Summary:

- Archaeoastronomy
- Models of the solar system
- The scientific method

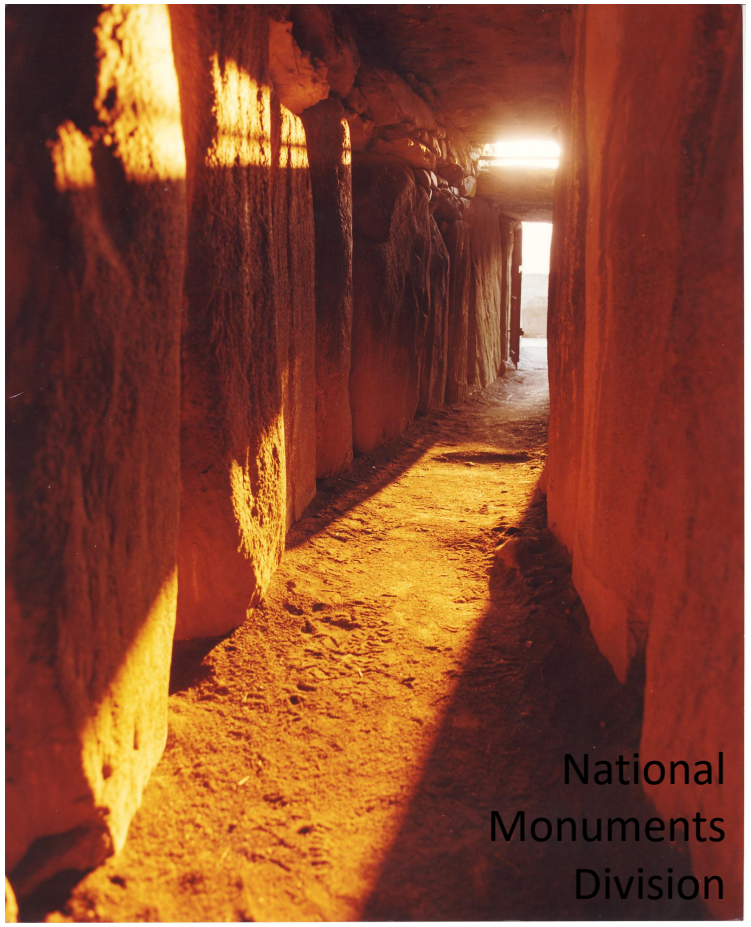
Astronomy

A History

https://github.com/DimitriosAstro/Astronomy

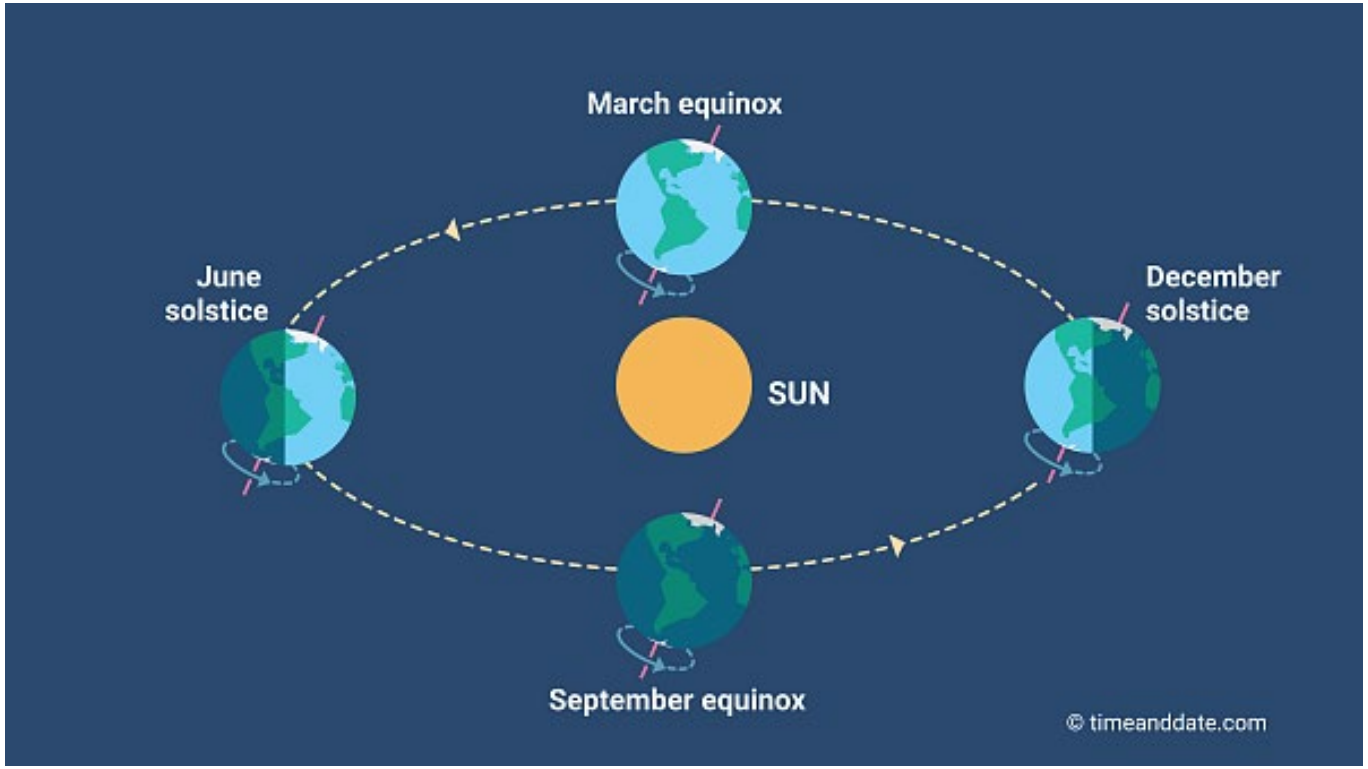
Archaeoastronomy

- The study of how celestial phenomena influenced ancient cultures



Solstice

The time when the sun is at its highest or lowest point in the sky, giving us the longest (summer) and shortest (winter) days of the year



