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Science Big Pictures 2023 – 2024

Year 10

Autumn 01	*Autumn 02*	*Spring 01*
Content: Topic B2: organisation In this section we will learn about the human digestive system which provides the body with nutrients and the respiratory system that provides it with oxygen and removes carbon dioxide. In each case they provide dissolved materials that need to be moved quickly around the body in the blood by the circulatory system. Damage to any of these systems can be debilitating if not fatal. Although there has been huge progress in surgical techniques, especially with regard to coronary heart disease, many interventions would not be necessary if individuals reduced their risks through improved diet and lifestyle. We will also learn how the plant's transport system is dependent on environmental conditions to ensure that leaf cells are provided with the water and carbon dioxide that they need for photosynthesis. Topic C2: bonding, structure and the properties of matter Chemists use theories of structure and bonding to explain the physical and chemical properties of materials. Analysis of structures shows that atoms can be arranged in a variety of ways, some of which are molecular while others are giant structures. Theories of bonding explain how atoms are held together in these structures. Scientists use this knowledge of structure and bonding to engineer new materials with desirable properties. The properties of these materials may offer new applications in a range of different technologies. Working scientifically skills and oracy opportunity: Required practical food tests Required practical enzymes	**Content:** Topic P2: electricity Electric charge is a fundamental property of matter everywhere. Understanding the difference in the microstructure of conductors, semiconductors and insulators makes it possible to design components and build electric circuits. Many circuits are powered with mains electricity, but portable electrical devices must use batteries of some kind. Electrical power fills the modern world with artificial light and sound, information and entertainment, remote sensing and control. The fundamentals of electromagnetism were worked out by scientists of the 19th century. However, power stations, like all machines, have a limited lifetime. If we all continue to demand more electricity this means building new power stations in every generation – but what mix of power stations can promise a sustainable future? Topic B3: infection and response Pathogens are microorganisms such as viruses and bacteria that cause infectious diseases in animals and plants. They depend on their host to provide the conditions and nutrients that they need to grow and reproduce. They frequently produce toxins that damage tissues and make us feel ill. This section will explore how we can avoid diseases by reducing contact with them, as well as how the body uses barriers against pathogens. Once inside the body our immune system is triggered which is usually strong enough to destroy the pathogen and prevent disease. When at risk from unusual or dangerous diseases our body's natural system can be enhanced by the use of vaccination. Since the 1940s a range of antibiotics have been developed which have proved successful against a number of lethal diseases caused by bacteria. Unfortunately, many groups of bacteria have now become resistant to these antibiotics. The race is now on to develop a new set of antibiotics. Working scientifically skills and oracy opportunity: Required practical resistance Required practical IV characteristics	**Content:** Topic C3: quantitative chemistry Chemists use quantitative analysis to determine the formulae of compounds and the equations for reactions. Given this information, analysts can then use quantitative methods to determine the purity of chemical samples and to monitor the yield from chemical reactions. Chemical reactions can be classified in various ways. Identifying different types of chemical reaction allows chemists to make sense of how different chemicals react together, to establish patterns and to make predictions about the behaviour of other chemicals. Chemical equations provide a means of representing chemical reactions and are a key way for chemists to communicate chemical ideas. Topic P3: particle model of matter The particle model is widely used to predict the behaviour of solids, liquids and gases and this has many applications in everyday life. It helps us to explain a wide range of observations and engineers use these principles when designing vessels to withstand high pressures and temperatures, such as submarines and spacecraft. It also explains why it is difficult to make a good cup of tea high up a mountain! Working scientifically skills and oracy opportunity: Required practical density

