Radioactivity in medicine: signal and treatment

Student activity • observation and reasoning

YEAR 11 / LESSON 99 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

Why do diagnostic imaging and treatment need different radiation behaviour?

Compare hypothetical tracer imaging and targeted treatment without making personal medical recommendations.

Equipment

- Booklet, original medical diagrams and calculator

Hypothetical paper study only. No sources, medicines, bodily samples or medical-device operation. Do not ask pupils to disclose personal treatment histories.

Course coverage: Shared Physics / Double Award: 7.14. Medical uses of radioactivity.

Plan, model or apparatus sketch

Draw a labelled graph, nuclear diagram or application model appropriate to the question.

Method and reasoning

Read the whole sequence before starting

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1. Draw a hypothetical diagnostic tracer inside a body and a detector outside. Explain why sufficient radiation must escape to form a useful signal.

2. Distinguish a suitable short physical half-life from biological removal: one describes nuclear decay, the other removal of material from the body.

3. Use a purely invented tracer with activity 800 Bq and physical half-life 6 hours, ignoring biological removal for the calculation. Find its activity after 6 and 12 hours.

4. Compare diagnosis with treatment designed to deposit energy in selected tissue. Explain why type, energy, location and dose planning matter rather than naming one radiation type as universally best.

5. Distinguish an external radiotherapy beam from a radioactive tracer introduced into the body. Explain that external irradiation does not itself mean radioactive material is deposited.

6. Write a balanced benefit-and-risk explanation for the hypothetical examples. State that real choices and doses are determined by qualified clinical teams for each situation.

Cleanup

- Retain calculations and collect diagrams.

Record your evidence

Blank spaces are for your own work

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Reference and task data

The 800 Bq example is invented numerical practice, not a clinical dose or recommendation. Ignoring biological clearance, the values are 400 Bq at 6 hours and 200 Bq at 12 hours. Activity in Bq is not absorbed dose.

Case	Purpose / signal	Reasoning / limitation
Diagnostic tracer		
Physical decay calculation		
Targeted treatment		
External beam		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Why must diagnostic radiation reach a detector?

2. Define physical half-life.

3. Find the practice activity after 12 hours.

4. Does physical half-life describe biological excretion?

5. What differs between diagnosis and treatment?

6. Is activity in Bq a complete measure of patient risk?