Name _____ Period _____ Mrs. Coates—Earth Science

History of the Universe Unit Tracking Sheet

Learning Target	Question Example	Date Target was Taught in Class
The Big Bang Theory explains how the universe formed	*How did the Big Bang start?*	
The Doppler Effect is evidence of an expanding universe	*When a galaxy is traveling away from the Earth what is happening to the light waves?*	
The Big Bang created the first two elements—Hydrogen and Helium	*Over 99% of the atoms in our Universe are…*	
The Big Bang left behind an echo of energy	*How does Cosmic Microwave Background Radiation support the Big Bang theory?*	
Fusion inside stars created the elements on the Periodic Table	*Where did all of the iron, oxygen, gold, and other elements on Earth come from?*	

My Progress

	Pre-Test		The Big Bang Theory		Doppler Effect		H and He		Background Radiation		Stellar Fusion		Post Test	
4 (90-100%) 😀														
3 (80-89%) 😐														
2 (70-79%) 😟														
1 (0-69%) 😢														

AH–HA!

Why do scientists accept the Big Bang Theory?

Science Starter Sheet

Date	Question	Answer

Science Starter Sheet

Date	Question	Answer

History of the Universe—Timeline Activity

Part 1—Put these Universe events in the order that you believe they occurred (from the first event to the last event)

_____ The first flowers appeared on Earth

_____ The first stars in the Universe were formed

_____ The formation of our Moon

_____ The Big Bang

_____ The formation of Earth's oceans

_____ The first humans appeared on Earth

_____ The first atoms were formed

_____ The first galaxies were formed

_____ The first dinosaurs appeared on Earth

_____ The formation of our Sun

_____ The first bacteria appeared on Earth

_____ The first protons and neutrons were formed

_____ The formation of our Earth

Part 2—Now that you know the correct order of Universe events, estimate how long ago each event happened. (HINT: Scientists believe the Universe is nearly 14 billion years old).

Estimate			
Event	**How Many Years Ago?**	**Event**	**How Many Years Ago?**

Part 3—Use the Register Tape provided by your teacher to map out the event dates that you predicted in part 2. Mark one end of the tape "14 billion years ago" and the other end "Present Day." Every 3 inches is equal to 1 billion years.

14 Present Day

Part 4—After seeing the correct answers to Part 3, explain how close your answers were to the correct answers (which events did you most closely map):

Part 5—Write down the correct time line of events below:

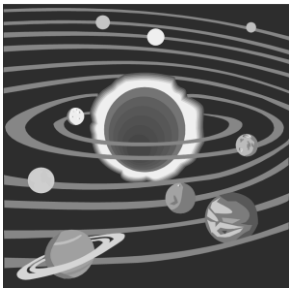
Correct Answers			
Event	**How Long Ago?**	**Event**	**How Long Ago?**

Analysis:

1. Why do you believe it is difficult for some people to understand how old the Universe is?

2. Name two new things that you learned today:

Birth of the Universe – Video Notes



1. What is everything made out of?

2. Where does all matter come from?

3. What size was the universe at the very beginning?

4. Name the American astronomer who first came up with the idea that the universe was once tiny?

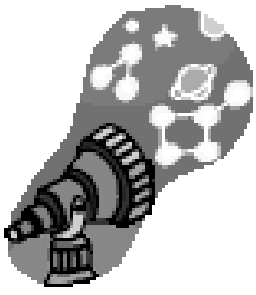
5. Describe what was happening to the baby universe in the first seconds of its life.

6. What was the baby universe made out of?

7. What were the first atomic nuclei to be formed once the universe cooled off enough? Why were they not atoms yet?

8. What enabled light to come through the universe?

9. What does that flash of light tell us about the universe now?



10. What other evidence do we have of the big bang?

11. Why are stars important for you and I to exist?

12. What kind of information does the picture of the cosmic background radiation give scientists?

13. How do stars form?

14. What is going on inside stars?

15. In what year was the Hubble Space telescope launched into space?

16. What is the importance of the Hubble space telescope?

17. How are heavy elements made inside stars?

18. What has to happen for heavier elements than iron to form?

19. Describe the death of a star.

20. Explain the importance of supernova explosions.

21. How did our Earth form?

History of the Universe Notes

How was the Universe Created?

