Secondary Education

3rd year: Sections LH - SE

Physics

Chapter 7: History of Development of Astronomy

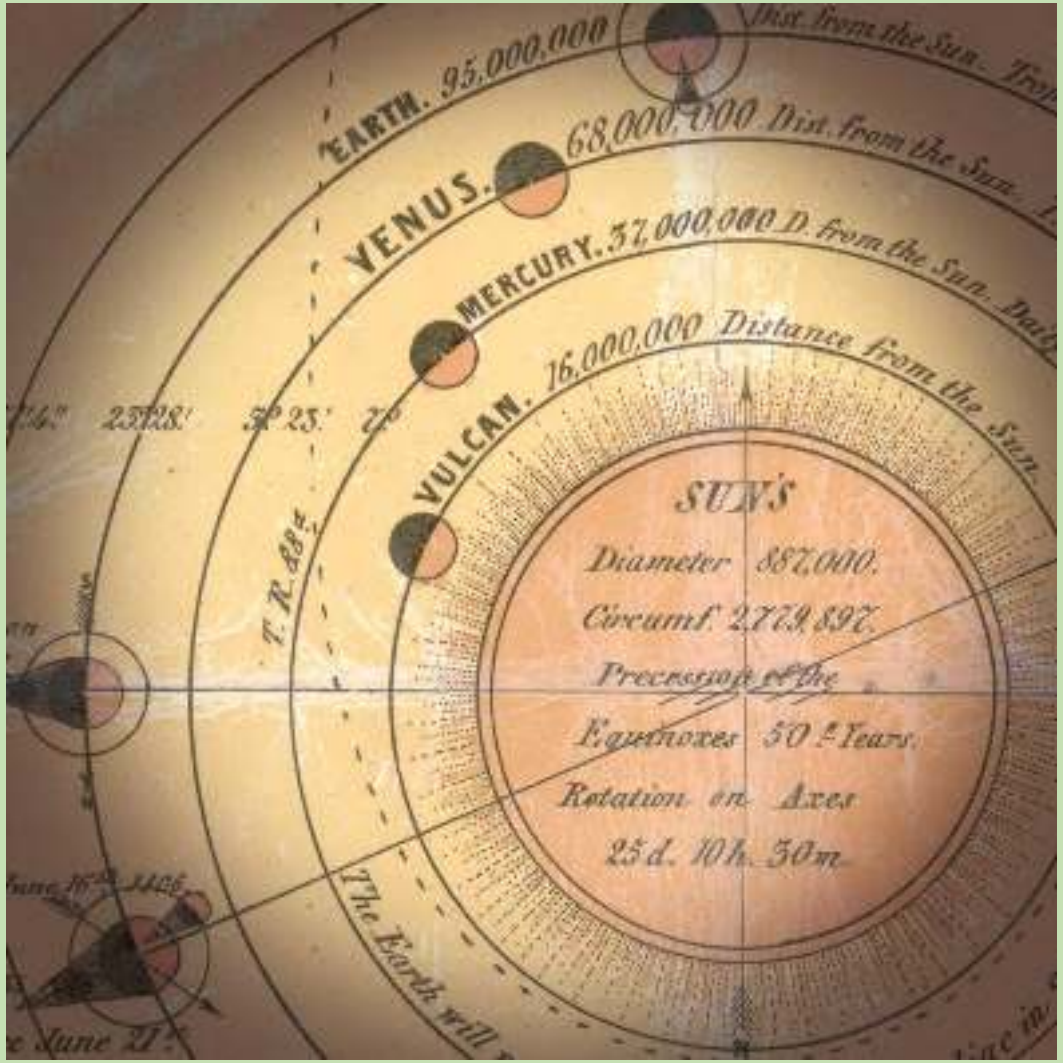
تم الاعتماد على الكتاب المدرسي الوطني الصادر عن المركز التربوي للبحوث والانماء

إعداد مصطفى سكرية

Chapter 7: History of Development of Astronomy

Objectives:

- Explain the geocentric theory of Aristotle and Ptolemy.
- Explain the heliocentric theory of Copernicus.
- Use Kepler's Laws.
- State the contributions of Galileo and Newton to astronomy.
- Define astrophysics.



