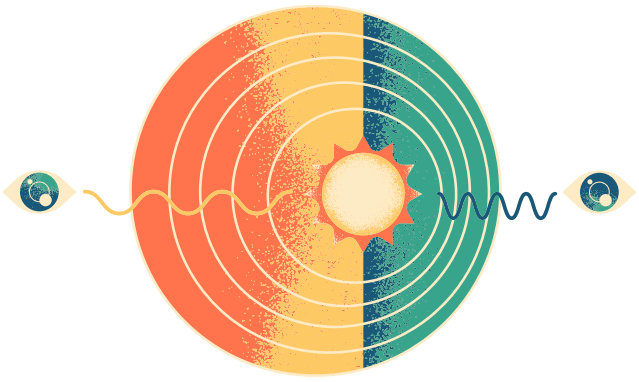
# Redshift - GCSE Physics

## Contents

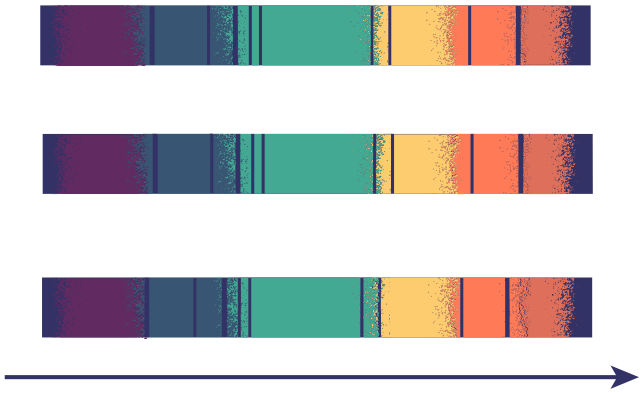


## 1. Introduction

- In Astronomy, redshift is used to describe celestial objects and distant galaxies that are moving away from Earth.
- Redshift is a phenomenon where wavelength of light emitted from a distant galaxy that is moving away from is shifted towards the red end of spectrum.
- Redshift is an evidence of the big bag theory's saying that universe is continuously expanding that is why its study become important.



