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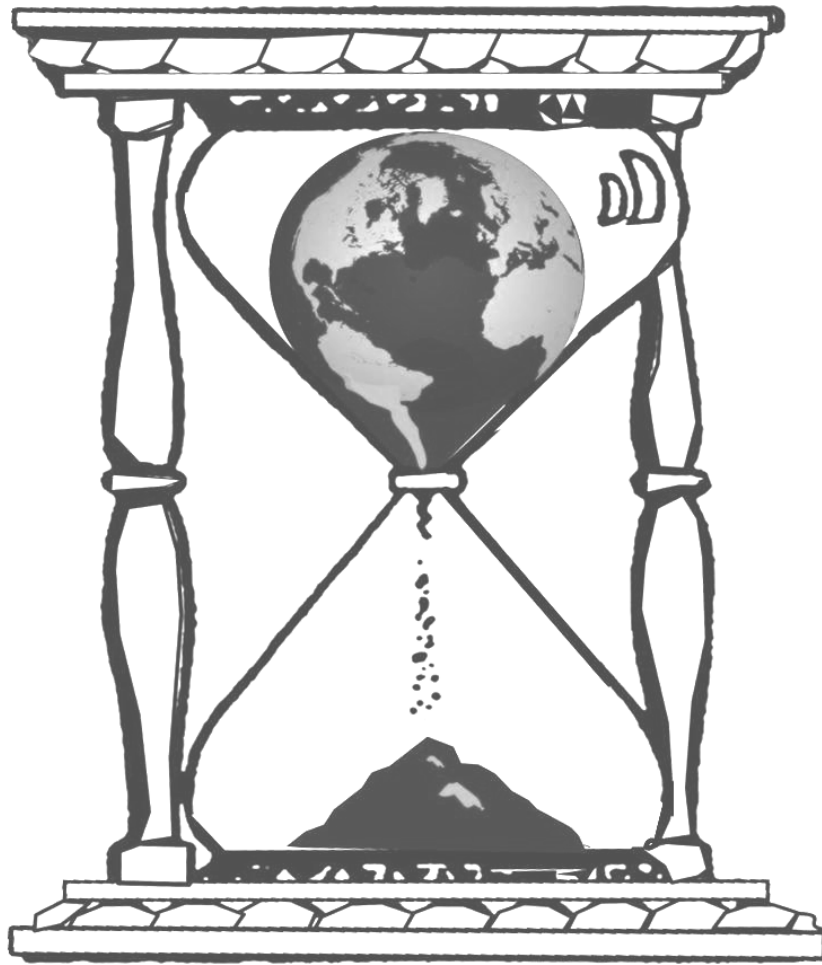
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i Think: World History

Age of Revolutions



by Kendra Corr

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Atlanta, Georgia

** It is the goal of InspirEd Educators to create instructional materials that are interesting, engaging, and challenging. Our student-centered approach incorporates both content and skills, placing particular emphasis on reading, writing, vocabulary development, and critical and creative thinking in the content areas.

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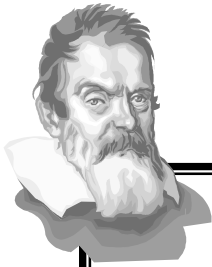
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Out With the Old; In With the New

Springboard:

Students should read “Looking at the World through Medieval Eyes” and answer the questions.

Objective: The student will be able to describe how new ideas of the Scientific Revolution conflicted with the medieval world view.

Materials: Looking at the World through Medieval Eyes (Springboard handout)
A Spirited Dinner Party (5-page handout)
Coming in Conflict (handout)

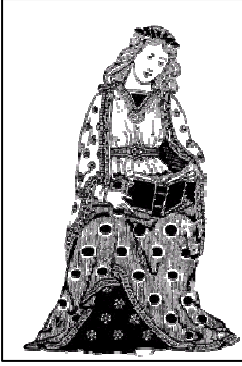
Terms to know:

