

32.1 Stars

- A **star** is essentially a giant, hot ball of gas.
- Stars generate light and heat through nuclear reactions.
- They are powered by the **fusion** of hydrogen into helium under conditions of enormous temperature, mass, and density.



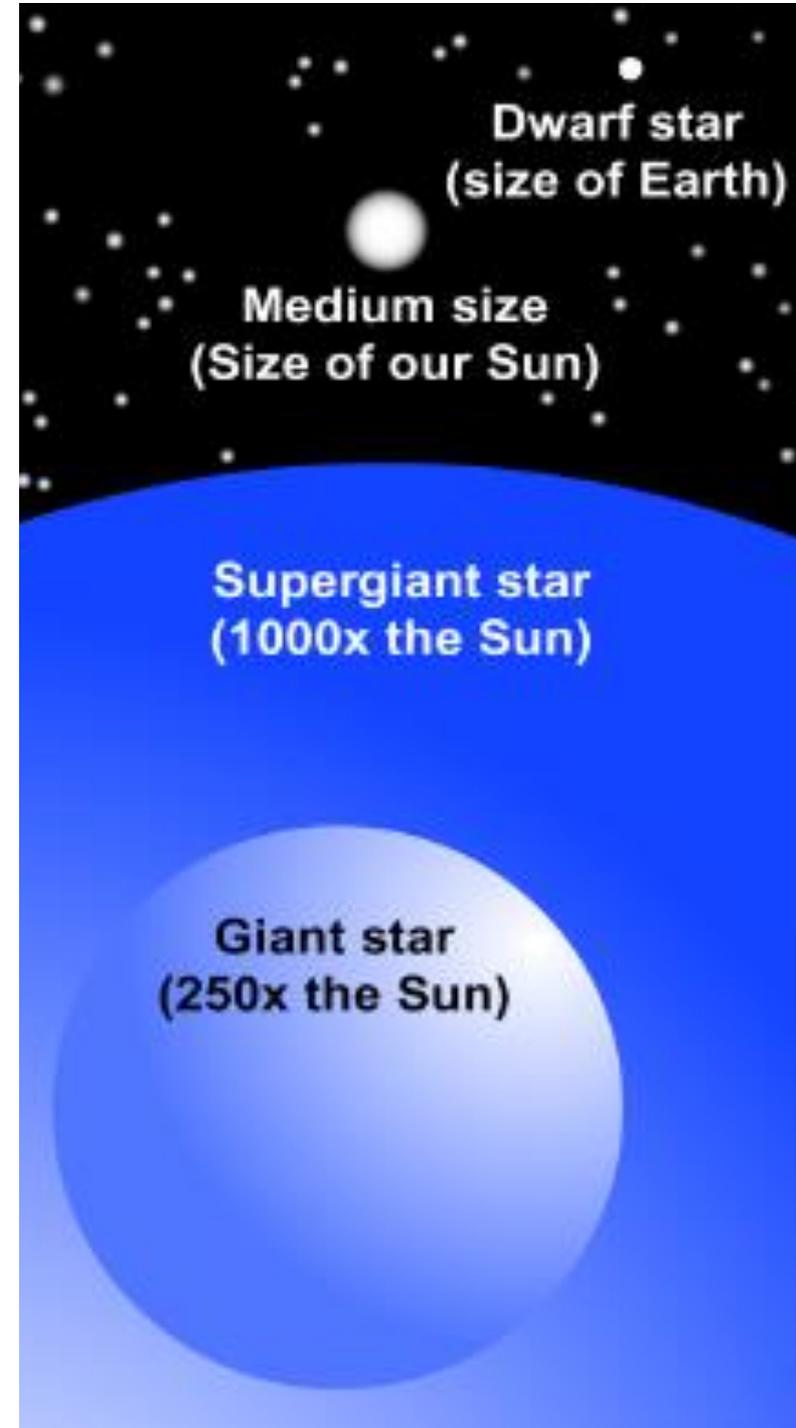
32.1 Stars

- Astronomers classify stars according to their physical characteristics.
- The main characteristics used to classify stars are **temperature, size and brightness.**

