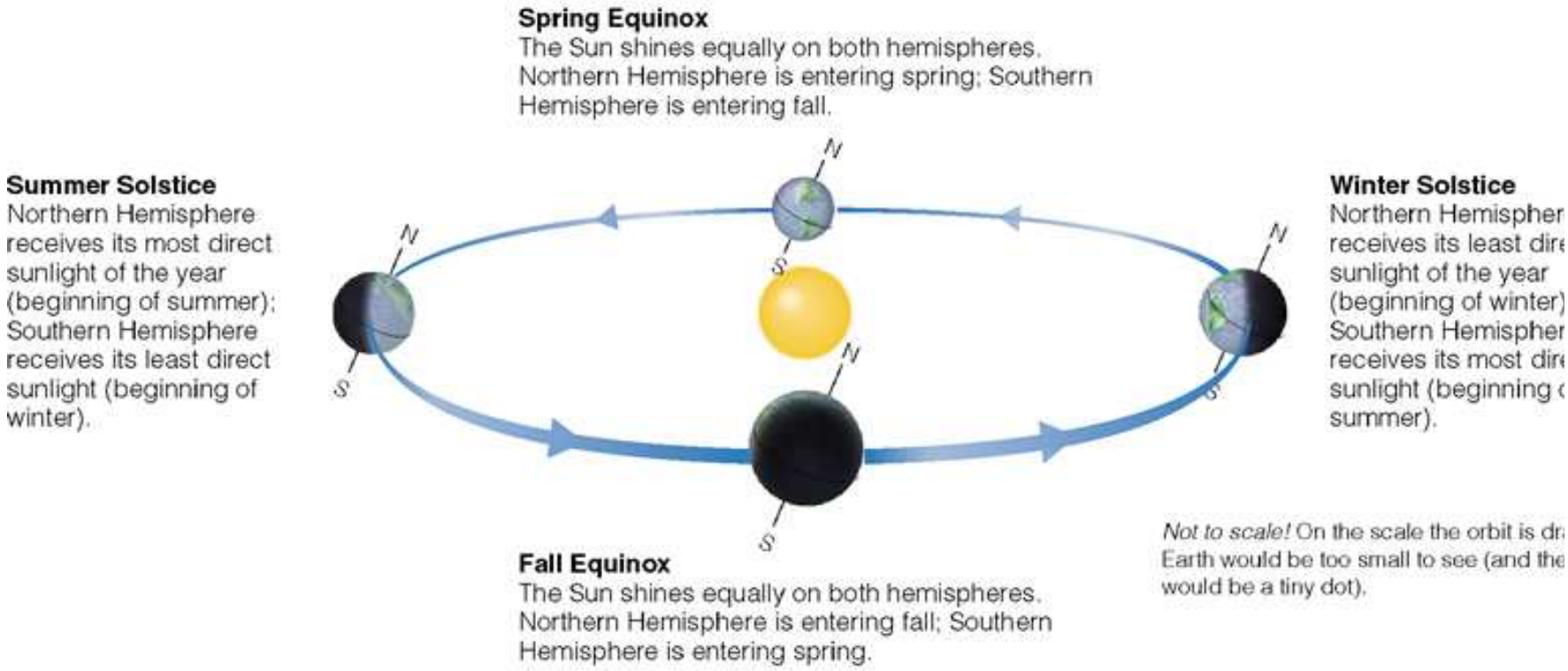


Why the Sun sets
to the West ?

Why do we have seasons (winter, summer) ?

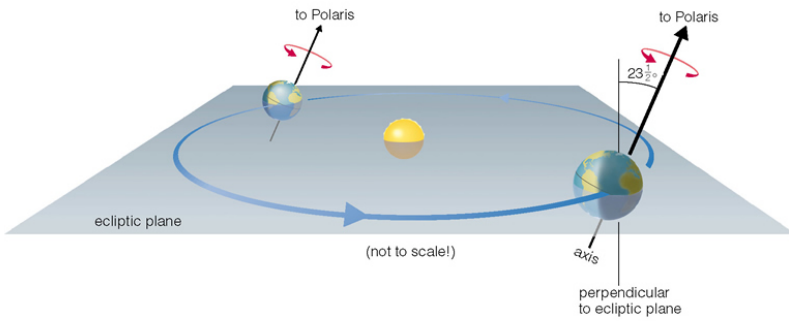
Why do opposite seasons occur in N and S hemisphere at a given time ?

