

The Scientific Revolution

Key Concepts

SCIENTIFIC REVOLUTION

Fresh Inquiries into
Natural Philosophy

COSMOLOGY

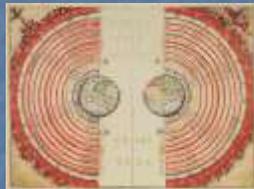
THE MEDIEVAL VIEW OF THE COSMOS

- A synthesis of
 1. Aristotle
 2. Ptolemy
 3. Christian theology



The Medieval View

- Most knowledge in the Middle Ages comes from the Bible and Greek/Roman sources.
- Supports **geocentric theory**—moon, sun, planets revolve around earth



Geocentrism

The belief that the earth is at
the center of the Universe

Photo by NASA

I. The Aristotelian Universe



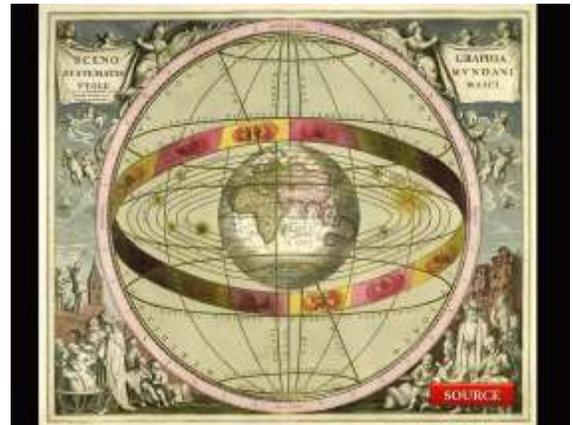
- Derived from Ptolemy, Aristotle, and Plato
- Classical Writings "Christianized"
- Components of Medieval Cosmology
- Medieval Physics
- Belief in "Matter" and "Form"
- Earth = Living, Protected Sphere

PTOLEMAIC/GEOCENTRIC CONCEPTION OF THE COSMOS

1. Earth centered
2. Series of 10 concentric spheres
3. Crystalline/transparent sphere
4. Perfect circular rotation
5. Heavenly bodies were orbs embedded in moving spheres
6. Beyond the 10th sphere = the kingdom of god/heaven
7. Man is at the center + god is in his place



Geocentric View:



THE RENAISSANCE'S IMPACT ON THE SCI. REV.

- Renaissance Humanists – mastered Greek and Latin language -> Galen, Ptolemy, Archimedes, Plato, and pre-socratics
- Humanists discovered new ancient texts by Galen and Aristotle
- Renaissance artists impacted Sci. Rev. –
 1. observation of nature
 2. use of perspective and math in painting
 3. proper understanding of human anatomy



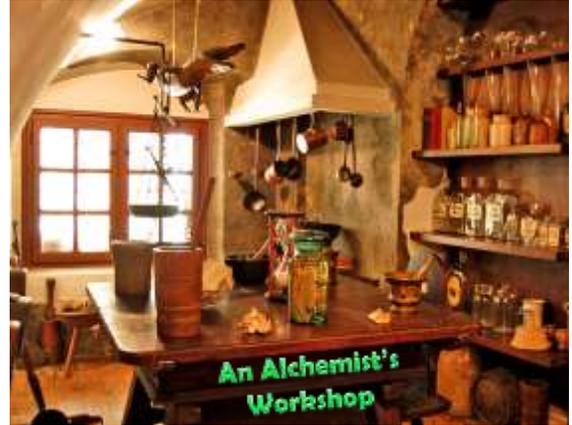
MORE BACKGROUND FACTORS TO SCI. REV.

- Technical problems
- Emphasis on practical over theoretical knowledge
- Printing press -> spread ideas quickly and easily
- Mathematics - military sci., navigation, geography
- Leonardo da Vinci – nature is inherently mathematical and it provided certainty



Magic

- Hermetic magic = the world is divine, we are part of the divine -> we can tap in and control the world
- Alchemy = changing substances -> stuff into gold
- Astrology = position of stars-> influences our lives
- Numerology = numbers have secrets
- Use magic to control and dominate nature
- All giants of the sci. rev. studied magic



II. Scientific "Revolutionaries"

A New Way of Thinking

- Renaissance prompts new ways of thinking (1300-1600)
- Scientific Revolution—new way of viewing the natural world—based on observation and inquiry
- New discoveries, overseas exploration open up thinking
- Scholars make new developments in astronomy and mathematics.

Nicolaus Copernicus

16th century

Polish Priest
& Astronomer

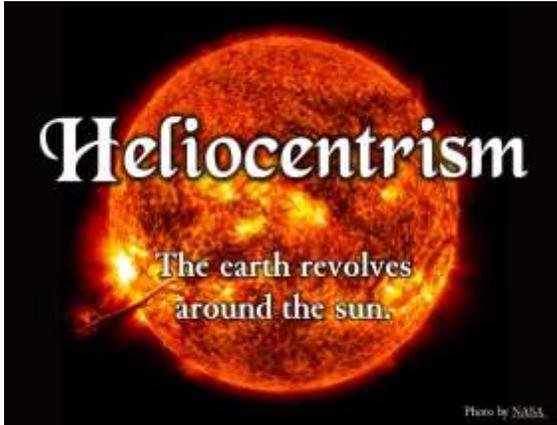
*On the Revolutions of
the Heavenly Spheres*
(1543 – Posthumous)



A. Copernicus (1473-1543)



- Aim to glorify God
- Sun-centered universe
- Challenged circular orbits
- Universe of staggering size
- Earth no different than any other planet
- *On the Revolutions of the Heavenly Spheres* (1543)
- Later scientists mathematically prove Copernicus to be correct



B. Tycho Brahe (1546-1601)



- Most sophisticated observatory of his day
- Arrogant nobleman
- Remained an Aristotelian
- Discovered comet shooting right through crystalline spheres

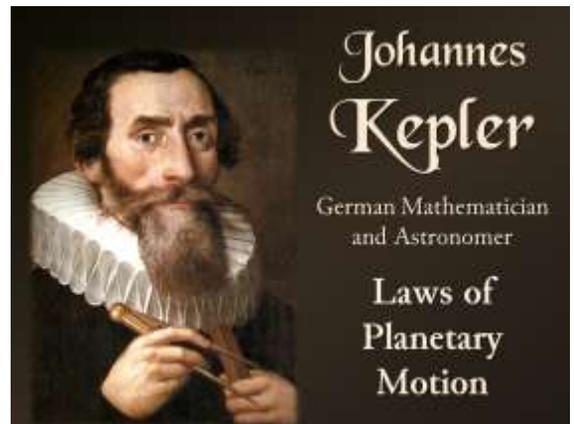
TYCHO BRAHE 1546-1601

1. Danish nobleman/Danish Royal Astronomer
2. Builds Uraniborg Castle – library, observatories, instruments
3. Spends twenty years gathering data
4. Didn't have the maths ability to make sense of data
5. Moves to Prague -> becomes imperial mathematician to the Holy Roman Emperor

BRAHE



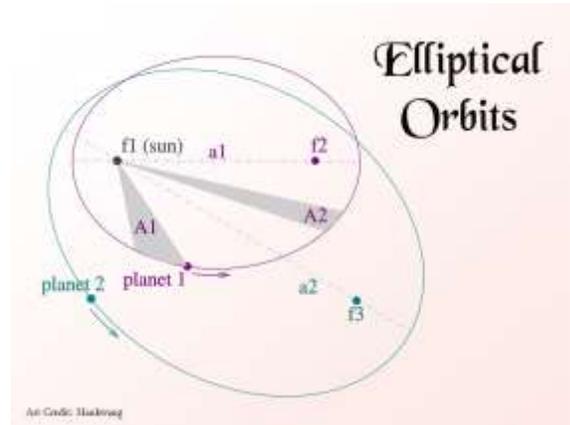
- While studying at University of Rostock in Germany, on 29 December 1566 Tycho lost part of his nose in a duel against fellow Danish nobleman Manderup Parsberg.[13][14] Tycho had earlier quarreled with Parsberg at a wedding dance at professor Lucas Bachmeister's house on the 10th, and again on the 27th. The duel two days later (in the dark) resulted in Tycho losing the bridge of his nose.[14] From this event Tycho became interested in medicine and alchemy.[19] For the rest of his life, he was said to have worn a replacement made of silver and gold,[13] using a paste to keep it attached.[14] Some people, such as Fredric Ihren and Cecil Adams have suggested that the false nose also had copper. Ihren wrote that when Tycho's tomb was opened in 24 June 1901 green marks were found on his skull, suggesting copper.[14] Cecil Adams also mentions a green colouring and that medical experts examined the remains.[15] Some historians have speculated that he wore a number of different prosthetics for different occasions, noting that a copper nose would have been more comfortable and less heavy than a precious metal one.



