



The Scientific Revolution

The Scientific Revolution

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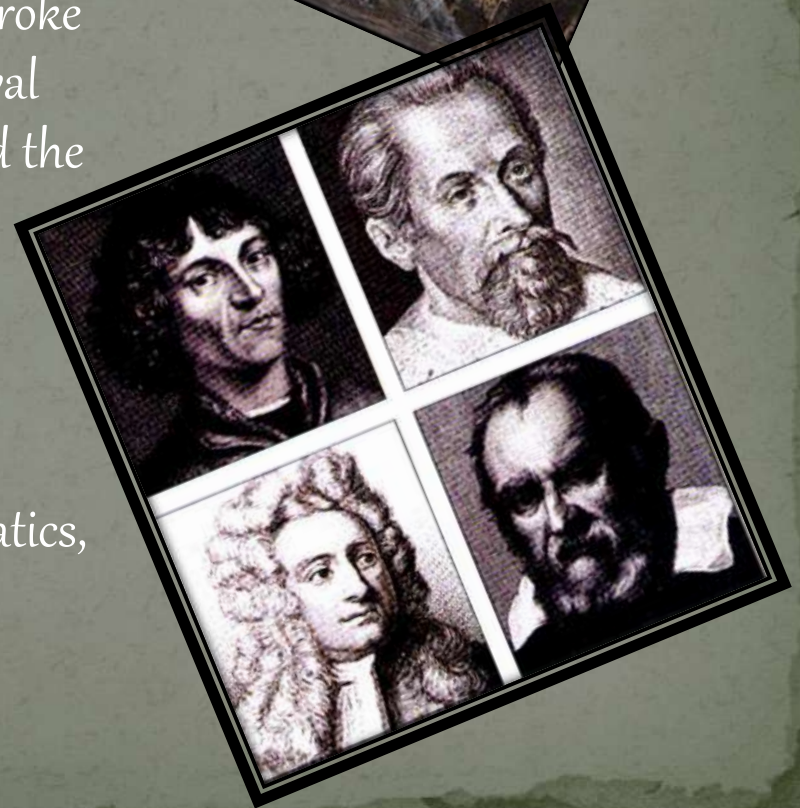
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Definition of The Scientific Revolution

- The **scientific revolution** refers to a series of events that mark the birth of science as we know today.
- The time span is roughly between 1500– 1700.
- It has been taken as the point when Europe broke away with her heritage of classical and medieval science, and from where “modern science” and the consequent “modern world” emerged.
- The individuals usually include Copernicus, Kepler, Galileo, Harvey, Descartes, Boyle and Newton.
- The subjects are astronomy, physics, mathematics, anatomy, physiology and chemistry.



Background and Origin

- *New ideas and items were introduced to Europe via trade relations with the east.*
- *Even during the middle ages university students started to study ancient sciences.*
- *Renaissance made people more interested in mathematics, anatomy, physiology and alchemy.*
- *Humanism placed Man as the centre of universe and proved that he can do anything.*
- *The invention of movable type printing.*
- *Reformation made people less dependent on religion.*
- *Long sea voyages and navigation required better quality instruments for navigation, mapping, shipbuilding and armaments. The New World provided new information virtually on everything, and it led to revisions of ideas about the natural world and new methods of organizing knowledge.*

