| Unit title | Unit 7: Principles and Applications of Physics II |
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| **Guided learning hours** | 60 |
| **Number of lessons** | 30 |
| **Duration of lessons** | 2 hours |
| **Links to other units** | |
| • Unit 3: Principles and Applications of Physics I<br>• Unit 22: Medical Physics Applications<br>• Unit 23: Materials Science | |

| Key to learning opportunities | | | |
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| **AW** | Assignment writing | **PA** | Preparation for assessment |
| **GS** | Guest speaker | **V** | Visit |
| **IS** | Independent study | **GW** | Group work |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| **Learning Aim A: Understand thermal physics, materials and fluids** | | | | |
| 1 | **A1** Thermal physics in domestic and industrial applications<br>• Quantities and units | GW | • **Tutor presentation:** Introduce the learning environment. Point out the centre's health and safety features as well as fire escapes, procedures and general housekeeping requirements.<br>• **Tutor-led discussion:** Write the words 'power' and 'watt' on the board. Ask learners to define the difference between them as part of an informal discussion. This will enable you to gauge learners' current knowledge and understanding of the topic.<br>• **Tutor presentation:** Introduce power and watts. Explain that power is a scalar quantity and a watt is the unit of measurement for calculating the power in a circuit. Then explain how watts are scaled up to kilowatts, megawatts and gigawatts. | • Tutor presentation |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| | | | ● **Small group work:** Learners define how they think temperature is measured. Ask them to consider the symbols and measurement scales used for temperature and how they have been produced from real world information.<br>● **Tutor-led discussion:** Groups share their ideas about measuring temperature.<br>● **Tutor presentation:** Explain how to convert between kelvin and Celsius.<br>● **Small group work:** Learners convert from Celsius to kelvin and vice versa.<br>● **Small group work:** Learners write their own definition of pressure.<br>● **Tutor-led discussion:** Groups share their definitions of pressure. Build on their ideas by writing a complete definition on the board. Ensure all learners write this down.<br>● **Tutor presentation:** Give a presentation on pressure and how it is measured. Explain the difference between $Nm^{-2}$ and Pascals. You could also demonstrate a Newton as follows:<br>○ Set up pendulums of differing weights against a 1 kg weight.<br>○ Then try to knock the 1 kg weight 1 metre in 1 second.<br>○ Discuss the limitations of the demonstration due to air resistance, temperature and friction acting on the 1 kg weight.<br>● **Homework:** Learners find a definition of 'work' in physics. | |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 2 | **A1** Thermal physics in domestic and industrial applications<br>• Definitions of work | GW | • **Learner presentations:** Learners present their homework findings to the group. Once all learners have shared their ideas, write a definition of 'work' on the board, to support further explanations within the session.<br>• **Small group work:** Guide learners to set up an experiment to find the work done by an object (e.g. the force multiplied by the distance an object moves). This is a simple experiment which can be scaled to fit the space available, from pushing a toy car across a table to pushing a real car across a car park).<br>• **Tutor presentation:** Show learners how to calculate the work done in their experiments. Discuss other forces at play in the experiments. Discuss the formulas used to calculate work, including work done as force × distance moved in direction of force ($W = F \times \Delta x$) and work done by a gas as pressure × change in volume of gas ($W = p \times \Delta V$).<br>• **Small group work:** Learners carry out an experiment to demonstrate work done by a gas in the form of pressure. This could be done with a pump and a tyre, using a video or a diagram to show the change in volume of the gas. Alternatively, balloons could be used here.<br>• **Group discussion:** Summarise the lecture by asking questions of the entire class and then selecting a learner at random to answer. | • Practical equipment (e.g. toy cars, ramps, spring-loaded 'car launcher', ruler, stop watch, ticker tape, ticker timer, protractor, tyre, pump, balloons, etc.)<br>• Tutor presentation |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 3 | **A1** Thermal physics in domestic and industrial applications<br>• Calculating efficiency | GW | • **Tutor presentation:** Introduce the subject of efficiency. Teach learners how to calculate efficiency using the following relationships:<br>o efficiency = useful energy output ÷ total energy input<br>o efficiency for heat engines<br>o maximum theoretical efficiency.<br>• **Small group work:** Learners take turns to say one word at a time, to piece together an explanation or definition of efficiency.<br>• **Tutor-led discussion:** Learners share their definitions of efficiency. As a class, come up with an accurate definition and ensure all learners make a note of it. Ask learners to suggest possible barriers to efficiency. List them on the board.