Stonehenge

Galaxy Picture Library / Alamy Stock Photo

Mayans - Chichén Itzá

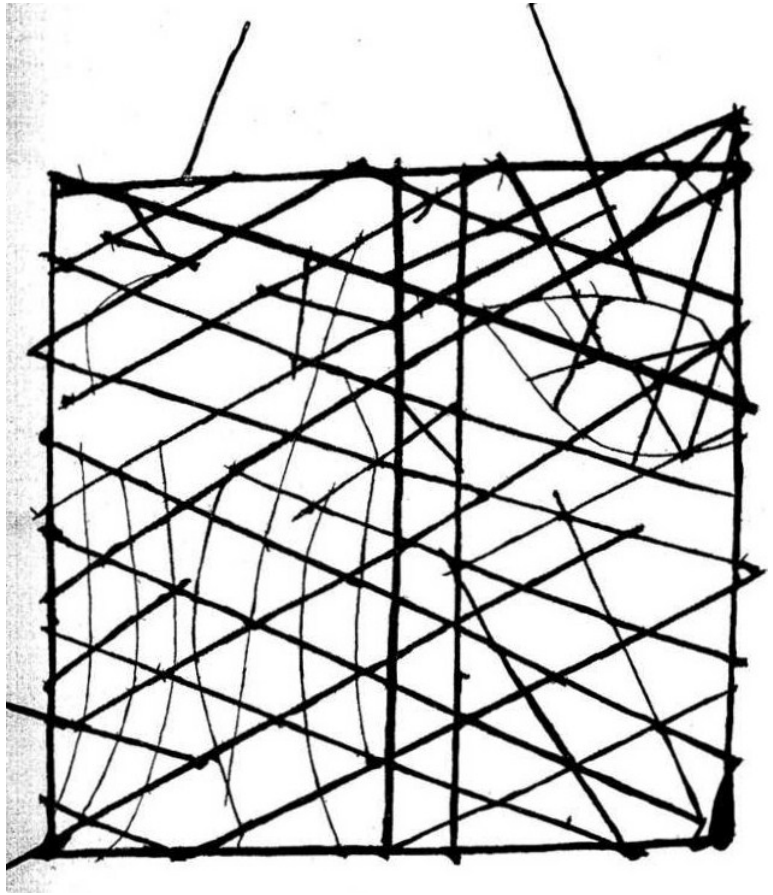
Richard Cohen

Egypt – Great Pyramids

Antikythera mechanism

Thanassis Stavrakis/AP

Polynesian Navigation



NZETC

Hawaii - Makahiki

Tony Hallas/Science Faction/Corbis

Solar System Models

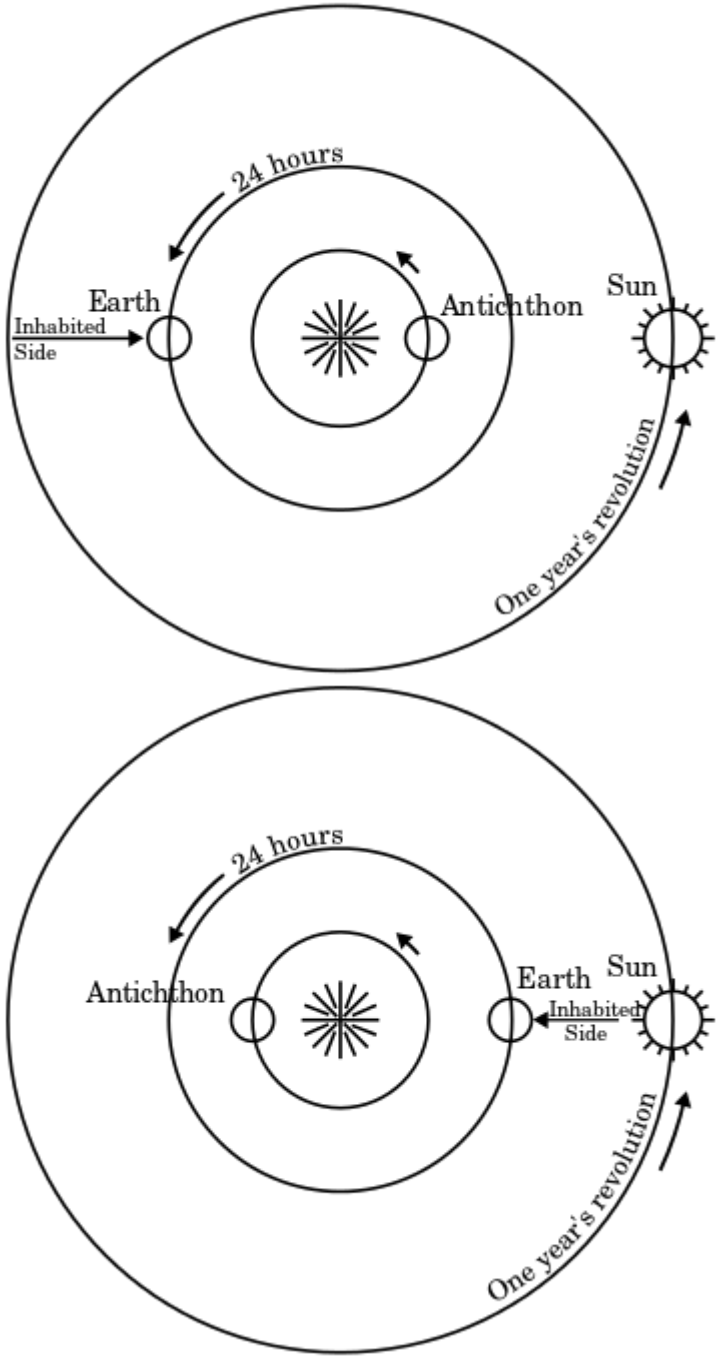
Each of these famous astronomers/scientists helped improve our model for the solar system by making new observations or taking new data

