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ESS 100 Name: Key

Midterm Review, Part 3:
Life Cycles of Stars, our Solar System, and The Earth

Earth History

1. Scientists think that the early Earth was completely molten. As soon as the Earth melted, layers began to form. Why did the Earth's materials separate into different layers?

They had different densities. Densest stuff sank to center.

2. Scientists have found evidence that the building blocks of life came from outer space. This evidence is amino acids. Where were these amino acids found? meteorites

3. According to the "Birth of The Earth" video, what caused the Earth to heat up to the point that it melted completely?

radioactive rocks

4. After the Earth melted, what caused the outside of the Earth to form a solid crust?

The coolness of space

5. Scientists used rock samples to find the actual age of the earth. Where did they get those samples?

Meteorites

6. Scientists think that much of the Earth's water was brought to Earth by meteorites

7. Before about 3.5 billion years ago, there was no oxygen on the Earth. Scientists think the Earth's oxygen was first produced by cyanobacteria (a.k.a. Blue-Green Algae)

Solar System Formation, Part 1

8. In the earliest stage of our Solar System's formation, what was it called?

Nebula

9. Describe our solar system during its earliest stage. Describe its...

a. Size Huge

b. Temperature Cold

c. Motion Slowly-turning

d. Shape Amorphous (no shape)

10. What types of materials were in the Solar system at that time? Be specific.

Dust (rock and metal)

Ice (mostly frozen Hydrogen and Helium)

11. Describe how the solar system first began to change.

a. What happened to its size?

It shrank

b. Why?

Gravity pulled it together

12. a. What happened to its temperature?

Heated up

b. Why?

Gravity compressed it

13. a. What happened to its motion?

It spun faster

b. Why did the motion change in this way?

Gravity pulled it together (like a figure skater pulling in arms)

14. a. What shape did the solar system become?

Disk

Solar System Formation, Part 2

15. a. What formed at the center of the nebula, before the Sun was "born?"

Protosun

b. Why did it form at the center? Why not at the edge?

That was the hottest part (because it had the most pressure)

16. In one part of the nebula, dust and ice remained. In another part of the nebula, only dust remained.

a. What is the name of the boundary between these two areas?

The Frost Line

b. Where in the nebula did both dust and ice remain?

Outside the Frost Line

17. The Sun was born when a process called nuclear fusion began.

18. Once the planets reached a sized that was about ½ mile across, the force of gravity was strong enough to pull other matter toward the forming planet. Before the planets reached this size, static electricity provided the force that caused them to clump together.

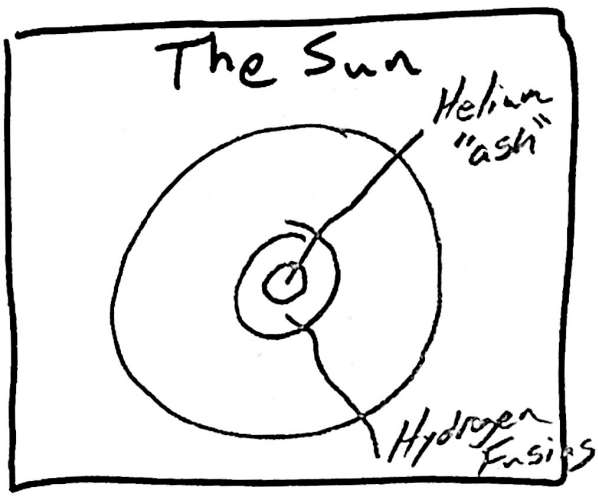
19. Why are the outer planets covered by large gas layers (probably surrounding rocky cores), while the inner planets are just rocky?
Outer planets formed beyond the Frost Line (where they could collect the "frozen gases" → Hydrogen + helium)

20. Today, the planets in our solar system are held in stable orbits. Gravity prevents the planets from flying away from the Sun, and momentum keeps them from falling into the Sun.

Medium Star Life Cycles

21. Draw a diagram of the Sun as it exists right now. In your diagram, show the fuel that is fusing and also show the substance that gets created during fusion. Draw the fuel and this new substance in the correct locations.

a. Label (name) the fuel that is being used to produce the Sun's energy.
b. Label (name) the substance that the fuel turns into when it fuses.



22. Number these star life stages in order, from earliest to latest

6 White Dwarf
3 Main Sequence
5 Planetary Nebula
2 Protostar
7 Black Dwarf
1 Nebula
4 Red Giant

23. a. Describe the relationship between a stars' masses and their temperatures. Are massive stars hotter or cooler than less massive stars?

More massive stars are hotter

b. Explain why.

More mass gives them stronger gravity and, therefore, more compression

24. Order these star colors according to temperature and mass. At one end, write "most massive." At one end, write "hottest."

Yellow, Red, Blue, Orange, White → Blue, White, Yellow, Orange, Red

Main Sequence

Hottest + Most mass

Coolest + least mass

25. When our Sun becomes a red giant why will it get bigger?

The core will heat up, causing it to expand outward.

