

History of Space Science to 1700s

Myths + Geocentric System + Heliocentric System

Qinghao Hu

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- ① Describe how early cultures created **myths** to explain the universe.
- ② Explain the differences between the **Geocentric System** and **Heliocentric System**.
- ③ Describe how humans' understanding of the universe developed in **chronological order**.
- ④ Describe how each scientist contributed to the **Geocentric** and **Heliocentric** systems.

The Start of Space Science: Myths

The origin of space science lies in myths and storytelling.

Myth

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.

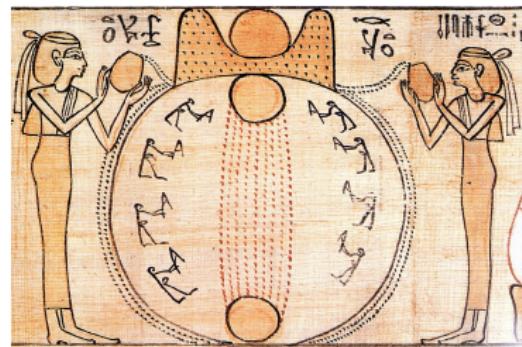


Figure: Ancient Egyptian Creation Myth

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.

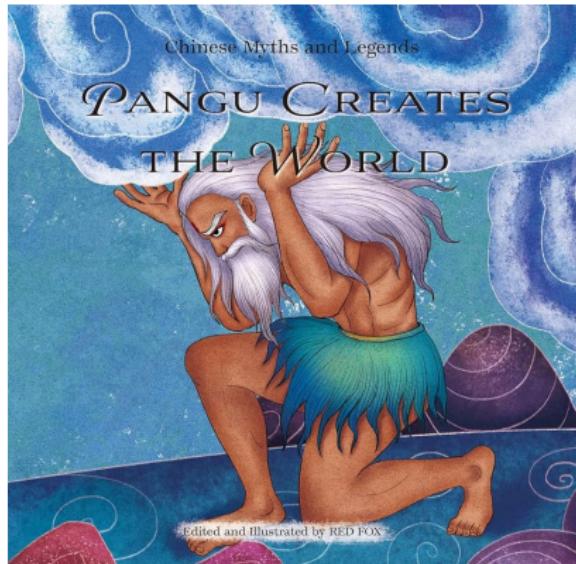


Figure: Pangu creates the Earth (from Amazon)

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

Eudoxus (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 people to use **mathematics and geometry** to analyze the heavens or Universe.

Note

Spheres were primarily **mathematical tools**, not physical objects.

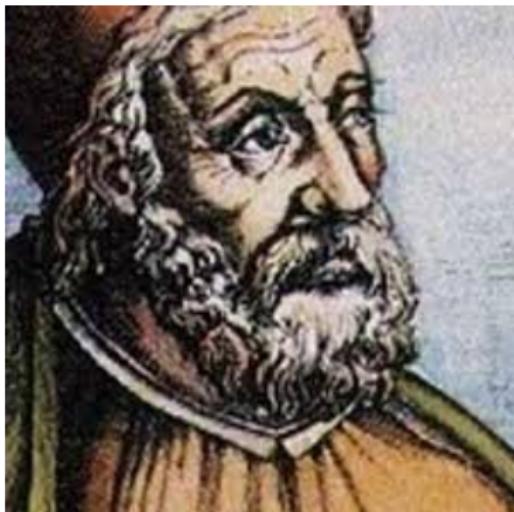


Figure: Eudoxus (from Locklin on Science)

Search: Please go to the first Link

You should go to the google classroom. There is a tab post by me!

By the way, did you see this model in any movie?



Figure: The screenshot from the "Game of Thrones"

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.

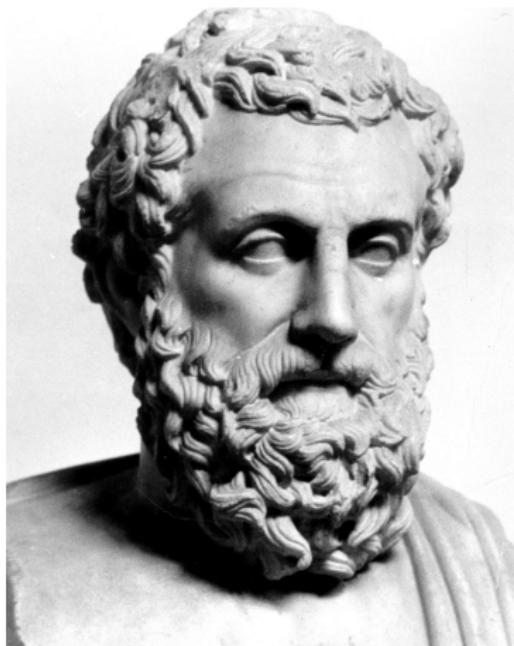


Figure: Aristotle (from *The New York Times*)

"On the Heavens"

- "On the Heavens" is Aristotle's chief cosmological treatise.
- Expanded Eudoxus'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**.



