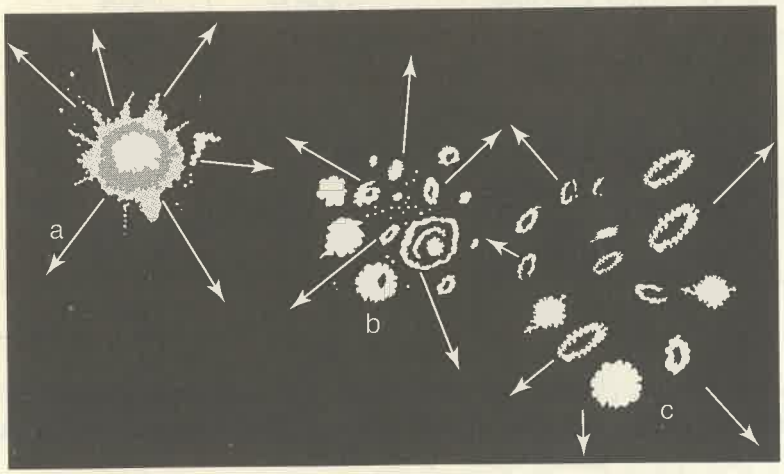
Lesson 1

The Formation of Our Solar System

S6E1a
S6CS1b, S6CS5a, S6CS7b, S6CS8b, S6CS8c

Throughout history, people have tried to make sense of what they saw in the sky. They asked questions about where stars, planets, moons, and other objects in the sky came from and how they were organized. As they gathered new evidence, they proposed scientific answers, and as their knowledge grew, they frequently changed these answers. This was particularly true of their view of the solar system and how it was formed. The **solar system** is made up of the sun, nine planets, moons that orbit some of the planets, comets, asteroids, and big and small space rocks.

Evidence gathered by scientists supports the idea that the universe began about 13.6 billion years ago in a great explosion. The **universe** is made up of everything—stars, families of stars, solar systems, planets, moons, comets, space rocks, dust, gases, and energy. The great explosion that produced the universe is called the **Big Bang**.



a: Big Bang (about 15 billion years ago)

b: Galaxies form (about 14–11 billion years ago)

c: Universe continues to expand (solar system forms about 4.5 billion years ago)

Some of the original material that exploded into space from the Big Bang consisted of the simplest kinds of matter: the elements hydrogen and helium. After about 200 million years, some of this matter came together to form the first stars. Later these stars were drawn together by gravity to produce families of stars called **galaxies**. The sun is a star that is part of a family of about 300 billion stars called the Milky Way Galaxy.

There is no single explanation of how the solar system was formed. Although scientists disagree on some ideas about the solar system's formation, they generally agree on certain facts and processes.

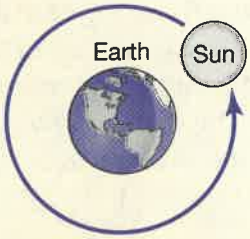
Most scientists agree that before 4.5 billion years ago, the space where our solar system is located was filled with gases and dust. This gigantic cloud of gases and dust is called a **nebula**. Something, perhaps an exploding star, disturbed the nebula. The matter in the nebula began to spin.

Scientists have evidence that this spinning began about 4.5 billion years ago. The spinning matter was the beginning of the solar system. Clumps of material began to come together. First, a clump formed in the center of the spinning matter. More and more matter was drawn into this clump by the attractive force of gravity. The clump grew larger and larger. Pressure inside the clump grew greater and greater. The growing pressure of the clump produced large amounts of heat. The clump eventually became the sun.

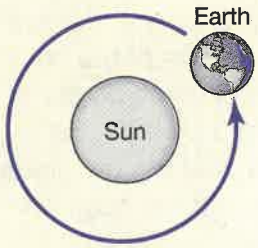
During the next 10–100 million years or so, grains of dust around the young sun collided into one another again and again. Many of these grains stuck together. Eventually these grains formed spheres that became the cores of the solar system's planets. Other grains came together to form moons, asteroids, comets, and space rocks.

Today we know that these objects revolve around the sun in paths called **orbits**. But this idea was not always believed. Centuries ago, most people thought that Earth was at the center of the solar system, not the sun. The motions of objects they saw in the sky seemed to support this idea. After all, people saw the sun rise in the east, set in the west, rise again in the east, and repeat this cycle each day. The stars and the planets did the same thing.

The idea that the objects in the solar system revolve around Earth is called the **geocentric theory**. The word geocentric comes from two Greek words that mean "Earth centered." *Geo* means "Earth" in Greek. The idea that the sun was the center of the solar system is called the **heliocentric theory**. The word heliocentric also comes from two Greek words that mean "sun centered." *Helios* is Greek for "sun."



