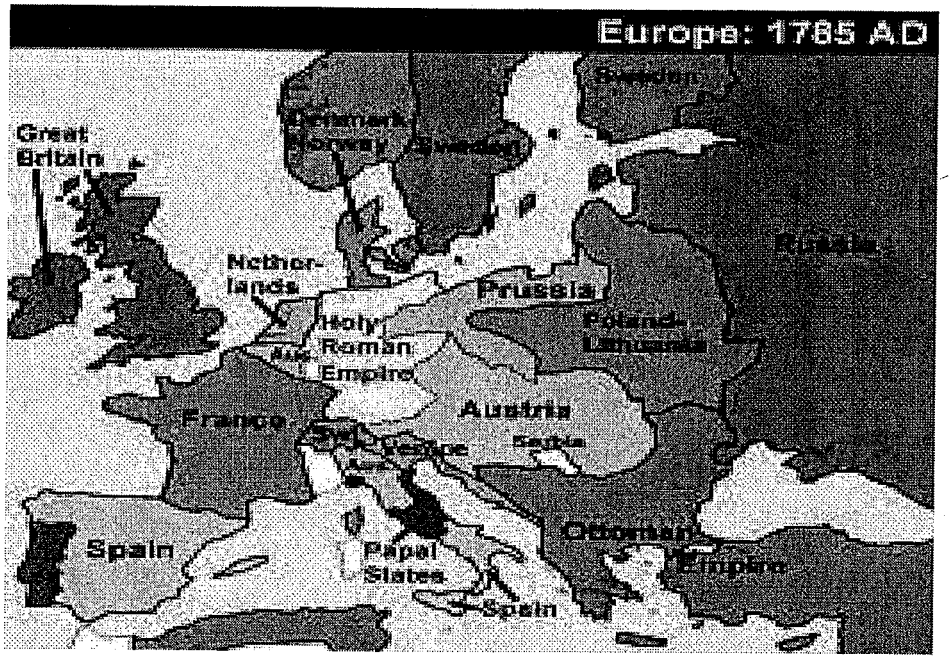
SCIENTIFIC REVOLUTION & ENLIGHTENMENT



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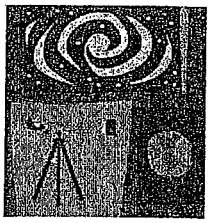
PERIOD_____

Unit 15: Scientific Revolution and Enlightenment



Scientific Revolution

- A revolution is a major/drastic change in society.
- The Scientific Revolution was a new way of thinking about science and nature. It was based on observation and a willingness to question accepted beliefs.
- Old Science: Scholars relied on ancient findings, church teachings, common sense and reasoning to explain the physical world.
- New Science: Scholars began to use observation, experimentation, and scientific reasoning to gather knowledge and draw conclusions about the world (Scientific Revolution).
- Famous Scientists:
  - -Copernicus: Developed the heliocentric model which states that the sun is the center of the solar system and the planets orbit the sun. Prior to Copernicus, people believed in the geocentric model which stated that the Earth was the center of the solar system.
  - -Galileo: His observations and findings supported Copernicus' heliocentric model. Galileo built telescopes.
  - -Newton: Law of universal gravitation (every object in the universe attracts every other object)

Enlightenment

- The Enlightenment was an intellectual movement in the 1700s that stressed reason and thought and the power of individuals to solve problems (Age of Reason).
- Enlightenment thinkers:
  - -Locke: Believed that people have natural rights (right to life, liberty, and property)
  - -Montesquieu: Believed that the powers of the government should be separated into 3 branches
  - -Voltaire: Believed that people should have free speech and religious freedom
  - -Rousseau: Believed in majority vote; wrote *Social Contract*
- Enlightenment despots were monarchs who accepted Enlightenment ideas, like Catherine the Great (Russia).

4- Who was Galileo and why was he important?

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5- Who was Sir Isaac Newton and why was he important?

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Throughout the Middle Ages, Europeans' scientific knowledge had experienced little change because the Catholic Church had preserved the acceptance of a system of beliefs based on the teachings of the ancient Greeks and Romans which it had incorporated into religious doctrine. During this period there was little scientific inquiry and experimentation. Rather, students of the sciences simply read the works of the alleged authorities and accepted their word as truth. However, during the Renaissance, this passivity began to change. The quest to understand the natural world led to the revival of the sciences.

