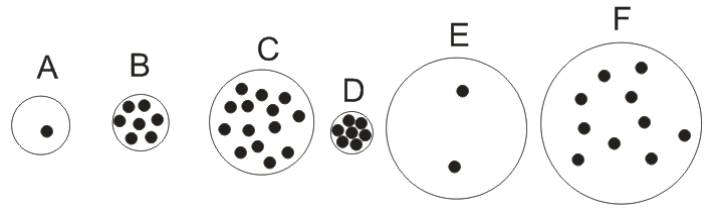


- Which of the lettered objects has the **least** mass?
A B C D E F
- Which of the lettered objects has the **least** volume?
A B C D E F
- Which of the lettered objects has the **least** density?
A B C D E F
- Which of the lettered objects has the **least** weight?
A B C D E F



A film canister stays the same size. Water leaves the film canister, and nothing else enters. During this process, what happens to the canister's...

- | | | | |
|-------------|--------------|--------------|-------------------|
| 5. Mass? | a. increases | b. decreases | c. stays the same |
| 6. Volume? | a. increases | b. decreases | c. stays the same |
| 7. Density? | a. increases | b. decreases | c. stays the same |
| 8. Weight? | a. increases | b. decreases | c. stays the same |

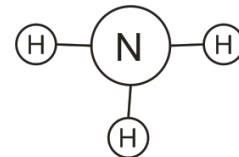
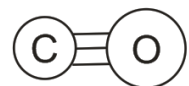
At first an object floats. Over time, the object gets bigger, and it begins to sink. What has happened to its...

- | | | | |
|-------------|--------------|--------------|--------------------|
| 9. Density? | a. increased | b. decreased | c. stayed the same |
| 10. Mass? | a. increased | b. decreased | c. stayed the same |

- If an object's density decreases, and its mass stays the same, what has happened to its **volume**?
a. increased b. decreased c. stayed the same
- What must happen in order for something's weight to decrease while its mass stays the same?
a. It must be at the equator. b. It must be nighttime.
c. It must be in water. d. It must move to a location with different gravity.
e. This is not possible.

- What is the most abundant element in the universe?
a. Nitrogen b. Hydrogen c. Oxygen d. Helium e. Carbon
- Average air pressure at sea level is closest to:
a. 0psi b. 5psi c. 10psi d. 15psi e. 20psi

- How many atoms are shown on the right?
0 1 2 3 4 5 6 7 8
- How many elements are shown on the right?
0 1 2 3 4 5 6 7 8
- How many particles are shown on the right?
0 1 2 3 4 5 6 7 8



- Right now we are experiencing typical atmospheric air pressure. What causes this air pressure?
a. the weight of air b. the walls of the classroom c. Sunlight heating the air d. Wind
- A suction cup sticks to glass because:
a. The glass molecules attract the suction cup
b. When the suction cup is pressed, microscopic hooks grab the glass surface
c. A vacuum under the cup pulls the cup toward the glass
d. Air pressure outside the cup pushes the cup toward the glass

20. In water, buoyancy:
- is a force of attraction between objects and the water's surface.
 - is caused by differences in pressure at different depths.
 - changes the weight of floating objects.
 - causes bubbles to become less dense than rocks
21. This process involves a solid and requires energy to be added.
- Condensation
 - Freezing
 - Melting
 - Evaporation
22. This process involves a gas and requires energy to be removed.
- Condensation
 - Freezing
 - Melting
 - Evaporation
23. What combination of conditions would cause the air in the classroom to be most dense?
- High humidity, High Temperature, High air pressure
 - Low humidity, High Temperature, Low air pressure
 - High humidity, Low Temperature, High air Pressure
 - Low humidity, Low Temperature, Low air Pressure
 - Low Humidity, Low Temperature, High air Pressure
24. Moving rapidly to a **higher** elevation causes ear pain. Which of the following correctly explains the source of this pain when you move to a **higher** elevation?
- The ear drum is stretching outward because outside air pressure is decreasing
 - The ear drum is stretching inward because outside air pressure is decreasing
 - The ear drum is stretching outward because outside air pressure is increasing
 - The ear drum is stretching inward because outside air pressure is increasing
-
25. Use words and/or a diagram to show how differences in air pressure to create buoyancy that pushes objects upward. *[Suggestion: draw a bubble and show the pressures acting on the bubble.]*
26. a. What usually happens to a substance's volume when the substance is heated?
- b. Explain how this change in volume is caused by particle motion on a microscopic level.
27. I can create fire by rapidly compressing the air inside a device called a fire piston. *Why* does rapidly compressing the air inside the piston cause that air to heat up? In general, why does compressing something heat it up?

