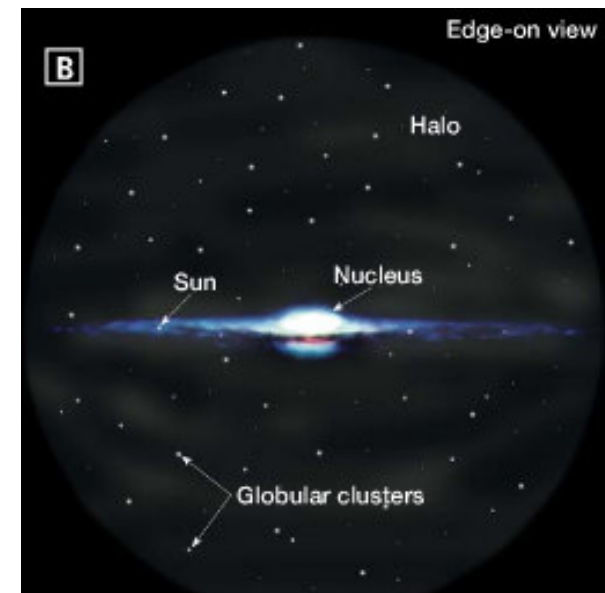
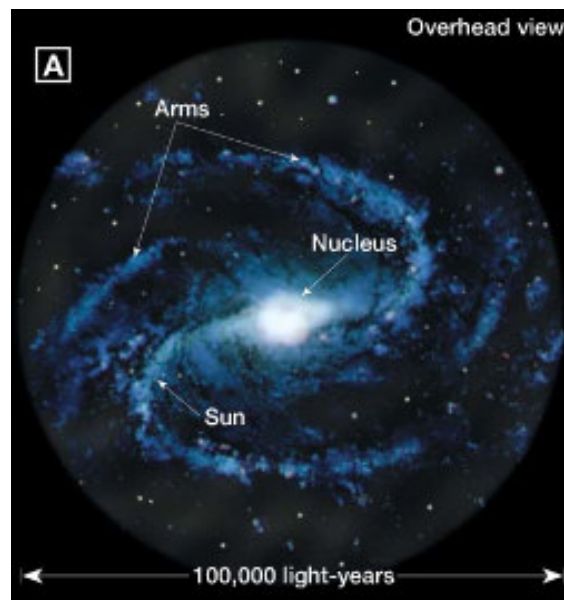


Ch 25.3 The Universe

- **Galaxies** are large groups of stars, dust, and gases held together by gravity.

The Milky Way Galaxy

- The galaxy where our solar system is located. It has at least three distinct spiral arms.
- As viewed from Earth, it appears as a hazy band of white light arching across the entire night sky.
- It is about 100,000 light-years wide and about 10,000 light-years thick. It takes 230 million years for our solar system to orbit the nucleus.



Spiral Galaxies

- Named for the usually spiral structures that extend from the center into the disk. The spiral arms are sites of ongoing star formation.



Elliptical Galaxies

- Galaxies having an approximately ellipsoidal shape and a smooth, nearly featureless brightness profile. They range in shape from nearly spherical to highly flattened.



Irregular Galaxies

- Galaxies do not have a regular shape. They neither a nuclear bulge nor any trace of spiral arm structure.



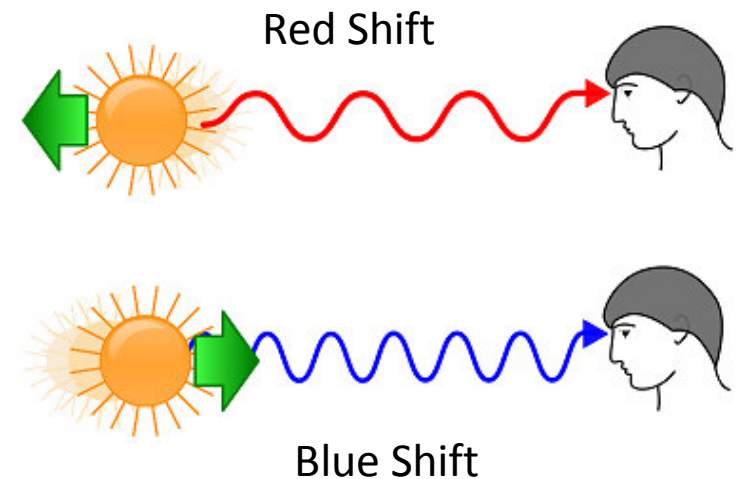
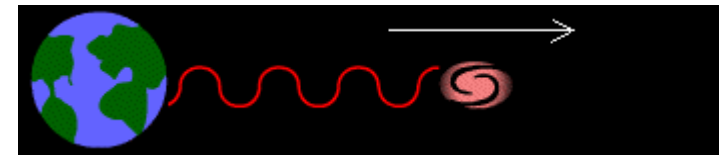
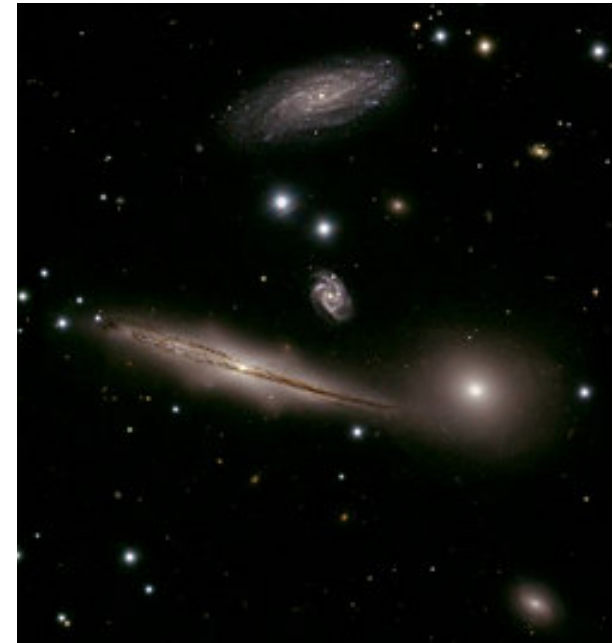
Galaxy Clusters

- Galaxies found in clusters. Groups and clusters may contain from ten to thousands of galaxies. Our own cluster is called the **Local Group** which contains at least 28 galaxies.

