Chapter 18: The Scientific Revolution *AP European History*

I. Modern Science: Precise knowledge of the physical world based on the union of experimental observations with sophisticated mathematics.

- World-View: Medieval & early modern Europe = primarily religious & theological – transformation by the European upper classes who came to see the world primarily in secular and scientific terms.

II. Scientific Thought in 1500's

A. Aristotelian View: Basis of knowledge in physics and the knowledge of motion on earth. (based on the theories of the Greek philosopher Aristotle during the 4th century B.C.)

1. Theory: ***Geocentric*** – a motionless earth is at the center of a universe which consist of **10 spheres**, each made up of perfect, unchanging elements.
2. Earth – located at the center of the universe was imperfect and consisted of 4 changeable elements.
    1) Air
    2) Fire
    3) Earth
    4) Water
3. The Church adopted and conformed Aristotle's theory to Christian doctrine during the Middle Ages.

III. The Copernican Hypothesis

B. Copernican Hypothesis: Stated in his book published the year after his death *On the Revolution of the Heavenly Spheres*

1. Theory: **Heliocentric** – The sun is at the center of the universe & the Earth and stars revolved around a fixed sun.
    a. Theory developed by Nicolaus Copernicus from 1506 to 1530.
        1) Never question Aristotleian belief in crystal spheres (idea that circular motion was most perfect and devine)
2. Scientific & Religious implications:
    1st – destroyed the main reason for believing in crystal spheres capable of moving the stars around the earth.
    2nd – universe of staggering size
    3rd – characterization of the earth as just another planet destroyed the basic idea of Aristotelian physics

- where then was heaven?

IV. From Brahe to Galileo

C. Tycho Brahe: Danish astronomer who built the most sophisticated observatory in the world.

1. Charted the stars collecting massive amounts of data, but theory was limited by mathematical knowledge.

D. Johannes Kepler: Assistant to Brahe, who used his data to formulate 3 famous laws of planetary movement.

1. Laws: Based on mathematical findings
    1) The orbits of the planets are elliptical.
    2) Planets do NOT move at a uniform speed.
    3) The time a planet takes to make its complete orbit is precisely related to its distance from the sun.

E. Galileo Galilei: Book – *The Two New Sciences*

1. Conducted controlled experiments:
    1) Acceleration experiment demonstrated the uniform force of gravity.
    2) Law of Inertia – at rest was not the natural state of objects.
2. Used the telescope to study the Moon & stars proving further the imperfect state of Aristotle's spheres.

F. Isaac Newton: Book – *Mathematical Principles of Natural Philosophy* ***"Principa"***

1. Newton integrated the astronomy of Copernicus, corrections by Kepler, and the physics of Galileo into a single explanatory system.
    * He developed a set of mathematical laws that explain motion & mechanics – basis of the laws of universal gravitation.

G. Causes of the Scientific Revolution?

1) Long term contribution of medieval intellectual life & medieval universities
2) The recovery of classical scholarship during the Renaissance
3) The challenges of navigation during long sea voyages
4) Improvements in scientific instruments

V. Scientific Methodology

A. **Francis Bacon:** Father of empirical method (empiricism) – knowledge must be pursued through experimental & inductive reasoning.
   1. Argued that scientific discoveries would bring about much greater control over the physical environment, making people rich and nations powerful.

B. **Rene Descartes:** Father of deductive reasoning – use of self evident principles to ascertain scientific laws.
   1. A systematic & mathematical approach to science which doubted everything that could reasonably be doubted.
   2. Descartes' reasoning **reduced all substances to "matter" and "mind"** – or physical & spiritual > known as ***Cartesian dualism***

C. **Modern Scientific Methodology:** Joined precise observations & experimentalism with the search for general laws that may be expressed in rigorously logical mathematical language.

VI. Religion: The role of religion in the development of science.

A. **Protestants & Calvinist:** promoted scientific inquiry as a question of Individual conscience & not of religious doctrine.