28. The universe is getting colder. Why?
29. Provide four reasons to explain why the Earth's interior is hot.
30. A hot air balloon is flying over Essex, hovering at the same altitude. Suddenly the pilot turns on the flame, heating the air in the balloon and causing the balloon to rise due to a decrease in its density.
- What, if anything, is happening to the balloon's mass as the air inside heats up?
 - Explain why.
 - What, if anything, is happening to the balloon's volume as the air inside heats up?
 - Explain why.
 - Explain why the change(s) in mass and/or volume cause(s) the density of the balloon to decrease.

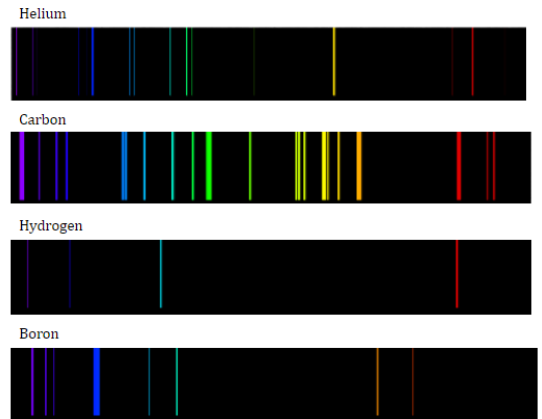
Astronomy:

- X-rays, infrared radiation, microwaves, gamma rays, visible light, and ultraviolet light are all types of...
 - Sound waves
 - Space waves
 - Electromagnetic radiation
 - Cosmic Rays
- Which star color is the hottest?
 - White
 - Orange
 - Red
 - Yellow
 - Blue
- The diagram on the right shows a star's spectrum and the emission lines of different elements. Use these diagrams to identify the element that is present in the star's atmosphere.
 - Helium
 - Carbon
 - Hydrogen
 - Boron
- Which of the following correctly lists, in order, possible stages in the life cycle of a star that is **much larger than our sun (25 times larger)**?
 - Nebula, White Main sequence Star, Red giant, Supernova, Black hole
 - Nebula, Blue Main sequence Star, Red giant, White Dwarf, Black Dwarf
 - Nebula, Red giant, White Dwarf, Black Dwarf
 - Nebula, Blue Main sequence Star, Red giant, Supernova, Neutron star
 - Nebula, Yellow Main sequence Star, Red giant, White Dwarf, Black Hole
- Which of the following elements can only be created during a supernova?
 - Hydrogen
 - Helium and elements up to the weight of iron
 - Elements heavier than iron
- Which of the following elements was (were) produced in the first few seconds after the Big Bang?
 - Hydrogen
 - Helium and elements up to the weight of iron
 - Elements heavier than iron
- Which of the following elements are produced by nuclear fusion in some stars?
 - Hydrogen
 - Helium and elements up to the weight of iron
 - Elements heavier than iron
- A Black hole will always form when...
 - A star is cold enough to collapse
 - Nuclear fusion stops in a star
 - The mass left over after a supernova is greater than 1.4 solar masses.
 - The mass left over after a supernova is greater than 3 solar masses.
- If the gas pressure suddenly decreased inside a star, what sequence of events would follow?
 - Contraction (shrinking), cooling, and decreased gas pressure
 - Contraction (shrinking), heating, and increased gas pressure
 - Contraction (shrinking), cooling, and increased gas pressure
 - Expansion, cooling, and decreased gas pressure
 - Expansion, heating, and increased gas pressure

Star's Spectrum:

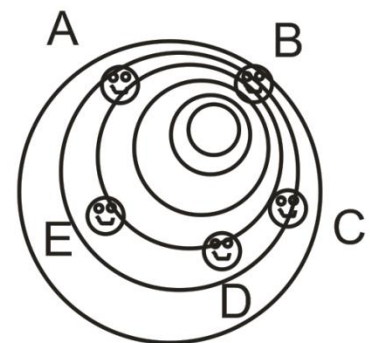
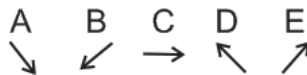


Emission Lines of Various Elements:

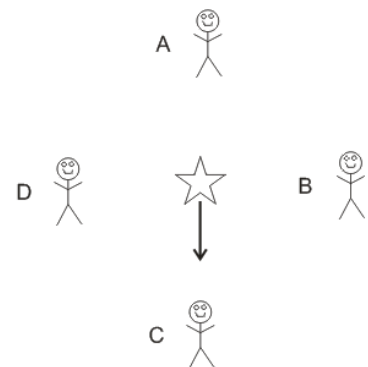


10. If the gas pressure suddenly increased inside a star, what sequence of events would follow?
- Contraction (shrinking), cooling, and decreased gas pressure
 - Contraction (shrinking), heating, and increased gas pressure
 - Contraction (shrinking), cooling, and increased gas pressure
 - Expansion, cooling, and decreased gas pressure
 - Expansion, heating, and increased gas pressure
11. A supernova occurs when...
- Gas pressure in a star increases until the star explodes.
 - A star's outer layers fall inward, hit the core, and then bounce outward.
 - Gravity decreases in a star, allowing a star's layers to fly outward at near the speed of light.
 - Hydrogen fusion increases in a star.
13. When did the first stars and galaxies form?
- seconds after the Big Bang
 - 1 billion years after the Big Bang
 - 4.6 billion years ago
 - 13.8 billion years ago
 - 670 billion years ago
14. What is the age of the universe?
- 670 million years
 - 1 billion years
 - 4.6 billion years
 - 13.8 billion years
 - 670 billion years

15. The sound waves on the right were produced by a moving object. Which arrow shows the object's direction of travel?

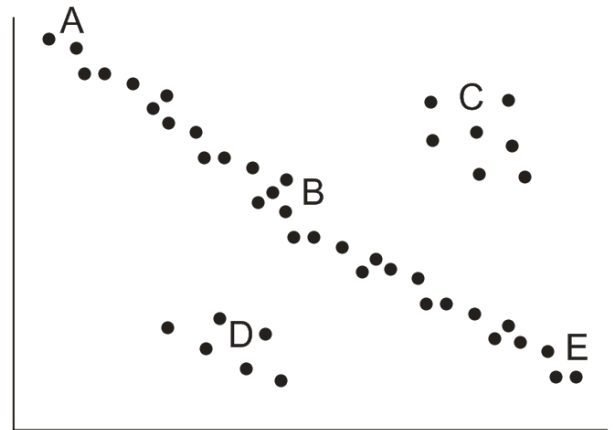


16. Which smiley face hears the lowest pitch sound?
17. The diagram on the right, an arrow shows the direction of the star's movement. The people are not moving. Which person observes a red shift while looking at the star?



#18-24 refer to the Hertzsprung-Russell diagram on the right. The diagram is missing its axis labels.

18. In the diagram, which letter is positioned closest to a star like our present day Sun?
19. Which letter is located near the coolest stars?
20. Which letter is located near the most luminous (brightest) stars?
21. Which letter(s) is(are) located near main sequence stars?
A. Letters A,B, and C B. Letter B only
C. Letters C, B, and D
D. Letters A, B, and E E. Letters C and D
22. Which letter is located near red giants?
23. Which letter is located near white dwarfs?
24. Which letter is located near blue stars?