Wikipedia.org

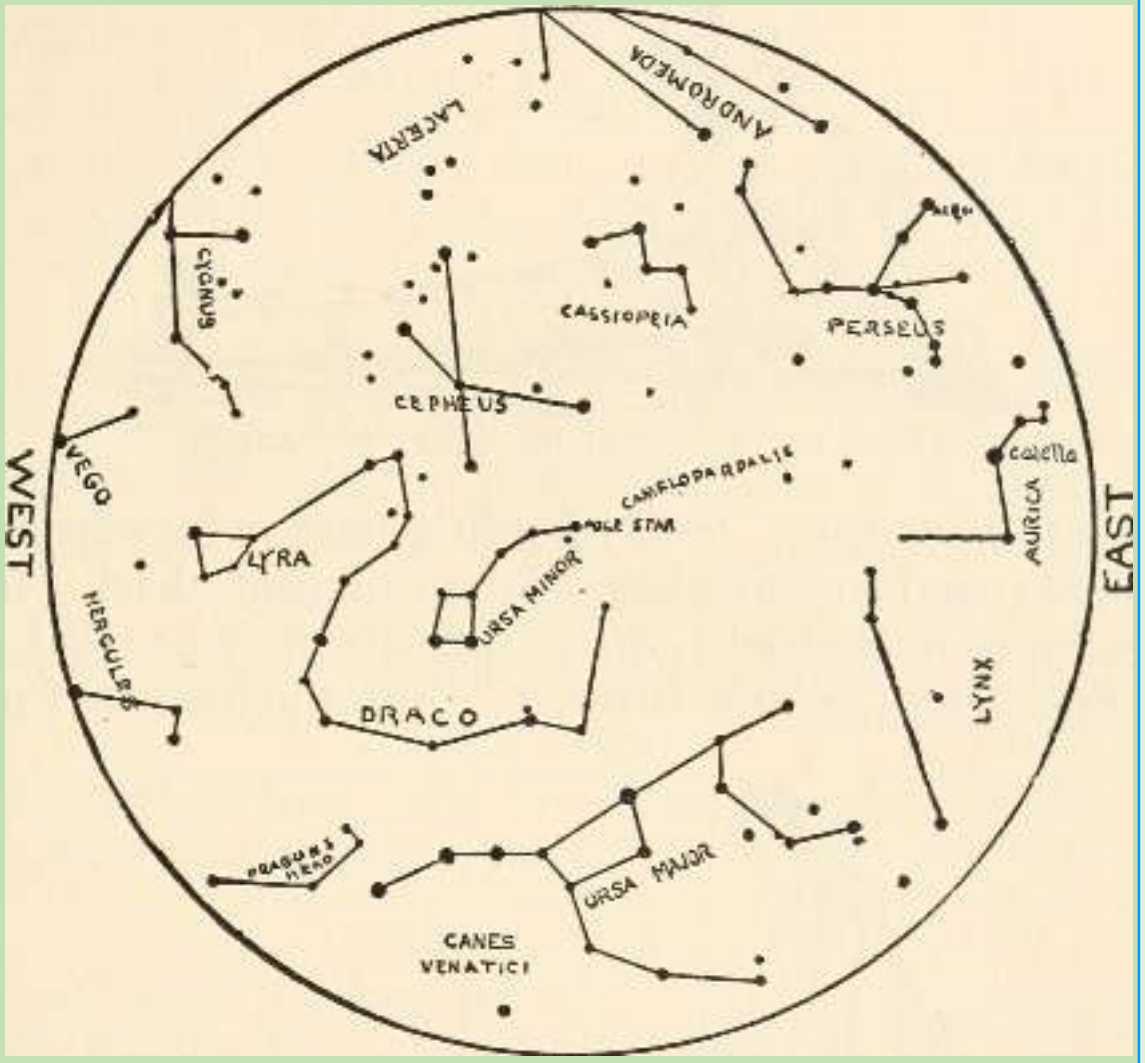
Chapter 7: History of Development of Astronomy

Astronomy or Astrology?

Astrology is an art founded on the study of stars in order to determine their influence on terrestrial events, on the lives and characters of people, and on their destiny.

Astronomy is the science that studies the position, motion, structure and evolution of celestial bodies: planets, stars, galaxies, etc.

Astronomy was born from the necessity of everyday life.



