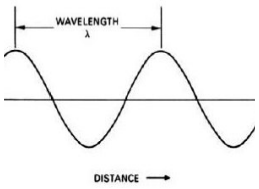
Science 10 Name:_____

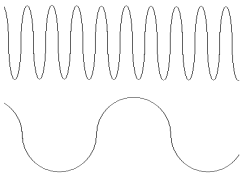
Mr. Korbutt Blk:_____ Date:_____

Evidence of the Big Bang Theory

Evidence Supporting the Big Bang Theory

- Electromagnetic Energy
- forms of energy that travel at the _____ _____ _____ (_____), each with its own frequency and wavelength
  - Electromagnetic spectrum
  - the total range of light/energy described in wavelengths and frequencies, from radio waves to gamma rays
  - radiation is energy carried by _____.
  - You can't see these waves, but they all have two characteristics to consider:
  - _____: the _____ from one point of the wave to the same point on another.





_____: is the _____of waves to pass a point in _____

- Frequency and wavelength are _____from each other, meaning when one goes ____ the other goes_____.

Why does this matter: Redshift

- The _____ _____ is part of this spectrum
- Visible light is a combination of _____ of light (ROY G BIV)
- Each colour has a different wavelength
  - Red light has the _____ wavelength
  - Blue light has the _____ wavelength
- Astronomers use the spectrum from distant stars to learn more about those stars
- Different _____ emit a unique set of colours their electrons are excited
- Coloured lines or emission _____ _____are a kind of signature or "fingerprint" for the atoms
- Each element has a different set of emission colours because they have different energy level spacing
- spectra allows astronomers to determine which chemical elements are present in the _____
- Indicates temperature, pressure, magnetic field, condition of gases in the star
- able to tell the _____ between Earth and the star is increasing or decreasing

Spectroscope

- instrument used to separate _____ into its colours
- Combination of a _____ and a tiny viewing telescope

Spectroscopy

- by comparing the lines from stars to those line spectra produced in the lab, scientists are able to identify the presence of particular elements.

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Doppler Effect

- Have you ever heard an ambulance speeding toward you with its siren?
- Does the sound change as the ambulance reaches you and speeds away from you?
- The Doppler effect is the _____ in frequency, or wavelength, of a wave due to its _____ relative to an _____
- This change in sound is an example of the _____ _____
- The sound into the boys left ear is shortened in wavelength because the ambulance is approaching him. _____ wave = _____ pitch
- The wavelength of the sound into his right ear is lengthened because the ambulance is moving away. _____ wave = _____ pitch
- The frequency of a wave is modified by the _____ of a source _____ or _____ from the observer.
- When a "source" approaches an observer, the wavelength are pushed together (shorter wavelength) which produces a higher frequency.
    - Spectral lines are shifted towards _____ wavelengths - a _____
- The opposite occurs when the "source" is receding from the observer.
    - Spectral lines are shifted towards _____ wavelengths - a _____

Cosmological Red Shift

- Edwin _____ observed the line spectra from many different galaxies in the sky
- most of the spectre for the galaxies were shifted towards the red end of the spectrum - a redshift
- Hubble concluded that is most of the galaxies were redshifted, they must be _____ in all directions and the universe is _____ from a single point - _____ _____
- He is famous for determining the direct relationship between speed and distance of receding galaxies

Cosmic Microwave Background Radiation

- In 1965 Arno Penzias and Robert Wilson were using a new microwave antenna with the intention of using ti for telecommunications
- What they picked up was microwave radiation from the sky in all directions, not just from stars.
- But what did it mean?
- Penzias and Wilson accidentally discovered _____ _____ _____ (_____) radiation
- It is believed that this is leftover radiation from the initial big bang.
- Penzias and Wilson later won a Nobel Prize for their serendipitous find.

Radiation Mapping

- In 1989, NASA laughed Cosmic Background Explorer (_____) satellite created detailed maps of the background radiation from distant parts of the universe
- Wilkinson Microwave Anisotropy Probe (_____) (launched in 2001) provided even more precise measurements of the radiation. WMAP confirmed the data gathered by COBE. Fig 4.42
- ESA launched _____ in 2009, to study the CMB in even greater detail. It

covered a wider frequency range and at a higher sensitivity

Where do we go from here?

Dark Energy

- The unknown energy that is causing the _____ of the expansion of the universe
- Supernovae in distance galaxies are _____ (∴ dimmer) than they should be, thanks to an accelerating universe
- They are travelling faster than predicted by their redshift, spectrum according to Hubble's Law
- Through the study of light from these distance supernovae, it was determined that the slowing universe started to speed up again _____ years ago.

Dark Matter

- 90% of matter in and between galaxies is of an unknown form that does not _____ or _____ light (so we can't see it)
- It can be detected through its _____ by the way it affects objects we can see
- Without dark matter, normal matter would have been unable to _____ and form stars and galaxies…even us

Your Mission

- Read Topic 4.4 Concept 1 & 3 p. 352-358, 362-365
- Complete Workbook Questions Topic 4.4
- Read Investigation 4D The Age fo the Universe p.366/367 for tomorrow