The Scientific Revolution

**I. Definition of the Scientific Revolution**

* The Scientific Revolution (1543 – 1687) was a period of time in which many breakthrough discoveries were made in science and philosophy, as well as an era in which the Europeans’ perception of the universe and their role in it was changed forever.
* Although the SR began by only affecting the scientific and intellectual elite (5 % of the population or so) the concepts that originated during the SR eventually spread to all of the population.

**II. Before the Scientific Revolution**

* Prior to the SR, all scientific concepts came from either the Bible or ancient scientists. Since, during the Middle Ages, most of the works of other ancient scientists were lost, Aristotle, Ptolemy, and Galen became the only, and therefore ultimate, authorities, on their fields. The old beliefs came from:
* The Bible: naturally, the main source of information, in all respects, was the Bible, whose teachings were taken literally (for example, if a story stated that the world stopped spinning, Europeans believed that the world actually did stop spinning).
* Aristotle: was the greatest philosopher of ancient times. He was viewed as the absolute authority on physics, although many of his theories were wrong

-His theories included the belief that there was no movement without a mover

* Ptolemy: a great astronomer from ancient times, he stated that the earth was the center of the universe and that the sun and all the planets moved around in crystalline spheres.

-Since this alone was not able to mathematically explain retrograde motion Ptolemy added in epicycles which, through some very complicated calculations, could approximate planetary motion.

* Galen: though his influence was far lesser than that of Aristotle and Ptolemy, Galen’s medical and anatomical theories dominated the scientific world for years even though they were proved wrong by dissections.

**III. Causes of the Scientific Revolution**

* One cause was that scientists were simply beginning to take note of the inadequacies of the standard theories, and, although they greatly preferred to make slight changes to the theories some scientists were beginning to question the old authorities.
* Still, it is unlikely that the scientists would have challenged the established theories without the influence of the other ancient scientists, especially Archimedes, that disagreed with the old theories.
* Another influence was the interest in what is now regarded as magic, but was then seen as serious science.

-These branches of science included alchemy and astrology, and were linked by the belief that the world could be understood through several secret truths

**IV. The Major Scientific Discoveries**

* Nicolaus Copernicus was a Polish priest and astronomer who shook the foundations of European beliefs.

-He challenged Ptolemy’s system simply because it was too complex and he felt that there had to be a better system mathematically. So, based on mathematics, he developed a new, sun-centered system that placed earth as the third planet rotating around the sun.

-Copernicus even began developing the concept of gravity, for he stated that large masses have their own attractive forces. However, he kept the crystalline spheres and did not account for the stars. His major work was:

-The Revolution of Heavenly Bodies (start of scientific revolution), which, fearing the Church, he did not publish until his deathbed. The book sparked a major controversy

* Giordano Bruno: made the mistake of openly supporting Copernicus and ridiculing the old philosophy; The church arrested him, and after his refusal to recant, burned him at the stake
* Tycho Brahe: stargazer who meticulously recorded star data for years.
* Johann Kepler: a brilliant mathematician who developed the first theories of motion. With the aid of Brahe’s star data, Kepler came of with the theory that the planets moved in ellipses, and that they did not move at a steady rate.

-Instead, as they came closer to the sun, they accelerated, and they slowed down as they moved away.

* Galileo Galilei: was the first scientist to use the telescope. With the telescope, he saw Jupiter’s moons (the existence of which proved that not everything orbited the earth, as was previously thought) and the craters on the moon (which proved that heaven was not perfect

-So, in 1632, he wrote the Dialogue on the Two Great World Systems; But this did not fool the church, for they forced him to recant in 1633 and made him spend the last years of his life under house arrest.

-Galileo is really considered to be the first modern scientist, for he developed the scientific method of experimentation and was one of the first mechanists

* Isaac Newton: brought to a climax all the previous works in his masterpiece, The Principia, which described three laws of motion

-law of universal gravitation (which applied the concept of gravity to both the earth and the heavens). Newton also supported observation and experimentation, and helped further develop the scientific method.

**V. The New Epistemologies**

* Became more widespread, especially through Galileo and Newton. The opposite philosophy to mechanism is teleology, which stated that everything is made for a purpose, and was used by Aristotle.
* Mainly, however, the discoveries helped the scientific method develop. The scientific method, which was a new theory on how to obtain and verify knowledge, stressed experience, reason, and doubt and rejected all authority. -The scientific method revolutionized science, and made measurement of data, and mathematics, essential parts of science.
* The scientific method was actually a combination of two theories of knowledge:
* Empiricism (a.k.a. induction) → was advocated by Francis Bacon (who wrote New Atlantis a description of an ideal society based on science) and supported going from particular knowledge (observation) to general knowledge.
* Rationalism advocated by Rene Descartes who stated that senses can lie and that the only way to find truth was to start from one fact

-proceed to deduce all other statements Descartes also stated that there was an essential divide between the world of thought and reality

-In other words, he took Bacon’s statement that religion and science should be separate and turned it into a far-reaching divide between the reality of the world and our perception of it

**VI. The Famous Empiricists**

* Empiricism was a very influential epistemology, and soon, it was beginning to be applied to other fields, not just science. Actually, several individuals used empiricism to develop political theories.
* Thomas Hobbes: was a radical Nominalist who stated that there are no abstract ideas; did not believe in abstract good or evil.