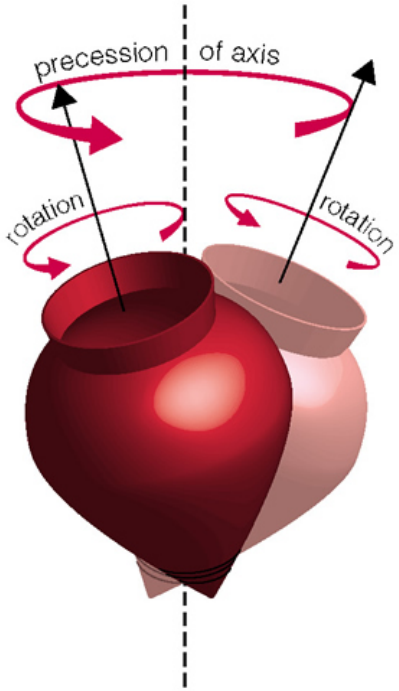
-- See in-class notes and movie (why_does_flux_sunlight_vary.swf)

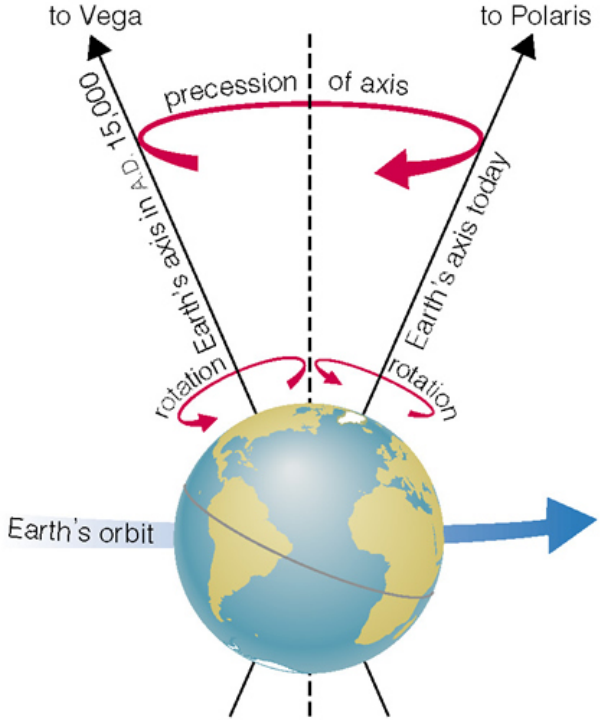


Precession of the Earth's tilted axis

Precession of the Earth's tilted axis

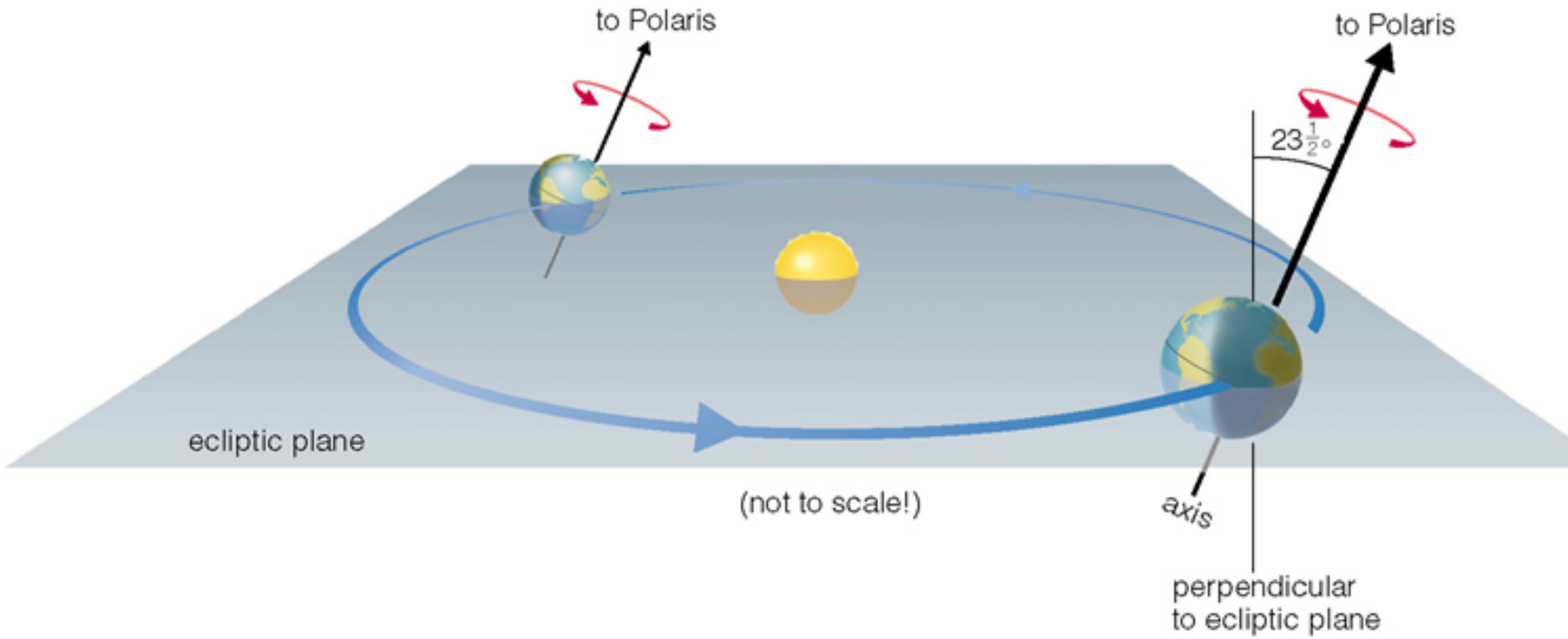


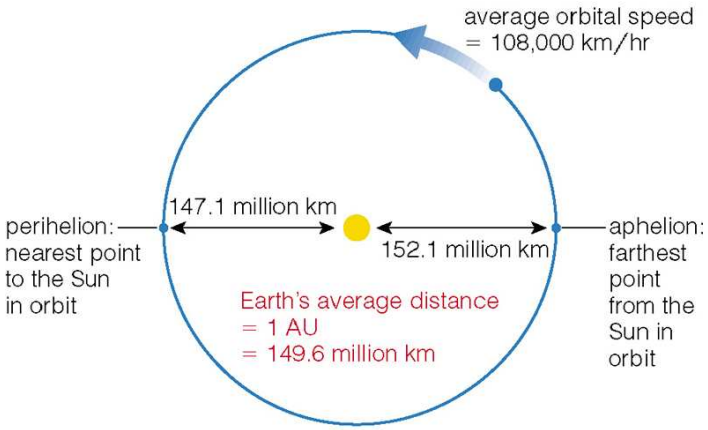




Tilt of the Earth's axis w.r.t. a line perpendicular to the ecliptic plane remains 23.5 deg, but the Earth's axis itself precesses (slowly rotates, a bit like a spinning top) about this line once every 26,000 years

Orbital Motion of Earth about Sun and Earth's tilted axis





Tilt of Earth's axis with respect to (a line perpendicular to) the ecliptic plane = 23.5 deg

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Lecture 9: Th Sep 28

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- **Hwk1 will be given back on Tue Oct 3**
  Solution set for homework 1 is posted in glass case outside lecture hall