What is a Theory?

Events that formed the Universe

- THE _____ _____ - superfast expansion
- The universe is a hot soup of _____, _____, and other particles.
- Quarks clump into _____ and neutrons
- 3 minutes after the big bang, the universe _____ enough for the first _____ to form.
- The First atoms were_____(H) and _____(He)
- Matter separates into _____.
- Gas and dusts accumulate as a _____.
- Nebula _____ to form a spinning disk
- _____pulls gases to the center of the disk
- Gas at the center of the disk becomes hot and dense enough for _____ _____ to begin
- Then _____ and _____ form

Moving Galaxies

- Most galaxies are _____ _____ from Earth
- Only a couple are moving _____ us
- The _____away a galaxy is the _____ it is moving.
- The universe is _____!

The Big Bang Theory

- If all galaxies are moving away from each other, then they must have been _____ _____ at some point.
- All the matter in the universe came together at _____ _____.
- Then _____ billion years ago the universe formed in an enormous _____.

How do we know the Universe is expanding? The _____ Effect

- The _____ change in the _____ of a wave caused by the relative _____ between the source of the wave and the observer.

Waves

- _____= the distance from the top of one crest to the top of the next one
- The _____ of a wave is equal to the number of waves that pass a particular point in one second.

Doppler Effect in Water *Draw and describe what you see.*

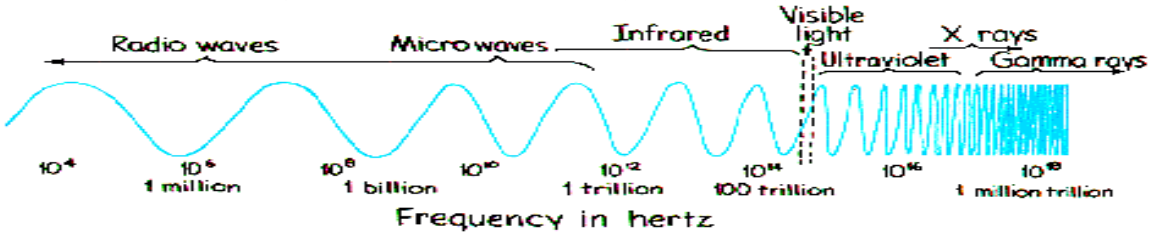
Stationary Bug		Bug Moving	
	_____		_____
	_____		_____
	_____		_____
	_____		_____
	_____		_____

Doppler Effect in Sound

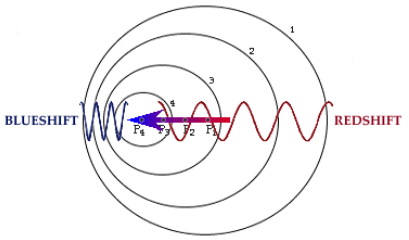
- What happens to sound when it is in motion? *Describe or Draw it.*

LIGHT

- Light is an _____ wave.
- The _____ _____ is a continuous range of waves extending from radio waves to gamma rays.



- The Doppler Effect also occurs for _____. When a light source approaches, there is an increase in _____; when it moves away, there is a decrease if frequency.
- An increase in frequency is called a _____. A decrease in frequency is called a _____



➢ **Because most galaxies show a _____ in the color of their light, this is evidence that they are moving _____from one another. So _____ is evidence that our universe is _____!**

Spectrum Lab Sheet

Use a spectroscope or diffraction grating film to observe the different sources of light. Color the spectral lines that you see for each source.

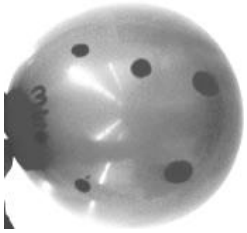
Hydrogen Gas	Helium Gas
Neon Gas	Traditional Light Bulb
Florescent Light Bulb	Electronic Device

Analysis:

1. Why do traditional light bulbs and florescent light bulbs have different spectral lines?
2. What happens when you look through TWO spectroscopes or TWO pieces of film?
3. Why do you believe each atom has different spectral lines?
4. How could a spectroscope inform an astronomer of what elements are in a star?