- Ptolemy
- Pythagoras
- Aristarchus

- Copernicus
- Tycho
- Kepler
- Galileo

Pythagoras

570 – 495 BCE



Guan-Ze Liao/wikimedia

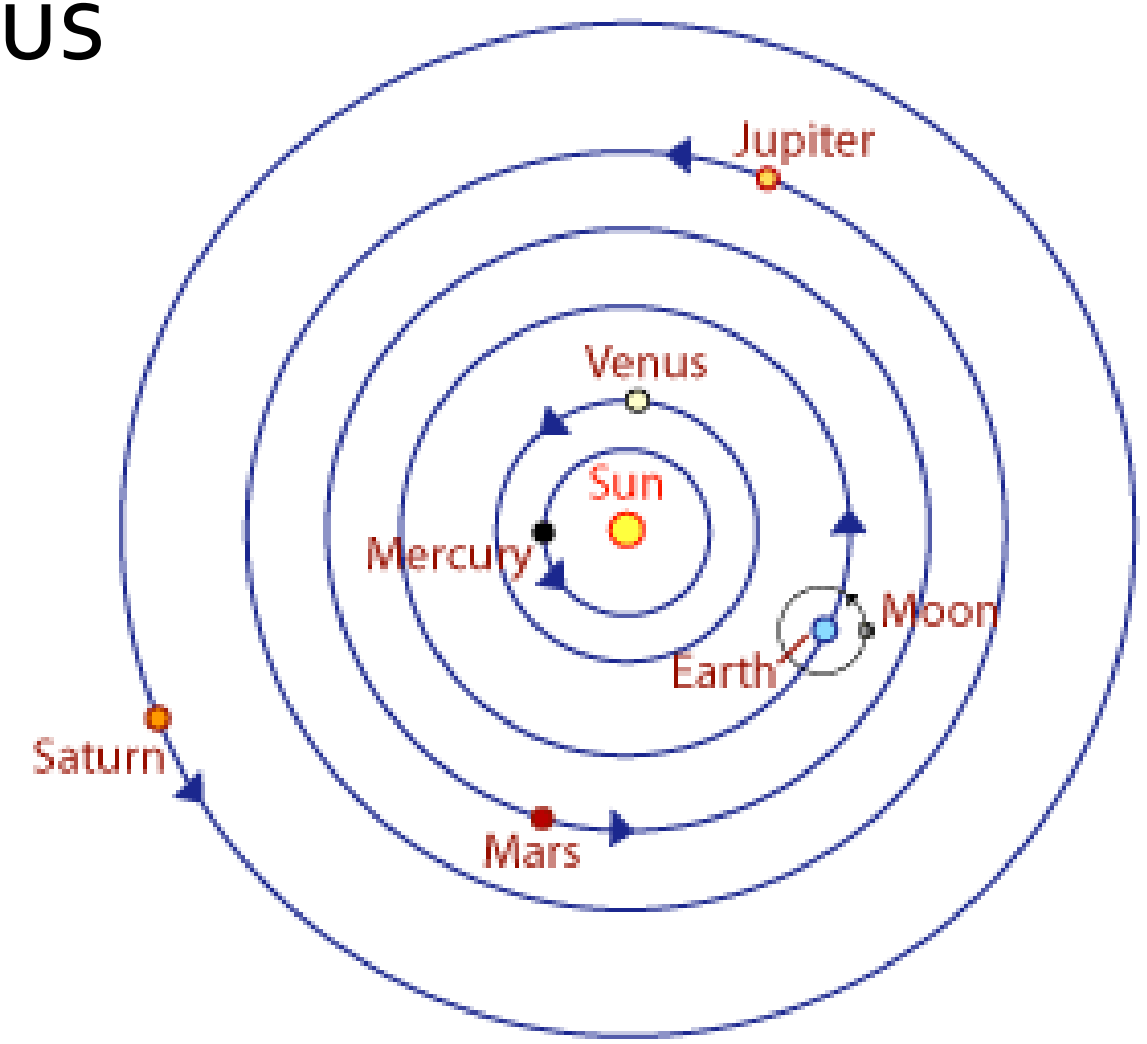
Ancient Greeks

- Eudoxus (409 – 356 BCE): Model of 27 nested spheres
- **Aristotle** (384 – 322 BCE): Universe can be divided in 2 parts:
    1. Imperfect, changeable Earth,
    2. Perfect Heavens (described by spheres)

Aristotle expanded Eudoxus' model to use 55 spheres!

