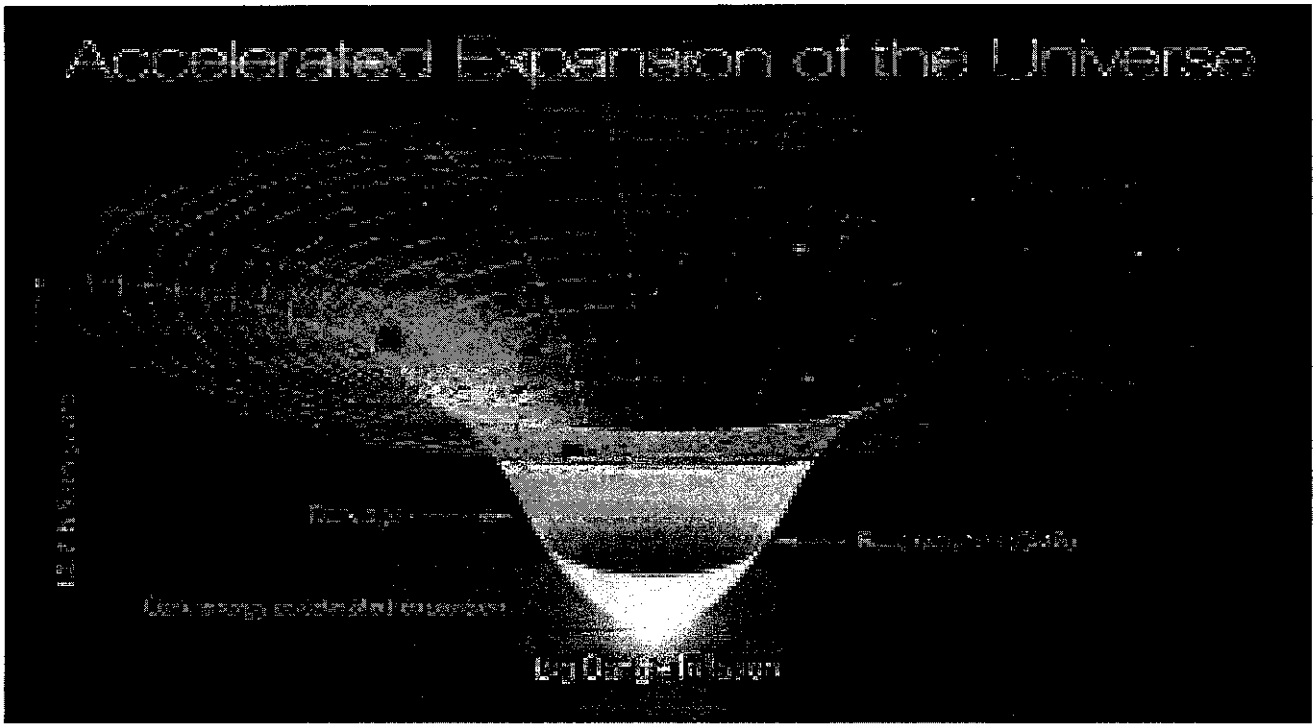
THE BIG BANG THEORY

HOW THE UNIVERSE BEGAN



Have you ever wondered how stars and galaxies formed? Today we are going to study the Big Bang Theory. Our task, however, is to study the formation of the universe and also the elements that make up these stars and galaxies.

Background Information:

About 14 billion years ago, the universe began in an explosion – The Big Bang. The Big Bang model can reliably describe its evolution from one hundredth of a second, up to the present day.

