ST NINIAN'S HIGH SCHOOL

East Renfrewshire

East Renfrewshire Council: Education Depart
Practitioner Moderation Template

Prior to the moderation exercise, please complete the following information and submit it to your facilitator with assessment evidence from one learner that you judge to have successfully attained the Es' and Os'.

Experiences and Outcomes:

By exploring radiations beyond the visible, I can describe a selected application, discussing the advantages and limitations.

SCN 3-11b

Describes the electromagnetic spectrum as a family of waves including Gamma rays, X rays, Ultraviolet, visible light, infrared, microwaves, television and radio.

Extended learning

By carrying out a comparison of the properties of parts of the electromagnetic spectrum beyond the visible, I can explain the use of radiation and discuss how this has impacted upon society and our quality of life.

SCN 4-11b

Compares non-visible parts of the electromagnetic spectrum, finding their common properties (speed propagation) individual properties(range of frequencies, wavelengths) and discusses their uses.

Learning Intentions:

To investigate areas beyond the visible spectrum using a prism and photodiode

To explore uses and detection of infrared, microwaves, radio waves, ultraviolet and X-rays through discussion, demonstration and research.

To research medical applications of the electromagnetic spectrum on the internet.

To present information as part of a team in the form of a presentation about an area of the spectrum, it's properties and uses.

Success Criteria:

(Study Guide1.2 Electromagnetic Spectrum 1-5)

1. I can state in order of increasing wavelength the bands of the electromagnetic spectrum: Gammma rays, X rays, ultraviolet, visible light, infrared, microwaves, TV and radio.
2. I can state detectors of the different bands of the Electromagnetic Spectrum
3. I can describe one use of X-rays ultraviolet and gamma radiation in medicine and the use of microwaves and radio waves in telecommunications
4. I can describe where to find each band in the spectrum in order of wavelength, frequency or energy.

5. I can state that all radiations in the electromagnetic spectrum travel at the speed of light.

6. I can work as part of team to produce a presentation meeting guidelines given.

Briefly outline the context and range of quality learning experiences that have been provided making reference to the chosen design principles.

Teacher Guide attached

Lessons

1. **Detecting Infrared** (depth, relevance, progression).
Experiment to observe that signals are detected beyond the red end of the spectrum introducing the 'invisible' areas of the spectrum
Investigating Infrared (breadth, enjoyment, coherence)
Short video clips, virtual animations of use of IR camera to find out how infrared is used particularly in thermography to find blood clots, infection and tumours.

2. **Investigating UV and X-rays** (breadth, enjoyment, coherence)
Use UV lamps to show fluorescence. Show how this can cause photosensitive chemicals on a safety badge to change colour and investigate how we can protect ourselves from UV from the sun. Discuss advantages and disadvantages of UV exposure.
Discussion of how X-rays are taken and what they can show. CT scan versus X-rays discussed. When are X-rays not appropriate? How do dentists/radiographers protect themselves?

3. **Investigating properties of microwaves, radio and TV waves** (breadth, enjoyment, coherence)
Show how radio waves are generated. Show properties including reflection and diffraction. Use a dish reflector to focus microwaves. Use mobiles to demonstrate transmission of radio. Bluetooth/microwaves discussion.

4.**Investigating Gamma** (depth, challenge, progression)
Show Geiger counter detecting background radiation and radiation from rock samples.
Show the absorption of radiation and discuss safety precautions.
Use animation to show the use of Gamma as a tracer because it can pass through the body.

5.**Consolidation of knowledge** (challenge, progression, coherence)
Answer Written Questions on the Spectrum Order and Detectors
Discussion of answers

6.**Researching the EM spectrum** (challenge, enjoyment, breadth, personalisation & choice)
Use of internet to research the spectrum and its applications.
Presenting the information in power point as part of a team.

Record the range of assessment evidence that was gathered to meet the success criteria (Say, Write, Make, and Do) considering breadth, challenge and application.

Say
Most verbal interactions (questions/discussions) were not recorded – but end of lesson quiz answers were given aloud. Self checks and homeworks were also discussed.
Photograph of pupils presenting their work **SC 5**
Copies of written feedback generated by team discussion **SC 5**

Write
Recording results of 'Detecting infrared' **SC 1 & 2**
Recording use of fluorescent chemicals **SC2**
Self Check answers on wavelength, frequency & energy, location of each band and detection of different types. **SC 1,2,4&5**
Homework answers on wavelength and frequency, speed, location of each band, medical uses and telecommunications uses. **SC1,3,4 & 5**
Answers to end of lesson quiz on wavelength & speed **SC1,5**

Make
Copy of Power Point on Infrared (criteria included)

Do
Pupils carried out an experiment to detect infrared using a photodiode. **SC 1 & 2**
Pupils investigated the effect of UV on photosensitive chemicals, namely inks – other items also tested not recorded. **SC2**
Pupils peer reviewed power point presentations – copies kept **SC5**

Briefly outline the oral/written feedback given to the pupil on progress and next steps, referring to the learning intention and success criteria.

Oral feedback given throughout e.g on detector types when correcting self checks and return of homework.

Written feedback in class jotter and homework jotter highlighted.

Peer feedback on presentation of research given along with teacher feedback.

Pupil Voice:
What have you learned? How did you learn? What skills have you developed?
Pupil gave peer reviews of presentations.

Pupils said they enjoyed researching and presenting and were surprised by how the existence of infra red was originally detected.