- **Quiz 2 today**

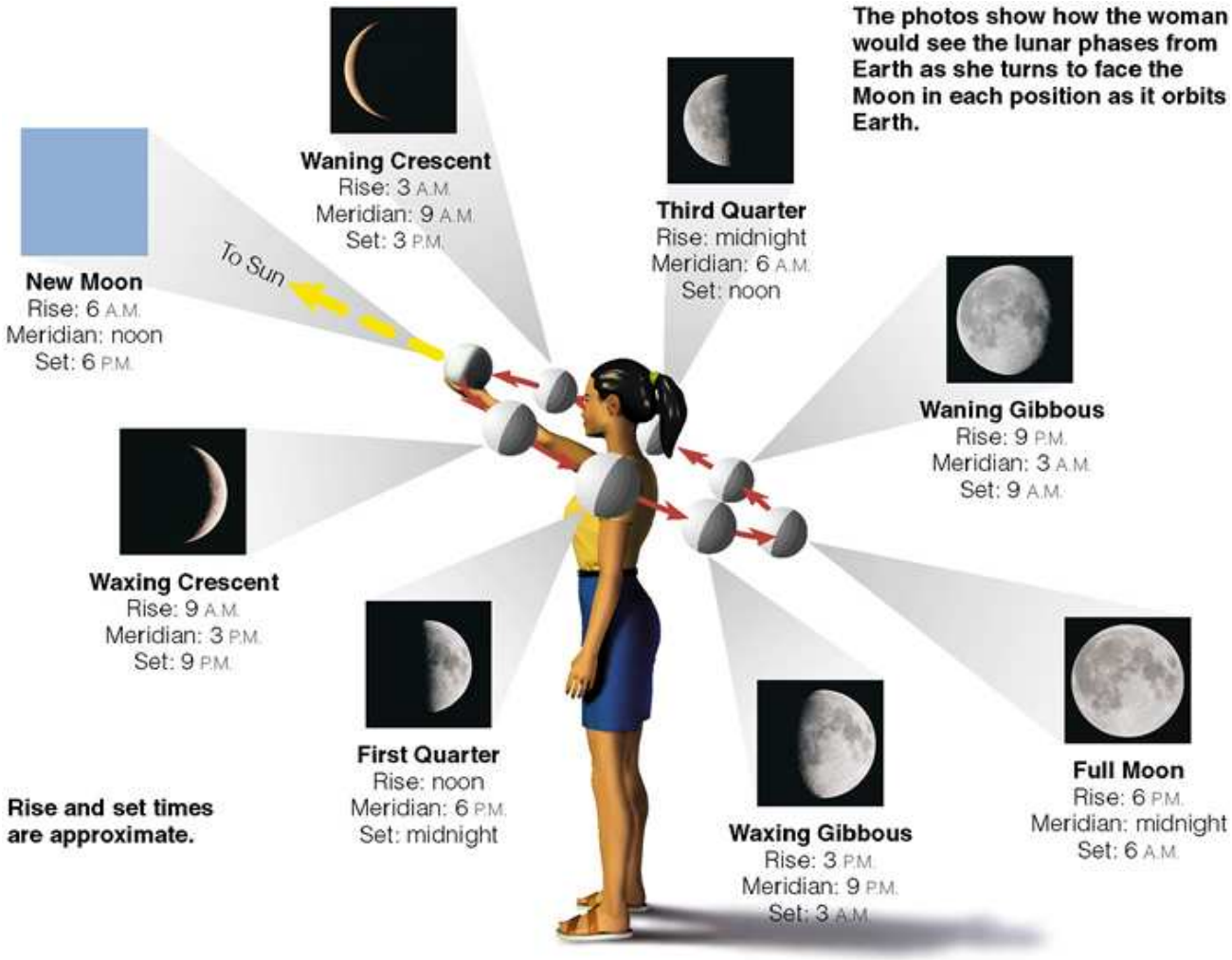
- **Pick up Hwk2 today**

- **Exam 1 on Thursday Oct 5 (details on class site)**

Phases of the Moon

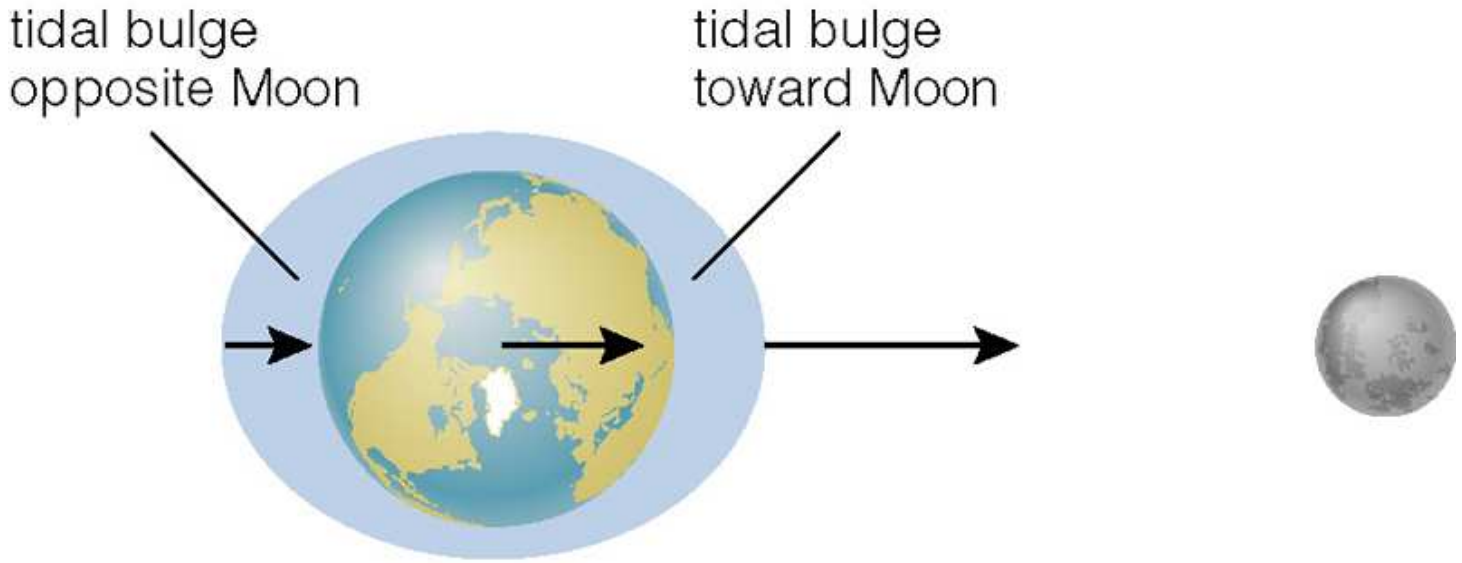
Lunar Cycle

- In class notes
- See in class animation



Tides on Earth due to the Moon

