

S1S4 Deep Dive Study Guide: Galaxies and Gravity

Quiz

Instructions: Answer the following questions in 2-3 complete sentences, using only information from the provided context.

1. What are the two primary factors that determine the strength of gravitational interactions between objects?
2. According to the provided text, what is a field model and what purpose does it serve in explaining forces?
3. Explain the difference between mass and weight, including how each is affected by changes in gravity.
4. Based on the experiments described (dropping objects of different masses), what principle do they demonstrate about gravitational force, and what factor on Earth can alter the results?
5. How does the theory of General Relativity describe the phenomenon we perceive as gravity?
6. What is the Big Bang Theory, and how did Edwin Hubble's observations support the idea of an expanding universe?
7. Describe the process of star formation, beginning with a nebula.
8. What is nuclear fusion, and what role does gravity play in allowing this process to occur within stars?
9. List and briefly describe the three shapes of galaxies mentioned in the text.
10. What is a light-year, and why do scientists use it as a unit of measurement?

Answer Key

1. Gravitational interactions are dependent on the masses of the interacting objects and the distance between them. The force of gravity increases with greater mass and decreases rapidly with greater distance.
2. A field model is used to explain how two objects can exert a force on each other without physically touching. It shows that objects have a region of influence, or field, surrounding them, and when these fields overlap, motion occurs.
3. Mass is the amount of matter in an object and does not change with location. Weight is the measure of the gravitational force exerted on an object at the surface of a planet; because it is a measure of gravitational attraction, weight changes when gravity varies, but mass does not.
4. The experiments demonstrate that all objects are pulled to Earth at the same rate, regardless of their mass. The difference in the velocity of falling objects on Earth is not due to gravitational force but is caused by varying air resistance.
5. General Relativity explains that gravity is a distortion of space-time caused by massive objects. The feeling of gravity is simply objects responding to this curvature of space created by other massive objects.
6. The Big Bang Theory is a scientific model stating the universe began with a giant blast of matter and energy about 14 billion years ago. Edwin Hubble observed that distant galaxies are moving rapidly away from our galaxy and each other in a process known as red shift, which supports the theory that the universe is expanding from a central point.
7. Stars form from giant clouds of dust and gas called nebulae. Gravity pulls the particles in the nebula tightly together, causing the cloud to condense, spin, and heat up until the matter becomes so hot that nuclear reactions begin.
8. Nuclear fusion is a process where two nuclei join to form a larger nucleus, releasing the heat and light energy that causes stars to shine. Gravity is essential because it holds the massive star

of exploding gases together, creating the extreme heat and pressure in the core required for nuclear fusion to occur.

9. The three galaxy shapes are Spiral (middle-aged, disc-shaped with arms, like the Milky Way), Elliptical (older, larger, with stars revolving in various directions), and Irregular (younger, unorganized shape with lots of nebulae).

10. A light-year is the distance light travels in one year, which is equal to 9.5 trillion kilometers. Because the universe is so vast and light travels so quickly (300,000 km/sec), scientists use its speed to measure the expansiveness of space.

Essay Questions

1. Trace the role of gravity throughout the history of the universe, from its function immediately following the Big Bang to the formation of stars, galaxies, and our solar system.

2. Using the concepts of field models, mass, and distance, construct a detailed explanation of how gravitational forces work between celestial bodies like the Earth, Sun, and Moon.

3. Describe the complete lifecycle of a star as detailed in the text, starting from its origins as a nebula. Explain the forces and processes involved, including condensation, nuclear fusion, and the role of gravity in each step.

4. Discuss the evidence for the Big Bang Theory and the expanding universe. Incorporate the concepts of red shift, the estimated age of the universe, and the tools scientists use to observe distant cosmic phenomena.

5. Compare and contrast the three types of galaxies—spiral, elliptical, and irregular. Discuss their relative ages, shapes, composition, and the different ways their stellar objects move in relation to the galactic center.

Glossary of Key Terms

<i>Term</i>	<i>Definition</i>
Big Bang Theory	A scientific model describing how the universe began with a giant blast of matter and energy about 14 billion years ago, after which it began to cool and expand.
Elliptical Galaxy	An older, larger type of galaxy that can contain trillions of stars, which revolve around the galaxy's center in a variety of directions.
Field Model	A model used to explain how two objects can exert a force on each other without physically touching by showing the region of influence (field) surrounding them.
Galaxy	A family of stars, gases, and space dust held together by gravity. Most galaxies contain billions of stars and are grouped together in clusters.
General Relativity	A theory that describes gravity as a distortion of space-time, where objects with greater mass create more curvature, and the force of gravity is the response to this distortion.
Gravity	An attractive force that exists between all objects that have mass. Its strength depends on the masses of the objects and the distance between them.
Gravitational Field	A region of influence that exists around any object with mass. When another object with mass is placed in this field, the two objects experience gravitational forces toward each other.
Irregular Galaxy	A younger, unorganized galaxy with lots of nebulae (clouds of dust and gas) that will eventually be shaped into a more organized form by gravity.

Light Year	The distance light travels in a year, equivalent to 9.5 trillion kilometers. It is used to measure the vast distances in space.
Mass	The amount of matter in an object. Mass does not change with location or variations in gravity.
Milky Way	Our home galaxy, which is a spiral galaxy containing hundreds of billions of stars, gases, and dust held together by gravity.
Nebula	A giant cloud of dust and gas from which stars and galaxies are thought to form.
Nuclear Fusion	A process in which two nuclei join to form a larger nucleus, releasing heat and light energy. It is the energy source that causes stars to shine.
Red Shift	The phenomenon, observed by Edwin Hubble, where distant galaxies are seen moving rapidly away from our galaxy and from each other, providing evidence for the expanding universe.
Remote Sensing Instruments	Tools, such as radio telescopes, that can detect various forms of electromagnetic radiation (radio waves, microwaves, visible light) to study distant stars and astronomical processes.
Solar System	A system formed from collapsing nebulae, where a central star (the Sun) ignited and surrounding materials clumped together to form planets, moons, asteroids, and comets.
Spiral Galaxy	A middle-aged, disc-shaped galaxy with arms spiraling from a central bulge. The stars and objects within it revolve in the same direction around the center.
Star	A large, huge ball of gas in space that generates its own energy through nuclear reactions (nuclear fusion) in its core.
Weight	The measure of the gravitational force exerted on an object at a planet's surface. It is a force and a vector that changes with varying gravity and height.