Our Expanding Universe

Subject: Science

Grade Levels: 8th

Rational or Purpose: To compare various models of universal formation.

Materials:
marker (such as a Sharpie)
round balloon

Lesson Duration: 1 hour

TEKS Objectives:
112.48. Astronomy.
(c) (5a-c)

Background Information:
Since the beginning of time, people have tried to explain how the universe was formed. Nicolaus Copernicus, who influenced scientists such as Galileo, Kepler, and Hubble, conducted some of the first studies of the origin of the universe.

Over the past century, scientists have presented three models describing the origin of the universe. Georges Lemaitre proposed the **Big Bang Theory** in 1926. This model states that all matter in the universe originated in a central, tremendously hot location. When the region began to cool, atoms of hydrogen were formed and were able to keep their structure intact. Then, about 15 billion years ago, these atoms were drawn to each other by gravity. This region exploded and matter was hurled outward. This expansion and cooling has continued. As a result, the universe is filled with radiation that is the left-over heat from the Big Bang. This Cosmic Microwave Background radiation (CMB) was discovered in the 1960's. Additional evidence that supports this theory is the red-shifting of most distant galaxies. The Big Bang is currently the most accepted model.

The second model agrees with the Big Bang Theory. It states that when the universe began, all matter was located within a specific region of space. An explosion occurred, sending matter forcibly outward. However, the **Oscillating-Universe Theory** states that the universe undergoes periods of expansion and contraction. Eventually, all the matter in the universe would get hotter and brighter and eventually collapse together in an event called the "Big Crunch," then a new Big Bang would occur resulting in a new universe. According to supporters of this theory, our universe is now in a period of expansion.

A third model, called the **Steady State Theory** suggests that the universe has always looked as it does now, and its overall composition does not change. In this theory, galaxies are not moving away from each other, but new stars are being made from energy in the center of galaxies. The new stars spiral out from the center. The galaxy reabsorbs the energy given off by stars throughout their life cycles. The energy is then reused to produce new stars. This model avoids the idea of an explosive expansion and contraction. Since the Steady State model suggests that the universe looks now as it always has, discoveries such as microwave radiation and the location

of small, distant objects that radiate more energy than entire galaxies called quasars weaken this theory.

Activity:
Students will represent the natural world, using models and identify their limitations
They will have the opportunity to recognize, analyze, review, and critique contributions of scientists. Finally, students will describe characteristics of the universe, such as stars and galaxies using visual tools such as graphs, maps, and charts.

Part I: Organizing Information in a Venn Diagram
1. On a piece of notebook paper, draw three intersecting circles to make a 3-ring Venn diagram.
2. Label one circle “Big Bang Theory”, one “Oscillating Universe Theory”, one “Steady State Theory.”
3. Using the background Information and a textbook or the internet, organize the information in a Venn diagram.

Part II: Our Expanding Universe
Procedure
1. Partially blow up the balloon to about the size of your fist. **Do not tie a knot in the balloon!**
2. Using the marker, make an “X” on the side of the balloon. This “X” represents our home galaxy, the Milky Way.
3. Mark approximately 20 more dots on the balloon, distributing them evenly. These spots represent other galaxies.
4. Keeping an eye on the home galaxy, blow more air into the balloon. Observe what happens to the dots now in relation to the home galaxy.

Data Analysis and Interpretation
1. As you blow the balloon up, what happens to the dots?

2. Do all dots move the same direction from the home galaxy?

3. If you over inflate the balloon, it will pop! Would this also happen to the universe? Explain your answer.

4. Why might the universe *not* explode as it grows?

Remember that scientific **models** are a simple, compact way to represent the structure and function of the real object, system or concept. Models contain only the fewest details necessary to describe the real thing, so they may not give a completely true description of the object or system. Models, like systems, can be **static** or **dynamic**. After viewing the “Models” PowerPoint presentation, answer the following questions:

5. Describe the model created in this activity.

6. What are the limitations of this model?

7. A comedian once said, “I have a map of the U.S. in my glove compartment. The scale is 1 mile equals one mile.” Why would people laugh at this?