Science Explores the Vast and the Minute

A. Fill in the Blanks

Complete the sentences with the correct scientific term.

1. A massive, gravitationally bound system of stars, stellar remnants, interstellar gas, dust, and dark matter is called a _____.
2. The center of an atom, which contains protons and neutrons, is called the _____.
3. The scientific method begins with an _____ which leads to a question.
4. A (n) _____is made of two or more atoms bonded together.
5. To see the rings of Saturn, you would use a _____.

B. Match the Following;

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

Column A	Column B
1. Atom	A. A tool that uses lenses to magnify distant objects.
2. Cell	B. A vast system of billions of stars held by gravity.
3. Galaxy	C. The basic structural and functional unit of all known organisms
4. Telescope	D. The smallest unit of ordinary matter that forms a chemical element
5. Microscope	E. A tool that uses lenses to magnify very small, nearby objects

C. Practice Problems

These questions require a bit more thought. Write your answers in complete sentences where necessary.

1. Explain the main difference between a solar system and a galaxy.

2. List the following items in order from smallest to largest: Planet, Atom, Cell, Universe, Galaxy.
3. What is a light-year? Is it a measure of time or distance? Explain.
4. What is the difference between a light microscope and an electron microscope in terms of what they use to see and how powerful they are?
5. Describe the relationship between atoms and molecules. Use water (H_2O) as an example.
6. Why can't we see a virus with our naked eye?
7. What is the role of a space probe, like Voyager 1? How is it different from a telescope?
8. List the following items in order from largest to smallest: Milky Way Galaxy, The Sun, A Human Cell, A Water Molecule, The Universe.
9. What is the "habitable zone" (or "Goldilocks zone") around a star?
10. Name two things that are part of the "vast" scale of science and two things that are part of the "minute" scale.

D. Warm-up Questions

Answer these quick questions to get your brain warmed up!

1. What scientific instrument would you use to observe the craters on the Moon?
2. What is the basic, smallest unit of all living things?
3. What is the name of the galaxy that contains our Solar System?
4. What scientific instrument would a biologist use to study a single bacterium?
5. What are the three main subatomic particles that make up an atom?

E. Challenge Questions

Think critically and apply your knowledge to answer these challenging questions.

1. Scientists often say, "We are made of stardust." What do they mean by this? Connect the "vast" (stars) with the "minute" (atoms in our bodies).
2. The James Webb Space Telescope observes the universe in infrared light, which allows it to see objects that are extremely far away. Why does seeing farther away in space mean we are also "looking back in time"?
3. If you were a scientist who discovered a new, single-celled organism, what is the first tool you would use to study it, and what are two questions you would try to answer about it?
4. Explain why the development of new technology (like more powerful telescopes and microscopes) is essential for making new scientific discoveries about the vast and the minute.

5. An atom is mostly empty space. If this is true, why don't we fall right through the floor?

F. Word Problems & Application

Apply your scientific knowledge to solve these scenarios.

1. The star Proxima Centauri is about 4.2 light-years away from Earth. If a major event, like the star turning into a supernova, happened today, how long would it take for astronomers on Earth to see it?
2. A biologist wants to study the detailed, 3D structure of a virus, which is about 100 nanometers in size. Should she use a high-powered light microscope or an electron microscope? Justify your answer.
3. The distance from the Earth to the Sun is approximately 149,600,000 kilometers. Express this number in scientific notation.
4. An astronomer observes that the light from a distant galaxy is "redshifted." What can she infer about the motion of that galaxy relative to Earth?
5. A typical human hair is about 100 micrometers thick. A red blood cell is about 8 micrometers in diameter. Approximately how many red blood cells could you line up side-by-side to match the thickness of one human hair?

G. True or False

1. A light-year is a unit used to measure very long periods of time. _____
2. Our Sun is one of the largest and brightest stars in the universe. _____
3. A molecule is always smaller than the atoms that make it up. _____
4. Electron microscopes use powerful lenses to bend beams of light. _____
5. Our solar system is located in the center of the Andromeda Galaxy. _____