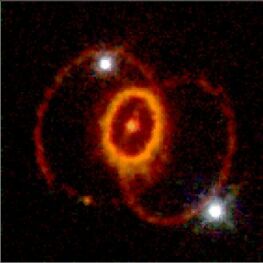
Chem 1 Hour\_\_\_\_\_ Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
Wexle/Steinhorst  
“Stardust”  
Date assigned:

Instructions:   
1. Do a close reading of the article.   
2. Circle unknown vocabulary and define them in any available space on this paper, or attach a separate sheet.   
3. Examine the questions at the end of the article. Find the answer to each question in the article and mark the location of each answer with the question number. Then write the answer in the space provided.

The supernova of 1987  
Such explosions are the origin of the heavier elements, such as iron, nickel, and cobalt.

Stardust  
A wide array of elements make up planet Earth and every living thing on it. What is science’s view of the cosmic origin of these elements that we take for granted in our environment and in our lives?

The “big bang” theory is the generally accepted theory for the origin of the universe. This theory holds that an unimaginably dense, grapefruit-sized sphere of matter exploded about 15 billion years ago, spewing the products of that explosion as a rapidly expanding cloud with a temperature in the range of 1030 Kelvin. Within 1 second, the universe was populated with the particles we explore: protons, electrons, and neutrons. Within a few more seconds, the universe had cooled by millions and millions of degrees, and protons and neutrons began to combine to form helium nuclei. After only about 8 minutes, scientists believe, the universe was about one-quarter helium and about three-quarters hydrogen. In fact, this is very close to the composition of the universe today, 15 billion years later. But humans, animals, and plants are built mainly from carbon, oxygen, nitrogen, sulfur, phosphorus, iron, and zinc – heavier elements that have only a trace abundance in the universe as a whole. Where do these heavier elements come from?

The cloud of hydrogen and helium cooled over a period of thousands of years and condensed into stars like out sun. There hydrogen atoms fuse into more helium atoms and energy streams outward. Every second on the sun, 700 million tons of hydrogen is converted to 695 million tons of helium, and 3.9 x 1026 joules of energy is evolved.

Gradually, over millions of years, a hydrogen-burning star becomes more and more dense and hotter and hotter. The helium atoms initially formed in the star begin to fuse into heavier atoms – first carbon, then oxygen, and then neon, magnesium, silicon, phosphorus, and argon. The star becomes even hotter and more dense. Hydrogen is forced to the outer reaches of the star, and the star becomes a red giant. Under certain circumstances, the star will explode, and earth-bound observers see it as a supernova. A supernova can be as much as 108 times brighter than the original star. A single supernova is comparable in brightness to the whole of the galaxy in which it is formed (with its 100 billion stars).

The supernova that appeared in 1987 gave astronomers an opportunity to study what happens in these element factories. It is here that the heavier atoms such as iron form. The elements spewing out of an exploding supernova move through space and gradually condense into planets, of which ours is just one.

**Questions:**

1. What two elements were formed within seconds after the Big Bang?

2. Which is the most common element in the universe?

3. What is the name of the process (look for the verb and change it into a noun) that causes hydrogen to form helium, and also causes helium to form heavier elements?

Diagram (and label the parts of your diagram) the process of hydrogen forming helium:

4. Where does the formation of lighter elements occur (such as carbon and argon)?

5. During what kind of cosmic event are the heavier elements formed (such as iron)?