**Redshift in Space (Distant moving Galaxies emitting light)**



**Visible Light Spectrum showing Red Shift**

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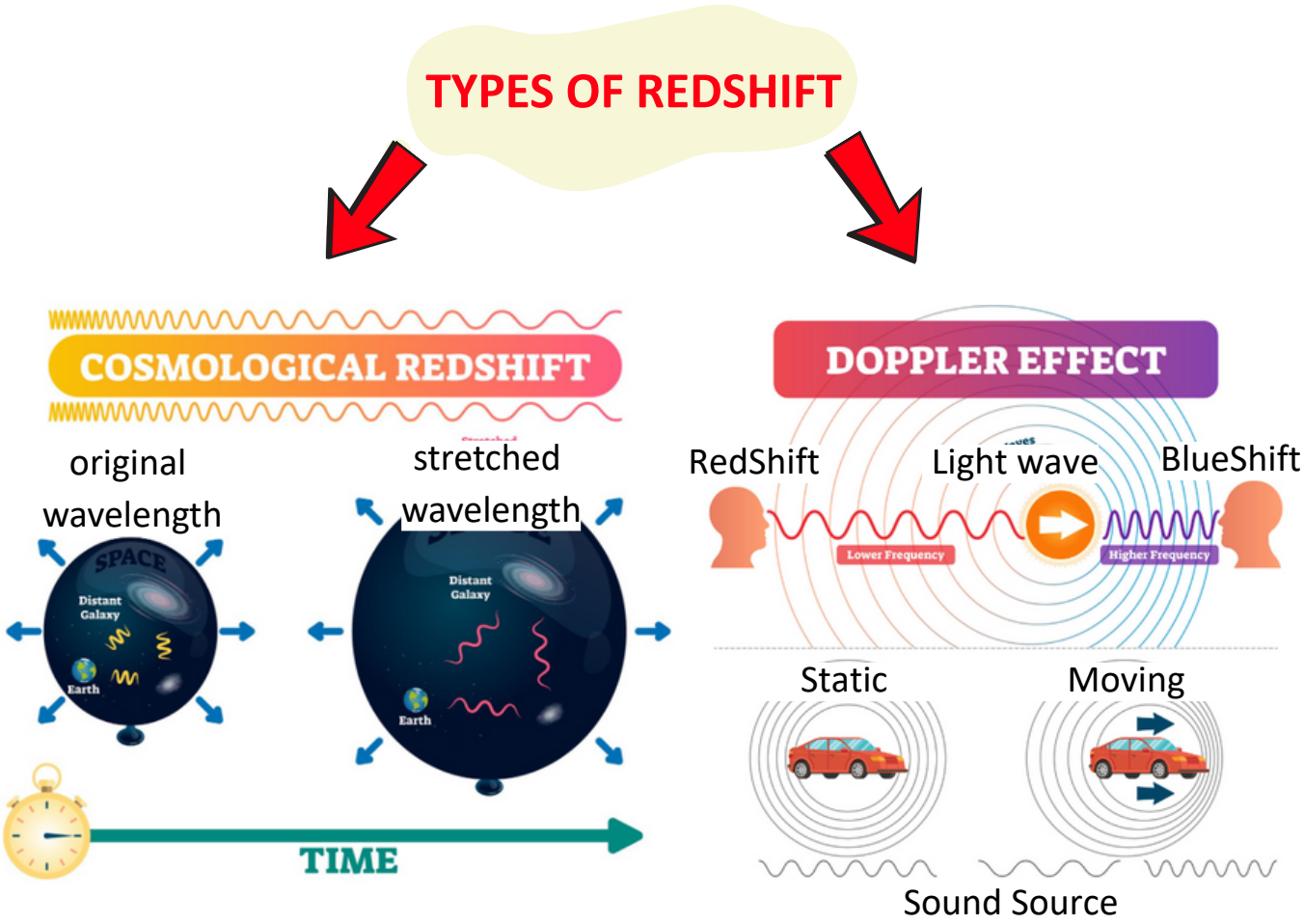
## 2. What is Redshift and Examples


**Red Shift is basically a phenomenon related to the origin of universe in which the wavelength from the distant celestial objects is stretched shifting it to the red end of the spectrum. This proves the fact that Universe is continuously expanding.**




It arises due to expansion of space, galaxies are moving apart from each other and the light stretches traveling through these galaxies

It occurs when a sound source is moving away from an observer causing the the sound waves to stretch