C. Johannes Kepler (1571-1630)

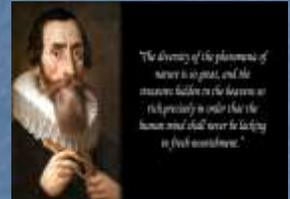


- Planetary motion conforms to mathematical formula
- Elliptical orbits
- Planets do not move at uniform speeds in their orbits



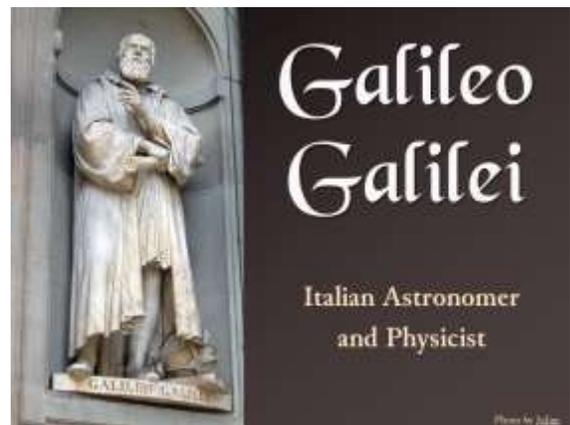
JOHANNES KEPLER

1. Teacher of math and astronomy in Austria
2. Interested in astrology and hermetic mathematical magic
3. Brilliant mathematician and astronomer
4. Becomes Brahe's assistant
5. Succeeds Brahe as Imperial Mathematician
6. Uses Brahe's data to develop 3 laws of planetary motion



KEPLER'S THREE LAWS OF PLANETARY MOTION

1. Elliptical orbits
2. Speed of planets is greater when closer to sun
3. Planets with larger mass revolve slower

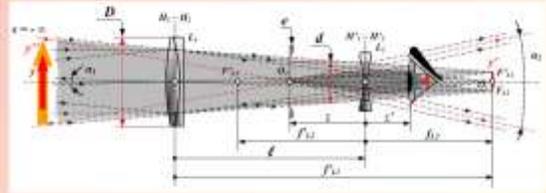


D. Galileo Galilei (1564-1642)



- Early practitioner of the experimental method
- Mathematical formula for acceleration of falling objects
- Law of inertia
- Italian scientist Galileo Galilei makes key advances in astronomy
 - His discoveries using the telescope
 - Supports heliocentric model
 - Mountains on the moon
 - 4 moons around Jupiter

Refracting Telescope



Galileo's improved telescope allowed him to see things in space that others had not been able to see.

Art Credit: Tamaslex

Lunar Mountains and Craters



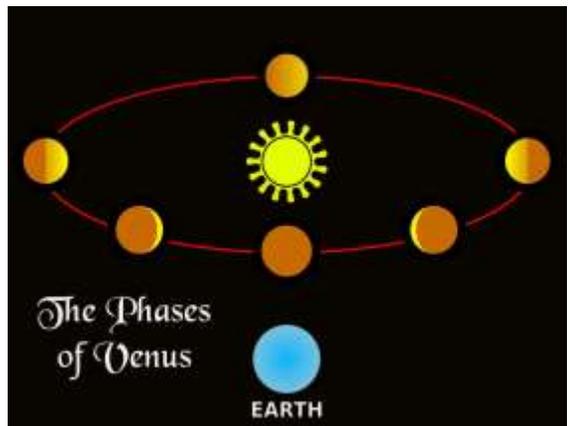
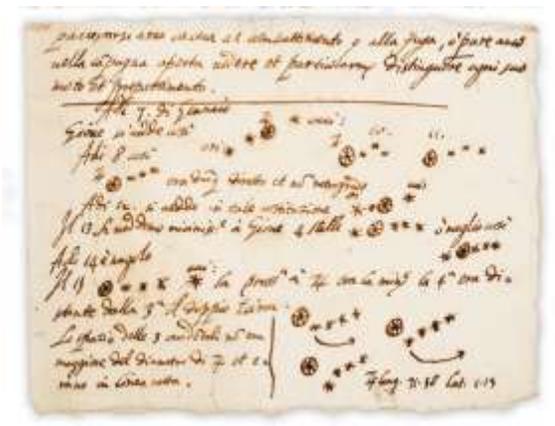
The moon's surface was not smooth as was traditionally believed.

Photo by ESA

Galilean Moons



Galileo discovered four moons orbiting Jupiter, proving that objects orbited planets other than earth.



The Phases of Venus

EARTH

D. Galileo Galilei (1564-1642)



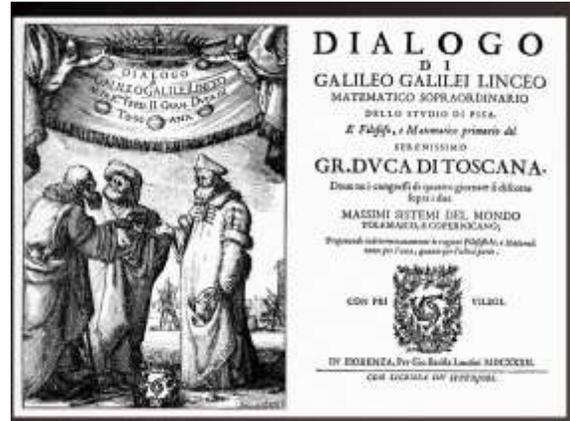
- Challenges categories of "form" and "matter"
- Heavens were no longer a spiritual world, but one of matter
- End of his life

GALILEO GALILEI

1564-1642

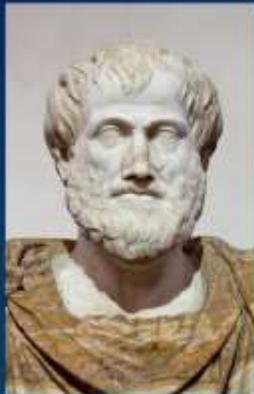
- Italian mathematician and astronomer -> taught maths at Pisa and Padua
- First to use telescope to observe the heavens
- Uses telescope to see mountains and craters on moon, sunspots, moons of Jupiter
- 1610 publishes *The Starry Messenger* -> advocated the heliocentric view
- The Roman Inquisition/Holy Office of the Catholic church condemns Galileo's ideas and forces him to recant
- Writes new book in Italian not latin -> more accessible/alarming to the church
- Brought before the Inquisition again -> found guilty of error -> placed under house arrest for rest of life

Sidereus Nuncius (1610) *The Starry Messenger*



I know
u didn't

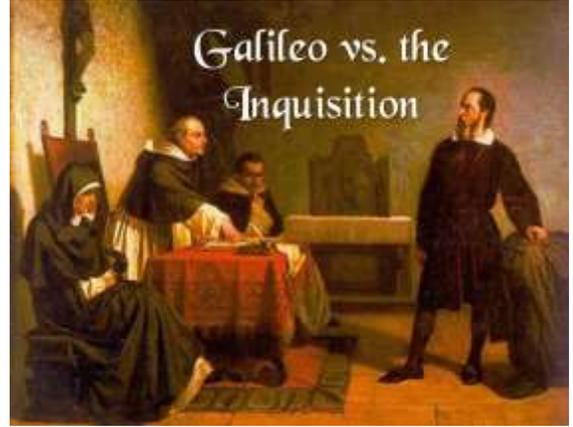
Aristotle believed that heavenly bodies were perfect spheres made up of the fifth element.



