

## History and Discovery of Asteroids

## Thinking Outside the Box!

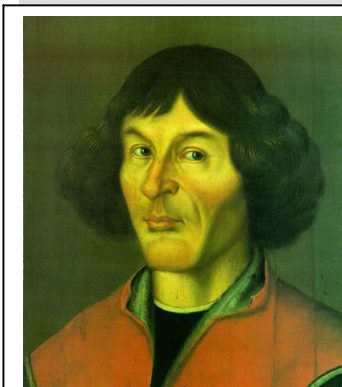
### FLASHBACK—EARLY ASTRONOMY

#### The Classical Planets

Mercury, Venus, Mars, Jupiter and Saturn are known as “**the classical planets**” because, nearly two thousand years ago, early astronomers studied their positions in the sky. They were able to recognize the patterns for how these five planets’ positions shifted over time. These “classical planets” were large enough and bright enough that astronomers could observe them without any special instruments. They only used their unaided human eyes.

#### Early Astronomers

- made observations...
- formed theories and models
- communicated with other astronomers
- were skeptical of new theories



Early 16<sup>th</sup> century portrait of Copernicus

**Ptolemy** was an early Greek astronomer who lived and worked in Egypt from about 85 to 150 AD. He thought that the Earth was at the center of the planetary system. In his model, the Earth remained motionless while the planets and sun orbited around it in the following order: Mercury, Venus, Sun, Mars, Jupiter, and Saturn. Educated people accepted Ptolemy’s **geocentric** (Earth-centered) theory for almost 1500 years.

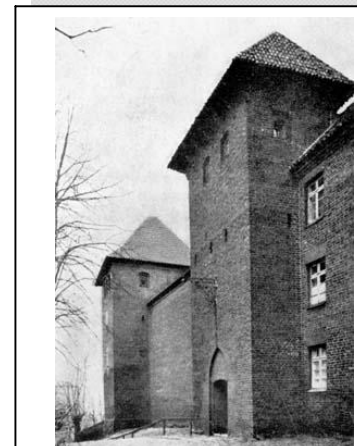
#### Challenging a Classic Theory

In 1530, after making observations for thirty years, **Nicolas Copernicus** proposed that the solar system is sun-centered. In his **heliocentric** model, the Earth rotates on its axis once daily and travels *around the sun* once a year. He also thought that all the known planets

orbited *around the sun*. Copernicus’ theory challenged Ptolemy’s classic theory.

#### Copernicus’ Contributions to Science

Copernicus, like other early astronomers, was not a professional astronomer. In fact, the science of astronomy was just developing, so early astronomers were amateurs who observed the skies as a hobby. Copernicus’s training was in church law and medicine. While he was a churchman at Frauenburg cathedral in Germany, he painted and translated Greek poetry into Latin for relaxation, until astronomy became his primary interest. He observed the skies with his unaided eyes from a tower built into the wall around the cathedral. He carried on his investigations quietly by himself.

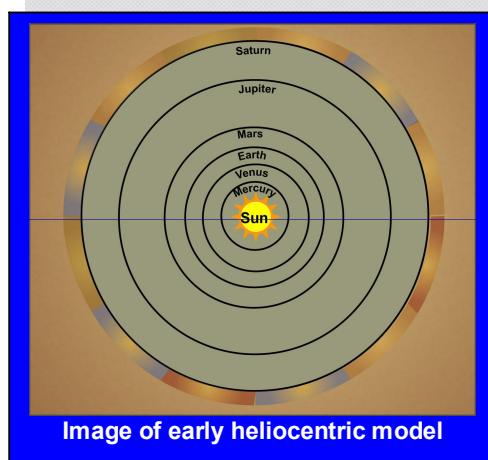
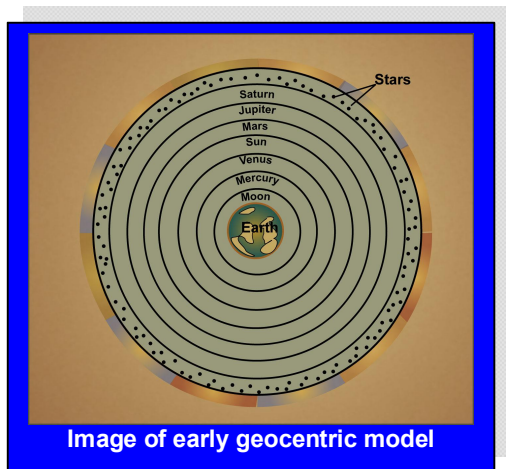


The tower at Frauenburg Cathedral where Copernicus conducted his observations.

Copernicus was a perfectionist. Even after working on his sun-centered theory for thirty years, he thought that there were still observations to be checked and rechecked. His work might not ever have been published if **George Rheticus**, a young German mathematics professor who spent two years working with the master astronomer, had not encouraged him.

## Copernicus Sparks Controversy

Copernicus died in 1543. He never knew what a “stir” his work caused in the scientific community. The German philosopher Johann Goethe later wrote, “The world had scarcely become known as round and complete in itself when it was asked to waive the tremendous privilege of being the center of the universe.” What Goethe meant is that only fifty years after Christopher Columbus sailed to New World and showed that the Earth was not flat, Copernicus proposed that the Earth was not the center of the Solar System. This meant that people had to change their ideas about the Earth on which they lived. As with many newly proposed scientific ideas, Copernicus’ planetary system was not immediately accepted by the scientific community. In fact, it was rejected outright by many of his 16<sup>th</sup> century colleagues. However, Copernicus’ discovery prompted astronomers’ to ask new questions. Some of these questions are central to the NASA Dawn mission. If you were an astronomer during Copernicus’ time and faced with a changing model of the universe—from geocentric to heliocentric—what questions would you have about this new Solar System?



### Additional Resources

For more about Ptolemy, a Greek astronomer, go to:

<http://nineplanets.org/psc/theman.html>

<http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Ptolemy.html>

<http://www.hao.ucar.edu/public/education/sp/images/ptolemy.html>

To learn more about Copernicus’ life and work, visit the following Web sites:

<http://www.blupete.com/Literature/Biographies/Science/Copernicus.htm>

<http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Copernicus.html>

[http://es.rice.edu/ES/humsoc/Galileo/Things/copernican\\_system.html](http://es.rice.edu/ES/humsoc/Galileo/Things/copernican_system.html)

Explore the Solar System with this interactive Web site:

<http://liftoff.msfc.nasa.gov/academy/space/solarsystem/solarsystemjava.html>

### **Questions relating to Thinking Outside the Box!**

1. What planets were known as the “classical planets”? Why were they considered “classics”?
2. What did the early astronomers use to make their observations of the planets?
3. How was Copernicus’ heliocentric theory of our solar system different from Ptolemy’s geocentric theory?
4. On what did Copernicus base his theory?
5. What important discovery did Christopher Columbus make 50 years before Copernicus’ theory was published?
6. Did Copernicus publish his own theory? Why or why not?
7. Why was Copernicus’ theory not readily accepted?
8. Were all these early astronomers professional scientists?
9. Compare and contrast Copernicus’ astronomy laboratory and technology with astronomy labs and technology available today.