Ultraviolet, X-rays and gamma rays

Student activity • observation and reasoning

YEAR 10 / LESSON 63 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How can useful short-wavelength radiation also damage living tissue?

Analyse original application cards and a labelled model of ultraviolet transmission. No ultraviolet lamp or radioactive source is used.

Equipment

- Original application cards and practice-data sheet
- Booklet and calculator

Desk-based analysis only. Do not use UV lamps, security lamps, radioactive rocks, gas mantles or sealed radioactive sources. No sunscreen is applied to pupils and no skin or eye exposure test is performed.

Course coverage: Shared Physics / Double Award: 3.10–3.13. Short-wavelength electromagnetic uses and hazards.

Plan, model or apparatus sketch

Draw a labelled wave, ray or apparatus diagram appropriate to this activity.

Method and reasoning

Read the whole sequence before starting

YEAR 10 / LESSON 63 / PHYSICS + SCIENCE (DOUBLE AWARD)

1. Place ultraviolet, X-rays and gamma rays beyond visible violet in a spectrum diagram. Show increasing frequency and decreasing wavelength, with the same vacuum speed.

2. Match ultraviolet fluorescence in security marking, X-ray medical imaging and gamma-ray sterilisation or cancer treatment to their regions. Explain the purpose of each application.

3. For a security-marking diagram, distinguish invisible incident ultraviolet from visible light emitted by fluorescence. Do not call the purple light of a lamp ultraviolet itself.

4. Use invented detector readings: lamp-off background 5 units; clear film 105 units; coated film 25 units. Subtract background and calculate the coated-to-clear transmitted-signal percentage.

5. Explain why that model is not an SPF measurement or evidence that a product gives complete protection. Discuss layer thickness, wavelength sensitivity and controlled geometry.

6. Identify UV damage to skin and eyes and ionising-radiation damage from X-rays and gamma rays. Match shielding, source control and limiting exposure to the application without proposing classroom exposure tests.

Cleanup

- Return cards and retain the background correction and limitations.

Record your evidence

Blank spaces are for your own work

YEAR 10 / LESSON 63 / PHYSICS + SCIENCE (DOUBLE AWARD)

Reference and task data

Practice detector units are arbitrary: corrected signals are 100 and 20, so the model transmission is 20%. This does not measure sunscreen SPF. Visible fluorescence is emitted light, not direct sight of ultraviolet. X-rays and gamma rays are ionising; ultraviolet hazards depend on wavelength and exposure.

Condition	Raw signal / units	Corrected signal
Lamp off	5	
Clear film	105	
Coated film	25	

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

YEAR 10 / LESSON 63 / PHYSICS + SCIENCE (DOUBLE AWARD)

1. Which of UV, X-rays and gamma rays has the longest typical wavelength?

2. What light do you see from fluorescent ink?

3. Find the background-corrected clear-film signal.

4. Find the model transmission percentage.

5. Why is the result not SPF?

6. Why control exposure even when radiation has a useful application?