



The Sutton Academy

Knowledge Rich Curriculum Plan

SCIENCE- Physics Year 10

Radioactivity

Lesson/Learning Sequence	Intended Knowledge: <i>Students will know that...</i>	Prior Knowledge: <i>In order to know this, students need to already know that...</i>	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Atoms	- Students will know that atoms are very small, having a radius of about 1×10^{-10} m - Students will know that the radius of the nucleus of an atom is less than $1/10\,000$ of the radius of an atom. - Students will know that most of the mass of an atom is concentrated in the nucleus. - Students will know that electrons are arranged at different distances from the nucleus, called energy levels. - Students will know that an electron may move further from the nucleus of the atom (to a higher energy level) through the absorption of electromagnetic radiation - Students will know that an electron may move closer to the nucleus (to a lower energy level) by emitting electromagnetic radiation Students will know that electromagnetic radiation is a type of radiation that is a wave	<i>Students need to already know that an atom is made up of protons, neutrons and electrons. They should already know that:</i> <i>Protons are positive subatomic particles with a relative mass of 1. They are found in the nucleus of an atom.</i> <i>Neutrons are a neutral subatomic particle. They have a relative mass of 1 and are found in the nucleus of an atom</i> <i>Electrons are a negatively charged subatomic particle. They have a negligible relative mass and are found in electron</i>	Quantitative and qualitative comparisons of magnitudes of size.	Tier 2 Radius: a straight line from the centre to the circumference of a circle or sphere Tier 3 Atom: The smallest indestructible building blocks of all substances. Atomic number: The number of protons within the nucleus of an atom. Atomic mass: The number of protons and neutrons within the nucleus of an atom.
Lesson: Mass Number, atomic number and isotopes	- Students will know that an atom has an equal number of protons and electrons as atoms have no overall electrical charge - Students will know that all atoms of a particular element have the same number of protons. - Students will know that the number of protons in an atom of an element is called its atomic number. - Students will know that the total number of protons and neutrons in an atom is called its mass number. - Students will know that to calculate the number of neutrons in an atom you would subtract the atomic number from the mass number			Tier 2 Tier 3 Atomic number: This is the number of Protons found in the nucleus of an atom Relative Atomic Mass (Ar): This is the mass of an atom compared to all the other atoms in the period table. It is a ratio and has no unit. Atomic mass: The total mass of the number of protons and neutrons. The relative mass of each proton and neutron = 1. The mass of an electron is not included because it is regarded as having no mass.

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	- Students will know that atoms of the same element (have the same number of protons) with different numbers of neutrons are called isotopes - Students will know that atoms become positive ions if they lose outer electron(s) Students will know how to relate differences between isotopes to differences in subatomic particles			
Lesson: History of the Atom	- Students will know that new experimental data will lead to scientific models being changed or developed - Students will know that the discovery of subatomic particles in order were: electrons --> protons --> neutrons - Students will know that before electrons were discovered, atoms were thought to be tiny spheres that couldn't be divided (John Dalton's model) - Students will know that the discovery of the electron led to the plum pudding model. (JJ Thompson) - Students will know that the plum pudding model is the idea that an atom is a ball of positive charge with negative particles (electrons) scattered in it - Students will know that in the alpha scattering experiment alpha particles were fired at gold foil. The observations made were that most of the positively charged alpha particles went straight through the gold foil, and some alpha particles were deflected, suggesting that there was a positive charge in the centre of the atom - Students will know that the results of the alpha scattering experiment led to	<i>Students need to already know that all substances are made up of atoms</i> <i>Students need to already know that scientific ideas develop over a period of time</i>		Tier 2 Tier 3 The Nuclear Model: The atom is made up of a densely positively charged nucleus. The rest of the atom is mainly empty space, with electrons surrounding the nucleus John Dalton's Atomic Theory: Atoms are tiny hard spheres, that can't be broken down into anything smaller The discovery of the neutron: The neutron was discovered as being a part of the nucleus. Plum Pudding Model: Electrons were discovered. The atom is made up of a ball of positive charge, with negatively charged particles scattered inside randomly. The Bohr Model: Very similar to the nuclear model, but the electrons are in energy levels (or shells) surrounding the nucleus.

