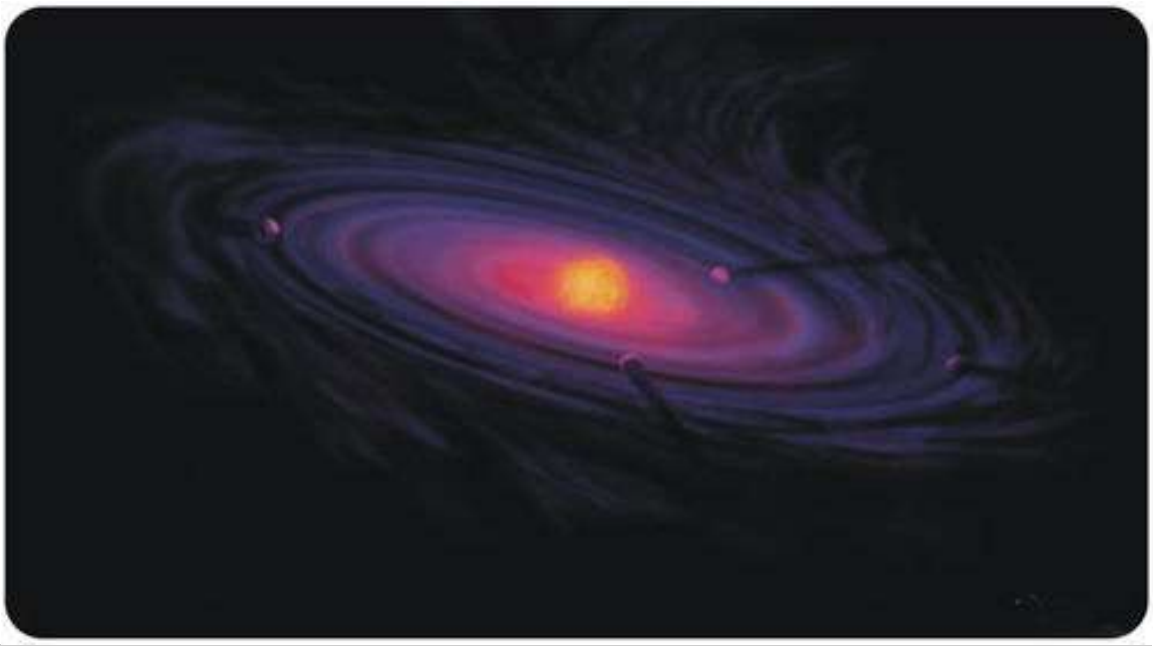
A Giant Nebula

The most widely accepted explanation of how the solar system formed is called the **nebular hypothesis**. According to this hypothesis, the Sun and the planets of our solar system formed about 4.6 billion years ago from the collapse of a giant cloud of gas and dust, called a **nebular cloud**.

The nebula was drawn together by gravity. As the nebula collapsed, the gravity at the center increased and the cloud started to spin because of its angular momentum. As it collapsed further, the spinning got faster, much as an ice skater spins faster when he pulls his arms to his sides during a spin.

Much of the cloud's mass migrated to its center but the rest of the material flattened out in an enormous disk, as shown in **Figure** below. The disk contained hydrogen and helium in the center, along with heavier elements and even simple organic molecules on the outside.



An artist's painting of a protoplanetary disk.

Formation of the Sun and Planets

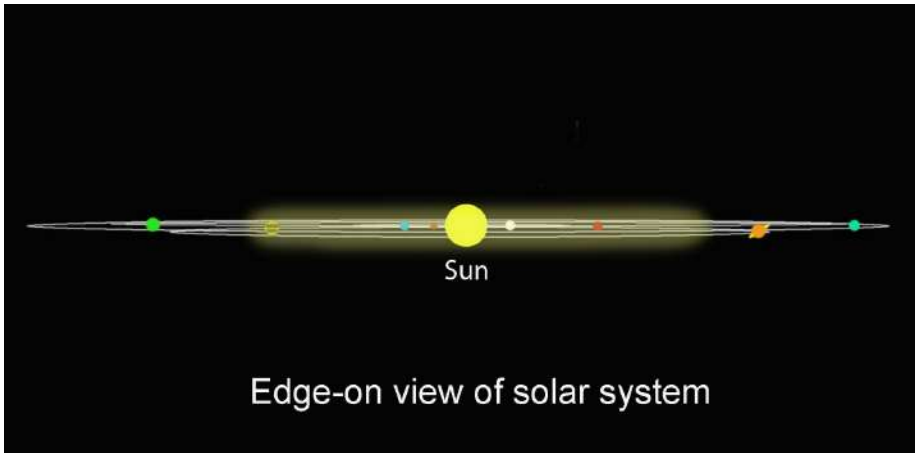
As gravity pulled matter into the center of the disk, the density and pressure at the center became intense making a **protostar.** When the pressure in the center of the disk was high enough, nuclear fusion began. A star was born—the Sun.

Meanwhile, the outer parts of the disk were cooling off. Matter condensed from the cloud and small pieces of dust started clumping together. These clumps collided and combined with other clumps. Larger clumps, called **planetesimals**, attracted smaller clumps with their gravity. Gravity at the center of the disk attracted heavier particles, such as rock and metal and lighter particles remained further out in the disk. Eventually, the planetesimals formed **protoplanets**, which grew to become the planets and moons that we find in our solar system today.

Because of the gravitational sorting of material, the inner planets — Mercury, Venus, Earth, and Mars — formed from dense rock and metal. The outer planets — Jupiter, Saturn, Uranus and Neptune — condensed farther from the Sun from lighter materials such as hydrogen, helium, water, ammonia, and methane. Out by Jupiter and beyond, where it's very cold, these materials form solid particles.

The nebular hypothesis was designed to explain some of the basic observations of the solar system:

- The orbits of the planets lie in nearly the same plane with the Sun at the center (Figure Below)
- The planets revolve in the same direction
- The planets mostly rotate in the same direction
- The axes of rotation of the planets are mostly nearly perpendicular to the orbital plane
- The oldest moon rocks are 4.5 billion years



Edge-on view of solar system