Hubble Balloon Lab

Based on The Expanding Universe lab from U. Wash.

Data Collection (10 minutes)

1. Work in pairs.
2. Blow up your balloon "all the way" (don't push the limit, though), but **do not tie it shut**.
3. Mark and number 10 galaxies in random locations on the balloon surface. (An x or a dot will be easier to measure than a sketch of a galaxy.)
4. Let most of the air out of the balloon. It should be as small as possible while still staying round. Do not tie it shut.
5. Choose one galaxy to be your "home" galaxy. (Label it somehow.)
6. Measure and record the **initial distance** from your home galaxy to every other galaxy. Be precise – measure to at least tenths of centimeters.
7. Now re-inflate the balloon. You may tie it now…. if you don't mind popping it later. Also record an estimate of the **time** it took to inflate the balloon.
8. Repeat the measurements, recording **final distance**.
9. *Kill your balloon*. (Or take it home as a memento.)

Data Analysis: fill in the rest of the table and create a graph as follows.

1. **Difference**: Calculate the distance each galaxy moved by subtracting the initial distance from the final distance.
2. **Velocity**: Calculate the velocity of each galaxy by dividing the **difference** by the time it took to inflate the balloon (change in d = v t).
3. **Hubble Constant**: Graph velocity on the vertical axis and final distance on the horizontal axis. Draw a straight line that goes roughly through the middle of your points. Calculate the **slope** of the line. This is your Hubble Balloon Constant.

Interpretation: answer on a separate sheet of paper.

1. What are the units of your Hubble Balloon Constant? Can you simplify them?
2. Calculate the age of your balloon universe. What assumptions must you make?
3. You made a measurement on your balloon that is not possible for us to make in the real universe. What was it? How do we get around this problem in the real universe?

Homework: due Thurs 05/03/07 in class Name:

Assume the value of the *actual* Hubble constant is 69 km/s Mpc.

1. What do those weird units mean: km/s Mpc?

2. Calculate the age of the universe, assuming the Hubble constant has always had the same value. (This will involve some unit conversion because of the weird units. 1 parsec = 3.09×10^{16} meters.)

3. Once we have measured the Hubble constant, we can use it to determine distances to other galaxies. What measurement would we need to make to find the distance to a distant galaxy using the Hubble Law?