Did the learner successfully attain the outcomes? **YES**

WAVES AND RADIATION
Study Guide

1.2 Electromagnetic Spectrum

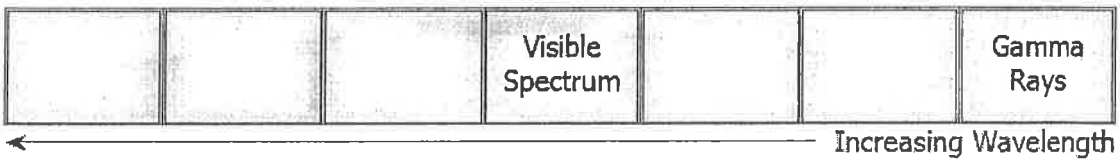
At the end of the section you should be able to :

- ❑ 1 State in order of increasing wavelength the bands of the electromagnetic spectrum: Gamma rays, X rays, ultraviolet, visible light, infrared, microwaves, TV and radio.
- ❑ 2 State sources and detectors of the different bands of the electromagnetic spectrum.
- ❑ 3 Give examples of applications for each band of the electromagnetic spectrum.
- ❑ 4 State that the higher the frequency of electromagnetic radiation the greater the energy of the wave.
- ❑ 5 State that all radiations in the electromagnetic spectrum travel at the speed of light.

Self Check 1.2 Electromagnetic spectrum

1. Which member of the electromagnetic spectrum has:-
   (a) the highest frequency
   (b) the highest energy

2. (a) Copy the diagram of the electromagnetic spectrum and complete it with the following words:-
   Visible Light, Infrared, X-rays, Ultraviolet, Radio & TV,
   Gamma Rays and Microwaves.



   (b) Which of the radiations in the diagram has the lowest frequency.

3. What speed do all the waves in the electromagnetic spectrum travel at?

4. What frequency of light is emitted by a helium neon laser which has a wavelength of 632.8 nm?

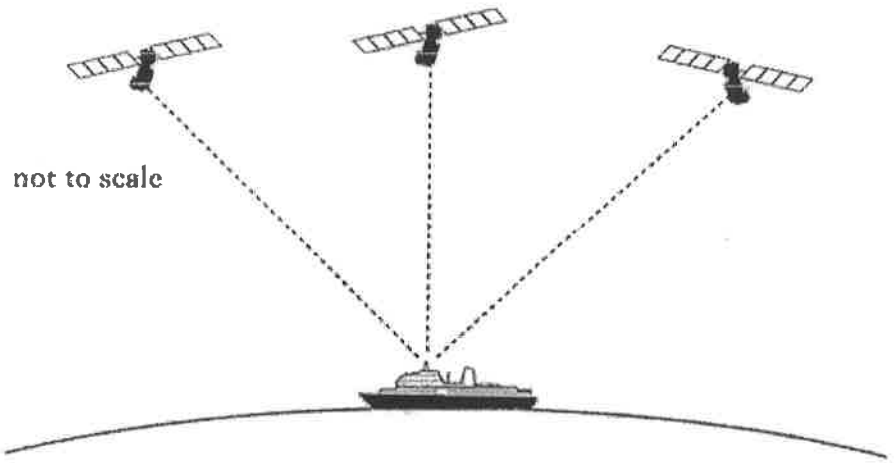
5. Copy and complete the table shown below giving examples of applications of each member of the electromagnetic spectrum.

TYPE OF RADIATION	Sources	Detectors
Radio & TV		
		CCD
Visible		CCD
Ultra Violet		CCD /Photodiode
		CCD
Gamma rays		

6. Name three types of radiation that are emitted from the sun.

7. Name three types of radiation that are emitted from electronic circuits.

8. A ship has a satellite navigation system. A receiver on the ship picks up signals from three global positioning satellites.



These satellites can transmit radio signals at three different frequencies, 1176MHz, 1228MHz and 1575MHz. The satellites orbit at a height of 20200km above the Earth's surface.

(a) (i) State the speed of the radio signals.

(ii) One of the satellites is directly above the ship. Calculate the time taken for the signal from this satellite to reach the ship.

(iii) Calculate the wavelength of the 1228 MHz signal.

(b) State which of the three signals has the shortest wavelength.

1.2 EM Spectrum

1(a) Gamma

(b) Gamma

2(a)

Radio and TV Microwaves Infra Red Visible Ultra Violet X Ravs Gamma Ravs

3 $3x\ 10^{8}\ ms^{-1}$

4. $v = f \times \lambda$, $3x\ 10^{8} = f \times 632.8 \times 10^{-9}$, $f = 5 \times 10^{14} Hz$

5.