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)

Retrograde motion

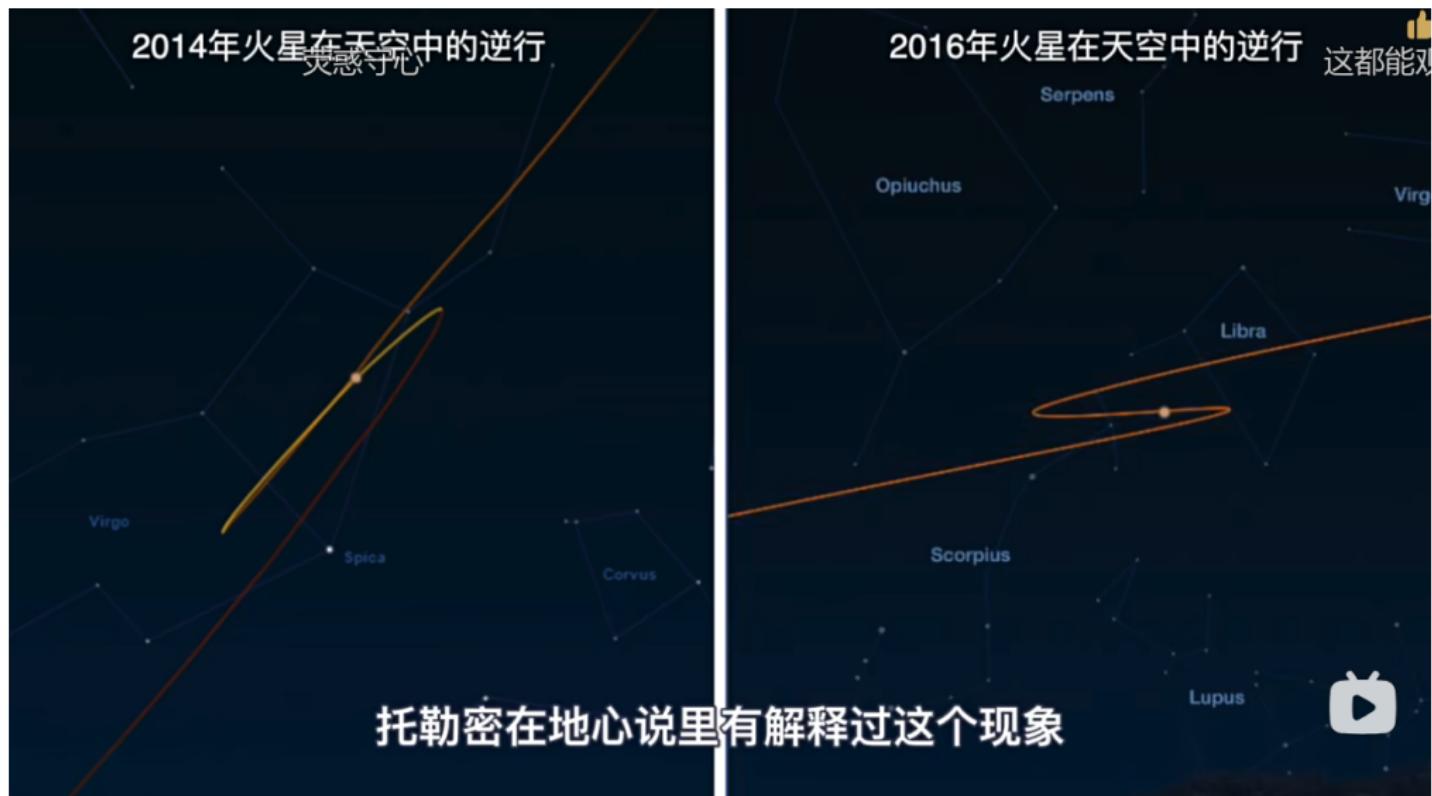


Figure: This is the Screenshot from Bilibili by me

- 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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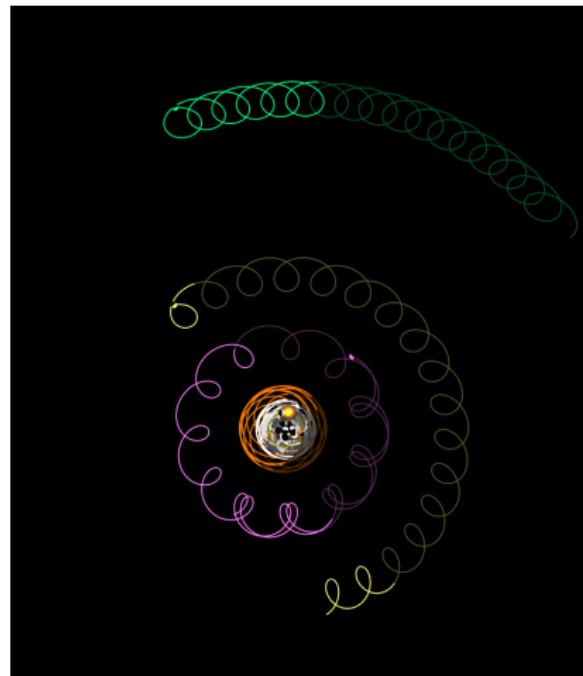


Figure: Screenshot from orbitimulator.com by author

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

Is this model easy to use?