Assessment objectives: 4.2.1.0 Principles of organisation 4.2.2.1 The human digestive system 4.2.2.2 The heart and blood vessels 4.2.2.3 Blood 4.2.2.4 Coronary heart disease: a non-communicable disease 4.2.2.5 Health issues 4.2.2.6 The effect of lifestyle on some non-communicable diseases 4.2.2.7 Cancer 4.2.3.1 Plant tissues 4.2.3.2 Plant organ system 4.2.1.1 Chemical bonds 4.2.1.2 Ionic bonding 4.2.1.3 Ionic compounds 4.2.1.4 Covalent bonding 4.2.1.5 Metallic bonding 4.2.2.1 The three states of matter 4.2.2.2 State symbols 4.2.2.3 Properties of ionic compounds 4.2.2.4 Properties of small molecules 4.2.2.5 Polymers 4.2.2.6 Giant covalent structures 4.2.2.7 Properties of metals and alloys 4.2.2.8 Metals as conductors 4.2.3.1 Diamond 4.2.3.2 Graphite 4.2.3.3 Graphene and fullerenes 4.2.4.1 Sizes of particles and their properties (chemistry only) 4.2.4.2 Uses of nanoparticles (chemistry only) End of topic tests in topics studied Big test 1: Exam of summary of B1, C1, P1 topics	**Assessment objectives:** 4.2.1.1 Standard circuit diagram symbols 4.2.1.2 Electrical charge and current 4.2.1.3 Current, resistance and potential difference 4.2.1.4 Resistors 4.2.2.0 Series and parallel circuits 4.2.3.1 Direct and alternating potential difference 4.2.3.2 Mains electricity 4.2.4.1 Power 4.2.4.2 Energy transfers in everyday appliances 4.2.4.3 The National Grid 4.2.5.1 Static charge (physics only) 4.2.5.2 Electric fields (physics only) 4.3.1.1 Communicable (infectious) diseases 4.3.1.2 Viral diseases 4.3.1.3 Bacterial diseases 4.3.1.4 Fungal diseases 4.3.1.5 Protist diseases 4.3.1.6 Human defence systems 4.3.1.7 Vaccination 4.3.1.8 Antibiotics and painkillers 4.3.1.9 Discovery and development of drugs 4.3.2.1 Producing monoclonal antibodies (biology only) 4.3.2.2 Uses of monoclonal antibodies (biology only) 4.3.3.1 Detection and identification of plant diseases (biology only) 4.3.3.2 Plant defence responses (biology only) End of topic tests in topics studied	**Assessment objectives:** 4.3.1.1 Conservation of mass and balanced chemical equations 4.3.1.2 Relative formula mass 4.3.1.3 Mass changes when a reactant or product is a gas 4.3.1.4 Chemical measurements 4.3.2.1 Moles 4.3.2.2 Amounts of substances in equations 4.3.2.3 Using moles to balance equations 4.3.2.4 Limiting reactants 4.3.2.5 Concentration of solutions 4.3.3.1 Percentage yield (chemistry only) 4.3.3.2 Atom economy (chemistry only) 4.3.4.0 Using concentrations of solutions in mol/dm3 (chemistry only) 4.3.5.0 Use of amount of substance in relation to volumes of gases (chemistry only) 4.3.1.1 Density of materials 4.3.1.2 Changes of state 4.3.2.1 Internal energy 4.3.2.2 Temperature changes in a system and specific heat capacity 4.3.2.3 Changes of state and specific latent heat 4.3.3.1 Particle motion in gases 4.3.3.2 Pressure in gases (physics only) 4.3.3.3 Increasing the pressure of a gas (physics only) End of topic tests in topics studied
Spring 02	***Summer 01***	***Summer 02***
Content: Topic B4: bioenergetics In this section we will explore how plants harness the Sun's	**Content:** Topic P4: atomic structure Ionising radiation is hazardous but can be very useful.	**Content:** Topic C9: chemistry of the atmosphere The Earth's atmosphere is dynamic and forever changing. The