Aristarchus

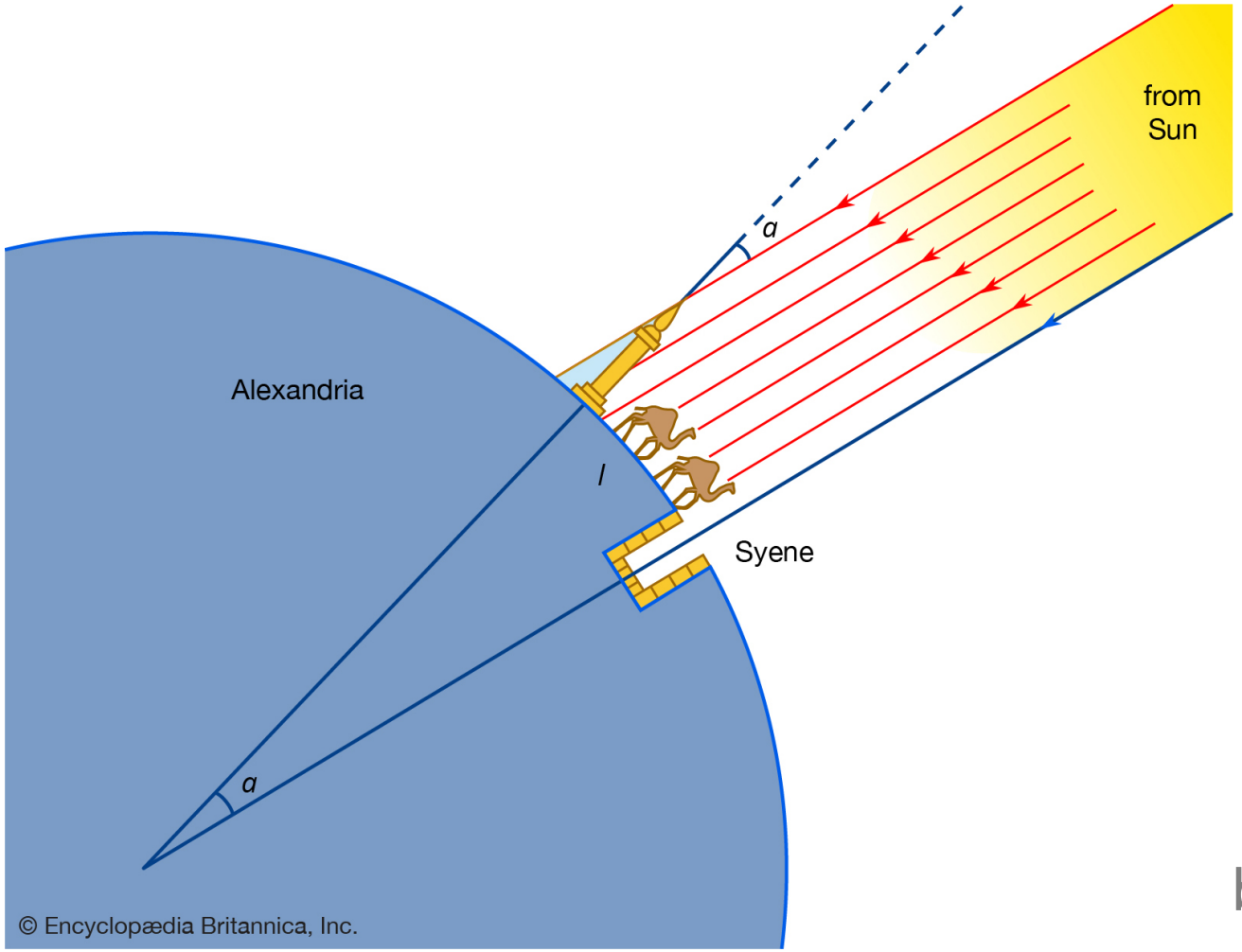
310 – 230 BCE



Aristarchus' Heliocentric Model

(Not to scale)

Eratosthenes 276-194 BCE



Angular distance between Syene and Alexandria:
~ 7^0

Linear distance between Syene and Alexandria:
~ 8,000 km
$360^0/7^0 = 51.4$

8,000 km x 51.4 =

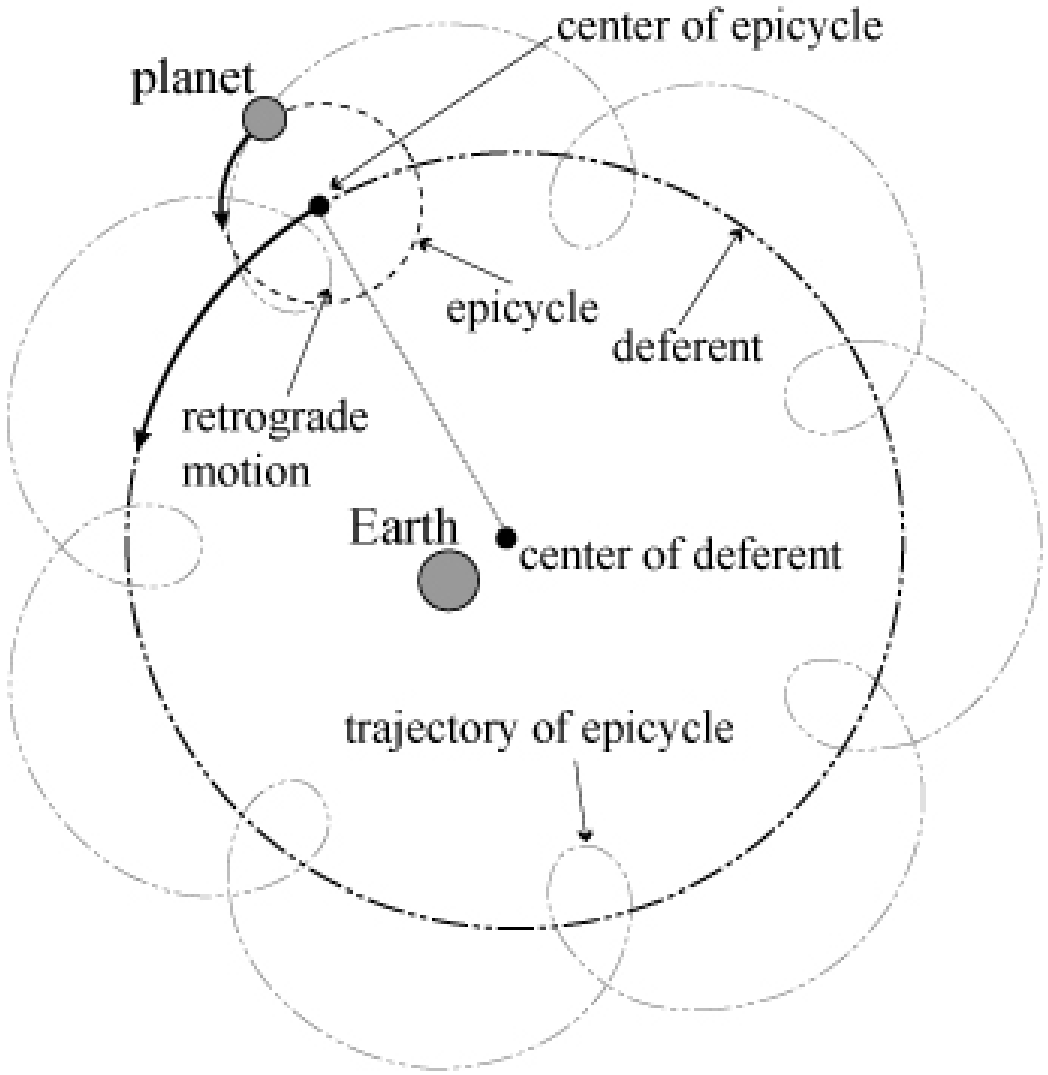
→ Earth Circumference ~ 41,200 km – better than any previous radius estimate.