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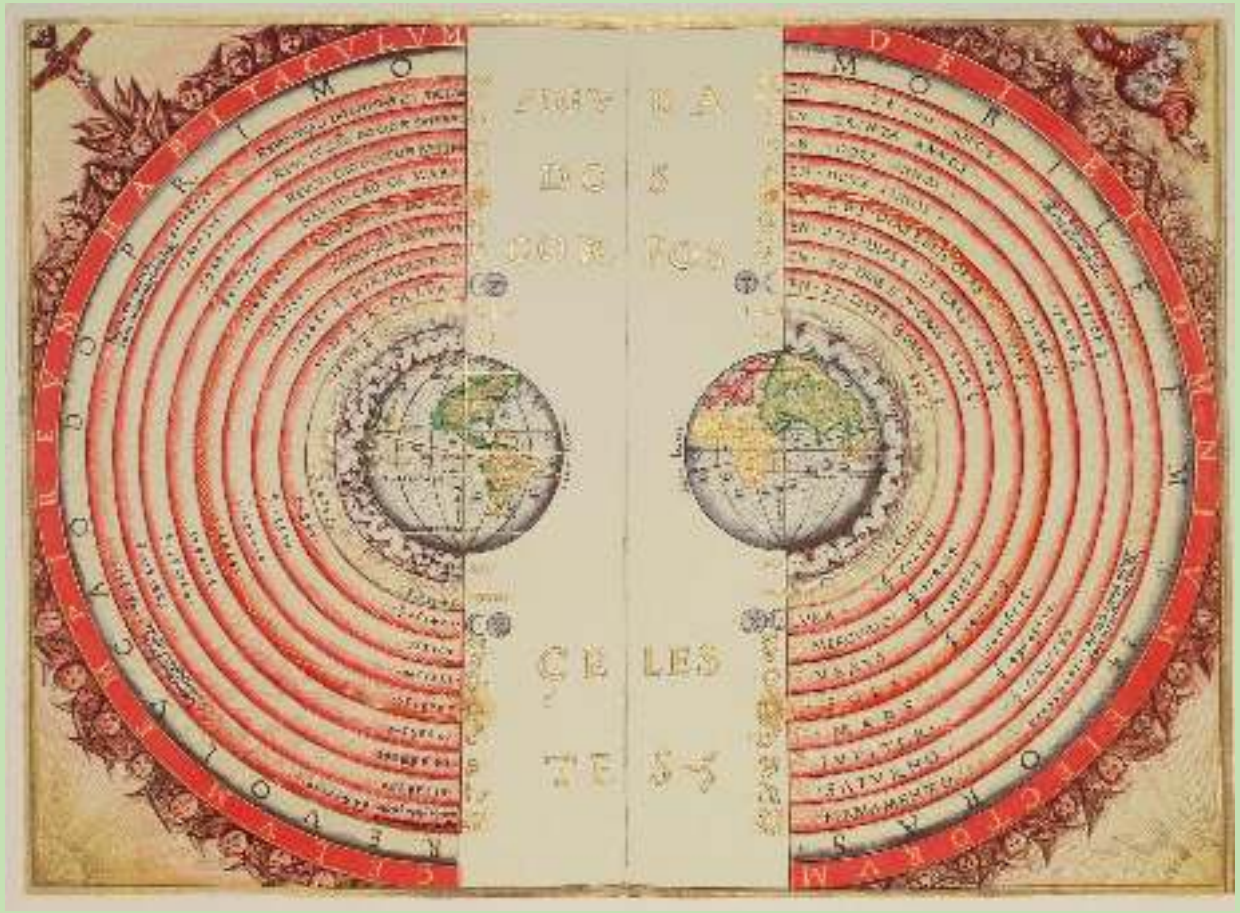
The Geocentric theory of Plato (428-348 B.C.) and Aristotle (384-322 B.C.)

- The Universe is spherical.
- All celestial bodies, including Earth, are spherical.
- Earth is immobile and is at the center of the Universe.
- Any celestial motion must be circular and uniform around Earth.
- The fixed stars are the farthest from Earth and are carried by a sphere whose period of revolution is one day.