Type of Wave	**Typical Source(s) of Wave**	**Application(s)**	**Detector(s)**
Radio and TV	electronic circuits	communications	Antenna / Aerial, Radio Telescopes
Microwave	electronic circuits	communications, heating food	Antenna / Aerial, Radio Telescopes
Infra Red	warm objects, the Sun	remote control (TV) treating muscle injuries	Charge-coupled Diodes (CCDs), Thermistors, thermocouple
Visible Light	LEDs, Lamps, the Sun	seeing, photography	Eye, CCDs Photographic Film. LDR, Photodiode
Ultra Violet	gas discharge lamps, the Sun	making vitamin D, treatment for skin conditions	Fluorescent Materials, Photodiode, CCDs

X Rays	very fast electrons striking a metal surface	detecting broken bones, scanner at airport	Photographic Film, CCDs
Gamma Rays	radioactive nuclei decaying	sterilisation, medical / industrial tracers cancer treatment	Photographic Film Geiger-Muller Tube

6. Visible, UV, IR etc

7. microwave, TV and radio

ELECTROMAGNETIC SPECTRUM

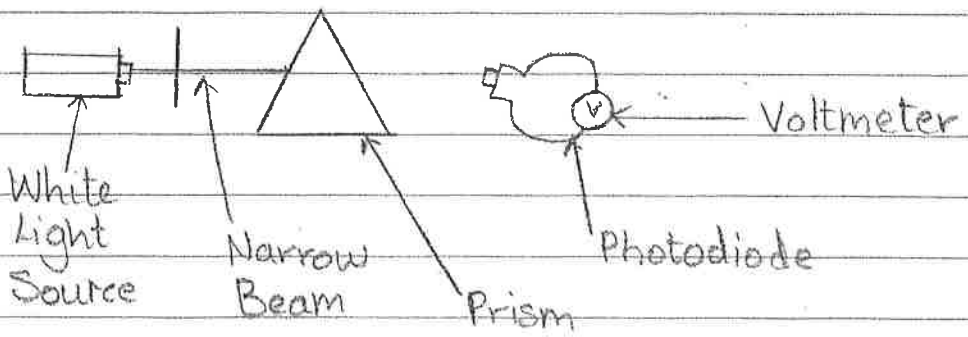
1st Sept'17 Detecting Infrared

AIM:
To detect infrared using a photodiode. To compare the voltage with the that of visible light.

LEARNING INTENTION 1+2

METHOD: *

CONTRIBUTES TO SUCCESS CRITERIA 1+2

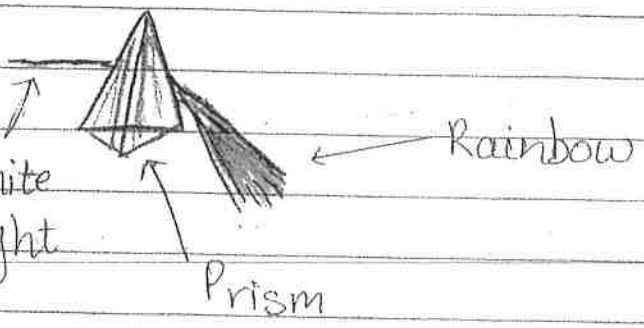


RESULTS-

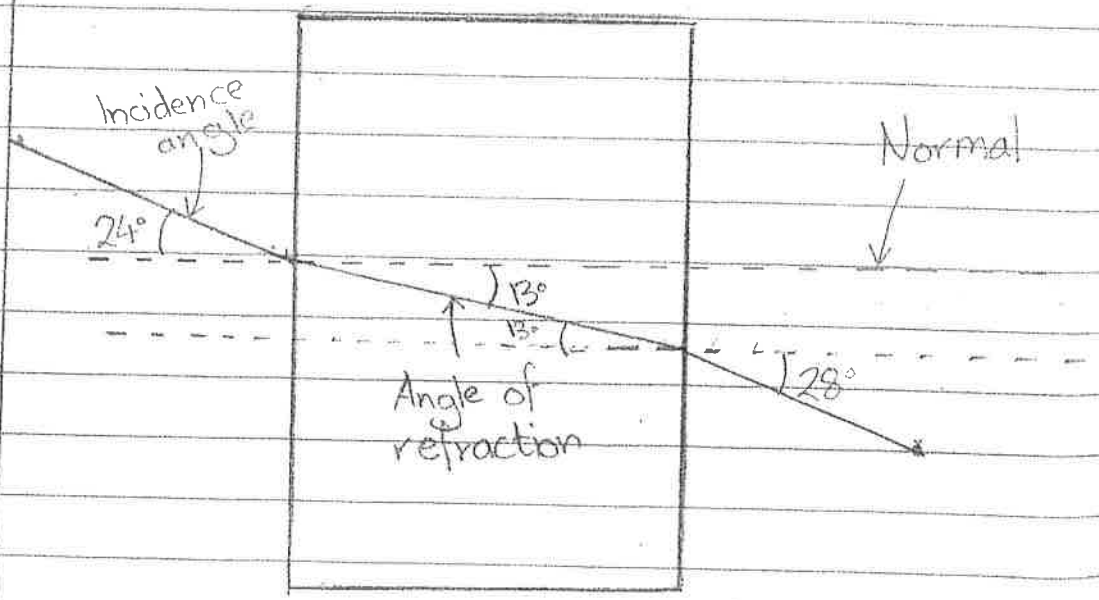
	Voltage (mV)
No light source	73.3
Violet	70.9
Green	71.6
Red	82.8
Outside red	92.2

* Record the voltage for each colour and outside the red end.
Draw the spectrum and prism.