- medieval** - related to the Middle Ages
- astronomer** - one who studies the planets and stars
- hypothesis** - an educated, scientific guess
- scientific method** - process for proving or disproving hypotheses
- philosopher** - a thinker
- objectivity** - the ability to approach situations without being influenced by personal emotions or beliefs
- revolutionary** - (*adj.*) completely different or radical; (*also n.*) one who promotes revolution

Procedure:

- After reviewing the Springboard, explain that *as the Middle Ages came to a close, people began to question the established ideas of the time. This lesson examines some of the important thinkers and scientists that challenged the ideas of the Middle Ages.*
- Distribute “A Spirited Dinner Party.” **For group instruction** assign parts or have the students read the play in groups. **For individualized instruction** the student should read the play independently.
- Then hand out “Coming in Conflict” The student(s) should work independently or in pairs to record the revolutionary ideas from the play and generate their definition of the Scientific Revolution.
- Have the student(s) share and compare their ideas. (*See the Teacher Page for suggested answers.*)

LOOKING AT THE WORLD THROUGH MEDIEVAL EYES



The European Middle Ages was not a time of great learning or discovery. Most of what people knew and believed about the world around them came from Christian teachings and, as the period progressed, Ancient Greek ideas. Yet there was little advancement in any of the ancient ideas.

The Greeks used reasoning and logic to draw conclusions about the world, but did not test their views. They believed people needed only to think to discover new knowledge. For example, Greek thinkers thought heavy objects fell faster than lighter ones, simply because it made sense to them. This conclusion was supported by what Aristotle, a great philosopher of the day, said in his laws of motion, so the belief became an accepted fact. However no one thought about testing this idea until hundreds of years later when it was found to be false.

The accepted ideas of the Middle Ages usually began from what people already accepted to be true. Some of these “truths” were from the Greeks, but many others came from and were supported by Christian **theology**. For example, the Greeks reasoned that the “universe” was everything they could see. Since the Earth seemed to stay still while stars and the sun seemed to change position, they concluded that everything in the universe revolved around the Earth. The Church taught that God created the universe for humans, so it seemed logical that everything revolved around Earth. The Church also taught that only God knows everything and people can only know what God chooses to tell them through the Bible. Europeans believed they could never know much about the world, and this way of thinking did not encourage change. Therefore the Church remained the greatest power of the Middle Ages. In short, people relied only on their faith to explain what reason could not.

Which of these **BEST** states the main idea of the passage?

- A. People during the Middle Ages were very advanced for the time.
- B. The Christian Church encouraged new ideas and discoveries.
- C. Medieval thinkers did not advance much beyond the Greeks.
- D. Aristotle was a great philosopher who wrote laws of motion.

The word **theology** in the last paragraph **MOST NEARLY** means

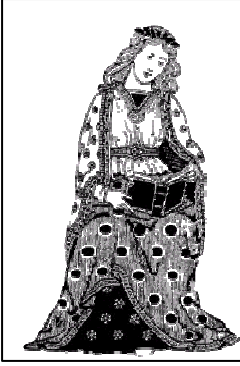
- A. beliefs
- B. leaders
- C. science
- D. philosophers

Which comment would **LEAST LIKELY** have been made by a medieval thinker?

- A. “Based on what I know, I think that the sun revolves around the earth.”
- B. “I conducted the experiment three times with three different results!”
- C. “There are some things that we just cannot know about the universe.”
- D. “Based on common sense, this seems reasonable so it must be true!”

Obviously, people began to think differently after the Middle Ages. What do you think could have led to new ways of thinking? _____

LOOKING AT THE WORLD THROUGH MEDIEVAL EYES—ANSWERS AND EXPLANATIONS



The European Middle Ages was not a time of great learning or discovery. Most of what people knew and believed about the world around them came from Christian teachings and, as the period progressed, Ancient Greek ideas. Yet there was little advancement in any of the ancient ideas.

The Greeks used reasoning and logic to draw conclusions about the world, but did not test their views. They believed people needed only to think to discover new knowledge. For example, Greek thinkers thought heavy objects fell faster than lighter ones, simply because it made sense to them. This conclusion was supported by what Aristotle, a great philosopher of the day, said in his laws of motion, so the belief became an accepted fact. However no one thought about testing this idea until hundreds of years later when it was found to be false.

