

## Unit 5

### Scientific Revolution and Enlightenment

#### **Section 1: Scientific Revolution**

##### **What was the Scientific Revolution?**

- "Scientific Revolution" refers to:
  - historical changes in thought & belief
  - changes in social & institutional organization that unfolded in Europe between roughly 1550-1700
- Began with Nicholas Copernicus (1473-1543), who claimed a heliocentric (sun-centered) universe
- Ended with Isaac Newton (1642-1727)

##### **Scientific Revolution**

- All of the following groups were involved in the S.R.
  - Mathematicians
  - Astronomers
  - Philosophers
- The chronology overlaps with other significant events taking place in the world
  - What is often seen as the start of the Scientific Revolution, Copernicus in 1543, occurs at the same time as religious wars are breaking out

##### **New Ways of Thinking**

- The S.R. did NOT begin in a momentary flash of brilliance
- Did NOT immediately change the world
- It was NOT a single change
- Scientific revolutionaries sought to break free from traditional beliefs
  - They not only criticized, but replaced the medieval world view with their own
  - Far reaching repercussions= changed ideas of religion and God and man

##### **Medieval View of Science**

- Most knowledge in Middle Ages came from Bible, Greek/Roman sources
  - Supports geocentric theory—Moon, Sun, Planets revolve around Earth (Earth was considered the center of the universe)
- Renaissance prompts new ways of thinking
- Scientific Revolution—new way of viewing natural world—based on observation, inquiry
- New discoveries, overseas exploration opens up thinking

## **The Roots of Modern Science**

- Inventions made new scientific research possible
  - Telescope
  - Microscope
  - Printing press- spread innovative ideas quickly and easily

## **The Geocentric Theory**

- Widely accepted geocentric/Ptolemaic theory challenged as inaccurate
  - Ptolemaic/geocentric concept of the universe presented the earth as a fixed unmoving mass at the center of the universe
  - The spheres that surrounded the earth were made of a crystalline, transparent substance and moved in circular orbits around the earth
  - Beyond the tenth sphere was the Empyrean Heaven- the location of God and all the saved soul

## **The Heliocentric Theory- Copernicus**

- Copernicus develops heliocentric theory (opposed Ptolemy's theory)—planets revolve around sun which was at the center of the universe
  - The movement of the sun around the earth was really explained by the daily rotation of the earth on its axis
- Did not reject that the heavenly spheres moved in circular orbits (he was in error)

## **The Heliocentric Theory- Kepler**

- Kepler- German mathematician and astronomer who added to Copernican theory
- Realized that the orbits of the planets were not circles but were instead "flattened circles" called ellipses

## **Galileo Galilei (1564-1642)**

- First to make systematic observations of space
- Planets + Earth + Moon all seemed to be made of the same material
- Made his theories public in *The Starry Messenger* (1610)
- The Catholic Church ordered Galileo to abandon his ideas
  - Church attacked Copernican thesis because it removed humans from the center of the universe and God from a definite location
  - The heavens were no longer a spiritual world but a world of matter

### **Isaac Newton (1642-1726)**

- Considered the greatest genius of the Scientific Revolution
- In the first book of *Principia* Newton defined the three laws of motion that govern the planetary bodies, as well as objects on earth
- Newton supplied the first comprehensible development of the new theory of the universe that combined the work of Copernicus, Kepler, and Galileo
  - Created a new cosmology (study/concept of the universe)
  - Gave a mechanical explanation of the universe
  - Universal motion mathematically explained- solved the questions of how the planets move in an orderly fashion

### **Newton's Universal Law of Gravitation**

- Newton explained that every object in the universe is attracted to every other object by a force called gravity
  - Newton's world-machine concept dominated the modern worldview until the twentieth century when Einstein presented his concept of relativity
- Theories had major political + spiritual ramifications

### **Scientific Revolution Spreads**

- Medicine and the Human Body
  - Andreas Vesalius improves knowledge of anatomy
  - Edward Jenner produces world's first vaccination—for smallpox
- Discoveries in Chemistry
  - Robert Boyle argues that matter is made of many different particles
  - Boyle's law reveals interaction of volume, temperature, gas pressure

### **Scientific Method**

- Bacon and Descartes help to create the scientific method
- Bacon urges scientists to experiment before drawing conclusions
- Descartes advocates using logic, math to reason out basic truths
- Bacon, a lawyer, believed that scientific investigation must be built on inductive principles
  - Inductive inquiry= A scientist should go from particular to general