I know
u didn't

The Catholic Church continued to support biblical cosmology.





Conflict with the Church



- Church attacks Galileo's work, fears it will weaken people's faith
- Pope forces Galileo to declare his and other new findings are wrong

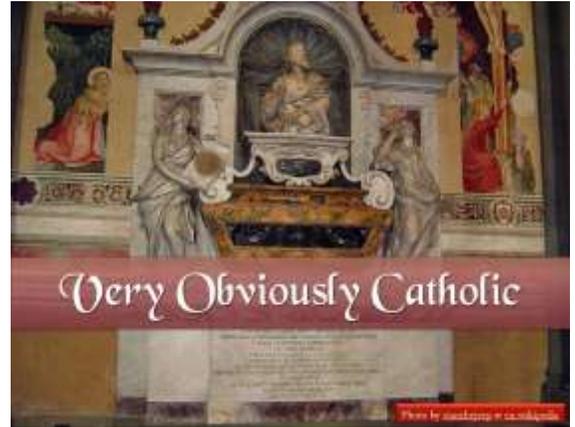
Cristiano Banti's 1857 painting *Galileo facing the Roman Inquisition*



Science vs. the Church?

Galileo recanted under pressure from the Church and remained under house arrest in his later years.

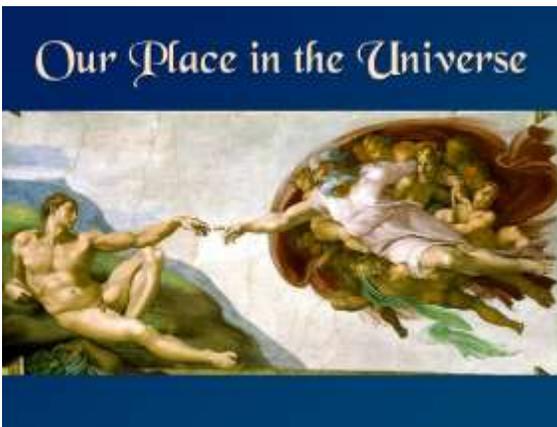




Science vs. Religion?

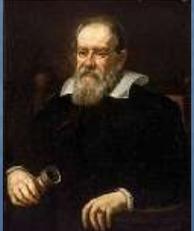
"A little philosophy inclineth man's mind to atheism; but depth in philosophy bringeth men's minds about to religion."

— Sir Francis Bacon

According to Stephen Hawking, "Galileo, perhaps more than any other single person, was responsible for the birth of modern science."

- Galileo works in mechanics/physics – the principle of inertia/uniform force causes an object to accelerate



The Center of the Universe?

Ptolemy <small>(Roman) Egypt</small>		GEOcentric Theory
Copernicus <small>16th c. Poland</small>		HELIOcentric Theory
Galileo <small>17th c. Italy</small>		CONFIRMED <i>Heliocentric Theory</i>

- ### The Scientific Method
- A Logical Approach
 - Revolution in thinking leads to development of scientific method—a series of steps for forming and testing scientific theories
 - Bacon and Descartes
 - Thinkers Bacon and Descartes help to create scientific method
 - Bacon urges scientists to experiment before drawing conclusions
 - Descartes advocates using logic and math to reason out basic truths

- ### E. Francis Bacon (1561-1626)
- 
 - Father of the Scientific Revolution
 - The Inductive Method
 - Emphasis on practical, useful knowledge
 - New attitude toward nature

- ### F. Rene Descartes (1596-1650)
- 
 - Significance of Doubt
 - The Deductive Method
 - Spatial relationships can be expressed in mathematical formulas
 - Father of "analytical geometry"

Deductive vs. Inductive Reasoning

 <p>Aristotle (Ancient Greek Philosopher)</p> <p>DEDUCTIVE REASONING</p> <p>Start with a premise</p> <p>Valid until disproven</p>	 <p>Sir Francis Bacon</p> <p>INDUCTIVE REASONING</p> <p>Start with observations</p> <p>Something must be PROVEN in order to be true</p>
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Deductive Reasoning



Premises { 1. All men are mortal.
2. Socrates is a man.

Conclusion { Therefore,
3. Socrates is mortal.

Innocent Until Proven Guilty

Conclusions are drawn from generalizations.

DEDUCTIVE

Start With
GENERALIZATIONS



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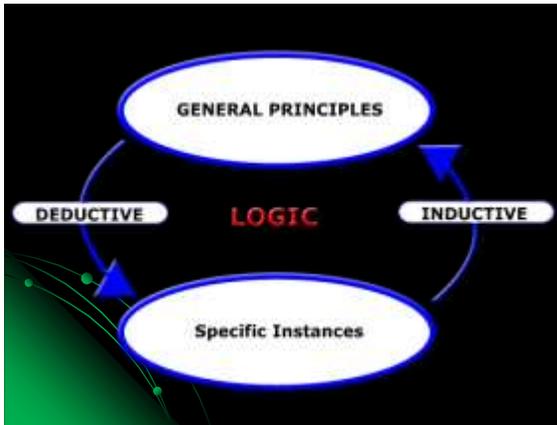
INDUCTIVE

Conclusions are drawn from a series of observations.

Start With
OBSERVATIONS



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Newton's Law
of
Universal
Gravitation

*Dependent on
Kepler's Laws*



F. Isaac Newton (1642-1727)



- Newton far from the perfect rationalist
- A great synthesizer
- Blends inductive and deductive methods
- Argues for a universe governed by natural laws
 - views the universe as a vast, perfect mechanical clock
- *Principia; Mathematical Principles of Natural Philosophy* (1687)
- Law of Gravity

Newton Explains the Law of Gravity

- Newton's Theories (continued)
 - Motion in space and earth linked by the law of universal gravitation—holds that every object in universe attracts every other object
 - Newton views the universe as a vast, perfect mechanical clock



Isaac Newton in 1702

SIR ISAAC NEWTON – THE GREATEST FIGURE OF THE SCIENTIFIC REVOLUTION

1. Professor of mathematics at Cambridge University
2. Invented the calculus = advanced math
3. Published the Principia = The Mathematical Principles of Natural Philosophy
 - a. the three laws of motion
 - b. applies terrestrial laws to planetary bodies
 - c. Universal Law of Gravitation = could explain all motion in the universe

THE NEWTONIAN SYNTHESIS



The combination of the new science + astronomy + mechanics + advanced math/calculus =

the universe was a regulated and uniform machine that operated according to natural laws



III. Causes of the Scientific Revolution



- Medieval Intellectual Life and Medieval Universities
- The Italian Renaissance
- Renewed emphasis on mathematics
- Renaissance system of patronage
- Navigational problems of long sea voyages
- Better scientific instruments

III. Causes of the Scientific Revolution (Continued)



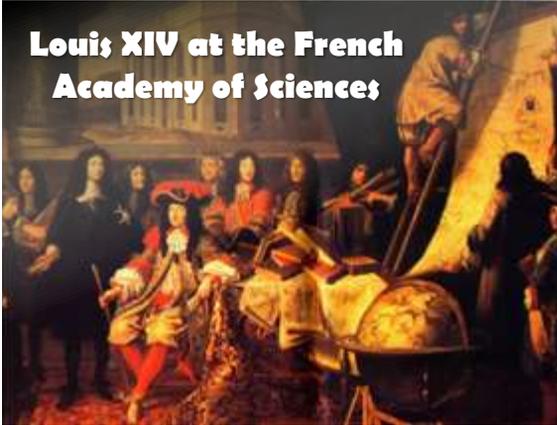
- Printing press -> spread ideas quickly and easily
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- Renaissance artists impacted Sci. Rev. –
 - observation of nature
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 - proper understanding of human anatomy

