Worksheet 3.2 **How it all began…**

You are a detective looking at the evidence hinting at how the Universe began long ago, your goal is to come to a conclusion on how exactly it happened.

Q1. The stars in our Universe are constantly releasing light. Light is a wave and can come in different wavelengths (distance between two wave peaks). The way we view light can change depending on if the source of the light is moving, similar to when the sound of a siren or train horn changes as it passes by you.

a. When the source is moving toward you does the wavelength get shorter or longer, and why?

The wavelength is shorter because the people are closer together.
The wavelength is shorter because the notes sound higher.

b. Light from distant stars we observe are redshifted, which means their light appears closer to the red end of the visible light spectrum and they have a longer wavelength. Which direction do you think these stars are moving?

Moving away from us

c. The opposite of redshift is blueshift. What do you think blueshift means?

The wavelength is shorter and an object is moving away.

d. Based on your answers so far do you think the Universe is spreading out, getting closer, or staying still?

Spreading out because the stars are moving away

Q2. Robert Wilson and Arno Penzias were two astronomers looking at a different form of light which we cannot see called microwaves. They had a telescope but there was always background noise they couldn't account for. What was this mysterious noise?

The noise is coming from the Universe itself as the noise isn't coming from a particular place. Like in the model if you are a planet moving around and you hear a noise the sound should change depending on where you are.

This noise is left over from the Big Bang when the universe first came to be. It is not a noise you can hear though because it is actually a form of light that we cannot see.

Q3. Take a balloon and mark some dots, these are your stars. As you blow up the balloon it expands, similarly to how the universe is expanding. How would you calculate the speed at which the dots are moving? Use the boxes below to illustrate what the 'stars' look like at the start vs the end

Stars in the beginning	Stars in the end
	

Example calculation:

Speed = Distance / Time

Distance between two stars
Time taken for them to get that far apart

Q4. Using the example of the dots how might you calculate the speed at which the universe is expanding? What important pieces of information would you need?

Speed = Distance / Time

Distance between two real stars

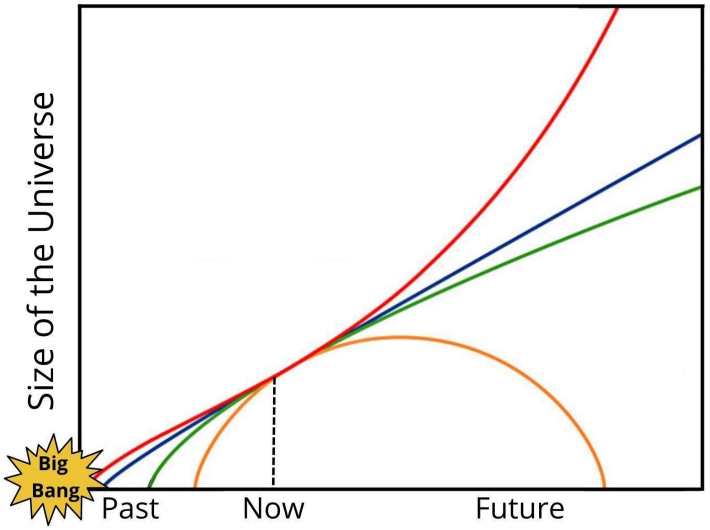
Time taken for them to get that far apart

Maybe you can also use redshift to find the speed

Q5. There were four theories for how the Universe will end.

- The Big Freeze - The Universe expands until the stars are so far away from each other (blue line)
- The Big Rip - The Universe expands quicker and quicker until even atoms are being torn apart. (red line)
- The Flat Universe -The Universe expands forever but constantly slows so expansion approaches zero. (green line)
- The Big Crunch - The Universe will start to slow and then collapse inwards leading to a reverse big bang. (orange line)

Which line in the graph below matches each theory.



Q6. The ending of the Universe is still an unanswered question and not one humans need to be worried about. Based on what you have learned so far, which do you think is the most likely way the Universe will end, and why?

- The big crunch because the Earth started so it needs to have an end
- The big freeze because everything is expanding and so it will keep doing the same thing