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	the conclusion that the mass of an atom is concentrated in the nucleus, and that the nucleus is charged (Ernest Rutherford) - Students will know that the model that developed from the alpha scattering model was referred to as the "nuclear model" - Students will know that Niels Bohr adapted the nuclear model, by suggesting that the electrons are orbiting the nucleus at set distances - Students will know that further experiments led to the discovery that the nucleus contained smaller particles, leading to the discovery of protons Students will know that experiments performed by James Chadwick led to the discovery of neutrons			
Lesson: Radioactive Decay	- Students will know that some atomic nuclei are unstable. - Students will know that when the nucleus becomes stable it releases radiation. Students will know that this is a random process known as radioactive decay - Students will know that activity is the rate at which a source of unstable nuclei decays. - Students will know that the unit of activity is becquerels (Bq) - Students will know that count rate is the number of decays recorded each second. - Students will know that a Geiger-Muller tube is a detector that is used to detect radiation - Students will know that nuclear radiation is emitted is either an alpha	<i>Students need to already know that protons are positively charged, neutrons are neutral and electrons are negatively charged</i>		Tier 2 <i>Unstable – likely to change</i> Tier 3 Activity – Rate at which a source of unstable nuclei decays. Measured in Becquerels (Bq) Count rate – Number of decays recorded each second using a detector (Geiger-Muller tube).

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	particle, a beta particle, a gamma ray or a neutron. - Students will know that an alpha particle consists of two neutrons and two protons, and is sometimes referred to as a helium nucleus. - Students will know that a beta particle is a high speed electron ejected from the nucleus as a neutron turns into a proton - Students will know that a gamma ray is electromagnetic radiation from the nucleus. - Students will know that an alpha particle has an electrical charge of +2 - Students will know that a beta particle has an electrical charge of -1. - Students will know that penetrating power is the ability for radiation to travel through a material. - Students will know that ionising power is the ability for radiation to ionise an atom. - Students will know that an alpha particle is weakly penetrating, and is stopped by paper - Students will know that a beta particle is moderately penetrating, and is stopped by aluminium foil - Students will know that a gamma ray is highly penetrating, and is stopped by thick lead - Students will know that an alpha particle is highly ionising - Students will know that a beta particle is moderately ionising - Students will know that a gamma ray is weakly ionising - Students will know that dangers associated with nuclear radiation is			

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	proportional to how ionising the radiation is Students will know how to apply knowledge of the properties of radiation to uses sources of radiation.			
Lesson: Nuclear Equations	- Students will know that nuclear equations are used to represent radioactive decay - Students will know that an alpha particle can be represented as a helium nucleus. - Students will know that a beta particle is represented by the symbol for an electron. - Students will know that alpha decay causes the mass number to decrease by 4 and the atomic number to decrease by 2 - Students will know that beta decay doesn't affect the mass number, but causes the atomic number to increase by 1. - Students will know that the emission of a gamma ray doesn't change the mass number or atomic number of an atom. Students will know how to represent alpha and beta decay through the use of a balanced equation	<i>Students need to already know that when representing atoms, the mass number goes superscript and the atomic number goes subscript.</i>	Writing equations	Tier 2 Emission: the production and discharge of something Tier 3 Transmutate: the changing of one element into another through nuclear radiation
Lesson: Half-Life	- Students will know that radioactive decay is random. - Students will know that the half-life of a radioactive isotopes is the time it takes for the number of nuclei of the isotope in a sample to halve, or the time taken for the count rate/ activity from a sample containing the isotope to fall to half its initial level.	<i>Students need to already know that unstable nuclei become stable through radioactive decay.</i>	Interpreting graphs	Tier 2 Random: happening without method or conscious decision. Tier 3 Half-life: The time taken for the radioactivity of a specified isotope to fall to half its original value

