# Science Measures and Understands Our Universe

## A. Fill in the Blanks

**Complete the sentences with the correct scientific term.**

1. The theory that the universe began from a single, extremely hot and dense point is called the _____.
2. A(n) _____ is a massive system of stars, stellar remnants, interstellar gas, dust, and dark matter, all bound together by gravity.
3. The distance that light travels in one full year is known as a _____.
4. The scientific method of analyzing light by splitting it into its different wavelengths or colors is called _____.
5. Our solar system is located in a spiral arm of the _____ galaxy.

## B. Match the Following;

**Match the term in Column A with its correct description in Column B.**

| Column A | Column B |
|---|---|
| 1. Light-Year | A. A vehicle designed to travel in space, often carrying instruments but not people. |
| 2. Nebula | B. The force of attraction between all masses in the universe. |
| 3. Gravity | C. A unit of distance used for objects within our solar system. |
| 4. Space Probe | D. A giant cloud of gas and dust where new stars are formed. |
| 5. Astronomical Unit (AU) | E. A unit of distance used for stars and galaxies, equal to about 9.5 trillion km. |

## C. Practice Problems

**Answer the following questions in complete sentences.**

1. Why do astronomers use units like "light-years" and "astronomical units" instead of just using kilometers?

2. List the following cosmic structures in order from smallest to largest: Universe, Star, Galaxy, Planet.
3. What is an Astronomical Unit (AU) and when is it most useful for measurement?
4. Explain the difference between a natural satellite and an artificial satellite. Give one example of each.
5. A star is 25 light-years away from Earth. If that star were to explode today, how long would it take for us on Earth to see the explosion?
6. How does a space probe, like the Voyager probes, help us learn about our universe?
7. What are the two main differences between a star and a planet?
8. Briefly describe the geocentric model of the universe. Why is it no longer accepted?
9. What is spectroscopy and what can it tell us about a distant star?
10. An astronomer observes a reddish star and a bluish-white star. Which star is hotter, and how do we know?

## D. Warm-up Questions

**Answer the following questions with a short sentence or a single word.**

1. What is the name of the galaxy we live in?
2. What is the fundamental force that keeps planets in orbit around a star?
3. What is the primary tool astronomers use to observe distant stars and galaxies?
4. What is a large cloud of gas and dust in space, often called a "star nursery"?
5. What is the model of the solar system that places the Sun at the center?

## E. Challenge Questions

**These questions require you to synthesize information and think critically.**

1. The Andromeda Galaxy is approximately 2.5 million light-years away. When we look at the Andromeda Galaxy through a telescope, what are we actually seeing? Explain your reasoning.
2. In simple terms, what is "redshift"? How does the redshift of distant galaxies provide evidence for the Big Bang Theory?
3. Why can a space telescope like the Hubble Space Telescope capture clearer images of distant objects than most powerful telescopes on the ground?
4. Imagine scientists discover a new planet orbiting a star 50 light-years away. What scientific method could they use to determine if this planet has an atmosphere and what gases it might contain?
5. Our Sun is an average, medium-sized star. What will likely happen to it at the end of its life? How is this different from the end-of-life for a star that is much more massive than our Sun?

## F. Word Problems & Application

**Apply your scientific knowledge to solve these scenarios.**

1. Light travels at approximately 300,000 kilometers per second. The planet Mars is, at a certain point, 90 million kilometers from Earth. How many seconds would it take for a radio message (which travels at the speed of light) to get from Earth to a rover on Mars?
2. You are an astronomer studying two galaxies. Galaxy A has a greater redshift than Galaxy B. What does this tell you about the relative speed and direction of movement of the two galaxies?
3. If 1 Astronomical Unit (AU) is about 150 million km, and Jupiter is 5.2 AU from the Sun, calculate the distance of Jupiter from the Sun in kilometers.
4. You are designing a mission to map the entire surface of the Moon in high detail. Would you choose to send a rover or an orbiter? Justify your choice.
5. A star is 40 trillion km away. Which unit of measurement is most appropriate to describe this distance: Astronomical Units (AU) or Light-Years (ly)? (Note: 1 ly ≈ 9.5 trillion km). Explain why.

## G. True or False

1. An Astronomical Unit (AU) is the average distance between the Earth and the Moon. _____
2. The color of a star indicates its size. _____
3. Because light travels so fast, the light we see from all stars is essentially happening in real-time. _____
4. Gravity is a force that pushes celestial objects away from each other. _____
5. T / F The geocentric model was proposed by Nicolaus Copernicus. _____