


Progression toolkit: Electromagnetic spectrum

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.				
As students' conceptual understanding progresses they can:					
Diagnostic questions	Identify types of electromagnetic radiation that can be naturally occurring.	Describe a range of sources of harmful electromagnetic radiation.	Describe some ways in which electromagnetic radiation can interact with matter.	Explain why some types of electromagnetic radiation are more ionising than others.	Apply understanding of ionising radiation to explain how radiotherapy works.
Response activities	Natural radiation	Bad radiation	Electromagnetic interactions	Most ionising	Radiotherapy
Response activities	Ready, steady, poster				

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning

<p>Natural radiation</p> <p>BEST STUDENT WORKSHEET</p> <p>Natural radiation</p> <p>There are seven best types of electromagnetic radiation:</p> <p>How do each type of EM radiation made?</p> <p>Draw six each type of electromagnetic radiation into one column:</p> <table border="1"> <thead> <tr> <th>Artificially made</th> <th>Naturally made</th> <th>Artificially and naturally made</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> <p><small>Developed by the University of York Science Education Group and the Salter's Institute and the Institute of Physics. The content may have been edited. Download the original from www.BestEvidenceScienceTeaching.org. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</small></p>	Artificially made	Naturally made	Artificially and naturally made				<p>Bad radiation</p> <p>BEST STUDENT WORKSHEET</p> <p>Bad radiation</p> <p>Electromagnetic radiation is not harmful. Sometimes it can be harmful.</p> <p>Where does harmful radiation comes from?</p> <p>For each statement, tick (✓) or use another to show what you think:</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I'm not sure</th> <th>I'm sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A. There is no harmful radiation in the atmosphere.</td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td>B. All electronic devices emit harmful radiation.</td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td>C. The Sun emits some harmful radiation.</td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> <p><small>Developed by the University of York Science Education Group and the Salter's Institute and the Institute of Physics. The content may have been edited. Download the original from www.BestEvidenceScienceTeaching.org. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</small></p>		I am sure this is right	I think this is right	I'm not sure	I'm sure this is wrong	A. There is no harmful radiation in the atmosphere.					B. All electronic devices emit harmful radiation.					C. The Sun emits some harmful radiation.					<p>EM interactions</p> <p>BEST STUDENT WORKSHEET</p> <p>Electromagnetic interactions</p> <p>Electromagnetic radiation transfers energy. It is made of oscillating electric and magnetic fields. In the photon model, radiation consists of small packets called photons.</p> <p>Electromagnetic radiation interacts with matter in different ways.</p> <p>What does EM radiation not do to matter?</p> <p>Put a tick (✓) in the box next to the best answer:</p> <p>A. Pass straight through. <input type="checkbox"/></p> <p>B. Move electrons through a conductor. <input type="checkbox"/></p> <p>C. Pull electrons off atoms. <input type="checkbox"/></p> <p>D. Knock atoms off. <input type="checkbox"/></p> <p><small>Developed by the University of York Science Education Group and the Salter's Institute and the Institute of Physics. The content may have been edited. Download the original from www.BestEvidenceScienceTeaching.org. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</small></p>	<p>Most ionising</p> <p>BEST STUDENT WORKSHEET</p> <p>Most ionising</p> <p>Gamma photons (or neutrinos) are different to ultraviolet photons. Some types of photons are more ionising than others.</p> <p>a. Which statement about ionising radiation is correct?</p> <p>Put a tick (✓) in the box next to the best answer:</p> <p>A. Infrared is more ionising than ultraviolet. <input type="checkbox"/></p> <p>B. Ultraviolet is more ionising than X-rays. <input type="checkbox"/></p> <p>C. Gamma radiation is more ionising than ultraviolet. <input type="checkbox"/></p> <p>D. Microwave radiation is more ionising than ultraviolet. <input type="checkbox"/></p> <p>b. What is the best reason for your answer to part a)?