wikipedia.org - Bartolomeu 1568

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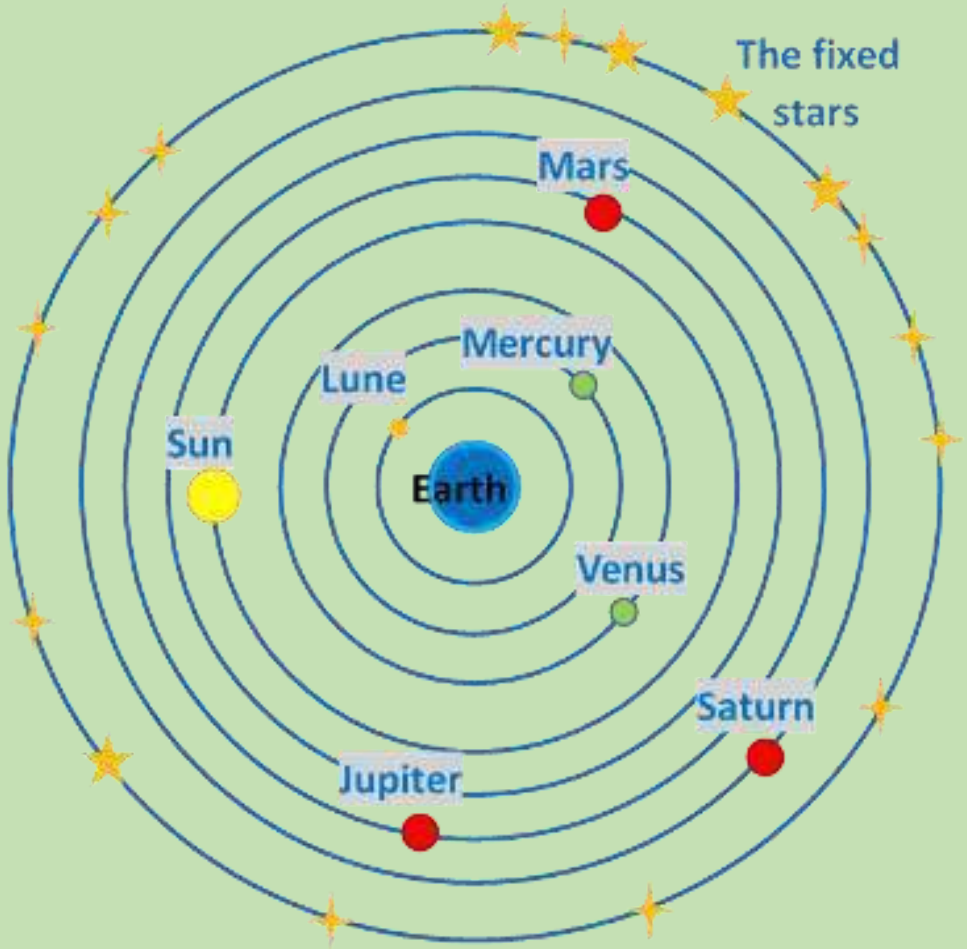
The Geocentric Ptolemaic System (70-147)

- Earth is immobile and is at the center of the Universe.
- The Moon and the Sun move uniformly along two circular orbits having the Earth as center.
- The other planets move uniformly along small circles called **epicycles**. The center of each epicycle moves along a circular orbit around Earth. This orbit is called the **deferent**.



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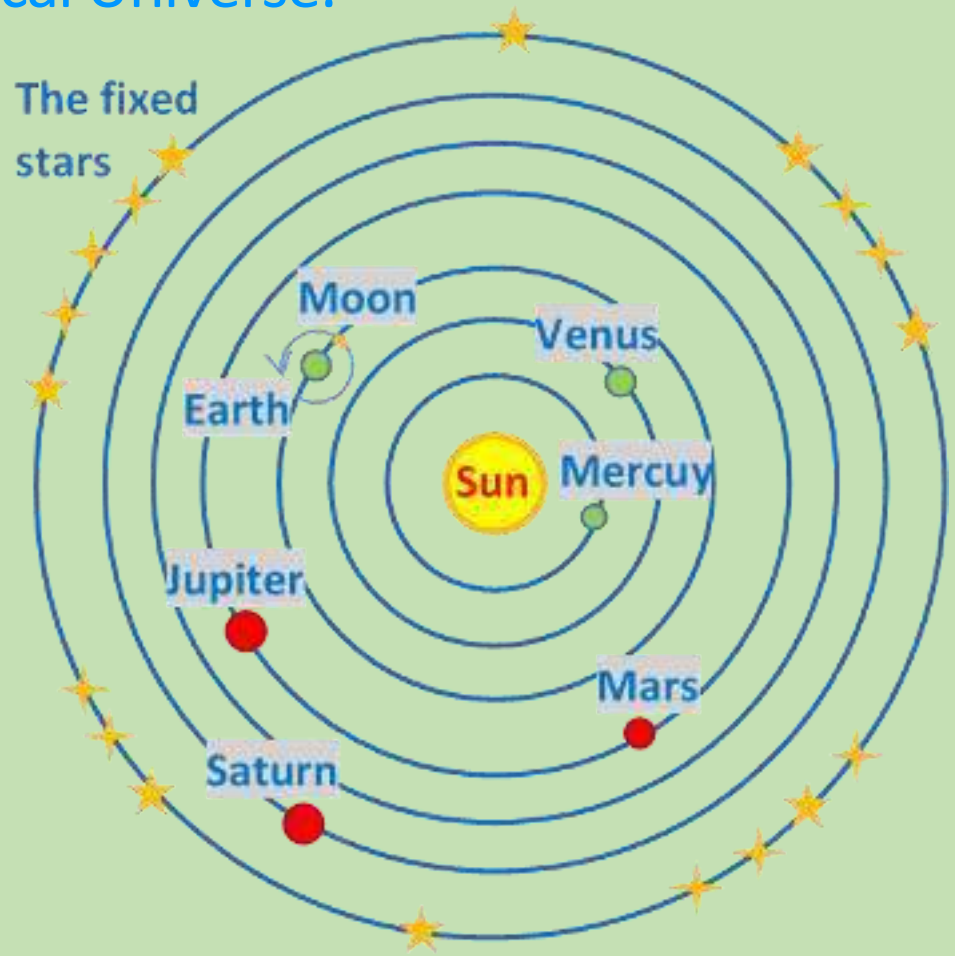
The Heliocentric theory of Copernicus (1473-1543)