DRAWN IN COLOUR



21st Sept '17 Refraction



ELECTROMAGNETIC SPECTRUM

5th Sept'17 UV Light

LIs 1+2

SC 1+2

← Security pen

Highlighter ↙

7th Sept'17 Self Checks

SC 4

a) Gamma ✓

b) Gamma ✓

2a)

| RADIO AND TV | MICROWAVES | ~~INFRA~~ INFRARED | VISIBLE LIGHT | UV | X-rays | GAMMA | ✓

SC 1

b) Radio and TV ✓

SC 4

SC 5

3. $3 \times 10^8 \text{ ms}^{-1}$ ✓

4. $V = F\lambda \quad | \div \lambda$

$V/\lambda = F$

$3 \times 10^8 / 632.8_{\times 10^{-9}} = F$

~~474083Hz = F~~ $4.74\text{~~83~~ Hz} = F$ ✓

good on sf

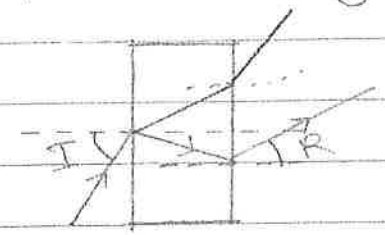
5.

Type of Radiation	Sources	Detectors
Radio and TV	Radio station	TV/~~Radio~~ ariels
Microwaves	Microwaves	~~Food~~ Diode
Infrared	Body Heat	CCD (Charge Coupled Device)
Visible	Sun	CCD
UV	Sun	Skin (photosensitive chemicals)

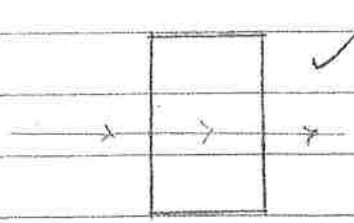
SC 2

1. Refraction is the change in speed of light (and wavelength) ~~through~~ a material of different density.

2a)



b)

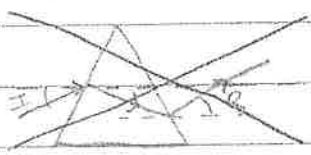


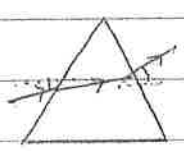
✓

Angle of incidence = 0°

refraction = 0°

c)





Homework 4

1. The parts of the electromagnetic spectrum are shown below.

Visible Light	Infrared Radiation	Gamma Rays	Ultraviolet Radiation
X-Rays	Radio Waves	Microwaves	

   (a) Rearrange these electromagnetic waves so that they are in order of **increasing frequency**.
   (b) What happens to the wavelength of electromagnetic waves as frequency increases?
   (a) What happens to the energy of electromagnetic waves as the frequency increases?
   (a) What speed do all electromagnetic waves travel at (in a vacuum)?

2. Briefly describe an application of the following types of electromagnetic radiation in medicine:
   (a) Ultraviolet
   (b) X-Raya
   (c) Gamma Rays

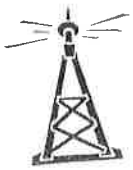
3. Briefly describe an application of the following types of electromagnetic radiation in telecommunications:

   (a) Radio waves
   (b) Microwaves

4. A microwave of frequency 300MHz travels for a distance of 4500km.

   (a) Calculate the wavelength of the wave.
   (b) Calculate how long it takes for the wave to travel this distance.

5. A radio carrier wave is sent out from BBC Radio 1 in London with a frequency of 97.5 MHz. A student in Edinburgh (which is 670 km away) is listening to the broadcast.



   (a) What is the wavelength of this radio wave?

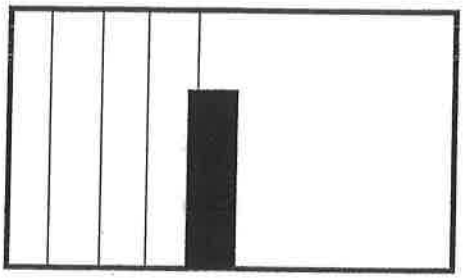
   (b) How long will it take the wave to travel from London to Edinburgh?

Homework 4 continued

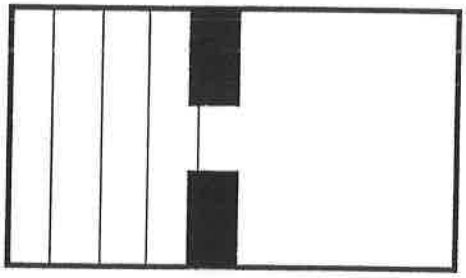
6. What is meant by the term 'diffraction'?

7. Copy and complete the diagrams below to show how waves would bend around the objects

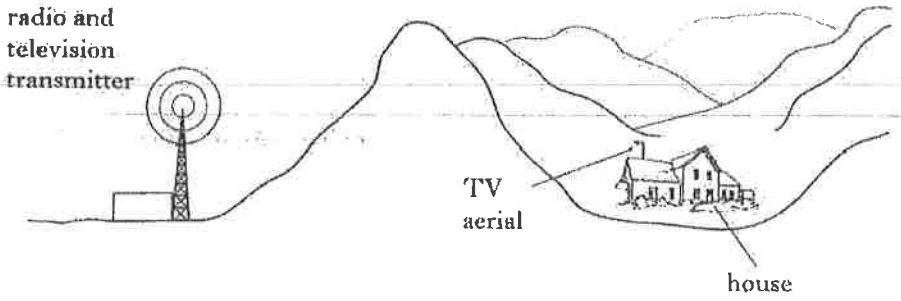
(a)



(b)



8. A hill lies between a radio and television transmitter and a house. The house is within the range of both the radio and television signals from the transmitter.



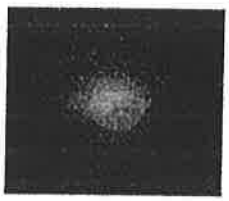
The house has a good radio reception but a poor television reception. Suggest an explanation for this.