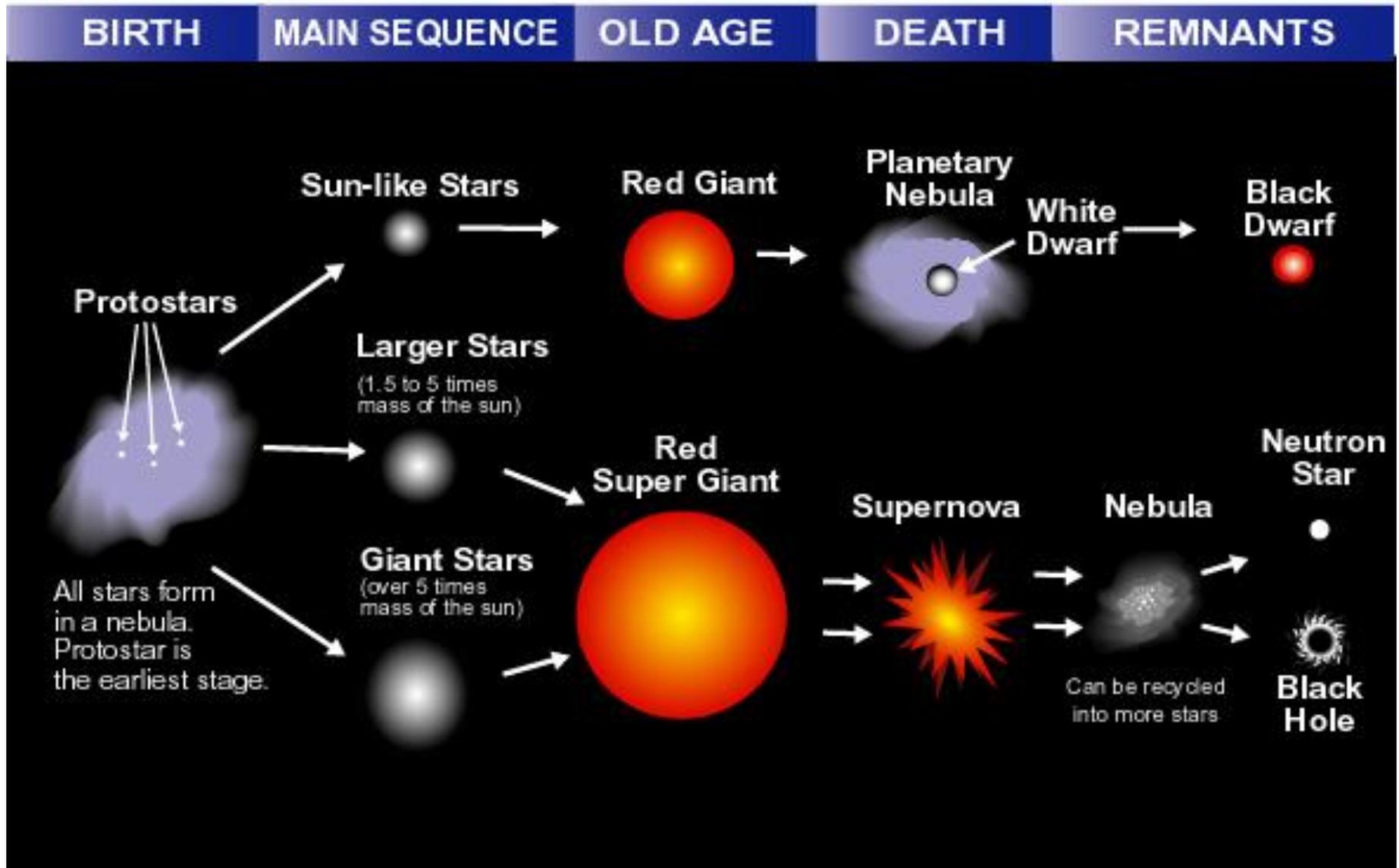
Star	Color	Temperature range (°C)
Betelgeuse	red	2,000 to 3,500
Arcturus	orange	3,500 to 5,000
Sun	yellow	5,000 to 6,000
Polaris	yellow-white	6,000 to 7,500
Sirius	white	7,500 to 11,000
Rigel	blue-white	11,000 to 25,000
Zeta Orionis	blue	25,000 to 50,000

32.1 Star Sizes

- **The sun**, with a diameter of 1.4 million kilometers, is a **medium-sized** star.
- The largest stars, called **supergiants**, have a diameter that can exceed 1,000 times that of the sun.
- **Giants**, are about 250 times the diameter of the sun.
- Stars that are smaller than the sun come in two categories, **white dwarfs** and **neutron stars**.



