Key Stage 5: Year 12 Applied Science

Overall Curriculum Goals

Level 3 Certificate in Applied Science aims to:

- prepare learners to progress to a qualification in the same subject area but at a higher level or requiring more specific knowledge, skills and understanding
- give learners personal growth and engagement in learning by enabling learners to learn in such a way that they develop:
  - skills required for independent learning and development
  - a range of generic and transferable skills
  - the ability to solve problems
  - the skills of project-based research, development and presentation
  - the ability to apply mathematical and ICT skills
  - the ability to apply learning in vocational contexts

Half Term 1	Half Term 2	Half Term 3	Half Term 4	Half Term 5	Half Term 6
KEY IDEAS/CONCEPTS **ASC1 1(f) Photosynthesis and food chain productivity.** Many scientists try to understand and control the photosynthetic process in order to increase crop yields and health, producing plants that are tolerant to insects, drought and disease. Knowledge of photosynthesis in plants can also be adapted to man-made systems to provide efficient ways to collect and use solar energy. **ASC1 2(a) Atomic structure.** Scientists working in any area of chemical industry or research require a firm understanding of atomic structure and electron configurations and their use in providing the fundamental basis for chemical structures and reactions. **ASC1 2(c) Amount of substance** Chemical engineers and synthetic chemists rely on their knowledge of mole and reaction stoichiometries to determine reacting masses and yields for large-scale industrial production of chemicals. Analytical chemists also apply similar concepts in quantitative analysis, together with the selection of correct reagents to ensure accuracy of outcomes. **ASC1 3(a) Useful energy and efficiency.**	**KEY IDEAS/CONCEPTS** **ASC1 1(e): Breathing and cellular respiration.** An understanding of respiration is vital to many scientists and healthcare professionals. Biochemists can analyse the rates of cellular respiration in samples of tissues. Sport physiologists can determine whether an individual is respiring aerobically or anaerobically using non-invasive methods. Engineers use their understanding of cellular respiration to clean up contamination in the environment, using cells which convert contaminants into energy. **ASC1 3(b): Electricity and circuits.** Electric circuits are found in a huge number of devices. Electrical and electronic engineers are able to alter the properties of an electrical circuit by adding different components. **ASC3: Science in the modern world.** This unit is designed to enable learners to develop their ability to interpret information, to process and present data and to evaluate their usefulness and appropriateness. Through their reading of a range of scientific texts, learners will engage with topical scientific issues, discuss the ethical and social implications of	**KEY IDEAS/CONCEPTS** **ASC1 1(a) Cell structure** Cell biologists explore the development and functions of cells and their related systems and interactions. Their work may include developing and testing new pharmaceuticals, diagnosing and screening diseases, testing foods and cosmetics to ensure their safety, developing fertility treatments, and carrying out cancer research, neurological research, genetic engineering, or embryology. **ASC1 1(b): Transport mechanisms.** Those working in the pharmaceutical industry need to understand how substances are absorbed and transported in cells. Knowledge of these mechanisms has applications in the development of drug therapies to treat cancer, dementia, diabetes and HIV, and in the production of amino acids for food products **ASC1 1(c): The heart**. Those working in cardiac sciences diagnose and monitor diseases that affect the structure and function of the heart, carry out exercise stress testing to determine whether the blood vessels supplying the heart are working properly, and programme pacemaker devices to ensure that they function correctly.	**KEY IDEAS/CONCEPTS** **ASC1 1(d): Homeostasis.** Health professionals need to be able to relate the principles of homeostasis to health and illness, and maintaining a patient's homeostasis is one of the most important roles of a nurse. Many of the tests that a nurse performs on a patient, such as measuring temperature or blood pressure, determine whether the patient's body is in homeostasis or in distress. Nurses need to know about the importance of maintaining insulin levels in people suffering from diabetes, in order to prevent severe consequences of blood sugar imbalance. **ASC1 2(e): Enthalpy changes.** The knowledge of enthalpy changes and the applications of Hess's Law are important in many areas of scientific research and industry. Biotechnologists develop new fuels such as biodiesel and must compare their energy values with other types of fuel. Development scientists working in the food industry analyse new products for their calorific value and these will also be checked by chemical analysts working for Trading Standards. Chemical engineers in industry will apply Hess's Law to enable the calculation of enthalpies of reaction in order to determine and better understand the likely	**KEY IDEAS/CONCEPTS** **ASC1 2(d) Bonding and structure** Materials scientists are involved in the applications of existing materials to new contexts, and the developments of new materials such as graphene-based nanomaterials. They need a knowledge and an understanding of the structures of those materials and the type and strength of forces present. **Revision prep on all topics covered in Unit 1 in anticipation of the formal assessment.**	**KEY IDEAS/CONCEPTS** **ASC4: The digestive system and diet.** The structure and function of the digestive system, and the enzymes involved in chemical digestion, could be investigated using the main enzymes involved, ie amylase, pepsin and lipase. These experiments could use different concentrations of enzyme or substrate, different pH or a range of temperatures, in order to relate the enzymes to their natural environments. Experiments to identify the main biological components of foods could also be carried out **ASC5: Investigating science.** Chemistry behind electrochemical cells.