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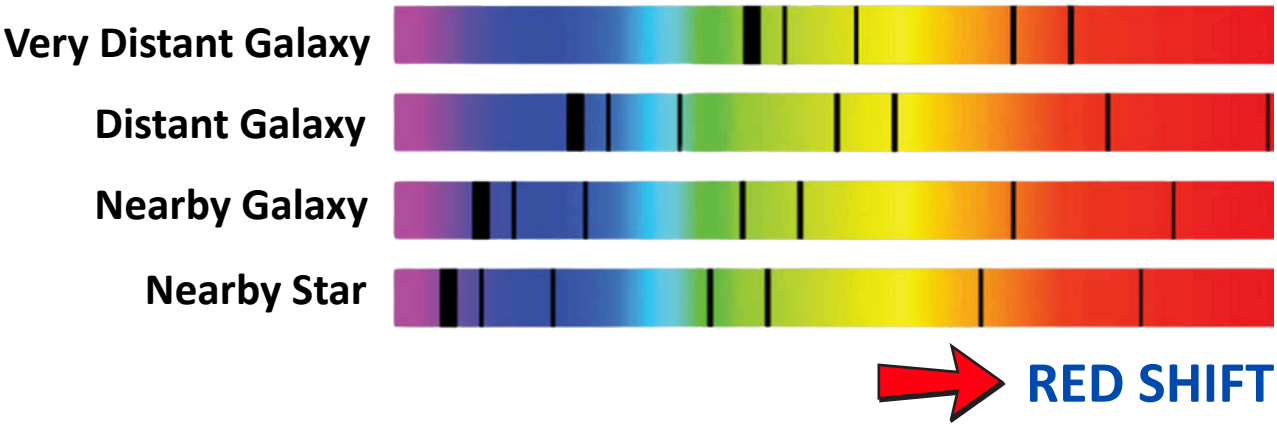
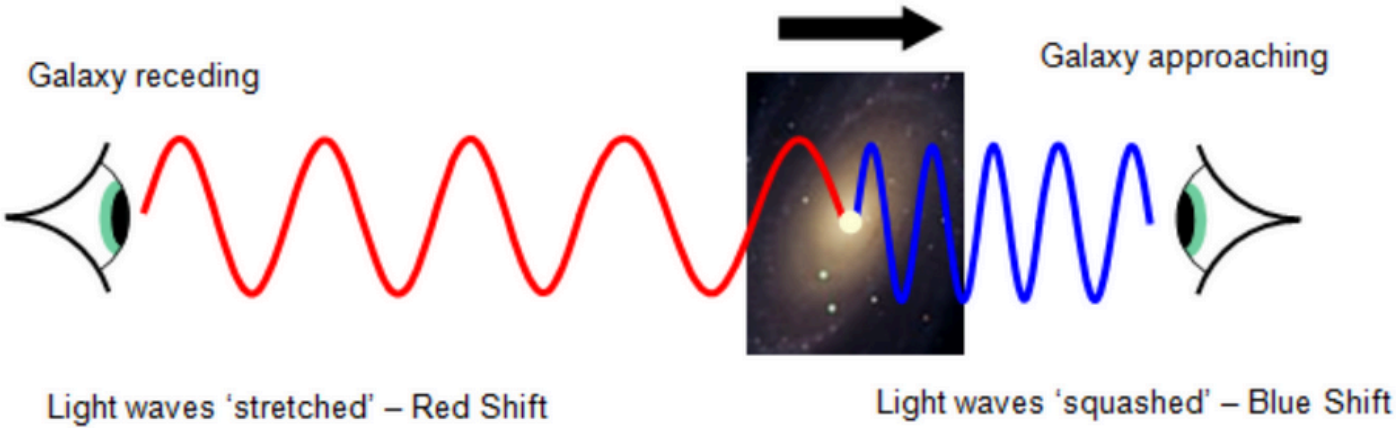
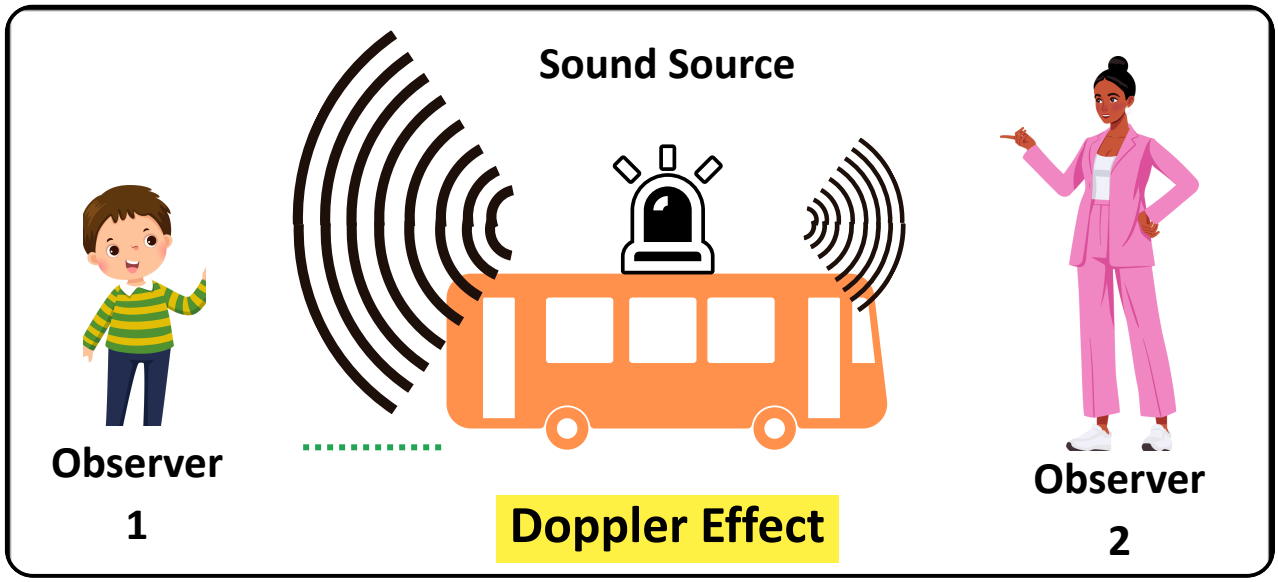


