Objectives

- Explain how new discoveries in astronomy changed the way people viewed the universe.
- Understand the new scientific method and how it developed.
- Analyze the contributions that Newton and other scientists made to the Scientific Revolution.
Terms and People

• Nicolaus Copernicus – Polish astronomer who proposed a heliocentric model of the universe

• heliocentric – Copernicus’s idea that the sun and not the Earth was at the center of the universe

• Tycho Brahe – Danish astronomer who collected data to prove that Copernicus was correct

• Johannes Kepler – mathematician who plotted the orbits of planets and discovered they are elliptical

• Galileo – the scientist who proved that the Earth moves around the sun; in 1633, the Inquisition forced him to recant his heliocentric views
Terms and People (continued)

- **Francis Bacon** – with Descartes, rejected the assumptions of Aristotle; viewed the scientific goal as improving technology, not supporting the Bible

- **René Descartes** – proposed the need to search for provable knowledge; the only assumption he could not question was doubt itself

- **scientific method** – a step-by-step process of discovery requiring the collection of accurately measured data

- **hypothesis** – a logical or possible explanation to a problem to be tested using the scientific method
Terms and People (continued)

- **Robert Boyle** – explained all matter as being composed of tiny particles that behave in knowable ways; proposed laws governing gases

- **Isaac Newton** – argued that there were uniform laws of nature and that all motions could be measured mathematically

- **gravity** – proposed by Newton as the force that keeps planets in orbit

- **calculus** – a branch of mathematics partially developed by Newton
How did discoveries in science lead to a new way of thinking for Europeans?

In the mid-1500s, a profound shift in scientific thinking brought the final break with Europe’s medieval past. At the heart of this Scientific Revolution was the assumption that mathematical laws governed nature and the universe.

People, therefore, could know, manage, and shape the physical world.
Until the mid-1500s, Europeans accepted Ptolemy and Aristotle, who believed the Earth was the center of the universe. This view had become Church doctrine.

In 1543, Polish astronomer Nicolaus Copernicus challenged this view.

- Copernicus proposed a heliocentric or sun-centered model.
- The Earth was just one of a number of planets revolving around the sun.
Copernicus’s revolutionary theory was rejected.

If the classic scholars were questioned, then all knowledge might be called into question.

But careful observations by **Tycho Brahe** supported Copernicus.

**Johannes Kepler** used Brahe’s data to calculate the orbits of the planets.

Kepler found that the planets don’t move in perfect circles as earlier believed.
In Italy Galileo Galilei built a telescope and observed several moons in orbit around Jupiter.

He said these movements were the same as those of the planets around the sun.

This contradicted Church doctrine that the Earth was the center of the universe.

Galileo was forced to recant his theories before the Inquisition.
Scientists rediscovered Greek philosopher Plato, who saw mathematics as the key to learning about the universe.

Despite opposition from the Church, a new approach to science emerged during the early 1600s.

Francis Bacon and René Descartes challenged medieval scholarship that sought only to make the world fit into the teachings of the Church.
Bacon and Descartes argued that truth is not known at the beginning of the inquiry, but rather at the end.

- Bacon stressed observation and experimentation.
- He wanted science to be useful in people’s lives.
Descartes emphasized human reasoning as the best road to understanding.

In his *Discourse on Method* (1637), he discarded all traditional authorities to search for knowledge that was provable.

The only thing he could not question was doubt.

"I think, therefore I am."

—Descartes
Over time, a step-by-step **scientific method** was developed. It required the collection of accurate data and the proposal of a logical **hypothesis** to be tested.
There were dramatic advances in medical knowledge in the 1500s and 1600s.

- Andreas Vesalius published *On the Structure of the Human Body* in 1543, the first accurate and detailed study of human anatomy.

- Anton van Leeuwenhoek perfected the microscope and became the first person to see cells and microorganisms.
There were dramatic advances in medical knowledge in the 1500s and 1600s.

- William Harvey described the circulation of blood, showing that the heart was a pump.

- Ambroise Paré developed new surgical techniques, tools, artificial limbs, and ointments to prevent infection.
Chemistry was transformed by the Scientific Revolution.

Medieval alchemists tried to transform ordinary metals into gold.

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**Isaac Newton** linked science and mathematics.

| Newton theorized that *gravity* was the force that controls the movements of the planets. | He believed that all motion in the universe can be measured and described mathematically. | He contributed to the development of *calculus*, a branch of mathematics, to help explain his laws. |
Section Review

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