### Monarchs of Europe: 1500–1800

#### Spain

<table>
<thead>
<tr>
<th>Ruler</th>
<th>Major Events</th>
<th>Results of Reign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charles V</td>
<td>Many enemies, Reformation, Peace of Augsburg</td>
<td>Spain powerful; empire divided between heirs</td>
</tr>
<tr>
<td>Philip II</td>
<td>Dutch revolt, Armada defeat</td>
<td>Spain weakened</td>
</tr>
</tbody>
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#### England

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<tr>
<th>Ruler</th>
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<tbody>
<tr>
<td>Henry VIII</td>
<td>Split with pope</td>
<td>Parliament strengthened</td>
</tr>
<tr>
<td>Elizabeth I</td>
<td>War with Spain</td>
<td>England undefeated</td>
</tr>
<tr>
<td>Charles I</td>
<td>Led troops into Parliament</td>
<td>Executed amid English Civil War</td>
</tr>
<tr>
<td>Cromwell</td>
<td>Civil War, conflicts abroad</td>
<td>Ruled alone, created resentment</td>
</tr>
<tr>
<td>Charles II</td>
<td>Restoration</td>
<td>Habeas Corpus Act</td>
</tr>
<tr>
<td>William and Mary</td>
<td>Glorious Revolution, English Bill of Rights</td>
<td>Parliament's power greatly increased</td>
</tr>
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#### France

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<tr>
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<tr>
<td>Henry IV</td>
<td>Survived massacre, issued Edict of Nantes</td>
<td>Calmed religious conflict, repaired war-torn country</td>
</tr>
<tr>
<td>Louis XIII</td>
<td>La Rochelle, clash with nobles, Thirty Years' War</td>
<td>Huguenots and nobles weakened</td>
</tr>
<tr>
<td>Louis XIV</td>
<td>Versailles built, revocation of the Edict of Nantes, military buildup</td>
<td>Absolutism firmly established, economic growth, expensive wars</td>
</tr>
</tbody>
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#### Russia

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<tbody>
<tr>
<td>Ivan IV</td>
<td>Reforms, expanded territory, terror</td>
<td>Time of Troubles</td>
</tr>
<tr>
<td>Peter I (the Great)</td>
<td>Reforms, streltsy rebellion, St. Petersburg built</td>
<td>Beginning of westernization</td>
</tr>
<tr>
<td>Catherine II (the Great)</td>
<td>Rebellion, rural government reform</td>
<td>More power for nobles over serfs</td>
</tr>
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</table>

#### Central Europe

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<tr>
<th>Ruler</th>
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</thead>
<tbody>
<tr>
<td>Maria Theresa (Austria)</td>
<td>War of Austrian Succession, Seven Years War</td>
<td>Continued competition with Hohenzollerns</td>
</tr>
<tr>
<td>Frederick II (the Great) (Prussia)</td>
<td>War of Austrian Succession, Seven Years War</td>
<td>Prussia as major European power</td>
</tr>
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</table>
Enlightenment and Revolution

1550–1800

The Big Picture
Beginning in the late 1500s, new discoveries and the use of reason in Europe during the Scientific Revolution and the Enlightenment led to changing ideas about government and society. Influenced by Enlightenment ideas, British colonists in North America established a new nation—the United States.

Theme
Science and Technology
Between about 1550 and 1800, scientists in Europe made advances in science through observation and experimentation. In this chapter, you will study these discoveries in science and learn how they affected the world.
Main Idea

New ways of thinking led to remarkable discoveries during the Scientific Revolution.

Content Statement 5 /Learning Goal (Ch 5-1)
Describe how the Scientific Revolution’s impact on religious, political and cultural institutions challenged how people viewed the world.

Content Statement 6/Learning Goal (Ch 5-2)
Describe how Enlightenment thinkers applied reason to discover natural laws guiding human nature in social, political and economic institutions

Content Statement 7/Learning Goal
Analyze how Enlightenment ideas challenged practices related to religious authority, absolute rule and mercantilism
• Geocentric theory: a scientific theory that has the earth as the center of the universe with the sun and stars revolving around it.