Tides: Motion of Earth & Centripetal vs Gravitational forces

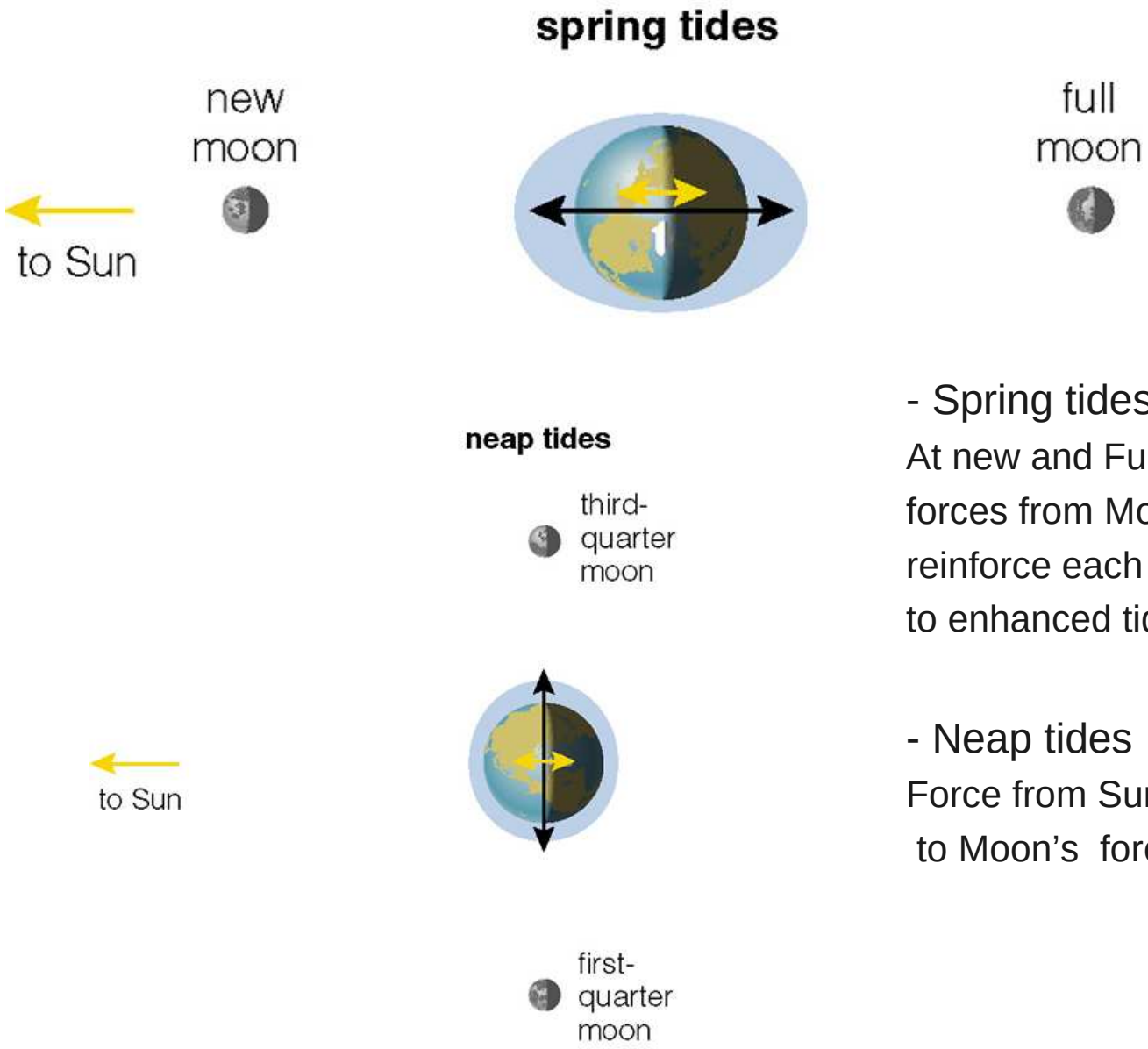


Not to scale! The real tidal bulge raises the oceans by only about 2 meters.

Why do we get tidal bulges of about same magnitude on both sides of Earth?

Why do we get 'high' tides twice a day?