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- Which of these **BEST** states the main idea of the passage? *(Choice C is the most general true statement according to the passage.)*
- A. People during the Middle Ages were very advanced for the time.
 - A. The Christian Church encouraged new ideas and discoveries.
 - B. Medieval thinkers did not advance much beyond the Greeks.*
 - C. Aristotle was a great philosopher who wrote laws of motion.

- The word **theology** in the last paragraph **MOST NEARLY** means *(Context clues from the paragraph indicate it was what the Church “taught.”)*
- A. beliefs *
 - B. leaders
 - C. science
 - D. philosophers

Which comment would **LEAST LIKELY** have been made by a medieval thinker?

- A. “Based on what I know, I think that the sun revolves around the earth.”
- B. “I conducted the experiment three times with three different results!” *
- C. “There are some things that we just cannot know about the universe.”
- D. “Based on common sense, this seems reasonable so it must be true!”

(The passage states that medieval thinkers did not TEST their ideas, so it’s unlikely they would have conducted experiments.)

Obviously, people began to think differently after the Middle Ages. What do you think could have led to new ways of thinking? Answers will vary, but students may reason that the Church’s power may have declined, encouraging people to move beyond Christian teaching to learn about the world around them.

A Spirited Dinner Party



Cast of Characters (in order of appearance):

Hostess, Annabeth Watson

Sir Frances Bacon (1561-1626)

René Descartes (1596-1650)

Nicolaus Copernicus (1473-1543)

Johannes Kepler (1571-1630)

Sir Isaac Newton (1643-1727)

Galileo Galilei (1564-1642)

(All are seated around a table.)

Watson: Welcome gentlemen! What an impressive gathering of some of the greatest minds in history. I am so pleased that you were all able to join me for an evening of good conversation and fine dining.

Bacon: Thank you for having us, Annabeth.

Descartes: Yes my dear, we are all so happy to join you this evening.

Watson: I am certain you all have interesting stories to tell and I can't wait to hear from each and every one of you. Why don't we begin with Mr. Copernicus, shall we? Nicolaus, please tell us a bit about yourself while we enjoy these delicious appetizers.

Copernicus: I'd be happy to start things off Annabeth. Well gentlemen, let me first say that I too am pleased to finally meet all of you. Though we never met in life, I am still most happy to make your acquaintance here in the Great Beyond!

Kepler: *(raises his wine glass)* Here! Here!

Copernicus: Yes, well, as you all know, I was perhaps most famous for being the first to formally challenge the medieval view of the universe.

Watson: You mean the idea that everything in the universe revolved around the Earth, do you not? What was it called? Helio – something?

Newton: The heliocentric view.

Copernicus: Yes Isaac, that is correct. After studying the stars for thirty years, I determined that our Earth actually revolves around the sun, along with everything else in our system.

Watson: What do you mean by “system?”

Copernicus: Well, in our case, I mean the “solar system.” You see, my dear, I was also the first to determine that there is indeed more than one system out there. The Greeks and medieval astronomers thought the entire universe is what we can see, as opposed to the idea that there may be many other bodies that we cannot.

Galileo: Nicolaus, you had to have known the Church would disagree with you.

Copernicus: Oh yes! You see when I was young I was actually a member of the Catholic clergy, so I definitely knew that what I was proposing would conflict with Church teachings. That was why I waited to publish my findings until I was almost seventy years old. I hoped they wouldn't punish an old man too harshly.

Bacon: And did they?

Copernicus: Actually, they might have, had I not died before the book was widely distributed. A dear friend of mine actually placed the first printed copy in my hands on the day I died.

Kepler: But thank goodness it DID get published!

Copernicus: Yes I suppose so; however I'm glad I did not live to endure the harsh criticism. Most educated people of the time rejected my life's work. *(sighs)* Hmm, they challenged that if the Earth rotated around the sun, we would fly off into space or better yet, that there would be constant terrible winds caused by the spinning. So you see, with all of the doubt, my work really did not change anything at the time.

Galileo: Don't be so hard on yourself, Nicolaus! Your work inspired me greatly!