IV. Consequences of the Scientific Revolution

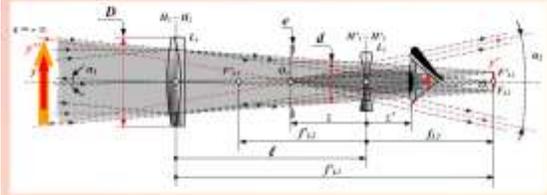


- Rise of the "Scientific Community"
 - Royal Society of London (1662)
 - Academy of Royal Sciences (1666)
- The modern scientific method
- A universe ordered according to natural laws

Louis XIV at the French Academy of Sciences



Technology



DRIVING SCIENCE

Art Credit: Tannofex

The Scientific Revolution Spreads



microscope



thermometer



simple mercury barometer

- Scientific Instruments
 - Scientists develop microscope, barometer, and thermometer
 - New instruments lead to better observations and new discoveries

The Scientific Revolution Spreads

- Medicine and the Human Body
 - Andreas Vesalius improves knowledge of anatomy



Andreas Vesalius

The Scientific Revolution Spreads



- Medicine and the Human Body (continued)
 - Galen – key ancient thinker who examined the physical world
 - Edward Jenner produces world's first vaccination—for smallpox



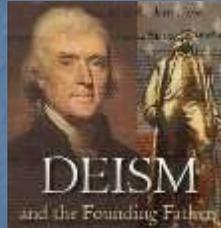
1802 caricature of Jenner vaccinating patients who feared it would make them sprout cow like appendages.

The Scientific Revolution Spreads

- Discoveries in Chemistry
 - Robert Boyle argues that matter is made of many different particles
 - Boyle's law reveals interaction of volume, temperature, and gas pressure.



IV. Consequences of the Scientific Revolution (cont)



- Laws discovered by human reason
- "De-Spiritualized" and demystified the Universe
- Mechanical View of the Universe
- Deistic View of God
 - God as the cosmic capitalist

The Enlightenment

"Sicle de Lumiere"
"The Century of Light"

I. What was it?



- Progressive, Rationalistic, Humanistic worldview
- Emerged out of the Scientific Revolution and culminated in the French Revolution
- Spokesmen = Rising Middle Class
- Paris = Center of Enlightenment
- Optimism about mankind's abilities

II. Key Ideas



- Distrust of Tradition and Revealed Religion
- Scientific method could be applied to society as well
- Society can get better as risks are taken
- Man is naturally good
- Good life is on earth

III. An Attack on the Old Regime

A. The World of the Old Regime



- Built on tradition
- World of hierarchy, privilege and inequality
- Allied with the Church
- Challenged by the reform impulse of supporters of the Enlightenment

B. Conflict with the Capitalistic Middle Class



- Support for the Middle Class social order against the traditional social order
- Size and increasing power of the Middle Class
- New notion of wealth
- Tension and discord created by the Middle Class

C. Popularization of Science



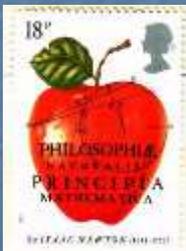
- The popularity of science in the 17th and 18th centuries
- *Conversations on the Plurality of the Worlds* (1686)—Bernard de Fontenelle
- The Scientific Revolution promised the comprehensibility of the workings of the universe

D. A New World of Uncertainties



- The Idea of Progress
- The anti-religious implications of the Enlightenment
- The relativity of truth and morality
- John Locke's New Psychology
--*Essay Concerning Human Understanding* (1690)
-- "Tabula Rasa"

IV. The Philosophes



- 18th century French intellectuals
- Interest in addressing a broad audience
- Committed to reform
- Celebrated the scientific revolution
- The "Mystique of Newton"
- Science applied to society

The "Enlightened" Individual → The *Philosophe*



- ▶ Not really original thinkers as a whole, but were great publicists of the new thinking → CHANGE & PROGRESS!
- ▶ They were students of society who analyzed its evils and advanced reforms.

The "Great Debate"

Reason & Logic



Traditions and Superstitions

- m_rationalism
- m_ empiricism
- m_ tolerance
- m_ skepticism
- m_ Deism

- m_ nostalgia for the past
- m_ organized religions
- m_ irrationalism
- m_ emotionalism

V. The Problem of Censorship



- The attempt of the Old Regime to control new thinking
- Publishers and writers hounded by censors
- Over 1000 booksellers and authors imprisoned in the Bastille in the early 1700's
- Battling censorship

VI. The Role of the Salon



- Protection and encouragement offered by French aristocratic women in their private drawing rooms
- Feminine influence on the Enlightenment

A Parisian Salon



Madame Geoffrin's Salon



The *Salonnières*



Madame Geoffrin
(1699-1777)



Mademoiselle Julie de Lespinasse
(1732*-1776)



Madame Suzanne Necker
(1739-1794)

Other Female Salons

- ▶ Wealthy Jewish women created nine of the fourteen salons in Berlin.
- ▶ In Warsaw, Princess Zofia Czartoryska gathered around her the reform leaders of Poland-Lithuania.
- ▶ Middle-class women in London used their salons to raise money to publish women's writings.

The Age of Reason & Enlightenment

18^c Politics

- ▶ BRITAIN → **Constitutional Monarchy**
- ▶ FRANCE → **Royal Absolutism**
(cultural and religious unity)
- ▶ PRUSSIA, HABSBURG EMPIRE,
RUSSIA → **"Enlightened Despotism"**
- ▶ OTTOMAN EMPIRE → **traditional empire**

The Origins of Enlightenment?

▶ **SCIENTIFIC:**

- ℳ Newton's system was synonymous with the empirical and the practical.
- ℳ Scientific laws could be expressed as universal mathematical formulas.
- ℳ Science allowed alternatives to be imagined in everything from politics to religion.

William Blake's *Newton*, 1795



The Royal Academy of Sciences, Paris



Official Scientific Academies in Europe During the Eighteenth Century

	Official Scientific Societies in all Europe (excluding colonies)	Official Scientific Societies in France
1700	6	2
1789	65	29

Zoology & Biology



A dissection at the Royal Academy, London.

Chemistry Labs & Botany Gardens



Natural History Collections



- ▶ Cocoa plant drawing.
- ▶ Sir Hans Sloane (1660-1753).
- ▶ Collected from Jamaica.



Natural History Collections



James Petiver's Beetles (London apothecary)

Private Collections



The Origins of Modern Museums.

Women & Science



The German astronomer Hevelius & his wife examine the heavens.

The Origins of Enlightenment?

▶ RELIGIOUS:

- ℳ physico-theology → an attempt (inspired by science) to explain God's Providence by reference to his work in nature & not primarily through his biblical Word.
- ℳ support of a "rational" religion, free from mysteries, miracles, and superstitions.

The Origins of Enlightenment?

▶ RELIGIOUS:

ℳ Deism

- √ The belief in the existence of a God or supreme being but a denial of revealed religion, basing one's belief on the light of nature and reason.
- ℳ Deists saw no point in any particular religion; they recognized only a distant God, uninvolved in the daily life of man.

The Origins of Enlightenment?

▶ RELIGIOUS:

ℳ Pantheism

- √ The belief that God and nature are one and the same.
- ℳ Gradually, highly educated Protestants & Catholics thought more about God's work as revealed through science, rather than through the Scriptures.

Centers of the Enlightenment



The Characteristics of the Enlightenment

1. Rationalism → reason is the arbiter of all things.
2. Cosmology → a new concept of man, his existence on earth, & the place of the earth in the universe.
3. Secularism → application of the methods of science to religion & philosophy.

