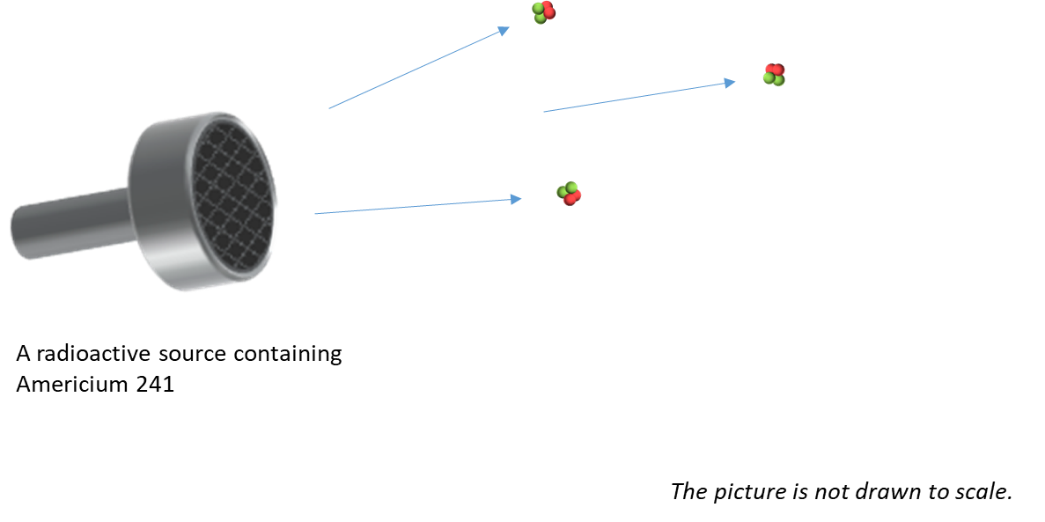
**Alpha particles**

Americium-241 is a radioactive isotope.

As it decays it emits alpha particles.



**1.** What is the best label to describe alpha particles?

*Put a tick (✓) in the box next to the best answer.*

|  |  |  |
| --- | --- | --- |
| **A** | Radioactive material. |  |
|  |  |  |
| **B** | Radioactive particles. |  |
|  |  |  |
| **C** | Radiation. |  |

**2.** What is the best description of what alpha particles can do?

*Put a tick (✓) in the box next to the best answer.*

|  |  |  |
| --- | --- | --- |
| **A** | They can emit radiation. |  |
|  |  |  |
| **B** | They can make atoms lose outer electrons. |  |
|  |  |  |
| **C** | They can make atoms radioactive. |  |

*Physics > Big idea PMA: Matter > Topic PMA5: Nuclear physics > Key concept PMA5.3: Ionising radiation*

|  |
| --- |
| **Diagnostic question** |
| **Alpha particles** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Some forms of radiation can ionise atoms or groups of atoms. Several properties of each form of ionising radiation are determined by its ionising power. |
| Observable learning outcome: | Describe the difference between radioactive particles and radiation. |
| Question type: | Simple multiple choice |
| Key words: | Radioactive material, radioactive particle, radiation |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 11-14, to aid transition from earlier stages of learning. |

**What does the research say?**

When discussing radiation, it is important to make a clear distinction between radioactive material and radiation. These two terms are commonly mixed up and this can lead to the forming of misunderstanding (Eijkelhof, 1990; Millar, 1994; Millar and Gill, 1996; Plotz, 2017). Students can also have the misunderstanding that radioactive materials contain ‘radiation’ (Millar, 1994) in much the same way as a wet sponge contains water.

Radioactive materials contain radioactive particles that are unstable and may undergo radioactive decay, and emit radiation. Alpha and beta particles are types of radiation, but it is common for students to describe them as ‘radioactive particles’ (Millar and Gill, 1996). This is wrong because they are both stable particles and do not undergo radioactive decay. Similarly, gamma radiation, which comprises of high energy photons, (which, at this stage, can be thought of as short bursts of electromagnetic wave) does not undergo radioactive decay.

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations, it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

1. C 2. B

**How to respond - what next?**

1. Alpha particles are best described as (ionising) radiation.

It is common for students to describe them as radioactive, but alpha particles are very stable.

2. Because alpha particles are stable, they do not decay or emit radiation – they *are* radiation. The electric charge on alpha particles and their mass causes them to pull outer electrons off atoms or groups of atoms, leaving charged particles called ions.

It is fairly common for students to think of radiation as something that is conserved, which can be transferred to other particles or materials to make them radioactive. To makes other materials radioactive, it is radioactive isotopes that must be transferred\* – because these are unstable and may decay.

\* High energy gamma photons can sometimes excite nuclei causing them to become radioactive, but this is an exception.

If students have misunderstandings about the difference between radioactive particles and radiation, it can help to review the processes of alpha and beta emission and to give students opportunity to write their own descriptions of each term and to practice using the terms correctly.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

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Plotz, T. (2017). Students' conceptions of radiation and what to do about them. *Physics Education,* 52(1)**,** 014004.