

**ASTR101**  
**Unit 6 Assessment – Answer Key**

1. Most of the stars are located in a flat, rotating disk. There are stars above and below the disk in a region known as the halo. In the center of the disk is a bulge of stars known as the central bulge or the nucleus. The solar system is located in the disk about two thirds of the way from the center to the edge.
2. Dark matter is composed of different particles than ordinary matter. It neither emits nor absorbs electromagnetic radiation and gets its name from this property. Dark matter exerts a gravitational force on ordinary matter with observable consequences. Without dark matter, the ordinary matter in our galaxy could not hold the high-speed stars in the outer part of the galaxy in their orbits. They would go flying off into space. The phenomenon of gravitational lensing is also evidence for the existence of dark matter. Ordinary matter is composed of protons, neutrons, and electrons.
3. Stars, galaxies, clusters of galaxies, superclusters, and voids. We know this from deep-sky observations and the maps that are generated from them.
4. In 1923, Hubble was able to identify several Cepheid variable stars in nearby spiral nebulae. From their known luminosity, he used the inverse-square law to calculate their distances. The distances were far too great for the spiral nebulae to be within our galaxy.
5. Hubble's law says that for galaxies outside our Local Group, their recessional velocity (or redshift) is directly proportional to their distance. Its importance is due to the fact that the explanation for this is that space is expanding, the most significant and productive concept in our understanding of the universe.
6. If space is expanding, the electromagnetic waves traveling through it will be stretched out (redshifted) by the expansion. If one distant galaxy is twice as far away as another, its light will take twice as much time to reach us and therefore will be twice as much redshifted. This explains why, in Hubble's law, the redshift is directly proportional to the distance.
7. The model consists of a balloon with small pieces of paper attached to its surface. As the balloon is blown up, its surface area increases and the pieces of paper become farther apart without changing size. The surface area represents expanding space, and the fact that the pieces of paper do not increase in size represents the fact that galaxies do not expand. In the model, the pieces of paper get farther apart without moving across the surface of the balloon (without moving through space), which is true for galaxies in our universe. The most significant way in which the model does not correspond to our universe is that the model space (the surface of the balloon) is two dimensional while space in our universe is three dimensional.

8. The visible universe is that part of the universe that is accessible to observation. Due to the finite speed of light and the finite age of the universe, the visible universe is finite in size. The universe itself is probably infinite, but in any case, it is much larger than the visible universe.

