WJEC (Eduqas) Physics GCSE

6.5: Black Body Radiation

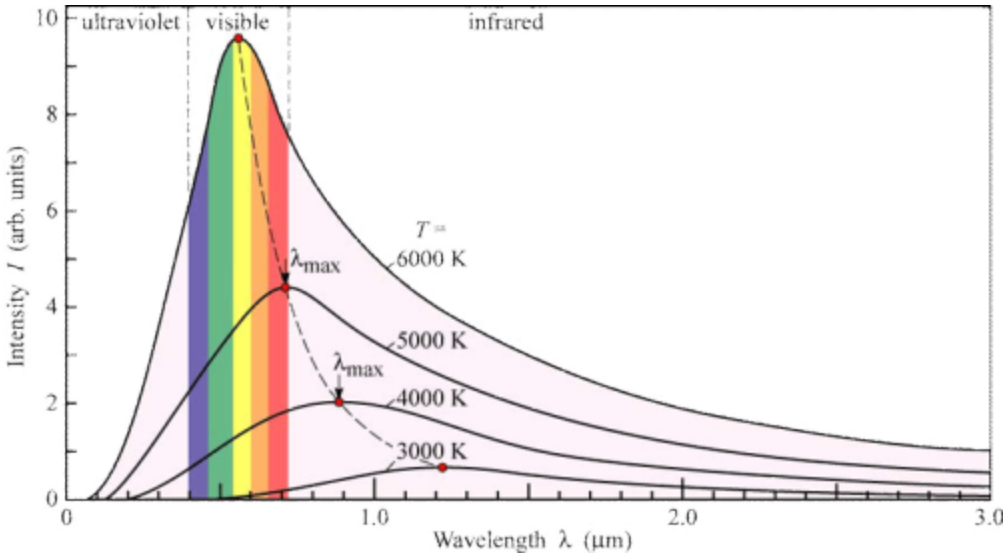
Detailed Notes

(Content in **bold** is for higher tier **only**)

Emission & Absorption

All objects **emit** and **absorb** electromagnetic radiation. The **intensity** and **type** of EM radiation depends on the **temperature** of the object. A **spectrum** of different wavelengths of radiation is emitted from objects, each with different amounts of energy.

As the temperature of an object's surface **increases**, the intensity of the radiation emitted **increases** and the wavelength of the peak intensity radiation **reduces**. This is often seen in stars; **hot stars** appear **bright** and **red** in colour whereas **cooler** stars are **dimmer** and **blue** in colour.



Intensity-wavelength graph for objects at varying temperatures (thestudentroom.co.uk).

Dark, **matt** objects are said to be the **best** absorbers and emitters of radiation. **White, shiny** objects are the worst as they **reflect** a lot of the radiation incident on them.

Black Bodies

Perfect black bodies are **theoretical**, meaning they don't really exist in the natural world. They have very special properties as they **do not transmit or reflect any radiation**, but then **absorb all radiation** incident on them. Black bodies are therefore also **perfect emitters** as objects that are good absorbers are also good emitters.

In the natural world, **stars** are considered to be the closest thing to a perfect black body as they are **good emitters** of almost all the EM spectrum. They are also **good absorbers** and the wavelengths that they don't absorb are so small, they are considered to be black bodies.

Earth's Temperature

Temperature on Earth changes due to fluctuations in the balance of emitted and absorbed radiation. If emission and absorption are **in balance**, the temperature remains **constant**. If

absorption is **greater than** emission, the temperature will **increase**. If absorption is **less than** emission, the temperature will **decrease**.

Several different factors affect how much radiation is emitted or absorbed, some are **natural** whereas some are influenced by increased **human activity**.

Greenhouse Gases

A greenhouse gas is any gas in the atmosphere that **absorbs radiation** within its molecular bonds. Examples include **carbon dioxide** (CO_2), **water** (H_2O) and **methane**. The greater the **concentration** of greenhouse gases in the atmosphere, the more radiation absorbed.

Emission & Absorption

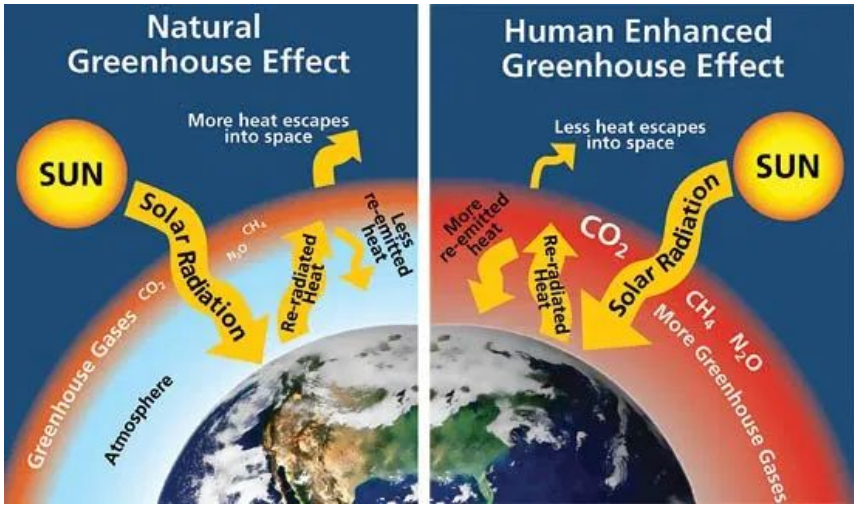
The temperature of Earth depends on the **balance** between infrared radiation **absorbed** by the surface and atmosphere, and the infrared radiation **emitted** from the surface and atmosphere. Absorbing this radiation will **increase** the **internal energy** of Earth and make it's surface **hotter**.

Radiation emitted from Earth's surface can be **absorbed** and **re-radiated** by the atmosphere, or it can **escape**, being **reflected** back out into space.

The Greenhouse Effect

The greenhouse effect is the effect of **natural** greenhouse gases **absorbing** and **emitting** radiation out in all directions. It helps to keep Earth at a **habitable temperature** for life.

However increased human activity has added **more greenhouse gases** to the atmosphere meaning the natural cycle is out of balance. As a result, more infrared radiation is **trapped**, being **absorbed** and **re-radiated** around the planet. Infrared absorption is therefore **greater than** emission, so the temperature of the planet **increases**. This is the '**enhanced greenhouse effect**' and is thought to be a contributor to global **climate change**.



The greenhouse and enhanced greenhouse effect (mrgeogwagg.wordpress.com).