# *PLANNING SUPPORT BOOKLET*

**J259**

**For first teaching in 2016**

This support material booklet is designed to accompany the OCR GCSE (9–1) specification in Physics B and Combined Science B(Twenty First Century Science).

***DISCLAIMER***

This resource was designed using the most up to date information from the specification at the time it was published. Specifications are updated over time, which means there may be contradictions between the resource and the specification, therefore please use the information on the latest specification at all times.If you do notice a discrepancy please contact us on the following email address: resources.feedback@ocr.org.uk

# Introduction

This support material is designed to accompany the OCR GCSE (9-1) specification in Physics B (Twenty First Century) for teaching from September 2016.

The Planning Guidance table on the following pages sets out *suggested* teaching times for the topics within the specification. Note that we always recommend that individual centres plan their schemes of work according to their individual needs. Actual teaching times for topics will depend on the amount of practical work done within each topic and the emphasis placed on development of practical skills in various areas, as well as use of contexts, case studies and other work to support depth of understanding and application of knowledge and understanding. It will also depend on the level of prior knowledge and understanding that learners bring to the course.

The table follows the order of the topics in the specification. It is not implied that centres teach the specification topics in the order shown, centres are free to teach the specification in the order that suites them.

## Delivery guides

The column ‘Delivery guides’ refers to individual teacher guides available from the GCSE Physics B qualification page.

These Delivery guides provide further guidance and suggestions for teaching of individual topics, including links to a range of activities that may be used and guidance on resolving common misconceptions.

## Ideas about Science (P7) and Practical Work (P8)

Ideas about Science (P7) and Practical Skills (P8) are not explicitly reference in the high level planning table below, as these ideas and skills are expected to be developed in the context of Topics P1–P6. Links to P7 learning outcomes and suggested practical activities are included in the outline scheme of work. Indications of where PAG activities can be carried out should not be seen as an exhaustive list.

| **Topic** | **Teaching hours** | **Delivery Guides** | **PAG opportunities** |
| --- | --- | --- | --- |
| **Chapter 1: Radiation and waves** |
| 1.1 What are the risks and benefits of using radiation | 5 / 5 hours | Radiation and waves – delivery guide |  |
| 1.2 What is climate change and what is the evidence for it? | 3 / 3 hours | Radiation and waves – delivery guide |  |
| 1.3 How do waves behave? | 7 / 7 hours | Radiation and waves – delivery guide | PAG4: measure the speed, frequency and wavelength of a wavePAG8: Investigate the reflection of light off a plane mirror and the refraction of light through prisms |
| 1.4 What happens when light and sound meet different materials? | 7 / 0 hours | Radiation and waves – delivery guide |  |
| **Total for chapter 1 = 22 / 15 hours** |
| **Chapter 2: Sustainable energy** |
| 2.1 How much energy do we use? | 4 / 4 hours | Sustainable energy – delivery guide |  |
| 2.2 How can electricity be generated? | 5 / 5 hours | Sustainable energy – delivery guide |  |
| **Total for chapter 2 = 9 / 9 hours** |
| **Chapter 3 Electric circuits** |
| 3.1 What is electric charge | 2 / 0 hours | Electric circuits – delivery guide |  |
| 3.2 What determines the current in an electric circuit? | 4 / 4 hours | Electric circuits – delivery guide | PAG6: Investigate the I-V characteristics of circuit elements |
| 3.3 How do series and parallel circuits work? | 5 / 5 hours | Electric circuits – delivery guide | PAG7: Investigate the brightness of bulbs in series and parallel |
| 3.4 What determines the rate of energy transfer in a circuit? | 4 / 4 hours | Electric circuits – delivery guide |  |
| 3.5 What are magnetic fields? | 4 / 3 hours | Electric circuits – delivery guide |  |
| 3.6 How do electric motors work? | 3 / 3 hours | Electric circuits – delivery guide |  |
| 3.7 What is the process inside an electric generator? | 4 / 0 hours | Electric circuits – delivery guide |  |
| **Total for chapter 3 = 26 / 19 hours** |
| **Chapter 4 Explaining motion** |
| 4.1 What are forces? | 4 / 4 hours | Explaining motion – delivery guide |  |
| 4.2 How can we describe motion? | 7 / 7 hours | Explaining motion – delivery guide | PAG3: Investigate acceleration of a trolley down a ramp |
| 4.3 What is the connection between force and motion? | 12 / 9 hours | Explaining motion – delivery guide |  |
| 4.4 How can we describe motion in terms of energy transfer? | 5 / 5 hours | Explaining motion – delivery guide |  |
| **Total for chapter 4 = 28 / 25 hours** |
| **Chapter 5 Radioactive materials** |
| 5.1 What is radioactivity? | 6 / 6 hours | Radioactive materials – delivery guide |  |
| 5.2 How can radioactive materials be used safely? | 3 / 3 hours | Radioactive materials – delivery guide |  |
| 5.3 How can radioactive materials be used to provide energy? | 4 / 0 hours | Radioactive materials – delivery guide |  |
| **Total for chapter 5 = 13 / 9 hours** |
| **Chapter 6 Matter – models and explanations** |
| 6.1 How does energy transform matter? | 5 / 5 hours | Matter – delivery guide | PAG1: Determine the densities of a variety of objects both solid and liquidPAG5: Determine the specific heat capacity of a metal |
| 6.2 How does the particle model explain the effects of heating? | 2 / 2 hours | Matter – delivery guide |  |
| 6.3 How does the particle model relate to material under stress? | 4 / 4 hours | Matter – delivery guide | PAG2: Investigate the effect of forces on springs |
| 6.4 How does the particle model relate to pressure in fluids? | 5 / 0 hours | Matter – delivery guide |  |
| 6.5 How can scientific models help us understand the Big Bang? | 6 / 0 hours | Matter – delivery guide |  |
| **Total for chapter 6 = 22 / 11 hours** |
| **Total teaching hours = 120 hours / 88 hours** |

