

# GALAXY ERA BEGINS — 12.7 BILLION YEARS AGO

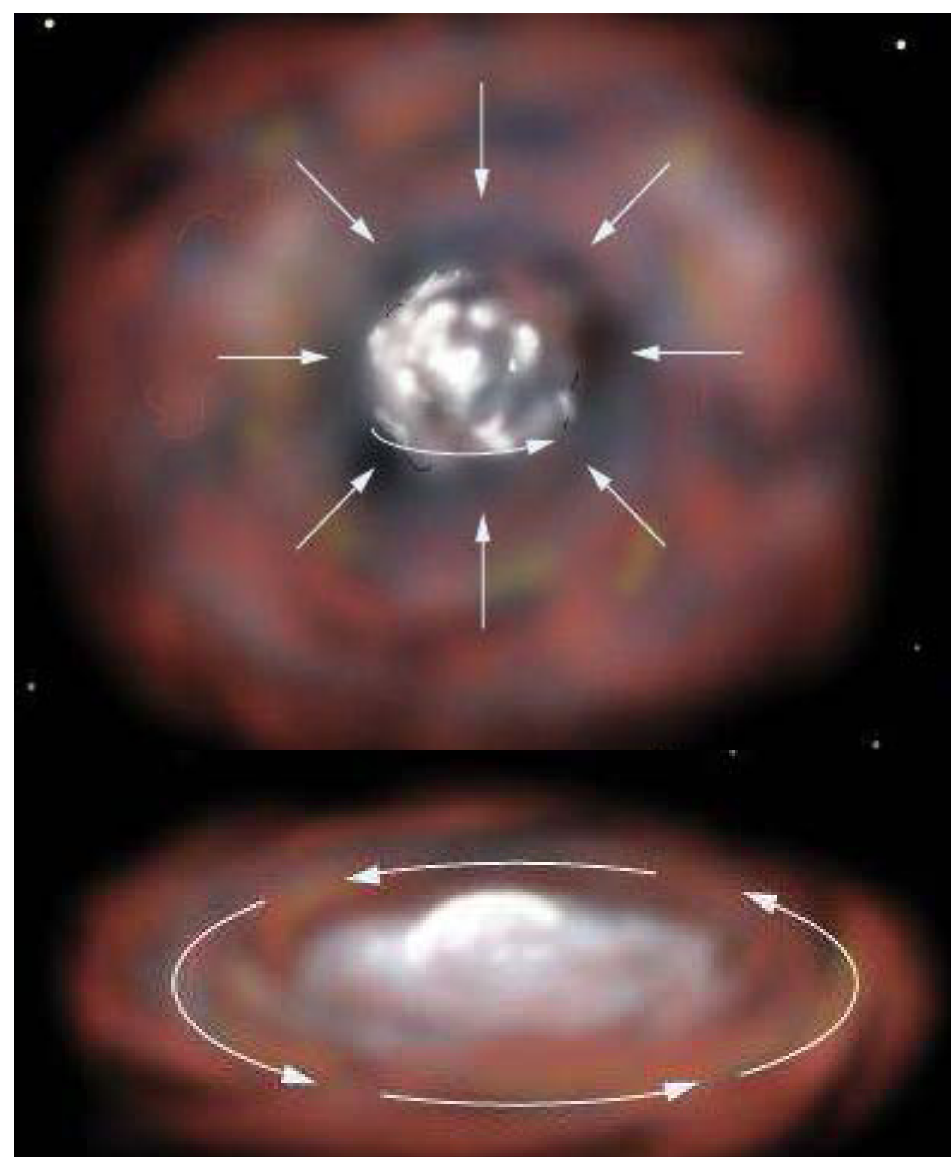
## Stars and galaxies are born

The universe is no longer smooth and uniform. Matter consists primarily of Hydrogen (H) and Helium (He) gas. High-density regions of this matter generate gravitational fields – the more mass, the more gravity. The more gravity, the more mass from surrounding areas is pulled in. Eventually localized regions condense under their own weight. Any spin at the start of contraction will increase as more contraction occurs. Gravitational energy is converted into heat – temperature rises. Once the size of this dense spinning sphere of gas is great enough, and its core temperature rises above  $10^6$  K, **nuclear fusion** begins – primarily the fusion of H to produce He and energy. As this newly created energy radiates outward, a shining **star** is born.

An **open cluster** is a group of up to a few thousand stars that formed together. A **globular cluster** is a spherical group of hundreds of thousands of stars with increasing star density towards its core.

When billions of stars orbit a shared center of gravity, we call them a **galaxy**. There are hundreds of billions of galaxies in the observable Universe. A galaxy often contains many clusters and large clouds of matter (gas, plasma, and ions) called **nebulas**.

