**Bad radiation**

Electromagnetic radiation is all around us.

Sometimes it can be harmful.



**v = f x λ**

Where does harmful radiation comes from?

*For each statement, tick (✓)* ***one*** *column to show what you think.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | There is no harmful radiation in the countryside. |  |  |  |  |
| **B** | All electronic devices emit harmful radiation. |  |  |  |  |
| **C** | The Sun emits some harmful radiation. |  |  |  |  |

*Physics > Big idea PSL: Sound, light and waves > Topic PSL7: Electromagnetic waves > Key concept PSL7.2: Electromagnetic spectrum*

|  |
| --- |
| **Diagnostic question** |
| **Bad radiation** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Electromagnetic radiation transfers energy and interacts with matter in different ways, depending on the frequency and matter. Each radiation type can be both helpful and harmful. |
| Observable learning outcome: | Describe a range of sources of harmful electromagnetic radiation. |
| Question type: | Confidence grid |
| Key words: | Electromagnetic radiation, harmful radiation, emit |

**What does the research say?**

One of the most common misunderstandings about radiation is that it is artificial and a result of technological progress. Often students think that living far from urban or industrial areas reduces or even eliminates exposure to radiation (Neumann, 2014).

It is helpful perhaps, to notice that *natural*, as in *naturally occurring*, is a term that is often related to the idea of ‘not dangerous’ (Plotz, 2017).

Students often think that all radiation is harmful for living beings (Millar and Gill, 1996) and as a result, there is a widespread fear to any type of radiation and in any situation (Morales Lopez and Tuzon Marco, 2021). This may, in part, be linked to lots of misunderstandings about EM radiation being circulated via inaccurate reports in the media. For example, in one analysis of 200 websites that contained information about radiation and radioactivity, 38% included misleading information. The misleading information typically described radiation as not natural and always harmful, with mobile phones, radios, televisions and other electrical devices often quoted as sources of harmful radiation (Acar Sesen and Ince, 2010).

In a survey of fifty 14- to 16-year-olds Neumann and Hopf (2012) found the majority had negative feelings about radiation, with only 16% having broadly positive feelings about it. Students also tend to think about there being two types of radiation, namely ‘good radiation’ and ‘bad radiation’. They do not generally recognise that each type of radiation can be both helpful and harmful (Plotz, 2017).

**Ways to use this question**

Students should complete the confidence grid 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.

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**

Statement C is right and statements A and B are wrong.

**How to respond - what next?**

Whether a particular type of EM radiation is harmful or not depends on both its frequency (type) and its intensity. For example, high intensity light from a laser can damage a person’s eye, but for normal intensities light radiation is quite safe.

A In the picture of the countryside, there is radiation from the Sun and also from rocks. There is a common misunderstanding that clean air greatly reduces or eliminates radiation. In areas where there is a lot of granite, dangerous levels of radioactive radon gas can build up inside homes that do not have the correct protection.

B It is common for students to have the misunderstanding that electronic devices emit harmful radiation, perhaps because there is a lot of misleading information in the media that describes radiation as not natural and always harmful – with mobile phones, radios, televisions and other electrical devices often quoted as sources of harmful radiation.

C Some students may have the misunderstanding that radiation emitted by the Sun is not harmful because it is natural, or they may think that light and heat are not forms of radiation. However, ultraviolet radiation from the Sun can cause sunburn and skin cancer.

If students have misunderstandings about describing a range of sources of harmful electromagnetic radiation, it can help to provide students with the opportunity to research different types of EM radiation and to identify both pros and cons of each type to emphasise that most things are neither wholly harmful nor helpful.

The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Ready, steady, poster.

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