The Characteristics of the Enlightenment

4. Scientific Method
 - Mathematical analysis
 - Experimentation
 - Inductive reasoning.
5. Utilitarianism → the greatest good for the greatest number.
6. Tolerance → *No opinion is worth burning your neighbor for.*

The Characteristics of the Enlightenment

7. **Optimism & Self-Confidence**
 - The belief that man is intrinsically good.
 - The belief in social progress.
8. **Freedom**
 - Of thought and expression.
 - Bring liberty to all men (modern battle against absolutism).
9. **Education of the Masses**

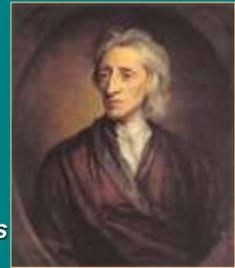
The Characteristics of the Enlightenment

10. **Legal Reforms**
 - Justice, kindness, and charity → no torture or indiscriminant incarceration.
 - Due process of law.
11. **Constitutionalism**
 - Written constitutions → listing citizens, rights.
12. **Cosmopolitanism.**

VIII. Famous Enlightenment Thinkers

John Locke (1632-1704)

- ▶ *Letter on Toleration*, 1689
- ▶ *Two Treatises of Government*, 1690
- ▶ *Some Thoughts Concerning Education*, 1693
- ▶ *The Reasonableness of Christianity*, 1695



John Locke's Philosophy (I)

- ▶ The individual must become a "rational creature."
- ▶ Virtue can be learned and practiced.
- ▶ Human beings possess free will.
 - they should be prepared for freedom.
 - obedience should be out of conviction, not out of fear.
- ▶ Legislators owe their power to a **contract with the people**.
- ▶ Neither kings nor wealth are divinely ordained.

John Locke's Philosophy (II)

- ▶ There are certain natural rights that are endowed by God to all human beings.
 - *life, liberty, property!*
- ▶ The doctrine of the Divine Right of Kings was nonsense.
- ▶ He favored a republic as the best form of government.

A. Baron de Montesquieu (1689-1755)



- *The Spirit of the Laws* (1748)
 - Monarchy
 - Republic
 - Despotism
- Despotism could be avoided if political power were divided and shared by a diversity of classes
- Power must check power
 - **A separation of political powers ensured freedom and liberty.**
- Admires British government
- French parliaments must be defenders of liberty
- Influence in the US

B. Voltaire (1694-1778) Francois-Marie Arouet



- Enthusiasm for English institutions
- Reformer not a revolutionary
- Admirer of Louis XIV
- Relationship with Frederick the Great
- "Ecrasez l'infame"
 - Crush the infamous thing
 - Deism

Voltaire (1712-1778)

- ▶ AKA → Francois Marie Arouet.
- ▶ *Essay on the Customs and Spirit of Nations*, 1756
- ▶ *Candide*, 1759
- ▶ *Philosophical Dictionary*, 1764



Voltaire's "Wisdom" (I)

- ▶ *Every man is guilty of all the good he didn't do.*
- ▶ *God is a comedian playing to an audience too afraid to laugh.*
- ▶ *If God did not exist, it would be necessary to invent him.*
- ▶ *It is dangerous to be right when the government is wrong.*
- ▶ *Love truth and pardon error.*

Voltaire's "Wisdom" (II)

- ▶ *Judge of a man by his questions rather than by his answers.*
- ▶ *Men are equal; it is not birth, but virtue that makes the difference.*
- ▶ *Prejudice is opinion without judgment.*
- ▶ *The way to become boring is to say everything.*
- ▶ *I may not agree with what you have to say, but I will defend to the death your right to say it.*

C. Diderot's *Encyclopedia*



- Ultimate strength of the philosophes lay in their numbers, dedication and organization
- Written between 1751-1772
- Attempted to illustrate all human knowledge
- Problems with publication
- Emphasis on practical science

C. Diderot's *Encyclopedia* (cont)



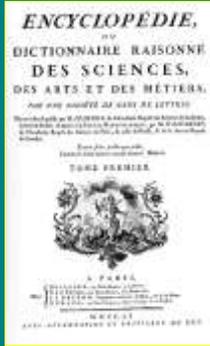
- Desire to change the "general way of thinking"
- Greater knowledge leads to human progress
- Emphasized moderation and tolerance
- Human nature can be molded
- Inalienable rights and the social contract
- Knowledge improves goodness

Denis Diderot (1713-1784)



- ▶ *All things must be examined, debated, investigated without exception and without regard for anyone's feelings.*
- ▶ *We will speak against senseless laws until they are reformed; and, while we wait, we will abide by them.*

Diderot's *Encyclopédie*



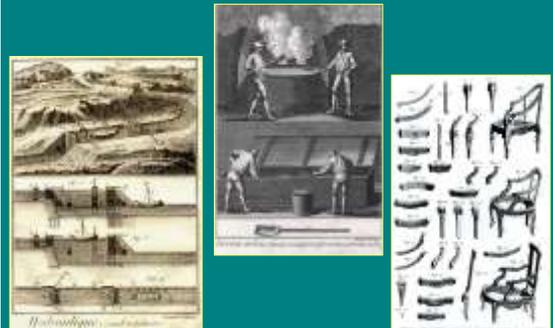
The *Encyclopédie*

- ▶ *Complete cycle of knowledge..... change the general way of thinking.*
- ▶ 28 volumes.
- ▶ Alphabetical, cross-referenced, illustrated.
- ▶ First published in 1751.
- ▶ 1500 livres a set.

Pages from Diderot's *Encyclopédie*



Pages from Diderot's *Encyclopédie*



Pages from Diderot's *Encyclopedie*



Subscriptions to Diderot's



D. David Hume (1711-1776)



- Human mind is nothing but a bundle of impressions
- Reason cannot decipher anything about the origins of the universe or the existence of God
- Hume's rationalistic inquiry results in undermining the Enlightenment confidence in reason itself

E. Jean-Jacques Rousseau (1712-1778)



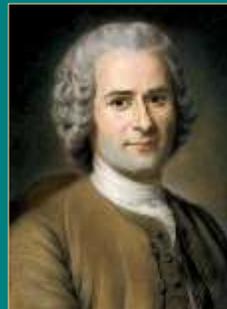
- His life
- Turns his withering critique of the Old Regime increasingly on the Enlightenment itself
- Rather than liberation, rationalism and civilization destroys the individual
- Man by nature was solitary, good and free

E. Rousseau (cont)



- Civilization represents decay, not progress
- Emile*—protect children from too many books
- The Social Contract* (1762) and the "General Will"
- Civilized man is an alienated man
- Transitional intellectual figure

Jean Jacques Rousseau (1712-1778)



- ▶ *A Discourse on the Sciences and Arts*, 1750
- ▶ *Emile*, 1762.
- ▶ *The Social Contract*, 1762.

Rousseau's Philosophy (I)

- ▶ **Question** → Does progress in the arts and sciences correspond with progress in **morality**?
 - As civilizations progress, they move away from morality.
 - Science & art raised artificial barriers between people and their natural state.
 - Therefore, the revival of science and the arts had corrupted social morals, not improved them!

Rousseau's Philosophy (II)

- ▶ Virtue exists in the "state of nature," but lost in "society."
- ▶ Government must preserve "virtue" and "liberty."
- ▶ *Man is born free, yet everywhere he is in chains.*
 - The concept of the "Noble Savage."
- ▶ *Liberty, Equality, Fraternity.*
 - Civil liberty → invest ALL rights and liberties into a society.

Rousseau's Philosophy (III)

- ▶ In *The Social Contract*:
 - The right kind of political order could make people truly moral and free.
 - Individual moral freedom could be achieved only by learning to subject one's individual interests to the "General Will."
 - Individuals did this by entering into a social contract not with their rulers, but with each other.
 - ✓ This social contract was derived from human nature, not from history, tradition, or the Bible.

Rousseau's Philosophy (IV)

- ▶ People would be most free and moral under a republican form of government with direct democracy.
- ▶ However, the individual could be "forced to be free" by the terms of the social contract.
 - He provided no legal protections for individual rights.
- ▶ Rousseau's thinking:
 - Had a great influence on the French revolutionaries of 1789.
 - His attacks on private property inspired the communists of the 19^c such as Karl Marx.

