

Electromagnetic Spectrum - Unit 1

What is electromagnetic radiation?	Electromagnetic radiation is a disturbance in an electric field.
Name the types of radiation in the electromagnetic spectrum in order of energy (highest first).	Gamma, X-ray, UV (ultraviolet), Visible, IR infra red, microwave, radio wave.
Do the waves cover a full range or are there discrete (separate) values for wavelengths of different types of energy?	The waves cover a continuous range of wavelengths called the electromagnetic spectrum. The types actually overlap!
Electromagnetic waves obey the wave formula: wave speed (metre/second, m/s) is equal to frequency (hertz, Hz) \times wavelength (metre, m). What happens to the frequency of a wave as the wavelength increases?	It decreases. The speed is constant so if wavelength increases frequency must decrease and vice versa.
Do high energy waves have a long or short wavelength?	A short wavelength - high frequency (think of the shaking a slinky demo!)
Do high energy waves have a high or low frequency?=-	A high frequency (think of the shaking a slinky demo!) and so a short wavelength
How does the electromagnetic spectrum travel?	All parts of it travel as waves of disturbances in an electric and magnetic field - hence the name!
How fast does each part of the electromagnetic spectrum travel in a vacuum?	All parts travel at the same speed - light travels at the same speed as radio waves - and as gamma rays! It is called the speed of light - 300,000,000m/s
Do all parts of the electromagnetic spectrum travel at the same speed through a medium other than a vacuum?	No, rays are refracted, slowed down as they travel through matter (think of the prism - blue bends best) Blue light slows down more than red light - but they still travel very fast!
What does the electromagnetic spectrum travel through best?	A vacuum - all parts of it do so at the same speed - the speed of light - the fastest possible speed - it is the only form of energy that can travel through a vacuum (space).
What does the electromagnetic spectrum do?	It moves energy from one place to as range of wavelengths called the electromagnetic spectrum.
What do the uses and hazards of the radiations in different parts of the spectrum depend on?	The frequency and wavelength of the wave. In other words the energy of the wave (energy is proportional to the frequency).
Which parts of the electromagnetic spectrum are the most hazardous?	The high energy parts (gamma, X-ray and high energy UV) because they are penetrating enough to enter our body cells and have enough energy to ionize DNA in our cells.
Why does UV radiation only	Because they cannot penetrate deeply enough to get through the

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cause skin cancer and not cancer of deeper organs?	skin. They are absorbed by the skin and do damage by ionizing the DNA in the skin cells only.
Have microwaves been proved to cause cancer?	No, we suspect they might be associated with cancers but we know they are not ionizing, so we don't know how they cause cancer or even if they do!
What do all parts of the electromagnetic spectrum do to something which absorbs them?	Make them get hotter.
Which parts of the electromagnetic spectrum are ionizing?	Gamma, X-ray and high energy ultraviolet.
What does ionizing mean?	It means that it makes ions form by giving enough energy to electrons orbiting the atom to escape and leave a charged ion behind. When this happens in complex molecules like DNA it can cause the structure to change - change the coding of the DNA.
Do ionising rays always cause cancer?	No, they just increase the probability of it developing as they cause mutations in cells that might be viable as a cancer cell.
What is the risk of gamma ray irradiation?	High level irradiation - cell death and radiation sickness and increase the risk of cancer; low level irradiation - increase the risk of cancer.
What is the risk of X-ray irradiation?	High level irradiation - cell death and radiation sickness and increase the risk of cancer; low level irradiation - increase the risk of cancer.
What is the risk of ultraviolet irradiation?	High level irradiation - skin cell death and severe sunburn and scarring (some of it in deep levels of skin that makes it age prematurely) and increase the risk of skin cancer - for the eyes - blindness; low level irradiation - increase the risk of cancer or cataracts of the eyes (opaque layer on the cornea).
What is the risk of microwave irradiation?	High level irradiation - heating of tissue and blood; low level irradiation - none proved.
How do we reduce exposure to gamma rays?	Radiation badges (dosimeters) monitor exposure of workers; lead aprons; doctors aim to minimise exposure within necessary treatments and never give unnecessary procedures that use them.
How do we reduce exposure to X-rays?	Radiation badges (dosimeters) monitor exposure of workers; lead aprons; doctors aim to minimise exposure within necessary treatments and never give unnecessary procedures that use them.
How do we reduce exposure to ultraviolet rays?	Sun cream absorbs them and/or reflects them, preventing them being absorbed into the skin. People are advised to avoid exposure to the sun at mid-day when the rays are most intense and to cover up with a hat and clothing.
How do we reduce exposure to microwaves?	We should only use cell phones for a minimal time - only when necessary - just in case there is a link between microwave radiation and brain tumours.
What three types of thing happen to a wave when it hits a surface?	It can be reflected, absorbed or transmitted.
What is the law of reflection?	Angle of incidence is equal to the angle of reflection.

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What type of surface is the best reflector?	A smooth shiny one.
What type of surface is the best absorber?	A dull, dark one.
What happens when radiation is absorbed?	The energy it carries makes the substance which absorbs it hotter and may create an alternating current with the same frequency as the radiation itself - this happens in aerials!
What type of electromagnetic energy is used for communication?	Radiowaves, microwaves, infra red and visible light.
Why are microwaves used to send information to and from satellites and within mobile phone networks?	Because they can pass through the Earth's atmosphere quite easily and be received and re-transmitted by the satellites without losing much of the signal.
Why can't radio waves be used to send messages to satellites?	Radio waves that hit the atmosphere normally leave the atmosphere (that is why we can receive them from outer space) but those that hit it at an angle tend to reflect within the atmosphere (like IR within optical fibres) - so they wouldn't get outside the atmosphere to the satellites.
What is used to send signals along optical fibres?	Infra red and visible light can be used to send signals along optical fibres and so travel in curved paths - they actually reflect within the fibre, but still stay inside if the fibre is curved.
Name the two types of communication signal that we can use.	Communication signals may be analogue (continuously varying) or digital (only on and off).
Which type of communication signal is the best (and why)?	Digital signals are best - they are less prone to interference problems than analogue (because it is easier to sort out the interference and get rid of it) and can be processed by computers.