### **Why the Scientific Revolution in Europe?**

- In the Middle Ages China was the most technologically advanced society in the world- after 1500 the West takes that distinction.
- Theories:
  - Chinese valued order- favored living in harmony with nature instead of dominating it; Europe valued competition
  - The best of China's civilization were drawn into its advanced civil service system and did not have the opportunity for scientific pursuits

### **Consequences of Scientific Revolution**

- Scientific community emerges
- Modern scientific method arises--theoretical, experimental
- Scientific revolution had little effect on daily life before late 18th century
- Increased confidence in the intellect of Western civilization- Europeans

## **Section 2: Enlightenment Overview**

### **18th Century**

- The 17<sup>th</sup> century had witnessed a growing skepticism about religion and an increasing secularization of thought
- The 18<sup>th</sup> century is the final phase before the violent reordering of society with the French Revolution
- Europeans began to evaluate their own civilization- the intellectuals of the Enlightenment advocated the use of the scientific method to foster progress towards a "better" society

### **Beliefs of the Enlightenment Movement**

- All institutions and all systems of thought were subject to the rational, scientific way of thinking
- Reason, natural law, hope, progress= words/ideas that define the Enlightenment

### **Characteristics of the Enlightenment**

- Rationalism = reason is the judge of all things
- Cosmology = a new concept of man, his existence on earth, and the place of the earth in the universe
- Secularism = science over religion
- Optimism and self-confidence= belief that man is intrinsically good
- Freedom of thought and expression
- Education of the masses

### ***Philosophes***

- The intellectuals of the Enlightenment were known by the French term *philosophes*
- *Philosophes*= professors, journalists, economists, political scientists, and social reformers
- Come mostly from: nobility, urban middle class
- Believed their role was to change the world
- Supported: religious tolerance, freedom of speech, freedom of the press

### **France during the Enlightenment**

- France became a center for Enlightenment thinking- Paris was the Enlightenment capital
- Most of the leaders of the Enlightenment were French- their ideas spread throughout the Western world

## **Section 3: Enlightenment Leaders**

### **Salons**

- 18th century= the Salon emerged as an important social meeting place
- Always hosted by women; one of the most important *Salonnières* was Madame Geoffrin
  - Hosted her salon between 1749 and 1769
  - Visited by, Voltaire, Montesquieu, Diderot, Turgot, Hume, Walpole and Edward Gibbon
- The salon was an opportunity for discussion, both in a large circle and in (numerous) small groups
- Etiquette was important
  - Men would withdraw from the general salon into a side room to talk business

### **Two Views on Government**

#### **Thomas Hobbes (1588-1679)**

- Wrote *Leviathan*
- Believed people were naturally selfish
- Without gov't he argued there would be "war of every man against every man"
- People had to hand over rights to an absolute ruler in order to gain law and order= social contract

#### **John Locke (1632-1704)**

- Wrote *Two Treatises of Civil Government and A Letter Concerning Toleration*
- Had a more positive view of human nature- a positive environment will create positive results
- Favored self-gov't
- Argued there are natural rights that are endowed by God to all human beings= life, liberty, property

### **The Baron de Montesquieu (1689-1755)**

- Three types of government:
  - Monarchy- suitable for middle-sized states
  - Republic- suitable for small states
  - Despotism- suitable for large states; rule by fear
- A separation of political powers ensured freedom and liberty
- Praised the concept of checks and balances that is built into the British constitution

### **Voltaire (1694-1778)**

- The greatest figure of the Enlightenment was Francois-Marie Arouet, known as Voltaire
- Known for his criticism of traditional religion and his philosophy of religious tolerance
- Supported deism= the belief in the existence of a God or supreme being but a denial of revealed religion- God uninvolved in daily life
  - God as clockmaker

### **Jean Jacques Rousseau (1712-1778)**

- Many Enlightenment thinkers believed that reason and science improved life; However, Rousseau argued that “civilization” corrupted people’s natural goodness
  - “Man is born free, yet everywhere he is in chains”
- Believed the only correct gov’t was direct democracy
  - People would have to give up some freedom for the common good; he explained this philosophy in *The Social Contract*

### **Rousseau’s Social Contract**

- Rousseau’s view of the social contract differed from that of Hobbes
- Hobbes believed the social contract was an agreement between a society and its gov’t
- Rousseau believed the social contract was an agreement among free individuals to create a society and form an agreed upon gov’t
  - Only a society that made its own laws was truly free

### **Denis Diderot (1713-1784)**

- Most famous contribution to the Enlightenment was the *Encyclopedia*
- Compiled the work of the philosophes into 28 volumes