It is useful for energy consultants to be able to compare the efficiency of different devices in our homes and workplaces. Energy is transferred by different devices, and the rate at which energy is transferred is called 'power'. Architects and energy consultants use U values to measure how effective different materials used in buildings are as insulators. That is, how effective they are at preventing heat energy from transmitting between the inside and the outside of a building.	scientific advances and explore how these issues are represented in the media. Through their research and their interaction with the scientific community, learners will also have the opportunity to explore how scientists work and the many varied roles they carry out.	**ASC1 2(b): The Periodic Table.** The patterns evident in the Periodic Table enable industrial and research and development chemists to predict properties and potential new applications of elements, from the inert nature of the noble gases to semiconductor properties of Group 4 (14), to the many applications and uses of the transition metals.	effect of reaction conditions on yields **ASC1 3(c): Dynamics.** Many types of scientists and engineers use Newton's laws of motion to predict the motion and interaction of objects. For instance, automotive engineers when designing crumple zones in cars and sports scientists in suggesting improvements in athletic abilities.		
Performance Outcomes in ASC2 investigations					
PO1 Biology: Light-dependent reaction in photosynthesis (the Hill reaction): Scientists working in agriculture and horticulture need to understand how to obtain and then maintain optimum conditions for plant growth. Photosynthesis is one of the processes these scientists need to consider. **PO3 Physics:** Specific heat capacity. Material scientists use this information when choosing materials for various applications, e.g. cooking utensils and radiators. The specific heat capacity of a material provides a measure of the rate of heating and cooling of the material and allows engineers and material scientists to compare different materials.	**PO1 Biology:** Rate of respiration. Biologists and those working in the healthcare professions need to understand the process of respiration. They need to be able to monitor respiration and interpret their observations as well as being able to suggest appropriate actions that can be taken to change undesirable observations. **PO2 Chemistry:** Volumetric analysis is used in many industries. It is a quick, convenient and accurate method of determining the amount of substance in a sample and can be applied to any scientific area, such as quality control, forensic analysis, ecological and environmental analysis, and trading standards. Analytical laboratories provide some of the most common examples of the application of scientific concepts in the real world, and are found in the food and beverage, water supply, brewing, and pharmaceutical industries.	**PO3 Physics:** Resistivity. Materials scientists need to be able to recommend appropriate materials for electrical components in a huge range of products. **PO2 Chemistry:** Analytical chemists apply colorimetric techniques to the determination of the concentration of coloured solutions or, by adding a suitable complexing agent, of some colourless solutions. Colorimetric analysis is used in many industries including, for instance, those associated with dyes, pigments and paints, medicines, food and beverages, and environmental pollution, as well as a wide range of quantitative trace metal determinations such as nickel and iron. Biomedical uses include the analysis of haemoglobin in blood and protein in serum.	**PO1 Biology:** Rate of respiration. Biologists and those working in the healthcare professions need to understand the process of respiration. They need to be able to monitor respiration and interpret their observations as well as being able to suggest appropriate actions that can be taken to change undesirable observations. **PO2 Chemistry:** Analytical chemists apply colorimetric techniques to the determination of the concentration of coloured solutions or, by adding a suitable complexing agent, of some colourless solutions. Colorimetric analysis is used in many industries including, for instance, those associated with dyes, pigments and paints, medicines, food and beverages, and environmental pollution, as well as a wide range of quantitative trace metal determinations such as nickel and iron. Biomedical uses include the analysis of haemoglobin in blood and protein in serum.		
Assessments					
Completion of Summer tasks 1,2&3 Summer task assessment Energy test Photosynthesis	Chemistry mid-oct progress test ASC3 Section A MOCK ASC3 Section B MOCK	ASC3 January FORMAL Coursework feedback and improvements	Coursework feedback and improvements	ASC1 mocks ASC2 FORMAL	ASC1 FORMAL No other assessments due to FINALs exam season for YR 12s.
CIAG					
Applied Science can lead to a wide variety of courses, especially science based vocational ones. Examples include: Nursing, Medical biology, Paramedic practice, Motorsport tech, Criminology, Marine Engineer, Diagnostic Radiography, Psychology, Counselling, Forensic Science, Sports Coaching, Surveying and more. Demonstrated in lessons, open evenings, year 11 marketing etc.					

