Name: Date:

HANDS-ON LAB

# Modeling the Expanding Universe

## BACKGROUND

You can use simple hands-on models to develop a better a sense of how rates of expansion affect objects in the universe. Try these two models using a rubber band and a balloon.

## MATERIALS

- balloon
- binder clip
- marker
- pen, ballpoint
- rubber band, thick
- ruler, metric
- scissors
- string

## PROCEDURE

**Part A:**

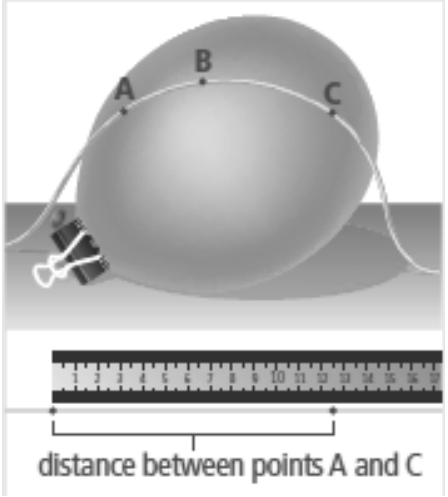
1. Use scissors to cut open a thick rubber band. Spread the rubber band against a ruler without stretching the band.
2. Use a ballpoint pen to mark the zero point at one end of the rubber band and then mark each centimeter from 1 cm to 5 cm as shown in Figure 1.
3. Hold the first mark (0 cm) in place next to the ruler while stretching the rubber band until the last mark (5 cm) aligns with the 10 cm mark on the ruler.
4. Observe and measure how many centimeters each mark has moved from its original location. Record your observations.

**Part B:**

5. Use a marker to make three dots in a row on an uninflated balloon. Label them “A,” “B,” and “C.” Dot B should be closer to A than dot C is to B.
6. Blow the balloon up just until it is taut. Use the binder clip to seal the balloon temporarily, but do not tie the neck.
7. Use string and a ruler to measure the distances between A and B, B and C, and A and C as shown in Figure 2.
8. With the balloon still inflated, blow into the balloon until its diameter is twice as large.
9. Measure the distances between A and B, B and C, and A and C. For each set of dots, subtract the original distances measured in Step 7 from the new distances. Then, divide by 2, because the balloon is twice as large. This calculation will give you the rate of change for each pair of dots.
10. Repeat Steps 8 and 9.

**FIGURE 5:** Part A

**FIGURE 6:** Part B



## ANALYZE

1. By how many centimeters did each mark move when the rubber band was stretched? What does this tell you about the rate of movement relative to the distance from the stretching point?

2. How is the rubber-band model similar to the expanding universe? How is it different?

3. With the balloon model, for which pair of points did the distance show the greatest rate of change: A and B, B and C, or A and C?

4. Suppose dot A represents Earth and that dots B and C represent galaxies. How does the rate at which galaxies are moving away from us relate to how far they are from Earth?