# Outline Scheme of Work: P5 – Radioactive materials

## Total suggested teaching time – 13 / 9 hours

|  |
| --- |
| **Additional online learning opportunities**As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. |
| **Statement** | **Teaching activities** |
| P5.1.2 |  PhET[Animation](https://phet.colorado.edu/en/simulation/rutherford-scattering) for Thomson and Rutherford experiments which can be used to reinforce understanding or to replace the 2nd plenary task. |
| P5.1.2 | Brian Cox [video](https://www.youtube.com/watch?v=-FWxd78sOZ8) on the model of the atom can be used as a Main activity or flipped learning. Rutherford scattering is from 4.14-4.55. |
| P5.1.4, P5.1.5, P5.1.6 | Activity 1 in this [IOP newsletter](http://www.iop.org/education/teacher/affiliation/newsletter/file_73002.pdf) offers a novel practical activity for students to make conclusions from scattering observations.  |
| P5.1.9 | [Video](https://www.youtube.com/watch?v=CaYoDxWxww8) explaining how to write decay equations, can be used as flipped learning. |
| P5.1.10, P5.1.11 | Cambridge International [Video](https://ocr.org.uk/rpgphys16) on half-life which can be used as flipped learning. |
| P5.1.10, P5.1.11 | Question 10, paper 4 of this Cambridge International [exemplar resource](https://ocr.org.uk/rpgphys17) can be used as a homework on half-life. |
| P5.1.10, P5.1.11 | Footprints Science Half-life [quiz](https://www.footprints-science.co.uk/index.php?quiz=Half_life) can be used as homework |
| P5.2.3 | This BBC Bitesize [guide](https://www.bbc.co.uk/bitesize/guides/z6k6cqt/revision/5)  can be used alongside the learner sheet in the main activity as flipped learning or homework. |

### P5.1 What is radioactivity? (6 /6 hours)

|  |
| --- |
| Links to KS3 Subject content* a simple (Dalton) atomic model
* differences between atoms, elements and compounds
* atoms and molecules as particles
 |
| Links to Mathematical Skills* M1b
* M1c
* M2g
* M3c
* M3d
* M4a
* M4c
 | Links to Practical Activity Groups (PAGs)* N/A
 |

