The Scientific Revolution

During the early 16th century, Martin Luther’s movement, called the Protestant Reformation, was beginning to de-stabilize the power of the Roman Catholic Church. Up to this point, everything that happened in the world that could not be explained by people was explained by the Church. This was all about to change.

Aristotle

Aristotle was a Greek philosopher who lived from 384 B.C. to 322 B.C. Aristotle was deeply interested in the way that the world worked, and tried to apply his observations in a scientific way. For example, Aristotle started to look at things like river deltas and canyons and claimed that even though you couldn’t watch erosion happening, the rivers were slowly carving out the canyons and building the river deltas. He claimed that the changes were just too slow for a human being, even in their whole lifetime, to notice the changes in any major way. Unfortunately, much of Aristotle’s observations were more influenced by what he thought than by true science.

One of Aristotle’s beliefs was that there were five elements: earth, water, air, fire, and aether. Aristotle claimed that elements tended to try to be with like elements. Therefore, according to Aristotle, a hot air balloon rises because the fire in the balloon wants to rise up to fire. Rain falls to the ground out of the air because water belongs below air.

Another Aristotelian belief was the belief that the earth is at the center of the universe, called a geocentric model. Aristotle believed that the sun, moon, stars, Mercury, Venus, Mars, Jupiter, and Saturn all revolved around the earth in different orbits. Aristotle’s beliefs, including geocentrism, were all official beliefs of the Roman Catholic Church at the time of the Renaissance.

Copernicus

Nicolaus Copernicus was a Polish scientist who began to observe the movement of planets, and realized that the models they had to make in order to make the Aristotelian model work didn’t make any sense. For instance, planets had to somehow sometimes move backwards in the sky (called retrograde motion) and the models couldn’t account for this without making some very strange motions. Copernicus proposed a model where the earth was moving around the sun, which would explain why planets sometimes seemed to move backwards, because the earth, in a shorter orbit, was passing those planets. The Copernicus model made seven basic claims:

1. There is no center of all the celestial spheres (stars and planets)
2. The earth is not the center of the universe (only the moon’s orbit)
3. The sun is the center of the universe (heliocentrism)
4. The earth is much closer to the sun than to the stars
5. When stars appear to move, it's because the earth is moving, not because they are.
6. The sun appears to move because the earth is moving. Therefore, the earth is moving in more than one way. (spinning and revolving around the sun)
7. Retrograde motion of the planets is due to the earth's movement.

Some astronomers would disagree with #1 and #3, but all of the rest of Copernicus's observations have been proven to be correct. Since he knew how controversial his observations would be, Copernicus waited until he was almost dead before publishing his book with these observations.

Galileo

Galileo Galilei was an Italian mathematician who first invented a telescope powerful enough to view heavenly bodies in enough detail to begin to see what was actually happening. Galileo accepted Copernicus's model of heliocentrism, and set out to use his telescope to prove it. When Galileo used his telescope and started to look at Jupiter, he noticed that it had moons, just like the earth, and that those moons were orbiting Jupiter, not the Earth. He used this logic to prove that it was probably true that since objects were orbiting something other than the earth, it was likely that the earth was not the center of the universe.

In 1616, the Catholic Church officially met to discuss Galileo's statements. They found the idea of heliocentrism to be "foolish and absurd in philosophy, and formally heretical since it explicitly contradicts in many places the sense of Holy Scripture." For the next 20 years, the Church tolerated Galileo's contradictions of their teachings, but in 1632, Galileo wrote a book in which two characters had a conversation about the issue of heliocentrism vs. geocentrism. Galileo made the character who believed in geocentrism appear to be foolish, and also have a resemblance to the pope. On June 22nd, 1633, Galileo's hearing in the church was officially ended, with three basic results:

1. Galileo is a heretic, because he claims that the earth revolves around the sun, which does not move
2. Galileo is to be put under house arrest for the rest of his life
3. Galileo's current book, and all future books, are banned and illegal to print.

The ban on Galileo's books was lifted within 100 years, although some books were slightly censored to not bear any resemblance to the pope himself. All traces of opposition to the idea of heliocentrism were gone from official Catholic beliefs by 1835.

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<td>1. Why did Copernicus wait until he was almost dead before he published his model of the solar system?</td>
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<td>2. What is the difference between heliocentric and geocentric models? Which one is correct?</td>
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<td>3. How was the Church's treatment of Galileo similar to Martin Luther? How is it different?</td>
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