Spring and Neap Tides



- Spring tides:

At new and Full moon, tidal forces from Moon and Sun reinforce each other leading to enhanced tides

- Neap tides

Force from Sun perpendicular to Moon's force on E\

History and Science of Astronomy

READ CHAPTER 3

History and Science of Astronomy

- 3000 BC Chinese astronomy
- 2700-2100 Egyptians & Babylonians

- 625 BC-150 AD **Greek scientists and geocentric models** (Thales, Pythagoras, Democritus, Plato Eudoxus, Aristotle, [Aristarchus], Apollonius, Hipparcus, Ptolemy)

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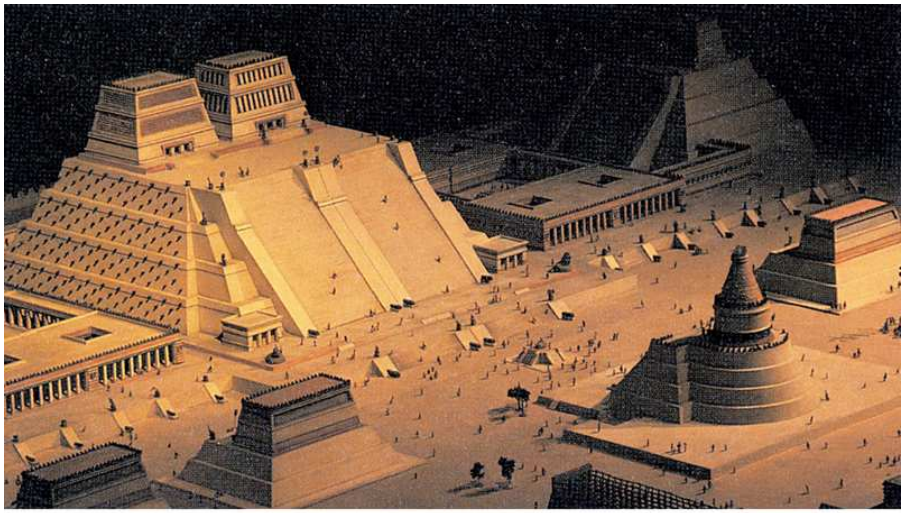
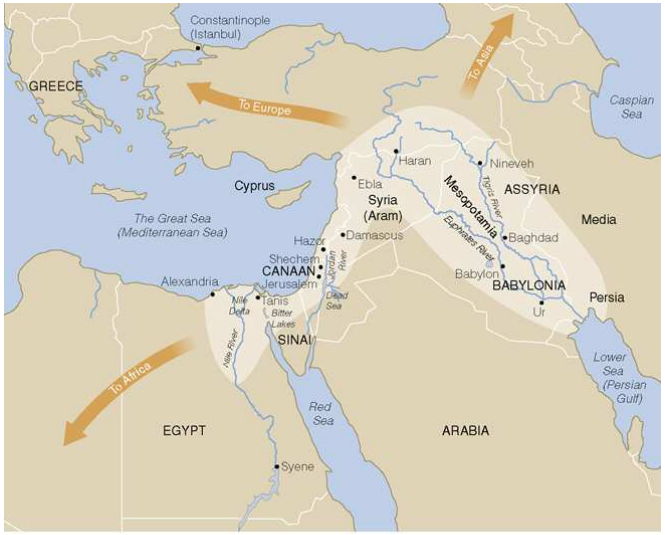
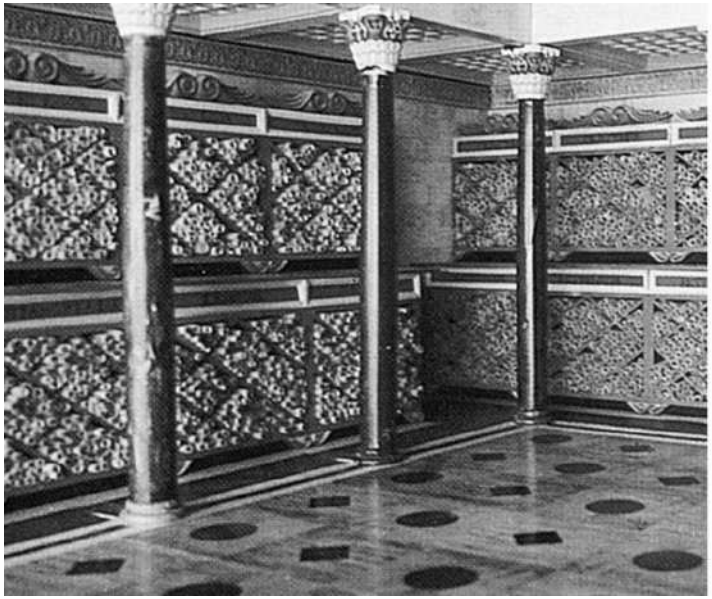