B. **Catholics:** suppressed scientific theories that conflicted with its teachings – discouraging scientific progress.
   1. All religious authorities: Catholic, Protestant & Jewish – opposed the Copernican system until about 1630.
   2. The catholic church became increasingly hostile to science during the Counter Reformation where they associated science with Protestantism.

C. Consequences of the Scientific Revolution:

1) Rise of new & expanding social group - the international scientific community
   > linked together by common interests and shared values
   > expansion of knowledge was their primary goal
   > science became competitive & the thought that even more scientific advance was inevitable
2) Introduced new knowledge & new way of obtaining it
   > refused to base its conclusions on traditional and established sources (ancient authorities & sacred texts)
3) Few consequences for economic life and the living standards of the masses until late 18th century
4) Improvements in techniques of navigation facilitated overseas trade
5) First & foremost an intellectual revolution – greatest impact being on how people thought and believed

The Enlightenment

I. Three central concepts at the core of Enlightenment thinking:

1. Natural science could and should be used to examine and understand all aspects of life.
   a. ***Reason***: Nothing is accepted on faith, instead everything was to be submitted to the rational, critical, scientific way of thinking.
2. Scientific method was capable of discovering the laws of human society as well as those of nature.
   b. **Social Science**
3. Progress was possible: human beings could create better societies & better people.

II. Enlightened Thinkers: *Philosophes* (French for philosopher) - intellectual writers who asked fundamental questions about the meaning of life, god, human nature, good & evil, and cause and effect.

- **philosophes were reformers – NOT revolutionaries**

A. Bernard de Fontenelle (1657-1757):
   1. Book – *Conversions on the Plurality of Worlds (1686)* = helped to make science more understandable to a broader audience – increasing the popularity of science.

B. Pierre Bayle (1647-1706):
   1. Book – *Historical & Critical Dictionary (1697)* = demonstrated that human beliefs had been extremely varied & often mistaken.

a. *Skepticism:* nothing could be known beyond all doubt.
- attacks of criticism were aimed at the doctrines of theology.

C. John Locke: Book – *Essays Concerning Human Understanding (1690)*

1. Theory: All ideas are derived from experience – the human mind at birth is like a blank tablet (*Tabla Rasa)*
   a. Human development is therefore determined by education & social institutions, for good or for evil.

D. Baron de Montesquieu (1689-1755)

1. Books: *The Persian Letters* – used wit to combat cruelty & superstition
2. & *The Spirit of Laws* – comparative study of republics, monarchies, and despotism.
   a. He advocated the separation of powers in government
      - major influence on the American Constitution.

E. Francois Maries Arouet (1694-1778) aka – Voltaire

1. Wrote a collection of essays which presented a pessimistic view of people and government.
   a. "people are not worthy of governing themselves & therefore could only hope for a good & fair monarch.
   b. Only realizable equality to Voltaire: "The citizen only depends on the laws which protect the freedom of the feeble against the ambitions of the strong."
2. he mixed the glorification of science and reason with an appeal for better individuals and institutions
3. he was a deist and hated all forms of religious intolerance – which he believed led to fanaticism and savage, inhumane action

F. Madame de Chatelet

1. concentrated on spreading the ideas of others – translation with an accompanying commentary of Newton's *Principia* into French
2. she openly criticized the discrimination of women in education

G. Denis Diderot (1713-1784) & Jean le Rond d'Alembert

1. edited the 17 volume *Encyclopedia: The Rational Dictionary of the Sciences, the Arts, and the Crafts* (1750-1765)
   a. a collection of hundreds of thousands of articles by leading scientist, famous writers, skilled workers, and progressive priest treated every aspect of life.
   b. revolutionary work that glorified science & industrial arts, questioned religion and immorality, criticized intolerance, injustice, and out-of-date social institutions.

- Attacked by the Pope – put on the Index (list of forbidden books)
- More importantly – the Encyclopedia showed that human beings could use the process of reasoning to expand human knowledge.

III. The Later Enlightenment

After 1770 – harmonious unity of the philosophes & their thought began to break down as the new world-view became accepted by the educated public – some thinkers sought originality by exaggerating certain Enlightenment ideas to the exclusion of others.