Newton: Yes, and I proved all those doubters wrong!

Watson: Nicolaus, you truly have a great deal of support at this table! Now my dear guests, let us have Mr. Kepler tell us about himself while we have our hot soup. Johannes, will you please?

Kepler: Certainly Annabeth, thank you. You know, Galileo, you were not the only one inspired by Nicolaus and his brilliant work. When I was at the university, I had a professor who actually presented both the geocentric AND Copernicus' heliocentric view. After reading his work, I was convinced Nicolaus was correct, and dedicated my work to prove him right.

Bacon: Did you do experiments?

Kepler: No, but I used my area of expertise to offer proof.

Newton: I see; you were a mathematical GENIUS! So you used math?

Kepler: Yes my friend, I did. Based upon Copernicus' ideas, I devised a precise mathematical formula to show how planets orbit the sun.

Galileo: And how did this prove that Nicolaus was right?

Kepler: I suppose it didn't exactly prove him right, but I did prove that the orbits of the planets are not perfect circles. Their orbits are actually squashed circles called ellipses. My work proved that the planets' speed in their orbits changes as they move further away from the sun.

Descartes: So you proved a related point, Johannes?

Kepler: Yes, Rene, and you have summed up my accomplishment with your question.

Watson: I'm sorry, Johannes, I'm afraid I do not understand what you mean.

Kepler: What my work proved, Annabeth, is that the universe works in predictable ways. Therefore, we mere humans can in fact, study and understand it. This differs completely from times past, when people thought they could only know what God chose to reveal to them.

Galileo: I told you he was a genius. In fact, when I left the University of Padua in Italy, I recommended him for the math professorship there.

Kepler: I remember, my friend, and I deeply appreciated your thinking of me at that time. However, it was too soon after my wife and young child died; and I felt I needed to remain in German lands for the sake of the rest of my family.

Watson: How terrible! I'm so sorry to hear that you had to endure such sadness, though sadness is indeed a part of life, is it not? (*brief pause; others nod*) And now, Galileo, please tell us a bit more about your life and career. I believe our main course is coming soon, so do speak to us while we wait.

Galileo: Certainly, Annabeth. And let me begin by saying that I, too, was inspired by Copernicus. However my early work was based more on trying to create an instrument that would allow me to see faraway objects.

Descartes: Like the planets and stars I assume?

Galileo: (*smiling*) Of course, and after developing my instrument which was somewhat like a telescope, I spent many years thereafter staring at the heavens.

Bacon: And I remember that you made some very interesting observations in your work.

Galileo: Thank you and you are correct. I noted that Jupiter has four moons. I saw spots on the sun and the rings of Saturn. I was also able to describe the moon in great detail, including its craters and dimensions.

Newton: So in what ways did you further the work of Copernicus?

Galileo: Actually, all my observations proved everything our friend Nicolaus had said. For instance, the fact that Jupiter had four moons encircling it proved that not EVERYTHING revolved around the Earth, as the Greeks and nearly all since had thought.

Newton: Then you published your findings, and if I'm not mistaken, it was then the trouble began for you, did it not, my friend?

Galileo: Oh yes, it did. (*sighs deeply*) That was a terrible time. The Church brought me up on charges of challenging their teachings. They threatened to torture me if I would not take back all I claimed to be true.

Bacon: How horrible! What did you do?

Galileo: Sir Francis, I felt such conflict within myself. I knew I was right, but as a dedicated Catholic being threatened by my Church, I did not want to risk being shunned and forced from the faith I loved. In the end, I announced publicly that I was wrong.

Kepler: As I heard the story, when you left the courtroom, you were overheard whispering "And yet it does move." Is this true?

Galileo: It is. I was so sad but I felt I had no choice. I was put under house arrest and all of my work was banned. Would you believe that the mark against me remained until 1992, when the Church formally cleared me of wrongdoing and apologized to my relatives!

Watson: That's terrible! Still it must make you feel better that by the time of your death, many others had begun to believe you? In fact, you and Johannes truly were the sparks for a multitude of scientific discoveries thereafter, were you not?

