Expansion of the Universe

Turn in one copy of this lab with each group member's printed name and signature. By signing, you certify that you have actively participated in the exercise and have put forth effort in equal share to your fellow group members.

Printed Name	**Signature**
_____	_____
_____	_____
_____	_____
_____	_____

Table 1

Galaxy Name	Apparent Magnitude (V)	$\lambda_{observed}$ (Å)	$\Delta\lambda$ (Å)

1. Compare the images of the galaxies in the Coma cluster to the second cluster. Are the galaxies in the second closer, or further away? Why do you think this is the case?

2. Does it take a longer or a shorter time to reach a signal-to-noise of 15 for the second cluster than for the galaxies in the Coma cluster? Why?

3. Take a look at the $\lambda_{observed}$ from your galaxies. Are the wavelengths longer (redder) or shorter (bluer) than the rest wavelength? Does this mean they are moving toward or away from us?

Table 2

Galaxy	Distance (Mpc)	Velocity (km/s)	Velocity (Mpc/Gyr)	H (Mpc/Gyr/Mpc)

4. Average H from table: _____ (Mpc/year/Mpc)

   Slope of Best Fit line: _____ (Mpc/year/Mpc)

5. Why must your best fit line go through (0, 0)?

6. How does the value for the slope compare to your calculated average value? Which do you think is a more accurate way to determine H? Why?

7. Again take a look at the units of H: (Mpc/year) / Mpc. If you just use algebra on these, what units does H really have? *(Hint: write it out carefully so the fractions are more obvious)*

8. Use your average value of H to find the current age of the Universe in *Gigayears (1 Gigayear = 1billion years)*. ** Show your work **