-
25.
 - a. What is the name of the process that produces most of the sun's energy?
 - b. What type of atoms serve as the fuel for this process?
 - c. What type of atoms does the sun produce during this process?
 - d. As this process occurs in the sun, does the sun's overall mass increase, or does it decrease?
 - e. Explain the reason for your answer to part d.
 26. At this very moment, we are orbiting the sun the sun at a speed of approximately 70,000 miles per hour. Our orbit represents a balance that keeps us from being pulled into the sun (and burned up) and also keeps us from flying away from the sun (and freezing in darkness).
 - a. What is preventing the Earth from being pulled in to the sun?
 - b. What is preventing the Earth from flying away from the sun?
 27. Where did almost all of our planet's coal, oil, and gas deposits come from?

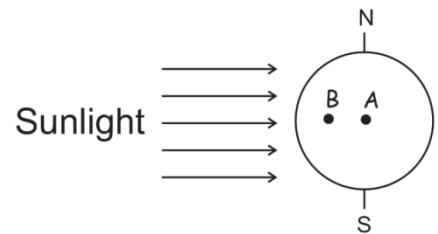
Extended Response Questions

- Five billion years ago, our solar system was a cold, slowly-turning cloud of dust and frozen gases (a nebula). Today our solar system is a star (our sun) surrounded by four rocky inner planets and four gas giant outer planets. Describe and explain each of the steps in the process that has transformed our solar system in the manner described above. For each step in the solar system's formation, identify the change that occurred and the cause of that change.
- Tell the story of our Sun from the present through its final fate. Name each of its stages and explain what causes each transition between stages. For each stage, identify the Sun's primary fuel (if any). [You can leave out the *planetary nebula* stage.]
- Briefly describe the Big Bang Theory and provide two pieces of evidence supporting the theory.

Earth Rotation and Moon Phases:

- The Earth's rotation is best described as a(n) _____ rotation.
 - counter-clockwise
 - clockwise
 - westward
 - Eastward

- If you are looking downward from above the Earth's north pole, in which direction does everything in the solar system appear to rotate and revolve?
 - Counter-Clockwise
 - Clockwise



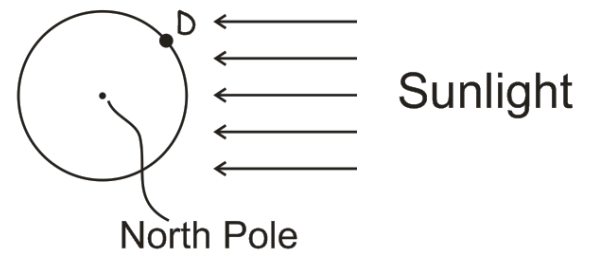
- In the diagram on the right, which letter is experiencing a ***later*** time of day? A B

- In the top diagram on the right, what is the approximate hour at letter A?

12PM	3PM	6PM	9PM
12AM	3AM	6AM	9AM

- In the diagram on the right, what is the approximate hour at letter D?

12PM	3PM	6PM	9PM
12AM	3AM	6AM	9AM



Questions 6-11 refer to the diagram below. Assume for all questions that the two moons are being viewed from the Earth's Northern Hemisphere.

6. Choose the moon that an observer would see if he/she were standing on the Earth in the Northern Hemisphere and looking at moon C.



Sunlight
↓ ↓ ↓ ↓ ↓

7. What is the name of moon phase C?
 Waxing crescent Waning Crescent New Moon
 Waxing gibbous Waning Gibbous Full Moon
 Waxing (1st) quarter Waning (last) quarter

8. What is the name of moon phase A?
 Waxing crescent Waning Crescent New Moon
 Waxing gibbous Waning Gibbous Full Moon
 Waxing (1st) quarter Waning (last) quarter

9. What types of tides are experienced during eclipses?
 a. Spring b. Neap c. Neither d. Can't tell

10. During which waning moon are tides the weakest?
 Waning Crescent Waning Gibbous Waning (last) quarter

11. In most coastal areas on the Earth, each day there is(are) _____ high tide(s) and _____ low tide(s).
 a. 1 and 1 b. 1 and 2 c. 2 and 1 d. 2 and 2

12. In this type of eclipse, daytime on Earth becomes dark as the moon blocks out part or all of the sun.
 a. Solar b. Lunar c. Neap d. Spring

