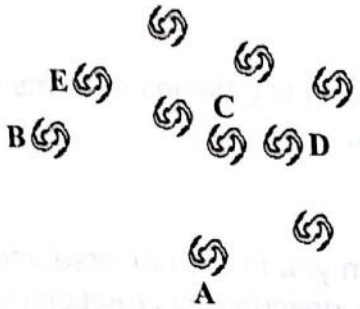
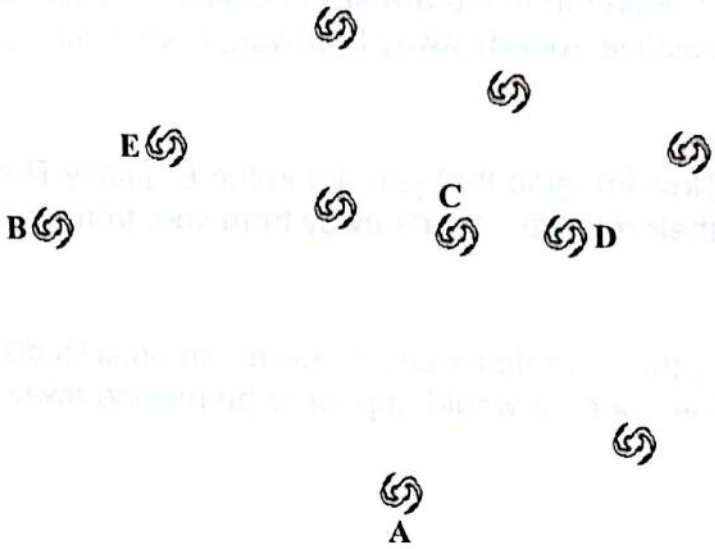
The two drawings below represent the same group of galaxies at two different points in time during the history of the universe.

Early Universe



Universe Some Time Later



1) Examine the distance between the galaxies labeled A–E in the Early Universe. Are all the galaxies the same distance from each other?

2) Describe how the universe changed in going from the Early Universe to the Universe Some Time Later.

3) Do the galaxies appear to get bigger?

4) Based on your answer to Question 3, do you think the stars within a galaxy move away from one another due to the expansion of the universe? Explain your reasoning.

5) Compare the amount that the distance between the D and C galaxies changed in comparison to the amount that the distance between the D and E galaxies changed. Which galaxy, C or E, appears to have moved farther from D?

6) If you were in the D galaxy, how would the A, B, C, and E galaxies appear to move relative to your location?

7) If you were in the D galaxy, would the A, B, C, and E galaxies all appear to move by the same amount in the time interval from the Early Universe to the Universe Some Time Later?

8) Imagine that you are still in Galaxy D. Rank the A, B, C, and E galaxies in terms of their relative speeds away from you, from fastest to slowest.

9) Now imagine that you are in the E galaxy. Rank the A, B, C, and D galaxies in terms of their relative speeds away from you, from greatest to smallest.

10) Is there a relationship between an object's distance away from you in the universe and the speed it would appear to be moving away from you? If so, describe this relationship.

11) Would your answer to Question 10 be true in general for all locations in the universe?

12) Consider the following discussion between two students regarding the possible location of the center of the universe.

Student 1: *Since all the galaxies we observe are moving away from us, we must be at the center of the universe.*

Student 2: *If you look at the drawing on the first page its pretty clear that all the galaxies move away from each other, so I think each galaxy must be at the center of the universe.*

Do you agree or disagree with either or both of the students? Explain your reasoning.