- The Sun is immobile and is at the center of the spherical Universe.
- Earth is a planet like any other.
- The planets are carried by spheres, and each planet is driven by the uniform rotational motion of its sphere around the Sun.
- The fixed stars are carried by the sphere that has the longest radius.
- The Earth revolves around the Sun in one year, and at the same time rotates on itself in twenty-four hours.
- The Moon is a satellite of Earth and has a uniform circular motion around it .



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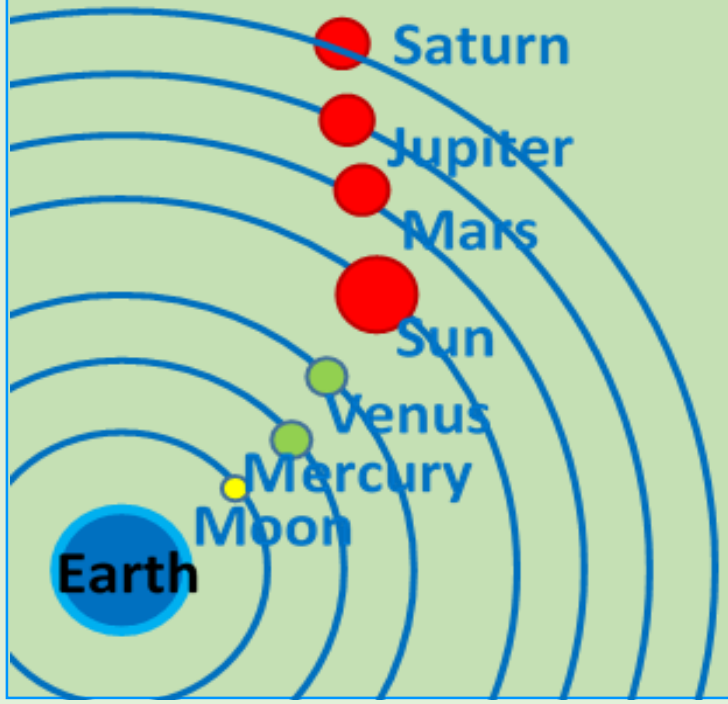
Difference between the geocentric and the heliocentric systems

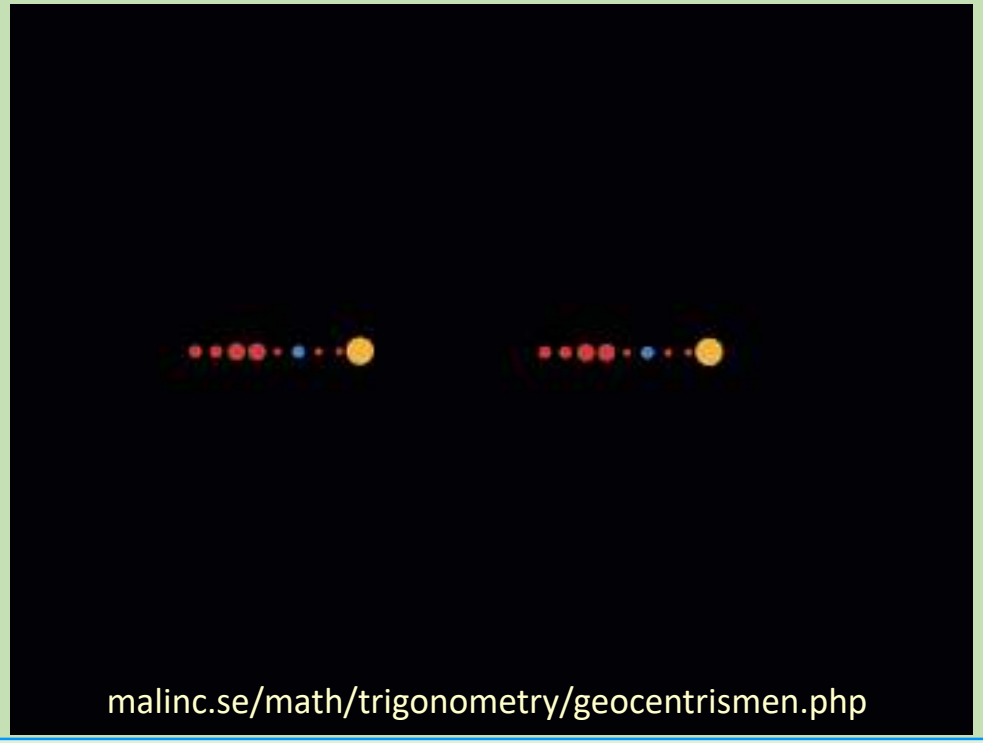
Geocentric system:

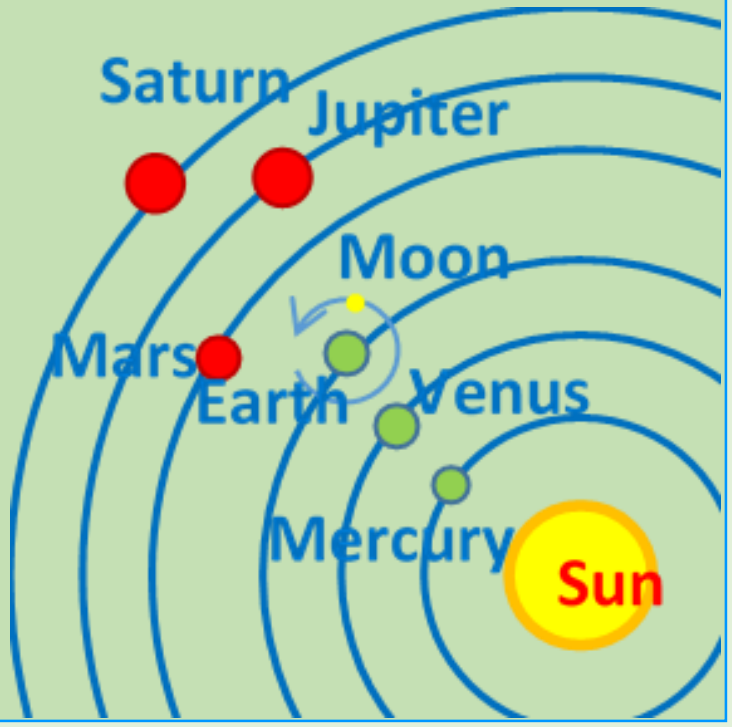
Earth is immobile and is at the center of the spherical Universe.

Heliocentric system:

The Sun is immobile and is at the center of the spherical Universe.







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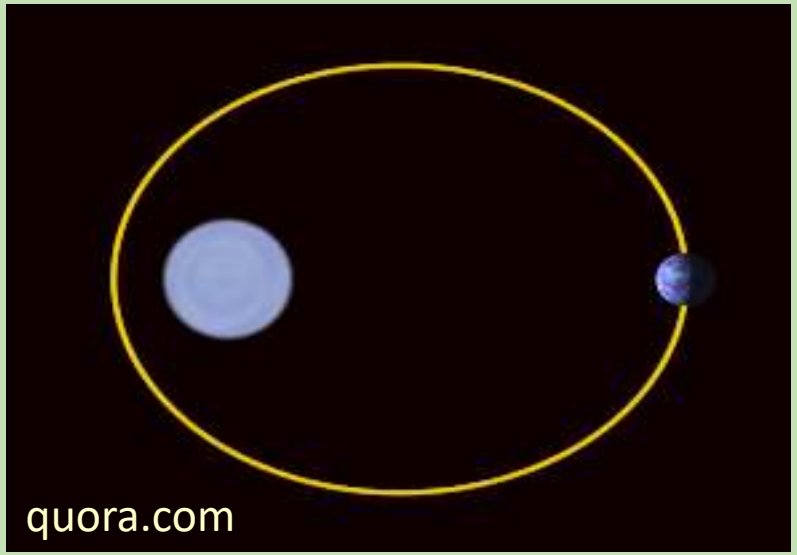
Kepler's Laws (1571-1630)

In 1601, the astronomer Tycho Brahe (1546-1601) died leaving all his paperwork to his assistant Johannes Kepler.