# Overview of P5.1 What is radioactivity?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr for separate and combined) | P5.1.1 describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleusP5.1.2 describe how and why the atomic model has changed over time to include the main ideas of Dalton, Thomson, Rutherford and Bohr | **Engage:** The discovery of the electron and the discovery of the atomic nucleusTwo short (around three minutes each) videos, featuring Professor Brian Cox, about some of the experiments leading to the discovery of atomic structure.[View full activity in P5.1 What is radioactivity? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg018-p51-what-is-radioactivity?activity=291313#291313)**Explore**: Rutherford scattering: Quantum mechanics, atomic nucleiAn interactive app featuring a virtual version of Rutherford’s experiment, as described in the previous video.[View full activity in P5.1 What is radioactivity? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg018-p51-what-is-radioactivity?activity=291318#291318)**Explain:** Pupils timeline how the atomic model has changed over time.**Extend:** Gravitational and electrostatic models of alpha particle scatteringTwo experiments in which gravity and electric charge are used to visualise the results of alpha particle scattering in Rutherford’s experiments.<https://spark.iop.org/gravitational-model-alpha-particle-scattering><https://spark.iop.org/electrostatic-model-alpha-particle-scattering>**Evaluate:** SAM question [J259-01](http://www.ocr.org.uk/Images/234632-unit-j259-01-breadth-in-physics-foundation-tier-sample-assessment-material.pdf) Question 6 | Link to delivery guide:<http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/>Link to [SAM](http://www.ocr.org.uk/Images/234632-unit-j259-01-breadth-in-physics-foundation-tier-sample-assessment-material.pdf): |
| 2 (1hr for separate and combined) | P5.1.3 recall the typical size (order of magnitude) of atoms and small moleculesP5.1.4 recall that atomic nuclei are composed of both protons and neutrons, and that the nucleus of each element has a characteristic positive charge | **Engage:** The scale of the universe 2This popular interactive allows users to scroll through orders of magnitude of scale with examples of objects of relevant sizes, from the observable universe down to the Planck length.[View full activity in P5.1 What is radioactivity? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg018-p51-what-is-radioactivity?activity=291337#291337)**Explore:** Build an atom: Atomic structure, atoms, atomic nucleiAn interactive app allowing users to build an atom from protons, neutrons and electrons, which gives the electric charge (ionisation) of the atom and tells whether the atom being built is stable or unstable.[View full activity in P5.1 What is radioactivity? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg018-p51-what-is-radioactivity?activity=291323#291323)**Explain:** Molymod atom building **Extend:** Elements, atomic radii and the periodic radiiA web page featuring a version of the periodic table in which elements are represented as circles of sizes proportional to their atomic radii.[View full activity in P5.1 What is radioactivity? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg018-p51-what-is-radioactivity?activity=291320#291320)**Evaluate:** Get pupils to order particles, atoms, molecules etc. according to size. | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/) |
| 3 (1hr for separate and combined) | P5.1.5 recall that nuclei of the same element can differ in nuclear mass by having different numbers of neutrons, these are called isotopesP5.1.6 use the conventional representation to show the differences between isotopes, including their identity, charge and mass | **Engage:** What are atoms and isotopes?A short (3 minutes), simple video about the structure of atoms and the nature of isotopes.[View full activity in P5.1 What is radioactivity? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg018-p51-what-is-radioactivity?activity=291331#291331)**Explore:** They may have already covered this in Chemistry to use questioning to assess pupils’ prior knowledge and understanding. **Explain:** Definition and structures<https://www.tes.com/teaching-resource/isotopes-6177149>**Extend:** Uses of Isotopes – research**Evaluate:** Get pupils to write their own definitions of isotopes giving examples. Swap and improve. | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/) |
