Name: _____ **Date:** _____

Answer Key: Cosmic Caverns and Quasars: A 9th Grade Galactic Quest

Challenge assumptions about cosmological expansion by analyzing spectroscopic shifts and the gravitational influence of unobservable mass.

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1. Spectroscopic analysis of the Andromeda Galaxy (M31) reveals a 'blueshift' rather than a redshift. What does this indicate about its motion within the Local Group?

Answer: B) It is gravitationally bound to the Milky Way and moving toward us.

While the universe as a whole is expanding (redshift), local gravitational forces can overcome expansion over short distances, causing nearby galaxies to move toward one another.

2. The rotation curves of spiral galaxies like the Pinwheel Galaxy (M101) remain flat at large distances from the center, implying the presence of ___.

Answer: A) Dark Matter

To account for the high orbital velocities of stars at the edges of galaxies, scientists conclude that an invisible mass—dark matter—must provide the necessary gravitational pull.

3. The Sombrero Galaxy (M104) is classified as an irregular galaxy because of its thick dust lane and prominent central bulge.

Answer: B) False

The Sombrero Galaxy is actually classified as a spiral galaxy (specifically Type Sa or Sb) seen nearly edge-on; it is not irregular.

4. How does the 'Cosmic Web' structure relate to the distribution of matter in the universe?

Answer: C) Matter clumps into filaments and clusters separated by massive voids.

On a large scale, the universe looks like a sponge, where galaxies concentrate along filaments of dark matter, leaving large empty 'voids' in between.

5. The active galactic nucleus of a distant galaxy that emits massive amounts of energy and outshines its host is called a(n) ___.

Answer: B) Quasar

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Quasars are extremely luminous galactic kernels powered by gas spiraling into a supermassive black hole.

6. Observing a galaxy with a high redshift means we are seeing it as it existed in the distant past.

Answer: A) True

Due to the finite speed of light, as we look further into the expanding universe (higher redshift), we are seeing light that was emitted billions of years ago.

7. What is the primary difference in star formation between elliptical galaxies and spiral galaxies?

Answer: B) Spirals have abundant gas for new stars; ellipticals have very little.

Elliptical galaxies are often 'red and dead,' meaning they have exhausted their cold gas and dust, resulting in very low rates of new star formation compared to spirals.

8. According to Hubble's Law, the velocity at which a galaxy recedes from us is directly proportional to its ___.

Answer: C) Distance

Hubble found that the further away a galaxy is, the faster it appears to be moving away, which is a core piece of evidence for the expansion of the universe.

9. Edwin Hubble's observations of the Great Andromeda Nebula proved it was located within the boundaries of the Milky Way.

Answer: B) False

Hubble used Cepheid variable stars to prove that Andromeda was a separate 'island universe' far beyond the Milky Way.

10. Which phenomenon suggests that the expansion of the universe is not slowing down, but actually accelerating?

Answer: B) Dark Energy

Dark energy is the theoretical force acting against gravity that causes the expansion rate of the universe to increase over time.