<br>• **Tutor-led practical session:** Carry out an experiment which demonstrates efficiency. For example, allow a toy car to roll down a ramp, then change barriers to efficiency (e.g. change the slope of the ramp, or lower friction by adding a lubricant).<br>• **Tutor-led discussion:** Compare the practical demonstration with an experiment to demonstrate the efficiency of an engine and identify its products of 'waste energy' (e.g. heat). Consider how an engine could be made more efficient. Ensure learners are confident with calculating efficiency for themselves.<br>• **Tutor-led discussion:** Discuss the concept of maximum theoretical efficiency. Show videos of cutting-edge technology and engineering which aim to get as close as possible to maximum theoretical efficiency.<br>• **Homework:** Learners research an example of a system which attempts to be as energy efficient as possible through conservation of energy. | • Tutor presentation<br>Practical equipment (e.g. toy cars, ramps, spring-loaded 'car launcher', ruler, stop watch, ticker tape, ticker timer, lubricant, protractor, etc.)<br>• Videos to demonstrate maximum theoretical efficiency |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 4 | **A1** Thermal physics in domestic and industrial applications<br>• Law of conservation of energy<br>• First law of thermodynamics<br>• Second law of thermodynamics | GW | • **Learner presentations:** Learners present their homework findings to the group. Explain and fill in any gaps to ensure all learners have a general understanding of energy efficiency within a system. Emphasise that no system is 100% efficient.<br>• **Tutor presentation:** Introduce the law of conservation of energy. Explain the concept of a perpetual motion machine and why it cannot possibly exist, referring to the law of conversation of energy and the associated laws of thermodynamics. Then explain the ideal gas equation ($pV = NkT$) and the arithmetic done with pressure, volume and temperature.<br>• **Tutor-led practical:** Set up a simple experiment to demonstrate the first law of thermodynamics, such as boiling a kettle with a whistle and identifying the different energy transfers. Then discuss isothermal and adiabatic processes with learners and ensure they understand the difference.<br>• **Tutor-led discussion:** Give an example of an engine and explain to learners the idealised engine cycle and its association with thermodynamics.<br>• **Tutor presentation:** Introduce the second law of thermodynamics, using examples such as heat engines, refrigerators and heat pumps. Explain the associated maximum theoretical coefficient of performance (COP). | • Tutor presentation<br>• Practical equipment (e.g. whistling kettle) |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 5 | **A1** Thermal physics in domestic and industrial applications<br>• Changes of state | GW<br>IS | • **Tutor-led discussion:** Introduce changes of state of substances by writing three words on the board: ice, water and steam. Ask learners to write down the six words they associate with the changes of state between them (melting, freezing, boiling, condensing, sublimation, deposition). Review these words as a class.<br>• **Tutor presentation:** Describe material states, using diagrams to show the density and structure of atoms within materials in these different states. Explain how changes in state can be used in both domestic and industrial processes, e.g. within refrigerators or engines. Consider latent heat and where it can be observed.<br>• **Tutor-led practical:** Set up an experiment to compare the speed of evaporation of boiling water with the speed of evaporation by latent heat (by leaving a beaker of water and looking at the amount that evaporates over the coming weeks). Ensure learners understand that latent heat evaporates water in exactly the same way as boiling, but more slowly. Introduce a condensing tube to the boiling water to show the changes of state from water to steam and back.<br>• **Tutor-led practical:** Demonstrate the latent heat of fusion by melting ice with and without a heat source. Learners compare the weight of melted ice from both beakers and perform the required calculations to find the specific latent heat of fusion of ice.<br>• **Individual activity:** Learners complete a work sheet with questions that require them to work out the thermal energy needed to melt and freeze given amounts of ice and water. Allow time for questions to ensure understanding. | • Tutor presentation<br>• Practical equipment (water, ice, beaker, tripod, Bunsen burner, condensing tube etc.)<br>• Worksheet |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 6 | **A2** Materials in domestic and industrial applications<br>• Elasticity, stress–strain curves, elastic limit, strength, yield point, plastic deformation<br>• Creep, fatigue, ductility, brittleness, malleability<br>• Elastic hysteresis | GW | • **Tutor-led discussion:** Ask learners to suggest definitions of stress, strain and elasticity. Encourage learners to build on each other's ideas to come up with accurate definitions. Write these definitions on the board and ensure all learners make a note of them.<br>• **Tutor presentation:** Explain how elasticity, stress–strain curves, material strengths, plastic deformation, creep and fatigue are applied within domestic and industrial applications.<br>• **Tutor-led practical:** Set up an experiment to demonstrate the points detailed in the presentation. Compare different materials to give learners a broad understanding of this topic.<br>• **Tutor-led discussion:** Allow learners to ask questions to ensure their understanding. | • Tutor presentation<br>• Practical equipment (e.g. wires made of different metals, weights, etc.) |
