Galaxy Identification Reading

1. Read the following information about galaxies.
2. Answer the questions that follow.

Background Information:
Galaxies are giant assemblages of stars, gas, and dust. They come in a wide variety of shapes and sizes, from pinwheels to spheres to footballs to shapeless clouds. Astronomers categorize galaxies for the same reason botanists and naturalists classify plants and animals: to better understand their evolution or structural relationships.

The galaxy classification scheme used by many astronomers today originated in 1926 when Mount Wilson astronomer Edwin Hubble sorted galaxies into three broad categories: ellipticals, spirals, and barred spirals (see Figure 1). Two additional categories, lenticulars and irregulars, though not in the original Hubble scheme, are generally included in the classification system.

Hubble "Tuning Fork" Diagram

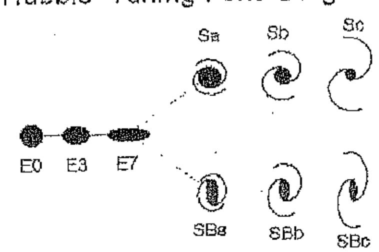

Figure 1

Elliptical galaxies are systems of smoothly distributed stars and no clearly defined internal structure. Though many are elliptical in shape, others are flattened or lens-shaped. Hubble classified the spherical elliptical as type E0, the intermediates as E1 through E6, and the lens-shaped as E7. Ellipticals are the largest type of galaxy, and many are sources of intense radio energy. Ellipticals contain little of no interstellar gas and dust and the stars within them are old.

Lenticular galaxies are recognized by astronomers as an intermediate class between the ellipticals and spirals. Classified as S0 galaxies (not on the "Tuning Fork"), the lenticulars have a central nucleus and are lens shaped like the spiral galaxies but they show little or no evidence of spiral structure, like the ellipticals. Additionally, they contain predominantly old stars and very little gas, although they often exhibit dark dust lanes.

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Spiral galaxies are shaped like whirlpools or pinwheels. Their arms wind out of a bright central region, called the nucleus, and wrap around the disk. Young, hot stars trace out the spiral arms like lights along a Christmas tree limb. Hubble noted that each spiral galaxy can be subclassified by the size of its nucleus and how tightly wound its arm are. Hence, spirals with large nuclei and tightly wound arms are type Sa; those with slightly fainter nuclei and more extended arms are type Sb; and those with loosely wound arms and inconspicuous nuclei are type Sc. In contrast with elliptical galaxies, spirals are rich in gas and dust, much of which is distributed in clouds along the arms. These clouds are hotbeds of star formation, and as a result, most of the young stars in spiral galaxies are found in the arms. The galaxy's nucleus, however, contains much less dust and gas, and stars there are generally much older. When spiral galaxies are viewed edge-on, the nuclear bulge is easily seen. crossed by a dark band of dust from the disk.

Our galaxy, the Milky Way galaxy, is thought to be a spiral galaxy although recent observations are making some astronomers think it is a barred spiral galaxy. Our Milky Way is roughly 100,000 lightyears across with our solar system about 26,000 lightyears from the center in the Orion arm, one of the spiral arms. A **lightyear** is a measure of distance equal to the distance light travels in one year or 5.87×10^{12} miles (almost 6 trillion miles). In our galaxy there are about 200 billion stars, clouds of dust and gas, and, like most galaxies, probably a black hole at the center.

Barred spirals look somewhat like the bent rotor blades of a helicopter. Stars and gas extend for thousands of light-years from each side of the nucleus in a straight "bar" structure. But, at the outer end of each bar, the stars and gas wrap scythe-like around the galaxy as normal spiral arms do. We often find young hot stars at the ends of bars. Barred spirals with tightly wound arms and prominent nuclei are type Sba; those with moderate nuclei and moderately wound arms are type SBb; and those with tiny nuclei and very loose arms are type SBc.

Irregulars are galaxies with no dominant shape to speak of (also not on the "Tuning Fork"). To some extent, this is a catch-all category. The irregulars' lack of distinct shape makes all irregular galaxies appear similar in many respects: patchy, sprawling conglomerations of stars and gas. Some irregulars, however, have conspicuous bars, while others have bars plus a distinctive but faint spiral arm pattern. Like the other galaxies, irregulars, too, have subcategories. If they are resolvable into stars, they are classed Irr+, type I or Im (for Magellanic irregulars—after the Magellanic clouds seen in the southern sky). Those that are completely shapeless are classified as Irr-, type II or I0.

It was once thought that these classifications might indicate the evolutionary path for all galaxies—from ellipticals to spirals. Today, astronomers concede that the different colors, ranging from young (blue) to old (yellow to red). This relationship can be clearly seen in a plot of stellar luminosity against color. This plot, known as the Hertzsprung-Russell of H-R diagram, helps astronomers understand how stars are born, live, and die. Thus, the predominant color of a galaxy illustrates the presence and extent of stars of different populations. Young stars radiating energy into gas and dust clouds appear as blue knots, while the old stars are yellow in appearance and more smoothly distributed than the younger members. An interpretation of these colors yields insights into the nature of galaxies and the stars within them.

Conclusion – answer the following questions on your own sheet of paper using complete sentences

1. What was the criteria that Hubble used to classify galaxies?

2. How can lenticular galaxies be easily confused with elliptical galaxies? How can lenticulars be distinguished from ellipticals?

3. How is the large amount of gas and dust in spiral galaxies related to determining the age of the galaxy?

4. What is the relationship between a star or galaxy's overall color and the temperature of the star or galaxy overall?

5. What would the overall color of a spiral galaxy be? Elliptical?

6. What would the overall temperature of a spiral galaxy be? Elliptical?