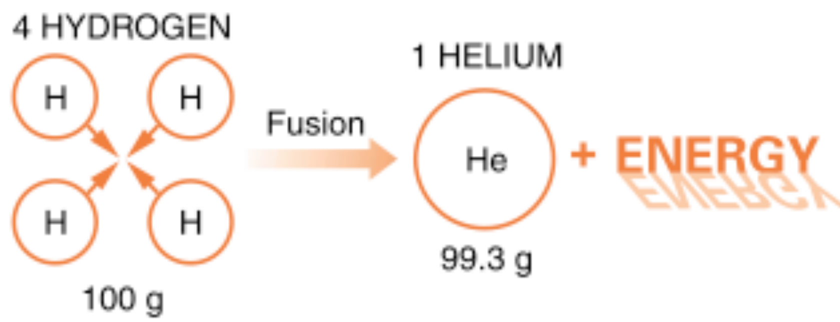
1. Star: A ______________________________ object made of gas found in outer space that radiates ________________________ _______________________.

2. Stars produce extremely great quantities of energy through the process of ______________ _____________. The chemical formula for nuclear fusion looks like this:



3. All stars have recognizable life cycles. The most important characteristic that will determine the type of life cycle a star will undergo is to look at a star's ______________________.

Star Formation:

The process by which light elements join to make heavier elements is called **nuclear fusion**. The sun generates most of its energy by fusing hydrogen to make helium deep within the sun. The loss of about 1 percent in mass during this process creates vast quantities of energy. However, nuclear fusion can occur only under extreme conditions of heat and pressure. For example, Jupiter, the largest planet in our solar system, is too small to have enough internal pressure to support fusion.

How does the Sun get energy?

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Introduction To Stars & Nuclear Fusion:

A **star** is a massive object in space that creates energy and radiates it as electromagnetic radiation through a process called **radiation** (radiation is the process of how energetic waves travel through matter). The sun is a star. If you compare the sun with the thousands of stars known to astronomers, the sun appears to be a typical star. Actually, most of the stars visible in the night sky are larger and brighter than the sun. At the same distances as the visible stars, there are more stars too dim to be visible from Earth.

How does the Sun's energy reach Earth (through what process)?

Most of the mass of the sun is hydrogen, the lightest element. When four hydrogen nuclei join to make a helium nucleus, they lose about 1 percent of their mass. The process by which light elements join to make heavier elements is called **nuclear fusion**. While 1 percent may seem like a small loss of mass, it is enough to create a great amount of energy. However, nuclear fusion can occur only under extreme conditions of heat and pressure.

Below, state the chemical formula for nuclear fusion: (Hint: You can find it earlier in this packet)

Once the energy is created deep in the sun, it moves to the sun's visible surface by **radiation** and **convection**. Convection is the same process that carries heat within Earth's interior to the surface. From the solar surface, the energy escapes as **electromagnetic energy/radiation**. The surface temperature of the star determines the kind of electromagnetic energy it radiates into space. The sun is a yellow star because its roughly 6000°C surface radiates most intensely as yellow light in the visible part of the spectrum.

Why is the Sun a yellow star?

Introduction To Star Formation:

Star formation begins when a cloud of gas and dust (mostly hydrogen) begins to draw together under the influence of gravity. There are two sources of this material. Some of it is hydrogen and helium left over from the formation of the universe about 14 billion years ago. The rest is the debris from the explosions of massive stars that formed earlier in the history of the universe. This initial phase takes place over a period on the order of 50 million years. (The process is faster for larger stars and slower for smaller stars.)

What force causes gas and dust to clump together?

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As the material draws together, heat from the collapse of the matter and from friction causes the temperature to increase until there is enough heat and pressure to support nuclear fusion. At this time, the star becomes easily visible since it produces and radiates great quantities of energy (heat & light). The star becomes less luminous after it fully condenses, and it spends most of its life as a **main sequence star**. [The Sun is currently in this stage] Gravitational pressure balanced by heat from nuclear fusion prevents the star from further shrinkage. This is the longest and most stable phase of stellar evolution.

What two forces are acting on a star during its main sequence phase?

___

After about 10 billion years, a star the size of the sun runs low on hydrogen. Fusion slows, and the core of helium collapses, causing the outer part of the star to expand quickly, becoming a **red giant**. Fusion of helium and other heavier elements replaces the hydrogen fusion process. The outer shell of gases expands and cools in the red giant stage, leaving behind a dense, hot core, which is a **white dwarf star**.

What are the next two stages of our Sun after its main sequence phase is over?

___

Stars with more than about 10 times the mass of the sun end their period in the main sequence more violently. These stars create a variety of heavier elements before they collapse. The collapse process of larger stars generates so much energy that these stars end their life in an explosion known as a **supernova**. They briefly generate more energy than the billions of stars that make up the whole galaxy. Most of the mass of the star is blown into space.

