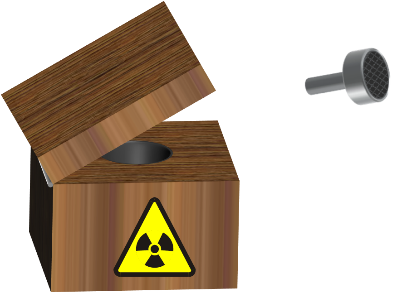
**Radioactive sources**

Radioactive sources are often used to demonstrate radioactivity.

A warning sign alerts people to the dangers of what is inside.



*Fill in the gaps to describe radioactive sources.*

*You should only use the words* ***radioactive particles*** *or* ***radiation****.*

Each radioactive source contains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The alpha source emits alpha particles.

Alpha particles are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The beta source emits beta particles.

Beta particles are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The gamma source emits gamma photons.

Gamma photons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Each radioactive source is stored in a metal box made of lead.

The lead box absorbs \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can decay and emit \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

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

|  |
| --- |
| **Diagnostic question** |
| **Radioactive sources** |

**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: | Focused cloze |
| Key words: | Radioactive material, radioactive particle, radiation |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught earlier in a teaching sequence at age 14-16, 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 activity individually as a pencil and paper exercise. The large text on the worksheet allows it to be copied A5 size, which fits a standard exercise book.

How students fill in the gaps will show you whether they 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 sentences 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.

**Equipment**

For the class (optional):

* A set of radioactive sources.

**Expected answers**

Each radioactive source contains **radioactive particles**.

The alpha source emits alpha particles.

Alpha particles are **radiation**.

The beta source emits beta particles.

Beta particles are **radiation**.

The gamma source emits gamma photons.

Gamma photons are **radiation**.

Each radioactive source is stored in a metal box made of lead.

The lead box absorbs **radiation**.

**Radioactive particles** can decay and emit **radiation**.

**How to respond - what next?**

Students often describe alpha or beta radiation as radioactive particles, which they are not because they are not unstable and do not decay to release radiation.

A radioactive material, that is the source of radioactivity, contains radioactive particles that over time decay to release radiation. Usually a radioactive material is formed from both radioactive and non-radioactive particles.

Alpha and beta particles are very fast-moving particles that can ionise atoms or groups of atoms. Gamma photons can be thought of as short bursts of electromagnetic wave that can cause ionisation.

Alpha, beta and gamma are all ionising radiation because they radiate away from a source and can cause ionisation.

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 definitions of each term and to practise using the terms correctly.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG), with the radiation sign from CLEAPPS sheet E232: Common safety signs.

**References**

Eijkelhof, H. M. C. (1990). *Radiation and risk in physics education.* Rijksuniversiteit Utrecht.

Millar, R. (1994). School students' understanding of key ideas about radiation and ionizing radiation. *Public Understanding of Science,* 3**,** 53-70.

Millar, R. and Gill, J. S. (1996). School students' understanding of processes involving radioactive substances and ionizing radiation. *Physics Education,* 31**,** 27-33.

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