| 4 (1hr for separate and combined) | P5.1.8 relate emissions of alpha particles, beta particles, or neutrons, and gamma rays to possible changes in the mass or the charge of the nucleus, or bothP5.1.9 use names and symbols of common nuclei and particles to write balanced equations that represent the emission of alpha, beta, gamma, and neutron radiations during radioactive decay M1b, M1c, M3cP5.1.7 recall that some nuclei are unstable and may emit alpha particles, beta particles, or neutrons, and electromagnetic radiation as gamma rays | **Engage:** A [video](https://www.youtube.com/watch?v=5oUagoF_viQ) on types of radioactive emissions**Explore:** card sort for alpha, beta and gamma emissions. Relating the change in mass/ charge etc. to the emission produced.**Explain:** Go through an example of how to write balanced equations for the different types of emission, get pupils to work through a couple of examples together as a class. **Extend:** pupils should be given plenty of practice in writing decay equations **Evaluate:** SAM question [J259-04](http://www.ocr.org.uk/Images/234636-unit-j259-04-depth-in-physics-higher-tier-sample-assessment-material.pdf) Question 9 | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/)Link to [SAM](http://www.ocr.org.uk/Images/234636-unit-j259-04-depth-in-physics-higher-tier-sample-assessment-material.pdf)  |
| 5 (1hr for separate and combined) | P5.1.10 explain the concept of half-life and how this is related to the random nature of radioactive decayM2e**P5.1.11 calculate the net decline, expressed as a ratio, in a radioactive emission after a given (integral) number of half-lives** M1c, M3d | **Engage:** A [video](https://www.youtube.com/watch?v=0vFHPfnW0Rc) about half-life **Explore:** Geiger Muller and sources demo count rate. **Explain:** Simple model of exponential decayA simple experiment involving the tossing of coins which provides an analogy for radioactive decay in order to help users understand the concept of a half-life.<https://spark.iop.org/simple-model-exponential-decay>**Extend:** Pupils draw a half-life graph from the above experiment**Evaluate:** Pupils write instructions on how to work out the half-life of a substance. | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/) |
| 6 (1hr for separate and combined) | P5.1.12 interpret activity-time graphs to find the half-life of radioactive materials M1c, M2g, M4a, M4c | **Engage:** half-life experiment [video](https://www.youtube.com/watch?v=fToMbj3Xz2c)**Explore:** Half-life of m&ms – use the sweets m&ms you can model the random nature of half-life by shaking them onto a plate and each time removing the sweets with the “m” facing up. If you count the remainder each time you can plot a nice exponential curve from the results. **Explain:** Measuring the half-life of protactiniumAn experiment involving a small quantity of radioactive material in which half-life can be calculated.<https://spark.iop.org/measuring-half-life-protactinium>**Extend:** Radioactive dating game: Carbon dating, radiometric dating, half lifeAn interactive app featuring various activities of increasing complexity, in which half-life can be observed in a population of unstable atoms, and carbon dating and the calculation of half-life are explained.[View full activity in P5.1 What is radioactivity? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg018-p51-what-is-radioactivity?activity=291325#291325)**Evaluate:** Give pupils examples of graphs and get then to calculate the half-life in each instance | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/) |