Key Stage 5: Year 13 Applied Science

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  - skills required for independent learning and development
  - a range of generic and transferable skills
  - the ability to solve problems
  - the skills of project-based research, development and presentation
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Half Term 1	Half Term 2	Half Term 3	Half Term 4	Half Term 5	Half Term 6
KEY IDEAS/CONCEPTS **ASC4: The human body (6 lesson teacher)** In this unit, learners will consider some physiological measurements used to monitor the activity of the body, and applications of these measurements, such as fitness screening and management in sports centres, or referral of patients recovering from heart attacks. Learners will investigate the components of a healthy diet for different groups, including children, the elderly and athletes, and the effects of an imbalanced diet on health, as studied by dieticians. They will explore the structure and function of the digestive system, the chemical reactions that are needed to sustain cells, and the impact of different enzymes involved in chemical digestion, as studied by biochemists. They will learn about oxygen transportation and saturation levels, and the use of pulse oximetry by nurses. **ASC5: Investigating science (3 lesson teacher)** In completing investigations, learners will develop their knowledge and understanding of the following concepts: • the scientific theories involved • equipment required to carry out the investigation	**KEY IDEAS/CONCEPTS** **ASC6a: Microbiology.** Microorganisms are vitally important in the modern world we live in. In natural habitats, microorganisms play a crucial role in the decomposition of organic matter and the recycling of nutrients. In traditional biotechnological industries, such as brewing and cheese production, microorganisms have been exploited for many years. More recent beneficial uses include their involvement in the production of novel food products, enzymes, pharmaceuticals and in genetic engineering. Microorganisms also cause disease and are responsible for millions of deaths every year, despite ongoing advances in medicines and healthcare. The roles of microbiologists in industry are varied but there are fundamental concepts and techniques underpinning all these different roles. **ASC5: Investigating science** Carry out the investigation and record results. In completing investigations, learners will develop their knowledge and understanding of the following concepts:	**KEY IDEAS/CONCEPTS** **ASC6a: Microbiology.** The main groups of microorganisms in terms of their structure and function. Learners will develop their knowledge and understanding of the following concepts: characteristic structural features of: • akaryotes • prokaryotes • eukaryotes identification of microorganisms using: • Gram staining • microscopy • colony characteristics • relating techniques used to identify microorganisms to their structure • identification techniques used in biotechnological industries Using aseptic techniques to safely cultivate microorganisms. In completing investigations, learners will develop their knowledge and understanding of the following concepts: • preparation of sterile growth media for use in cultivating microorganisms • importance of risk assessments in the safe cultivation of microorganisms	**KEY IDEAS/CONCEPTS** **ASC6a: Microbiology.** Using practical techniques to investigate factors that affect the growth of microorganisms. In completing investigations, learners will develop their knowledge and understanding of the following concepts: • factors affecting the growth of microorganisms, such as: temperature, pH, aerobic and anaerobic conditions, antibiotics, antivirals, disinfection, sterilisation, irradiation, osmotic potential, other antimicrobials such as toothpaste, mouthwash or plant derivatives such as lavender oil. • determine how factors affect growth, using counting and measuring techniques such as: viable counts of colonies on plates, a haemocytometer to count directly, a colorimeter to count indirectly, serial dilution, measurement of clear zones, viral plaque assay. The use of microorganisms in biotechnological industries In completing investigations, learners will develop their knowledge and understanding of the following concepts: • use of a range of microorganisms in biotechnological industries • the main features of an industrial fermenter (bioreactor)	**KEY IDEAS/CONCEPTS** **Following completion and submission of coursework, students to use AppSci lesson time supported with ICT facilities as "ILC" time to prep for the remaining exams.**	