Geocentric Theory

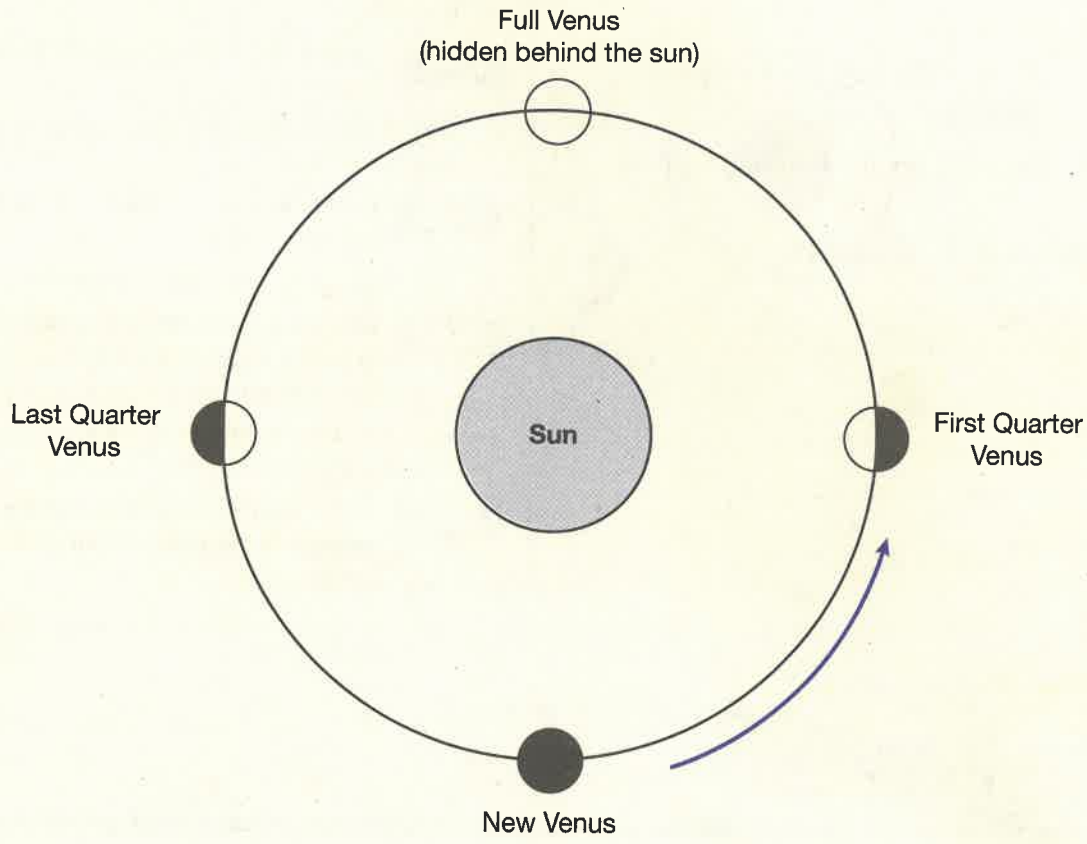


Heliocentric Theory

In the year 1610, an Italian scientist named Galileo looked into the night sky through a new instrument called a telescope. Using his telescope, Galileo discovered four tiny objects revolving around the planet Jupiter. This led Galileo to conclude that not everything in the solar system revolved around the Earth. Some objects, like the moons of Jupiter, revolved around other planets. But those who disagreed with Galileo said his discovery didn't matter because Jupiter revolved around Earth, carrying its moons with it.

Galileo then decided to study the planet Venus. About a hundred years earlier, a Polish astronomer by the name of Nicolas Copernicus suggested that the sun, not Earth, was at the center of the solar system. He predicted that if the sun were at the center of the solar system, Venus should go through phases like those of the moon. Sometimes Venus would look like a full moon. Other times it would look like a half moon. Still other times, it would look like a crescent moon.

Galileo observed Venus night after night and week after week. He discovered that as time passed, Venus did seem to change shape, just as our moon does. At one point, Venus looked like a full moon. But as weeks passed and as Venus moved farther away from the sun, its bright face grew thinner, just as Copernicus had predicted. Galileo reasoned that this could happen only if Venus revolved around the sun, not around Earth.



Choose the best answer for each question. Fill in the circle in the spaces provided on your answer sheet.

1. Which object is the largest?
   A. Earth
   B. the sun
   C. the Milky Way Galaxy
   D. a star

THINK STEP I should figure out which object contains the others.

2. Which happened MOST recently?
   A. the formation of the universe
   B. the formation of the solar system
   C. the formation of the sun
   D. the formation of the Milky Way Galaxy

THINK STEP To answer this question, I should put these events in a logical order of time.

3. The solar system is thought to be formed from which of the following objects?
   A. the universe
   B. the Milky Way Galaxy
   C. the sun
   D. a nebula

4. What was the FIRST discovery made by Galileo that supported Copernicus's idea that the sun, not Earth, was at the center of the solar system?
   A. the discovery of Jupiter
   B. the discovery of some of Jupiter's moons
   C. the discovery of the phases of Venus
   D. the discovery of the telescope

Before answering a question, examine all four choices and then choose the one that best answers the question.

1. Ⓐ Ⓑ Ⓒ Ⓓ		3. Ⓐ Ⓑ Ⓒ Ⓓ	
2. Ⓐ Ⓑ Ⓒ Ⓓ		4. Ⓐ Ⓑ Ⓒ Ⓓ	