ESS 100 (Stapleton) Name: Key

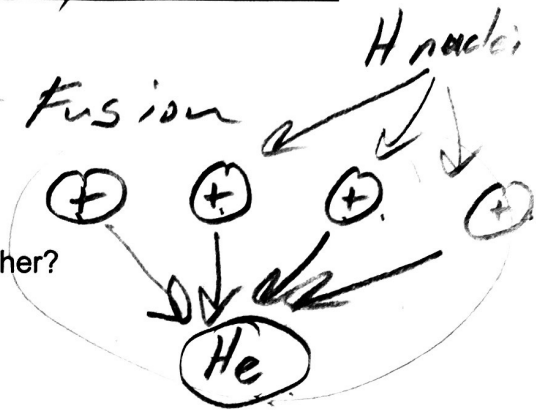
Notes: Life Cycle of our Sun(and other medium sized stars)

1. What process gives our Sun its energy? Nuclear fusion

2. What is the Sun's main fuel? Hydrogen

3. What is produced inside the Sun when this fuel is fused together?

Helium



4. What are the stages of our Sun's life (in order)?

Nebula, Protosun, Main Sequence Star, Redgiant, White Dwarf, Black Dwarf

5. What is a "main sequence" star?

A star that is fusing hydrogen in its core (Our Sun is one)

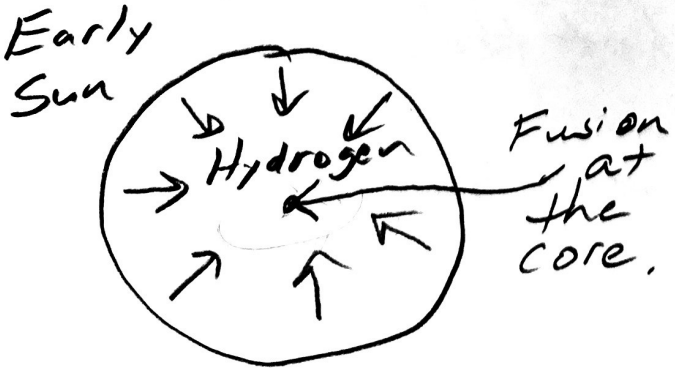
6. What color is our Sun, and what does that tell us about our Sun's temperature and mass? Explain your reasoning.

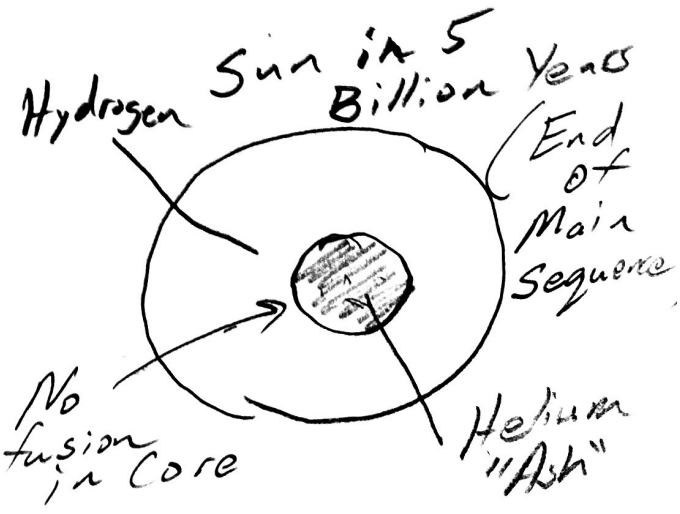
White → Temperature is medium → Pressure is medium → Mass is medium

7. Right now, our Sun is a main sequence star. What will happen to end this stage of our Sun's life?

the core runs out of hydrogen to fuse, Fusion stops in the core.

8. Draw a cross-section diagrams of our Sun at the beginning and the end of main sequence stage of life. Label the materials in the Sun, and explain why they are there..





What will hapen when our Sun leaves the *main sequence* is complicated! Let's go over the details...

9. Remember that, as fusion happens in the Sun's core, 4 hydrogen atoms fuse together to make 1 helium atom. So as the hydrogen in the Sun's core fuses to become helium, there will be _____ (more or fewer) particles in the core. This means the helium in the core will take up _____ (less or more) space than the hydrogen did.
This _____ (shrinking or growing) of the material in the core will cause the star's core to _____ (compress or expand),
and that will cause the core to _____ (cool down or heat up).

This event, just after core hydrogen fusion shuts off, is called Core contraction.

10. Core contraction heats up a shell of hydrogen around the star's core so much that:
the shell of hydrogen starts to fuse

Compared to the heat of core hydrogen fusion, this shell fusion is even hotter.

11. The intense fusion happening in the shell around the Sun's core will heat up the outer layers of the sun, causing them to _____ (compress together or expand outward). This expansion will cause the temperature of those outer layers to _____ (increase or decrease). The color of the Sun will change to red (a cooler color), and it will be known as a red giant.