Actual circumference = 40,075 km

Text: Matthew LeDuc – Weber HS

Ptolemy

100 – 170 CE



Indian Astronomy

Āryabhaṭa (476 - 550 CE)

- believed that the planets and the Moon shine by reflected sunlight
- proposed the motion of the stars is due to Earth's rotation
- Islamic, Chinese, and European astronomy is based on this work

Brahmagupta (598 - 668 CE)

- calculated the instantaneous motion of a planet
- gave correct equations for parallax
- theorized that all bodies with mass are attracted to the earth

Text: Matthew LeDuc – Weber HS – Top Image: Uncredited, Bottom Image: Frans B Solvyns

Chinese Astronomy

- Were considered the most persistent and accurate observers of celestial phenomena anywhere in the world before the Islamic astronomers
- Shi Shen (4th century BCE) was aware of the relation of the moon in a solar eclipse
- Xuan Ye school (~280 CE)
  - viewed the heavens as infinite in extent
  - celestial bodies as floating about in the infinite
- Shen Kuo (1031–1095 CE) used the models of lunar eclipse and solar eclipse in order to prove that the celestial bodies were round, not flat

Text: Matthew LeDuc – Weber HS – Image: Shen Kuo bust by Hans A. Rosbach

Islamic Astronomy

- Muslim scholars developed spherical trigonometry and algebra
- Abd al-Rahman al-Sufi (904-986 CE)
  - Book of Fixed Stars
  - First to record observing the Andromeda galaxy and the Large Magellanic Cloud
- Nasir al-Din al-Tusi (1201-1274 CE)
  - Tusi couple
  - Explains the apparent linear motion of heavenly bodies on the basis of circular motion

Text: Matthew LeDuc – Weber HS – Image: The constellation Sagittarius from *The Depiction of Celestial Constellations*