These scientific observers were surprised to find that their conclusions did not always match up with the accepted truths, and this finding inspired others to delve further into the study of the world around them. Scientific study quickly extended from the earth to the heavens, and Nicolas Copernicus, upon examining the records of the motions of heavenly bodies, soon discarded the old geocentric theory that placed the Earth at the center of the solar system and replaced it with a heliocentric theory in which the Earth was simply one of a number of planets orbiting the sun. Though this scheme seemed to comply better with the astronomical records of the time, Copernicus had little direct evidence to support his claims. However, eventually through the use of a telescope, Galileo Galilei was able to prove Copernicus' theory.

How did scientific thinking differ from the religious thinking of the medieval period:

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In the 1633 trial of Galileo Galilei, two worlds come into cosmic conflict. Galileo's world of science and humanism collides with the world of Scholasticism and absolutism that held power in the Catholic Church. The result is a tragedy that marks both the end of Galileo's liberty and the end of the Italian Renaissance.

Galileo Galilei was born in 1564 - the same year that Shakespeare was born and Michelangelo died. From an early age, Galileo showed his scientific skills. At age nineteen, he discovered the isochronisms of the pendulum. By age twenty-two, he had invented the hydrostatic balance. By age twenty-five, Galileo assumed his first lectureship, at the University of Pisa. Within a few more years, Galileo earned a reputation throughout Europe as a scientist and superb lecturer. Eventually, he would be recognized as the father of experimental physics. Galileo's motto might have been "follow knowledge wherever it leads us."

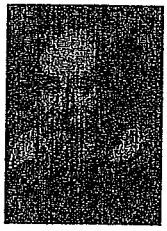
At the University of Padua, where Galileo accepted a position after three years in Pisa, he began to develop a strong interest in Copernican theory or the revolutionary idea that the Sun was at the center of the universe and that the Earth--rotating on an axis--orbited around the sun once a year. Copernicus' theory met mostly with skepticism. Skeptics countered with the "common sense" notion that the earth they stood on appeared not to move at all--much less at the speed required to fully rotate every twenty-four hours while spinning around the sun. Sometime in the mid-1590s, Galileo concluded that Copernicus got it right.

Galileo's discovery of the telescope in 1609 enabled him to confirm his beliefs in the Copernican system and emboldened him to make public arguments in its favor. Galileo decided that Copernicus was worth a fight. He decided to address his arguments to the enlightened public at large, rather than the academics. Galileo published a book involving a debate between a supporter of Copernicus and a supporter of the Church. The Church was angered by Galileo's book and brought him to trial. Galileo was found guilty of heresy and placed under house arrest. Eventually, Galileo went blind from looking at the sun through his telescope. While the Church temporarily succeeded in silencing scientists, science could not be permanently silenced.

Would you have challenged the Church as Galileo did? Explain your answer.

Old Science	New Science
Scholars relied on ancient findings, church teachings, common sense and reasoning to explain the physical world.	Scholars began to use observation, experimentation, and scientific reasoning to gather knowledge and draw conclusions about the world.

Some famous scientists:

Scientist's Name	Time Period	Country of Origin	Discoveries
Copernicus 	1500s	Poland	Developed the heliocentric theory which states that the sun is at the center of the solar system and the planets orbit the sun. Prior to Copernicus, people believed in the geocentric theory which stated that the Earth was the center of the solar system.
Galileo 	1630	Italy	His observations and findings supported Copernicus' heliocentric theory. He built telescopes. Discovered that Jupiter had four moons and that the sun had dark spaces. Studied the moon's surface.

How science changed the way we look at the world.