Astronomers believe that universe began in an enormous explosion called the big band. About 14 billion years ago, all the matter and energy that exists now in the universe were concentrated into a hot, dense "primordial atom" also known as the Singularity. Then, at the instant of the Big Bang, all matter and energy exploded outward in all directions. At some point, clumps of matter came together to form stars and galaxies that are still moving away 1

Materials:

Universe – divided into four quadrants	10 different colored paper strips
4 Hole punches	1 balloon
2 meter sticks – one with a pin	safety glasses
Data table	Four 5 cm circle overlays
4 plastic beakers	Small test tube

Procedure:

1. Make 30 hole punches of every color of construction paper. Share this work among your partners. Punch the paper so that the punches go into a plastic beaker.
2. Pour the punches into the test tube. Be careful to make sure all the punches get into the tube.
3. One person, and only one person, should blow up the balloon about half way. Release the air from the balloon and place the balloon over top of the mouth of the test tube. Turn the test tube upside down so that the punches enter into the balloon. Inflate the balloon again, be careful that you put too much air in and break the balloon. Knot the end of the balloon so the air will not escape.
4. You will now move to the work area and place your universe on the floor with the marked quadrants facing up.
5. Using a piece of tape, attach the balloon to the end of the meter stick that has no pin attached. Have one person hold the meter stick so that the balloon is about 18 inches above the center of your universe. **Put on your safety glasses.**
6. Have another person take the meter stick that has the pin taped to the end place the pin directly below the balloon. Gently poke the balloon with the pin until it pops. (If you hit the balloon to hard, you could end up with all your dots going off the paper and your experiment will be over.)
7. Throw away the broken balloon and any pieces that went flying and place the meter stick with the pin someplace that now one will accidently poke themselves.
8. Begin plotting the pattern of debris on the quadrant map provided. Table 1 on the next page shows the color of the dots and the element and symbol that it represents.
9. Using the 5 cm circle, place it on your quadrant so that it covers as many dots as you can. Any dot touching the circle will be included with in the grouping. Bring them into the circle. Using a dry erase marker, draw a circle around these dots. This will represent a galaxy forming in your universe. Do this to the remaining dots in your quadrant. There will be some dots that will be too far apart to bring into the groupings. These will remain as free elements floating through the universe.
10. Draw a red line from the primordial atom (center) to each of the galaxies you formed. Measure the distance (in cm) to each one and record this on table 3.

Table 1

Color of the hole punch	Element	Chemical Symbol
Red	Hydrogen	H
Orange	Helium	He
Yellow	Oxygen	O
Green	Nitrogen	N
Light Blue	Carbon	C
Dark Blue	Iron	Fe
Purple	Neon	Ne
Light Green	Argon	Ar
Brown	Lead	Pb
Black	Black Hole	BH