What is the Big Bang?

Recall how previously you learned that using the Doppler Effect will help determine if a red shift or a blue shift is occurring with respect to stars. This activity is designed to help you see how the red shift provides the opportunity to model the big bang Theory as it relates to the red shift.



Procedure:

1. Blow up the balloon until it is about 10 centimeters in diameter.
    - Do not tie the end.
    - Have a partner mark six dots scattered around the surface of the balloon.
    - Label one of dot as "MW," to represent the Milky Way Galaxy.
    - The other dots represent other galaxies throughout the universe.
2. Without letting any air out of the balloon, blow more air into the balloon until the diameter is approximately 5 cm larger.
    - Observe the change in the location of the dots relative to each other.
3. Repeat the process, this time blowing up the balloon so that it is 5 cm larger in diameter.
4. Now blow up the balloon so that it is almost as full as it can go. DO NOT POP IT. Repeat your observations.

Analysis:

1. If you were standing at the point labeled "MW," what kind of shift would you expect to see in the spectra of the dots representing other galaxies?

2. Why are color shifts important in understanding what is happening to the universe?

3. Imagine that you didn't see the balloon *start* expanding; but you then witnessed the balloon continue to expand, what could you infer about the size of the balloon before you began watching?

4. How does the expansion of the balloon relate to the expansion of the universe?

Hubble's explanation of the expanding universe

When Hubble noticed all of the red shifts compared to the very few blue shifts, he realized that the universe is expanding. Just as you did during the balloon analysis, scientists can now point to what the universe must have looked like in the past if we are currently watching it expand. Remember our loaf of raisin bread. If you walked into the kitchen and observed that the bread had been rising, what could you say about what the loaf looked like 15 or 20 minutes ago? The same thing happens with the universe. As we watch the universe get larger, we can say that at some point in time, the matter and energy that forms the universe must have been much closer together. What could have sent all of that material flying outward into space? Only an explosion beyond anything we have ever seen could have done that.

This explosion is known as the **big bang**, and is generally referred to as the beginning of the universe. At a certain time in the past, all matter and energy was found in one spot. Over 13 billion years ago, the big bang sent that matter and energy outward, and the universe began. If the universe is truly expanding, then that means that at some point in time, all of the matter must have been together, just as in the balloon analysis.

Graphing Redshift

For the last century, Astronomers have gathered information about bright objects in our sky. Below you will find information about 16 celestial objects. The objects are labeled as "M" objects (M stands for Messier, an Astronomer from the 18th century), or "NGC" objects (NGC stands for New General Catalog, which is a world-wide complied list of objects in our night sky).

Object **M60**, which is 55 million light-years away (Mly), is traveling at 1,117 km/s. Object **M82** is 11.5 Mly away, traveling 203 km/s. Object **NGC 5010** is 140 Mly away, traveling 2975 km/s. The object named **NGC 5078**, which is 94 Mly away, is traveling 2168 km/s. **M101**, just 21 Mly away, is traveling 241 km/s. **NGC 5490** is a whopping 218 Mly from Earth, and it is traveling 4,928 km/s.