# Outline Scheme of Work: P5 – Radioactive materials

## Total suggested teaching time – 13 / 9 hours

### P5.2 How can radioactive materials be used safely? (3 / 3 hours)

|  |
| --- |
| Links to KS3 Subject content* a simple (Dalton) atomic model
* differences between atoms, elements and compounds
* atoms and molecules as particles
 |
| Links to Mathematical Skills* N/A
 | Links to Practical Activity Groups (PAGs)* N/A
 |

# Overview of P5.2 How can radioactive materials be used safely?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr for separate and combined) | P5.2.1 recall the differences in the penetration properties of alpha particles, beta particles and gamma rays | **Engage:** What are radioactive isotopes (radionuclides) A longer (<5 minutes) and more detailed video about radioactive isotopes, describing some of their uses in medicine.[View full activity in P5.2 How can radioactive materials be used safely? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg019-p52-how-can-radioactive-materials-be-used-safely?activity=291377#291377)**Explore**: Nature of ionising radiationsA web page containing a succinct digest of the ranges, penetration power and identity.<https://spark.iop.org/nature-ionising-radiations>**Explain:** Demo penetrating powers of different sources using Geiger tube, sources, paper, thin aluminium and lead.**Extend:** pupils write a report on how to safely use radioactive materials**Evaluate:** SAM question [J259-02](http://www.ocr.org.uk/Images/234633-unit-j259-02-depth-in-physics-foundation-tier-sample-assessment-material.pdf) Question 7 | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/)Link to [SAM](http://www.ocr.org.uk/Images/234633-unit-j259-02-depth-in-physics-foundation-tier-sample-assessment-material.pdf) |
| 2 (1hr for separate and combined) | P5.2.2 recall the differences between contamination and irradiation effects and compare the hazards associated with each of theseP5.2.5 explain why the hazards associated with radioactive material differ according to the radiation emitted and the half-life involvedP5.2.4 explain how ionising radiation can have hazardous effects, notably on human bodily tissues | **Engage:** Radiation dose: Parts 1 and 2 A pair of medium-length (5 minutes and <7 minutes respectively) videos containing detailed descriptions of the effects on matter and living tissue of exposure to various kinds and levels of radiation.[View full activity in P5.2 How can radioactive materials be used safely? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg019-p52-how-can-radioactive-materials-be-used-safely?activity=291383#291383)**Explore:** pupils research the hazards associated with radioactive material and how these differ according to the type of radiation and half-life**Explain:** Feedback findings to class**Extend:** Polonium 210: Kremlin assassin poisonA somewhat sensationalist compilation of news items from the BBC and NBC news coverage of the assassination of Alexander Litvinenko using polonium 210.[View full activity in P5.2 How can radioactive materials be used safely? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg019-p52-how-can-radioactive-materials-be-used-safely?activity=291391#291391)**Evaluate:** Pupils write definitions of contamination and irradiation. Swap and improve | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/)The uranium decay chain: It’s not just an alpha emitter!A medium-length (<7 minutes) video about the decay chain of uranium 238, which explains its decay into substances with various different characteristic emissions.[View full activity in P5.2 How can radioactive materials be used safely? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg019-p52-how-can-radioactive-materials-be-used-safely?activity=291389#291389)Millisieverts and radiationA medium-length (<10 minutes) video containing a detailed explanation of the way that radiation doses and harms are measured, and the difficulties of assessing risk.[View full activity in P5.2 How can radioactive materials be used safely? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg019-p52-how-can-radioactive-materials-be-used-safely?activity=291381#291381) |
| 3 (1hr for separate and combined) | P5.2.3 describe the different uses of nuclear radiations for exploration of internal organs, and for control or destruction of unwanted tissue | **Engage:** Cancer treatment what happens during radiotherapy?A short (<5 minutes) [video](https://www.youtube.com/watch?v=Hv1Of2_drRc) about the use of radiotherapy to treat cancer.**Explore:** pupils in group set a research task on the medical uses of nuclear radiation. They should produce an information leaflet or posterExplain: present to classExtend: Isotopes: What are medical isotopes?A medium-length (<6 minutes) [video](https://www.youtube.com/watch?v=PimbPIyLeZg) about the use of radioactive isotopes in PET scanners.Evaluate: SAM Question [J259-03](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) Question 9 | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/)Link to [SAM](http://www.ocr.org.uk/Images/234635-unit-j259-03-breadth-in-physics-higher-tier-sample-assessment-material.pdf) |

# Outline Scheme of Work: P5 – Radioactive materials

## Total suggested teaching time – 13 / 9 hours

### P5.3 How can radioactive materials be used to provide energy? (4 / 0 hours)

|  |
| --- |
| Links to KS3 Subject content* fuels and energy resources
 |
| Links to Mathematical Skills* N/A
 | Links to Practical Activity Groups (PAGs)* N/A
 |