• Scientific revolution: a transformation in European thought in the 1500s and 1600s that called for scientific observation, experimentation, and questioning of traditional opinions.

• Scientific method: a method of inquiry that promotes observing, measuring, explaining, and verifying as a way to gain scientific knowledge.

• Heliocentric theory: scientific theory that has the sun as the center of the universe with the earth rotating around the sun.
1) **Dawn of Modern Science**

Some Middle Ages scholars sought answers about the natural world from the church.

<table>
<thead>
<tr>
<th>1) The Old View</th>
<th>2) New Viewpoints 1550’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Scholars relied on traditional authorities for beliefs of the universe</td>
<td><strong>Scientific Revolution</strong>, new way of thinking, posed theories, and developed procedures to test ideas</td>
</tr>
<tr>
<td>• <strong>Geocentric theory</strong>, Aristotle</td>
<td>• Why open to new ideas?</td>
</tr>
<tr>
<td>– Earth center of universe</td>
<td>– Reformation/printing press <strong>Chapter 1</strong></td>
</tr>
<tr>
<td>– Sun, moon, planets revolved around earth</td>
<td>– Exploration <strong>Chapter 2</strong></td>
</tr>
<tr>
<td>• Ideas upheld by church, accepted authority for European intellectuals</td>
<td>– New lands, new people, new animals</td>
</tr>
</tbody>
</table>
Ancient scholars could provide no information about new lands, people, animals

- Age of Exploration led scientists to study natural world more closely
- Other things to be discovered, things unknown to ancients
- Navigators needed more accurate instruments, geographic knowledge
- Scientists examined natural world, found it did not match ancient beliefs
3) The Scientific Method

New Approach to Investigation

- **Scientific Method**: a set of techniques for acquiring new knowledge about the natural world based on observable, measurable evidence.
  - Identify problem
  - Form hypothesis
  - Perform experiments to test hypothesis
  - Record results
  - Analyze results, form conclusion
  - P. 171

Scientific Method Scholars

- Two most important scholars in developing scientific method were **Bacon** and **Descartes**
  - **Francis Bacon**, experimentation to gain scientific knowledge
  - **Rene Descartes**, reason key
    - Believed everything should be doubted until proved by reason
    - Relied on math, logic
    - Influence modern scientific methods
The Scientific Method is a set of techniques for acquiring new knowledge about the natural world based on observable, measurable evidence.

**Step 1** Identify a problem or a research question to be answered.

**Step 2** Form a hypothesis that can be tested. A hypothesis is a proposed answer to the research question and is based on previous knowledge.

**Step 3** Perform experiments to test the hypothesis.

**Step 4** Record the results of the experiments.

**Step 5** Analyze the results of the experiments to form a conclusion that either proves or disproves the hypothesis.
Early scientists

• Made significant contributions in astronomy, physics and math

4) Copernicus

• Found geocentric theory of movement of sun, moon, planets not accurate
• Heliocentric theory, earth revolves around sun
• Concluded sun, not earth, near center of solar system
  • Copernicus developed detailed mathematical explanation of process
  • Was first scientist to create complete model of solar system
4) Copernicus Continued

- Copernicus’ famous book not published until last year of his life
- Knew church would oppose work
- Work contradicted teachings of church

Weaknesses of theory

- Mathematical formulas did not predict positions of planets well
- Copernicus did not want to be ridiculed for weaknesses
- Died 1543 after work published, other scientists expanded on ideas
5) Brahe and Kepler

*Brahe, Danish Astronomer*

- Brahe Discovered a *supernova*, distant exploding star suddenly visible on earth
- Book impressed Denmark’s King Frederick II
- Gave Brahe money to build two observatories

**Observations**

- Developed system to explain planetary movement
- Believed sun revolved around earth
- Other five known planets revolved around sun

**Kepler, German Mathematician**

- Hired as Brahe’s assistant to form mathematical theory from measurements of planets
- Published result of measurements of orbit of Mars after Brahe’s death
5) Kepler, German Mathematician

• Brahe’s assistant

• Kepler solved main problem of Copernican theory (1595)

