education

Department of
Education
FREE STATE PROVINCE

TECHNICAL SCIENCES

SUPPORT MATERIAL

GRADE 12

MARCH 2018

This document consists of 8 pages

TOPIC 9: ELECTROMAGNETIC RADIATION

Prescribed content

Electromagnetic radiation

- Define an electromagnetic wave and discuss its properties.
- Discuss the electromagnetic spectrum in terms of frequency and Wavelength
- Give the uses of electromagnetic radiation.
- Define a photon and give its energy as E = hf.
- Use E = hf in calculations.

Important terms/definitions

Electromagnetic wave	changing magnetic and electric fields that are mutually perpendicular to each other and perpendicular to the direction propagation of the waves.
Photon	a quantum of electromagnetic energy
Wavelength	the distance, measured in the direction of propagation of a wave, between two successive points in the wave that are characterized by the same phase of oscillation.
Frequency	the number of complete oscillations per second of energy (such as electromagnetic radiation) in the form of waves

Formulae

$E = h f$	E: the energy of a photon (J) f : the frequency of a photon (Hz) h: Plank's constant with the value of $6{,}63 \times 10^{-34}$ (J·s)
$c = f \lambda$	c: speed of light ($m \cdot s^{-1}$) f : frequency of the wave (Hz) λ: wavelength of the wave (m)
$E = \frac{hc}{\lambda}$	Combination of the two above equations

Mind map

Distance between wave crest
IS Unit
Meters

ELECTRO MAGNETIC WAVES

Define as

Self-propagating, changing magnetic and electric fields that are mutually perpendicular to each other and perpendicular to the direction propagation of the waves