energy in photosynthesis in order to make food. This process liberates oxygen which has built up over millions of years in the Earth's atmosphere. Both animals and plants use this oxygen to oxidise food in a process called aerobic respiration which transfers the energy that the organism needs to perform its functions. Conversely, anaerobic respiration does not require oxygen to transfer energy. During vigorous exercise the human body is unable to supply the cells with sufficient oxygen and it switches to anaerobic respiration. This process will supply energy but also causes the build-up of lactic acid in muscles which causes fatigue. Topic C4: chemical changes Understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organising their results logically. Knowing about these different chemical changes meant that scientists could begin to predict exactly what new substances would be formed and use this knowledge to develop a wide range of different materials and processes. It also helped biochemists to understand the complex reactions that take place in living organisms. The extraction of important resources from the Earth makes use of the way that some elements and compounds react with each other and how easily they can be 'pulled apart'. Working scientifically skills and oracy opportunity: Required practical photosynthesis Required practical making salts Required practical electrolysis	Although radioactivity was discovered over a century ago, it took many nuclear physicists several decades to understand the structure of atoms, nuclear forces and stability. Early researchers suffered from their exposure to ionising radiation. Rules for radiological protection were first introduced in the 1930s and subsequently improved. Today radioactive materials are widely used in medicine, industry, agriculture and electrical power generation Topic C5: energy changes Energy changes are an important part of chemical reactions. The interaction of particles often involves transfers of energy due to the breaking and formation of bonds. Reactions in which energy is released to the surroundings are exothermic reactions, while those that take in thermal energy are endothermic. These interactions between particles can produce heating or cooling effects that are used in a range of everyday applications. Some interactions between ions in an electrolyte result in the production of electricity. Cells and batteries use these chemical reactions to provide electricity. Electricity can also be used to decompose ionic substances and is a useful means of producing elements that are too expensive to extract any other way Working scientifically skills and oracy opportunity: Required practical temperature changes	causes of these changes are sometimes man-made and sometimes part of many natural cycles. Scientists use very complex software to predict weather and climate change as there are many variables that can influence this. The problems caused by increased levels of air pollutants require scientists and engineers to develop solutions that help to reduce the impact of human activity. Topic C10: using resources Industries use the Earth's natural resources to manufacture useful products. In order to operate sustainably, chemists seek to minimise the use of limited resources, use of energy, waste and environmental impact in the manufacture of these products. Chemists also aim to develop ways of disposing of products at the end of their useful life in ways that ensure that materials and stored energy are utilised. Pollution, disposal of waste products and changing land use has a significant effect on the environment, and environmental chemists study how human activity has affected the Earth's natural cycles, and how damaging effects can be minimised. Working scientifically skills and oracy opportunity: Required practical water purification
Assessment objectives: 4.4.1.1 Photosynthetic reaction 4.4.1.2 Rate of photosynthesis 4.4.1.3 Uses of glucose from photosynthesis 4.4.2.1 Aerobic and anaerobic respiration 4.4.2.2 Response to exercise 4.4.2.3 Metabolism 4.4.1.1 Metal oxides 4.4.1.2 The reactivity series 4.4.1.3 Extraction of metals and reduction	**Assessment objectives:** 4.4.1.1 The structure of an atom 4.4.1.2 Mass number, atomic number and isotopes 4.4.1.3 The development of the model of the atom 4.4.2.1 Radioactive decay and nuclear radiation 4.4.2.2 Nuclear equations 4.4.2.3 Half-lives and the random nature of radioactive decay 4.4.2.4 Radioactive contamination 4.4.3.1 Background radiation (physics only)	**Assessment objectives:** 4.9.1.1 The proportions of different gases in the atmosphere 4.9.1.2 The Earth's early atmosphere 4.9.1.3 How oxygen increased 4.9.1.4 How carbon dioxide decreased 4.9.2.1 Greenhouse gases 4.9.2.2 Human activities which contribute to an increase in greenhouse gases in the atmosphere 4.9.2.3 Global climate change 4.9.2.4 The carbon footprint and its reduction 4.9.3.1 Atmospheric pollutants from fuels

4.4.1.4 Oxidation and reduction in terms of electrons 4.4.2.1 Reactions of acids with metals 4.4.2.2 Neutralisation of acids and salt production 4.4.2.3 Soluble salts 4.4.2.4 The pH scale and neutralisation 4.4.2.5 Titrations (chemistry only) 4.4.2.6 Strong and weak acids 4.4.3.1 The process of electrolysis 4.4.3.2 Electrolysis of molten ionic compounds 4.4.3.3 Using electrolysis to extract metals 4.4.3.4 Electrolysis of aqueous solutions 4.4.3.5 Representation of reactions at electrodes as half equations End of topic tests in topics studied Big test 2: Mid Year Exam	4.4.3.2 Different half-lives of radioactive isotopes (physics only) 4.4.3.3 Uses of nuclear radiation (physics only) 4.4.4.1 Nuclear fission (physics only) 4.4.4.2 Nuclear fusion (physics only) 4.5.1.1 Energy transfer during exothermic and endothermic reactions 4.5.1.2 Reaction profiles 4.5.1.3 The energy change of reactions 4.5.2.1 Cells and batteries (chemistry only) 4.5.2.2 Fuel cells (chemistry only) End of topic tests in topics studied	4.9.3.2 Properties and effects of atmospheric pollutants 4.10.1.1 Using the Earth's resources and sustainable development 4.10.1.2 Potable water 4.10.1.3 Waste water treatment 4.10.1.4 Alternative methods of extracting metals 4.10.2.1 Life cycle assessment 4.10.2.2 Ways of reducing the use of resources 4.10.3.1 Corrosion and its prevention (chemistry only) 4.10.3.2 Alloys as useful materials (chemistry only) 4.10.3.3 Ceramics, polymers and composites (chemistry only) 4.10.4.1 The Haber process (chemistry only) 4.10.4.2 Production and uses of NPK fertilisers (chemistry only) End of topic tests in topics studied Big test 3: Full mock papers: Biology Paper 1, Chemistry Paper 1, Physics Paper 1