What is a supernova?

___

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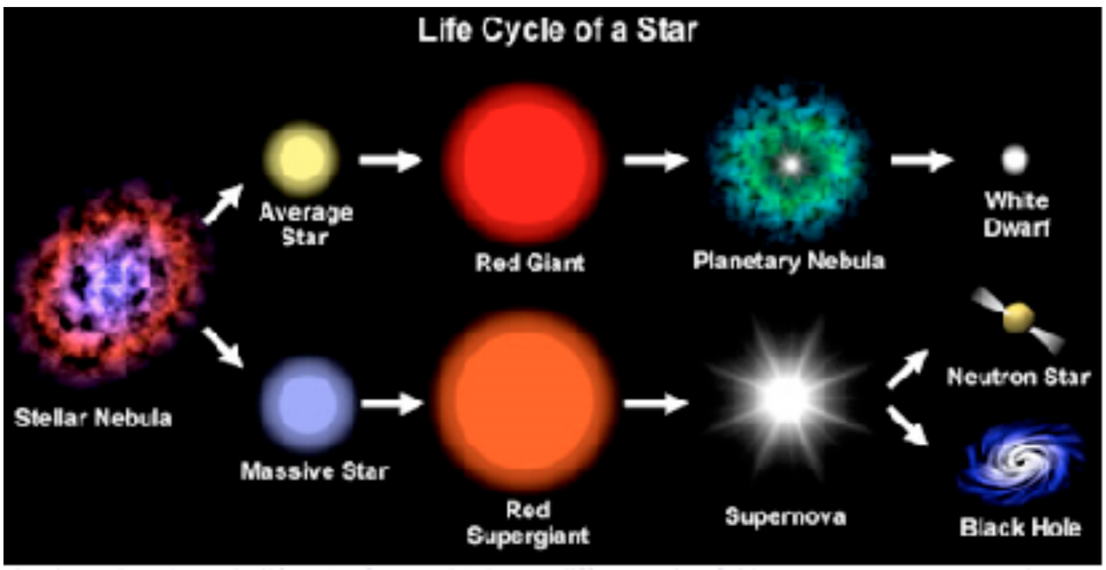
After a supernova, the core of the star may form an extremely dense object called a **neutron star**. Some stars are so massive that they form an object with gravity so strong that not even light can escape. This is called a **black hole**. Black holes cannot radiate energy, but they can be detected because energy is given off by matter that falls into the black hole. They can also be located by their gravitational effects on other objects.

Briefly describe what a neutron star and black hole are below:



Practice:

1.)

Which process combines lighter elements into heavier elements and produces energy within the Sun and other stars?

A) fusion B) insolation
C) conduction D) radioactive decay

2.)

Which object forms by the contraction of a large sphere of gases causing the nuclear fusion of lighter elements into heavier elements?

A) comet B) planet C) star D) moon

3.)

The probable fate of our sun is

A) to expand as a red giant, undergo a nova outburst and end as a white dwarf
B) to shrink to a white dwarf then eventually expand to a red giant
C) become hotter and expand into a blue supergiant
D) to become a black hole

4.)

What factor from the choices below determines whether a star will evolve into a white dwarf, a neutron star, or a black hole?

A) mass
B) percentage of helium
C) percentage of carbon
D) apparent brightness

5.)

According to our present theories of stellar evolution, our sun will change next into

A) a white dwarf
B) a black hole
C) a supernova
D) a red giant

6.)

What are the two most abundant elements in a main sequence star?

A) carbon and hydrogen
B) hydrogen and helium
C) helium and carbon
D) carbon and heavy metals

7.)

Which stars are the youngest?

A) Supergiant
B) White dwarf
C) Blue star
D) Red Dwarfs

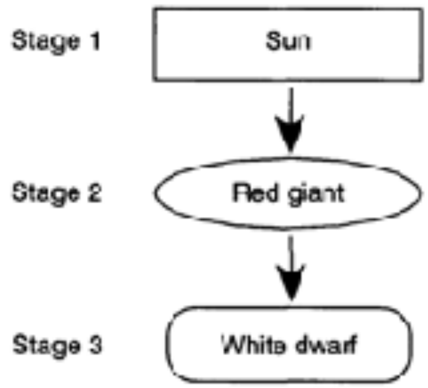
8.)

The explosion of a massive star near the end of its life is known as a

A) nova
B) pulsar
C) supernova
D) nebula

9.)

Stars are believed to undergo evolutionary changes over millions of years. The flowchart below shows stages of predicted changes in the Sun.



According to this flowchart, the Sun will become

A) hotter and brighter in stage 2, then cooler and dimmer in stage 3

B) cooler and dimmer in stage 2, then hotter and brighter in stage 3

C) hotter and dimmer in stage 2, then cooler and brighter in stage 3

D) cooler and brighter in stage 2, then hotter and dimmer in stage 3