| 7 | **A2** Materials in domestic and industrial applications | Site visit | • **Site visit:** Arrange for learners to visit a manufacturer of metal products, to learn how they test their materials to ensure they do not deform or fatigue in a manner which would make them unusable under the stresses and strains associated with their use.<br>• Encourage learners to ask questions, both about material testing and about routes into employment within the field.<br>• If a site visit is not possible, arrange for a visiting speaker or a video-conferencing call with a suitable expert. | • Access to a site where metal products are stress and strain tested<br>• Visiting speaker (if site visit is not possible) |
| 8 | **A2** Materials in domestic and industrial applications<br>• Compressive/tensile stress and strain<br>• Young's modulus | GW | • **Tutor presentation:** Introduce the calculation used to work out compressive and tensile stress and strains acting on a material. Ask learners to suggest the variables that can be put into a calculation to find a constant which can be used to compare different materials.<br>• **Tutor presentation:** Explain how to calculate tensile stress and | • Tutor presentation<br>• Worksheet |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| | | | tensile strain and then find Young's modulus for a material.<br>• **Small group work:** Give each learner a worksheet listing the stresses and strains of different materials. Ask them to work out Young's modulus for each material. Within their groups, learners then swap worksheets and check and discuss their answers.<br>• **Tutor-led discussion:** Learners suggest when and where Young's modulus may be variable for a given material. | |
| 9 | **A2** Materials in domestic and industrial applications<br>• Density<br>• Compressive/tensile stress and strain<br>• Young's modulus<br>• Hooke's law | GW | • **Tutor presentation:** Introduce the concept of density by explaining the difference in density of atoms in solids, liquids and gases. (This could link with a future lecture on atomic structure.)<br>• **Tutor-led practical:** Set up an experiment to show tensile/ compressive stress and strain. Explain the application of Young's modulus and how to work this out. Then discuss Hooke's law in relation to the stretching and compression of a wire or spring. Ensure learners understand the idea of elastic strain.<br>• **Tutor presentation:** Describe the applications of Young's modulus and Hooke's law within industry.<br>• **Small group work:** Give learners examples of stress and strain data for different materials and ask them to work out Young's modulus for each material. | • Tutor presentation<br>• Practical equipment (e.g. retort stands, clamps, wires made of a range of metals, rulers, etc.)<br>• Stress and strain data |
| 10 | **A3** Fluids in motion<br>• Fluid flow patterns, streamline and turbulent flow<br>• Viscosity, viscous drag<br>• Mass of fluid flow per | GW | • **Small group work:** Learners consider fluid flow patterns by working in groups to explain all the ways in which a liquid can move or interact with something else.<br>• **Tutor-led practical:** Set up a demonstration to show fluid flow patterns and demonstrate how streamlining can prevent turbulent flow. Add streamlined and turbulent objects to moving water to show flow patterns. Then show fluids with different viscosities and | • Practical equipment (fluids of different viscosity, pipes, stream tubes, streamlined and turbulent objects, Venturi meter, stopwatch, etc.) |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| | second for all points along a pipe or stream tube is constant<br>• Non-Newtonian fluid flow<br>• Rate of fluid flow and pressure<br>• Bernoulli's principle | | demonstrate that flow per second is constant within a pipe or stream tube. Finally, consider non-Newtonian fluid flow.<br>• **Tutor-led practical:** Carry out an experiment to shows how rate of flow is affected by pressure, for example, the rate at which different thicknesses of balloon deflate when untied. Use a Venturi meter to show Bernoulli's principle.<br>• **Individual work – summative assessment:** Learners write up their findings from the experiment, both for future reference and for your own records (to allow you to assess learners' abilities in written work). | |
| 11 | Assessment activity for learning aim A | AW | • Learners begin writing their assignments, outlining, describing, explaining and analysing the importance of thermal physics to both home and industrial situations. | • Assignment brief<br>• Research materials |
| 12 | Assessment activity for Learning aim A | AW | • Learners continue writing their assignments, outlining, describing, explaining and analysing the importance of thermal physics to both home and industrial situations. | • Assignment brief<br>• Research materials |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| **Learning aim B: Investigate the properties and uses of radioactivity** | | | | |