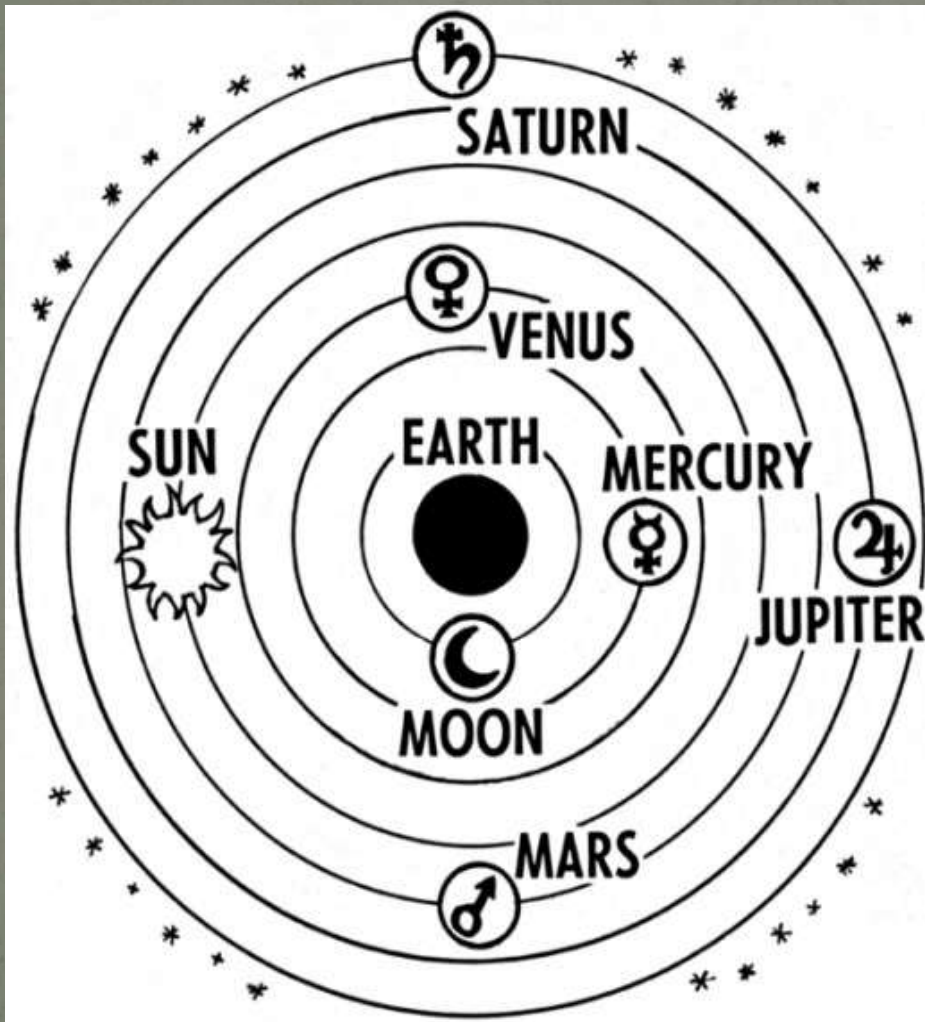
The older concepts: Aristotle and Ptolemy



- Until the mid 1500's, European scholars accepted and believed the teachings of Ptolemy, an ancient Greek astronomer
- Ptolemy taught that the Earth was the center of the universe
- People felt this was common sense, and the geocentric theory was supported by the Church.
- It was not until some startling discoveries caused Europeans to change the way they viewed the physical world.



Ptolemy's geocentric model of the solar system



- Ptolemy's geocentric model of the solar system:

1. Earth
2. Moon
3. Mercury
4. Venus
5. Sun
6. Mars
7. Jupiter
8. Saturn

The pioneers of scientific revolution: Nicholas Copernicus (1473-1543)