The Star Life Cycle



Formation of the Solar System

1 Nebula collapses.



2 Fusion begins.
Particles in cloud collide forming the seeds of planets.



3 Terrestrial planets form close to sun.
Gas planets form further away.

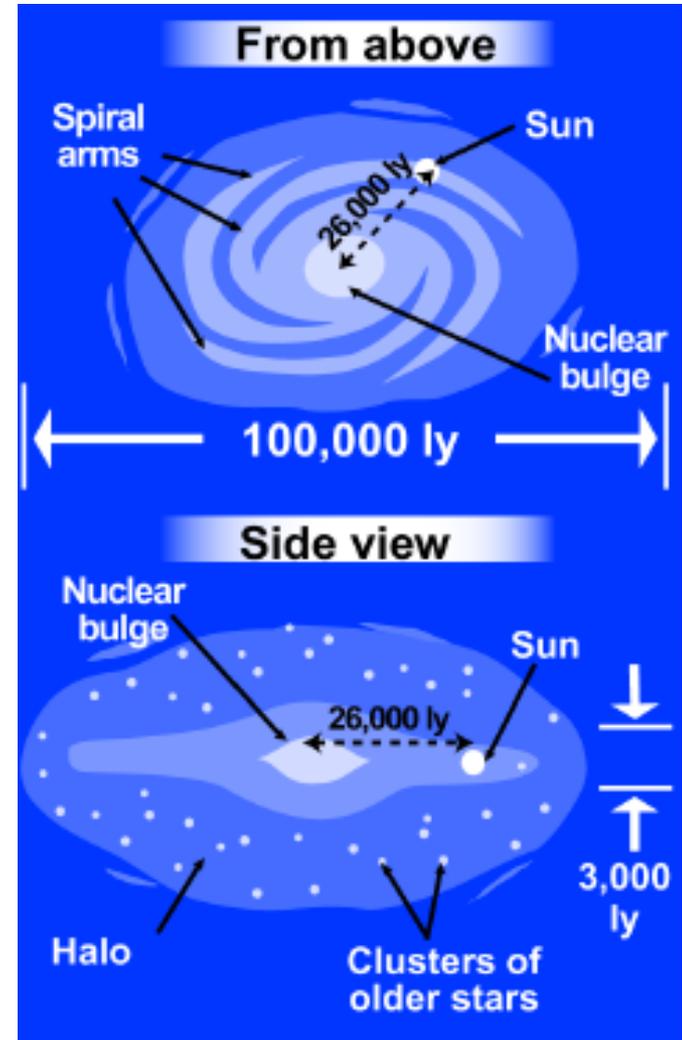


4 Nebula clears away.
Sun and planets are left.



32.2 Galaxies and the Universe