### **Adam Smith (1723-1790)**

- Wrote *The Wealth of Nations*
- Scottish philosopher who provided the foundation for economic liberalism- made the best statement of *laissez-faire* economics in 1776
- *laissez-faire* (French for “leave it alone” or “let people do as they choose”)= the state should in no way interrupt the free play of natural economic forces by gov’t regulations on the economy but instead should leave it alone

### **Adam Smith (cont.)**

- Gave the government only three roles:
  1. Protect society from invasion
  2. Defend its citizens from injustice
  3. Public works (roads, canals, bridges etc.) that individuals could not afford

### **Mary Wollstonecraft (1759-1797)**

- It was long thought by many intellectuals that women were naturally inferior to men
- The strongest statement for the rights of women was advanced by the English writer Mary Wollstonecraft (1759-1797)
- Wrote *Vindication of the Rights of Women* (1792)
- Argued that the Enlightenment was based on an ideal of reason innate in all human beings
  - If women have reason, then they too are entitled to the same rights as men

### **Cesare Beccaria (1738-1794)**

- Believed laws existed to preserve social order, not to avenge crimes
- Criticized torturing of witnesses/suspects, irregular trial practices, punishments that were cruel/arbitrary; wanted to abolish capital punishment
- Advocated for “speedy trials,” degree of punishment should be based on the seriousness of the crime
- Based his ideas on utilitarianism= greatest good of the greatest number of people
- Ideas influenced law reformers in Europe and N. America

### **Enlightened Despots**

- Definition: Absolute ruler who uses his or her power to bring about political and social change
- Tended to allow religious toleration, freedom of speech/press, and the right to hold private property- no parliament
- E.Despots= Frederick II of Prussia, Catherine the Great of Russia, Gustav III of Sweden, Charles III of Spain, Maria Theresa and Joseph II of Austria

## **Section 4: Enlightenment Culture**

### **Type of Culture**

- Historians make a distinction between a civilization's "high culture" and its "popular culture"
- High culture= culture of the educated/ruling classes
- Popular culture= written and unwritten culture of the masses; collective

### **Literacy During the Enlightenment**

- In the 18th century there was an expansion of both the reading public and publishing
- Books were expensive (one day's wages)
- Many readers for each piece of literature (20 : 1)

### **Rococo**

- New style of decoration and architecture
- Stressed grace, charm, gentle action
- Rejected strict geometrical patterns and had a fondness for curves
- Pursuit of pleasure and happiness (secular)

### **Rococo (cont.)**

Balthasar Neumann (1687–1753)

- German architect
- Designed most famous Rococo church in Germany

Antoine Watteau (1684-1721)

- Rococo Artist
- Depicted the world of upper-class joy and pleasure but also the fragility and transitory nature of pleasure, love, and life

### **Music of the Enlightenment Period**

- The eighteenth century was an important period in the history of music– its influence is still felt today
- Four major composers stand as musical geniuses
  - Johann Sebastian Bach + George Frederick Handel (Baroque style- first part of the 18<sup>th</sup> century)
  - Franz Joseph Haydn + Wolfgang Amadeus Mozart (wrote music today known as "classical"- second half of the 18<sup>th</sup> century)

### **Johann Sebastian Bach (1685-1750)**

- German composer and organist
- One of the greatest and most influential composers of the Western world
- Was taught by his father and later by his brother Johann Christoph
- Bach's works were soon forgotten after his death
- In 1829 Felix Mendelssohn performed Bach's St. Matthew Passion, spurring a world-wide interest in Bach



### **Major Works of Bach**

- *Brandenburg Concerti*
- *Unaccompanied Cello Suite No. 1 in G Major*
- *The Well-tempered clavier*
- *The Art of Fugue*
- *Mass in B-minor*
- *St. Matthew Passion*

### **George Frederick Handel (1685-1749)**

- G. F. Handel was one of the greatest European composers during the Baroque period of the 18th century
- Born in Germany
- Major works: *Water Music*, *Music for the Royal Fireworks*, *Messiah*

### **Franz Joseph Haydn (1750-1819)**

- Austrian composer
- Epitomizes the aims and achievements of the Classical era
- Intended for the priesthood, he was recruited at age eight to the choir at St. Stephen's Church, Vienna, where he learned violin
- Major works: *The Seasons*, *Rider Quartet*, *Concerto in D 3 Allegro*

### **Wolfgang Amadeus Mozart (1750-1819)**

- Austrian
- Wolfgang Amadeus Mozart was not only one of the greatest composers of the classical period, but one of the greatest of all time
- Major works: *A Little Night Music*, *Serenade in B-Flat for 13 Winds*, *Requiem*, *Don Giovanni*, *7<sup>th</sup> Symphony*, *The Flight of the Bumble Bee*