Major work:- *On the Revolutions of the Heavenly Spheres.*

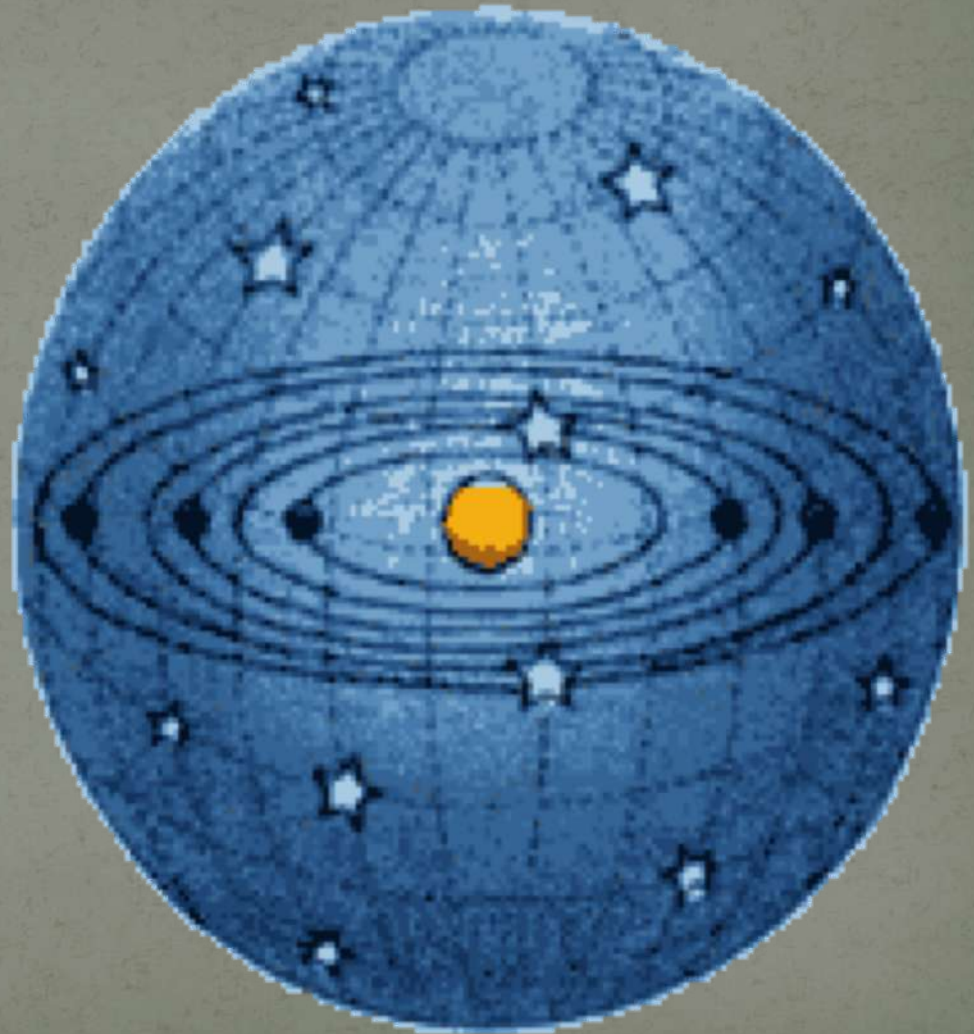


In his book, Copernicus made two conclusions:

1. The universe is heliocentric, or sun-centered.
2. The Earth is merely one of several planets revolving around the sun. The Copernican conception of the universe marked the start of modern science and astronomy

