

**Learning Goals for 19 November 2007 – Variable Stars**

- \* List and briefly describe four main types of variable stars: eclipsing binary, rotating star, eruptive, and pulsating
- \* Sketch the interplay of pressure and gravity in a pulsating star
- \* List the advantages and disadvantages for using RR Lyrae stars and Cepheid stars in determining distances
- \* State why some pulsating stars are ideal “standard candles”
- \* Summarize how astronomers use these kinds of variable stars to determine distances in the Galaxy
- \* Explain how our view of the Galaxy changed with the measurements of the distances to globular clusters.

**Learning Goals 21 November 2007 – Milky Way Galaxy**

- Explain briefly about how observations of stars and the interstellar medium have provided evidence for the structure of the disk and bulge of the Galaxy
- List 3 defining characteristics of each of the major parts of the Galaxy: disk, bulge, and halo.
- Explain why the arms in a spiral galaxy are so prominent.
- List the evidence supporting the theory for a supermassive black hole at the center of our galaxy.
- State the evidence for substantial dark matter in the Galaxy
- List the observations necessary in order to detect the presence of dark matter

**Learning Objectives 26 November 2007**

- Describe the Hubble tuning fork and summarize its use today.
- State the basic differences between elliptical, spiral, lenticular (S0), low surface brightness, and dwarf galaxies in how they look
- Outline the general differences in star and gas content for the various galaxy classifications
- Be able to classify galaxies based upon their morphology
- Give an overview of the structure of the Universe, from the Local Group to the Local Supercluster to the largest scale (voids and filaments)

**Learning Objectives 28 November 2007 – Evolution of Galaxies**

- Explain what is meant by “look-back time” and how astronomers use it.
- Summarize the considerations astronomers must make in interpreting the observations of galaxies farther and farther away
- Describe the evidence for Galaxies evolving over time
- Describe how the angular momentum of a proto-galactic cloud may affect the kind of galaxy that develops
- State the evidence that there have been mergers of galaxies
- Summarize how mergers of galaxies may be the source for elliptical galaxies

**Learning Objectives 30 November 2007 -- Finding distances to galaxies and the Hubble Law.**

- What kinds of standard candles are used to find distances to galaxies?
- What is Hubble’s Law and what is Hubble’s constant?
- What observations are needed in order to find the distance to a galaxy too far away to have an observable standard candle?

**3 December 2007 -- Watched “A Runaway Universe”**

- What were the astronomers observing to get the distances; why did they want these objects at their peak luminosities?
- Why are these objects considered good standard candles for galaxies 1 billion light years away or so?
- What was surprising about their observations that each team needed confirmation from another team to believe it?
- Why wouldn’t just pictures of the galaxies work for the astronomers? Why were spectra of the galaxies needed?
- What does an accelerating Universe mean for the future of the Universe?

**Learning Objectives 5 December 2007 -- Origin of the Universe**

- Explain the main points for the birth of the Universe
  - The role energy played at the very start
  - How the expansion caused the Universe to cool
  - What is meant by the particle era
  - How hydrogen and helium were formed
  - The source for the cosmic background radiation
- Summarize latest theories for formation of structure
  - Galaxies
  - Clusters of galaxies