| 13 | **B1** Structure of the atom and forces<br>● Basic model of atoms | GW<br>IS | ● **Tutor presentation:** Introduce the structure of atoms and ensure learners understand that they make up all matter.<br>● **Group discussion:** Ask learners what they think of when they imagine an atom and discuss learners' initial thoughts of what an atom is. Draw two different atoms on the board, without labelling them, and ask learners to identify the differences between them.<br>● **Tutor presentation:** Describe protons, neutrons and electrons, emphasising their individual charges (or lack thereof) and their sizes in relation to each other. As you speak, label these components on the two drawings of atoms on the board. Explain relative atomic masses and describe how differences between atomic shells make different atoms.<br>● **Individual activity:** Learners use basic atom models to build different atoms from given information.<br>● **Question and answer session:** Lead a question and answer session to test learner's understanding of the differences between protons, neutrons and electrons. | ● Tutor presentation<br>● Basic atom models |
| 14 | **B1** Structure of the atom and forces<br>● Experiments by Rutherford, Geiger and Marsden | GW | ● **Tutor presentation:** Introduce Rutherford, Geiger and Marsden, giving learners some information about their nationality, education and life. Describe their experiments, shooting alpha particles at gold sheets, and explain how the alpha particle deflection proves atomic structure as it is recognised today. Show a video and use numerous diagrams to illustrate the experiments. Consider previous ideas about atomic structure (namely, the 'plum pudding' model).<br>● **Small group work:** Learners research the history of ideas about | ● Tutor presentation<br>● Research materials<br>● Materials for timelines |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| | | | the atom and produce a timeline to summarise the key points.<br>• **Tutor-led discussion:** Learners share their timelines. Collate the main points and correct any errors or misconceptions, to produce a formal explanation and history of changing ideas about the atom. | |
| 15 | **B1** Structure of the atom and forces<br>• The periodic table | GW<br>IS | • **Tutor presentation:** Introduce the periodic table of elements. Explain how atomic number and mass are worked out from the number of protons and neutrons, using a diagram of an atom.<br>• **Individual activity:** Give each learner a copy of the periodic table and a worksheet with diagrams of different atoms. Learners count the electrons in each diagram and use the periodic table to identify the elements.<br>• **Group discussion:** Ask questions to ensure learners have understood the key points. | • Tutor presentation<br>• Copies of the periodic table<br>• Worksheets |
| 16 | **B1** Structure of the atom and forces<br>• Isotopes | GW<br>IS | • **Tutor presentation:** Introduce the idea of isotopes and show learners how to write isotope symbols. Explain the circumstances required for isotopes of elements to form.<br>• **Small group work:** Give learners examples of isotope symbols and ask them to work out the mass numbers.<br>• **Tutor presentation:** Discuss the applications of isotopes in industrial and domestic settings. Use videos and diagrams to suit the different learning styles in your class.<br>• **Individual activity:** Ask learners to research specific applications of different isotopes (allocate a specific topic to each learner).<br>• **Tutor-led discussion:** Learners share their research findings with the class. Ensure all key ideas have been covered.<br>• **Homework:** Ask learners to research the terms nuclear force and electric force and write definitions. | • Tutor presentation<br>• Research materials |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 17 | **B1** Structure of the atom and forces<br>• Forces and charges (nuclear force, electric force)<br>• Nucleus stability | GW | • **Tutor-led discussion:** Learners share their homework (definitions of the nuclear force and electric force). Collate their ideas to produce definitions and ensure learners write them down.<br>• **Tutor presentation:** Discuss nuclear force (holds protons together in the nucleus) and electric force (repels protons from each other). Explain how nuclear stability depends on the number of protons and neutrons within an atom. Use diagrams to show what happens when atoms become ions or form molecules with covalent bonds. Make links with atomic stability, referring back to the periodic table.<br>• **Homework:** Learners carry out research to answer the question, 'What is radiation?' | • Tutor presentation |