9. The sun emits both infrared and visible light.

(a) State which of these two has the greatest wavelength.

(b) How does the speed of red light compare with infrared?

(c) Red light has an approximate wavelength of 690 nm (690×10^{-9}m). Calculate the frequency of red light.



Homework 4

1)

a) Radio & TV Waves

Microwaves

Infrared

Visible Light

Ultraviolet

X-Rays

Gamma

b) The Wavelength decreases as the frequency increases

c) The energy increases as the frequency increases

d) They all travel at $3x10^{8}ms^{-1}$

2)

a) Ultraviolet is used to sterilise equipment

b) X-rays can be used to detect broken bones

c) Gamma rays can be used to kill cancer cells or sterilise equipment

3)

a) Radio Waves are used to transmit Radio and TV signals

b) Microwaves are used by mobile phones

4)

a) 1m

b) 0.015s

5)

a) 3.1m

b) $0.002s = 2x10^{-3}s$

6) Diffraction is the bending of waves as they pass through a gap or round an obstacle

25th Sept '17 | Homework 4

2! Excellent!
2! Ione

1a)* Gamma Rays → X-Rays → UV → Visible Light → Infrared → Microwaves → Radio Waves

SC4

1 b) The wavelength decreases as the frequency increases.

1 c) As the frequency increases as does the energy.

SC5

1 d) All waves in the spectrum travel at ~~300~~ $3 \times 10^8 ms^{-1}$.

1 * Radio Waves → Microwaves → Infrared → Visible Light → UV → X-rays → Gamma rays

SC3

1 2a) UV is used in treating skin conditions.

1 b) X-rays can be used to view bones.

1 c) Gamma Rays can treat cancer. (kills cancer cells)

SC2

1 3a) Radiowaves are ~~using~~ used in broadcasting music/news.

1 b) Microwaves are used in transmitting mobile phone calls.

4a) $v = f\lambda$ | $\div f$

$v/f = \lambda$

$3 \times 10^8 / 300 \times 10^6 = \lambda$

3 $1 = \lambda$ 1m ✓

b) $v = d/t$ | $\times t$

$vt = d$ | $\div v$

$t = d/v$

3 $t = 4500000 / 3 \times 10^8$

$t = 0.015_s$ ✓

5a) $v = f\lambda$

$3 \times 10^8 = 97500000 \times \lambda$ | $\div 97500000$

$3 \times 10^8 / 97.5 \times 10^6 = \lambda$

3 $3.08 = \lambda$

3.08_m ✓

b) $v = d/t$ | $\times t$

$vt = d$ | $\div v$

$t = d/v$

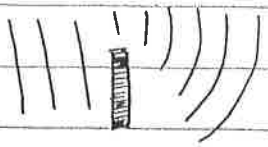
3 $t = 670000 / 3 \times 10^8$ ✓

$t = 0.002_s$

6. Diffraction is when ~~the speed of light changes~~ a wave meets the edge of a barrier and it bends around it. ✓

1

7/9 Good work!

7a) 

needs to be more carefully drawn with a ruler

b) 

8. Radio has a longer wavelength than TV. Waves with longer wavelengths diffract more and get to the house. (SC4) 1

(SC4) 1 9a) Infrared has a longer wavelength than visible light.

(SC5) 1 b) The speed of both waves are the same - $3 \times 10^8 ms^{-1}$.

c)

$v = f\lambda$

$3 \times 10^8 = F \times 690nm \quad | \div 690 \times 10^{-9}$

$4.35 \times 10^{14} = F$

3

$4.35 \times 10^{14} Hz$

End of lesson Revision Quiz Questions (verbal)

1. Give the definition of refraction.

   The change in speed (and wavelength) when light passes from one medium to another
2. State the colours of the spectrum in order of increasing wavelength

   VIBGYOR
3. Which part of the spectrum has the longest wavelength?

   Radio
4. Give an example of a longitudinal wave?

   Sound
5. What property do all EM waves have in common?

   Speed – 3×10^8 ms^{-1}

b) ✓

c) advantage = no CO_2 released into atmosphere
disadvantage = waste harms wildlife

Quiz

CORRECTED BY PUPIL

1. Refraction is the change in speed and wavelength of light as it enters a medium of different density. ✓

ANSWERS DISCUSSED AS A CLASS

2. ~~Radio → Microwaves~~ → Red, Orange, Yellow, Green, Blue, Purple ✓
Indigo + Violet = this is in order of decreasing wavelength

3. Radio ✓ SC1

4. Sound ✓

5. Travels at $3 \times 10^8 ms^{-1}$ ✓ SC5

ElectroMagnetic Spectrum - S3 Physics Project Remit

Your task is to present information to the rest of the class on a single area of the spectrum.
Your presentation must include:

- Your radiation type and where it lies in the spectrum (wavelength/frequency)(2 points)
- Who discovered it (if possible), how and when (2 points)
- What your radiation is used for (3 points)
- Any safety considerations (1 point)
- **At least one** interesting fact about you radiation (2 point)

You should present your team at the start (have an introduction page). Every team member must take an active part in researching and putting together the presentation.

Points awarded as follows

Content (breakdown shown above)	10 points
Presentation style	5 points
Good use of image	5 points
Pronunciation and Use of Words	5 points

(no words you don't understand or can't say – exception is scientist's names)

You will have two periods to complete your work as a team.