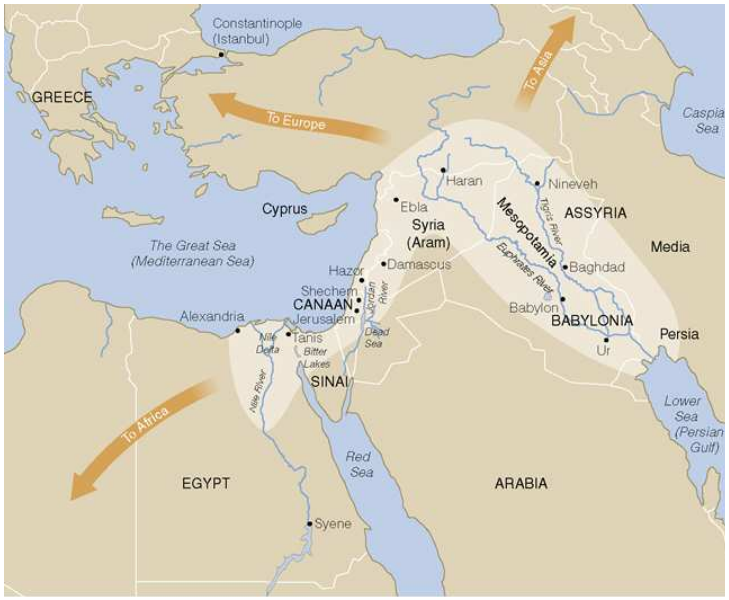
Library of Alexandria (300 BC-400 AD)

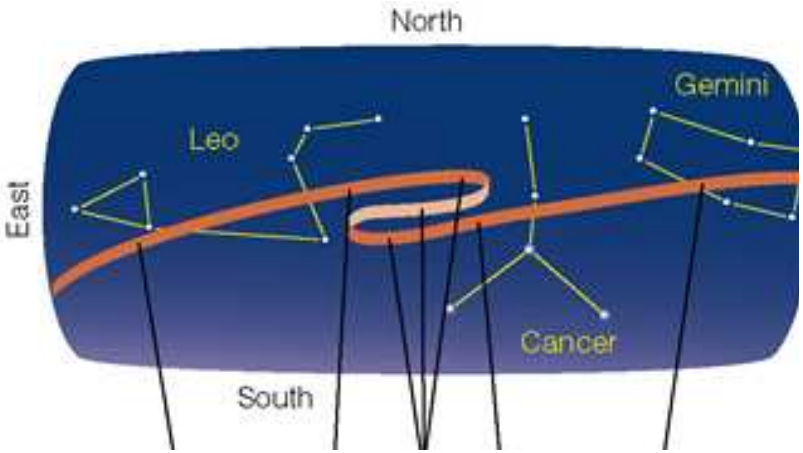
- Founded in Alexandria by Alexander the Great. Lasted 700 years (300 BC –400 AD)
- Half a million scrolls on papyrus. Great learning center.
- Director (Hypatia) was killed by anti-intellectual movements in ~415 AD

(Artist reconstruction)
Great Hall and Scroll room
in Library of Alexandria



Geocentric models and Greek Astronomy





See in-class notes

- Greeks believed in a <u>geocentric (Earth-centered) model</u> where celestial bodies (Sun, planets other than Earth) orbit about the Earth

  In Greek models, the celestial bodies move along **<u>sphere and circles</u>**, which they considered as the 'perfect shapes'

- Models used with various modifications by Plato, Eudoxus, and Aristotle

- Plato's models featured **<u>'perfect worlds</u>**': planets had **<u>constant speeds,</u>** in addition to moving along 'perfect' spheres and circles à **inconsistent with apparent retrograde motion of planets**

Geocentric models and Greek Astronomy

In order to explain apparent retrograde motion of planets, Eudoxus developed a very complex contrived geocentric model :

