

- Stars that travel in the same direction around a concentration of mass are characteristic orbits found in the arms of **spiral galaxies**
- Besides shape, color is what characteristic clearly separates **elliptical galaxies** from **spiral galaxies**
- the size of the region responsible for powering an AGN is Solar System size
- According to **Hubble's law**, as the distance of a galaxy increases its recessional velocity increases
- **Type Ia supernovae** be used to determine a galaxy's distance because Type Ia supernova have approximately the same luminosity
- Type Ia supernovae** can be used to measure the most distant objects
- Astronomers use galactic redshift as a measure of distance
- distance indicators from closest to farthest: parallax, main-sequence fitting, Cepheids, Type Ia supernovae
- the **Milky Way Galaxy** is a barred spiral galaxy
- RR Lyrae stars** are used to determine distances to globular clusters
- the radio region of the electromagnetic spectrum is best used to study structure in the Milky Way
- The distance to the center of the Milky Way cannot be measured directly because clouds of dust and gas obscure our view
- No globular cluster has zero heavy elements so we know that at least one generation of stars formed and died before the Milky Way's globular clusters formed
- Open star clusters primarily inhabit the disk part of spiral galaxies
- we can look in the disk of the **Milky Way** to find lots of gas and dust
- the rotation curve of the Milky Way suggests that it contains a large amount of matter NOT in the form of stars
- most of the mass in our galaxy is in the form of dark matter**
- The inverse of the value of H_0 is a time
- the increasing in space between galaxies increases redshifts of distant galaxies

- The **Big Bang** occurred everywhere in the universe
- The existence of the **cosmic microwave background radiation** tells us that the early universe was much hotter
- After the **Big Bang** photons began to travel freely through the universe.
- Observations of **Type Ia supernovae** in distant galaxies have shown that the expansion of the universe is increasing
- the discovery of dark energy was unexpected because the gravity provided by the mass contained within the universe was predicted to slow the expansion
- By the time the universe was a few minutes old, the majority of the normal matter in the universe was hydrogen, and the remainder was mostly helium
- superclusters are the largest
- Our Milky Way Galaxy is a member of the Local Group, the Virgo cluster, and the Virgo supercluster
- the large scale structure of the universe looks like a sponge with many large holes
- gravity is responsible for shaping the large scale structure of the universe
- the visible parts of galaxies form only in the densest parts of dark matter halos.
- cold dark matter halos provided the gravity to form galaxy fragments in the early universe
- Structure formation in the universe proceeds hierarchically, meaning that small objects collapse then merge to form larger objects
- Structure formation in our universe proceeds from the bottom then moves up
- the **Cambrian explosion** occurred 500 million years ago
- The phylogenetic tree of life was established using DNA sequencing
- All terrestrial life is carbon based
- Terrestrial life is carbon-based and requires water as its solvent
- cyanobacteria** and other **photosynthesizing organisms** have allowed Earth to have a large amount of oxygen in its atmosphere

-astrobiology is the study of the origin, evolution, distribution, and future of life in the universe