A. Baron Paul d'Holbach (1723-1789) *System of Nature* (1770)

Atheist – argued that human beings were machines completely determined by outside forces (free will, God, and immorality of the soul were foolish myths)

B. David Hume (1711-1776) Scottish philosopher - skepticism

The human mind is nothing but a bundle of impressions – which originate only in sense experiences & our habits of joining these experiences together.

- since our ideas ultimately reflect only our sense experiences, our reason cannot tell us anything about questions that cannot be verified by sense experience (in the form of controlled experiments or mathematics)
  ie. origin of the univers, existence of God
- Hume's rationalistic inquiry ended up undermining the Enlightenment's faith in the power of reason.

C. Marie-Jean Caritat, marquis de Condorcet (1743-1794)

Book ***Progress of the Human Mind*** **(1793)** hypothesized and tracked nine stages of human progress that had already occurred and predicted that the tenth would bring perfection (transformed the Enlightened belief in gradual, hard-won progress fanciful utopianism)

D. Jean-Jacques Rousseau (1712-1778)

- passionately committed to individual freedom
- he attacked rationalism and civilization as destroying, rather than liberating an individual
- basic goodness of the individual and the unspoiled child had to be protected from the cruel refinements of civilization
- Influenced early Romanticism

Political theory - Book: ***The Social Contract*** *(1762)*

Two fundamental concepts:

1) **General will** is sacred & absolute reflecting the common interest of all the people.
2) The monarch is the holder of **popular sovereignty**

* general will is not always the will of the majority – at times the general will may be the authentic, long term needs of the people as correctly interpreted by a farseeing minority

IV. Urban Culture and Public Opinion

The Reading Revolution

- Old style: sacred text, earthly duty, obedience to God – patriarchal & communal
- New style: many texts, constantly changing, reading – individual, silent, rapid

1. European market for books grew dramatically in the 18th century
2. Book trade throughout Europe expanded – contributed to the spread of French philosophes critical secular attitudes
3. growth in scandalmongering & denunciation of high political figures – particularly of the French aristocracy

A. Salons – elegant private drawing rooms where hostesses brought the various French elites together and mediated the public's freewheeling examination of Enlightenment thought.

- elite women also exercised an unprecedented feminine influence on artistic taste – **Rococo Style**
- Madame Geoffrin – financed the Encyclopedia and held regular meeting in her salon.

V. The Enlightenment & Absolutism

Benevolent Absolutism - most Enlightened thinkers (until the American Revolution) believed that political change could best come from above – from the ruler – rather from below.

- critical thinking was turning the art of good government into an exact science – enlighten the ruler
- rulers seemed to be listening to the philosophes and treating them with respect
- distrust of the people – belief that common people were deluded by superstitions and driven by violent passions

A. Enlightened Absolutism

1. Frederick the Great of Prussia (r.1740-1786)

a. War of Austrian Succession - violated the pragmatic Sanction guaranteeing Maria Theresa's succession to the Austrian throne by attacking Silesia
   - doubled Prussia's population and made it a European Great Power

b. The Seven Years War (1756-1763) – Austria, France & Russia made an alliance to defeat and divide Prussia
   - 1762: Czar Peter III took the throne of Russia and called off the attack of Prussia (admired Frederick)

* Frederick claimed that he was "only the first servant of the state"

c. Enlightenment changes:
   1. allowed for religious and philosophical tolerance
   2. promoted advancement of knowledge, improved schools, permitted scholars to publish their findings
   3. laws were simplified and torture was abolished
   4. Judges decided cases quick and impartially

d. Limits to Enlightenment:
   1. allowed serfdom to continue
   2. accepted extended privileges of the nobility
   3. he opposed emancipation of the Jews