-Hobbes used empiricism to develop a political system. Because, according to him, in the state of nature there would be a constant war of all-against-all b/c of competition, fear, and desire to show off

-Nobody could ever win the war, for, although a law of nature exists which states that if you want respect then respect others, people, the terrible beings that they are, will break the agreement to get what they want unless there is an outside authority enforcing the law.

-Hobbes’ absolute monarchy is not based on divine right, but, instead, it is based on a social contract in which the people agree that, since anything is better than the war of all-against-all, they will give up their natural rights to the government in exchange for protection.

* John Locke: the next significant empiricist, he was somewhat a reaction to Hobbes’ negativity.

-Locke began with the assumption that, at birth, each person is born with a tabula rasa (blank slate) and that all human nature and knowledge comes from either direct experience or from reflection.

-A great supporter of equality, toleration, and education; used his ideas to write a social contract, like Hobbes. Locke’s social contract, however, as stated in An Essay Concerning Human Understanding and Two Treatises of Government (1689), had almost nothing in common with Hobbes.

-Locke stated people are neutral, since it all depends on the environment; each person has certain inalienable rights of life, liberty and property; government is formed, to protect the rights; government must protect peoples’ rights, but not more, and the people must obey the government so long as it does not do more than necessary; if it does, people have the right to rebel and establish another government.

-The Declaration of Independence is pretty much just paraphrasing JL’s beliefs.

* David Hume: stated that there can’t be any absolute knowledge if everything is based on the senses. So, people can know things through common sense, but not through philosophy

**VII. The Effects of the Scientific Revolution**

* People felt that human understanding of the universe could be reduced to mathematical laws.
* The universe was no longer appeared to be a mystery. In fact, people felt that it was orderly, rational, and, most importantly, could be understood by humans.
* People felt that humans were able to control their own destiny.
* Natural laws: similar to the laws found in science by Newton, could govern other aspects of life as well, such as economics, politics, or ethics.
* Positive effects: gain of knowledge, greater toleration, less superstition and more scientific answers, and freedom to deviate from established theories, which opened the door for new developments
* Negative effects: loss of innocence, loss of traditional faith, loss of faith in heaven, earth is no longer regarded as the center skepticism, loss of personal/caring God.

**VIII. The Arts During the Scientific Revolution**

* Mannerism: Mannerism featured distorted human figures, strange perspectives and unnatural colors and lighting.

-The major Mannerist painter was El Greco

* Baroque: reflected the desire for grandeur and the wish to inspire and awe people with God’s greatness.

-A famous baroque painter was Caravaggio whose paintings were famous for their depictions of highly emotional moments.

-Other famous baroque painters were Rubens and Veláquez who glorified church figures and rulers. Bernini, a baroque sculptor and architect, did the inside and outside of St. Peter’s Cathedral in Rome.

* Classicism: like Baroque, Classicism attempted to awe the viewer. However, like the Renaissance, it attempted to awe the viewer with form and discipline – also they wished to return to ancient values. Big guy was Poussin whose paintings were more subdued than the baroque guys (he liked togas).
* The Dutch → b/c of Protestantism and republicanism, Dutch art was less religious (if religious only personal faith, not that of Church obviously) and more precise b/c big buyers were bourgeoisie (merchants not dumb nobles). Big dude was Rembrandt who pretty much just painted pictures of himself (pretty conceited, but really was just fascinated by human character and lighting).
* Monteverdi → invented concept of opera and orchestra, after many new instruments were invented. His masterpiece was Orfeo (1607).

**IX. The Literature During the Scientific Revolution**

* Michel de Montaigne: invented the essay (what did he have to do that for?); influenced by skepticism which eventually led to search for self-knowledge and his belief that acting righteously is more important than following doctrine
* Cervantes: wrote Don Quixote, which illustrated the wide gaps between rich and poor and the difference between reality and fantasy of his time by poking fun at society and politics Shakespeare: wrote plays that made timeless statements about human behavior and covered a very wide range of topics and emotions.

-his plays also reflected his time as death, turmoil and change were always present.

-the vigor in his plays showed the sense of achievement that also characterized the 1500s (don’t ask what achievements, please!).

* Corneille: was the dominant French playwright of the 1600s whose work reflects the rise of classicism. At first, he refused to follow the three new set rules for drama (unity of time, location and plot). His masterpiece was Le Cid

-condemned by Richelieu b/c it did not follow the three rules. But, Le Cid was still very popular.

* Racine: the model classical dramatist who still generated very emotional stuff.