Galaxies and the Expanding Universe

Geology Mr. Traeger

Name: _____ Period: _____ Date: _____

Purpose

The purpose of this activity is to become familiar with galaxies. It is also intended to familiarize the student with Edwin Hubble's ideas about and expanding universe.

Materials

Balloon Felt Tip Marking Pen String
Meter Stick

Part 1: Galaxy Types

1. What is a galaxy? How many stars live in them?

2. What is the name of the galaxy that we live in?

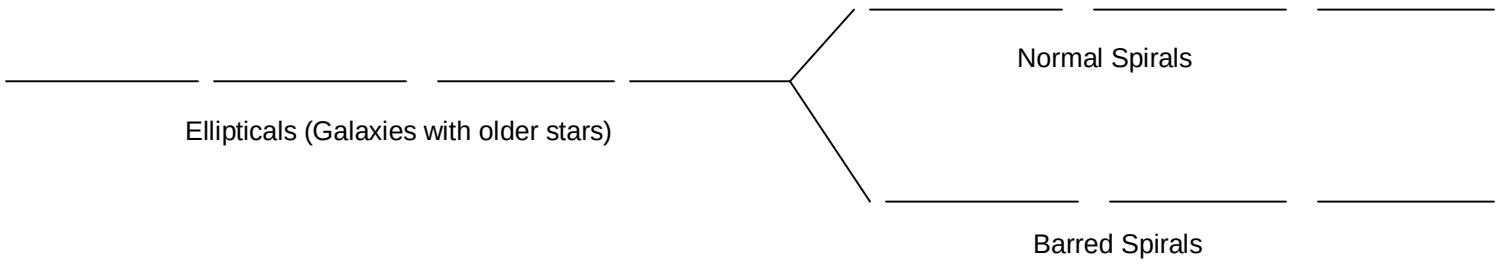
3. How big is our galaxy in light years at its widest point?

4. How far is our solar system from the center of our galaxy?

5. How long does it take our solar system to make one complete orbit of our galaxy?

6. How are galaxies classified?

7. Fill in the following table of Edwin Hubble's tuning fork diagram for galaxies. Write a short description or sketch the galaxy next to each galaxy type.



8. Why did Edwin Hubble classify galaxies as seen in #7? Why is this method of classification actually wrong?

9. What is an irregular galaxy? Why is it not on the chart seen in #7?

10. What are active galaxies, quasars, and blazars?

11. What type of galaxy is the Milky Way?

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Part 2: Expansion of a Balloon Universe

1. Get a balloon and a felt tip pen. Do not blow it up yet. Draw 4 galaxies in random fashion on your balloon.
2. Pick one of the galaxies on your balloon and identify it as the Milky Way.
3. Label the other 3 galaxies as galaxy 1, galaxy 2, and galaxy 3.
4. Blow up your balloon to a diameter of around 10 cm. Pinch off the end of the balloon, but do not tie it! Paper clip it!
5. Measure the distances in cm between the galaxy you identified as the Milky Way and galaxies 1, 2, and 3. Use your piece of string to do this. Record your data in the chart below.
6. Unpinch the end of the balloon and blow up your balloon to a diameter of around 20 cm. Pinch off the end of the balloon. Paper clip it!
7. Measure the distances in cm between the galaxy you identified as the Milky Way and galaxies 1, 2, and 3. Use your piece of string to do this. Record your data in the chart below.

	Measurements for 10 cm Balloon	Measurements for 20 cm Balloon	Change in Distance (value for 20 cm balloon ï value for 10 cm balloon)
Distance between Milky Way and Galaxy 1 (cm)			
Distance between Milky Way and Galaxy 2 (cm)			
Distance between Milky Way and Galaxy 3 (cm)			
Circumference of Balloon (Universe) (Use $2\pi r$)			

8. Is the change in distance larger or smaller for galaxies that are farther apart? What does this say about the speed of galaxies that are farther away? (Speed = change in distance over time.)

9. Is there a ñcenterò on the surface of the balloon universe? Why or why not?

10. How is the balloon universe different from the real universe in terms of space and time?

11. Will our universe expand forever or will it stop expanding and collapse back in on itself someday (the Big Crunch)?

Part 3: Hubble's Law

1. Using the ñSpectra of Fast Moving Galaxies,ò calculate the velocity of each galaxy. Remember that this is calculated by measuring the amount of Doppler RED shift of star spectra.
2. Plot the galaxy distance versus galaxy speed for each galaxy on the Hubbleôs Law worksheet. Make sure to label the letter of each galaxy next to the plot.
3. What does your graph tell you about the distance of a galaxy compared to its speed?

4. The idea that you just discovered in question #3 is called Hubbleôs Law. What does Hubbleôs Law tell us about how the universe is behaving?

5. According to Hubbleôs Law, is the universe expanding as seen with your balloon model?

6. According to Hubbleôs Law and your chart, how distant is a galaxy moving away from us at a speed of 120,000 km/sec? Show the math.