Geocentric vs. Heliocentric Solar System

Grade Range: Middle School  Lesson Time: 150 minutes

Key Terms
Geocentric  Heliocentric  Solar System

Materials and Resources
Calculator  Research materials  
Suggested building materials: Styrofoam balls of various sizes, paint, wire, string, poster board, tape, glue

Activity Overview
Although we might feel like we are at the center of the universe, this is not really true! History tells us that perceptions of the solar system—the Sun and all of the objects that orbit around it—have changed over time. In this activity, students will learn about two different conceptions of the solar system: the geocentric model developed by the Greek scientist and philosopher Claudius Ptolemy, and the heliocentric model developed by the astronomer Nicolaus Copernicus. Students will build scale models of both systems and give presentations explaining their similarities and differences. Students will recognize these models as a perfect historical example of the nature of science, specifically that scientific knowledge is tentative.

Essential Questions
1. What is a solar system?
2. How are the geocentric and heliocentric solar systems similar and different?
3. Why have the perceptions of the solar system changed over time?
4. Why is scientific knowledge tentative?

Objectives
● Compare two different models of the solar system
● Analyze the pros and cons of each model
● Build scale models of the geocentric and heliocentric solar systems
● Describe the nature of science, specifically the tentative nature of scientific knowledge

Introduction
To begin this activity, ask students to share what they already know about the solar system. Explain that our solar system is a collection of planets and their moons in orbit around the Sun, together with asteroids, meteoroids, and
comets. Explain to the students that they will be looking at a model of the solar system that was used prior to the 16th century and compare it to our current model in order to see how our perceptions of the solar system have changed over time.

zSpace Activity

Activity Questions Provided in Studio

Answers may vary. Sample answers are provided below.

1. The solar system refers to the Sun and all of the objects that orbit around it, but people did not always believe that the Sun was the center of our system. Let’s take a look at two different models of the solar system.

2. Here is a model of the solar system that people believed was accurate prior to the 16th century. It is called the geocentric model. “Geo-” means Earth and “-centric” means center. Why do you think people believed that the Earth was at the center of the solar system?

   Scientists form their opinions based on their current observations. At that time, the geocentric model explained the observable phases of the Moon and the motion of the Sun and stars. It also explained why objects fall towards the Earth (gravity).

3. Here is a model of the solar system that we currently use today. It is called the heliocentric model. “Helio-” means Sun and “-centric” means center. What observations or evidence do you think caused people to change their opinion about the center of the solar system?

   More advanced technology and astronomy tools were developed to gather evidence. People discovered that the Sun is the heaviest object in the solar system and lighter objects orbit heavier ones.

4. Now let’s look at both solar system models side-by-side. Astronomers use both models depending on which point of view makes their calculations easier. What similarities and differences can you find between the two models? Can you think of a situation where one point of view would be more beneficial than the other?

   Similarities: Both models include Mercury, Venus, Mars, Jupiter, and Saturn in the same order. Differences: The geocentric model places Earth at the center, whereas the heliocentric model places the Sun at the center. The geocentric model might be more useful when calculating distances from the Earth to other planets or stars. The heliocentric model might be more helpful when calculating each planet’s gravity or orbital path.

5. This shift in scientific beliefs from the geocentric to the heliocentric solar system model is a perfect example of the nature of science, specifically that scientific knowledge is tentative and subject to change based on new observations and evidence. Can you think of another historical example that demonstrates the nature of science? Hint: Think about the shape of Earth.

   Yes, people used to believe the Earth was flat.

Closing

Solar System Research and Scale Models

- Conduct research about the relative sizes of and distances between the Sun, Moon, and other planets
- Calculate ratios to represent their proportional sizes and distances
- Working as partners or in small groups, build scale models of the geocentric and heliocentric solar systems using the provided materials
- Label the Earth, Sun, Moon, and other planets in the solar system

Teacher Note: See the list of suggested items for model construction.

Presentation of Solar Systems
Questions for Discussion

1. Why do planets rotate around the Sun and not the Earth?
   *We say the Earth goes around the Sun because the Sun is about a million times more massive than the Earth.*

2. After analyzing these two different solar system models, what did you learn about the nature of science?
   *I learned that scientific knowledge is tentative and subject to change based on new observations and evidence.*

3. Do you think there are other current scientific beliefs that we may need to change in the future due to new observations or evidence? Name at least one example.
   *I think we may find new evidence that shows that life exists on other planets.*

Extension Activity: Research and write a report about either the Greek scientist and philosopher Claudius Ptolemy, who developed the geocentric model, or the astronomer Nicolaus Copernicus, who developed the heliocentric model.

Extension Activity: Research other historical examples that demonstrate the nature of science and present your findings to the class.

Follow-Up Activity: *Gravitational Force* - Newton’s Park

Differentiation

- Group students heterogeneously to allow students with a strong command of the English language to assist in reading or interpreting questions
- Give students a variety of presentation styles to choose from (using charts/graphs, PowerPoint, making 3D presentations, creating videos/movies, making posters)
- Use text-to-speech if needed