Bacon: Indeed they were, and that is where my role comes into play, Annabeth. You may recall that I asked earlier if Kepler had done any experiments. That would not even be a question today because of my work.

Watson: Really, how so?

Bacon: I urged scientists of my day to follow a series of steps to study and experiment. First a hypothesis or guess about something is formed, then observation and testing is done to either prove or disprove the hypothesis.

Newton: The scientific method!

Bacon: It is, Isaac, and I can tell from your reaction and all I have seen and heard that you followed my advice.

Galileo: I did, as well, actually. For example, to prove that objects of different weights fell at the same rate of speed, I dropped balls of various sizes from the top of the Leaning Tower of Pisa. And when I did so, they indeed fell at the same rate. I proved my hypothesis to be true – scientific method.

Bacon: Excellent! That is exactly what I mean! The Greeks had a horrible habit of assuming something was true just because they could not prove otherwise. Such is not science! It is only an opinion, an unproven idea.

Watson: Gentlemen, as we finish our wonderful main course, I for one would love to hear from Monsieur Descartes. Rene, you have not said much yet.

Descartes: Well, I suppose that is because unlike your other guests, I was not a scientist but a philosopher.

Copernicus: This is true. So why are you here with us? This is a meeting of scientific minds, is it not?

Descartes: Though it does seem so, my work in philosophy supported the sciences. You see, along with Sir Francis, I am credited with sweeping away the Greek and medieval ways of approaching science. My philosophy was about doubt!

Kepler: What do you mean?

Descartes: I thought scientists did not need experimentation, but only reason and rational thought.

Bacon: No experimentation? Are you crazy? That, sir, was exactly what the Greeks thought! And we all know THEM to be wrong.

Descartes: If I may ... it is true that the Ancient Greeks also relied upon reason. However their error was a failure to question ANYTHING! I think it is quite unwise to believe anything you cannot prove. Now, perhaps experiments can, in some instances, prove ideas, and in others not. My point is that science should be approached with reason, not emotion or religious belief.

Bacon: Now I understand what our philosopher friend is saying. His ideas actually became the key to scientific study, even in present times.

Copernicus: Oh yes, I have heard of this; you are speaking of “objectivity.”

Descartes: I am. Ideas in science should not fall prey to limits by human error or even long-held religious teachings. Just because something has long been BELIEVED to be true does not mean it is true.

Watson: Fascinating! And now, as we enjoy our dessert and coffee, we still have one more guest to hear from. Mr. Newton, would you enlighten us with your story as well?

Newton: Of course, but before I begin, I should like to make a point of my own. I want to say that if I have been able to see farther, it is because I had the privilege of standing on the shoulders of giants.

Watson: I’m sorry, but I don’t understand what you mean.

Newton: I’m talking about the men at this table. My work would never have happened without those who came before me. As I said earlier, I can explain why those that doubted Copernicus were wrong.

Copernicus: Thank you Isaac, I appreciate that.

Newton: You see, I introduced the law of gravity. I was able to explain how all objects in the universe are attracted to each other – like magnets. My laws proved once and for all that our universe is heliocentric.

Galileo: So in a real sense, your work pulled together all of ours, is that not the case?

Newton: Yes, it did. However, it was easier for me because by the time I came along, more people saw the universe as it is – a machine that works in predictable ways we humans can study and understand.

Bacon: Which is quite different than those who came before.

Newton: Definitely. Greek and medieval thinkers thought humans could know very little about the world. By my time and beyond, people held the mechanized world view I just described.

Watson: Wonderful! (*stands*) Well my dear gentlemen, this has certainly been a spirited dinner party to remember. I am so impressed with all of your work and thank you for your contributions to science. And with that, I bid you good night. (*All shake hands and exit.*)

Coming in Conflict

DIRECTIONS: Complete the chart, listing new ideas, theories and discoveries of each person in the play. Then, explain how their ideas would have conflicted with the medieval view of the world.

Scientist	Idea or discovery	How it conflicted

Based on what you've learned, how would you define the "Scientific Revolution?"
Why was it revolutionary? _____