Geocentrism (Aristotle, Ptolomy, Roman Catholic Church)	Heliocentrism (Copernicus, Galileo)
*Earth is the center of the universe (Because the Bible says earth has a special place in the universe due to God's creation.) *The moon orbits the earth, between the earth and the sun (because we can see eclipses) *Mercury and Venus both orbit between the earth and the sun (because we can see them during eclipses) *Mars, then Jupiter, then Saturn all orbit between the sun and the stars. *Mars, Jupiter, Saturn, and Venus all do loops sometimes in their orbits (called retrograde motion) *All planets are roughly the same size *There are "fixed stars" that are on the outside of the universe.	*The earth is not the center of the universe *The sun is the center of the universe *The earth is closer to the sun than the stars *The earth is moving (in orbit around the sun) *The earth is spinning on its axis (which is why the sun seems to move/why we have night and day) *The planets are also orbiting the sun (Mercury, Venus, Earth, Mars, Jupiter, and Saturn) and look like they are moving backwards (retrograde motion) because the earth is orbiting the sun faster than Mars, Jupiter, or Saturn. They are not doing any loops. *The moon is orbiting the earth *There are 4 moons orbiting Jupiter *There are "fixed stars" that are on the outside of the universe.

When you compare/contrast these two models, things to consider:

***Which one gives more Power to the Roman Catholic Church and why?**

Brahe and Kepler	Galileo	Bacon and Descartes
- A Danish astronomer, Tycho Brahe, carefully recorded the movements of the planets for many years - Brahe produced mountains of accurate data based on his observations - However, it was left to his followers to make mathematical sense of them - After Brahe's death in 1601, his assistant, a brilliant mathematician named Johannes Kepler, continued his work - After studying Brahe's data, Kepler concluded that certain mathematical laws govern planetary motion - One of these laws showed that the planets revolve around the sun in elliptical orbits instead of circles, as was previously thought - Kepler's laws showed that Copernicus's basic ideas were true - They demonstrated mathematically that the planets revolve around the sun	- An Italian scientist named Galileo Galilei built on the new theories about astronomy - Galileo built his own telescope and used it to study the heavens in 1609 - Galileo announced that Jupiter had four moons and that the sun had dark spots; he also noted that the earth's moon had a rough, uneven surface - This shattered Aristotle's theory that the moon and stars were made of a pure, perfect substance - Galileo's findings frightened both Catholic and Protestant leaders because they went against church teaching and authority - In 1632, he published *Dialogue Concerning the Two Chief World Systems* - This book presented the ideas of both Copernicus and Ptolemy, but it clearly showed that Galileo supported the Copernican theory - The pope angrily summoned Galileo to Rome to the Inquisition court - Under the threat of torture, Galileo agreed that the ideas of Copernicus were false	- The scientific method is a logical procedure for gathering and testing ideas - It begins with a question arising from an observation; scientists next form a hypothesis, or unproved assumption - The hypothesis is then tested in an experiment or on the basis of data - Finally, scientists analyze and interpret their data to reach new conclusions - A conclusion either confirms or disproves - Francis Bacon, an English writer, attacked medieval scholars for relying too heavily on the conclusions of Aristotle; instead of reasoning from abstract theories, he urged scientists to experiment and then draw conclusions - This approach is called empiricism, or the experimental method - In France, René Descartes took an interest in science - Rather than using experimentation, Descartes relied on mathematics and logic; he believed that everything should be doubted until proved by reason

The Enlightenment

Global History and Geography I

The Enlightenment refers to an important movement in Europe during the 18th century. Enlightenment thinkers were influenced by the Scientific Revolution. They believed that by applying reason and scientific laws, people could better understand both nature and society. They also hoped to apply these principles to improve society. Many Enlightenment thinkers questioned the divine right of kings and the power of the Roman Catholic Church.

Enlightenment thinkers like the French philosopher, Voltaire, advocated religious toleration and intellectual freedom. His ideas influenced the leaders of the American and French Revolutions. Jean-Jacques Rousseau believed a government should express the "general will" of the people. His book, ***The Social Contract***, helped to inspire the democratic ideals of the French Revolution. Another French philosopher, Montesquieu, argued for the separation of powers in government as a check against tyranny. His ideas encouraged the development of a system of checks and balances in the U.S. Constitution. Even some absolute rulers, like Catherine the Great, were influenced by Enlightenment thinkers. These rulers attempted to reform societies from above. They attempted to use some of the ideas of the Enlightenment, such as encouraging education and trade, while at the same time maintaining their traditional royal powers. Such rulers were called Enlightened Despots.