• Copernicus assumed planets orbited in circle

• Kepler found assumption untrue

• Proved planets orbited in oval pattern, ellipse

• Wanted to prove Copernicus wrong, instead proved heliocentric theory correct

• Kepler’s mathematical solar system model also correct
Discoveries in Astronomy, Physics, and Math

6) Galileo Galilei

- Built first telescope used for astronomy
- Craters on moon, sunspots
- Saturn, moons of Jupiter
- Milky Way made up of stars

7) Isaac Newton

- Brought together astronomy, physics, math
- Book explained law of universal gravitation
- Gravity affects objects on earth, also in universe
- Keeps planets in orbit
Newton’s Findings

Newton developed calculus, new kind of math

- Used calculus to predict effects of gravity
- German philosopher Gottfried von Leibniz also developed calculus at same time
- Each accused the other of plagiarism
- Historians believe it was simple case of independent discovery
Section 1

Enlightenment and Revolution

The church feared reason as an enemy of faith, but eventually began to embrace some of the achievements of the Scientific Revolution.

Table: Science and the Church

<table>
<thead>
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<th>Science and the Church</th>
<th>Conflicts</th>
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<tr>
<td>Church was primary resource for knowledge, learning</td>
<td>Most scientists did not want to challenge role of Christianity</td>
</tr>
<tr>
<td>Cathedral schools, universities trained people to run the church</td>
<td>Church explained world through inspiration, revealed truth</td>
</tr>
<tr>
<td></td>
<td>Science explained world through logical reasoning</td>
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The church feared reason as an enemy of faith, but eventually began to embrace some of the achievements of the Scientific Revolution.
8) Science and the Church

**Galileo’s Theories**

- Brought him into direct conflict with the church
- Church leaders pressured him not to support ideas of Copernicus
- *Dialogue concerning Two Chief World Systems, 1632*, showed support

**Trial 1633**

- Pope Urban VII ordered Galileo to Rome to stand trial before Inquisition
- Church wanted to stamp out heresy, or dissenting views

**House Arrest**

- Galileo stated would not use Copernican theory in work in order to receive more lenient sentence.
- Pope ordered Galileo under house arrest, where he spent rest of life
Scientists used the scientific method to acquire new knowledge and make great discoveries in the fields of Biology and Chemistry.

**Vesalius**
- Used bodies of executed criminals for dissection
- Hired artists to produce accurate drawings
- *On the Workings of the Human Body, 1543*

**William Harvey**
- English physician, early 1600s
- Observed, explained workings of human heart
- Described blood, circulatory system functions
Antony van Leeuwenhoek, Dutch scientist, 1600s
• Used interest in developing magnifying lens to invent microscope

Robert Hooke, English physician, inventor
• Used early microscope to describe appearance of plants at microscopic level
• Credited with creating the term cell
Enlightenment and Revolution

Chemistry

**Robert Boyle**
- Father of modern chemistry
- First to define *element*
- *The Sceptical Chemist*, 1661, described matter as cluster of tiny particles (now called atoms)
- Changes in matter occurred when clusters rearranged

**Antoine-Laurent Lavoisier**
- French chemist, 1700s
- Developed methods for precise measurements
- Discovered law of Conservation of Mass, proved matter could not be created, destroyed
- Recognized, named oxygen, introduced metric system, invented first periodic table
**Science and Art**

### Renaissance
- Study of art, architecture not separate from study of science
- Artists learned anatomy in order to paint the body

### Architecture
- Mathematics, physics crucial to great architecture
- Also used in engineering achievements of the time

### Artists
- Experimented with chemistry of paints, nature of light
- Used math to create compositions of perfect balance

### Science and religion
- Combined to produce great artistic achievements of the Renaissance
- Most art, architecture dedicated to glory of God
Science and Community Summary

- Scientific Revolution established new way of thinking about physical world
- Great advances made in astronomy, physics, biology, chemistry
- Advances influenced developments in arts, architecture
- Scientific Revolution soon would cause philosophers, scholars to wonder if reason could solve poverty, war, ignorance