After long calculations, Kepler published his three empirical laws.

These laws give a complete description of the motion of the planets:

- **1st law:** The planets move along ellipses around the Sun that is at one of the foci.
- **2nd law:** The velocity of the planet is related to its distance from the Sun: The velocity decreases as the distance increases and vice versa.
- **3rd law:** The period of revolution of the planet increases with its average distance from the Sun.



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Application Exercise

1) Indicate the form of the trajectories described by the planets around the Sun, according to Kepler's first law.

The trajectories described by the planets around the Sun are ellipses.

2) State Kepler's second law.

The velocity of the planet is related to its distance from the Sun: The velocity decreases as the distance increases and vice versa.

3) The average distance of Venus and that of Uranus from the Sun are $d_1 = 0.72$ A.U and $d_2 = 19.19$ A.U. respectively.

The period of revolution of one of these two planets is 84 years and that of the other planet is 224.7 days. Which one is the period of Venus? Justify.

According to Kepler's 3rd law: The period of revolution of the planet increases with its average distance from the Sun. Then the period of revolution of Venus is 224.7 days. since Venus is closer to the Sun than Uranus

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Galileo Galilei (1564-1642)

Convinced by Copernicus' heliocentric theory, Galileo looked for the experimental proof. In 1609, he made the first telescope designed for astronomical observations.


quora.com

Isaac Newton (1643-1727)

After a few years, in 1687, Newton deduced, from Kepler's laws and from Galileo's Mechanism,
the law of universal gravitation:

Any two bodies attract each other with a force that varies with the inverse of the square of the distance between them and with the product of their masses.

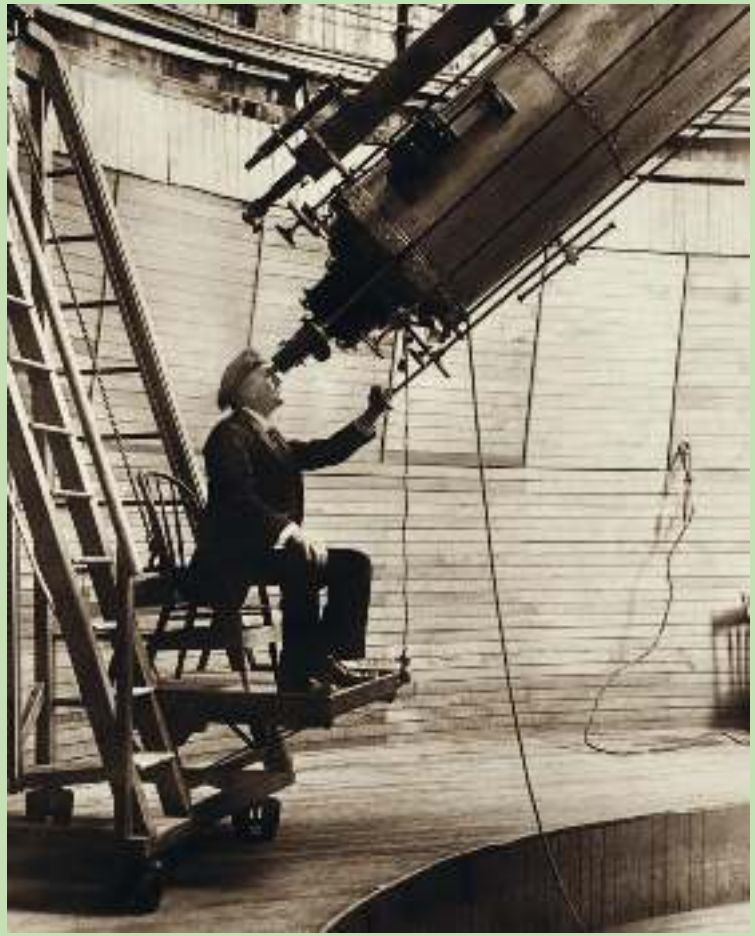
Chapter 7: History of Development of Astronomy

The Development of Astronomy in the 18th and 19th Centuries

The development of the instruments enabled Edmund **Halley** (1656-1742) to detect the motion of the stars and hence to put an end to the concept of sphere of fixed stars.

In 1781, William Herschel (1738-1822) discovered the seventh planet in the solar system, Uranus.

In the middle of the 19th century, **astrophysics** was born. Astrophysics is the science that studies the constitution, the physical properties, and the evolution of the stars.



