

**GCSE Science**

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**Module P2 – Radiation and Life**

**What you should know**

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|  **Name:** **Science Group:** **Teacher:** |

**R.A.G. each of the statements to help focus your revision:**

*R = Red: I don’t know this*

*A = Amber: I partly know this*

*G = Green: I know this*

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| **P2.1 What types of electromagnetic radiation are there? What happens when radiation hits an object?** | **R.A.G.** |
| I can interpret situations in which one object affects another some distance away in terms of a general model of electromagnetic radiation:a. one object (a source) emits radiation |  |
| b. the radiation travels outwards from the source and can be reflected, transmitted or absorbed (or a combination of these) by materials it encounters |  |
| c. radiation may affect another object (a detector) some distance away, when it is absorbed |  |
| I understand that light is one of a family of radiations called the electromagnetic spectrum |  |
| I understand that a beam of electromagnetic radiation transfers energy in ‘packets’ called photons |  |
| I understand that the higher the frequency of an electromagnetic radiation, the more energy is transferred by each photon |  |
| I can list the electromagnetic radiations in order of the energy transferred by each photon, or in order of frequency: radio waves, microwaves, infrared, red visible light violet, ultraviolet, X-rays, gamma rays |  |
| I can recall that all types of electromagnetic radiation travel at exactly the same, very high but finite, speed through space (a vacuum) of 300 000 km/s |  |
| I understand that the energy arriving at **a square metre** of surface each second is a useful measure of the strength (or ‘intensity’) of a beam of electromagnetic radiation |  |
| I understand that the energy transferred to an absorber by a beam of electromagnetic radiation depends on both the number of photons arriving and the energy of each photon |  |
| I understand that the intensity of a beam of electromagnetic radiation decreases with distance from the source **and explain why, in terms of the ever increasing surface area it reaches and its partial absorption by the medium it travels through** |  |

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| **P2.1 What types of electromagnetic radiation are there? What happens when radiation hits an object? *Continued*** | **R.A.G.** |
| I understand that some electromagnetic radiations (ultraviolet radiation, X-rays, gamma rays) have enough energy to change atoms or molecules, **which can initiate chemical reactions** |  |
|  I can recall that high energy ultraviolet radiation, X-rays and gamma rays can cause ionisation |  |
| I understand that the electromagnetic radiations which are ionising are those with high enough photon energy to remove an electron from an atom or molecule (ionisation). |  |

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| **P2.2 Which types of electromagnetic radiation harm living tissue and why?** | **R.A.G.** |
| I understand that the heating effect of absorbed radiation can damage living cells |  |
| I can relate the heating effect when radiation is absorbed to its intensity and duration |  |
| I understand that some people have concerns about health risks from low intensity microwave radiation, for example from mobile phone handsets and masts, though the evidence for this is disputed |  |
| I understand that some microwaves are strongly absorbed by water molecules and so can be used to heat objects containing water |  |
| I understand that the metal cases and door screens of microwave ovens reflect or absorb microwave radiation and so protect users from the radiation |  |
| I canrecall that some materials (radioactive materials) emit ionising gamma radiation all the time |  |
| I understand that with increased exposure to ionising radiation, damage to living cells increases eventually leading to cancer or cell death |  |
| Iunderstand that the ozone layer absorbs ultraviolet radiation, emitted by the Sun, **producing chemical changes in that part of the atmosphere** |  |

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| **P2.2 Which types of electromagnetic radiation harm living tissue and why? *Continued*** | **R.A.G.** |
| I understand that the ozone layer protects living organisms from some of the harmful effects of ultraviolet radiation |  |
| I canrecall that sun-screens and clothing can be used to absorb some of the ultraviolet radiation from the Sun |  |
| Irecall that physical barriers absorb some ionising radiation, for example: X-rays are absorbed by dense materials so can be used to produce shadow pictures of bones in our bodies or of objects in aircraft passengers’ luggage, and radiographers are protected from radiation by dense materials such as lead and concrete |  |

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| **P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it?** | **R.A.G.** |
| I understand that all objects emit electromagnetic radiation with a principal frequency that increases with temperature |  |
| I can recall that the Earth is surrounded by an atmosphere which allows some of the electromagnetic radiation emitted by the Sun to pass through |  |
| I can recall that this radiation warms the Earth’s surface when it is absorbed |  |
| I understand that the radiation emitted by the Earth, **which has a lower principal frequency than that emitted by the Sun**, is absorbed or reflected back by some gases in the atmosphere; this keeps the Earth warmer than it would otherwise be and is called the greenhouse effect |  |
| I can recall that one of the main greenhouse gases in the Earth’s atmosphere is carbon dioxide, which is present in very small amounts |  |
| I canrecall that other greenhouse gases include methane, present in very small amounts, and water vapour |  |
| I caninterpret simple diagrams representing the carbon cycle |  |

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| **P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it? *Continued*** | **R.A.G.** |
| I can use the carbon cycle to explain:a. why, for thousands of years, the amount of carbon dioxide in the Earth’s atmosphere was approximately constant |  |
| b. that some organisms remove carbon dioxide from the atmosphere by photosynthesis (e.g. green plants) and many organisms return carbon dioxide to the atmosphere by respiration as part of the recycling of carbon |  |
| c. why, during the past two hundred years, the amount of carbon dioxide in the atmosphere has been steadily rising |  |
| I can recall that the rise in atmospheric carbon dioxide is largely the result of:a. burning increased amounts of fossil fuels as an energy source |  |
| b. cutting down or burning forests to clear land |  |
| **I understand that computer climate models provide evidence that human activities are causing global warming** |  |
| I understand how global warming could result in:a. it being impossible to continue growing some food crops in particular regions because of climate change |  |
| b. more extreme weather events, **due to increased convection and larger amounts of water vapour in the hotter atmosphere** |  |
| c. flooding of low lying land due to rising sea levels, caused by melting continental ice and expansion of water in the oceans. |  |

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| **P2.4 How are electromagnetic waves used in communications?** | **R.A.G.** |
| I understand that electromagnetic radiation of some frequencies can be used for transmitting information, since:a) some radio waves and microwaves are not strongly absorbed by the atmosphere so can be used to carry information for radio and TV programmes |  |
| b) light and infrared radiation can be used to carry information along optical fibres because the radiation travels large distances through glass without being significantly absorbed |  |
| I can recall that information can be superimposed on to an electromagnetic carrier wave, to create a signal |  |
| I can recall that a signal which can vary continuously is called an analogue signal |  |
| I can recall that a signal that can take only a small number of discrete values (usually two) is called a digital signal |  |
| I can recall that sound and images can be transmitted digitally (as a digital signal) |  |
| I can recall that, in digital transmission, the digital code is made up from just two symbols, ‘0’ and ‘1’ |  |
| I understand that this coded information can be carried by switching the electromagnetic carrier wave off and on to create short bursts of waves (pulses) where ‘0’ = no pulse and ‘1’ = pulse |  |
| I can recall that when the waves are received, the pulses are decoded to produce a copy of the original sound wave or image |  |
| I understand that an important advantage of digital signals over analogue signals is that if the original signal has been affected by noise it can be recovered more easily **and explain why** |  |
| I can recall that the amount of information needed to store an image or sound is measured in bytes (B) |  |
| I understand that, generally, the more information stored the higher the quality of the sound or image |  |
| I understand that an advantage of using digital signals is that the information can be stored and processed by computers |  |

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| **Grades A\* - C (Higher)** | All statements shown in **bold** as well as all statements shown in normal type. |
| **Grades C – G (Foundation)** | All statements shown in normal type. |