The Elastic Universe: Instructions

Goal: To visualize the universe expanding in all directions.

Materials:

Student grouping: groups of 3-4 students; can be larger. For each group:

- a ~50cm strip of elastic ribbon (e.g. 1-2cm wide from haberdashery)
- at least ten~1cm round stickers
- stapler, ruler, marker pen
- large piece of paper
- worksheet

Introduction:

Students will model the expansion of space by stretching a piece of elastic. In this model, the elastic represents space, and stickers attached to the elastic are galaxies.
Students will use rulers to measure distances between these galaxies, to find out what happens to them when space expands.

Procedure:

- Prepare each model of the universe (teacher can pre-prepare if time is short). Staple about 10 stickers evenly along the elastic at approximately one-inch (~3cm) intervals. Label the galaxy stickers A-J.
- In each group, two students each take an end of the elastic and hold it taut without stretching against the piece of paper. On the paper, mark and label the starting positions of the stickers.
- Each group chooses one sticker to be the home galaxy. To model the expanding universe, hold the home galaxy still and gradually pull on both ends of the elastic.
- After stretching the elastic, mark the new positions of the galaxies. Students should observe what happens to the distance between the galaxies, and measure how far they have moved, recording it on the worksheet.
- The class should then get together and different groups can feed back what they have found. Different groups will have picked different home galaxies. The following discussion points can be raised.

Discussion points:

- Are the galaxies moving away from each other?
- Is there a centre to the expansion?
- Are the galaxies themselves expanding?
- Is there a pattern to how far apart the galaxies appear to be?
- Is there a pattern to how much each galaxy has moved?
- How did the pattern depend on which galaxy was the home galaxy?

The model shows how that if space expands uniformly (i.e., the same amount of stretching everywhere), we will observe that galaxies appear to move away from us. What's more, galaxies father away from us appear to be moving faster, as they move a greater distance in the same amount of time. Every galaxy sees the same pattern.

This activity is taken from Cosmic Questions: Our Place in Space and Time, by the Harvard-Smithsonian Center for Astrophysics. Adapted for QUEST course by J. Dunkley, I. Levine.