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SCS

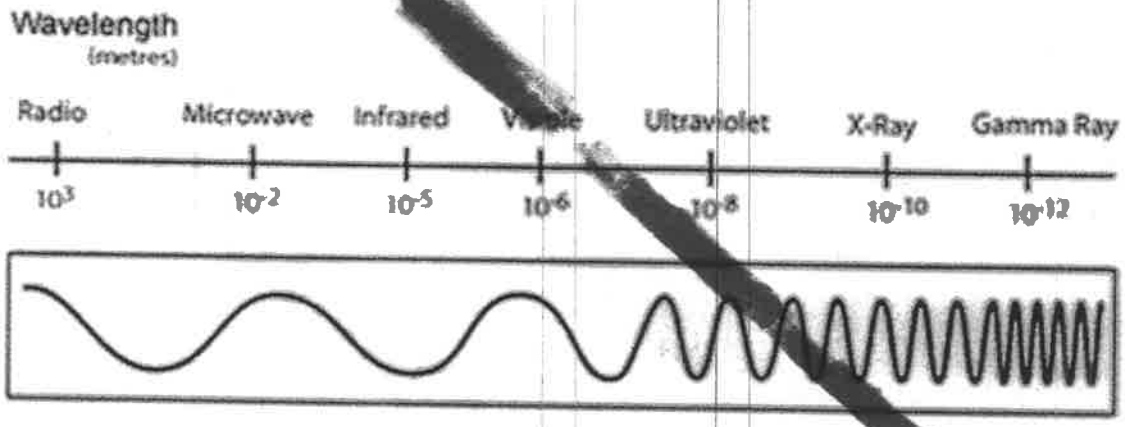
SC5

MICROWAVES

BY [redacted]

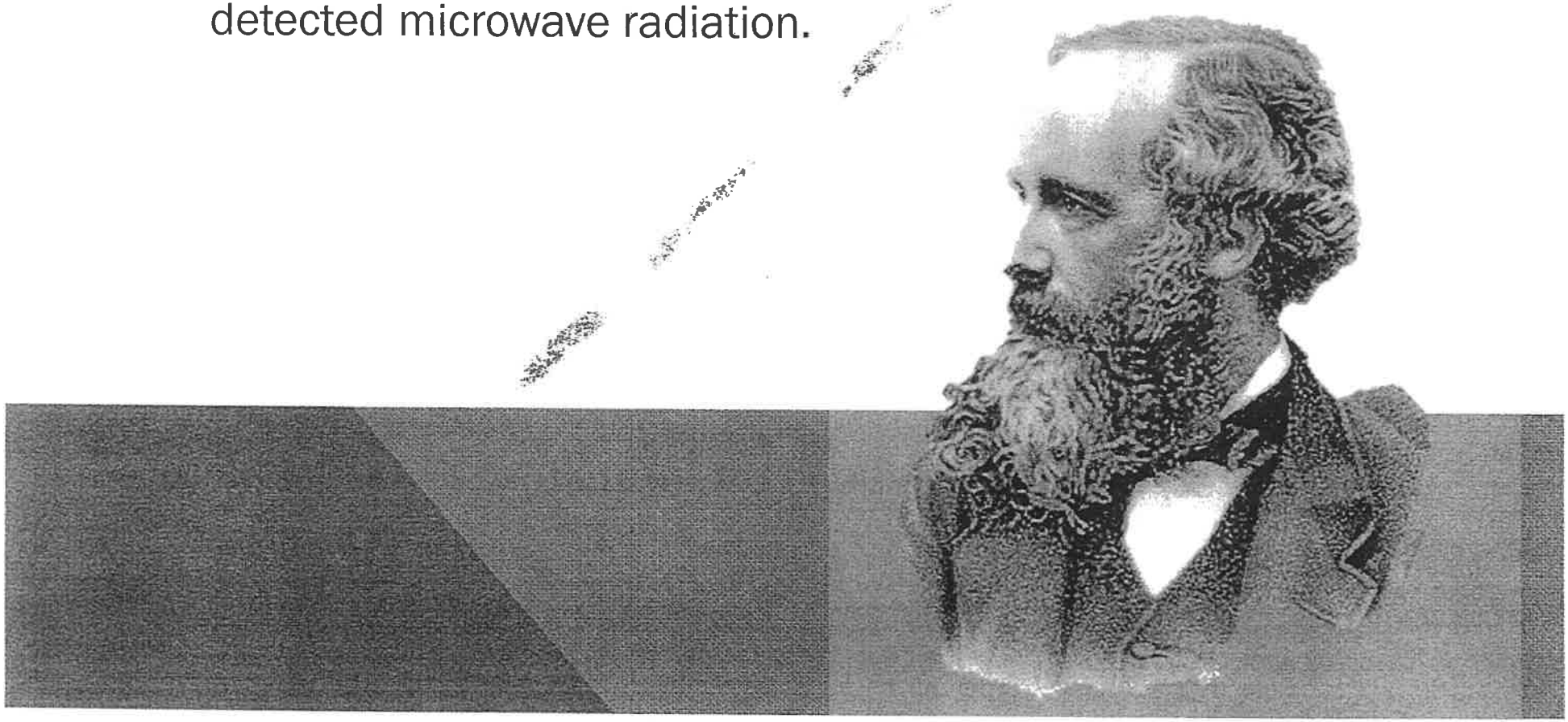
RADIATION

- The microwave has the second lowest frequency, hence having the second highest wavelength on the electromagnetic spectrum.