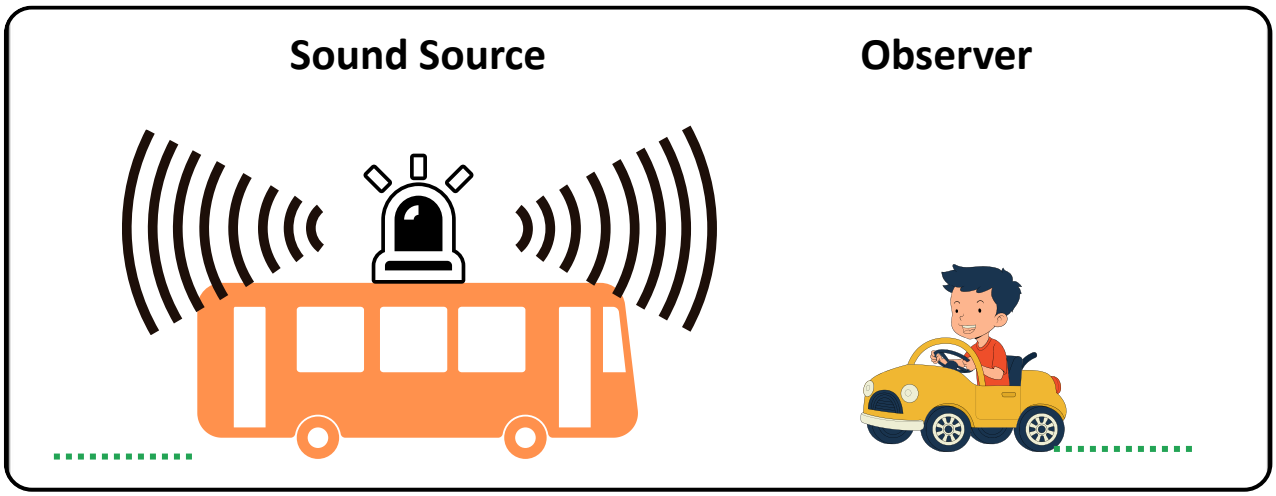

- The **visible light spectrum** show us the visible wavelengths and those exact wavelengths that are **absorbed by the gaseous molecules** present on the Sun. These molecules absorb some part of the light that reach at the surface of Earth. When examined we can see that those **black lines** shown in the visible light spectrum is the part that shows the absorbed wavelengths.

- It is observed that these black lines in **spectrums from different galaxies and stars are not the same** instead they are **shifted towards the red end**. That is called **Redshift.** This happens because the **Universe is expanding** and the **galaxies are moving away from earth**, **the farthest the galaxy the more Red shift** is observed in spectrum. This is related to origin of the Universe.