2. Catherine the Great of Russia (r.1762-1796)
    1. Married to Peter III – deposed of Peter in a palace coup and assumed the throne as Tsarina in 1762
        a. Three main goals:
            1) bring western culture to backward Russia
               - imported western architects, artist, and intellectuals
               - corresponded with Voltaire
               - offered to publish the Encyclopedia in Russia
            2) domestic reform
               - ended torture & allowed limited religious toleration
               - failed to end serfdom due to Pugachev's rebellion, Catherine gave the nobles absolute control of their serfs
            3) territorial expansion – conquest of the Caucasus & partition of Poland

3. Austrian Hapsburgs
    1. **Maria Theresa (r.1740-1780)**
       reforms to make the state stronger and more efficient:
        1) policies limiting the papacy's political influence in her realm
        2) administrative reforms strengthened the central breaucracy – tax on lands of nobles.
        3) reduced power of lords over their hereditary serfs

    2. **Joseph II (r.1780-1790)**
        1) granted religious toleration and civic rights to Protestants and Jews
        2) abolished serfdom in 1781 – in 1789 decreed that all peasant labor obligations be converted into cash payments

Chapter 19: *Pre Industrial Europe*

I. Agricultural Revolution

A. Open-Field System: Medieval agricultural system of village farming.

1. Large, open fields that were cut into narrow strips (each owned by a villager) and farmed as a community.
2. Traditional methods of plowing, sowing, and harvesting which resisted new methods of farming.
3. Evolved from a **two year system** (one year of harvest /one year fallow) to a **three year rotation** (1 year growing wheat – 1 year of oats or beans – 1 year fallow)
4. Common lands – open meadows were used to pasture livestock.
5. *Gleaning of the grain* – collection of grains left after harvest by poor women which made the difference between life and death in lean years.

B. Agricultural Changes in the Low Countries: The introduction of intensive farming during the mid 17th century for the following **two reasons**.

1. Limited land required methods that could provide maximum yields and new engineering techniques that allowed the Dutch to reclaim lands that had been flooded by the sea.
2. Densely populated cities with heavy commerce provided an endless demand for crops produced by Dutch peasant farmers.
    a. New agricultural methods included:
        1) Enclosure of open-fields
        2) Crop rotation which included a wide variety of crops which put nutrients back into the soil for other crops.
        3) Heavy fertilization due to growth of livestock.
        4) Drainage of flooded lands "polders" & built dikes used to control further flooding.

C. English adaptation of Dutch methods

1. ***Cornelius Vermuyden*** (Dutch Engineer) – hired to direct the drainage of lands in Southern England which proved to be some of the most fertile lands in England.
    a. Reclaimed lands had no common rights or traditions allowing for the introduction of new crops & methods of agriculture.

2. ***Viscount Charles Townsend*** "Turnip Townsend"
   a. Used Dutch farming methods and crops such as the Turnip:
      1) He drained extensive areas, fertilized heavily, and sowed crops in a regular rotation with out leaving fields fallow – influencing agricultural changes throughout England.
3. ***Jethro Tull:*** English Innovator who used empirical research to develop better farming methods:
   1) Used horses instead of slow-moving oxen for plowing.
   2) Created a seed drill to distribute seeds in an even manner at a proper depth.
   3) Selective breeding of ordinary livestock.

D. The cost of enclosure & agricultural changes

1. Many historians stress the initiative and enterprise of English landowners which contrasted with the inertia & conservatism of continental landowners.
   a. They also assert that the open fields were enclosed fairly with both large & small owners receiving their fair share after strips had been surveyed & consolidated.
2. Other historians argue that large landowners controlled Parliament which made the laws.
   a. they had Parliament pass hundreds of "enclosure acts" – authorizing the fencing of open fields
   b. heavy legal & surveying costs of enclosure was divided among landowners – peasant farmers had to sell their small holdings to afford the fee & landless cottagers lost acces to common pasture lands without any compensation
3. Assessing conflicting views:
   a. much of English common land was already enclosed by 1750 – enclosure acts simply completed the process.
   b. the population of landless cottagers had already appeared in large numbers by 1700.
   c. tenant farmers – who rented land from big landowners, hired wage laborers & sold their output on the cash market – steadily grew starting in the early 18th century resulting in the decline of independent peasant farmers.
4. Two major historical developments in England
   a. the rise of market-oriented estate agriculture and the emergence of a landless rural proletariate
      1) landowners held most of the land & pursued profits aggressively, leasing their holdings through agents at competitive prices to middle-size farmers, who relied on landless laborers for their workforce.
         - **Proletarianization**