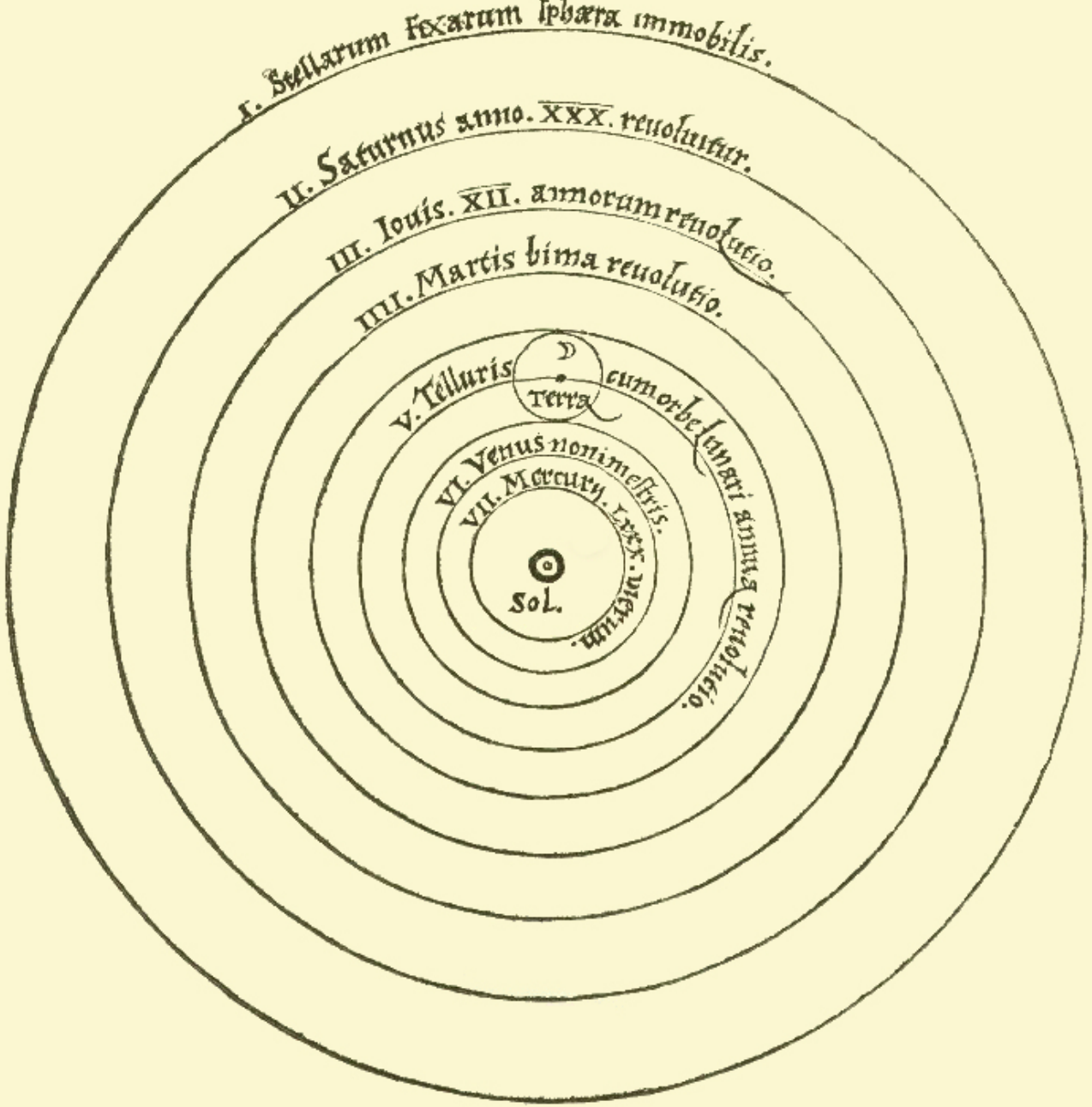
Islamic Astronomy

- Ibn al-Haytham (965-1040 CE)
  - the “father of optics”
  - his work developed camera obscura
  - his work aided in development of telescopes
  - started the foundations of the scientific method
- Many schools and mosques that taught math and astronomy were overseen by Muslim women
- Mariam al-Astrulabi (mid 900s CE Syrian female)
  - perfected the making of astrolabes
  - used to calculate altitude of celestial bodies in the sky

Text: Matthew LeDuc – Weber HS – Image: Arabic astrolabe, Katie Eagleton and the Whipple Museum

Copernicus

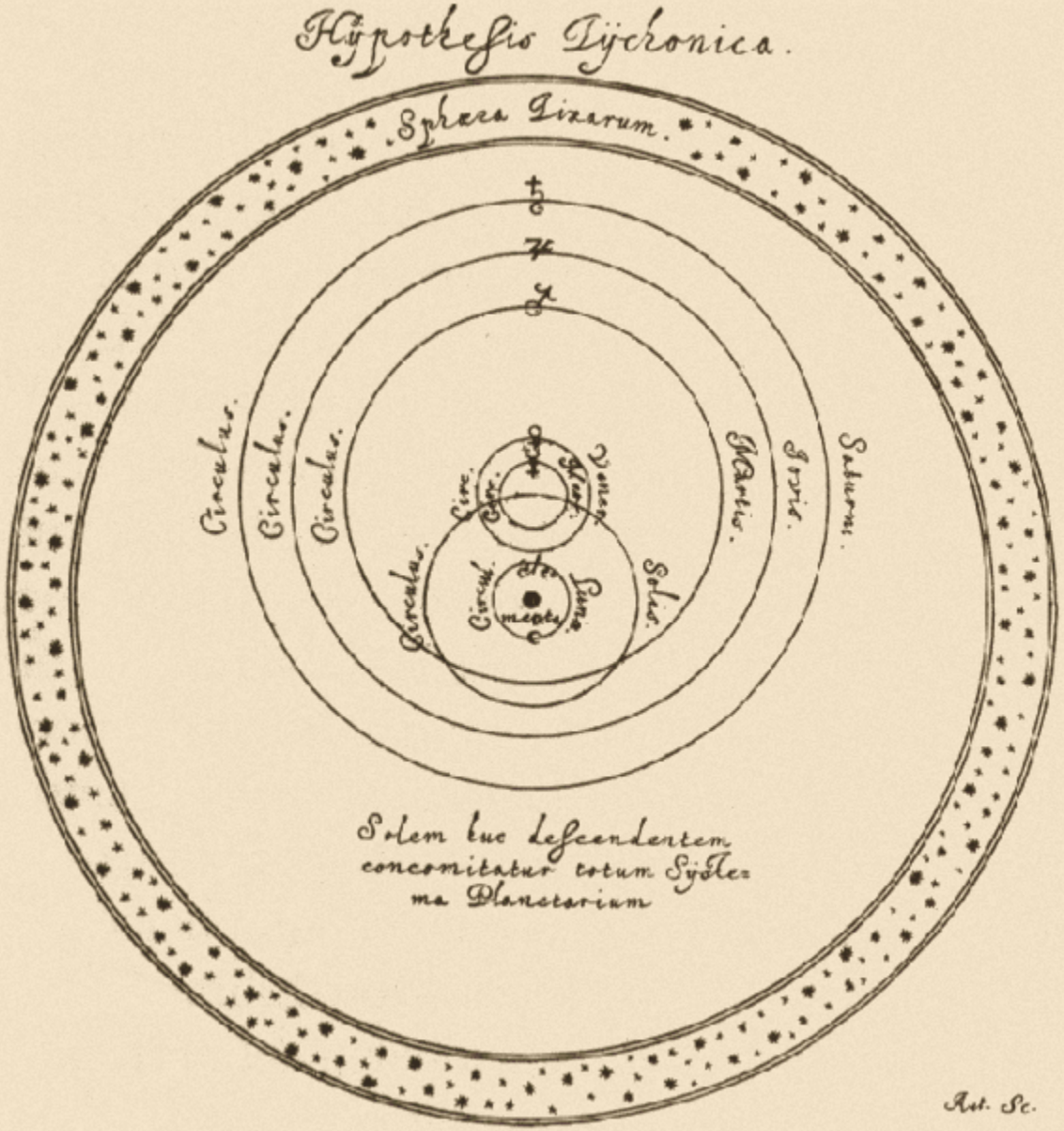
1473 – 1542 CE



Nicolaus Copernicus

Tycho

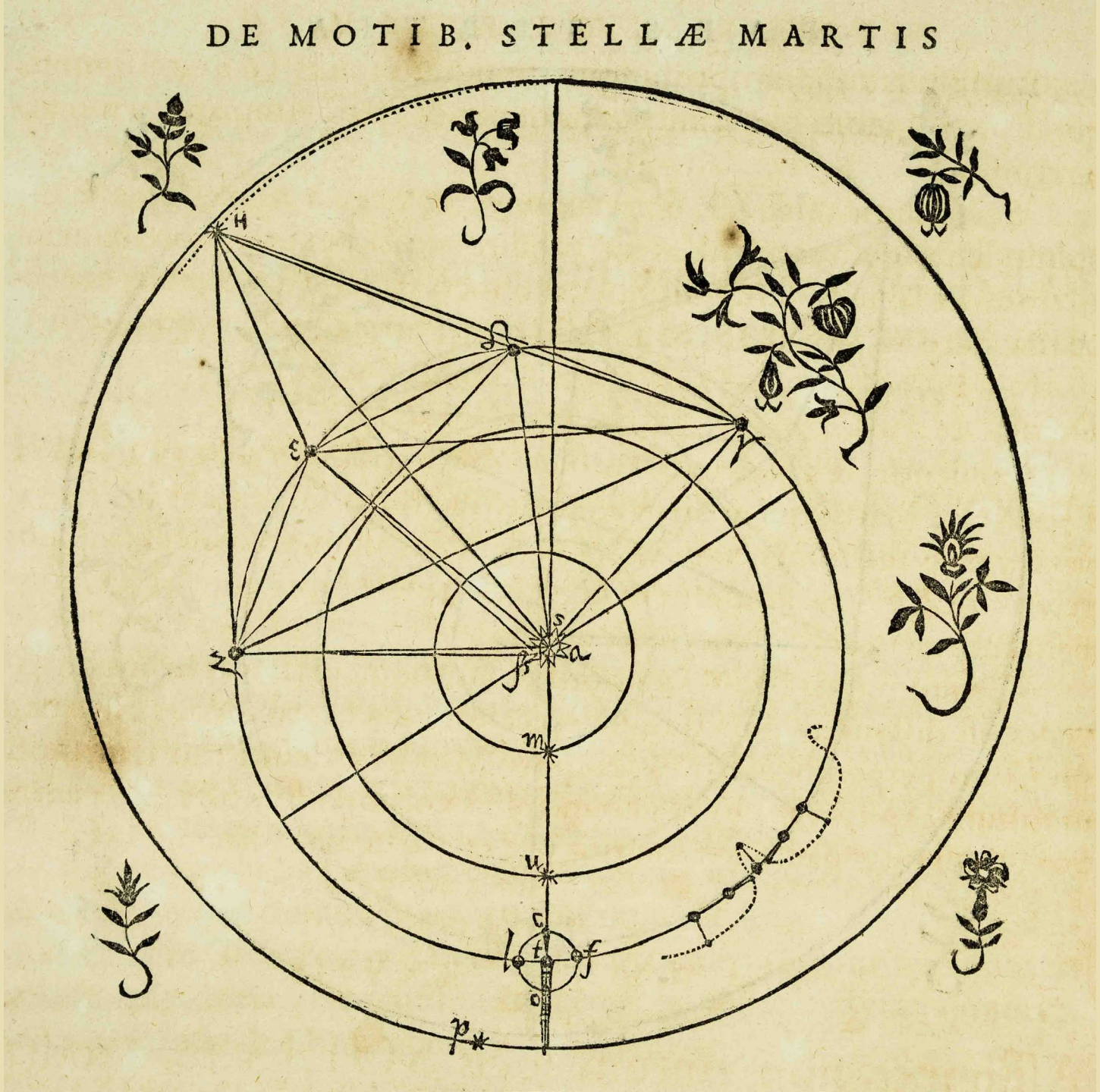
1546 – 1601 CE



Tycho Brahe

Kepler

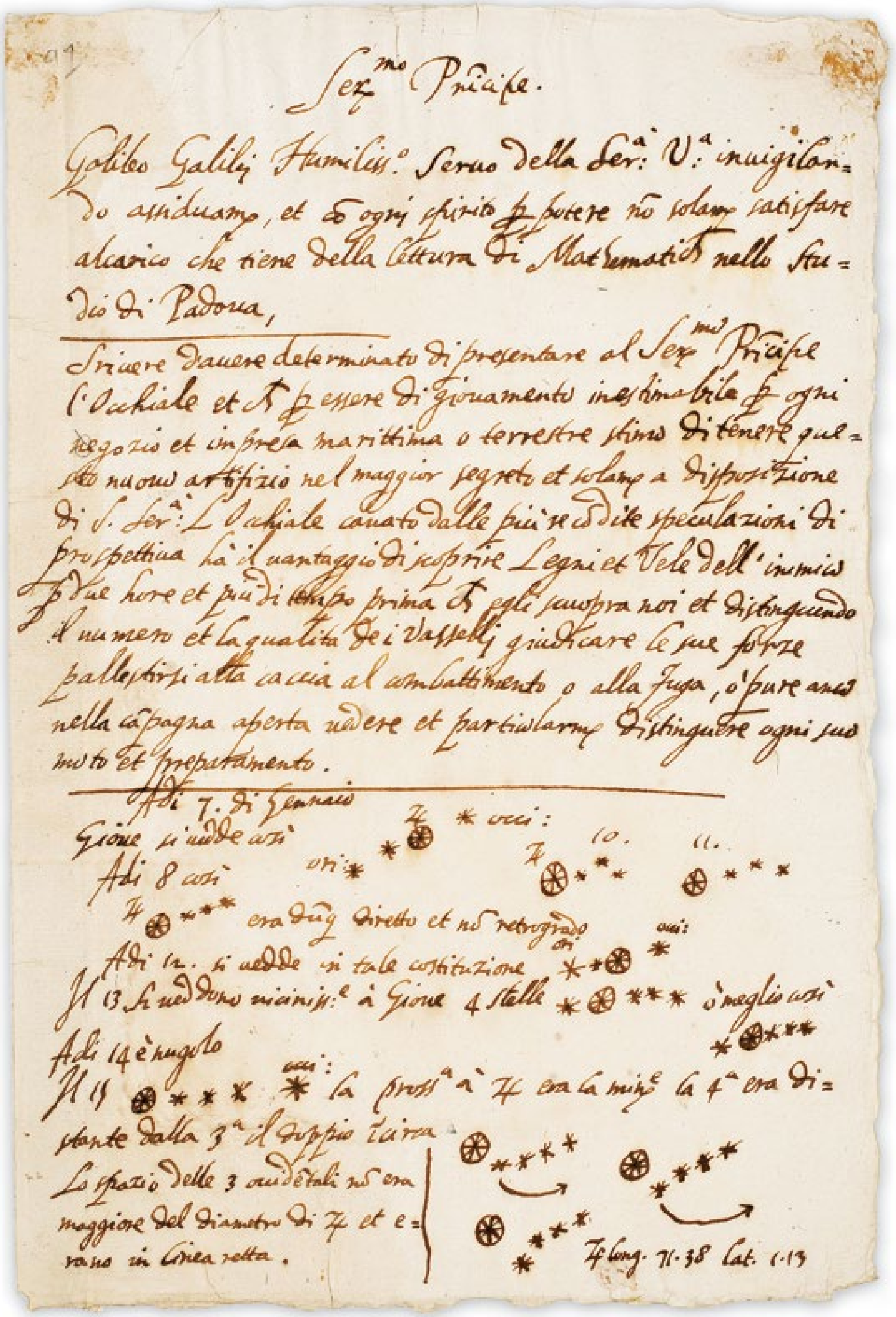
1571 – 1630 CE



Sean Wilkinson

Galileo

1594 – 1642 CE



Ser.mo Principe.

Galileo Galilei Humiliss.o Servo della Ser.tà V.a invigilando assiduamente, et con ogni spirito per potere non solamente satisfare al carico che tiene della lettura di Matematiche nello Studio di Padova,

Scrivere d'havere determinato di presentare al Ser.mo Principe l'Ochiale et di poter essere di giovamento inestimabile per ogni negozio et impresa marittima o terrestre stimo di tenere questo nuovo artifizio nel maggior segreto et solamente a disposizione di V. Ser.tà L'Ochiale cavato dalle più recondite speculazioni di prospettiva ha il vantaggio di scoprire Legni et Vele dell'inimico per due hore et più di tempo prima che egli scuopra noi et distinguendo il numero et la qualità dei Vasselli giudicare le sue forze pallestirsi alla caccia al combattimento o alla fuga, o pure ancora nella campagna aperta vedere et particolarmente distinguere ogni suo moto et preparamento.

Adi 7. di Gennaio Giove si vedde così