</p> <p>Put a tick (✓) in the box next to the best answer:</p> <p>A. It has a longer wavelength. <input type="checkbox"/></p> <p>B. It has a higher frequency. <input type="checkbox"/></p> <p>C. It causes more heating. <input type="checkbox"/></p> <p>D. It is more radioactive. <input type="checkbox"/></p> <p><small>Developed by the University of York Science Education Group and the Salter's Institute and the Institute of Physics. The content may have been edited. Download the original from www.BestEvidenceScienceTeaching.org. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</small></p>	<p>Pulling electrons</p> <p>BEST STUDENT WORKSHEET</p> <p>Pulling electrons</p> <p>Some types of electromagnetic radiation can ionise atoms. An atom is ionised when it loses or gains electrons. Ionising radiation forces atoms to lose electrons.</p> <p>Some students are discussing how electromagnetic radiation can ionise an atom.</p> <p>Will: EM radiation is made of oscillating electric and magnetic fields.</p> <p>Violet: EM radiation is made of photons.</p> <p>Zain: EM radiation bashes into electrons to knock them off an atom.</p> <p>Xavier: gamma radiation is more ionising than ultraviolet.</p> <p>Yasmine: Some photons have more mass than others.</p> <p>To answer:</p> <ol style="list-style-type: none"> Who is right about how EM radiation causes ionisation? <ul style="list-style-type: none"> Explain your answer. Who is wrong about how EM radiation causes ionisation? <ul style="list-style-type: none"> What would you say to help them understand? <p><small>Developed by the University of York Science Education Group and the Salter's Institute and the Institute of Physics. The content may have been edited. 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<p>Linking ideas</p>	<p>Confidence grid</p>	<p>Simple multiple choice</p>	<p>Two-tier multiple choice</p>	<p>Talking heads</p>																										
<p>Radiotherapy</p> <p>BEST STUDENT WORKSHEET</p> <p>Radiotherapy</p> <p>Radiotherapy is a type of cancer treatment.</p> <p>A linear accelerator (LINAC) used for radiotherapy.</p> <p>Write messages these are used to describe radiotherapy.</p> <p>Radiotherapy is a type of cancer treatment.</p> <p>A. It uses gamma radiation to destroy cancer cells.</p> <p>B. Side effects are usually temporary and can be managed with medication or other treatments.</p> <p>C. Some side effects are tiredness, skin irritation, and nausea.</p> <p>D. Surrounding healthy cells are exposed to much less radiation.</p> <p>E. The radiation damages the DNA inside the cancer cells, making it difficult for them to grow and divide.</p> <p>F. The radiation is carefully targeted on the cancer cells.</p> <p>G. The radiation is targeted from several different directions.</p> <p><small>Developed by the University of York Science Education Group and the Salter's Institute and the Institute of Physics. The content may have been edited. Download the original from www.BestEvidenceScienceTeaching.org. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</small></p>	<p>Ready, steady, poster</p> <p>BEST STUDENT WORKSHEET</p> <p>Ready, steady, poster</p> <p>All electromagnetic waves are part of the EM spectrum. The EM spectrum is often split into seven types of radiation. Each type of radiation has a distinct set of properties.</p> <p>For this research one type of electromagnetic wave.</p> <p>Next lesson you will have 20 minutes to work in a group to make a very big, informative poster about one type of EM radiation.</p> <p>Use the notes to prepare the 'ingredients' for your poster:</p> <ul style="list-style-type: none"> Information – the facts to write onto your poster. Clip art – photos from the internet printed out in large text to stick onto a big poster (NB you need to add a source to the bottom of any quotes to state where you got it from e.g. the website name). Printouts – printed out as large as you can to stick onto a big poster. Drawings – your own illustrations drawn out ready to stick on. Decorations – framed decorations to beautify your poster, e.g. a picture, message or if you could get it printed about a cool 'head' power station. Title – a very big title, drawn or printed off ready to stick on. <p><small>Developed by the University of York Science Education Group and the Salter's Institute and the Institute of Physics. The content may have been edited. Download the original from www.BestEvidenceScienceTeaching.org. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</small></p>																													
<p>Sequencing</p>	<p>Application and practice</p>																													