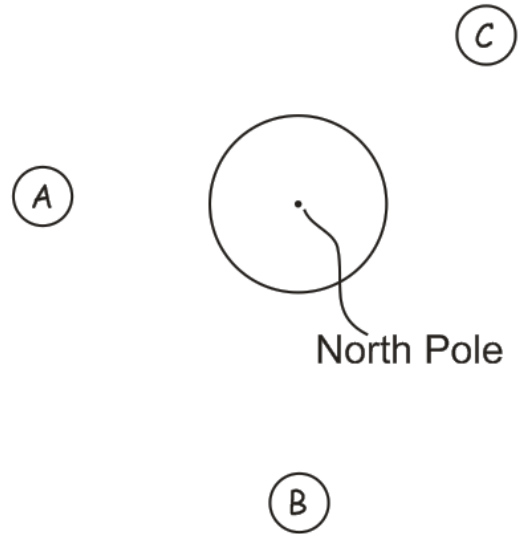


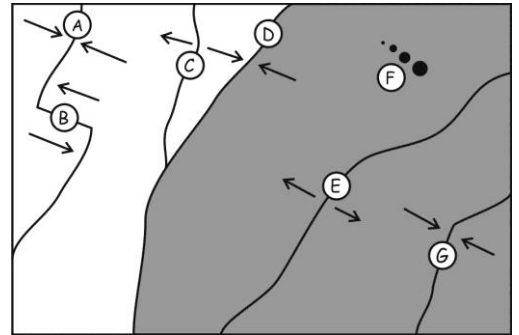
Plate Tectonics

Match each description to the appropriate rock type. Choices: **A= Mafic B = Felsic**

1. A B This is the primary constituent of ocean crust
2. A B An example of this material is a rock type is called granite.
3. A B Similar to the material found in the Earth's mantle
4. A B When piled up, tends to form steep volcanoes
5. A B Higher viscosity when molten
6. A B The most explosive eruptions involve this type of material.
7. A B Relatively dark in color/shade
8. A B Seafloor sediment is primarily composed of this type of material.
9. A B Contains relatively high amounts of iron

Match each feature name to the corresponding feature on the plate map on the right.

10. A B C D E F G Ocean/Ocean Divergent
11. A B C D E F G Ocean/Ocean Convergent
12. A B C D E F G Ocean/Continent Convergent
13. A B C D E F G Continent/Continent Divergent
14. A B C D E F G Continent/Continent Convergent
15. A B C D E F G Transform Boundary
16. A B C D E F G Hotspot



Each of the real-world locations below forms in an area that is similar to one of the lettered locations on the map. Match each real-world location to its corresponding map location.

17. A B C D E F G Andes Mountains (South America)
18. A B C D E F G Himalayas (Mt. Everest).
19. A B C D E F G East Africa
20. A B C D E F G San Andreas Fault, California
21. A B C D E F G Hawaii
22. A B C D E F G Mid-Atlantic Ridge
23. A B C D E F G Japan

Part II: For each lettered feature on the map above, darken all of the descriptions below that apply. [Suggestion: start with letter A. Darken that letter for all of the descriptions that apply to location A on the map. Continue the process one map feature at a time. For each letter, sketch a cross-section diagram.]

24. A B C D E F G Some mafic magma may reach the surface.
25. A B C D E F G Some felsic magma may reach the surface.
26. A B C D E F G Steep, *composite cone* volcanoes
27. A B C D E F G Rounded, *shield* volcanoes
28. A B C D E F G *Relatively* violent eruptions *can* occur.
29. A B C D E F G *Relatively* gentle eruptions *can* occur.
30. A B C D E F G Shallow-focus earthquakes
31. A B C D E F G Deep-focus earthquakes
32. A B C D E F G New ocean crust is being created here.
33. A B C D E F G A line of volcanoes of diminishing size
34. A B C D E F G There is an ocean trench nearby.
35. A B C D E F G Situated over a **relatively hot** part of the mantle
36. A B C D E F G There are tall mountains, but no volcanoes.

Final Question: Water Cycle Extended Response

At the equator, air at the surface of the ocean is warm. This warm air rises and produces rain. Explain why the air rises and why it produces rain. Make sure that you mention all of the relevant changes in temperature, density, pressure, and states of matter. Explain why each of those changes occurs.