• the standard procedures/techniques to be used in the investigation, including measurements, observations, accuracy, reliability and validity • trials done to practise techniques or determine parameters • modifications made as a result of the trials • related commercial and industrial uses.	• risk assessments. • recording qualitative data in an appropriate format • recording quantitative data accurately in an appropriate format, to a suitable level of precision and with correct units	appropriate aseptic techniques used to cultivate a range of microorganisms, including safe disposal of • microorganisms and equipment Inoculation of media using techniques including: • streak plates • lawn plates • pour plates • mycelial discs • viral plaque counts. **ASC5: Investigating science** Analyse results, draw conclusions and evaluate the investigation In completing investigations, learners will develop their knowledge and understanding of the following concepts: • anomalous data and reasons for anomalies • carrying out appropriate calculations • appropriate ways to present quantitative data, including graphs and charts • appropriate use of IT to process and analyse data • drawing conclusions that are valid and relevant to the purpose of the investigation • explaining conclusions by referring to information obtained from secondary sources • evaluation of the techniques used and the results obtained • identification and explanation of any sources of quantitative and qualitative error • making justified recommendations for improvements to the investigation.	• the use of industrial fermenters in biotechnological industries • industrial processes and techniques such as: batch and continuous processing, microbial fermentation, immobilisation of enzymes, genetic engineering, biodegradation. • the use of microorganisms in a range of biotechnological industries, such as: food production, environmental health, pharmaceuticals, forensic science, agriculture, alternative energies, waste water treatment. **ASC5: Investigating science** Present the findings of the investigation to a suitable audience. In completing investigations, learners will develop their knowledge and understanding of the following concepts: • combining text and images to prepare an effective presentation for a suitable audience • summarising the purpose, data obtained and conclusions of the practical investigation • correct use of appropriate scientific terminology • relevance to industrial processes • production of a bibliography that makes use of the Harvard Reference System.		
Performance Outcomes in Unit 5 investigation					
PO1 Prepare for a scientific investigation. Learners should produce a plan which includes the overall purpose of the investigation, details of the individual practical tasks to be undertaken and the aims of these tasks. Learners should	**PO2 Carry out the investigation and record results.** Learners should prepare risk assessments for each individual task in the investigation. Learners will provide evidence of the standard procedures being followed correctly supplemented	**PO3 Analyse results, draw conclusions and evaluate the investigation.** The expectation is that learners will have made use of primary and secondary sources as part of their planning.	**PO4 Present the findings of the investigation to a suitable audience.** Learners will write a report on their scientific investigation. This report should include all points from PO1-4.		

ensure that they have included details of the observations or measurements to be made.	by video or photographic evidence. Learners should prepare their own tables to record their results, with correct headings and units, and data should be recorded accurately and to an appropriate number of significant figures				
Performance Outcomes in Unit 6a investigation					
	PO1 Identify the main groups of microorganisms in terms of their structure. **L**earners will use appropriate research techniques to investigate the characteristic features of akaryotes (viruses), prokaryotes (bacteria) and eukaryotes (fungi) in terms of component parts and/or cell components. Learners will then undertake a practical activity to identify different types of bacteria using Gram staining, before researching how the differences in structure of different types of bacteria enable them to be identified using the Gram staining technique. They will research the use of other identification techniques (microscopy and colony characteristics) to find out how the structure of the microorganisms enables them to be identified using these different techniques. Learners will then consider how these identification techniques are used in industry	**PO2 Use aseptic techniques to safely cultivate microorganisms** Learners should perform three different cultivation techniques, which includes streak plate, lawn plate, pour plate, mycelial discs and viral plaque counts, and should ensure that they have used at least two different types of microorganism (eg bacteria and fungi) **PO3 Use practical techniques to investigate the factors that affect the growth of microorganisms.** Learners should investigate three different factors that promote or inhibit growth from the list, including temperature, pH, nutrients, aerobic/anaerobic conditions, antibiotics, antivirals, disinfection, sterilisation, irradiation, osmotic potential and antimicrobials such as toothpaste or mouthwash.	**PO4 Identify the use of microorganisms in biotechnological industries.** The use of continuous and batch processing and industrial fermenters in biotechnological industries. Learners should consider the benefits to society of the use of these microorganisms. Learners should research the use of genetic engineering of microorganisms in a further biotechnological industry.		
Assessments					
ASC4 Summer task ASC5 Summer task ASC4 Test 1 - Digestive system, Diet and the Nervous system test	ASC4 Test 2 - Skeleton, Muscle and transport of Oxygen test ASC4 Mock	ASC4 FORMAL JAN ASC5 Coursework feedback and improvements	ASC5/6a Coursework feedback and improvements	ASC5 FORMAL ASC6a FORMAL	
CIAG					
Applied Science can lead to a wide variety of courses, especially science based vocational ones. Examples include: Nursing, Medical biology, Paramedic practice, Motorsport tech, Criminology, Marine Engineer, Diagnostic Radiography, Psychology, Counselling, Forensic Science, Sports Coaching, Surveying and more.					