# Overview of 5.3 How can radioactive materials be used to provide energy?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 (1hr separate science only) | P5.3.1 recall that some nuclei are unstable and may split into two nuclei and that this is called nuclear fissionP5.3.2 relate the energy released during nuclear fission to the emission of ionising radiation and the kinetic energy of the resulting particles | **Engage:** Fission vs. fusion nukesA very short (1 minute) video about the difference between fission- and fusion-based nuclear weapons.[View full activity in P5.3 How can radioactive materials be used to provide energy? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg020-p53-how-can-radioactive-materials-be-used-to-provide-energy?activity=291447#291447)**Explore:** Nuclear fission: Fission, chain reaction, nucleusAn interactive app in which users can observe the effect of firing neutrons at atoms of uranium 238 and uranium 235, before moving on to exploring the nature of chain reactions and then simulating the generation of nuclear power.[View full activity in P5.3 How can radioactive materials be used to provide energy? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg020-p53-how-can-radioactive-materials-be-used-to-provide-energy?activity=291437#291437)**Explain:** Use diagrams to explain the process of nuclear fission**Extend:** Creating the elementsA medium length (6 minutes) video about the creation of chemical elements in cosmic processes.[View full activity in P5.3 How can radioactive materials be used to provide energy? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg020-p53-how-can-radioactive-materials-be-used-to-provide-energy?activity=291443#291443)**Evaluate:** Pupils write their own definition of fission. Swap with partner and improve. Get pupils to tell you their definitions and use their answers to come up with a definitive definition for all learners to write down. | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/)Nuclear physics: Binding energy per nucleonA short (4 minutes) video about the binding energies of different chemical elements.[View full activity in P5.3 How can radioactive materials be used to provide energy? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg020-p53-how-can-radioactive-materials-be-used-to-provide-energy?activity=291445#291445) |
| 2 (1hr separate science only) | P5.3.3 explain how nuclear fission can lead to further fission events in a chain reactionP5.3.4 describe the process of nuclear fusion and recall that in this process some of the mass may be converted into the energy of radiation | **Engage:** Is nuclear power good or bad?A long-ish (14 minutes) video briefly dealing with some arguments for and against the use of nuclear power.[View full activity in P5.3 How can radioactive materials be used to provide energy? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg020-p53-how-can-radioactive-materials-be-used-to-provide-energy?activity=291449#291449)**Explore:** Discussion surrounding dangers involved in Nuclear power, learners may have some knowledge of the Chernobyl and the Fukushima disasters.**Explain:** Put learners into groups and put them in sides of for and against. Learners to research and prepare for a debate on nuclear power. **Extend:** Nuclear power plant simulator An online game in which players have to run a nuclear power station at a profit while avoiding meltdowns.[View full activity in P5.3 How can radioactive materials be used to provide energy? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg020-p53-how-can-radioactive-materials-be-used-to-provide-energy?activity=291455#291455)**Evaluate:** Nuclear debate. | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/) |
| 3 (1hr separate science only) | P5.3.3 explain how nuclear fission can lead to further fission events in a chain reactionP5.3.4 describe the process of nuclear fusion and recall that in this process some of the mass may be converted into the energy of radiation | **Engage:** A short (<2 minutes) video about the levels of radioactivity and the potential harm thereof around the site of the Chernobyl disaster.[View full activity in P5.3 How can radioactive materials be used to provide energy? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/delivery-guide-gpbdg020-p53-how-can-radioactive-materials-be-used-to-provide-energy?activity=291451#291451)**Explore:** chain reactions with [lolly sticks](https://www.youtube.com/watch?v=F0jQgGz7GfY)**Explain:** Lesson element Nuclear fission – [Activity](https://www.tes.com/teaching-resource/ks4-physics-nuclear-fission-activity-11136151)**Extend:** Use diagrams to explain the process of nuclear fusion and the chain reaction involved**Evaluate:** SAM question [J259-02](http://www.ocr.org.uk/Images/234633-unit-j259-02-depth-in-physics-foundation-tier-sample-assessment-material.pdf) Question 8 | Link to delivery guide [Radioactive materials](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-physics-b-j259-from-2016/delivery-guide/topic-gpbt05-p5-radioactive-materials/)Link to [SAM](http://www.ocr.org.uk/Images/234633-unit-j259-02-depth-in-physics-foundation-tier-sample-assessment-material.pdf) |
| 4  |  | Pupils to complete the [End of chapter quiz P5](https://interchange.ocr.org.uk/Downloads/Twenty-First-Century-Physics-Quizzes.zip). After completion pupils to swap and mark quizzes.Pupils use their quizzes to create a revision list from Chapter 5 | [End of chapter quiz P5](https://interchange.ocr.org.uk/Downloads/Twenty-First-Century-Physics-Quizzes.zip) will be available on OCR interchange, so a login will be required  |

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