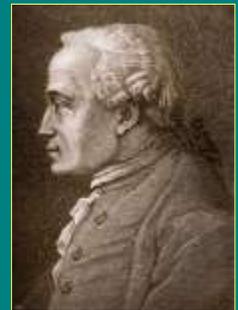
F. Immanuel Kant (1724-1804)



- One of few philosophes to live to see the French Revolution
- Enlightenment was a personal process—release from immaturity
- More optimistic than Rousseau
- "Dare to Know"—Enlightenment was an act of personal courage

Immanuel Kant (1724-1804)

- ▶ *Critique of Pure Reason*, 1781
- ▶ "What is Enlightenment?", 1784
- ▶ *Metaphysical Foundations of Natural Science*, 1786



Kant's Philosophy

- ▶ *Dare to Know!*
- ▶ He introduced the concept of transcendentalism → some things are known by methods other than empirically.
 - The belief in the existence of a non-rational way to understand things.
- ▶ The existence of neither time nor space is determined by empirical understanding.
 - These type of things are *a priori*.
 - ✓ They transcend sensory experience.
 - ✓ They are pure, not empirical [[concepts like faith, pre-existence, life after death].

Thomas Paine (1737-1809)



- ▶ *Common Sense*, 1776
- ▶ *The Rights of Man*, 1791

The American "*Philosophes*"



John Adams
(1745-1826)



Ben Franklin
(1706-1790)



Thomas Jefferson
(1743-1826)

.....life, liberty, and the pursuit of happiness.....



The American Revolution

Enlightenment ideas help spur the American colonies to shed British rule and create a new nation.

Britain and Its American Colonies

- The American Colonies Grow
 - American colonies grow large and populous during the 1600s and 1700s
 - Colonies thrive economically through trade with Europe
 - Britain's Navigation Act restricts that trade (1651)
 - Other trade laws add restrictions and taxes
 - Colonists identify less and less as British subjects

Americans Win Independence

- British-Colonial Tensions Arise
 - Britain and American colonies win the French and Indian War in 1763
 - Britain taxes colonists to help pay the war debts
 - Colonists argue that British cannot tax them without their consent

Americans Win Independence

- Growing Hostility Leads to War
 - Colonists protest tea tax with “Boston Tea Party” in 1773
 - Colonists meet in Philadelphia to address British policies (1774)
 - British and Americans exchange fire at Lexington and Concord in 1775

Americans Win Independence

- The Influence of the Enlightenment
 - Colonial leaders push for independence, rely on Enlightenment ideas
 - Declaration of Independence—document justifying colonial rebellion
 - Leader Thomas Jefferson writes Declaration, uses ideas of John Locke

Changing Idea: Colonial Attachment to Britain	
Old Idea	New Idea
American colonists considered themselves to be subjects of the British king.	After a long train of perceived abuses by the king, the colonists asserted their right to declare independence.



Americans Win Independence

- Success for the Colonists
 - Despite British military might, colonists have advantages:
 - Motivating cause of freedom
 - French assistance
 - War's expense for Britain
 - British surrender at Yorktown in 1781; colonists win the war

Americans Create a Republic

- A Weak National Government
 - Articles of Confederation set government plan for new republic
 - Articles create legislature only, no executive or judicial branches
 - Result is weak national government that fails to provide unity and order

Americans Create a Republic

- A New Constitution
 - Leaders call Constitutional Convention in 1787 to revise articles
 - Group instead creates a new government under U.S. Constitution
 - Constitution contains many political ideas of the Enlightenment



Enlightenment Ideas and the Constitution

Enlightenment Idea	U.S. Constitution
Locke A government's power comes from the consent of the people.	<ul style="list-style-type: none"> • Preamble begins "We the people of the United States" to establish legitimacy. • Creates representative government • Limits government powers
Montesquieu Separation of powers	<ul style="list-style-type: none"> • Federal system of government • Powers divided among three branches • System of checks and balances
Rousseau Direct democracy	<ul style="list-style-type: none"> • Public election of president and Congress
Voltaire Free speech, religious toleration	<ul style="list-style-type: none"> • Bill of Rights provides for freedom of speech and religion.
Beccaria Accused have rights, no torture	<ul style="list-style-type: none"> • Bill of Rights protects rights of accused and prohibits cruel and unusual punishment.

Americans Create a Republic

- The Federal System
 - Constitution creates three branches of government
 - Provides checks and balances—ensures branches share power equally
 - Promotes federal system—power divided between nation and states
- The Bill of Rights
 - Some fear too much national power, few protections of rights
 - Leaders win support for Constitution by adding a Bill of Rights
 - Ten amendments to Constitution that protect freedoms

Reading During the Enlightenment

- ▶ Literacy:
 - 80% o/o for men; 60 o/o women.
- ▶ Books were expensive (one day's wages).
- ▶ Many readers for each book (20 : 1)
 - novels, plays & other literature.
 - journals, memoirs, "private lives."
 - philosophy, history, theology.
 - newspapers, political pamphlets.

An Increase in Reading



An Increase in Reading



"Must Read" Books of the Time

Isaac Newton	<i>Mathematical Principles of Natural Philosophy</i> (1687)
John Locke	<i>Essay Concerning Human Understanding</i> (1689)
John Locke	<i>Two Treatises of Civil Government</i> (1690)
Voltaire	<i>Philosophical Letters</i> (1734)
Montesquieu	<i>The Spirit of Laws</i> (1748)
Jean-Jacques Rousseau	<i>The Social Contract</i> (1762)
Jean-Jacques Rousseau	<i>Emile or On Education</i> (1762)
Denis Diderot and Jean d'Alembert	<i>Encyclopedie</i> (1751-81)
Condorcet	<i>Sketch for a Historical Picture of the Progress of the Human Mind</i> (1795)

Mary Wollstonecraft

- Women should be equally educated along with men.
- Women should enter professions traditionally dominated by men like medicine and politics.
- Wrote *A Vindication of the Rights of Woman*



Mary Shelley



- Daughter of Mary Wollstonecraft.
- Mistress and later wife of poet Percy Bysshe Shelley.
- Author of *Frankenstein* in the summer of 1816, later published in 1818.

Climate and the writing of *Frankenstein* (continued)



Illustration from the 1831 edition.

- The Shelley's (Mary Wollstonecraft Godwin calling herself Mary Shelley though she is not yet married to Percy) spend the summer with Lord Byron at his villa by Lake Geneva in Switzerland.
- The weather being too cold to carry out normal summer activities, the group reside indoors staying up all night in intellectual discussions. They often sit around the fire reading German ghost stories.

Climate and the writing of *Frankenstein* (continued)

- Lord Byron suggests that to entertain themselves indoors each of them write his or her own supernatural tale.
- During this time Mary Godwin conceived of the idea for *Frankenstein*.



Boris Karloff as the Monster in 1931.

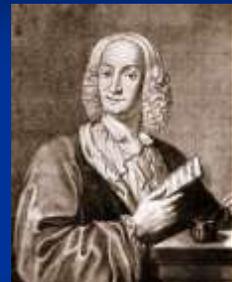
The Enlightenment Spreads

Baroque Music

- Representative Composers
 - Antonio Vivaldi
 - Johann Sebastian Bach
 - George Friedrich Handel

Antonio Vivaldi (1678-1741)

- Representative Works
 - Most famous work *Le quattro stagioni* (*The Four Seasons*), written in 1723.
 - 46 operas
 - 76 sonatas
 - Chamber music
 - Sacred music



Johann Sebastian Bach (1685-1750)

- Representative Works
 - cantatas
 - chorales
 - organ works
 - lute music
 - chamber music
 - canons and fugues
- Famous piece: "Jesu Joy of Man's Desiring"



George Frederick Handel (1685-1759)

- Representative Works
 - 42 operas
 - 29 oratorios
 - 120 cantatas, trios, duets
 - numerous arias
 - chamber music
- Most famous work: *Messiah* oratorio traditionally performed during the Christmas season, including "Hallelujah Chorus".



Changes in music during the Enlightenment

- *Classical* music, with a new, lighter style, emerged during the Enlightenment. Haydn, Mozart, and Beethoven were three classical composers from Austria.

