

## CHAPTER OVERVIEW

### 28: The Evolution and Distribution of Galaxies

How and when did galaxies like our Milky Way form? Which formed first: stars or galaxies? Can we see direct evidence of the changes galaxies undergo over their lifetimes? If so, what determines whether a galaxy will “grow up” to be spiral or elliptical? And what is the role of “nature versus nurture”? That is to say, how much of a galaxy’s development is determined by what it looks like when it is born and how much is influenced by its environment?

Astronomers today have the tools needed to explore the universe almost back to the time it began. The huge new telescopes and sensitive detectors built in the last decades make it possible to obtain both images and spectra of galaxies so distant that their light has traveled to reach us for more than 13 billion years—more than 90% of the way back to the Big Bang: we can use the finite speed of light and the vast size of the universe as a cosmic time machine to peer back and observe how galaxies formed and evolved over time. Studying galaxies so far away in any detail is always a major challenge, largely because their distance makes them appear very faint. However, today’s large telescopes on the ground and in space are finally making such a task possible.

[28.1: Observations of Distant Galaxies](#)

[28.2: Galaxy Mergers and Active Galactic Nuclei](#)

[28.3: The Distribution of Galaxies in Space](#)

[28.4: The Challenge of Dark Matter](#)

[28.5: The Formation and Evolution of Galaxies and Structure in the Universe](#)

[28.E: The Evolution and Distribution of Galaxies \(Exercises\)](#)

Thumbnail: Collisions and mergers of galaxies strongly influence their evolution. This image shows the inner regions of these two galaxies, as taken by the Hubble Space Telescope. The cores of the twin galaxies are the orange blobs to the lower left and upper right of the center of the image. Note the dark lanes of dust crossing in front of the bright regions. The bright pink and blue star clusters are the result of a burst of star formation stimulated by the collision. (credit right: modification of work by NASA, ESA, and the Hubble Heritage Team (STScI/AURA)-ESA/Hubble Collaboration).

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