Galaxies are usually found in groups and clusters that are gravitationally linked into huge **superclusters** of galaxies. These surround voids in which almost no galaxies are seen.



Artist's depiction of the formation of a protostar from gravitational condensation of gas in a nebula. © Prentice Hall



The Pleiades – or Seven Sisters – Open Cluster. The cluster is dominated by hot blue stars that have formed within the last 100 million years. Astronomers estimate that the cluster will survive for about another 250 million years, after which it will have dispersed due to gravitational interactions with its galactic neighborhood. © NASA/ESA/AURA/Caltech



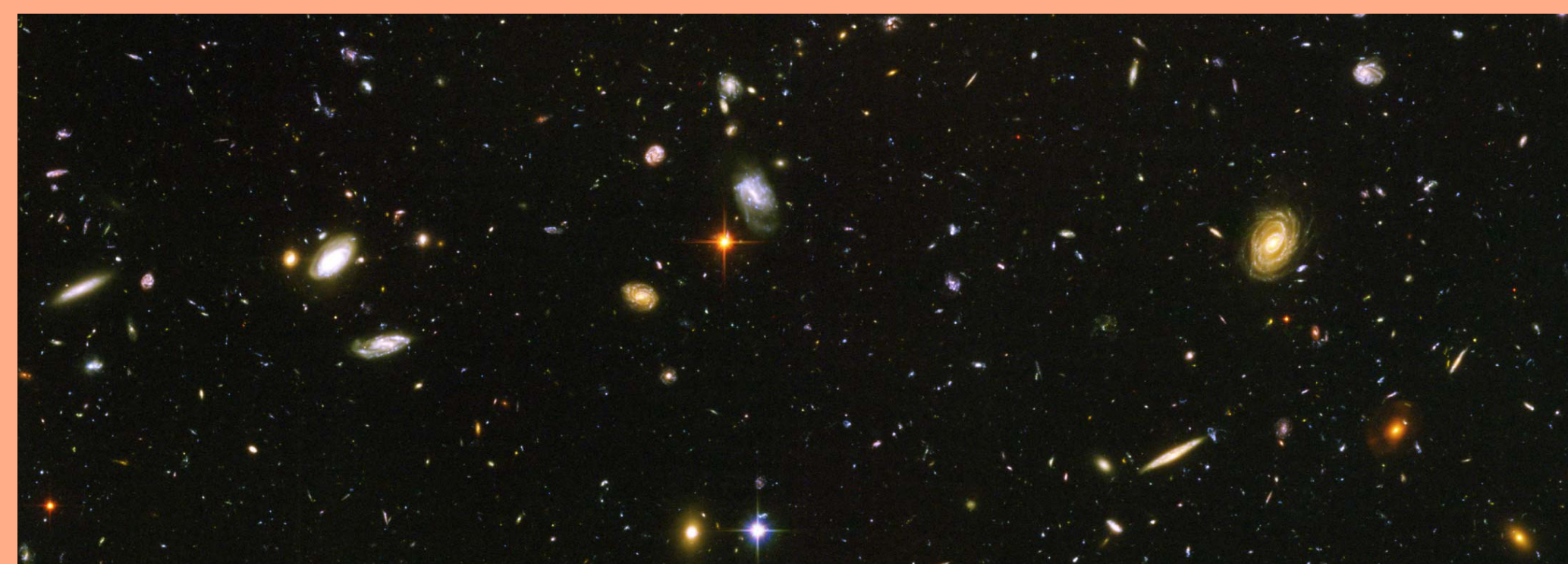
Giant Star-Forming Nebula – Thousands of sparkling young stars surrounded by a vast region of dust and gas. © NASA



M81 – Bode's Galaxy – similar to the Milky Way Galaxy. It is one of the brightest galaxies that can be seen from Earth and is found in the northern sky in Ursa Major. At an apparent magnitude of 6.8, it is just at the limit of naked-eye visibility. Its angular size is about the same as that of the full moon. This image combines data from the Hubble and Spitzer Space Telescopes and the Galaxy Evolution Explorer missions. © NASA/JPL-Caltech/S. Willner (Harvard-Smithsonian Center for Astrophysics)

## HUBBLE DEEP FIELD

The poster to the left and image below show the **HUBBLE DEEP FIELD** – a view of nearly 3,000 galaxies as seen by NASA's Hubble Space Telescope. The view represents a "deep" core sample of the universe, cutting across billions of light-years and creating the one of the deepest visible-light images of the cosmos. Within the image, we can see galaxies of various ages, sizes, shapes, and colors.



Header Image: Star formation within the Eagle Nebula © NASA/ESA