Questions:

1- What was the Enlightenment?

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2- How was the Enlightenment influenced by the Scientific Revolution?

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3- Who were important Enlightenment philosophers? What did they believe?

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People of the Enlightenment -1600s & 1700s

Name	From	Wrote	Main Ideas
 Locke	England	Two Treatises on Gov't	-Observation: gov't exists to "preserve life, liberty, & property" -Hypothesis: people should be sovereign (rule) -Hypothesis: monarchs not chosen by God
 Hobbes	England	Leviathan	-Observation: Life without gov't is "solitary, poor, nasty, brutish, & short." -Hypothesis: Absolute gov't needed to control evil behavior (not divine right)
 Montesquieu	France	The Spirit of Laws	-Observation: "When the legislature & executive are united in the same person, there is no liberty (freedom)" -Hypothesis: Gov't must have "*Separation of Powers*" – 3 branches
 Rousseau	France	The Social Contract	-Observation: "man is born free, but everywhere he is in chains." - Hypothesis: Gov't is contract between people & rulers. Gov't must be what people want.
 Voltaire	France		-Observation: Life is better with liberty -Hypothesis: Freedom of speech & religion, separation of church & state -"I disapprove of what you say, but I will defend to the death your right to say it. "

Which of these beliefs from the European Enlightenment still influence us today?

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Let's Review: Answer the following questions:

1. What was Galileo's idea?

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2. Why do you think Galileo took back his idea when the Inquisition or Catholic court told him to?

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3. Before 1500, how did scholars decide what was true or false?

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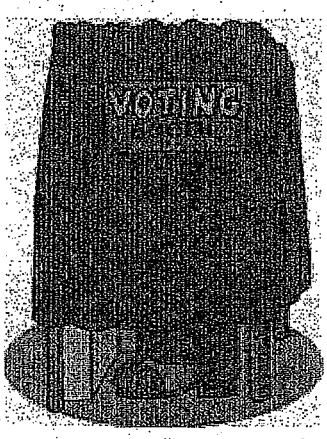
Enlightenment: a new intellectual movement in the 1700s that stressed reason and thought and the power of individuals to solve problems; Age of Reason

Old Idea:	New Idea:
A monarch's rule is justified by divine right.	A government's power comes from the consent of the governed (citizens).

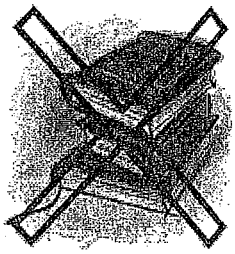


Enlightenment Philosophers	Major Ideas
John Locke 	• People have natural rights (right to life, liberty, property). • It is the job of government to protect these natural rights. • If government does not protect these rights, the people have the right to OVERTHROW it! (Revolution)

IMPACT OF ENLIGHTENMENT

I. GOVERNEMNT CENSORSHIP:

- Government and church leaders worked to **defend** the "old" views by **censoring** books and having controversial books **banned** and burned and writers thrown in prison (ex. Voltaire).



II. ENLIGHTENED DESPOTS - Some monarchs accepted the Enlightenment ideas.

- Catherine the Great of Russia – allowed religious toleration and free education for all including women

III. DEMOCRACY AND NATIONALISM:

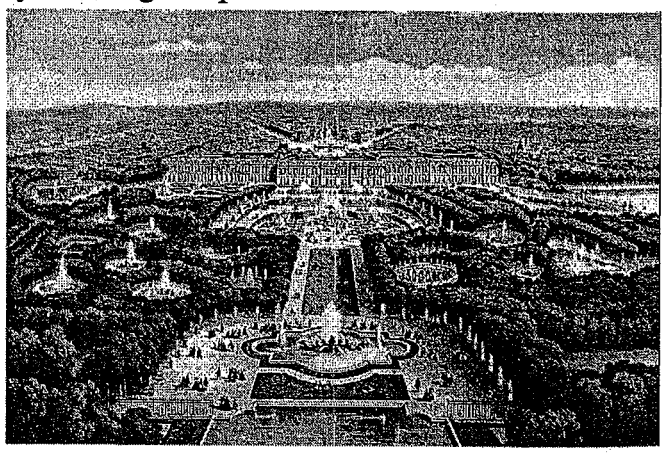
- Sparked people's interest and encouraged **American** colonies to rebel against Great Britain in the American Revolutionary War and later the **FRENCH** REVOLUTION!