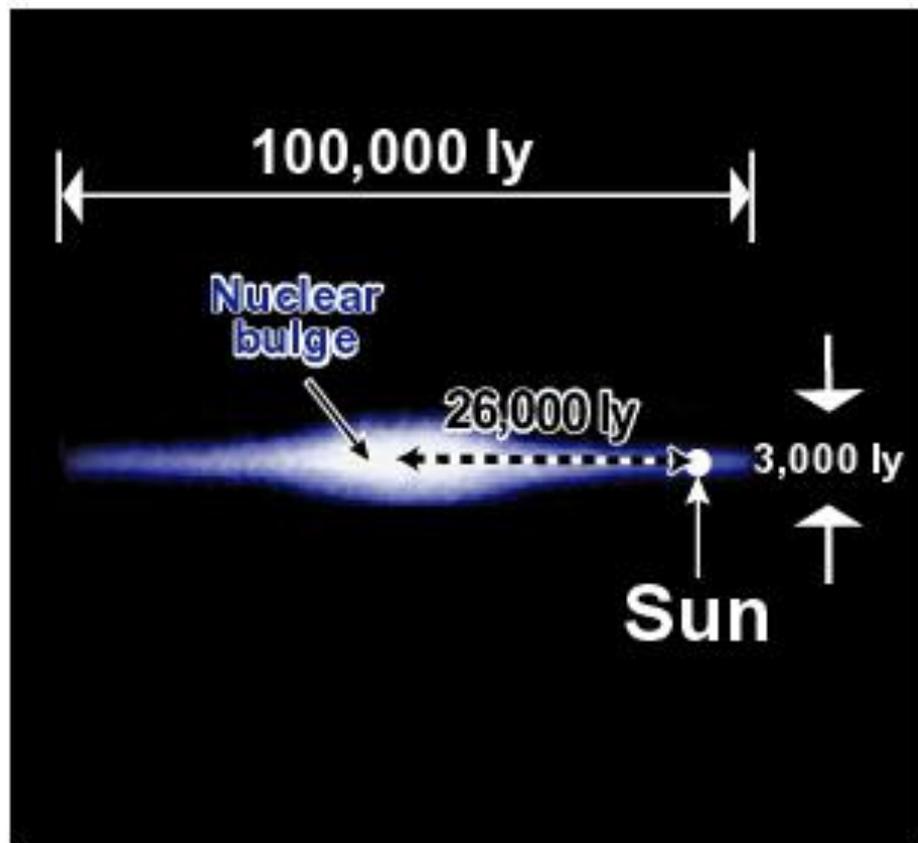
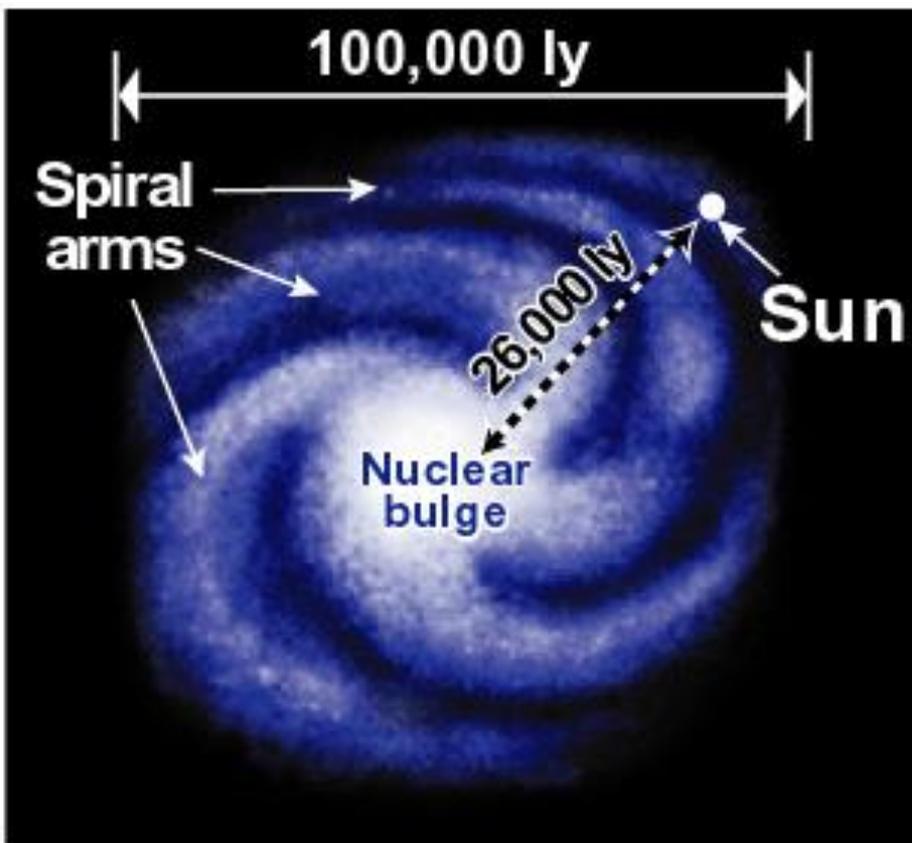
- A **galaxy** is a huge group of stars, dust, gas, and other objects bound together by gravitational forces.
- In the 1920s, American astronomer Edwin Hubble (1889-1953) discovered that there were galaxies beyond the Milky Way.
- ***The Milky Way*** is a typical spiral galaxy.