| 18 | **B2** Ionising radiation<br>• Radioactive decay and half-life | GW<br>IS | • **Tutor-led discussion:** Learners share the findings from their homework research about radiation. Collate the key ideas.<br>• **Tutor presentation:** Discuss radiation. Make links with electric force and nuclear force and describe how the nuclei of larger atoms may lose particles in the form of radiation. Explain radioactive decay and the concept of half-lives.<br>• **Individual activity:** Learners research Marie Curie and her original findings in the field of radioactivity, then consider the history of other notable radiation scientists.<br>• **Tutor-led discussion:** Learners share their research findings with the class.<br>• **Tutor-led practical:** After considering health and safety with learners, demonstrate how a Geiger counter works, using suitable radioactive sources. Explain the applications of a Geiger counter in industry. | • Tutor presentation<br>• Research materials<br>• Geiger counter<br>• Radioactive sources |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 19 | **B2** Ionising radiation<br>• Effect of a magnetic field | GW | • **Tutor presentation:** Introduce ionising radiation. Explain that alpha radiation is most likely to cause ionisation of atoms, followed by beta and then gamma radiation. Use diagrams and videos to demonstrate what happens when an atom is ionised by a radioactive particle. Pay particular attention to the effects of alpha and beta decay in terms of the transformation of a nucleus. Explain the effect of a magnetic field on atoms and describe how electrons create a magnetic field.<br>• **Small group activity:** Learners produce diagrams to show the effects of radiation on atoms and explain how ionisation takes place. Each group should create a poster for display within the classroom, as an aid to memory.<br>• **Tutor-led discussion:** Show flash cards which detail the effects of radiation on atoms and ask learners to suggest what they think is happening for each card. This will help to consolidate learning. | • Tutor presentation<br>• Videos about ionising radiation and the effects of a magnetic field on atoms<br>• Materials for posters<br>• Flash cards |
| 20 | **B2** Ionising radiation<br>• Nuclear fission principles | GW | • **Tutor-led discussion:** Ask learners what they think is meant by the term 'nuclear fission'. Guide them towards an accurate definition.<br>• **Tutor presentation:** Introduce nuclear fission, including the use of nuclear fission in the production of energy. Explain what happens at an atomic level, describing how neutrons interact with the nucleus to produce lighter elements, releasing energy in chain reactions. Use video and diagrams to support your explanations.<br>• **Group activity:** Learners discuss the risks, benefits and long-term effects of nuclear energy.<br>• **Tutor-led discussion:** Learners share their ideas from the group activity. Collate the key points in a mind map or as a list and encourage learners to make notes.<br>• **Quiz:** Check learner understanding with a quiz on nuclear fission. | • Tutor presentation<br>• Quiz on nuclear fission |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 21 | **B2** Ionising radiation<br>• Detection of ionising radiation using the Geiger–Muller tube | GW<br>IS | • **Tutor-led discussion:** Revise Geiger counters.<br>• **Tutor presentation:** Use videos, diagrams and, if possible, a practical demonstration to show how a Geiger–Muller tube detects ionising radiation. Also discuss scintillation counters.<br>• **Individual activity – formative assessment:** Learners produce work which details the use of a Geiger counter and describes how it works. This could be in the form of an instruction manual for somebody to use, or even build, a Geiger counter. | • Geiger counter<br>• Scintillation counter<br>• Radioactive sources<br>• Research materials |
| 22 | **B2** Ionising radiation<br>• Health hazards and radiation dosimeter badges in industry | GS | • **Guest speaker:** Arrange for an industry representative to speak to learners about the health hazards of working within an industry at risk from radiation. Ask them to discuss specific health hazards, symptoms of radiation poisoning and methods used to ensure the safety of workers. Ask them to explain how protective methods such as radiation dosimeter badges are used. Learners can ask questions about employment and routes into employment. | • Visiting speaker (via video conferencing, if necessary) |
| 23 | **B2** Ionising radiation<br>• Background radiation (natural and human developed sources) | GW | • **Small group work:** Learners suggest possible sources of background radiation, both natural and man-made.<br>• **Tutor-led discussion:** Groups share their ideas with the class. Collate their responses to produce a definitive list.<br>• **Tutor presentation:** Talk about background radiation. Consider different sources, e.g. naturally-occurring radon gas in south-west England, cosmic rays, medical products and nuclear power. Illustrate cosmic radiation by leaving a Geiger counter working throughout the presentation, counting background radiation.<br>• **Small group work:** Learners assess who is at risk from radiation sources and who benefits from them.<br>• **Tutor-led discussion:** Groups share their ideas. | • Tutor presentation<br>• Geiger counter<br>• Research materials |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| 24 | **B2** Ionising radiation<br>• Nuclear power station accidents | GW<br>IS | • **Tutor presentation:** Use documentaries and news reports to give a general account of nuclear power station accidents (e.g. Chernobyl and Fukushima). Discuss the histories, causes, effects and current efforts to control the aftermath at the sites.<br>• **Individual activity – formative assessment:** Learners produce work detailing the impact of a power station accident of their choice. This could take the form of a warning for someone starting a new job at a nuclear power plant, giving information about the risks involved if an accident occurs. | • Tutor presentation<br>• Documentary on nuclear power station accidents<br>• Research materials |