II. Population Explosion of the 18th Century

A. Reason for lack of population growth in the 16th & 17th centuries:

1. Until 1700 – the total population of Europe grew slowly much of the time, and it followed an **irregular cyclical pattern**
   a. Population decline in the 14th century due to the plague resulted in a decline of serfdom in Western Europe & and increase in the standard of living for peasants & artisans.
   b. A population surge in the 16th century resulted in a shortage of food & food prices rose faster than wages – an issue intensified by an inflow of precious medals from America & a Price Revolution > resulted in a stoppage of population growth – death rate increased due to war, famine & disease

B. In the 18th century the population of Europe grew markedly in all areas of Europe for the following reasons:

1. Decline in **death rate:**
   a. Plagued ravaged western & central Europe for the last time in 1721.
      1) Stricter quarantine measures held to stop the disease from entering the Mediterranean ports of Europe.
      2) The brown rat from Asia drove the plague carrying black rat out of Europe.
   b. Public health measures – promoted by absolutist monarchs reduced epidemics.
      1) Improvements in water supply and sewage systems reduced deadly diseases like typhoid & typhus.
      2) Drainage of swamps & marshes reduced disease carrying insects.
   c. Improvements in transportation (canals & roads) helped to reduce famine from crop failure by allowing emergency food supplies to be moved more easily.

III. The Cottage Industry

A. A growth in the population of Europe during the 18th century increased the number of rural workers with little or no land, which in turn contributed to the development of industry in rural areas.

*** Economic system: a kind of *capitalism***

B. The *Putting-Out System*: where two main participants, the merchant capitalist & the rural worker, interact to produce finished goods.

1. Reasons for the growth of the putting out system:
   a. Competitive advantage – abundant rural labor force willing to work for low wages, unregulated production allowing changes and experimentation production.
   b. Produced goods for the commoner: knives, forks, housewares, buttons, gloves, clocks & musical instruments.
   c. Absolute monarchs saw rural industry as a way to improve the conditions of their poorer populations in the country side and assisted by reducing the power of guilds

2. **The Textile Industry**: The making of linen, woolen, and cotton cloth.
   a. Textile production dominated the cottage industry – **involving the entire family**.
   b. New technology increased out put – *the flying shuttle,* invented by John Kay, increased the speed of weaving thread.
   c. ***"Spinsters"*** – lack of spun thread led families to hire out labor to widows and unmarried women who spun thread for a living.

C. Problems with the Cottage Industry: relations between workers and employers were often marked by sharp conflict.

1. Constant disputes over the weights of materials & quality of the cloth.
   a. Merchants (capitalists) accused workers of stealing raw materials
   b. Weavers (workers) complained that merchants delivered underweight bales
   c. Labor was poorly organized, hard to control, and tended to work in spurts – ""holy Monday"
      * Led merchant capitalists to search for ways to produce more efficiently and to squeeze more out of the "undisciplined" cottage workers

IV. Building the Atlantic Economy

A. Growth of world trade

1. Spain & Portugal – revitalized their empires & began drawing more wealth from renewed development.
2. Countries of Northwestern Europe: Netherlands, France, and Great Britain benefitted the most
   * Great Britain – kingdom of England & Scotland formed in 1707 became the leading maritime power

B. Mercantilism & Colonial Wars

1. European mercantilism: system of economic regulations aimed at increasing the power of the state, aimed at creating a favorable balance of foreign trade in order to increase a country's stock of gold

2. English mercantilism: unusual idea that government should serve the private interests of individuals and groups as well as public needs of the state
   a. **Navigation Acts** – laws that gave British merchants and shipowners a virtual monopoly on trade with British colonies.
      1) a form of economic warfare originally targeting the Dutch
      2) combined with the **Anglo-Dutch wars between 1652 and 1674** – did serious damage to Dutch shipping and commerce