The Milky Way Galaxy

From above

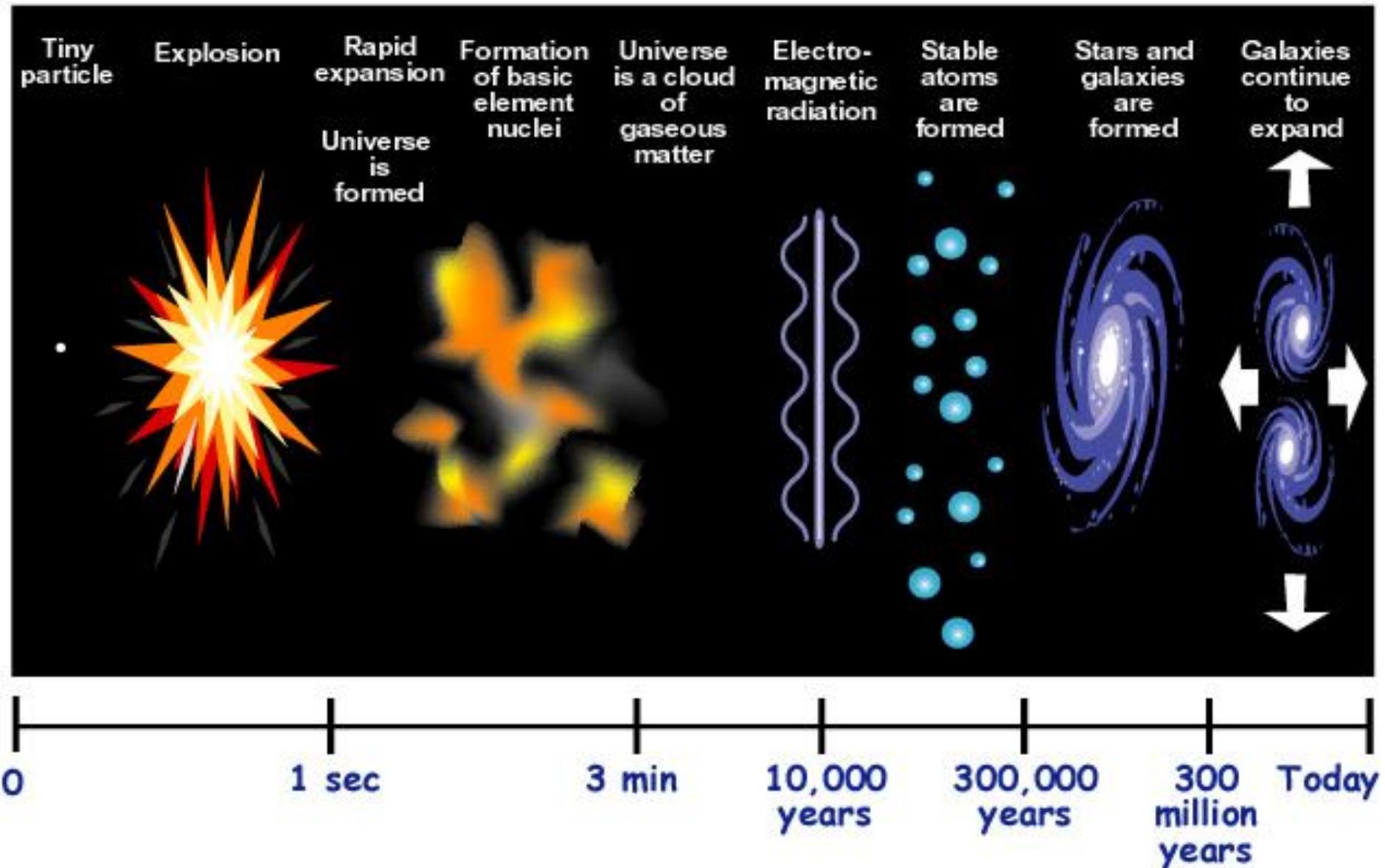
Side view



32.2 Galaxies and the Universe

- According to the **Big Bang** theory, all of the matter and energy in the universe started out compressed into a space no bigger than the nucleus of an atom.
- Immediately after the explosion, the universe began to expand and cool.
- The universe continued as a giant cloud of gas until about 300 million years after the Big Bang. Parts of the gas cloud began to collapse and ignite to form clusters of stars—the first galaxies.

Big Bang Timeline



32.2 Evidence for Big Bang

- In the early 1900s, **Hubble** began to study the motion of galaxies.
- He used Cepheid stars to determine the distances of galaxies from Earth.
- By the early 1930s, he had enough evidence to prove that galaxies were moving away from a single point in the universe.
- In the 1960s, Arno **Penzias** and Robert **Wilson**, two American astrophysicists, were trying to measure electromagnetic radiation emitted by the Milky Way.
- Later it was determined that they had discovered the cosmic microwave background radiation predicted by the Big Bang theory.