CREATE AN EXPANDING UNIVERSE

Our Universe is expanding. Everything we see is moving away from us. It can be hard to imagine but this demonstration will help to visualise what's happening.

Work in pairs to create your own expanding Universe and record the results.

Instructions

1. Fill in the colours of your dots in the table below.

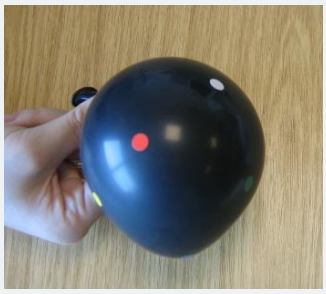
   Select which colour will be the Milky Way and make a note.

"Milky Way" colour
e.g. Yellow

2. Blow up the balloon a little bit and hold the "nozzle" closed, but do not tie it up.

   Stick your dots onto the balloon, spreading them out over the whole surface.

   Each of the dots represents a whole galaxy, with the surface of the balloon being the Universe that they exist in.



3. Use the string to measure the distance from your 'Milky Way' dot to one of the other dots. You may find this part easier if you have someone to help you!.

Now measure the string distance with a ruler.

When you have measured the distance, write it down in your table in the D1 column.

Repeat this for all of the other dots.

Dot colour	First distance to D1 (cm)	Second distance to D2 (cm)	Change in distance: D2 – D1 (cm)	Speed, v (cm/second)
Yellow	0	0	0	
Orange				
Blue				
Green				
Red				

4. Now carefully blow the balloon right up, using the timer to see how long it takes. Write down the time in seconds.

Balloon expansion time
e.g. 10 seconds

5. Now re-measure all the distances from the "Milky Way" to the other dots. Note them in the D2 column of your table. Don't forget that the distance from your "Milky Way" dot to itself is zero.

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6. Work out the speed of each galaxy. Remember that:

$$Distance\ travelled = speed \times time\ taken$$

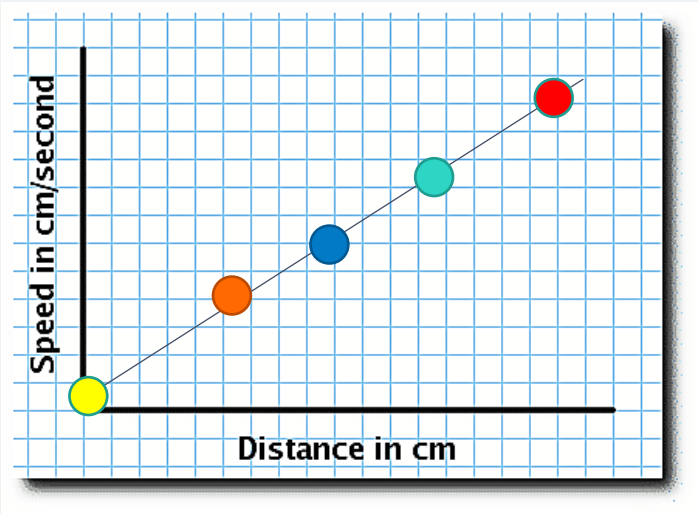
Here, the **distance travelled** is the difference between D1 and D2, so calculate *D2 - D1* for each of the dots and write them in the 4th column of the table.

The **time taken** is the time to blow the balloon up. Work out the speed, v, for each dot and put it into the 5th column. Your "Milky Way" dot has not moved so its speed will be zero.

7. We are investigating the relationship between the speed and distance of galaxies.

The best way to see this is to plot a graph of distance along the bottom axis and speed up the side.

Put the points for all your dots on the graph using D2 as the Distance.



8. Use the ruler to draw a straight line that goes as close to as many of the points as possible (don't forget the "Milky Way" dot!). This is called the line of best fit.

9. Answer the following questions:

1. Do all the dots move at the same speed?

No.

2. Do they get faster or slower as they get further from the Milky Way?

They get faster, or the speed increases, with distance.

3. What graph in astronomy does this represent?

The Hubble's Law plot showing how galaxies are moving away from us.

4. Redshift can be used as a measure of distance – what is redshift?

The change in wavelength of light as an object moves away from us. The light is stretched moving it to the redder part of the spectrum.

5. What theories does the expansion of the Universe support?

The Steady State theory AND the Big bang Theory.