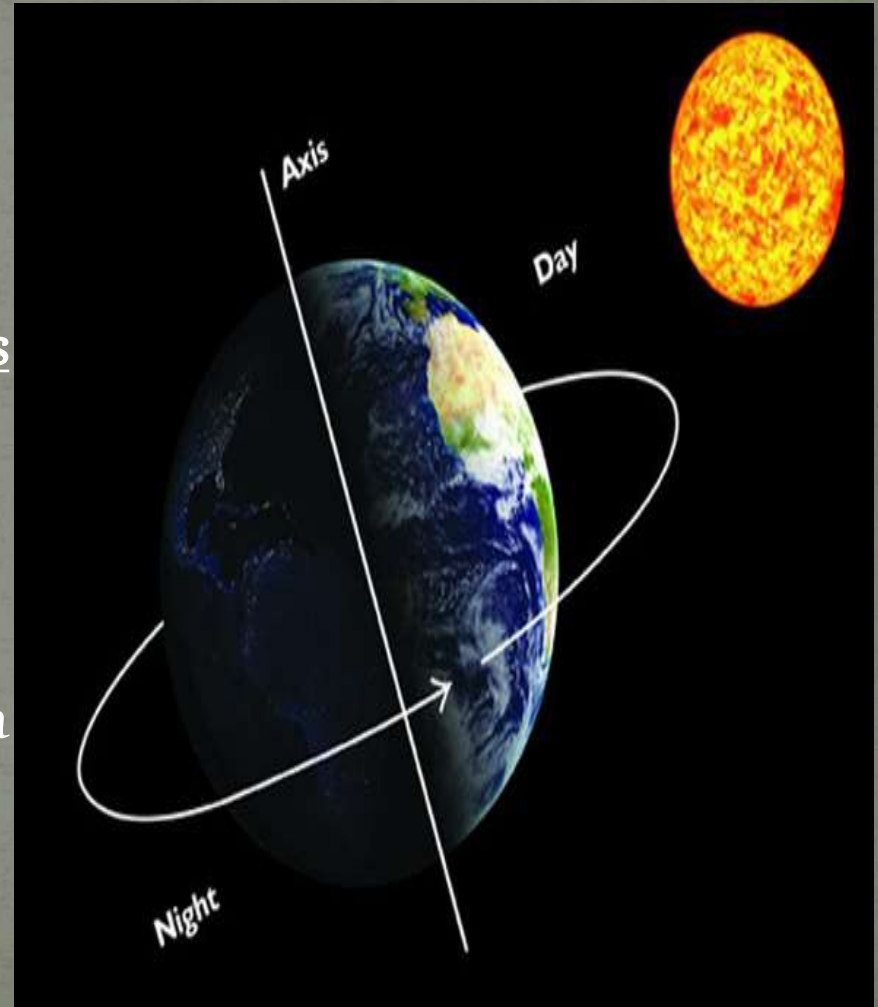
Copernicus' model of the solar system:

1. Sun
2. Moon
3. Mercury
4. Venus
5. Earth
6. Mars
7. Jupiter
8. Saturn



Reactions to Copernicus

- Most scholars rejected his theory because it went against Ptolemy and the Church, and because it called for the Earth to rotate on its axis.
- Many scientists of the time also felt that if Ptolemy's reasoning about the planets was wrong, then the whole system of human knowledge could be wrong.



Tycho Brahe (1546-1601)



- In the late 1500s, Danish astronomer Tycho Brahe provided evidence that supported Copernicus' heliocentric theory.
- Brahe set up an astronomical observatory.
- He carefully observed the sky, accumulating data about the movement of the stars and planets.

Johannes Kepler (1571-1630)

- After Brahe's death, his assistant, the German astronomer and mathematician Johannes Kepler, used Brahe's data to calculate the orbits of the planets revolving around the sun.
- Kepler's calculations supported Copernicus' heliocentric theory
- His calculations also showed that the planets moved in oval shaped orbits, and not perfect circles, as Ptolemy and Copernicus believed
- Kepler's findings help explain the paths followed by man-made satellites today.



Galileo Galilei (1564-1642)