Is this model easy to understand?

The Sun-centered Universe

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**.

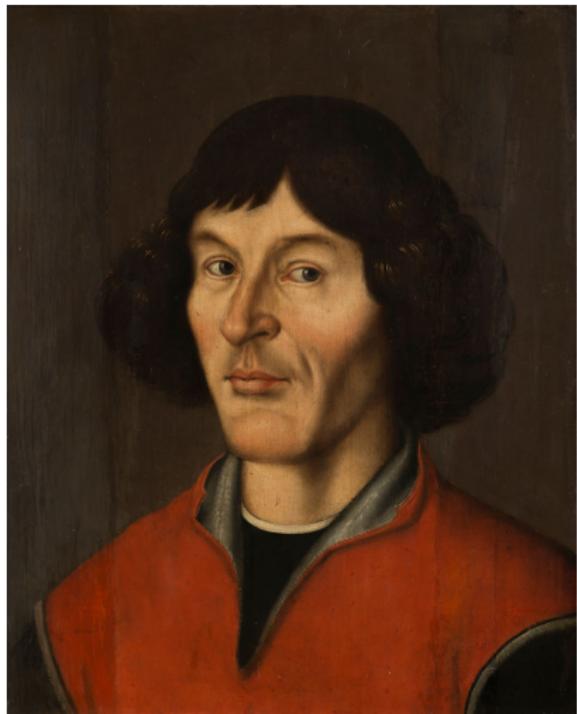


Figure: Nicolaus Copernicus (*Britannica*)

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

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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Interesting fact

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



Figure: Tycho Brahe (*Britannica*)

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.
 - Square of orbital period \propto cube of distance from Sun.
- Provided mathematical proof for heliocentrism.

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Interesting fact

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



Figure: Johannes Kepler (space)

- 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.

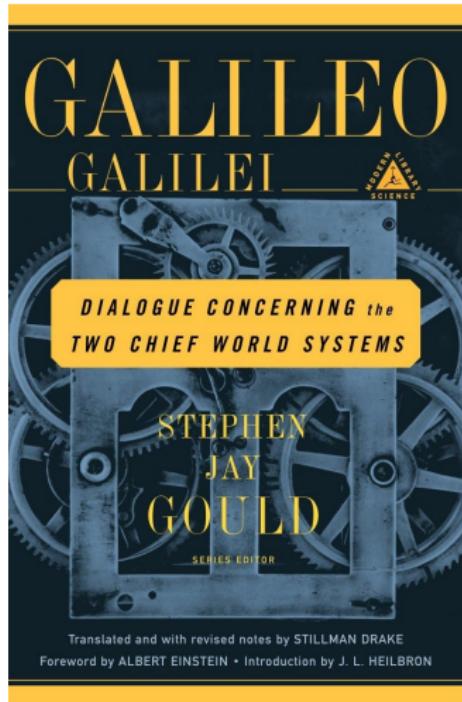


Figure: Dialogue Concerning the Two Chief World Systems by Galileo

- 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.

Student Activity: Fill in the Scientist Names and Create a Timeline

Instructions: 1. Use the word bank to fill in the blank names. 2. Once completed, arrange the scientists in **chronological order** on a timeline.

Word Bank: Eudoxus, Aristotle, Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo Galilei

- ① _____ developed **concentric spheres** to explain planetary motion.
- ② _____ used a **telescope** to observe moons of Jupiter, phases of Venus, and publicly supported heliocentrism.
- ③ _____ proposed a **Sun-centered (heliocentric) universe** with circular orbits, still keeping some small epicycles.
- ④ _____ wrote the **Almagest** and introduced **epicycles** to explain **retrograde motion**.
- ⑤ _____ formulated **Kepler's laws of planetary motion**: elliptical orbits, equal areas in equal times, period-distance law.
- ⑥ _____ built precise observatories and collected extremely accurate astronomical data.
- ⑦ _____ proposed a **geocentric model** with a **spherical Earth** and **perfect circular orbits**.

Optional: Draw a simple timeline and place each scientist in chronological order.

Chronological Order of Scientists and Their Contributions:

- ① **Eudoxus** developed **concentric spheres** to explain planetary motion.
- ② **Aristotle** proposed a **geocentric model** with a **spherical Earth** and **perfect circular orbits**.
- ③ **Ptolemy** wrote the **Almagest** and introduced **epicycles** to explain **retrograde motion**.
- ④ **Copernicus** proposed a **Sun-centered (heliocentric) universe** with circular orbits, still keeping some small epicycles.
- ⑤ **Tycho Brahe** built precise observatories and collected extremely accurate astronomical data.
- ⑥ **Kepler** formulated **Kepler's laws of planetary motion**: elliptical orbits, equal areas in equal times, period-distance law.
- ⑦ **Galileo Galilei** used a **telescope** to observe moons of Jupiter, phases of Venus, and publicly supported heliocentrism.

Students can compare this with their filled-in word bank and check their timelines.

APA reference

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