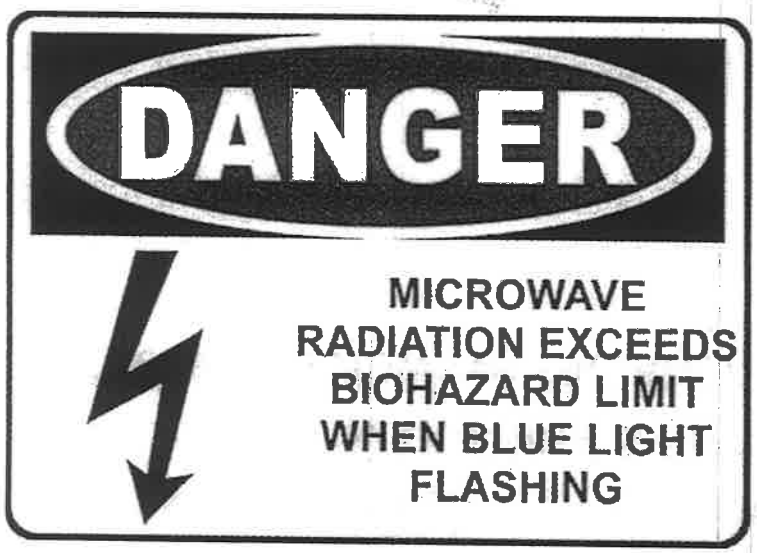
WHO DISCOVERED THEM?

- Microwaves were first predicted by James Clerk Maxwell in 1864.
- Later during 1888 Heinrich Hertz proved the existence of microwaves by building a device that produced and detected microwave radiation.



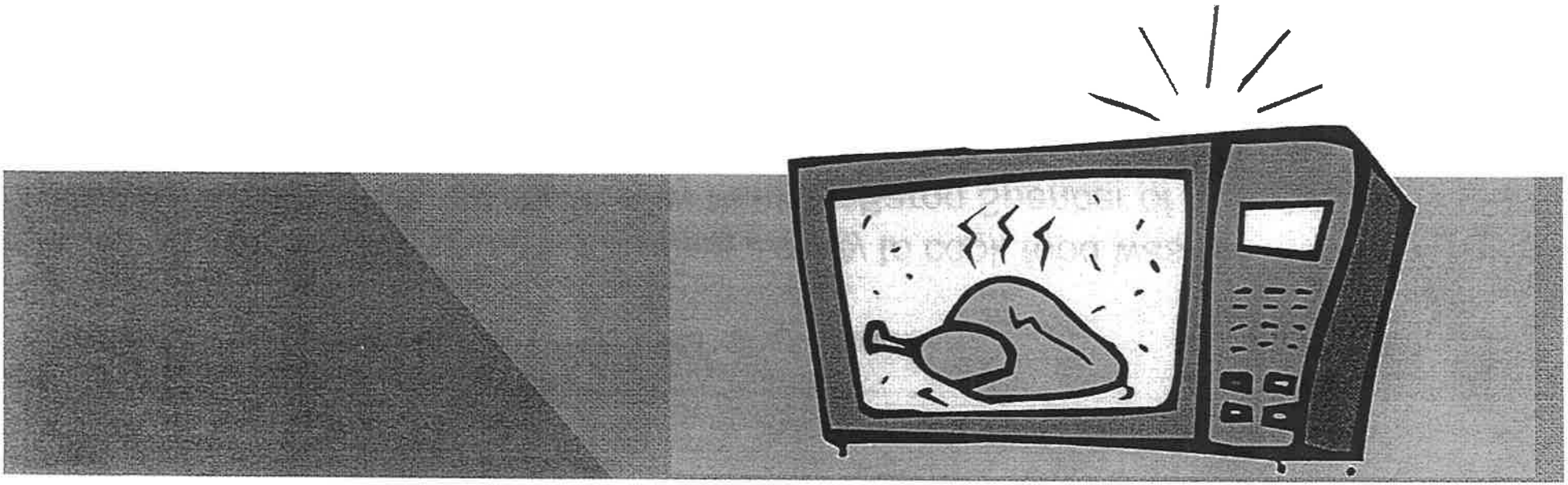
DANGERS

Microwaves leaking from an oven may pose a hazard to people nearby



USES?