3. From 1701 to 1763: Britain and France were locked in a series of wars to decide which nation would become the leading maritime power (overseas expansion)
    a. **War of Spanish Succession** – *Peace of Utrecht* (1713): France was forced to cede Newfoundland, Nova Scotia, and the Hudson Bay territory to Britain. Spain gave control of the ***Asiento*** – Spanish West African slave trade
    b. **War of Austrian Succession** (1740-1748) – included Anglo-French conflicts in India & North America
    c. **Seven Years' War** (1756-1763) – **French & Indian War** in North America: British siege of Quebec resulted in French defeat and the Treaty of Paris (1763) – France lost all its possessions on the mainland of North America, and most of its holding in India.
        - Results: By 1763, British naval power had triumphed decisively & Britain had realized its goal of monopolizing a vast trading and colonial empire for its exclusive benefit.

C. Land & Labor in British America

1. British empire in North America: secured an important outlet for surplus population limiting poverty in England, Scotland, and northern Ireland.
    a. settlers benefited by having access to virtually free and unlimited land
    b. cheap land and a tremendous demand for scarce labor power were critical factors in the growth of slavery in the British colonies
        1) African slaves constituted a majority of the population in Britain's Caribbean colonies – sugar & tobacco plantations
        2) Development of a wealthy aristocratic planter class in southern colonies – primarily tobacco plantations with African slave labor (1700-1774)
    c. rapid population growth of white settlers + increased agricultural development / trade = the highest average income and standard of living in the world

D. The Growth of Foreign Trade

1. Rapidly growing and increasingly wealthy agricultural populations of the North American mainland colonies provided an expanding market for English manufactured goods
2. The mercantilist system formed in the 17th century to attack the Dutch and to win power and profit for England achieved remarkable success in the 18th century.

E. The Atlantic Slave Trade

1. Slave trade intensified between 1701 and 1800
    a. Slaves made a decisive contribution to the development of the Atlantic economy:
        1) made possible large-scale production of valuable commodities(sugar, coffee, tobacco, rice and in the 19th century- cotton) for sale in Europe
    b. Negative consequences in Africa: slave trade led to internal wars, destroyed political unity, and resulted in population stagnation.
    c. Abolitionist (anti-slavery) movements in England between 1788 and 1792 led to the **abolition of the British slave trade by Parliament in 1807**

F. Revival in Colonial Latin America

1. Revival of Spanish empire:
    a. death of Charles II (Habsburg) – followed by Louis XIV's grandson Philip V (r. 1700-1746) brought new men and fresh ideas from France (reasserted royal authority, overhauling state finances and strengthening defense)
    b. Spain received Louisiana from France in 1763 – expanding into western North America
    c. silver mining recovered in 1800 – accounting for half of the worlds silver production
2. Social classes in Spanish colonies:
    a. **Creoles** – people of Spanish blood born in America (made up most of the wealth merchant class that dominated trade)
        1) debt peonage – from 1600 on, a system in which a planter or rancher would keep the estate's Christianized, increasingly Hispanicized Indians in perpetual debt bondage (serfdom)
    b. **Mestizos** – offspring of Spanish men and Indian women (made up a large middle group of the population).

G. Adam Smith and Economic Liberalism (unregulated capitalism)

1. Scottish professor, Adam Smith (1723-1790) *Inquiry into the Nature and Causes of the Wealth of Nations* (1776)
   a. critical analysis of mercantilism – which meant a combination of stifling government regulations for state-approved monopolies and government favorites
   b. Smith argued for free competition, which would best protect consumers from price gouging and give all citizens a fair and equal right to do what they do best.
   c. **Government should limit itself to "only three duties"**
      1) provide a defense against foreign invasion
      2) maintain civil order with courts and police protection
      3) sponsor certain indispensable public works and institutions that could never adequately profit private investors
   d. The **"invisible hand" of free competition** for one and for all disciplined the greed of selfish individuals and provided the most effective means of increasing the wealth of both rich and poor.