**Irradiation**

Food is sometimes exposed to gamma radiation.

This process is called irradiation.

Irradiation can destroy organisms on food that may cause illness.

Irradiation can extend shelf life and keep food fresh for longer.



Some students are discussing irradiation.

**Vincent:** It will make the strawberries a little bit radioactive.

**Yusuf:** It can kill insects on the strawberries.

**Xavier:** Afterwards, there will be no gamma radiation in the strawberries.

**Wiktoria:** Gamma radiation will ionise atoms and destroy harmful bacteria.

**Zaynab:** The strawberries will be changed a little bit by the radiation.

**To answer**

1. Who is right about irradiation?

* + *Explain your answer*

2. Who is wrong about irradiation?

* + *What would you say to help them understand?*

|  |  |
| --- | --- |
| Cards for  **Irradiation** | **Vincent:** It will make the strawberries a little bit radioactive. |
| **Wiktoria:** Gamma radiation will ionise atoms and destroy harmful bacteria. | **Xavier:** Afterwards, there will be no gamma radiation in the strawberries. |
| **Yusuf:** It can kill insects on the strawberries. | **Zaynab:** The strawberries will be changed a little bit by the radiation. |

|  |  |
| --- | --- |
| Cards for  **Irradiation** | **Vincent:** It will make the strawberries a little bit radioactive. |
| **Wiktoria:** Gamma radiation will ionise atoms and destroy harmful bacteria. | **Xavier:** Afterwards, there will be no gamma radiation in the strawberries. |
| **Yusuf:** It can kill insects on the strawberries. | **Zaynab:** The strawberries will be changed a little bit by the radiation. |

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

|  |
| --- |
| **Response activity** |
| **Irradiation** |

**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: | Explain why ionising radiation does not make objects radioactive. |
| Activity type: | Talking heads |
| Key words: | Irradiation, ionisation, gamma radiation, decay |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Radiation remains

**What does the research say?**

Classroom discussions about ionisation often do not include opportunity for students to consider what happens to radiation particles after they have caused an ionisation (Eijkelhof, 1990). It is common for students to think that an object exposed to radiation becomes radioactive as a consequence\* (Prather, 2005), perhaps because they think that radiation is conserved (Morales Lopez and Tuzon Marco, 2021) and can transfer from one material to another.

In a series of lesson observations of a class of 14 students, age 16-17, Eijkelhof (1990) found that although the teacher consistently referred to the ‘absorption of radiation’, students typically described it as being stopped by a material. This suggests some students may have a mental model of radiation bouncing off of a material.

When an alpha or beta particle causes ionisation, some of the energy it has because of its motion is transferred to the electrons it forces away from atoms or groups of atoms, reducing its speed.

*\*An exception to this rule is the example of high-energy gamma photons that may excite atomic nuclei.*

**Ways to use this activity**

This task is intended for discussion in pairs or small groups. It can be done as a pencil and paper exercise or projected onto a screen.

Students should read the statements and follow the instructions on either the worksheet or the PowerPoint. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class.

Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as the scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

NB in any class, small group discussions typically improve over time and a persistence with this strategy is often very successful in the medium to long term.

**Expected answers**

Wiktoria, Xavier, Yusuf and Zaynab are right, and Vincent is wrong.

The gamma radiation will ionise atoms or groups of atoms in the strawberries, bacteria and insects. This can damage key molecules in cells so that the bacteria and insects are killed. The cells of the strawberries may also be damaged and the strawberries may become sterile (seeds will not grow). The taste and consistency of the strawberries, like with all preserving techniques, may be slightly changed.

The gamma radiation used for irradiation, is strictly controlled for the time and intensity of exposure to minimise changes to the strawberries, and to maximise shelf life.

Gamma photons do not contain radioactivity, and do not cause the strawberry to become radioactive. Instead, electromagnetic fields created by gamma photons can force electrons off atoms, or groups of atoms, forming ions.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Strawberries by Beverly Buckley from Pixabay.

**References**

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

Morales Lopez, A. I. and Tuzon Marco, P. (2021). Misconceptions, Knowledge, and Attitudes Towards the Phenomenon of Radioactivity. *Science & Education*.

Prather, E. (2005). Students' beliefs about the role of atoms in radioactive decay and half-life. *Journal of Geoscience Education,* 53(4)**,** 345-354.