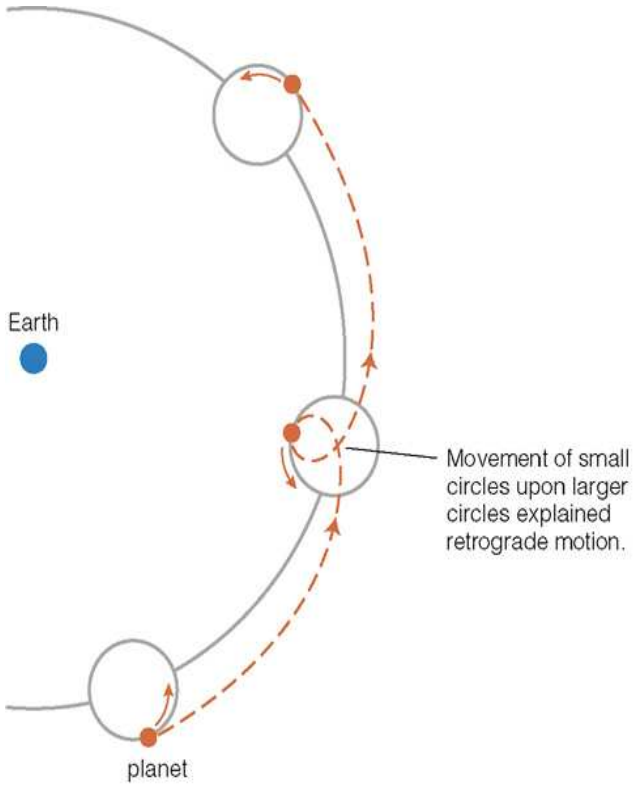
- à planetary orbits are represented by spheres within spheres, and different spheres have different axes

- à planets on different spheres move at different speeds

Geocentric models and Greek Astronomy

In order to explain apparent retrograde motion of planets, Apolonius developed a simpler elegant geocentric model where

- à planets moved along epicycles. Epicycles are small circles whose centers move on larger circles called deferent.
- à the center of the epicycles move along a larger circle
- à to an observer on Earth, the planets APPEAR to move forward, then backward on sky



Geocentric models with epicycles were also used by Hipparcus and Ptolemy

Geocentric models and Greek Astronomy

Points to Ponder

- How did the Greek scientists (625 BC -140 D) differ from earlier civilisations such as the Chinese, Egyptian and Babylonians ?
- Why did they fail to come up with heliocentric models even after 1000 years?
- To what extent was the scientific method used by the Greeks?

History and Science of Astronomy

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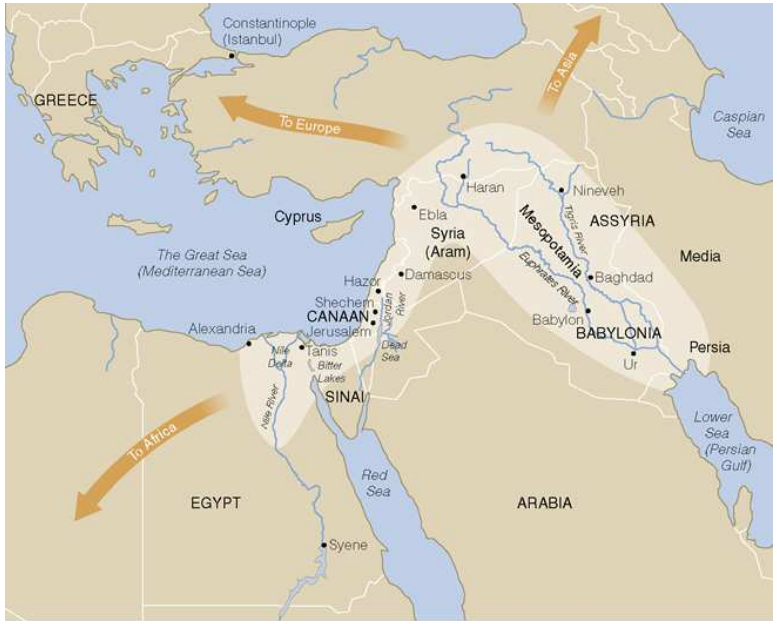
- 2700-2100 Egyptians & Babylonians
- 625 BC-150 AD **Greek scientists and geocentric models** (Thales, Pythagoras, Democritus, Plato Eudoxus, Aristotle, [Aristarchus], Apollonius, Hipparcus, Ptolemy)
- 300 BC Expansion of Greek empire into Middle East (Egypt, Mesopotoamia)
- 300 BC-400 AD Library of Alexandria



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- 300 BC Expansion of Greek empire into Middle East (Egypt, Mesopotoamia)
- 300 BC-400 AD Library of Alexandria
- 600-800 AD House of Baghdad; compilation of knowledge by Arabs from Egyptians, Greeks, Hindu, Chinese. Development of arithmetic.
- 800-1400 Knowledge compiled by Arabs spreads throughout the Byzantine Empire

- 1453 Capital of Byzantine Empire, Constantinople, falls to the Turks. Eastern scholars move to Europe transferring knowledge, leading to European Renaissannce

- 1473—1642
  Heliocentric models and birth of modern astronomy (Copernicus, Brahe, Kepler, Galilei)