12. While the outside of a red giant is red, if you could see the part of the star closer to the core, it would be white, blue, or even ultraviolet.

Let's Summarize the Red Giant Phase So Far...

13. After it leaves its "main sequence" phase, our Sun will become a Red Giant. In this stage, what will happen to Our Sun's size? Explain why.
It Becomes huge. The hydrogen shell burning is so hot that it makes the sun expand, pushing the outer layers even further out.

14. When our Sun becomes a red giant, what will happen to its surface temperature? Why?
Surface cools, because as a gas expands it cools off.

15. When our Sun becomes a red giant why will it turn red?

Red is a cooler color -- It is cooling off.

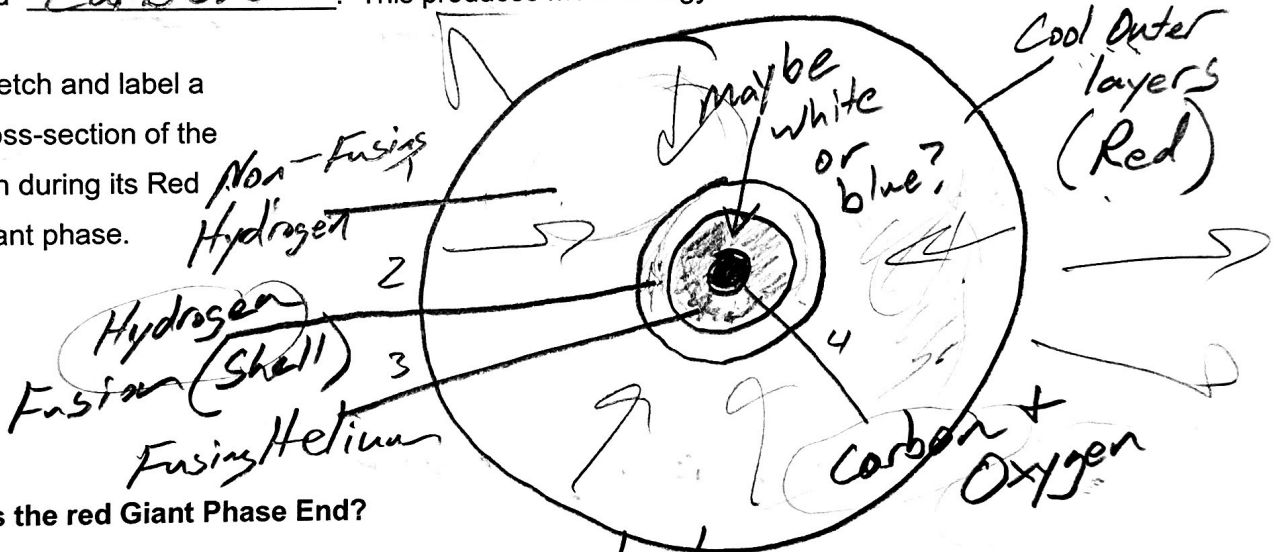
16. What is the main source of the Sun's energy during the Red Giant stage?

Hydrogen fusion in a shell around the core.

What else happens in the Red Giant Phase?

17. As fusion continues to happen, the Sun's core continues to _____ (shrink or expand), so its temperature continues to _____ (cool or heat up). Eventually it becomes hot enough for the helium in the core to fuse into Oxygen and carbon. This produces more energy.

18. Sketch and label a cross-section of the sun during its Red Giant phase.



How does the red Giant Phase End?

19. As fusion continues, particles of light, called photons travel away from the star. These are the light we see. But photons also have momentum, so they can push things. The starlight created by fusion creates a Wind of photons that slowly push away the star's outer layers. When these outer layers are gone, there is _____ (more or less) pressure pushing on the core, so fusion stops. When this happens, what is left of the star _____ (cools down or heats up). This temperature change causes the star to _____ (compress or expand), which causes the temperature to increase. Since the star got its color from its outer layers, it will no longer be red. It will be white, because the remaining inner layers are hot.

Our Sun's Final Stage Summary:

20. As our Sun enters its final stage of life, what will happen to its color and temperature? Explain why. It will turn white because light blows away the outer red layers, revealing the core, which is white hot on the outside.

21. What is the source of the Sun's energy at this stage? No fusion. No new energy. Just leftover heat.

22. What type of star will the Sun be at this point?

White Dwarf

23. There are actually a few more stages in our Sun's life. Our Sun will eventually turn into a red dwarf, then a ~~brown dwarf~~ black dwarf, and finally a ~~dead red dwarf~~. This will happen because... ~~Heat dies~~

A "brown dwarf" is a different thing entirely!

24. Our Sun is about 4.6 Billion Years old, and it will turn into a red giant in about 5 billion Years from today.