Stars

By Cindy Grigg

[1] What is a star? A star is a giant ball of gases held together by gravity. It makes heat and light. Different stars produce different amounts of energy. The amount of energy given off determines the star's surface temperature and color. Red stars are cooler, yellow stars like our sun are a little hotter, and blue stars are the hottest.

[2] Stars are formed in nebulae. A nebula (plural nebulae) is a large cloud of dust and gas in space. The word nebula comes from the Latin word for cloud. Most of the gas in a nebula is hydrogen gas. Over billions of years, the cloud contracts and gets denser and denser as well as warmer and warmer. As more and more gas is pulled into the cloud, it begins to spin. As the cloud spins, atoms of hydrogen gas bump into one another. The faster the gas spins, the more the atoms bump together, and the temperature of the spinning cloud gets hotter.

[3] When the temperature reaches ten million degrees Celsius, a chemical change called nuclear fusion begins to take place. In this change, two atoms of hydrogen gas combine, or fuse together, to form an atom of helium gas. This chemical change gives off a large amount of energy in the form of heat. This is a process like the opposite of an atomic bomb. Just as splitting atoms (nuclear fission) gives off a huge amount of energy, the fusion that takes place in a star also releases huge amounts of energy. The result is the formation of a new star. The new star gives off heat and light from the nuclear fusion of hydrogen atoms. New stars are constantly forming in space.

[4] The star expands and "burns" brightly for a few billion years. Even though we use the word "burn" with stars, they are not actually on fire. The heat and light are released by the chemical process of atoms joining together. This middle stage in the life cycle of a star is called the main sequence. As the hydrogen is used up, the star begins to fuse helium and heavier elements. This uses more of its energy. The star begins to cool off, expand, and becomes a red giant. Red giants give off lots of light but not much energy. Smaller stars become white dwarfs as they get older, and large stars explode as supernovae which burn brightly and quickly. The material that explodes from a supernova becomes the gases and dust that creates new stars.

[5] If the helium core survives the explosion and is massive enough, it may become a black hole. A black hole is a massive star that has collapsed onto itself. It is very dense. Its gravity is so strong, not even light can escape. It is invisible. Scientists have evidence that a black hole is the center of the Milky Way Galaxy. Its mass has been estimated at over three million times the mass of our sun!

[6] Our sun, which is about 4.6 billion years old, is a middle-aged star. It is about half-way through its life cycle. Our sun is also a medium-sized star. As it ages, the hydrogen will be used up and more helium will be formed. The helium core will cool and shrink. Its outer shell will glow more brightly than before, but will give off less radiant energy. It will grow bigger and bigger, becoming a red giant that will expand to the orbit of Mars. As it ages even more, the red giant will cool and contract until it becomes a white dwarf. All this will happen in another 4-5 billion years!

[7] Star ages are related to their starting masses. In general, stars with the smallest starting mass last for the longest time, up to about 100 billion years. Stars like our sun that start with an average mass will last about 10 billion years. Stars with the largest masses may last only a few billion years.

[8] Stars come in a variety of sizes and colors. A few stars are dwarf stars that are smaller than Earth. Other stars are supergiants that are hundreds of times larger than our sun. Our sun is a medium-sized star with a diameter of about 1,400,000 km. or 865,000 miles. It would take over one hundred Earths to equal the size of the sun. One of the smallest stars known is Van Maanen's Star. This dwarf star is about 9,800 km. or 6,100 miles wide. It is about the same size as the planet Mars. Antares is a supergiant star with a diameter about 330 times bigger than our sun!

[9] From our viewpoint here on Earth, some stars appear brighter than others. Stars are not all the same distance from us. Some are closer, and some are farther away. The closer a star is to Earth, the brighter it will appear. Larger stars appear brighter than smaller stars.

[10] If you have ever looked at a fire, you know that parts of it are different colors. Different colors are made by different degrees of temperature. Stars burning at different temperatures also look different colors. The coolest stars are red. They are also called M-type stars. Our sun is a G-type star with a surface temperature from 5,000 to 6,000 degrees Kelvin. The hottest stars are blue, also known as O-type stars. They have surface temperatures between 30,000 and 60,000 degrees Kelvin, or 53,500 degrees to 107,500 degrees Fahrenheit!

[11] The star nearest to Earth is our sun. It is the center of our solar system. Its gravity causes the planets to orbit around it and holds them in place. The sun rotates on its axis just like the planets do. It takes about 25 days to rotate. About two-thirds of the sun is hydrogen and one-third helium. Energy is produced in the sun's core as the hydrogen is fused into helium because of heat and pressure. Energy rises to the surface of the sun and cools as it rises. From the surface, the energy is radiated into space as heat and light. Without it, we could not survive.

Name _____ Science Pd _____

Stars

1. A star _____.
   - (A) Gives off heat and light
   - (B) Can be red, yellow, or blue
   - (C) Is the sun
   - (D) All of the above

2. Stars are made _____.
   - (A) By red giants
   - (B) By splitting atoms
   - (C) From a cloud of gases and dust called a nebula

3. The light and heat from a star are made by _____.
   - (A) A chemical process called nuclear fusion
   - (B) A chemical process called nuclear fission
   - (C) Burning wood

4. All stars were formed billions of years ago.
   - (A) False
   - (B) True

5. Stars begin as a nebula. The middle stage of their life cycle is _____.
   - (A) Black hole
   - (B) Main sequence
   - (C) White dwarf
   - (D) Red giant

6. As stars age, the next stage of their life cycle is _____.
   - (A) Main sequence
   - (B) Red giant
   - (C) White dwarf
   - (D) Black hole

7. When small stars get old, they become a _____.
   - (A) Black hole
   - (B) Main sequence
   - (C) White dwarf
   - (D) Red giant

8. When large stars get old, they _____.
   - (A) Are in main sequence
   - (B) Explode into a supernova
   - (C) Become a white dwarf

9. Scientists believe that a _____ is at the center of the Milky Way Galaxy.
   - (A) Main sequence
   - (B) White dwarf
   - (C) Black hole
   - (D) Red giant

10. Our sun will end its life as a _____.
    - (A) Black hole
    - (B) Main sequence
    - (C) White dwarf
    - (D) Red giant