STAR POWER

Read the article to learn about how stars produce elements, then answer the questions.

Stars aren't just nice to look at—check out these other claims to fame!

☆ Stellar Energy

Stars shine because they give off a huge amount of energy—but where does this energy come from? The answer lies with the hydrogen atoms in the star's core. The heat and pressure within a star, along with the star's gravity, are great enough to drive two hydrogen atoms together in the process of **nuclear fusion**. Through this process, multiple hydrogen ions combine to form a single helium ion. Because the protons in each hydrogen atom have the same positive charge, this reaction requires a great deal of energy to get started. The result of the process is one helium nucleus, particles known as positrons and neutrinos, and a vast amount of energy in the form of gamma rays.

☆ Hydrogen, Helium, and the Big Bang

The Big Bang theory states that the universe rapidly expanded from its early hot, dense state. Within the first 20 minutes after the Big Bang, hydrogen and helium nuclei formed as protons and neutrons collided. As time passed, neutrons began to decay, and there were no longer enough neutrons to form additional helium nuclei. Scientists calculate that based on the rate of expansion suggested by the Big Bang theory, the universe should be **approximately ¾ hydrogen and ¼ helium**. And indeed, this is the proportion that we observe in the universe today!

In 1925, **Cecilia Payne** was the first to determine that stars are primarily made of hydrogen and helium.

☆ The Other Elements

If hydrogen and helium began to form just after the Big Bang, where do the other elements on the periodic table come from? These atoms are produced by stars as well. In older stars known as **red supergiants**, the hydrogen supply becomes depleted, and the star becomes hotter. The increase in energy allows helium atoms to start to fuse into new elements such as carbon, oxygen, magnesium, and silicon—all of the elements in the periodic table up to iron. At that point, iron atoms will not continue to fuse with other atoms because the reaction would require more energy. Eventually, however, the star will collapse, then explode in a **supernova**, creating a variety of elements that are heavier than iron and will be dispersed in the universe.

Questions

Answer the following questions on a separate sheet.

1. Explain how the universe would be different without the existence of stars.

2. Create a visual model for how stars produce helium and other elements.

Want to find out more about how a star is born, lives, and dies? Visit: **go.nasa.gov/3sTKS9A**.