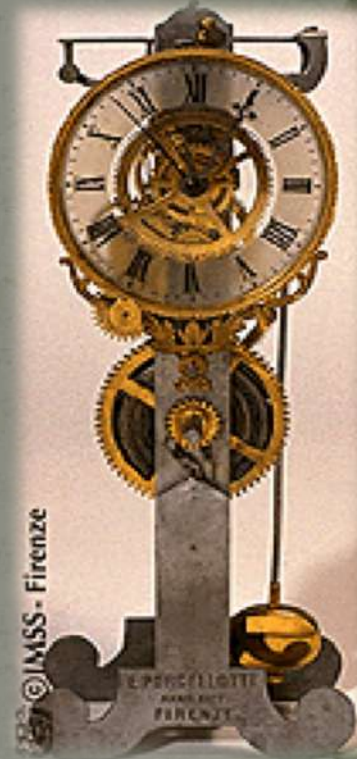


- Galileo Galilei was an Italian astronomer who built upon the scientific foundations laid by Copernicus and Kepler.
- Galileo assembled the first telescope which allowed him to see mountains on the moon and fiery spots on the sun.
- He also observed four moons rotating around Jupiter – exactly the way Copernicus said the Earth rotated around the sun.
- Galileo also discovered that objects fall at the same speed regardless of weight.

Inventions of Galileo Galilei



- 1593- thermo scope/older version of thermometer
- 1597- compass
- 1609-telescope
- 1641- pendulum clock



Galilean Moons

Images © NASA (Brian May edit)



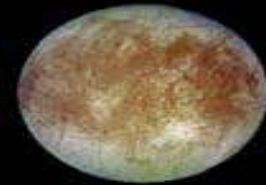
Ganymede
5262 km



Callisto
4820 km



Io
3642 km



Europa
3122 km

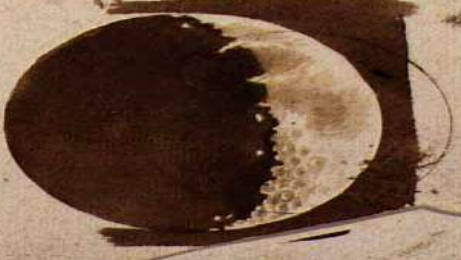


Earth's Moon
3474 km

Earth
12,756 km



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Scientific Method

- a new approach to science
- Emerged by the early 1600 and followed the prediction of mathematics
- used to confirm findings and to prove or disprove a hypothesis.
- did not rely on the classical thinkers or the Church
- depended upon a step-by-step process of observation and experimentation.
- Steps followed :
 1. State the problem
 2. Collect information
 3. Form a hypothesis
 4. Test the hypothesis
 5. Record & analyze data
 6. State a conclusion
 7. Repeat steps 1 – 6

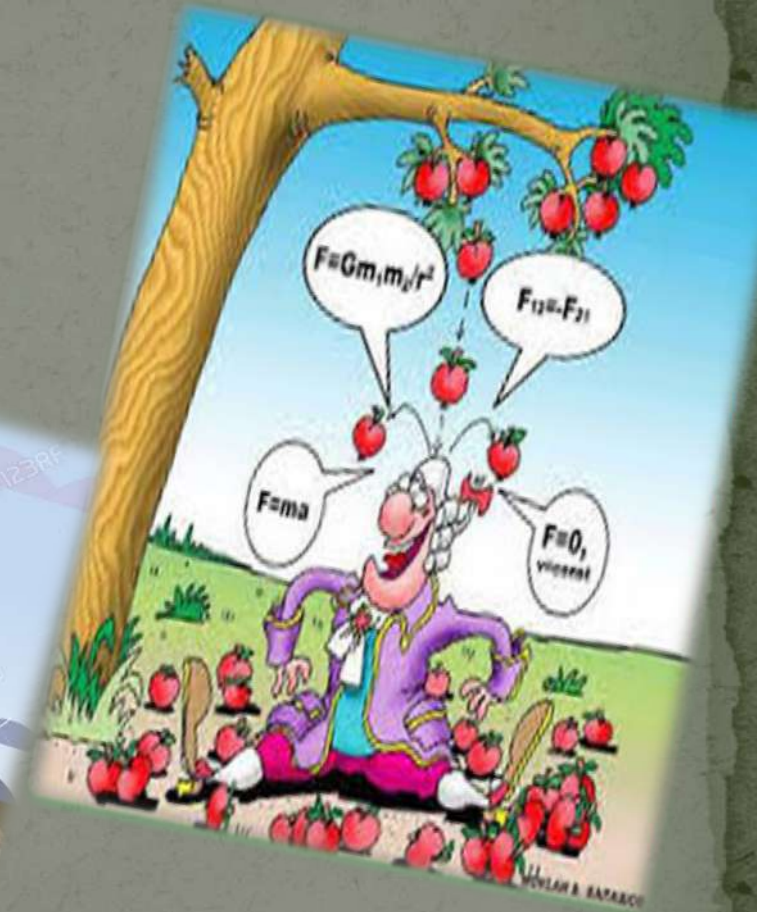


Isaac Newton (1642-1727)