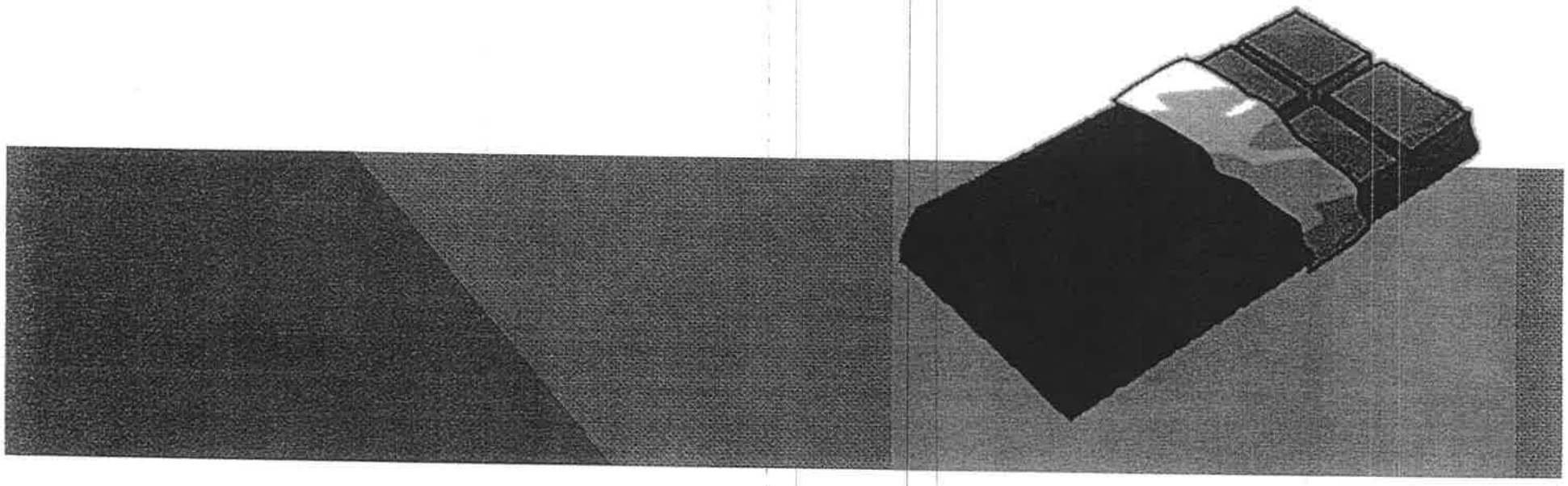
- Microwaves are most commonly known for their use in cooking food.
- They were also used in World War II radar systems to detect enemy bomber ships.
- They are used in place of radio waves for communication.
- In some cases, microwaves can be used to treat health problems more effectively than drugs.



INTERESTING FACTS?

- The idea of using microwave energy to cook food was accidentally discovered by Percy LeBaron Spencer of the Raytheon Company when he found that radar waves had melted a candy bar in his pocket.

- It is possible to measure the wavelength, and in turn the frequency, of a microwave using a chocolate bar.



Microwaves. MRS Nosek

Content	Position in the spectrum (2)	2
	Discovery (2)	2
	Uses (3)	2
	Interesting fact (2)	1
	Safety (1)	1
Style	(5)	3 4
Image	(5)	3
Pronunciation/word use	(5)	4
	Total (25)	19

We were impressed by
Technical detail
Mention of Maxwell

Point to Work on

order of slides.

Team Presenting Assessed by Microwaves
Ultra violet

Content	Position in the spectrum (2)	2
	Discovery (2)	2
	Uses (3)	3
	Interesting fact (2)	2
	Safety (1)	1
Style	(5)	4
Image	(5)	5
Pronunciation/word use	(5)	3
	Total (25)	22

We were impressed by All of the images and info

Point to Work on presenting skills

MICROWAVES WRITTEN FEEDBACK TO OTHERS

Gamma Rays — Microwaves

Content		
	Position in the spectrum (2)	2
	Discovery (2)	2
	Uses (3)	3
	Interesting fact (2)	1
	Safety (1)	1
Style	(5) 3	
Image	(5) 4	
Pronunciation/word use	(5) 3	
	Total (25)	19

We were impressed by the amount of information

Point to Work on

Eye Contact.

Team Presenting x rays — Assessed by Microwaves

Content		
	Position in the spectrum (2)	2
	Discovery (2)	2
	Uses (3)	3
	Interesting fact (2)	2
	Safety (1)	1
Style	(5)	3
Image	(5)	5
Pronunciation/word use	(5)	4
	Total (25)	22

We were impressed by The animations

Point to Work on

You were all a bit monotone

Team Presenting: ~~Visible Light~~ Microwaves Gamma Rays

Content	Position in the spectrum (2)	1
	Discovery (2)	1
	Uses (3)	2
	Interesting fact (2)	1
	Safety (1)	1
Style	(5)	2
Image	(5)	4
Pronunciation/word use	(5)	2
	Total (25)	14

We were impressed by

The chocolate bar fact

Point to Work on

~~Dialogoue~~ Dialogue

Team Presenting: Microwaves Assessed by: UV Group.

Content	Position in the spectrum (2)	2
	Discovery (2)	2
	Uses (3)	2
	Interesting fact (2)	1
	Safety (1)	0
Style	(5)	3
Image	(5)	4
Pronunciation/word use	(5)	4
	Total (25)	19.

We were impressed by

Point to Work on

FEEDBACK GIVEN TO MICROWAVES GROUP.

Team Presenting microwaves **Assessed by** Infrared

Content		
	Position in the spectrum (2)	2
	Discovery (2)	1
	Uses (3)	2
	Interesting fact (2)	2
	Safety (1)	1
Style	(5)	4
Image	(5)	4
Pronunciation/word use	(5)	3
	Total (25)	19

We were impressed by

~~the cho~~ intresting facts

Point to Work on

pronunciation and order

Team Presenting MICROWAVES **Assessed by** X-RAYS

Content		
	Position in the spectrum (2)	2
	Discovery (2)	2
	Uses (3)	3
	Interesting fact (2)	2
	Safety (1)	1
Style	(5)	1
Image	(5)	3
Pronunciation/word use	(5)	5
	Total (25)	19

We were impressed by

Professionalism. Improvisation

Point to Work on

Uh → Take a break rather than going straight to ah. Address the audience a wee bit more (Aww, don't worry)