Have Properties of

Defined as Wavelength

Frequency Defined as

Number of waves per second
SI Unit Hertz

Range is called the

Electromagnetic Spectrum

Which includes

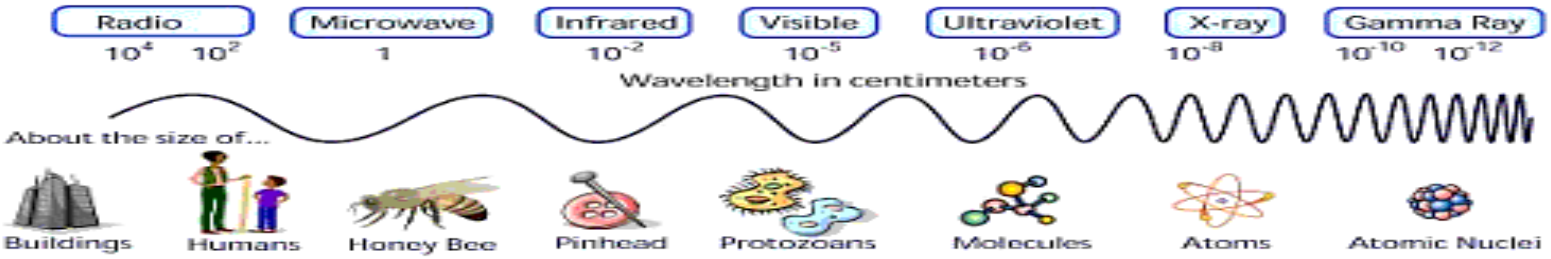
Can travel through

Vacuum Empty Space

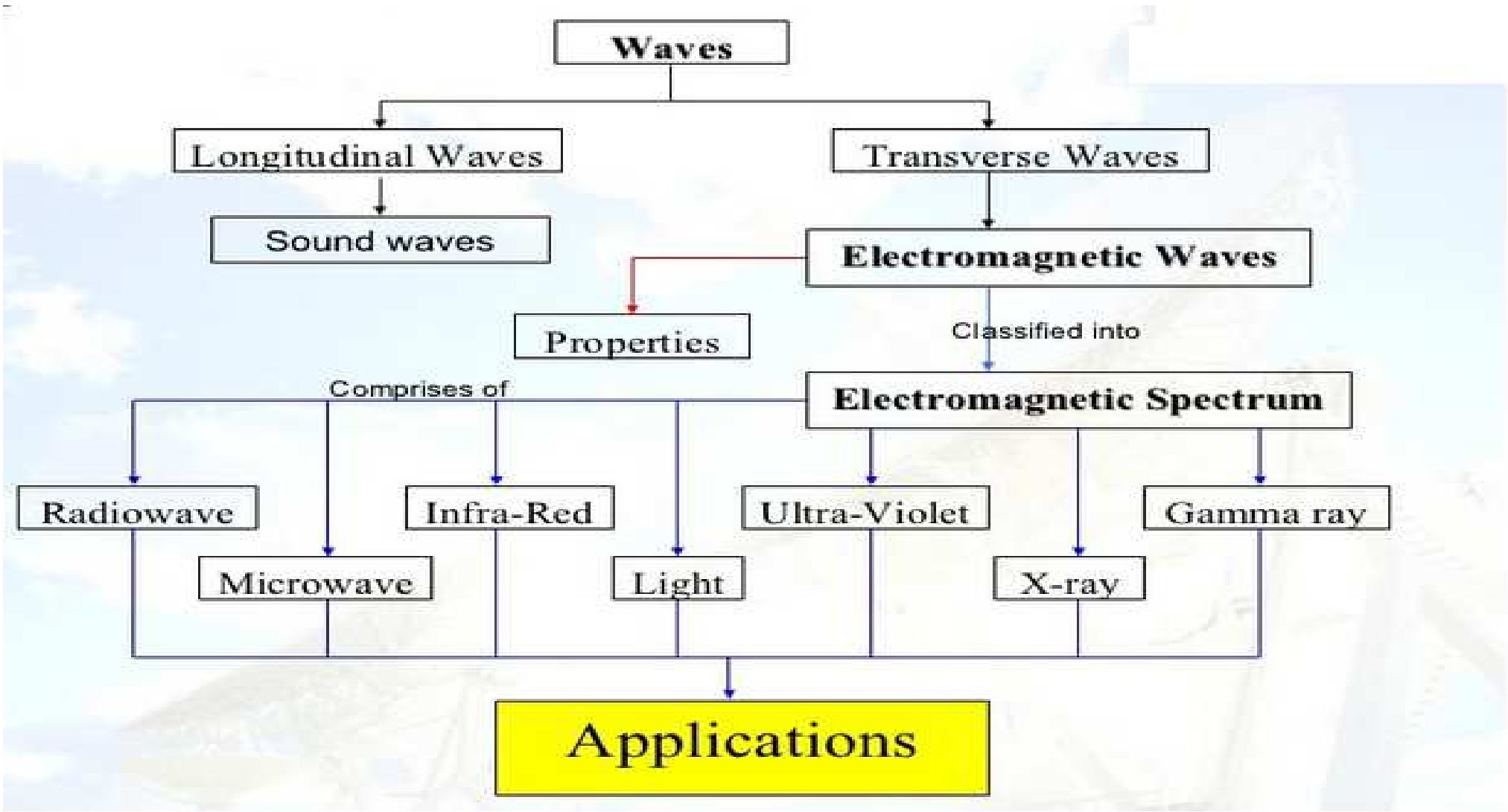
Sun's energy goes to Earth

Electromagnetic Radiation

Photon and give its energy as E = hf



Min map



Activity 1

1.1 Define Electromagnetic wave

1.2 List the properties of the electromagnetic radiation

1.3 Discuss the Electromagnetic spectrum in terms of frequency and wavelength

1.4 Complete the table below by matching the types of radiation with its application/ Uses, life science aspect and its issues.

ELECTROMAGNETIC SPECTRUM

Type of radiation	Applications/ Uses	Life science aspect	Issues
Radio and TV			
Microwaves			
Infrared			
Visible light			
Ultraviolet			
x-rays			
Gamma rays			

Use the words in the table below complete the table above.

Applications	Life science aspect	Issues
Nuclear medicine security	Medical diagnosis, cancer therapy	Cell phone use
Thermal imaging heating	Deep heating	Cancer causing
Communication, ovens, radar	Vitamin D production	
Medical security	Absorbed by atmosphere	Ozone depletion, cancer causing
Communications remote controls	MIR	Cancer causing. Radiation damage
All pervasive	Medical diagnosis, cancer therapy	Requires control for band use
Sterilization. Cancer control	Photosynthesis, human vision	Greenhouse effect

Activity 2

2.1 Describe a photon of light as a quantum of energy

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2.2 Calculations problems

2.2.1 Ultraviolet radiation has a frequency of $6.8 \times 10^{15}\ s^{-1}$. Calculate the energy, in joules, of the photon.

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2.2.2 Calculate the energy, in joules per photon, of microwave radiation with a frequency of $7.91 \times 10^{10}\ s^{-1}$.

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2.2.3 A sodium vapour lamp emits light photons with a wavelength of 5.89×10^{-7} m. What is the energy of these photons?

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2.2.4 One of the electron transitions in a hydrogen atom produces infrared light with a wavelength of 7.464×10^{-6} m. What amount of energy causes this transition?

2.2.5 Find the energy in kJ for an x-ray photon with a frequency of 2.4×10^{18} s^{-1}.