



C5: Radiation and Life

Here is a checklist of knowledge and understanding needed for Radiation and Life. You will be expected to apply your knowledge and understanding to familiar and unfamiliar situations.

C5.1 What happens when radiation hits an object? What types of radiation are there?

Understanding and having a general model of how the spectrum of electromagnetic radiation behaves can help people to understand the effects of radiation on us, how devices can use radiation, and how protection is needed. While most people enjoy and benefit by some direct exposure to sunlight, clothing and sunscreen lotions are used to protect the skin from excessive exposure.

I should be able to:

- recall that light is one of a family of radiations. The spectrum of visible light (red → violet) can be extended in both directions:
radio microwave infrared ^{red} light ^{violet} ultraviolet X-ray gamma
- interpret a situation in which one object affects another some distance away in terms of the following general model of electromagnetic radiation:

One object (a source) emits radiation (of some kind). This travels from the source and can be reflected, transmitted or absorbed by another object (a detector) some distance away.

For example:

lamp Light → eye

- describe simply how the heating effect of non-ionising radiation can be related to its intensity;
- recognise that the metal cases and door screens of microwave ovens protect us from the radiation;
- recall that people can be protected from ionising radiation, for example, sun-screens and clothing can be used to absorb most of the ultraviolet radiation from the Sun;
- recall that ionising radiation includes: X-rays, gamma rays, and ultraviolet radiation.

C5.2 Is it safe to use mobile phones?

Which types of radiation harm living tissues and why?

In recent years the UK use of mobile phones has proliferated (become widespread) as a result of their perceived benefits, yet there are concerns about health risks

I should be able to:

- recall that the heating effect of absorbed radiation can cause damage to living tissues;
- recognise that low intensity microwave radiation, for example from mobile phone hand sets and masts, may be a health risk but this is disputed;
- appreciate that ionising radiation can also cause damage directly to living cells;
- *explain that, when ionising radiation strikes molecules, it makes them more likely to react chemically;*
- give examples of how exposure to different amounts of ionising radiation can affect living cells.

When provided with necessary additional information relating to case studies, enquiries or media reports about alleged health risks due to radiation emitted from technological devices, or ultraviolet radiation from the Sun, I should be able to:

- show understanding of risk, including:
 - explain why the demand that something be ‘completely safe’ is impossible to satisfy;
 - interpret information on the size of risks and compare risks using given information;
 - *explain why given statements of risk may not be completely accurate;*
 - discuss data on a given hazard, taking account of the chances of its occurring and its consequences;
 - suggest ways of reducing specific risks;
 - discuss choices in terms of a balance between risk and benefit;
 - *distinguish between perceived risk and actual risk;*
 - *suggest reasons for differences between actual and perceived risk in specific cases;*
 - use the precautionary principle (‘better safe than sorry’) to justify some particular course of action;
 - *explain what the ALARA (as low as reasonably achievable) principle means and apply it to a given situation.*
- show understanding of correlation and cause, including:
 - identify valid and invalid conclusions that follow from correlation (e.g. recognise that individual cases do not provide convincing evidence for or against);
 - explore given data sets for evidence that a particular factor affects the chance of an outcome;
 - discuss the design of studies to explore whether a factor increases the chance of an outcome;
 - assess critically reported studies, with reference to the size of samples and how these were chosen;

discuss whether the presence (or absence) of a plausible theory led to a causal link being accepted (or questioned).

C5.3 How does the Earth's atmosphere protect us from harmful radiation from the Sun? How does radiation make life on Earth possible?

Life on Earth is only possible because of the atmosphere's greenhouse effect and the protection which the ozone layer provides, from the Sun's ultraviolet and other ionising radiations. Sunlight that penetrates the atmosphere is essential to photosynthesis.

*Plants need carbon dioxide, water and light for photosynthesis, and produce biomass and oxygen.
Animals and plants need oxygen for respiration.*

I should be able to:

- recall that the Earth is surrounded by a thin layer of atmosphere which allows light radiated from the Sun to pass through;
- appreciate that this radiation provides the energy for photosynthesis;
- recall the equation for photosynthesis;
- relate the process of photosynthesis to the amounts of oxygen and carbon dioxide in the atmosphere;
- describe the greenhouse effect in terms of the radiation absorbed and emitted by the Earth and the effect on its surface temperature;
- recognise that oxygen is needed by animals and plants for respiration;
- recall that ozone in the upper atmosphere absorbs ultraviolet radiation, *producing oxygen*, and so protects living organisms, especially animals, from its harmful effects;
- understand that oxygen in the upper atmosphere also absorbs ultraviolet radiation, producing *ozone*.

C5.4 What is the evidence for global warming, why might it be occurring, and how serious a threat is it? What could we do to prevent or reduce global warming?

In the past decade global warming has become an accepted scientific fact and most scientists are now convinced that it results from human activity. The Intergovernmental Panel on Climate Change anticipates major consequences but climate modellers are very uncertain about how global warming will affect particular regions. Future citizens need to be aware of both the risks associated with inaction and what can be done to mitigate climate change

I should be able to:

- recall that one of the greenhouse gases in the Earth's atmosphere is carbon dioxide, present in small amounts;
- recall that other greenhouse gases include methane, present in trace amounts, and water vapour;
- appreciate that the carbon cycle can be represented by a diagram;

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- use the carbon cycle to explain:
 - why for thousands of years the amount of carbon dioxide in the Earth’s atmosphere was approximately constant;
 - how decomposers play an important part in the recycling of carbon;
 - that during the past two hundred years, the amount of carbon dioxide in the atmosphere has been steadily rising;
 - that the rise in atmospheric carbon dioxide is largely the result of:
 - burning increased amounts of fossil fuels as an energy source,
 - burning forests to clear land;
- discuss how global warming could result in:
 - climate change and how this could affect living organisms,
 - extreme weather conditions in some regions,
 - rising sea levels, due to expansion and melted ice, which would cause flooding of low-lying land;

When provided with necessary additional information relating to case studies, enquiries or media reports about climate change (global warming)

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 - *explain why given statements of risk may not be completely accurate;*
 - discuss data on a given hazard, taking account of the chances of its occurring and its consequences;
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 - discuss choices in terms of a balance between risk and benefit;
 - *distinguish between perceived risk and actual risk;*
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discuss whether the presence (or absence) of a plausible theory led to a causal link being accepted (or questioned).