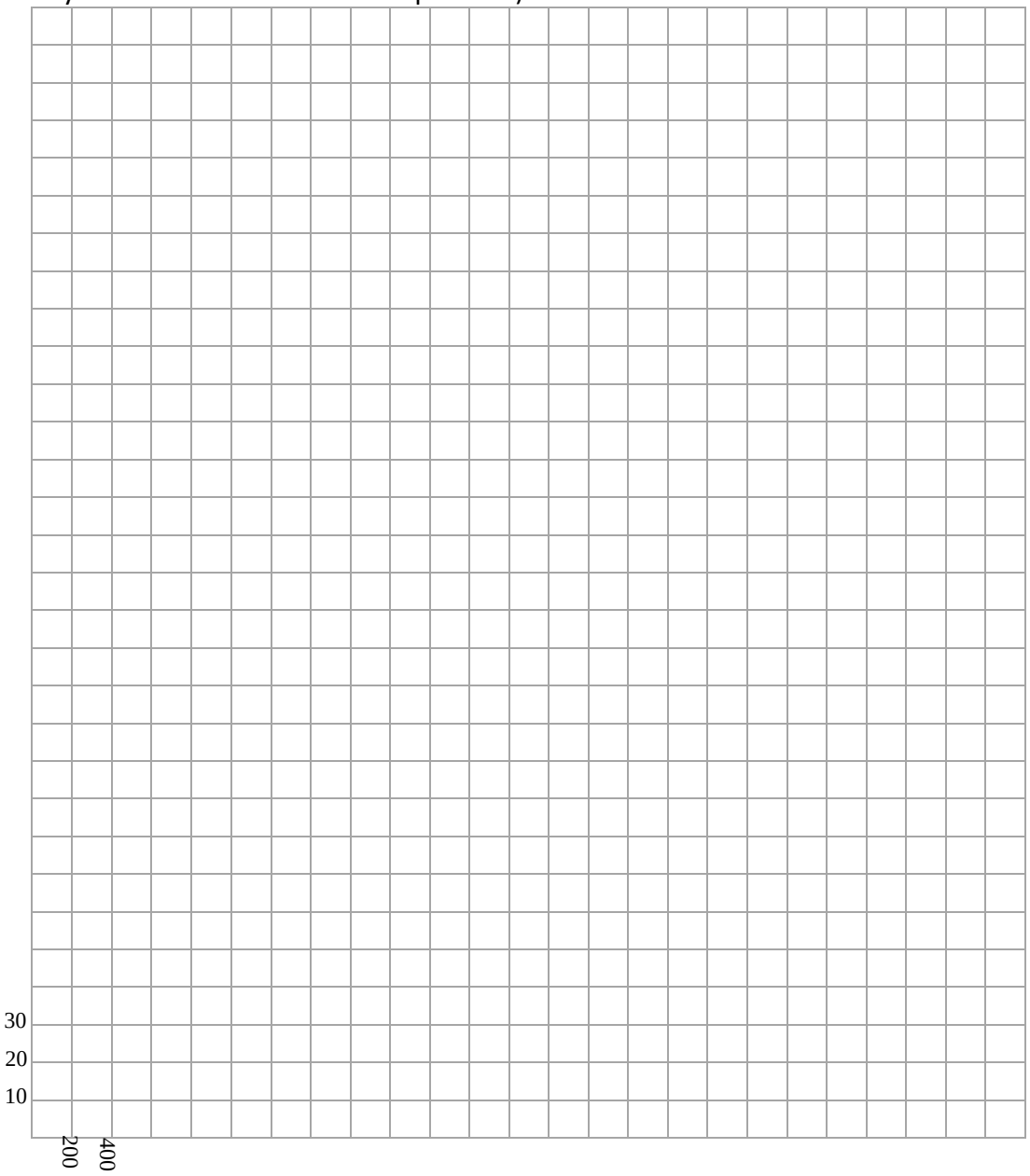
Object **M64** is 24 Mly from our planet, traveling 408 km/s, while object **NGC 5101** is 89 Mly away, traveling at 1,868 km/s. **M51**, 23 Mly away, is moving at a speed of 463 km/s. **NGC 5091** is 150 Mly away from Earth, traveling at 3,420 km/s. An object called **M105** is 32 Mly away, traveling at 911 km/s, and just a little farther is object **M95**, 33 Mly away, and it is moving at 778 km/s.

M74 is closer than those last two, at just 30 Mly away. Its speed is 657 km/s. **M84** is twice as far, 60 Mly away! Its speed is 1,060 km/s! Object **M49** is 56 Mly away, traveling at 997 km/s. And **M66** is 36 Mly away, traveling at 727 km/s.