Classical Music

- Representative Composers
 - Joseph Haydn
 - Wolfgang Amadeus Mozart
 - Ludwig van Beethoven

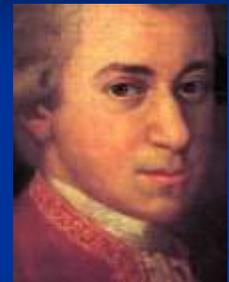
Joseph Haydn (1732-1809)

- Known as "Father of the Symphony" and "Father of the String Quartet"
- Representative Works
 - 104 Symphonies
 - numerous concertos for various instruments
 - 15 operas
 - other music



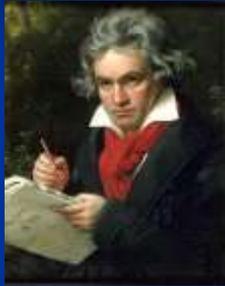
Wolfgang Amadeus Mozart (1756-1791)

- Representative works
 - 23 operas
 - numerous symphonies
 - "Toy Symphony"
 - concertos
 - "Flute concerto no. 2 in D Major, K 314"
 - piano music
 - chamber music
 - sacred music
 - masses



Ludwig van Beethoven

- Representative Works
 - Symphonies (5th and 9th probably the most famous)
 - Piano music
 - “Für Elise”
 - Vocal music
 - Operas
 - Choral music



Changes in literature during the Enlightenment

- Eighteenth century writers began writing novels, lengthy works of prose fiction. *Pamela*, by Samuel Richardson, is often considered the first English novel.

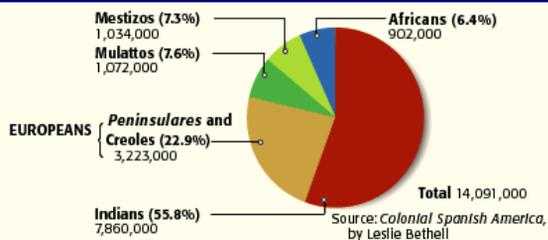
Latin American Peoples Win Independence

Spurred by discontent and Enlightenment ideas, peoples in Latin America fight colonial rule.

Colonial Society Divided

- A Race and Class System
 - Latin America has social classes that determine jobs and authority
 - **Peninsulares**—born in Spain, they head colonial government and society
 - **Creoles**—American-born Spaniards who can become army officers
 - **Mestizos**—have both European and Native American ancestry
 - **Mulattos**—have both European and African ancestry
 - Slaves and Native Americans are at the bottom of society

The Divisions in Spanish Colonial Society, 1789



SKILLBUILDER: Interpreting Graphs

1. **Clarifying** Which two groups made up the vast majority of the population in Spanish America?
2. **Making Inferences** Of the Europeans, which group—peninsulares or creoles—probably made up a larger percentage?

Revolutions in the Americas

- Revolution in Haiti
 - Haiti is the first Latin American territory to gain freedom
 - **Toussaint L'Ouverture** leads slave revolt against the French (1791)
 - Toussaint eventually dies in a French prison in 1803.



Revolutions in Haiti

- Haiti's Independence
 - Jean-Jacques Dessalines declares Saint Domingue a country in 1804
 - Saint Domingue becomes first black colony to win independence
 - Renames Haiti, means "mountainous land" in the Arawak language
 - Emperor Jacques is assassinated in 1806 by disaffected members of his administration.



Creoles Lead Independence

- The Spread of Enlightenment Ideas
 - Enlightenment ideas inspire Latin American revolutionaries
- Creole Leaders
 - **Simón Bolívar**—wealthy Creole leads Venezuela in revolution
 - **José de San Martín**—leader of Argentinean revolutionary forces



1. Bolívar's 1807 return from Europe by way of the United States allowed him to study the American system of government.
2. In 1810, Bolívar went to London to seek support for the revolution in Latin America. At the same time, he studied British institutions of government.

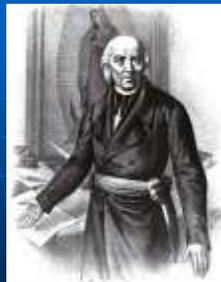
Portraits of Bolivar and San Martin



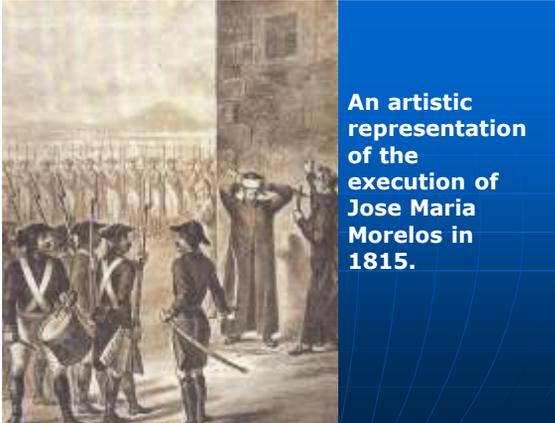
Creoles Lead Independence

- Bolívar's Route to Victory
 - Venezuela declares independence in 1811; Bolívar wins war by 1821
- San Martín Leads Southern Liberation Forces
 - Argentina is independent in 1816; San Martín helps free Chile
 - Bolívar's and San Martín's armies drive Spanish out of Peru in 1824.

Mexico Ends Spanish Rule



- A Cry for Freedom
 - Padre **Miguel Hidalgo**—priest who launches Mexican revolt (1810).
 - 80,000 Indian and Mestizo followers march on Mexico City
 - **Jose Maria Morelos**—leads revolt after Hidalgo's defeat, but loses
 - Both Hidalgo and Morelos were executed.



An artistic representation of the execution of Jose Maria Morelos in 1815.

Mexico Ends Spanish Rule

- Mexico's Independence
 - Mexican creoles react; Iturbide (a Mexican General) declares Mexico independent (1821)
 - Iturbide reigns briefly as emperor until March 1823.
 - In 1823, Central America breaks away from Mexico



Agustín de Iturbide



Iturbide is credited with designing the first Mexican flag. (1821-1823)



Today's Flag of Mexico
The tri-color flag is still used, and the presence of the eagle is also used in the modern flag of Mexico used since 1968.

Brazil's Royal Liberator

- A Bloodless Revolution
 - Napoleon invades Portugal; royal family moves to Brazil (1807)
 - Portuguese court returns to Portugal after Napoleon's defeat (1815)



The Imperial Palace in Rio de Janeiro where King John VI of Portugal had transferred the Portuguese Royal Court to Brazil.

Brazil's Royal Liberator



Pedro I of Brazil

- Portuguese prince Dom Pedro stays behind in Brazil
 - Dom Pedro accepts Brazilian's request to rule their own country
 - He officially declares Brazil's independence (September 1822)
- By 1830, nearly all of Latin American regions win independence



Flag of the independent Empire of Brazil under Pedro I

IX. Enlightened Despotism



- The manner of political reform
- Frederick the Great of Prussia
- Catherine the Great of Russia
- Joseph II of Austria
- True reform or a cynical, manipulative consolidation of power?