Monarchy

A monarchy is a government that is controlled by a king or queen. Monarchy was the primary system of government in Europe during the Renaissance. During this time, the idea of divine right was strongly reinforced by the churches of Europe, most notably the Roman Catholic Church. Kings were approved by the pope, in some cases even personally crowned by the pope, symbolizing that their authority and power come from God. Monarchies are hereditary rule systems, where the leader passes on his government position to his son or daughter upon his death.

Kings got their power from the Church, but also from nobles. Nobles were very wealthy citizens who own most of the land. Since they have the money and the land of the country, their support is necessary for the king to continue to have power. In order to make sure that the nobles were happy with the king's power, the king would normally grant special privileges to the nobles. In many countries, a noble could beat or even kill a peasant with little or no consequence, while any offense committed against a noble by a peasant was severely punished.

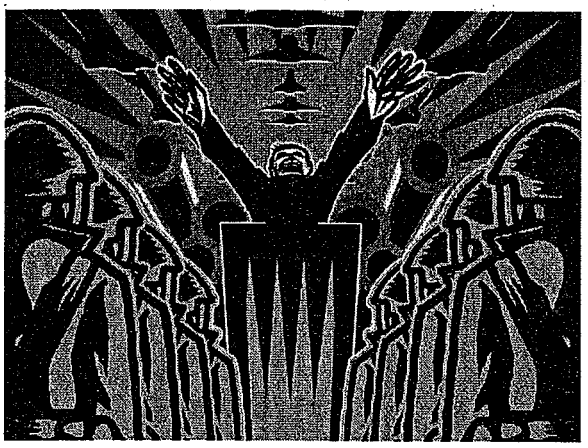
In the world today, most monarchies are extremely limited in their power and influence. **Constitutional monarchies** normally combine the power of the king with the power of elected officials, thereby limiting the power of the monarch. The degree to which the monarch's power is limited depends on the country. Great Britain still has a monarch and Queen Elizabeth is recognized by 16 countries as their head of state. Despite being the queen of these countries, Elizabeth has no actual power, and has nothing to do with making or enforcing the laws of those countries. Conversely, in Saudi Arabia, the king holds more power than any other person or group in the government, and basically runs the country.



Palace at Versailles—The French king's summer retreat home. While French citizens were starving, the French kings started to build a massive palace. Gold was everywhere. This lifestyle was one of the main reasons for the French wanting a democracy rather than monarchy in the 1790's during the French Revolution.

Dictatorship

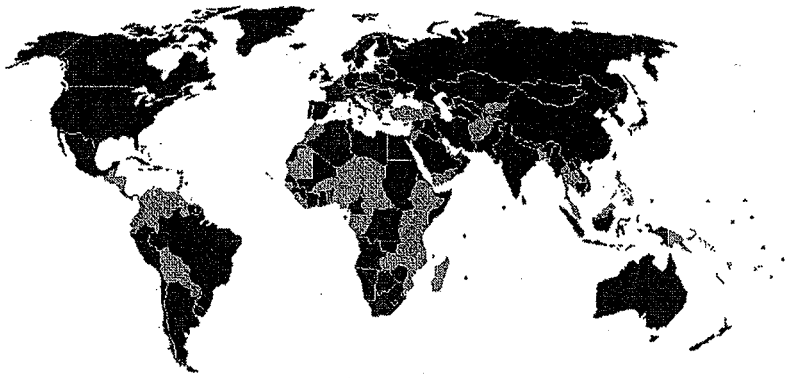
A dictatorship is a form of government where the entire government is run by one individual. Dictatorships are normally formed in areas of the world where people don't have as many rights. Dictatorships are the most efficient form of government, because the leader doesn't need to get approval from any other group of people before he is able to make his ideas into laws.