Organize the data above into a table:

Object	Speed (km/s)	Distance (Mly)
M60	*1,117*	*55*

Now make a scatter plot graph with each celestial object below. Don't forget to label the objects on the graph as well as the x and y axis.
(HINTS: speed will be on the x-axis and distance will be on the y-axis; label the x-axis in increments of 200—up to 5000, and the y-axis in increments of 10—up to 250)



Analysis Questions:

1. Which object is farthest from Earth?

2. Which object is closest to Earth?

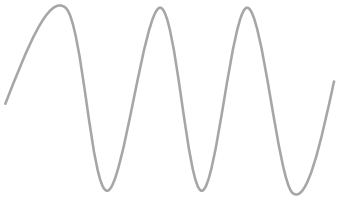
3. Which object has the fastest speed?

4. Which object has the slowest speed?

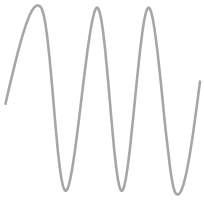
5. Finish the following sentence: *The farther away an object is from Earth, the…*

6. Match each of the following objects to a wavelength below. Remember, the farther an object is from the Earth, the longer the wavelength of light that is emitted.

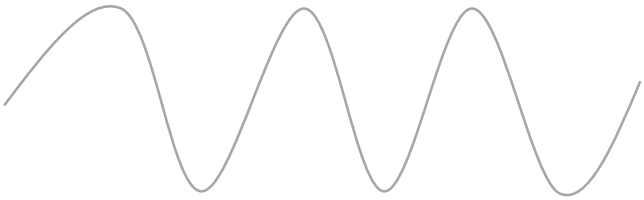
Objects:
M105
NGC 5091
M101
NGC 5010



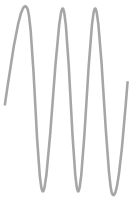
A. _____



B. _____



C. _____



D. _____

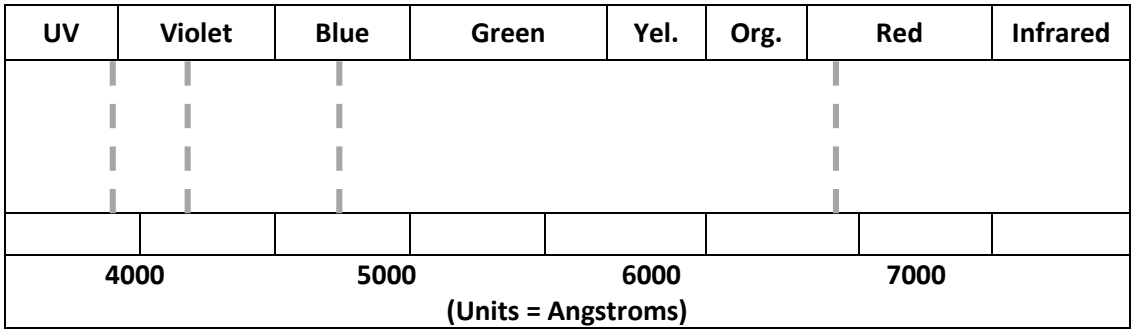
7. If astronomers found a galaxy that was 90 Mly away, traveling at 100 km/s, would that information fit the pattern on your graph? Explain your answer with a full sentence.

8. There are many galaxies and other celestial objects in our sky that are listed as having negative speeds (like -230 km/s, or -1,056 km/s). What do you think this means? Why?

Coloring Red and Blue Shift

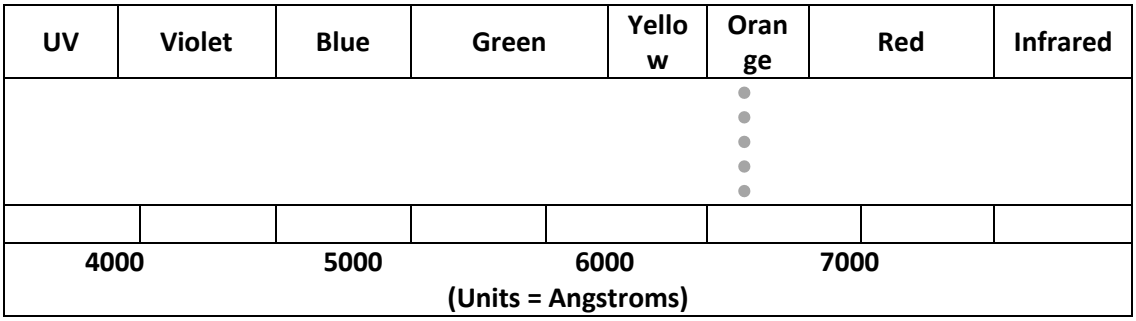
A. Color the DASHED spectroscopy lines.
B. Use the spectrum key to name the element OR the ELEMENTS.
C. Identify whether the star has red shift or blue shift (which way did the lines move?)

