**Hot summer days**

On average days are hotter in summer.



Why is it hotter in summer?

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** | Days are longer |  |  |  |  |
| **B** | The Sun is hotter |  |  |  |  |
| **C** | The Earth is closer to the Sun |  |  |  |  |
| **D** | The Sun is higher in the sky |  |  |  |  |
| **E** | More radiation from the Sun reaches the ground |  |  |  |  |

*Physics > Big idea PES: Earth in space > Topic PES2: Earth and Sun > Key concept PES2.1: Days and seasons*

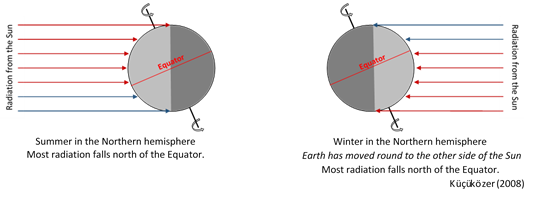
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| --- |
| **Diagnostic question** |
| **Hot summer days** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | The temperature is higher in the summer because the tilt of the spinning Earth increases the length of a day and increases the heating effect of the Sun’s radiation. |
| Observable learning outcome: | Explain why average temperature is higher in summer and lower in winter. |
| Question type: | Confidence grid |
| Key words: | Radiation |

**What does the research say?**

In the summer one reason temperatures are higher is because the part of the Earth experiencing summer is tilted towards the Sun. This means the Sun is higher in the sky and the radiation from it is spread out over a smaller area of land giving a bigger heating effect. Ojala (1992) suggested representing the uneven distribution of the Sun’s radiation over the Earth’s surface with a diagram that shows how equal amounts of radiation spread. Küçüközer (2008) used a computer simulation to show what proportion of all radiation reaching the Earth fell above or below the equator during the summer and the winter.



In text book diagrams, rays representing radiation from the Sun reaching the poles appear significantly longer than those reaching the equator. Such diagrams can reinforce the misunderstanding that it is warmer in the summer because we are closer to the Sun. When students encounter these diagrams for the first time they often do not have an accurate understanding of scale and do not realise that the differences in distances here are too small to make a noticeable difference to temperature (Ojala, 1992; Ojala, 1997). Ojala also found that the common practice of showing all four seasons on one diagram caused confusion and suggested using a separate diagram for each season.



The most common reason students (wrongly) give for why it is warmer in the summer is the Earth being closer to the Sun at that time (Allen, 2014; Driver et al., 1994; Baxter, 1989). Bakas and Mikropoulos (2003) found that Greek students aged 11-13 (n=102) were more likely to explain that higher temperatures in summer are caused by the Sun being higher in the sky, or because the days are longer, but without explaining the cause of these phenomena.

Constructivist teaching strategies that challenge student misunderstandings were shown to significantly improve knowledge about the causes of seasons (Trumper, 2006) and elicit longer retention of the scientific concepts (Tsai and Chang, 2005).

**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**

Statements A, D and E are correct.

B and C are wrong.

**How to respond - what next?**

Several factors combine to make the average temperature higher in summer and they are all caused by the tilt of the Earth: days are longer so that the ground is heated for more time; and the Sun is higher in the sky so its radiation is less spread out when it hits the ground and it heats more strongly. Both of these contribute to more radiation from the Sun reaching each square metre of ground. An additional factor is that when the Sun appears higher in the sky there is less atmosphere between it and the ground, so less of its radiation is scattered away from the surface. It may be helpful to introduce this ides to extend understanding for some students.

Students may choose statement B based on everyday experience. It is not the Sun itself that is hotter, but a combination of the above reasons which explain why it feels hotter. The response suggestions in diagnostic question: *Heating the towel* describe how this might be demonstrated.

Answer C is a common misunderstanding that may persist.

If students have misunderstandings about why it is hotter in summer, it can help to reteach the ideas to the class, perhaps demonstrating with a globe and bright light, and then give the students an activity in which they can practise explaining in their own words so that they can consolidate their understanding. This can work best when students discuss explanations in pairs or small groups, which encourage social construction of new ideas through dialogue.

The following BEST ‘response activity’ could be used in this way:

* Response activity: Explaining summer

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: https://pixabay.com/photos/people-kids-child-girl-boy-baby-2599687/

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