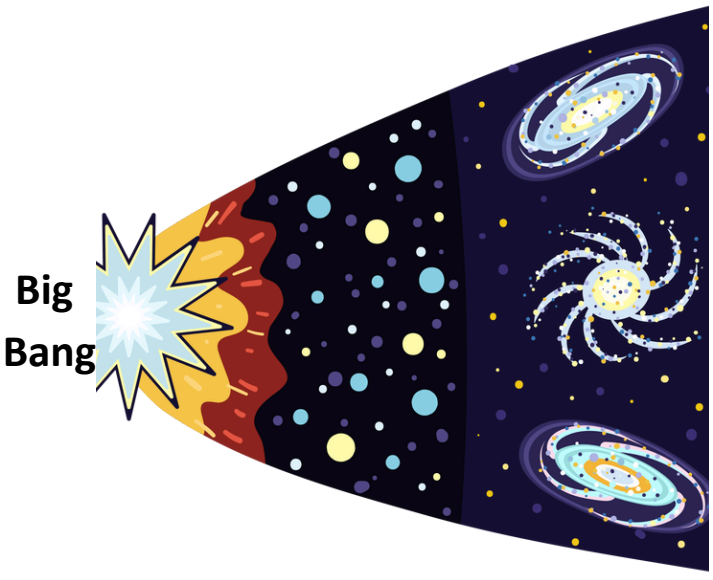


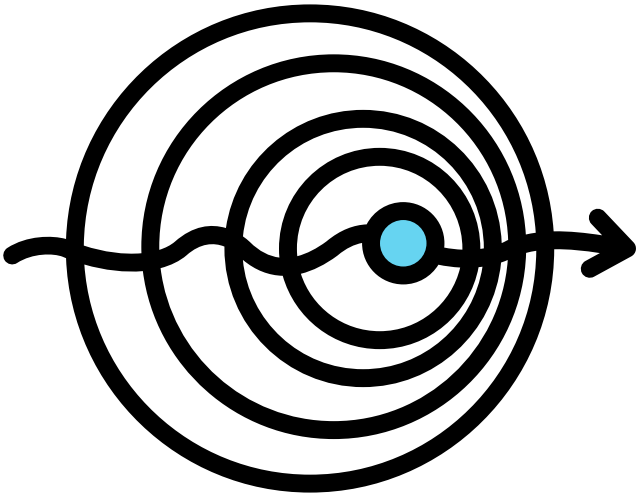

- The Siren bus is going **away from the observer 1** and **towards the observer 2,** we can see in the diagram clearly that the resource is producing sound waves of **more frequency towards the 2nd observer and the wavelength is low.** On the other hand the **sound waves** experienced by the **1st observer are of lesser frequency but higher wavelength.**
- Suppose there is a **3rd observer** who experiences the sound waves from the siren bus while he/she is **in car** and with **same velocity as that of the siren bus**, then there will be **no change in the sound waves** experienced by that observer.



## 3. Redshift and Origin of Universe

- **Redshift** is **fundamental concept** for understanding the **origin and expansion of Universe.**
- **In 1969, Edwin Hubble** discovered that there is relationship between Redshift of the light travelling from distant galaxies and expansion of universe.
- Due to the **expansion of Universe, the light wavelength travelling through it is stretched** resulting into **Cosmological Redshift.**
- The **Doppler Redshift** arises from the relative motion in space but the **Cosmological Redshift** is caused by the expansion of Universe itself.
- By the observations of distant galaxies through redshift, it is concluded that the **galaxies are made a million years ago from Big Bang.**



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## # Origin of The Universe

### Big Bang Theory

- According to the **Big Bang Theory** suggested in **1920's** the whole Universe and all matter in it started as **a tiny point of concentrated energy** about **13.5 billion years ago**. The Universe expanded from this point and is **still expanding**. As the Universe expanded, **gravity caused the matter to clump together** to form the stars and other celestial objects.

### Cosmic Microwave Radiations

- Astronomers discovered **radio waves coming all over from the Universe.** Astronomers realized that this was the **radiation predicted in Big Bang Theory**. **In the beginning of Universe huge amount of radiations were released** according to Big Bang Theory. The **wavelength of these radiation is now increased** and is only detectable as **Microwave radiations** called as **Cosmic Microwave Background(CMD).**

### Steady state Theory

- The theory was **suggested in 1948**. This theory says that the **Universe has already existed and is expanding.** New matter is continuously created as the Universe expands.

## 4. FAQ's

**(1) What is Redshift?**

**Answer:** Redshift is the phenomenon where the wavelength of light is stretched coming from the distant galaxies. It basically happens because of the galaxies moving away from us and the expansion of Universe.

**(2) How is Redshift measured/observed by Astronomers?**

**Answer:** Redshift is measured by observing Visible Light Spectrum.

**(3) How is Redshift related to Doppler effect?**

**Answer:** Redshift is a type of Doppler effect where the light gets stretched and its wavelength becomes longer and frequency lowers.

**(4) What does redshift from distant galaxies tell us?**

**Answer:** Redshift observed from distant galaxies tells us about the universe's expansion and origin of the universe and its evolution.

**(5) What is CMB?**

**Answer: CMB** is Cosmic Microwave Background, means that microwave radiations are coming from all over the universe which were radiated in the beginning of it through Big Bang explosion.