Star 1:



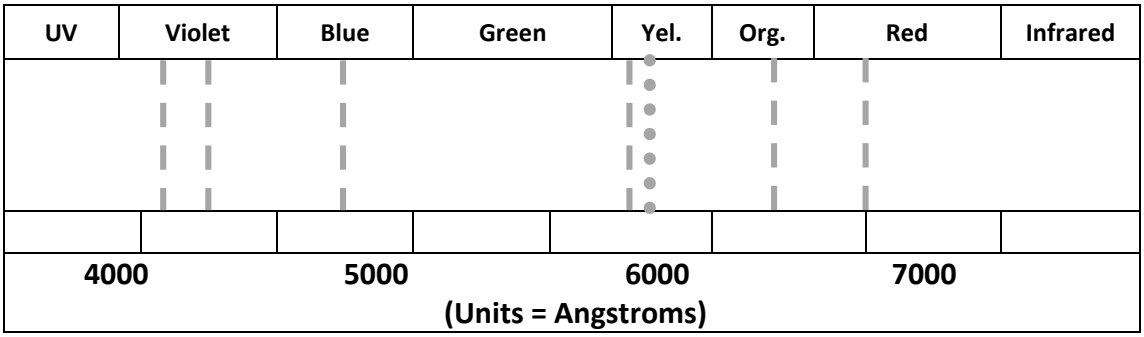
Which element? _____ What shift? _____

Star 2:



Which element? _____ What shift? _____

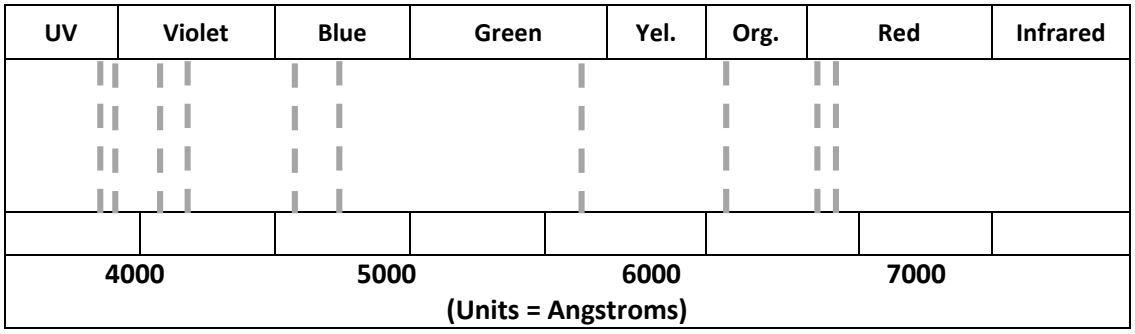
Star 3:



Which element? _____ What shift? _____

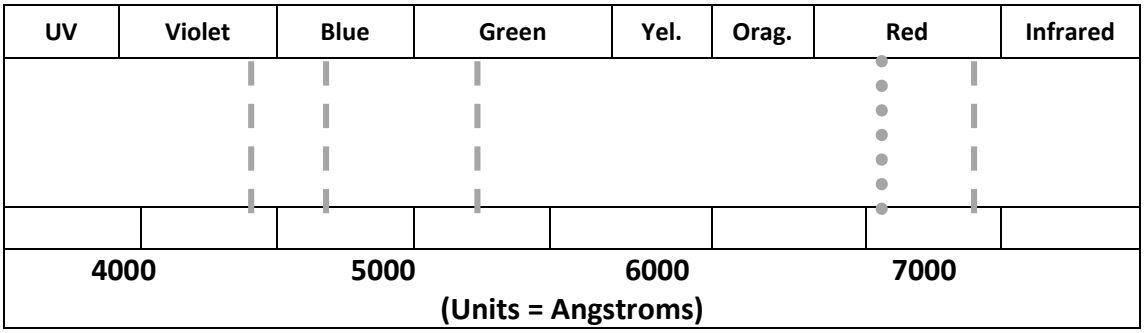
Now each star will have MORE THAN ONE element within it!

Star 4:



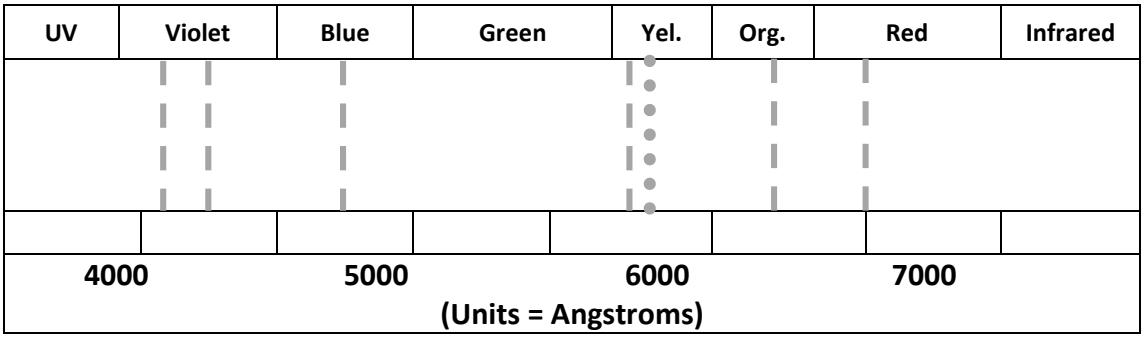
Which 2 Elements? _____ What shift?_____

Star 5:



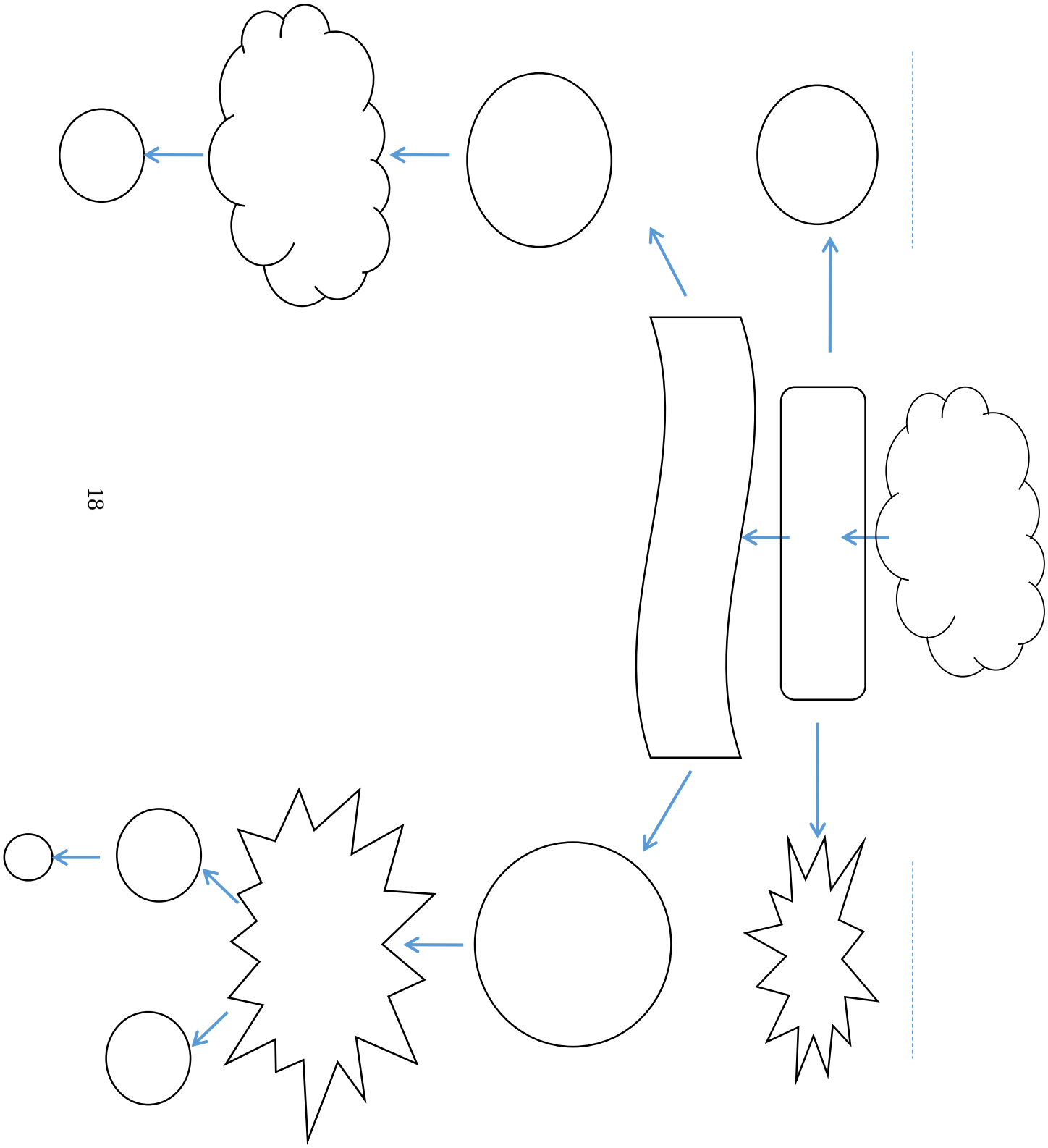
Which 2 Elements? _____ What shift?_____

Star 6:



Which 2 Elements? _____ What shift? _____

Star Life Cycle



Star Life Cycle

Extra Notes:

The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

Periodic Table and Heavy Elements

I. Shade in the following elements on your periodic table with a different color for each group

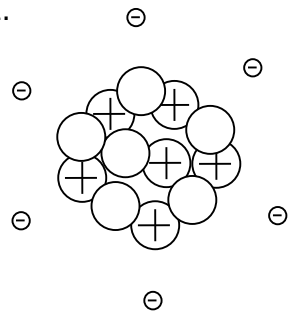
Light elements produced in Big Bang	**Heavier elements formed by nuclear fusion.**	**Heaviest elements form in supernova**
Hydrogen (H)	Iron (Fe)	Tin (Sn)
Helium (He)	Nitrogen (N)	Nickel (Ni)
Lithium (Li)	Silicon (Si)	Lead (Pb)
	Magnesium (Mg)	Zinc (Zn)
	Sulfur (S)	

II. For each of the following elements identify whether it most likely originated from the big bang, nuclear fusion in stars, or through supernovas

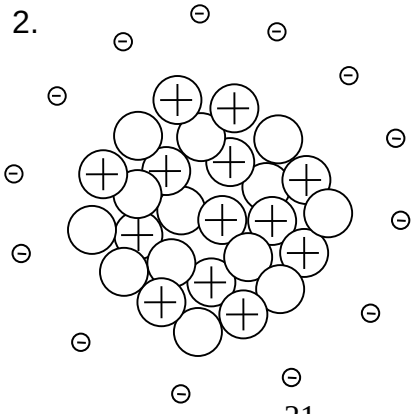
1. Gold (Au): _____
2. Sodium (Na): _____
3. Hydrogen (H): _____
4. Carbon (C): _____
5. Helium (He): _____
6. Uranium (U): _____
7. Oxygen (O): _____
8. Lead (Pb): _____
9. Xenon (Xe): _____

Name the element shown by the following drawings:

1.



2.



Now draw a picture of an Oxygen atom: