History of Space Science to 1700s Myths + Geocentric System + Heliocentric System

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Qinghao Hu SES4U September 29, 2025 1/23

Expectations

- Describe how early cultures created myths to explain the universe.
- 2 Explain the differences between the Geocentric System and Heliocentric System.
- Describe how humans' understanding of the universe developed in chronological order.
- Describe how each scientist contributed to the Geocentric and Heliocentric systems.



The origin of space science lies in myths and storytelling.

3/23

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At the beginning of mankind, early civilizations did not understand modern science. They created stories and myths to explain the universe.

Examples

Two examples are taken from Grade 10 English.

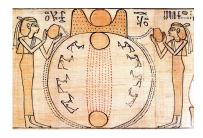


Figure: Ancient Egyptian Creation Myth

Example I: Pangu Creates the World

- From Chinese culture.
- Pangu used his hands and legs to break the chaos.
- His left eye became the Sun.
- His right eye became the Moon.
- His flesh became the soil.

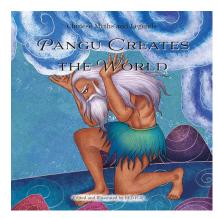


Figure: Pangu creates the Earth (from *Amazon*)

Example II: The Turtle Island Myth

- From Indigenous peoples of North America.
- The Earth was formed on the back of a giant turtle – "Turtle Island".
- A woman gave birth to twins.
- The Good Twin placed the Sun in the sky for warmth and daylight.
- The Bad Twin placed the Moon in the sky for cold and darkness.
- Such myths explained the cosmos before scientific astronomy.



Figure: From Sequoia Proudly Indigenous

Ancient Greek Space Science and the Geocentric Model

Eudosus (390–337 BCE): Concentric Spheres Geocentric System

- Mathematician and astronomer.
- Proposed the first geometric model of planetary motion.
- Used 27 concentric spheres with Earth at the center
- The first to use mathematics and geometry to analyze the heavens.

Note

Spheres were primarily mathematical tools, not physical objects.



Figure: Eudosus (from Locklin on Science)

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Qinghao Hu SES4U September 29, 2025 9 / 23

Aristotle (384-322 BCE): The Second Geocentric System

- Known as The Father of Western Philosophy.
- Ancient Greek philosopher.

Interesting Fact

He liked to bathe in olive oil and then sell it to others.

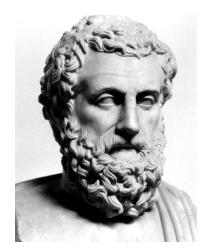


Figure: Aristotle (from *The New York Times*)

"On the Heavens"

- "On the Heavens" is Aristotle's chief cosmological treatise.
- Expanded Eudosus's model using 55 concentric spheres.
- Earth is a sphere and stationary at the universe's center.
- Everything else travels in perfect circular orbits
- Universe is spherical and finite.

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Figure: Page one of "On the Heavens"

Ptolemy (100-170 AD): The Final Geocentric System

- Developed the Geocentric Model.
- Model dominated for over 1400 years.
- Mathematician, astronomer, geographer, and music theorist.



Figure: Ptolemy (from University of Toronto)

29, 2025 12 / 2

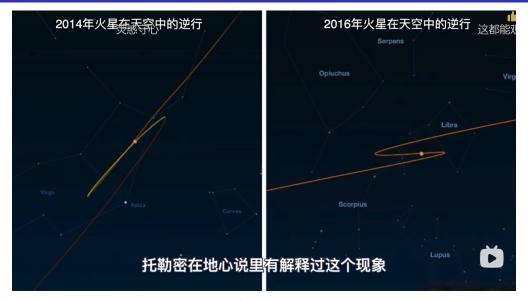


Figure: This is the Screenshot from Bilibili by me

Almagest

- Most famous work by Ptolemy.
- Introduced epicycles to explain retrograde motion
- Model accurately predicted planetary positions.
- Planetary orbits were circular, not spherical.

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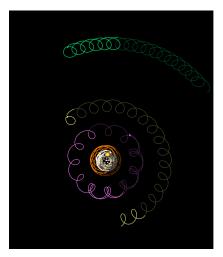


Figure: Screenshot from orbitsimulator.com by author

Student Activity I

According to the animation, try to summary the characteristics of "Geocentric System"

Is this model easy to use?

Is this model easy to understand?

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Introduction to Heliocentric System

The Sun-centered Universe

16/23

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Copernicus and the Sun-Centered Universe

- Nicolaus Copernicus
- Born into a wealthy family
- Doctorate in Canon Law
- He read a lot of cosmic books from Ptolemy

Interesting Fact

He was a clergyman.



Figure: Nicolaus Copernicus (Britannica)

Copernicus' Heliocentric System

Based on the Ptolemy's geocentric system:

- Sun replaces Earth as the center.
- Planets arranged by distance from the Sun.
- Retrograde motion explained by Earth's motion, no epicycles needed.
- Small epicycles still used to refine circular orbits.
- He believed the Universe is still spherical and finite

Website

 ${\bf Visit:\ https://osp.berry.edu/CopernicanSystem.html}$

Fact

Initially, the heliocentric model was only a mathematical hypothesis.

Tycho Brahe

- Built advanced observatories.
- Collected the most precise astronomical data.
- Proposed a hybrid model:
 - Sun orbits Earth
 - Other planets orbit Sun
- Data later allowed Kepler to formulate his laws.

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Figure: Tycho Brahe (Britannica)

Interesting fact

He died from a ruptured bladder after holding in his urine.

Johannes Kepler

- Student of Tycho Brahe.
- Used precise data to show planetary orbits are elliptical.
- Kepler's Three Laws of Planetary Motion:
 - Elliptical orbits with Sun at one focus.
 - Equal areas in equal times.
- Provided mathematical proof for heliocentrism.

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Figure: Johannes Kepler (space)

Interesting fact

He was owed wages for 20 years and died on the way to get his wages.

Galileo Galilei

- First to use a telescope to observe the universe.
- Discovered four moons orbiting Jupiter.
- Publicly challenged geocentric model.
- Faced opposition from the Catholic Church for contradicting the Bible.
- He suggested that our universe is not a dome

Interesting Fact

The Bible teaches how to go to heaven, not how the heavens go.



Figure: Galileo Galilei (Britannica)

Dialogue Concerning the Two Chief World Systems

- Pope Urban VIII supported Galileo to introduce both systems.
- Book compares Ptolemaic and Copernican systems.
- Written as a conversation between:
 - Salviati defends heliocentrism.
 - Simplicio supports geocentrism.
 - Sagredo neutral observer.
- Written in Italian, accessible to general public.

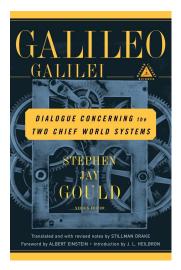


Figure: Dialogue Concerning the Two Chief World Systems by Galileo

After the Dialogue

- Book seen as an attack on the Pope and Catholic authority.
- Galileo forced to recant heliocentrism, condemned as "vehemently suspected of heresy".
- Sentenced to lifetime house arrest in Florence, but continued his studies.

Reference



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