The Expanding Universe

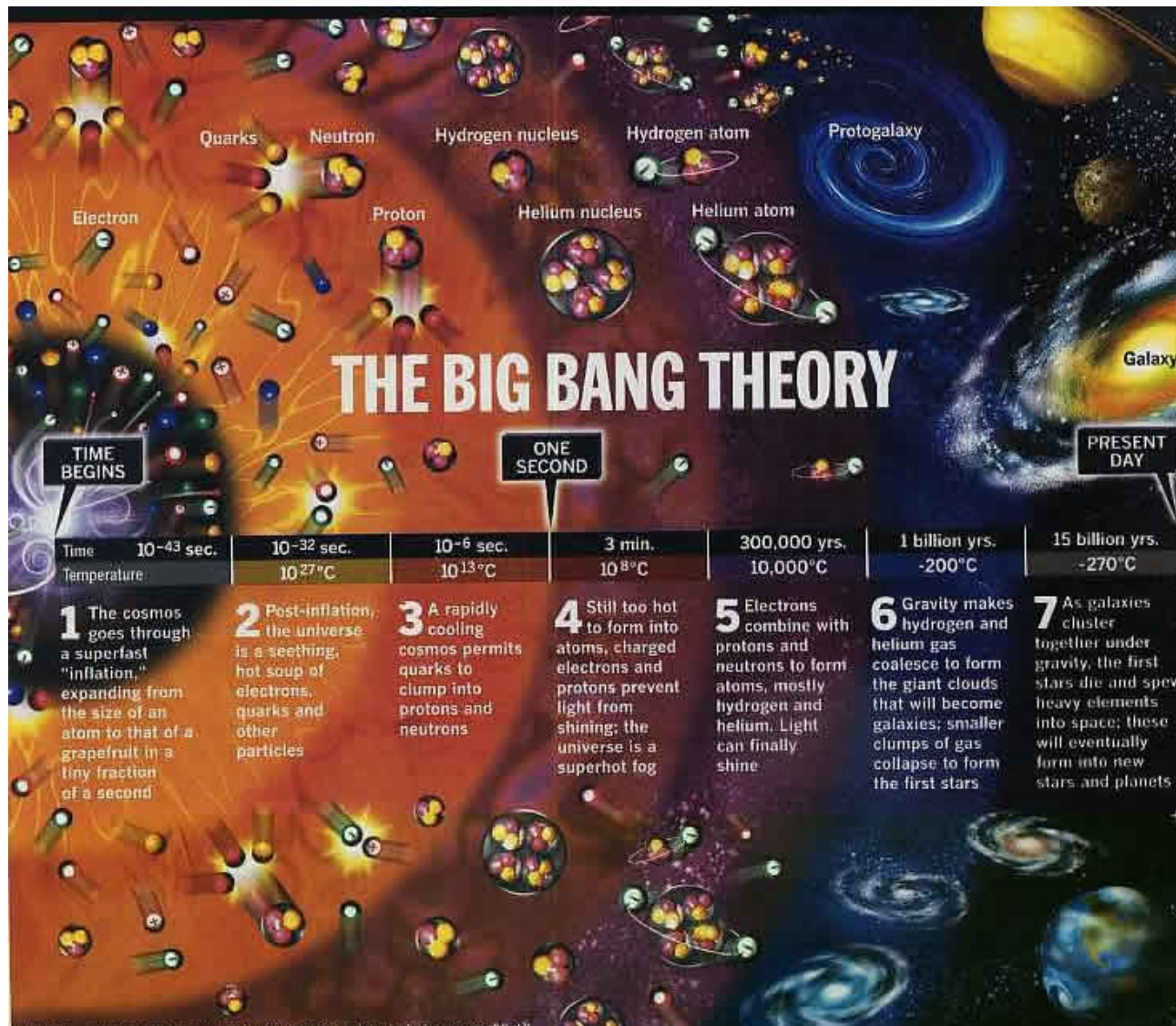
Red Shifts

- An important discovery in modern astronomy was made in 1929 by Edwin Hubble.
- An increase in the wavelength of radiation emitted by a celestial body as the body moves away from the viewer. A consequence of the Doppler effect.
- Doppler red shifts of galaxies exhibit the greatest red shifts are the most distance.
- Hubble's law** – galaxies (except for a few nearby) are retreating from us at a speed that is proportional to their distance.
- This means the universe is expanding.



The Big Bang Theory

- At one time, the entire universe was confined to a dense, hot, supermassive ball. Then, about 13.7 billion years ago, a violent explosion occurred, hurling this material in all directions.



Further Evidence of the Big Bang Theory

- In 1964, two astronomers, Arno Penzias and Robert Wilson, in an attempt to detect microwaves from outer space, inadvertently discovered a noise of extraterrestrial origin.
- The noise did not seem to emanate from one location but instead, it came from all directions at once.
- It became obvious that what they heard was radiation from the farthest reaches of the universe which had been left over from the Big Bang.
- This discovery of the radioactive aftermath of the initial explosion lent much credence to the Big Bang theory.

