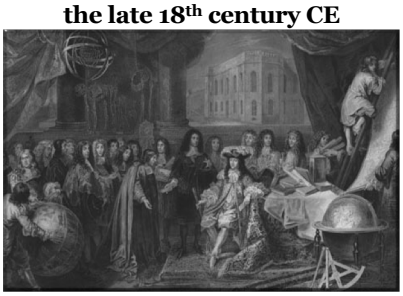
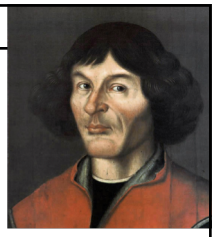
SSWH13: Examine the intellectual, political, social, and economic factors that changed the European worldview from the 16th century to the late 18th century CE

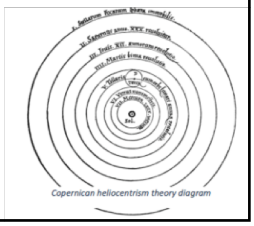


Element A: Explain the scientific contributions of Copernicus, Galileo, Kepler, and Newton and how these ideas changed the European worldview

Copernicus



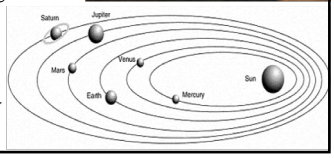
- Nicolaus Copernicus, a Polish scientist, published his argument for a helio- or sun-centered universe in 1543.
  - Although his work received little notice, it importantly abandoned Ptolemy's geo- or earth-centered construction of the universe that had been the accepted understanding since the 100s CE.
  - His case for the helio-centered universe denied experience: one could see the sun moving around the earth and couldn't feel the earth moving at all.



Copernican heliocentrism theory diagram

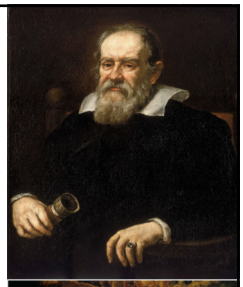
Kepler

- More than 60 years later, Johannes Kepler, a Danish mathematician tested and proved Copernicus' idea using models and mathematics.
  - He also discovered that planets orbit the sun, not in a circle, but in an oval-shaped ellipse (Theory of Planetary Motion).



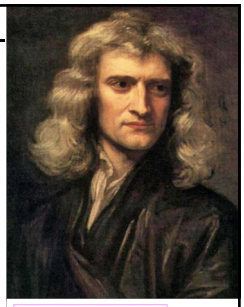
Galileo

- In Italy, Galileo Galilei looked in his telescope and, for the first time, saw mountains and valleys on the moon, spots on the sun, rings around Saturn, and moons orbiting Jupiter.
  - He thus further proved that not everything in the universe revolved around the earth.
  - He also disproved Aristotle by demonstrating that all objects fall at the same rate.
- His work, published in 1632, created an uproar in European society.
  - His challenge to the ancient worldview and church teachings was so upsetting that he was tried before the Inquisition and forced to recant his findings.



Newton

- English scientist, Isaac Newton, built on the work of Copernicus, Kepler, and Galileo in the 1680s.
  - He realized that the same force, gravity, that made objects fall to the earth also kept the planets in their orbits around the sun.
  - He explained the laws of motion and developed mathematics to measure motion.



Newton's Law of Universal Gravitation

The force of gravity, F_g, is given by

$$F_g = \frac{G m_1 m_2}{R^2}$$

where,

G = gravitational constant = 6.668×10^{-8} dynes cm^3 g^{-2}
m_1 = mass of object #1
m_2 = mass of object #2
R = distance between the objects

Scientific Revolution's Impact

- With the discoveries of these scientists, educated Europeans no longer believed the universe was being held in place and order by God.
  - They had to abandon ancient views of the universe and long-standing church doctrine.
  - Instead, they began to acknowledge the workings of physics and new understandings brought about by the Scientific Revolution.