- most influential scientist of the Scientific Revolution
- used mathematics to prove the existence of gravity - a force that kept planets in their orbits around the sun, and also caused objects to fall towards the earth.
- *major work- Principia; Mathematical Principles of Natural Philosophy (1687)*
- invented calculus: a method of mathematical analysis.
- discovered laws of light and color, and formulated the laws of motion:
 1. A body at rest stays at rest
 2. Acceleration is caused by force
 3. For every action there is an equal opposite reaction

The legend of Newton and his law of gravitation



Francis Bacon (1561-1626)



- Francis Bacon was an English philosopher who wrote *Advancement of Learning*.
- Bacon popularized the scientific method and used it with philosophy and knowledge
- Bacon argued that truth could not be known at the beginning of a question, but only at the end after a long process of investigation.

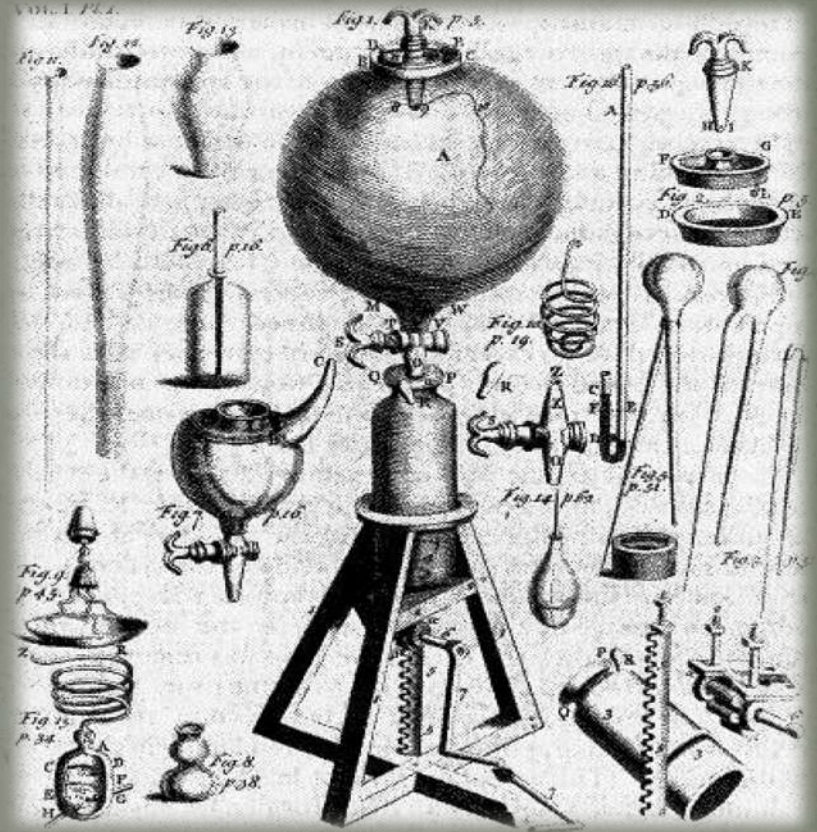
Rene Descartes (1596-1650)



- Descartes was a French scientist, mathematician, and philosopher.
- He emphasized human reasoning as the best road to understanding.
- Like Bacon, Descartes also believed that truth was only found after a long process of studying and investigation.