In order for a dictatorship to work, normally the leader needs the support of the military. It is the army that actually enforces his laws, and forces people to follow what he says. They are the ones who scare people into making sure that they follow the rules that the dictator makes. In exchange for their support, the dictator makes sure that the leaders of the military enjoy special privileges that other people don't have.

Dictators normally live extremely good lives, and enjoy many privileges, normally at the expense of the people. Dictators normally do not make decisions that will benefit the greatest number of people, they just make decisions based on what would be best for them. Governments that are dictatorships often claim to be something different. Some claim to be communist, monarchies, or even republics or democracies, but if one person is controlling everything that is happening in the government, and making all of the laws, then that country is really a dictatorship.

Dictators keep power, until it is taken away from them, or until they die, which is normally the same thing. Most of the world's dictatorships end in a coup d'etat (coo day ta). A coup d'etat is when a group of people, normally military leaders, overthrow the current government and set up one of their own. When coups occur, normally a new dictatorship is established.

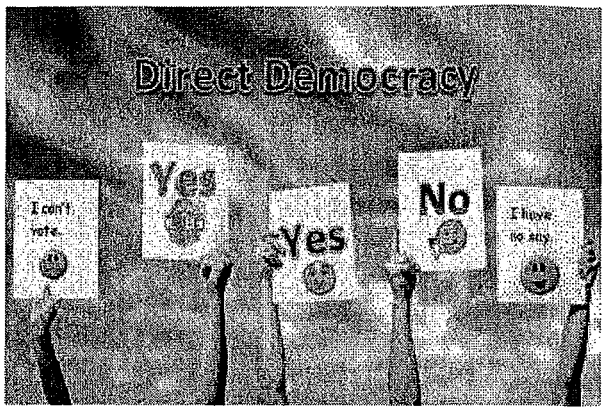


All of the red countries are considered to be ruled by some type of dictatorship.

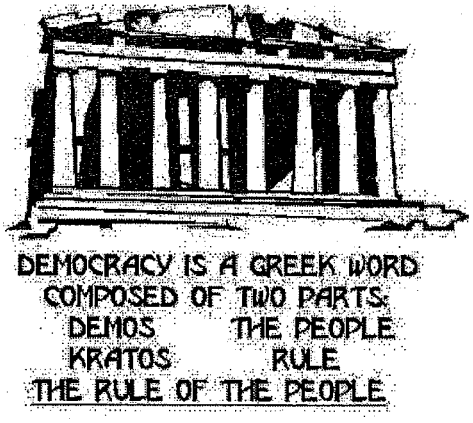
Over the last decade, quite a few dictators have been overthrown. With the rise of ISIL in the Middle East, many people wonder if Syria's dictator, Assad, will be overthrown as well.

Democracy

Democracy is a type of government where people vote on the laws of the country. In a **direct democracy**, people would literally vote on every single law that is made a part of their country. If America was a direct democracy, then we would literally see every night what laws were being voted on by the people, and then submit our ideas and votes for each law. Since our Congress makes new laws all the time, this would be impractical.



There is a different type of democratic government, called a **representative democracy** where every person in the government votes for somebody else to represent them. This is a lot more similar to the American governmental system. This is normally the way that many parliamentary systems work throughout the world. When a country has a prime minister as its leader, that country has a parliament. In a parliamentary system, the people vote for government officials, then those officials vote for the leader. In this system, the government is always controlled by a majority party.



In a democracy, every person gets one vote. In a representative government, each person voted to be a leader in the government would represent the same number of people.

A majority rules, so as long as more than 50% of the people living in the country vote for something, that is exactly what ends up becoming a law. One of the downfalls of a democracy, is that often groups that are in the minority are not represented in their government, and the laws always benefit the people who are in the majority.

There are not any true democracies in the world today. Most often, when people use the word democracy to describe a government, it is meant to refer to a government where the power of the people is greater than the power of the government, most notably as a contrast to Communism, Dictatorship, or any other Authoritarian government.

Graphic Organizer for Governments Stations

Government:	Democracy	Republic	Monarchy	Theocracy	Communism
How are the leaders chosen?					
What countries are an example of this type of government (you may need to use a computer to research this question)					
Do all citizens have the same rights? Explain.					
How is the power of the government limited?					
Draw a picture that represents the government, leaders, laws, and people					