| 25 | **B3** Applications of radioactivity<br>• Nuclear power and use of Uranium 235 | GW | • **Tutor presentation:** Introduce the uses of Uranium 235. Describe its acquisition and history in science. Explain how Uranium 235 is split through fission to start a chain reaction, releasing energy which drives turbines to create an electric charge.<br>• **Small group work:** Learners draw a flow diagram of the process by which Uranium 235 is used to create electricity.<br>• **Tutor-led discussion:** Learners consider where in the world Uranium 235 is used to create electricity. Share statistics about the percentage of worldwide energy produced through this method and encourage learners to take notes.<br>• **Small group work:** Learners note the benefits and drawbacks of our reliance on nuclear energy and possible developments we may see in the future. | • Tutor presentation<br>• Research materials |
| 26 | **B3** Applications of radioactivity<br>• Radiocarbon dating and radioisotope | GW<br>IS | • **Tutor-led discussion:** Give learners samples of rocks and ask them to guess how old they are. (It is unlikely they will be able to do this.) Introduce the idea of radiocarbon dating.<br>• **Tutor presentation:** Talk about radiocarbon dating of rocks. Discuss the uses and implementation of radiocarbon dating of | • Rock samples<br>• Tutor presentation<br>• Research materials<br>• Materials for posters |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| | dating | | rocks in different industries and for different purposes. Explain the limitations of radiocarbon dating.<br>● **Tutor presentation:** Introduce radioisotope dating of rocks older than 60,000 years. Describe how the method works and its application where radiocarbon dating cannot be used.<br>● **Individual activity:** Learners produce a poster describing how samples can be dated using radioisotopes (carbon-14 or other isotopes). These posters can be displayed in the classroom for future reference. | |
| 27 | **B3** Applications of radioactivity<br>● Gamma and x-ray radiography in medical treatment and industry | GW<br>GS | ● **Tutor presentation:** Describe the discovery of X-rays and the first X-ray images of the human body.<br>● **Guest speaker:** Arrange for a visiting speaker to give a talk about X-rays and gamma radiography. Give learners time to ask questions about the industry in which the speaker works and the route they took to employment. This will develop learners' social skills as well as building links with industry.<br>● **Tutor-led discussion:** Learners consider applications of X-rays and gamma radiography in medical and industrial situations. Discuss the risks to operatives and methods used to protect their health. You may wish to make links with related biology content. | ● Tutor presentation<br>● Visiting speaker |
| 28 | **B3** Applications of radioactivity<br>● Radioactive tracers in medical diagnosis and industrial flow monitoring<br>● Production of | GW | ● **Tutor presentation:** Building on the previous session, introduce radioactive tracers and describe how they are used in medical diagnosis. Show examples of X-rays and compare them with images produced using radioactive tracers.<br>● **Tutor presentation:** Describe the different types of radioactive tracer and detail their uses, both in medical diagnosis and in industrial flow monitoring. | ● Tutor presentation, including images produced using X-rays and radioactive tracers<br>● Practical equipment<br>● Quiz on radioactive tracers |

| Lesson | Topic | Lesson type | Suggested activities | Classroom resources |
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| | plutonium for nuclear weapons | | • **Tutor-led practical:** Carry out an experiment to demonstrate how radioactive tracers work.<br>• **Quiz:** Use a quiz about the different types of radioactive tracer to check learner understanding.<br>• **Paired activity:** Learners research and create a presentation about the use of nuclear weapons in history.<br>• **Learner presentations:** Learners share their research findings from the paired activity.<br>• **Tutor led discussion:** building on the points raised during the learners presentation. | |
| 29 | • Assessment activity for Learning aim B | GW | • **Individual activity:** Learners begin work on their assignment with access to books, journals and websites as well as their lecture notes. Emphasise the importance of handing in work on time, using the glossary to ensure command words are met, and referencing secondary sources. | • Assignment brief |
| 30 | • Assessment activity for Learning aim B | AW | • **Individual activity:** Learners continue work on their assignment with access to books, journals and websites as well as their lecture notes. Emphasise the importance of handing in work on time, using the glossary to ensure command words are met, and referencing secondary sources. | • Assignment brief<br>• Research materials |

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