“I think, therefore I am”

Other scientific advances: Chemistry



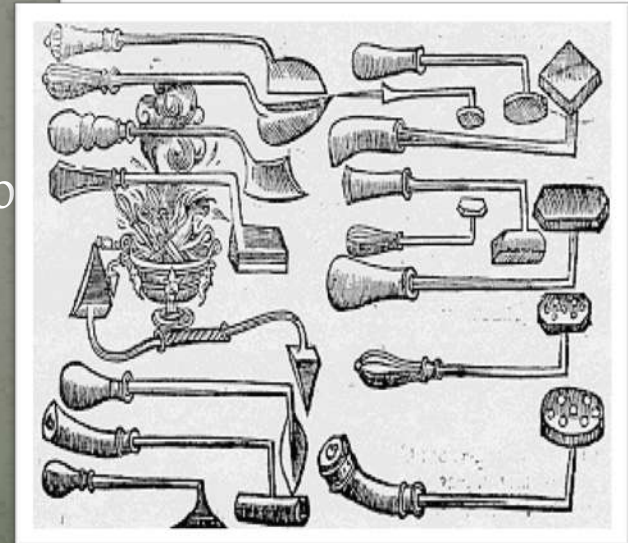
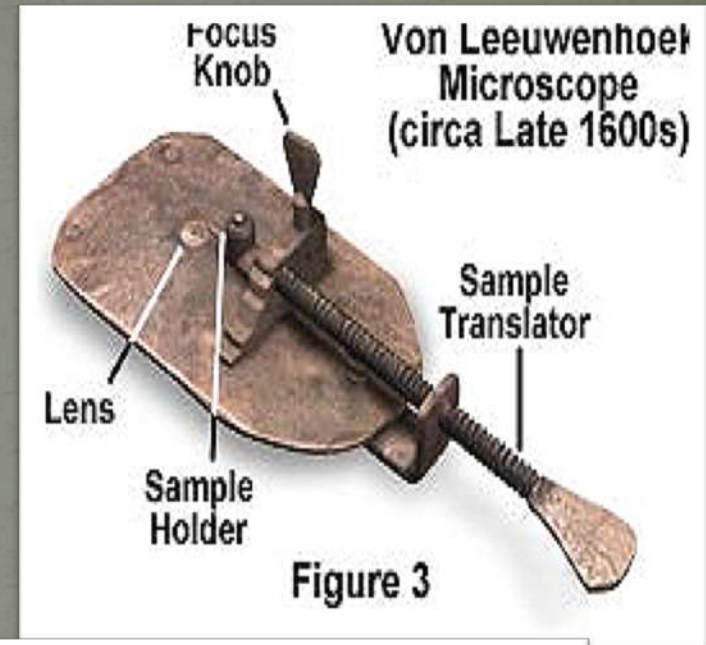
Robert Boyle and his air pump

Medicine: Human anatomy by Andreas Vesalius



Discoveries of medical science

- *Andreas Vesalius- Human Anatomy*
- *William Hervey- Circulation of Blood, heart's function as pump*
- *Ambroise Paré -new and more effective ointment for preventing infection, technique for closing wounds and stitches*
- *Anton Von Leeuwenhoek - perfected the microscope and became the first human to see cells and microorganisms.*





The consequences of scientific revolution

- Rise of the “Scientific Community”
 - Royal Society of London (1662)
 - Academy of Royal Sciences (1666)
- Emergence of the modern scientific method
- A universe ordered according to natural laws
- Laws discovered by human reason
- “De-Spiritualized” and de-mystified the Universe
- Mechanical View of the Universe
- Technological advancement
- Application on society: the enlightenment

Reaction of religious orthodox group



- *Role of orthodox Christianity*
- *Supporters of Older ideas*
- *Court of Inquisition*
- *Trials of Copernicus, Galileo*
- *Death sentences*



Galileo's trial

THE END