Adi 8 così era dunque diretto et non retrogrado

Adi 12. si vedde in tale costituzione

Il 13 si veddono vicinissime a Giove 4 stelle o meglio così

Adi 14 è nugolo

Il 15 la pross.a a Giove era la min.e la 4.a era distante dalla 3.a il doppio incirca

Lo spatio delle 3 occidentali non era maggiore del diametro di Giove et erano in linea retta.

Giove long. 71.38 lat. 1.13

University of Michigan

The Heliocentric Model

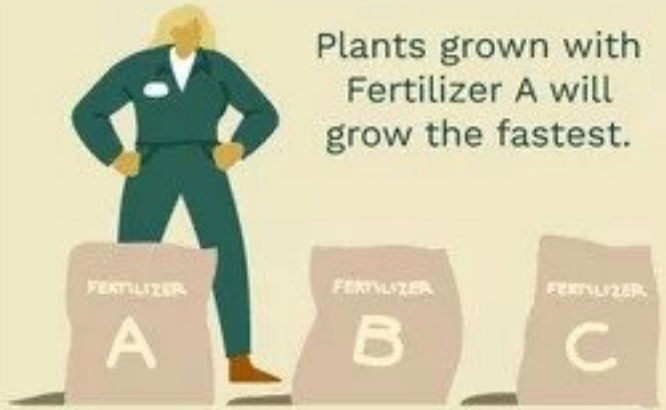
- Galileo's observations of the phases of Venus and the Galilean moons of Jupiter proved that not everything orbits the Earth
- His observations of sunspots and lunar craters proved the heaven was not perfect
- He suggested that we couldn’t measure stellar parallax yet and that some stars are so distance they have no parallax
- Galileo showed that we can move with the motion of the Earth around the sun (as can the moon) without being left behind as Earth moved in its orbit by formulating an early version of Newton’s first law of motion

How does this evolution follow the Scientific Method?

Steps of the Scientific Method

Observation

Question



Hypothesis

Results

Conclusion

PEER REVIEW!

ThoughtCo.

Up next:

Solar System Structure