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Answer Key: Blast Through the Deep Field: A 9th Grade Galactic Physics Quest

High schoolers calculate cosmic distances using redshift and analyze Hubble's Law to map the accelerating expansion of our universe.

1. When observing the spectra of distant galaxies, Edwin Hubble noted a systematic 'redshift.' What physical phenomenon causes this shift toward longer wavelengths?

Answer: C) The stretching of spacetime as the universe expands

Cosmological redshift occurs because the space through which light travels is expanding, stretching the photons' wavelengths toward the red end of the spectrum.

2. According to the Big Bang theory, the universe was once an incredibly hot, dense state. The residual heat from this event, cooled to roughly 2.7 Kelvin, is known as the _____.

Answer: A) Cosmic Microwave Background (CMB)

The Cosmic Microwave Background is the 'afterglow' of the Big Bang, representing the moment the universe became transparent to light about 380,000 years after its birth.

3. True or False: Most of the mass in a typical galaxy, such as the Sombrero Galaxy, consists of visible stars and gas clouds.

Answer: B) False

Observations of galactic rotation curves suggest that roughly 85% of cosmic matter is 'Dark Matter,' which does not emit light and cannot be seen directly.

4. Which of these galactic structures is characterized by a lack of rotational symmetry and often results from tidal interactions between two passing galaxies?

Answer: B) Irregular Galaxy

Irregular galaxies, like the Antennae Galaxies, often gain their chaotic shapes through gravitational collisions or 'galactic cannibalism.'

5. The Andromeda Galaxy and the Milky Way are currently moving toward each other and are part of a gravitationally bound group of roughly 50 galaxies called the _____.

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Answer: C) Local Group

The Local Group is the specific galaxy cluster inhabited by the Milky Way; gravity keeps these galaxies together despite the overall expansion of the universe.

6. True or False: Elliptical galaxies are generally composed of older, redder stars and contain very little of the cool gas needed for new star formation.

Answer: A) True

Elliptical galaxies are often called 'red and dead' because they have exhausted their gaseous reservoirs and mostly contain low-mass, long-lived stars.

7. In 1998, observations of Type Ia Supernovae led to the discovery that the expansion of the universe is not slowing down, but accelerating. What is the name of the mysterious force driving this?

Answer: B) Dark Energy

Dark energy is a hypothetical form of energy that permeates all of space and exerts a negative, repulsive pressure, causing the rate of expansion to increase.

8. The _____ describes the relationship where a galaxy's velocity of recession is directly proportional to its distance from Earth.

Answer: B) Hubble-Lemaître Law

Hubble's Law (now the Hubble-Lemaître Law) provides the mathematical basis for understanding the scale and expansion rate of the universe.

9. True or False: The 'Observable Universe' includes all galaxies in existence, regardless of whether their light has had time to reach us since the Big Bang.

Answer: B) False

The 'Observable Universe' is limited by the speed of light and the age of the universe; there are likely regions beyond this 'horizon' that we cannot see yet.

10. If you are looking at the 'Whirlpool Galaxy' through a telescope, you are seeing it as it existed millions of years ago. This concept is fundamental to astronomy and is known as:

Answer: B) Look-back time

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Because light travels at a finite speed, the further away an object is, the further back in time we are seeing it. Galaxies acts as 'time machines' for astronomers.