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	- Students will know how to represent the half life of a substance by drawing a graph. - Students will know how to determine the half-life of a radioactive sample from given information TRIPLE HT ONLY: Students will know how to calculate the net decline in a radioactive emission after a given number of half-lives			Half-life: The time taken for half of a sample of isotopes to decay.
Lesson: Radioactive Contamination	- Students will know that contamination is the unwanted presence of materials containing radioactive atoms on other materials. - Students will know that hazards associated with contamination are due to the decay of the contaminating atoms. - Students will know that irradiation is the process of exposing an object to nuclear radiation. - Students will know that any object that has been irradiated doesn't become radioactive itself. - Students will know how to compare hazards associated with contamination and irradiation - Students will know that suitable precautions are taken to protect against any hazard that a radioactive source used in the process of irradiation may present. Students will know how to explain the importance of peer review when looking at hazards associated with radiation.	<i>Students need to already know that the hazards associated with radioactive decay are linked with the ionising power of the radiation.</i>		Tier 2 Sterilisation: removal or killing of microorganisms from a material Tier 3 Contamination: where radioactive material is deposited on or in an object or person Irradiation: where a material is exposed to radiation without itself becoming radioactive
Lesson: TRIPLE ONLY: Background Radiation	- Students will know that background radiation is around us all of the time - Students will know that sources of background radiation include natural sources (rocks, cosmic rays from space) and man-made sources (fallout			Tier 2 Cosmic: relating to the universe. Tier 3 Sievert: unit of radiation dose

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	from nuclear weapons testing and nuclear accidents) Students will know that level of background radiation is affected by occupation and location Students will know that radiation dose is measured in sieverts (Sv), and that 1000 mSv = 1 Sv			
Lesson: TRIPLE ONLY: Half lives of isotopes and uses of nuclear radiation	- Students will know that radioactive isotopes have a very wide range of half-life values - Students will know how to explain the variation of hazards associated with radioactive material differs according to the half-life involved - Students will know that nuclear radiations are used in medicine to explore internal organs and to control/ destruct unwanted tissue - Students will know that radioactive tracers are used to explore internal organs - Students will know that isotopes with small half-lives are used as radioactive tracers - Students will know that the exposure to radiation is minimised as much as possible when used to destruct unwanted tissue Students will know how to evaluate the perceived risks of using nuclear radiations in relation to given data and consequences	<i>Students need to already know that radiation is ionising</i> <i>Students need to already know that half-life is the time taken for half a sample of radioactive isotopes to decay</i>	Evaluating skills	Tier 2 Tier 3
Lesson: TRIPLE ONLY: Nuclear Fission and Fusion (2 lessons)	- Students will know that nuclear fission is the splitting of a large and unstable nucleus - Students will know that for fission to occur the unstable nucleus must absorb a neutron. - Students will know that when a nucleus undergoes fission it splits into two smaller nuclei that are roughly			Tier 2 Tier 3 Fission: the splitting of large nuclei into smaller nuclei Fusion: the fusion of smaller nuclei into larger nuclei

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	equal in size, whilst also emitting two or three neutrons and gamma rays. - Students will know that energy is released during fission reactions - Students will know that the products of fission reactions have kinetic energy - Students will know that the neutrons released during fission may go on to start a chain reaction - Students will know that the chain reaction caused by the release of neutrons is controlled in a nuclear reactor - Students will know that the chain reaction caused by the release of neutrons is not controlled in a nuclear weapon, which causes the explosion to happen. - Students will know how to draw and interpret diagrams that represent nuclear fission and chain reactions - Students will know that nuclear fusion is the joining of two light nuclei to form a heavier nucleus. Students will know that in a nuclear fusion reaction some of the mass may be converted into radiation.			