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Chapitre 7 : Histoire du développement de l'astronomie

The Development of Astronomy in the 20th and 21th Centuries

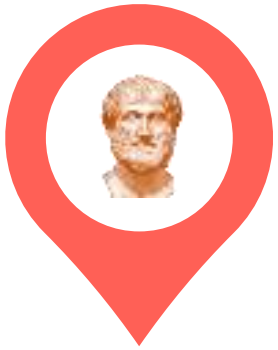
After the discovery of Pluto in 1930, Pluto was considered to be the ninth planet in the Solar System.

At the end of the 20th century and the beginning of the 21st century, more and more similar objects were discovered in the External Solar System, in particular Eris, estimated slightly larger and more massive than Pluto.

This evolution led the International Astronomical Union (IAU) to redefine the concept of planet, Ceres, Pluto and Eris being since 2006 classified as dwarf planets.

wikipedia.org
nasa.gov

Astronomy Timeline



384 B.C.

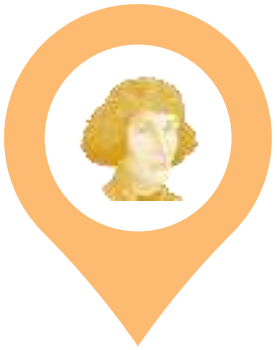
ARISTOTLE

The Geocentric Theory
The Earth is the center of the Universe

140

PTOLEMY

The Geocentric Theory
The Earth is the center of the solar system



1473

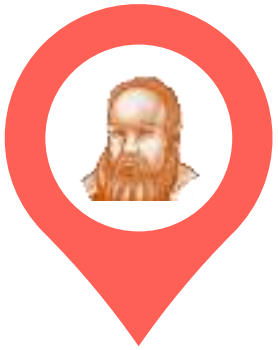
COPERNICUS

The Heliocentric Theory
The Sun is the center of the universe

1600

KEPLER

The Heliocentric Theory
Tree empirical laws for the motion of planets

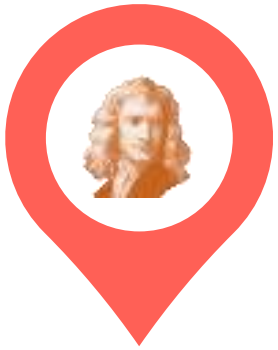


1609

GALILEI

He improved the telescope to study the planets and stars

Astronomy Timeline



1643

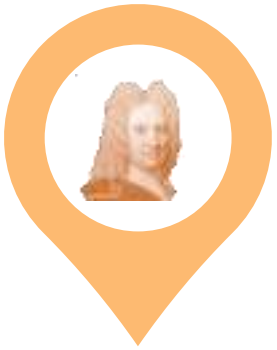
NEWTON

He defined the three laws of motion

1687

GRAVITY

Newton stated that everything in the universe was pulled by another object



1700

HALLEY

The development of the instruments enabled him to detect the motion of the stars

1781

HERSCHEL

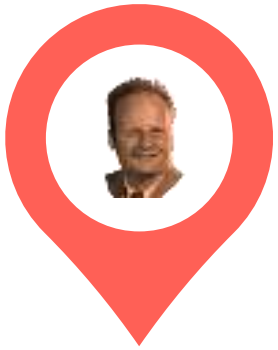
He discovered the seventh planet in the solar system, Uranus.

1930

PLUTO

Discovery of Pluto
It is the largest known dwarf planet.

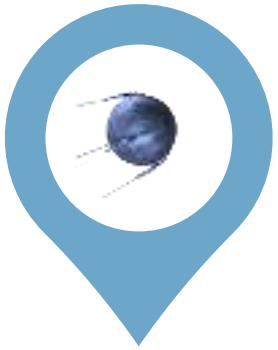
Astronomy Timeline



1938

HANS BETHE

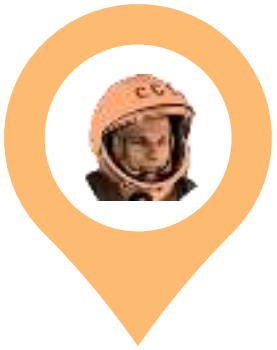
Explanation of how stars generate energy



1957

1ST SATELLITE

Russia launches the first artificial satellite, Sputnik 1



1961

YURI GAGARIN

Russia takes the lead in the space race. The first person orbited the Earth

1969

APOLLO 11

Neil Armstrong and Buzz Aldrin step onto the lunar surface

2019

BLACK HOLE

The first image of a black hole at the center of galaxy M87

Astronomy Timeline

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April 2020