“Enlightened Despotism”

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



- ▶ 1712 -- 1786.
- ▶ Succeeded his father, Frederick William I (the “Soldier King”).
- ▶ He saw himself as the “**First Servant of the State.**”

Absolutist Prussia



The Holy Roman Empire



Art Credit: David Luzzo & N3MO

The Holy Roman Empire

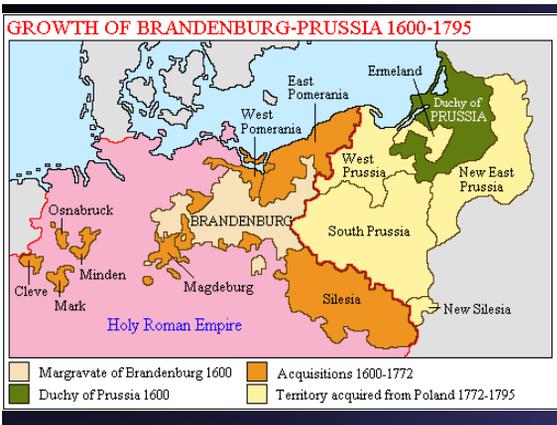
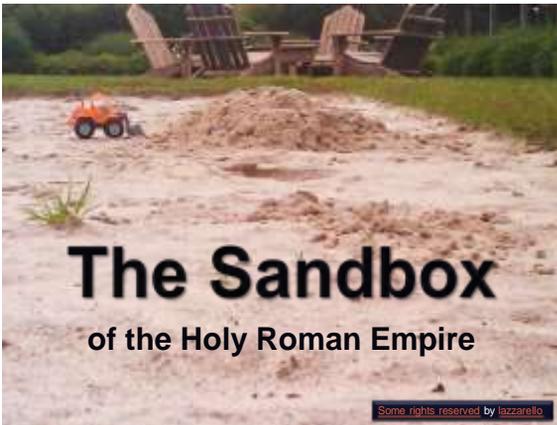


*“Neither Holy,
nor Roman,
nor an Empire!”*

-- Voltaire



Confederation



Frederick William

(r. 1640-1688)



The "Great Elector"

Father of Prussian Absolutism

Frederick William I

(r. 1713-1740)



The "Soldier King"

Soldatenkönig

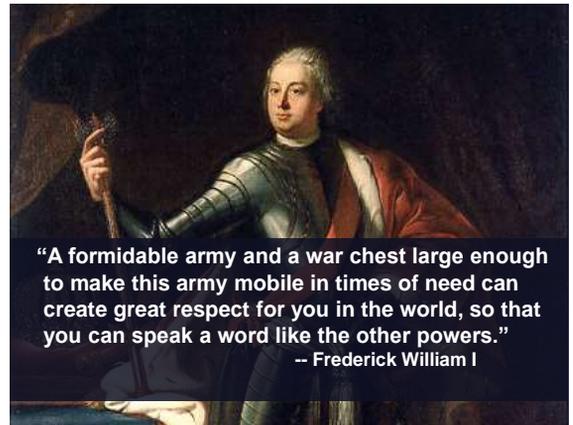
Frederick II "the Great"

(r. 1740-1786)



Enlightened Absolutist

Friend of Voltaire



"A formidable army and a war chest large enough to make this army mobile in times of need can create great respect for you in the world, so that you can speak a word like the other powers."
-- Frederick William I

MILITARISM



Carl Röchling (d. 1920), *Attack of the Prussian Infantry*

MILITARISM

12TH

Largest Population



Carl Röchling (d. 1920), *Attack of the Prussian Infantry*

MILITARISM



12TH
Largest Population

4TH
Largest Army

Carl Röchling (d. 1920), *Attack of the Prussian Infantry*

MILITARISM



Armies from Russia to the United States adopted the Prussian drill model.

Carl Röchling (d. 1920), *Attack of the Prussian Infantry*

Baron von Steuben



Trained Washington's Continental Army in Prussian-style drill



"Sparta of the North"

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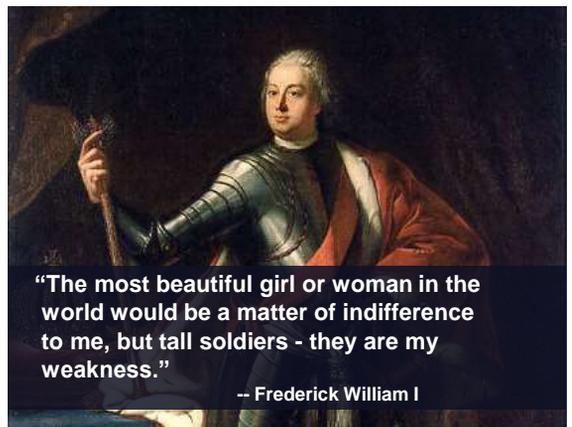
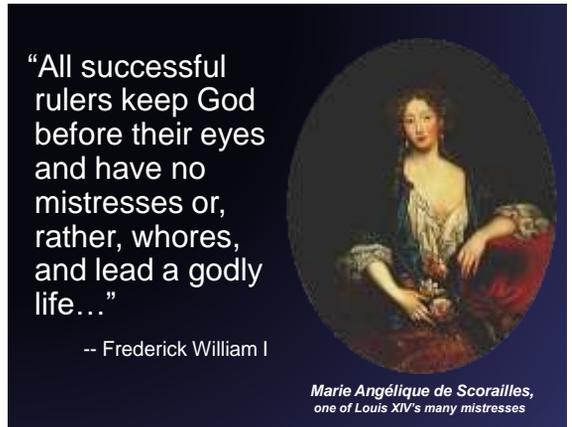


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Building an Absolutist State

Church	Protestant Religious Toleration
Nobility (Junkers)	Cooperation (Service Nobility)
Representative Bodies (Estates)	Reduced Power Taxation by Decree
Education	Compulsory Public Education (1 st system of its kind)

Catherine the Great (r. 1762-1796)




- ▶ German Princess Sophie Friederike Auguste of Anhalt-Zerbst.
- ▶ 1729 -- 1796.

RUSSIA UNDER CATHERINE THE GREAT

1. German wife of the Tsar -> has her husband murdered
2. Becomes Tsarina -> claims to be an enlightened reformer
3. Tried to reform the law code -> issues *Instruction* -> nothing changes
4. Landowning aristocrats gain more power/influence - Charter of the Nobility
5. Conditions worsen for the peasantry/serfs
 - Cossacks = tribal warriors who fought in southern Russia

Reformer? OR Despot?

- 1767: Catherine summons the Legislative Commission.
- 1768-1774: Russo-Turkish War.
- 1771-1775: Pugachev Rebellion is suppressed.
- 1772: First partition of Poland.
- 1785: Charter of Nobility.
- 1793: Second partition of Poland.

Map 18.2: The Partitioning of Poland



Reformer? OR Despot?



The Partitions of Poland



Russian Expansionism in the Late



AUSTRIAN EMPRESS MARIA THERESA



EMPRESS MARIA THERESA 1740-1780

1. Reforms her empire to strengthen it against Prussia
2. Makes the empire more centralized and bureaucratic
3. Enlarges and modernizes the army
4. Deeply Catholic and conservative -> resisted the radical reforms the philosophes wanted

Joseph II of Austria (r. 1765-1790)

- ▶ 1741 — 1790.
- ▶ His mother was Maria Theresa.



EMPEROR JOSEPH II 1780-1790

1. Great believer in the Enlightenment
2. Reason should dominate government and society
3. Radical reforms
4. Abolished serfdom
5. Economic modernization -> eliminated internal trade barriers, monopolies, and guild restrictions
6. New law code/equality before the law
7. Religious reforms = toleration
8. Reforms too radical -> upset everyone
9. When he died most reforms cancelled -> failed

Habsburg Family Crest



Joseph II, Holy Roman Emperor

- 1772: First partition of Poland.
- 1778-1779: He failed to annex Bavaria to Austrian lands.
- 1781: Declared the Toleration Patent.
- 1781: Abolition of serfdom and feudal dues.
- 1785: He failed to exchange the Austria Netherlands for Bavaria.
- 1787-1792: Austria joined Russia in the Russo-Turkish War, but little was gained.

Joseph II of Austria



The Legacy of the Enlightenment?

1. The democratic revolutions begun in America in 1776 and continued in Amsterdam, Brussels, and especially in Paris in the late 1780s, put every Western government on the defensive.
2. Reform, democracy, and republicanism had been placed irrevocably on the Western agenda.

The Legacy of the Enlightenment?

3. New forms of civil society arose --- clubs, salons, fraternals, private academies, lending libraries, and professional/scientific organizations.
4. 19^c conservatives blamed it for the modern “egalitarian disease” (once reformers began to criticize established institutions, they didn’t know where and when to stop!)

The Legacy of the Enlightenment?

5. It established a materialistic tradition based on an ethical system derived solely from a naturalistic account of the human condition (the “Religion of Nature”).
6. Theoretically endowed with full civil and legal rights, the individual had come into existence as a political and social force to be reckoned with.