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

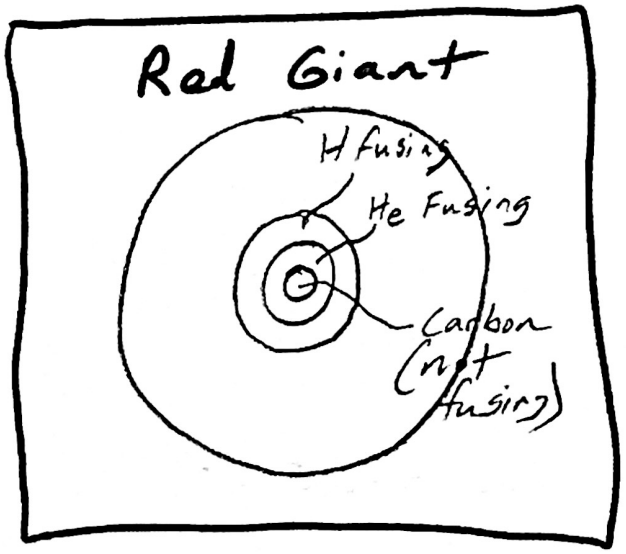
The outer layers will cool off, due to their expansion (they get pushed out without gaining all of the heat from the core)

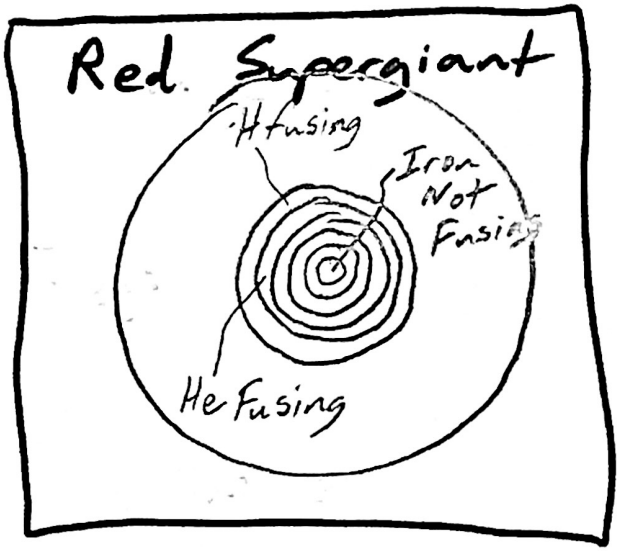
Life Cycles of Very Massive Stars

27. Order the stages in a Massive Star's life cycle, and number them to indicate their order. Some of the descriptions below do not apply.

6 NeutronStar/Black Hole/ Recycling
2 Protostar
1 Nebula
3 Main Sequence Star
5 Supernova
4 Red Supergiant

28. Draw two cross-section diagrams showing the layers of a red giant and a red supergiant. Label the material in the innermost layer and the two outermost layers in which fusion is happening. The number of layers in your red supergiant does not have to be exactly correct.





29. a. After a supernova occurs, what are the two options for the matter that is left behind?

Black hole (if over 3 solar masses are left)

b. What happens to the matter that "leaves?" Neutron Star (If less is left)

It blows out into space and gets recycled in new solar systems like ours.

Waves and The Big Bang

30. List all of the colors of light, in order of wavelength.

Longest Wavelength → R O Y G B I V ← Shortest Wavelength

Red Orange Yellow Green Blue Indigo Violet

31. Does your list go from shortest to longest wavelength or from longest to shortest?

32. Draw an object moving to the left and giving off light waves. Make sure that you draw the waves that are in front of the object and behind it.

33. If an object has a red-shift, what does that tell us about the object?

It's moving away from us.

34. Define "Doppler Effect":

The apparent change in wavelength that we see or hear when something moves towards us or away.

35. What created all of the elements that we have in the Universe today?

a. The heaviest elements: Atoms of Gold, lead, mercury, and Uranium are all **heavier than iron.** None of these substances were created by the Big Bang. What created them?

Supernovae

b. The lightest element: Stars are made mostly of hydrogen. Where did the hydrogen come from? When was it created?

The Big Bang

c. Medium Elements: What created the elements that are **heavier than hydrogen and helium, but lighter than iron?**

Nuclear Fusion inside stars

36. Very briefly describe how the size and temperature of the Universe has changed over time.

It's getting bigger and colder.

37. Briefly list three pieces of evidence supporting the Big Bang Theory

1) CMBR -- Heat that we can see, left over from the Big Bang

2) All distant galaxies have redshifts -- so they're moving away, and space is expanding.

3) The Big Bang Theory predicted the abundance of H (75%) and He (25%) in the Universe.

38. Explain how the CMBR is evidence for the Big Bang theory?

It's heat

39. Explain how Edwin Hubble provided evidence for the Big Bang theory.

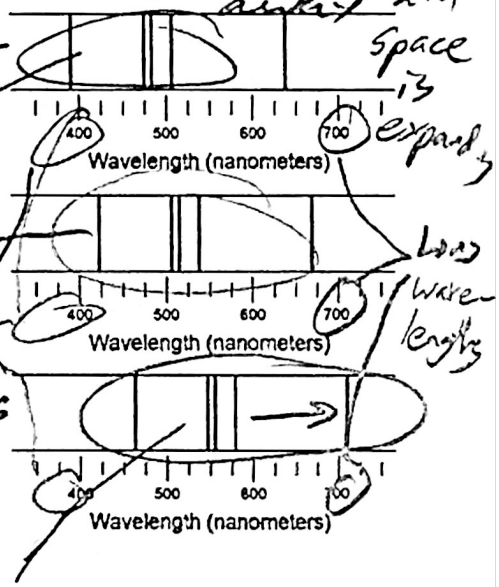
He showed that all galaxies have redshifts, so they're moving away and space is expanding

40. Explain how to correctly answer a question like this one...

The diagram on the right shows the spectral lines given off by one element. One set of lines was observed by heating up the element here on Earth. Another set of lines was observed coming from star that is moving toward us. The other set of spectral lines was observed coming from a star that is moving away from us.

Label each of the sets of spectral lines with one of these labels:

- "Observed on Earth"
- Moving toward Earth
- Moving away from Earth



These are not "redshifted" or "Blue shifted"

Short wavelengths

Long wavelengths

The lines that shift toward shorter wavelengths are moving toward us. (blue shift)

Lines that are shifted toward longer wavelengths are moving away (red-shift)

23. How old is the Universe?

Appx. 13.7 Billion Years