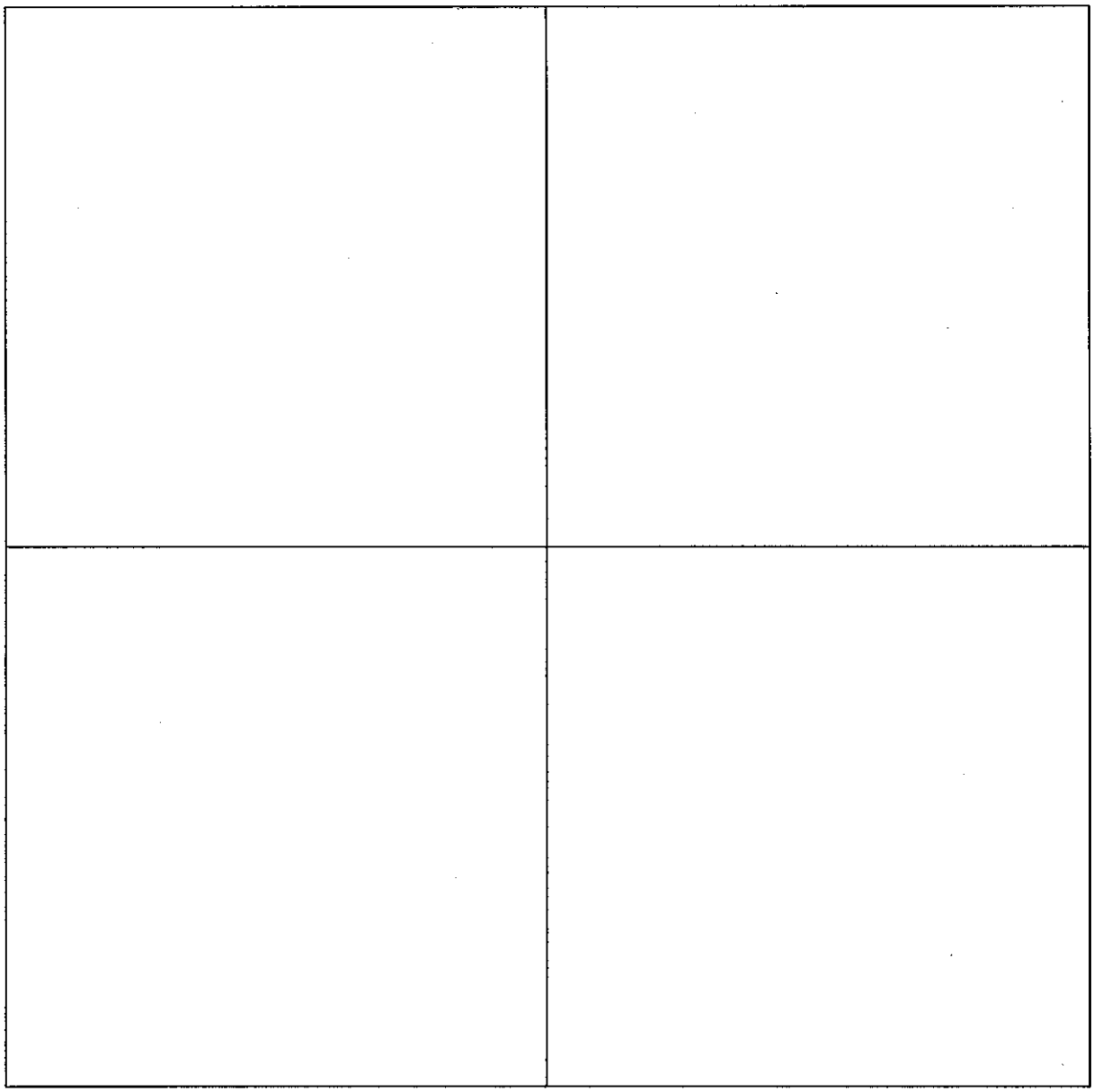
Table 2

Element	H	He	O	N	C	Fe	Ne	Ar	Pb	Total Mass	Distance
Mass (MT)	5	4	3	2	2	1	1	1	1		
Galaxy Name											
Far Far Away	1 5MT	0 0MT	3 9MT	0 0MT	2 4MT	0 0MT	1 1MT	2 2MT	4 4MT	25MT	3.5 cm $3.5x10^9$ km

11. You have to imagine that all the elements that you have plotted are moving outward into space. As the elements move outward they will continue to clump with other elements. Remember that anything moving away from the primordial atom will cause a shift in the spectral lines of each element. This is called a red shift. The red line you drew, represents this. The black dots represent a black hole. Any matter within 2cm of a black dot disappears into the black hole and cannot be counted. Circle your black holes also and record their distance.
12. Look at the elements that are present in each of your galaxies. These are the elements that you will be able to identify using spectral analysis. Look at table 2. A mass amount has been assigned to each element. You will determine the mass (metric tons) of each galaxy in your universe. Also each cm equals one billion kilometers. Convert your cm to km and show the distance. You need to get creative here also. Name each of your galaxies. Table 2 is an example. You will fill this information into the data table on the next page. Extra data tables are available if needed.

DATA TABLE

ELEMENT	H	He	0	N	C	Fe	Ne	Ar	Pb	Total	Distance
Mass	5	4	3	2	2	1	1	1	1	Mass	
Galaxy											



Draw the locations of each of your galaxies on the map of your universe above. Use red lines similar to those you drew on your original universe to show the distance to each galaxy you found.

ANALYSIS QUESTIONS

1. In what ways was this lab similar to the actual Big Bang?

2. Which galaxies would you say moved the fastest?

3. Which galaxies would have the greatest red shift? Explain.