

Yew Chung International School

Science Curriculum Framework

(First implementation 2020-21)

**Yew Chung Science Curriculum Framework**

**Part One Introduction**

## **Educational Philosophy of Yew Chung international School (YCIS)**

The YCIS Curriculum supports the implementation of the mission and educational philosophy of Yew Chung in relation to the learning and teaching in its schools. The underpinning principles and practices of Yew Chung is as follows:

**YCIS Mission, Principles and Practices**

**Mission**

To raise globally competent and compassionate leaders with a servant’s heart, who aspire to, and act for, a better world.

**Principles & Practices**

* We believe that the core purpose of education is character formation, and it is the most important shared responsibility of the school and home.
* We believe that each child is unique, with innate talents and gifts that should be nurtured to the fullest potential.
* We believe that quality student-teacher relationships are at the heart of meaningful engagement, leading to highly effective learning and teaching.
* We believe that ‘Learning Communities’ best enable students and teachers to creatively and holistically explore different fields of knowledge, fostering individual and collaborative learning skills that are critical for the 21st Century.
* We believe in equipping our graduates with a deep respect for and understanding of world cultures, mastery of Chinese and English, plus proficiency in other modern languages, as well as a strong commitment to meeting challenges of their generation.

**耀中国际学校的使命丶理念与实践**

使命 培养具有全球视野能力、能同情共感、立志追求更美好世界的仆人领袖。

* 理念与实践 我们相信，教育的核心目的是品格培养，这是学校和家庭最重要的共同责任。
* 我们相信，每个孩子都是独一无二的，其天赋才能应该得到充分培养。
* 我们相信，良好的师生关系，有意义的师生互动，是教与学相得益彰的基石。
* 我们相信，“学习社区”最能促使师生创造性地、全面地探索不同的知识领域，让学生掌握 21 世纪至关重要的个人和协作学习技能。
* 我们相信，我们的毕业生能真诚地尊重和理解世界各地文化，精通中英双语以及其他现代语言，并能以坚定的态度迎接时代的挑战。

## **Guiding Principles**

The purpose of studying Science at YCIS is to inspire a life-long appreciation of Science, and to foster the growth of an inquiring mind, whilst stimulating curiosity and developing critical thinking skills. Our students incorporate skill develop and the use of technology, mathematics and language as tools to develop scientific understanding. They have the confidence to ask questions, find solutions and then actively apply their scientific knowledge to everyday life.

An understanding of the implications of science and its uses will allow our students to be socially and ethically responsible citizens of the world. Our students will develop the skills to develop independence in learning, transform knowledge acquisition to deeper understanding and apply their understand to the real world, hence contributing to the advancement of human civilization and the environment.

**Belief Statements**

We believe students learn Science best when they...

* Are motivated and engaged in the learning process;
* Are empowered and challenged to develop their innate gifts and talents through independence in learning;
* Make Science relevant to their own lives by applying scientific principles to personal, local, and global real-world issues;
* Are given the opportunity to learn in many ways, which may include:
  + whole group instruction,
  + small group collaborations,
  + independent inquiry,
  + primary and secondary research,
  + project-based activities, and
  + hands-on experiences that reinforce scientific principles (experiments);
* Use age-appropriate technology to facilitate the learning process;
* Understand and use appropriate scientific language to synthesise material and to communicate it to others;
* Use their knowledge of Science to improve the lives of all living things and to care for the Earth;
* Are aware of the changing nature of Science through the study of renowned scientists (their struggles and triumphs), global history and international current events;
* Are taught and assessed through differentiated means for understanding and skills gained;
* Integrate their learning with other subject areas.

**Stages of Learning:**

The following key stages of learning are recognized at YCIS …

Stage 1: Years 1 – 2

Stage 2: Years 3 – 6

Stage 3: Years 7 – 9

Stage 1

Students in Years 1 and 2 will observe the natural and humanly-constructed world around them. Hand-on learning is the primary approach. Students will be provided with the opportunity to ask and answer science-related questions. They will observe changes over a period of time. Students will also be provided with learning experiences that allow them to notice patterns, groupings and classifications. They will be expected to communicate using simple scientific language.

Stage 2

Students will broaden their scientific view of the world. They will explore everyday phenomena and the relationships between living things and familiar environments. They will be provided with opportunities to draw simple conclusions. In Years 5 and 6, students will develop a deeper understanding of a range of scientific ideas. They will be introduced to more abstract ideas and begin to recognise how these ideas help them to understand and predict how the world operates. Students will recognise that scientific ideas and knowledge change and develop over time. Different types of scientific enquiry will be used to answer questions. Students will learn how to draw conclusions, based on data and observations, using evidence to justify ideas and scientific knowledge and understanding to explain their findings.

Stage 3

Stage 3 is a sequential programme that aims to develop key knowledge and conceptual understanding, focusing on the scientific disciplines of Biology, Chemistry and Physics. Students will be required to develop an extended specialist vocabulary and to use technical terminology accurately and precisely. Their learning will make connections between the science disciplines and involve the application of mathematical knowledge. Students will determine the appropriate type of scientific enquiry to undertake.

**Overarching Learning Expectations**

Upon graduating from YCIS, students will be equipped to:

* + Continue to develop the skills for independent learning, reasoning, creating and collaborating;
  + Engage in opportunities for scientific study, critical thinking and creativity within a global context, thinking and working as a global citizen;
  + Demonstrate an in-depth set of scientific skills, body of knowledge, methods and techniques that characterise science and technology;
  + Analyse, evaluate and synthesise scientific information for the purpose of solving problems;
  + Apply and integrate technology, mathematics, communication and other interdisciplinary skills in the study of Science;
  + Develop an appreciation of the struggles, triumphs and contributions of scientists, and maintain an awareness of the possibilities and limitations associated with Science and scientists;
  + Understand the relationships between scientific disciplines and the overarching nature of Science;
  + Apply and integrate the nature of Science to personal, local, and global real-world issues that promote awareness and stewardship of the environment, our planet, and all living things;
  + Demonstrate an awareness of the moral, ethical, social, economic and environmental implications of using Science and technology to guide actions;
  + Exhibit open-mindedness, celebrate diversity, and respect the beliefs and values of all people with a sense of social responsibility and compassion;
  + Demonstrate an awareness of the need for and the value of effective collaboration and communication during scientific activities;
  + Exhibit experimental and investigative scientific skills.

**Part Two: Curriculum Design**

**Rationale**

This document serves to provide a set of agreed Science standards to be implemented by Yew Chung schools. As each school differs with regards to its student, parent, staff and local population, its structure, its access to resources and equipment, its collective experience and its structure, schools are to design and implement their own curricula to facility the guiding principles and Science standards described in this document. The information below provides guidance on the design of school curriculum.

Currently, concepts and skills are developed in connection with longstanding curriculum fields: Biology, Chemistry, Earth & Space Science and Physics. Key concepts are identified for each year level and the skills to develop students’ knowledge to a deeper understanding is achieved through a focus on skills, both learning skills and science-specific skills. The diagram below shows the link between the key concepts, skills and four main subject fields.

A close up of a logo

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**Guidelines on design and implementation of the Yew Chung curriculum**

Yew Chung schools are responsible for implementing the curriculum in line with the philosophy and principles outlined above. The following guidelines should be followed.

In the design and implementation of learning programmes, schools should seek to:

* Engage students’ interest and motivate them to learn by:
  + adopting approaches which ensure that students are active learners;
  + framing learning experiences in contexts which are authentic for students;
  + allowing students to apply their learning to real life situations;
  + providing opportunities for students to work collaboratively with community members;
  + promoting collaboration across and within subject areas and among students and teachers;
  + continuously reviewing learning activities to ensure that meaningful learning is taking place.
* Respect and cater for the needs of individual learners by:
  + assessing in order to understand students’ needs, proficiency levels, interests and background;
  + employing various strategies to cater for learner diversity and enable all students to develop their innate gifts and talents;
  + providing meaningful extension opportunities;
  + supporting students and enabling them to see challenges as opportunities for growth.
* Take a holistic approach to teaching and learning by:
  + finding opportunities to develop students’ thinking and learning skills and creativity through activities, discussions and projects;
  + integrating character development into the learning programmes.
* Promote the view that students are active contributors to their own learning by:
  + developing skills that allow them to become aware of how they learn;
  + equipping them with the knowledge of when and how to use specific strategies for learning and problem-solving;
  + guiding them to evaluate their own strengths and areas for improvement through meaningful and purposeful feedback;
  + promoting life-long learning principles throughout the school community.
* Structure and scaffold learning systematically by:
  + responding to identified gaps in students’ knowledge;
  + making use of data on students’ progress to refine programmes;
  + making explicit the way in which skills, knowledge, understandings, dispositions and character dimensions are taught and assessed within and across subject disciplines and groups/year levels;
  + revisiting or reinforcing previous learning where required.
* Prepare students to face the challenges of globalisation by:
  + examining local, global, and intercultural issues in order to understand their own country’s perspective and to appreciate and respond to the perspectives of those from other backgrounds;
  + enabling them to engage in appropriate interactions with people from different cultures; and to act for collective wellbeing and sustainable development;
  + developing their mastery of the Chinese and English languages (and other modern languages, where appropriate), which are central to this process.

Schools should design their curriculum plans based on the framework, implementing the key concepts, selecting appropriate content, designing engaging learning experiences and integrating available technologies to give students a high-quality learning pathways in Science that is connected with other subject areas, where appropriate. It is suggested that teachers identify the key concepts to students early in a unit, then focus more on the skill development of students to develop their knowledge, understanding, wisdom and vision as they investigate the contents listed beneath each concept.

Modern models for curriculum, teaching and learning plans may include:

* + Theme-based – linking different key concepts within Science (and from other subject areas) to create a series of themes for students to explore, effectively addressing each of the concepts throughout.
  + Project-based learning (PBL) – establishing driving questions that promote learning along the way of investigating, exploring and designing possible solutions to questions.
  + Topic-based – maintaining traditional subject boundaries – Biology, Chemistry, Physics and Environmental and Science Space, with a focus on student inquiry processes to explore key concepts and develop skills.

A school should endeavor to design a curriculum plan that is uniquely suited to their environment, facilities, equipment, culture and student/parent experiences.

Consideration of current trends in the real-world, as well as, future trends, should be integrated into designing learning experiences, which may include:

* + Understanding and integrating the Internet of Things (IoT) using a variety of sensors and microcomputers (like the Arduino Uno) for measuring, recording and acting on real-life data. Projects incorporating IoT approaches are ideally suited for cross-curricular and PBL projects. Student may explore key ideas like: types of data, precision, accuracy and calibration, variability, repeatability and reliability.
  + Collecting small and big data – using methods of sampling and measuring data, increasing reliability, precision and accuracy using appropriate equipment and instrumentation. Accessing datasets and identifying their scope, strengths and limitations for exploring and predicting trends.
  + Organising small and big data – using methods of classification, clustering, regression and prediction. The basic principles of these processes are being implemented in current machine learning models. Schools are encouraged to develop students’ understanding of these fundamental processes and may discuss artificial intelligence and machine learning models use of data to identify patterns, trends and make predictions.
  + Understanding how artificial intelligence and machine learning models can support professionals in in their jobs, how they can be implemented in solutions to global problems, and how they are advancing research, society and human endeavours.

**Part Three: Curriculum Overview**

This overview shows the vertical and horizontal development of the Science curriculum.

**Skill Development: Primary Years**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** |
| 1S01 Ask simple questions to understand the world around us. | 2S01 Ask questions and recognize that they can be answered in different ways. | 3S01 Ask relevant questions and use different types of scientific enquiries to answer them. | 4S01 Ask relevant questions and use different types of scientific enquiries to answer them. | 5S01 Plan scientific enquiries to answer questions, including recognising and controlling variables as necessary. | 6S01 Plan scientific enquiries to answer questions, including recognising independent and dependent variables and controlled variables as necessary. |
| 1S02 Observe closely, following simple experiments. | 2S02 Observe closely, using simple experiments. | 3S02 Set up simple practical enquiries and comparative tests following instructions. | 4S02 Set up simple practical enquiries, comparative and fair tests following instructions. | 5S02 Perform practical enquiries, comparative and fair tests following instructions. | 6S02 Design and perform practical enquiries, comparative and fair tests with guidance. |
| 1S03 Perform simple measurements. | 2S03 Perform simple tests and measurements. | 3S03 Make careful observations and take measurements using standard units. | 4S03 Make systematic and careful observations and take accurate measurements using a range of equipment. | 5S03 Perform measurements using scientific equipment taking repeated readings as appropriate for improved reliability. | 6S03 Perform measurements using a range of scientific equipment, with increasing precision, taking repeat readings as appropriate. |
| 1S04 Identify physical features that may be used to compare and group objects, materials and living things. | 2S04 Identify and classify objects, materials and living things using physical features. | 3S04 Gather, record, classify and present data in a variety of ways to answer questions. | 4S04 Gather, record, classify and present data in a variety of ways to provide support to answer questions. | 5S04 Record data and results using scientific diagrams and labels, classification keys, data tables and scatter graphs to show relationships. | 6S04 Record data and results of increasing complexity using scientific diagrams and labels, classification keys, data tables and scatter graphs. |
| 1S05 Use observation and gather simple data to investigate questions | 2S05 Use observation and gather data suggest answers to questions. | 3S05 Record and organise data using labelled diagrams, keys and tables. | 4S05 Record and organise data using scientific conventions to pose solutions. | 5S05 Use test results to identify relationships (including cause and effect), understand simple systems and make predictions. | 6S05 Use test results to identify relationships, understand systems and make predictions with evaluation of results and simple justification. |
| 1S06 Respond to questions of a scientific nature. | 2S06 Pose and respond to scientific questions. | 3S06 Use results to draw simple conclusions and suggest improvements. | 4S06 Use results to draw conclusions, raise further questions and suggest improvements. | 5S06 Identify scientific evidence from experiments and research that can be used to support or refute scientific ideas. | 6S06 Identify scientific evidence from experiments and research that can be used to support or refute scientific ideas, approaches and thinking. |
| 1S07 Participate in guided investigations to explore problems in daily life. | 2S07 Collaborate in guided investigations to explore problems in daily life. | 3S07 Apply scientific concepts and skills to understanding daily life. | 4S07 Apply scientific concepts and skills to understanding daily life. | 5S07 Apply the scientific method, scientific concepts and skills to improving daily life and problems. | 6S07 Apply the scientific method, scientific concepts and skills to improving daily life and problems. |
| 1S08 Communicate scientific information such as similarities and differences. | 2S08 Communicate scientific information using appropriate language. | 3S08 Use simple evidence to communicate scientific information. | 4S08 Use evidence to communicate scientific information and ideas. | 5S08 Use evidence to communicate scientific arguments, explore solutions and work collaboratively. | 6S08 Use evidence to communicate scientific arguments, make predictions, explore solutions and work collaboratively. |

**Skill Development: Secondary Years**

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| --- | --- | --- |
| **Year 7** | **Year 8** | **Year 9** |
| **Scientific Attitudes:** | | |
| 7S01 Understand the need for using the scientific method, identifying clearly the importance of controlled experiments to determine scientific relationships. | 8S01 Understand the need for using the scientific method, using independent, dependent and controlled variables to “tell the story” of the investigation. | 9S01 Understand the need for using the scientific method, using independent, dependent and controlled variables to develop reasoned conclusions based on sound scientific approaches and theory. |
| 7S02 Demonstrate objectivity by concern for accuracy and repeatability in experimental design. | 8S02 Demonstrate objectivity by concern for accuracy, precision and repeatability in experimental design. | 9S02 Demonstrate objectivity by concern for accuracy, precision, repeatability and reproducibility in experimental design and approach to validating empirical data. |
| 7S03 Evaluate risks by exploring lab safety. | 8S03 Evaluate risks by exploring lab and chemical safety. | 9S03 Evaluate risks by exploring lab and chemical safety through scientifically accepted risk assessment and management approaches. |
| **Measurement:** | | |
| xS11 Use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature appropriate to the topics covered in each year level. | | |
| 7S12 Use and derive simple equations and carry out appropriate calculations. | 8S12 Use and derive equations and carry out appropriate calculations for theoretical and experimental tasks. | 9S12 Use and derive equations and carry out appropriate calculations for theoretical and experimental tasks involving the combination of simple equations. |
| 7S13 Perform simple conversions calculations of units. | 8S13 Perform conversions calculations of units in measurement and use equations. | 9S13 Perform conversions calculations of units in measurement and use equations with unit analysis. |
| **Experimental Skills and Investigations:** | | |
| 7S21 Ask questions and develop a line of enquiry based on observations of simple real-world phenomena, building on prior knowledge and experience. | 8S21 Design effective questions and develop a line of enquiry based on observations of real-world phenomena, building on prior knowledge and experience. | 9S21 Design insightful questions and develop a line of enquiry based on observations of the real-world phenomena, building on theoretical research. |
| 7S22 Perform appropriate types of scientific enquiries to test simple hypotheses. | 8S22 Select, plan and carry out appropriate types of scientific enquiries to test hypotheses. | 9S22 Design, plan, implement and evaluate appropriate types of scientific enquiries to test hypotheses. |
| 7S23 Identify independent, dependent and controlled variables in experimental investigations. | 8S23 Identify relationships between independent and dependent variables through experimental methods whilst controlling variables. | 9S23 Identify, and verify by underlying theory, the relationship between independent and dependent variables through experimental methods and understand the effects that uncontrolled variables may have on the results. |
| 7S24 Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, identifying simple risks. | 8S24 Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, identifying risks and ways to minimise risk. | 9S24 Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, identifying risks using an appropriate risk management approach. |
| 7S25 Collect and record observations and measurements using a range of methods for different investigations. | 8S25 Collect and record observations and measurements using a range of methods for different investigations including the use of data loggers, sensors or instrumentation suitable for measurement. | 9S25 Collect and record observations and measurements using a range of methods for different investigations using digital measurements with consideration to the precision and possible problems using digital equipment in measurement. |
| 7S26 Apply sampling techniques and statistical approaches to summarise data, including averaging results. | 8S26 Apply sampling techniques and statistical approaches to summarise data, including averaging and identifying and identifying anomalies. | 9S26 Apply sampling techniques and statistical approaches to summaries data, including measures of central tendency, measures of spread and identifying and explaining anomalies. |
| **Analysis and Evaluation:** | | |
| 7S31 Apply mathematical concepts and calculate results. | 8S31 Apply mathematical concepts and calculate results to compare experimental and theoretical results and tasks. | 9S31 Apply mathematical concepts and calculate results in complex and challenging questions arising from theoretical and experimental analysis. |
| 7S32 Present observations and data using appropriate methods, including data tables and graphs. | 8S32 Present observations and data using appropriate methods, including data tables, graphs and trendlines. | 9S32 Present observations and data using appropriate methods, including data tables, graphs and trendlines and their equations (and simple r2 values as a measure of model fit to the data). |
| 7S33 Interpret observations and data by identifying patterns and draw conclusions. | 8S33 Interpret observations and data by identifying patterns and draw conclusions with justification. | 9S33 Interpret observations and data by identifying patterns, draw conclusions and make predictions with justification. |
| 7S34 Present reasoned explanations by explaining data in relation to hypotheses. | 8S34 Present reasoned explanations by considering results and theory in relation to hypotheses. | 9S34 Present reasoned explanations by considering results and theory in relation to hypotheses and predictions. |
| 7S35 Evaluate data, showing awareness of possible sources of error. | 8S35 Evaluate data, showing awareness of possible sources of systematic error in experimental procedures. | 9S35Evaluate data, explaining the effects that potential sources of systemic errors might have on the conclusion. |
| 7S36 Identify further questions arising from an investigation. | 8S36 Generate further questions arising from an investigation and suggest improvements. | 9S36 Generate further questions arising from an investigation, suggest improvements and potential benefits to further results. |
| 7S37 Evaluate the reliability of method used in an investigation. | 8S37 Evaluate the reliability, accuracy and precision of methods used in an investigation and suggest improvements. | 9S37 Evaluate the strengths and limitations of primary and secondary research, assessing for reliability of methods and data, and suggesting possible improvements and further research. |
| **Secondary Research Skills:** | | |
| 7S41 Conduct basic research of online and printed to produce summaries of keys ideas and evidence. | 8S41 Conduct research of multiple online and printed materials to produce organised summaries of key ideas and evidence. | 9S41 Conduct research of multiple science articles, websites, books and scientific articles to produce organised summaries of key ideas and evaluate evidence. |
| 7S42 Organise multiple sources of information into subtopics related to the main task related to the main line of enquiry. | 8S42 Organise and evaluate multiple sources of information into concise subtopics related to the main line of enquiry. | 9S42 Organise, evaluate and generate multiple sources of information into concise subtopics related to the main line of enquiry. |
| 7S43 Construct a simple source analysis to show the reliability of the sources used (typically around 2 – 5 sources for a research assignment). | 8S43 Construct a detailed source analysis to show the reliability of a variety of sources used (typically around 3 to 6 sources in a research assignment). | 9S43 Construct a detailed source analysis to show the reliability and credibility of a variety of sources used (typically around 4 to 7 sources in a research assignment). |

**Concept Development: Primary Years**

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| --- | --- | --- | --- | --- | --- |
| **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** |
| **Domain A: Life Processes and Living Things** | | | | | |
| 1LP101 Living things have a variety of external features. | 2LP101 Living things need other living things and non-living things for growth. | 3LP101 Living things grow, change and have offspring similar to themselves. | 4LP101 Animals process food for energy and growth. | 5LP101 Living things have systems that help them to function. | 6LP101 Living things get their characteristics from their parents. These characteristics can be used for classification. |
| 1LP102 Living things can be classified based on different features. | 2LP102 Living things have an interdependence on each other and their environment. | 3LP102 Living things require structures for growth and function. | 4LP201 Living things interact with each other and their environment in a number of different ways. | 5LP102 Living things have structural features and adaptations that help them to survive in their environment. | 6LP102 Characteristics of living things change over time due to inheritance, natural selection and migration. |
| 1LP201 Living things live in areas where their needs are met. |  |  |  | 5LP103 Living things go through changes as a part of their lifecycle. |  |
| **Domain B: Materials and Properties** | | | | | |
| 1MP101 Objects can be made of different types of materials. | 2MP101 Materials can be used for specific purposes or combined for new purposes. | 3MP101 Matter can exist as solid, liquid or gas. | 4MP101 Natural and processed materials have different properties. | 5MP101 Solids, liquids and gases have different observable properties and behave in different ways. | 6MP101 Properties of different materials can be used to identify the material. |
| 1MP201 Materials have physical properties. | 2MP102 The shapes of solid objects can be changed by physical manipulation processes. | 3MP102 A change of state between solid and liquid can be caused by adding or removing heat. | 4MP102 Natural and processed materials have a range of physical properties that influence their use. | 5MP102 Materials in different states can be used in different ways depending on their properties. | 6MP102 Changes to materials can be reversible or irreversible. |
| 1MP202 Everyday materials can be physically changed. |  |  |  |  |  |
| **Domain C: Physical Processes** | | | | | |
| 1PP101 Light and sound are produced by a range of different sources. | 2PP101 A push or pull can affect how an object moves or change its shape. | 3PP101 Forces can be exerted by one object on another object through direct contact or from a distance. | 4PP101 Sound is generated by vibrating air that originates from a resonating source. | 5PP101 Gravity and friction act as forces that affects the motion of falling objects. | 6PP101 Light from a source can be absorbed, reflected and reflected. |
| 1PP102 Light and sound can be sensed by us. | 2PP201 Heat can be produced in different ways and can move from one object to another. |  | 4PP102 Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources. | 5PP102 Simple machines can be used to enable forces to have a greater effect. | 6PP102 Electric circuits enable energy to be transferred and transformed through connections and components. |
| **Domain D: Environmental Science and Space** | | | | | |
| 1ES101 Observable changes occur in the environment around us. |  | 3ES101 Rocks can be described by their characteristics which give them properties that make them useful to man. |  | 5ES101 The Solar System consists of planets that orbit the Sun. |  |
| 1ES102 Changes in the environment affect the way we interact with it. |  | 3ES102 Soils and rock can contain previously living organisms. |  | 5ES102 The relative movements of the Earth, Moon and Sun causes changes on the Earth. |  |

**Concept Development: Secondary Years**

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| --- | --- | --- |
| **Year 7** | **Year 8** | **Year 9** |
| **Domain A: Life Processes and Living Things** | | |
| 7LP101 Cells are the basic units of living things and contain specialised structures and functions. | 8LP101 Animals have processes to obtain nutrients and produce energy from food to function and grow. | 9LP101 Most animals and plants exchange gases with the environment. |
| 7LP102 Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive, grow and reproduce. | 8LP102 Plants have processes to obtain nutrients and produce energy to function and grow. | 9LP102 Aerobic and anaerobic respiration processes enable organisms to extract energy from food. |
| 7LP201 Vertebrates use skeletal and muscular systems to provide support and facilitate movement. | 8LP201 Production processes enable plants and animals to develop offspring. | 9LP201 Genetic information is passed from parents to offspring, giving them specific characteristics. |
| 7LP301 Interactions between organisms, including the effects of human activities, can be represented by food chains and food webs. |  | 9LP202 Ecosystems are affected by changes in the genetics within the population and the environment in which they live. |
| **Domain B: Materials and Properties** | | |
| 7MP101 Mixtures, including solutions, contain a combination or pure substances that can be separated using a range of techniques. | 8MP101 All matter is made of atoms that are composed of protons, neutrons and electrons. | 9MP101 Atomic structure and properties of elements are used to organise them in the Periodic Table. The atomic structure give rise to specific physical and chemical properties. |
| 7MP102 Differences between elements, compounds and mixtures can be described at a particle level. | 8MP102 Atoms can gain or lose electrons and become charged ions to form ionic bonds. | 9MP102 Chemical bonds join atoms together by the interaction of their electrons. |
| 7MP103 Properties of different states of matter can be explained in terms of motion and arrangement of particles (particle theory). | 8MP103 Elements have a range of physical and chemical properties predicted by the Periodic Table. | 9MP201 Different types of chemical reactions can be used to produce a range of products. |
| 7MP201 Chemical changes involve substances reacting to form new substances. | 8MP201 Chemical reactions involve rearranging atoms to form new substances. In chemical reactions, mass is neither created nor destroyed. | 9MP202 Chemical reactions can occur at different rates depending on various physical and chemical factors. |
| 7MP202 Acids and alkalis are types of chemical substances that have specific chemical and physical properties. | 8MP202 Chemical reactions involve energy transfer, the rate of which can be influenced by various factors. | 9MP203 The molar ratios of atoms and ions that make up the reactants and products in a balanced chemical reaction are constant. |
| **Domain C: Physical Processes** | | |
| 7PP101 Forces are pushes or pulls that act in pairs due to the interaction between two objects. | 8PP101 The motion of objects can be explained and predicted by laws relating speed to distance and time. | 9PP101 Electricity, the flow of charge, can be controlled and used by electric circuits involving series and parallel components. |
| 7PP102 Forces affect the shape or motion of an object. | 8PP201 Sound energy transfer through a medium can be explained and understood as a longitudinal wave with specific characteristics and behaviours. | 9PP102 Energy usage can be determined and calculated in electrical appliances. |
| 7PP201 Electricity can be generated in a variety of ways that involve chemical reactions (batteries, nuclear solar cells or fuel cells) or by magnets. | 8PP202 Light energy transfer can be explained and understood as a transverse wave with specific characteristics and behaviours. | 9PP201 Magnetic fields are formed by the flow of electric current through coils. |
| **Domain D: Environmental Science and Space** | | |
| 7ES101 The main types of rocks on Earth are produced by natural processes as part of a rock cycle. | 8ES102 Weight in Science is considered a measure of gravitational force and is dependent on the mass of the planet and other objects. | 9ES102 Energy can be transferred through processes such as conduction, convection and radiation that help us to understand the dynamics of the Earth’s interior, oceans and the atmosphere. |
| 7ES102 Rocks can be classified based on their characteristics and physical and chemical properties. | 8ES201 The Sun, like other stars, has an effect on planets depending on their distance and rotation speed. | 9ES201 The core, mantle and atmosphere of the Earth act fluids and follow the laws of fluid dynamics. |
| 7ES201 The atmosphere of the Earth involves a cycle of carbon and has an impact of climate. |  |  |

**Part Four: Assessment Design**

**Rationale**

Assessment encapsulates the wide variety of methods or tools that educators use to evaluate, measure, and document the academic readiness, learning progress, skill acquisition, or educational needs of student. Three main purposes of assessment can include:

* + Assessment of Learning – providing evidence of achievement for students, teachers, parents and others. This is usually summative and done at the end of units.
  + Assessment for Learning – involves collecting evidence of what students can do in order to identify gaps in knowledge, correct misconceptions, identify confusions and provide feedback to students to improve.
  + Assessment as Learning – engages students in reflection on their own thinking and learning. It is implemented through the design of assessment experiences that ask the student to reflect on how they have learned and how they have developed their thinking.

**Assessment Instruments:**

A variety of assessment instruments should be used when implementing the YCIS Science Curriculum, which should include the following:

* + Written examinations, tests and quizzes;
  + Short and extended experimental investigations;
  + Primary (discovery) and secondary (academic reading) research;
  + Opportunities to apply to real-world scenarios (which may include: entrepreneurial approaches and solving global issues).

**Assessment Criteria:**

Assessment instruments should incorporate the following criteria through a set of balanced questions and tasks that provide students with the opportunity to demonstrate:

* + Knowledge and Understanding – assesses student’s memorisation of key concepts and ideas, as well as, exploring their understanding of these key concepts and ideas by extending the questioning into more complex (integrating multiple fields of Science) and/or challenging (difficult, multiple-step processes) tasks.
  + Investigative Processes – assesses the student’s ability to implement and adapt scientific methods and skills. This includes demonstration of the scientific method through scientific inquiry, research, experimental investigations and scientific communication following accepted conventions.
  + Human Endeavour – assesses student’s understanding of the history of scientific discovery and thought, as well as, how science can be applied in the real world and continue to develop scientific thought. This criteria should also explore the life of leading scientists, their struggles and failures, for students to understand how the process of discovery is usually achieved.

Assessing student responses to a set of criteria, as listed above, will enable students, teachers and parents to determine strengths and areas needing further improvement in terms of scientific skill set. This will enable teachers and peers to provide more constructive feedback and advice on improvement, informally and in reporting and feeding back to parents. Effective communication of how students are going in Science, combined with suggestions for strategies for improvement, should form the basis of stronger learning communities.

**Assessment Design Consideration:**

The effective design of assessment instruments should include the following considerations:

* + Sequentially progressing from simple to more challenging questions;
  + Incorporating English as an Alternative Language (EAL) considerations;
  + Clear identification and balance of questions on knowledge and understanding, investigative processes and human endeavours;
  + Clear assessment criteria, marks or rubrics for student to understand what is needed for success;
  + Appropriate feedback is provided through student drafts, revision activities and assessment reviews;
  + Provide students with opportunities to be successful at differentiated levels, whilst also providing challenge to students of any ability.

**Suggested Events to Support Learning and Assessment:**

The following list provides some alternative ideas and thoughts on how to advance Science in our schools and encourage a culture of excellence in learning, as well as, motivating students:

* + Science Fairs – involve guest speakers, setting up science activity stations (such as a mini-science centre), running mini science shows during assemblies to promote the event.
  + STEM/STEAM Challenge – providing a full or half day challenge for a particular year level or two on a particular task to be solved. Teams can be divided up to complete smaller workshops and return together to complete a culminating task.
  + Science Camps – run an intensive science programme over 1 or more days where students can connect with experts from around the world, design great questions, meet local and global challenges and work in smaller learning communities to solve real-world problems. This can be a great opportunity to partner with a university.

**Part Five: Detailed Curriculum Scope and Sequence**

**Year 1:**

Students in Year 1 explore the world around them and raise their own questions. They experience different types of scientific enquiries, including practical activities, and begin to recognise ways in which they might answer scientific questions. They use simple features to compare objects, materials and living things and, with help, decide how to sort and group them, observe changes over time, and with guidance begin to notice patterns and relationships. Students ask questions and use simple secondary sources to find answers. They use simple measurements and equipment (for example, hand lenses, egg timers) to gather data, carry out simple tests, record simple data, and talk about what they found out and how they found it. With help, they record and communicate findings in a range of ways and begin using simple scientific language.

Science involves observing, asking question about, and describing changes in, objects and events. People use science in their daily lives, including when caring for their environment and living things.

**Skills:**

|  |  |
| --- | --- |
| 1S01 | Ask simple questions to understand the world around us. |
| 1S02 | Observe closely, following simple experiments. |
| 1S03 | Perform simple measurements. |
| 1S04 | Identify physical features that may be used to compare and group objects, materials and living things. |
| 1S05 | Use observation and gather simple data to investigate questions |
| 1S06 | Respond to questions of a scientific nature. |
| 1S07 | Participate in guided investigations to explore problems in daily life. |
| 1S08 | Communicate scientific information such as similarities and differences. |

**Domain A: Life Processes and Living Things**

**Description:**

Students use the local environment throughout the year to explore and answer questions about plants growing in their habitat and animals living in their habitat. Where possible, they observe the growth of flowers and vegetables that they have planted. They may learn how to take care of animals taken from their local environment and the need to return them safely after study. Students become familiar with the common names of some fish, amphibians, reptiles, birds and mammals, including those kept as pets.

Students become familiar with flowers and characteristics of deciduous and evergreen trees, and plant structures (including: leaves, flowers (blossom), petals, fruit, roots, bulb, seed, trunk, branches and stem). Students work scientifically by: observing closely using a magnifying glass and comparing and contrasting familiar plants, describing how they were able to identify and group plants, and drawing diagrams of the parts of different plants, including trees. Students keep records of how plant have changed over time, for example, leaves falling off trees and bulbs opening; comparing and contrasting what they have discovered about different plants.

Students have opportunities to learn the names of the main body parts (including head, neck, arms, elbows, legs, knees, face, ears, eyes, hair, mouth, teeth) through games, actions, songs and rhymes.

Students work scientifically by: using observations to compare and contrast animals at first hand or through videos and photographs, describing how they identify and group them; grouping animals according to what they eat; and using their senses to compare different textures, sounds and smells.

**Concepts:**

|  |  |
| --- | --- |
| 1LP101 | Living things have a variety of external features.   * Understand the difference between living and non-living things. * Identify and describe the basic structure of a variety of common plants, including trees, flowers, seedlings and leaves. * Describe and compare the physical features of common animals: fish, amphibians, insects, reptiles, birds and mammals, including pets). * Identify, name, draw and label the basic parts of the human body; say which part is associated particular functions and issues. * Recognise similarities and differences between self and others and the need to treat all living creatures with respect and sensitivity. |
| 1LP102 | Living things can be classified based on different features.   * Plants can be classified by their leaves. * Animals can be classified by what they eat (herbivores, carnivores, omnivores). * Animals can be classified by as fish, amphibians, reptiles, birds, insects and mammals. |
| 1LP201 | Living things live in areas where their needs are met.   * Identify that most living things live in habitats to which they are suited. * Identify and describe the basic needs of animals, including humans, for survival (water, food, air, shelter). * Describe the environments in which different plants and animals live (water, land, air). * Recognise the five senses that enable humans and other animals to be aware of the environment around them. * What happens when the environment changes? |

Suggested Learning Experiences:

* + Identify a variety of common plants and animals in the local environment.
  + Collecting leaves from around the school or local area. Exploring the similarities and differences between the leaves.
  + Investigating the different types of trees, bushes and mosses that might grow in a particular area.
  + Identify and name a variety of plants and animals in their habitats, including microhabitats found locally and comparing them to those found globally.

Suggested Assessment Instruments:

* + Collect, compare and group different types of leaves to form a chart of similarities and differences.
  + Identify the common features of fish, amphibians, insects, reptiles, birds and mammals.
  + Draw the parts of the human body.
  + Construct a chart to show animals that eat plants (herbivores), eat meat (carnivores) and eat both (omnivores).
  + Collect photos of the different types of homes that animals build for themselves. What makes these homes good for the animals in their environment?

Technology Integration:

* + Use of a microscope (connected to an iPad) to magnify leaves and very small animals.

**Domain B: Materials and Properties**

**Description:**

Students will explore, name, discuss and raise and answer questions about everyday materials so that they become familiar with the names of materials and properties such as: hard/soft; stretchy/stiff; shiny/dull; rough/smooth; bendy/not bendy; waterproof/not waterproof; absorbent/not absorbent; opaque/transparent. Students explore and experiment with a wide variety of materials, not only those listed in the programme of study, but including for example: brick, paper, fabrics, elastic, and foil. Students work scientifically by: performing simple tests to explore questions, for example: ‘What is the best material for an umbrella? ...for lining a dog basket? ...for curtains? ...for a bookshelf? ...for a gymnast’s leotard?’

**Concepts:**

|  |  |
| --- | --- |
| 1MP101 | Objects can be made of different types of materials.   * Distinguish between an object and the material from which it is made. * Identify and name a variety of everyday materials, including: wood, plastic, glass, metal, water and rock. |
| 1MP102 | Materials have physical properties.   * Describe the simple physical properties of a variety of everyday materials. * Compare and group together a variety of everyday materials on the basis of their simple physical properties, including sorting materials for recycling. |
| 1MP103 | Everyday materials can be physically changed.   * Predicting and comparing how the shapes of objects made from different materials can be changed through actions like: bending, twisting and stretching. |

Suggested Learning Experiences:

* + Identifying the similarities and differences in a set of common objects and then identifying what they are made of.
  + Doing simple tests on objects to discover what they are made of (eg. tapping a metal object to hear its sound).

Suggested Assessment Instruments:

* + Group objects based on what they are made of.
  + Select types of materials (wood, plastic, glass, metal, water and rock) for particular uses.
  + Which materials can be bent, twisted or stretched?

Technology Integration:

* + Taking photos of different objects and grouping them based on what they are made of.

**Domain C: Physical Processes**

**Description:**

Students will observe and talk about the sources of light and sound and how these are different to objects that may reflect light (eg. Moon). Sound involves the vibration of a string, air or other medium caused by the source. We can sense light and sound. Objects can be visually seen only when light illuminates them.

**Concepts:**

|  |  |
| --- | --- |
| 1PP101 | Light and sound are produced by a range of different sources.   * Sources of light include: the Sun, stars, lamps. * Identify that light is reflected from surfaces. * Sources of sound include: musical instruments, people and animals, speakers. * Recognise that light from the sun can be dangerous and that there are ways to protect one’s eyes. |
| 1PP102 | Light and sound can be sensed by us.   * Recognise that light is essential in order to see things, and that dark is the absence of light. * Recognise that shadows are formed when a source of light is blocked by a solid object. * We hear sounds when objects (strings) or mediums (air) are vibrated. * We can make sound by blowing, shaking, scraping and striking. |

Suggested Learning Experiences:

* + Exploring how sound changes using musical instruments to explore volume (loudness) and pitch.
  + Investigate patterns in the way the size of shadows change.

Suggested Assessment Instruments:

* + Identify what objects can be sources of light.
  + Explain what happens when light is reflected from a surface.
  + Identify what objects can be sources of sound.
  + Tell people why they should not look directly at the Sun.
  + Explain why objects make shadows in the light.
  + What types of objects can be strung, blown, shaken, scraped, struck to make sounds.

Technology Integration:

* + Using GarageBand on an iPad to make different types of sounds for students to identify.

**Domain D: Environmental Science and Space**

**Description:**

Students will observe and talk about changes in the weather and the seasons. Students talk about concepts such as how day length varies and changes of humidity as appropriate to local conditions. Links are made with everyday materials, for example finding connections between seasons and clothing needed.

**Concepts:**

|  |  |
| --- | --- |
| 1ES101 | Observable changes occur in the environment around us.   * Identify different types of seasons (e.g.: four seasons, wet/dry seasons), including those personal to them. * Observe and describe weather associated with the seasons. |
| 1ES102 | Changes in the environment affect the way we interact with it.   * Observe changes across the seasons and how these affect the lives of people in the local area and on the global level. |

Suggested Learning Experiences:

* + Making tables and charts about the weather.
  + Making displays of what happens in the world around us, including day length with seasonal changes.

Note: Students are warned that it is not safe to look directly at the Sun, even when wearing dark glasses.

Suggested Assessment Instruments:

* + Identifying the seasons of the year and what types of weather, environmental conditions and changes do we observe in each season.
  + Exploring what the seasons look like in other countries and identifying any similarities and differences.

Technology Integration:

* + Measuring climate variables: temperature, light level, rain levels, etc.

**Year 2:**

Students in Year 2 explore the world around them and raise their own questions. They experience different types of scientific enquiries, including practical activities, and begin to recognise ways in which they might answer scientific questions. Students use simple features to compare objects, materials and living things; and with help decide how to sort and group them and observe changes over time. With guidance, they begin to notice patterns and relationships. Students ask questions and use simple secondary sources to find answers. They use simple measurements and equipment to gather data, carry out simple tests, record simple data, and talk about what they have discovered and how. With help, they record and communicate their findings in a range of ways and begin to use simple scientific language.

**Skills:**

|  |  |
| --- | --- |
| 2S01 | Ask questions and recognize that they can be answered in different ways. |
| 2S02 | Observe closely, using simple experiments. |
| 2S03 | Perform simple tests and measurements. |
| 2S04 | Identify and classify objects, materials and living things using physical features. |
| 2S05 | Use observation and gather data suggest answers to questions. |
| 2S06 | Pose and respond to scientific questions. |
| 2S07 | Collaborate in guided investigations to explore problems in daily life. |
| 2S08 | Communicate scientific information using appropriate language. |

**Domain A: Life Processes and Living Things**

**Description:**

Students are introduced to the basic needs of animals for survival, as well as the importance of exercise and nutrition for humans. They are also introduced to the processes of reproduction and growth in animals. The focus at this stage is on questions that help students to recognise growth; however, they are not be expected to understand how reproduction occurs.

Students are introduced to the idea that all living things have certain characteristics that are essential for keeping them alive and healthy. They begin to ask and answer questions that help them become familiar with the life processes common to all living things. Students are introduced to the terms ‘habitat’ (a natural environment or home of a variety of plants and animals) and ‘micro-habitat’ (a very small habitat, for example for woodlice under stones, logs or leaf litter). They raise and answer questions about the local environment that help them identify and study a variety of plants and animals within their habitat and observe how living things depend on each other, for example, plants serving as a source of food and shelter for animals. Students compare animals in familiar habitats with animals found in less familiar habitats, for example, on the seashore, in a woodland, in the ocean, in the rainforest. Students work scientifically by: sorting and classifying according to whether things are living, dead or were never alive, recording their findings by using charts. They describe how they decided where to place things by exploring questions, for example: ‘Is a flame alive? Is a deciduous tree dead in winter?’ They talk about ways of answering questions, and construct a simple food chain that includes humans (e.g. grass, cow, human). They describe the conditions in different habitats and micro-habitats (under log, on stony path, under bushes) and find out how the conditions affect the number and type(s) of plants and animals that live there.

**Concepts:**

|  |  |
| --- | --- |
| 2LP101 | Living things need other living things and non-living things for growth.   * Recognise that animals cannot make their own food. * Identify that animals and humans need the right types and amounts of food, and that they get nutrition from what they eat. * Identify healthy lifestyle choices, including diet and exercise; apply these to everyday life; and justify how the choice (including: eating the right amounts of different types of food, and hygiene) will improve health and wellbeing. * Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant. |
| 2LP201 | Living things have an interdependence on each other and their environment.   * Explain the important role plants play in the environment. * Describe how animals and plants depend on each other. * Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food, comparing animals from different locales. |

Suggested Learning Experiences:

* + Investigate the way in which water is transported within plants.
  + Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.
  + Care for plants and describe their importance to the environment (e.g. that plants give us oxygen).
  + Describe how to protect endangered animals and habitats.

Suggested Assessment Instruments:

* + Write down the types of food that humans and animals eat.
  + Explain how food helps us and list the food groups that keep us healthy.
  + Explain why a person might still get sick even when they are exercising often.
  + Investigate whether plants need food or not. If not, how do they grow?
  + Suggest how we might investigate the conditions that support plants to grow better.
  + Name the variables in an investigation into conditions that support plants to grow higher.
  + Make a prediction on whether plants will grow higher when exposed to more sunlight.
  + Read a simple data table showing results on plant heights after a month given their location in sunlight and extract relevant information to answer questions.

Technology Integration:

* + Measure the amount of light, water needed for plants to grow using electronic sensors.
  + Using a video camera (or iPad) to record a time lapse video of plants growing in different conditions.
  + Use of iPads to record results in a data table format.

**Domain B: Materials and Properties**

**Description:**

Students identify and discuss the uses of different everyday materials so that they become familiar with how some materials are used for more than one thing (metal can be used for coins, cans, cars and table legs; wood can be used for matches, floors, and telegraph poles) or different materials are used for the same thing (spoons can be made from plastic, wood, metal, but not normally from glass). They learn about the properties of materials that make them suitable or unsuitable for particular purposes, and are encouraged to think about unusual and creative uses for everyday materials. Students learn about people who have developed useful new materials, for example John Dunlop, Charles Macintosh or John McAdam. In identifying recyclable materials, students take responsibility for their own rubbish.

Students work scientifically by: comparing the uses of everyday materials in and around the school with materials found in other places (at home, the journey to school, on visits, and in stories, rhymes and songs); observing closely, identifying and classifying the uses of different materials, and recording their observations.

**Content:**

|  |  |
| --- | --- |
| 2MP101 | Materials can be used for specific purposes or combined for new purposes.   * Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. * Investigate the effect of mixing different materials together. * Identify recyclable materials. * Understand how materials (such as paper) can be changed, remade or recycled into new products. |
| 2MP102 | The shapes of solid objects can be changed by physical manipulation processes.   * Investigate how some objects change when they are squashed, bent, twisted and stretched. * Explore how materials maybe used for different purposes depending on how they change when manipulated. |

Suggested Learning Experiences:

* + Investigate how and suggest why different parts of everyday objects, such as toys and clothes, are made of different materials.
  + Explore the local environment to observe a variety of materials, and describe ways in which materials used.
  + Explore how materials change when warmed or cooled, squeezed or stretched.

Suggested Assessment Instruments:

* + Group common materials based on whether they are natural or man-made.
  + Identifying what common objects are made of.
  + Identifying what materials would be good to make particular objects based on their properties.
  + Explaining why some materials for good for a particular purpose (eg. glass or wood).
  + Explain how some materials may be manipulated to suit purposes.

Technology Integration:

* + Perform simple research using websites to identify what objects are made of.
  + Test objects for conductivity using a lamp circuit.

**Domain C: Physical Processes**

**Description:**

Students will explore what happens when light reflects off a mirror or other reflective surface, playing mirror games to answer questions about how light behaves. Students learn about why it is important to protect their eyes from bright lights. They look for and measure shadows, and discover how shadows formed and what causes shadows to change.  
*Note*: Students should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses.  
Students work scientifically by: looking for patterns in what happens to shadows when the light source moves or the distance between the light source and the object changes.

**Content:**

|  |  |
| --- | --- |
| 2PP101 | A push or pull can affect how an object moves or change its shape.   * Investigating ways that objects move on land, through water and in the air. * Exploring how different strengths of pushes and pulls affect the movement of object. * Exploring how different strengths of pushes and pulls can change the shape of an object. * Examine how gravity pulls objects towards the Earth. |
| 2PP201 | Heat can be produced in different ways and can move from one object to another.   * Describe how heat can be produced through such processes as: friction and motion, electrical or chemical (burning). * Explore how heat can be transferred through conduction * Use a thermometer to measure the effects of heating an object. |

Suggested Learning Experiences:

* + Identify changes that occur in everyday situations due to heating and cooling.

Suggested Assessment Instruments:

* + Define a force as a push or pull.
  + Identify everyday actions as pushes or pulls.
  + Draw arrows on simple diagrams to show the pushing or pulling forces.

Technology Integration:

* + Measuring and recording temperature. Discussing how temperatures affect our decisions.

**Year 3:**

Students in Year 3 are given a range of scientific experiences to enable them to raise their own questions about the world around them. They start to make their own decisions about the most appropriate types of scientific enquiries they might use to answer questions; recognise when a simple fair test is necessary, and help decide how to set it up. Students talk about criteria for grouping, sorting and classifying; and they use simple keys. Students begin to look for naturally occurring patterns and relationships and decide what data to collect to identify them. They help make decisions about what observations to make, how long to make them for and the type of simple equipment that might be used.

Students learn how to use new equipment, such as data loggers, appropriately. They collect data from their own observations and measurements, using notes, simple tables and standard units, and help to make decisions about how to record and analyse this data. With help, students look for changes, patterns, similarities and differences in their data in order to draw simple conclusions and answer questions. With support, they identify new questions arising from the data, making predictions for new values within or beyond the data collected, and find ways of improving what they have already done. They also recognise when and how secondary sources might help them to answer questions that cannot be answered through practical investigations. Students use relevant scientific language to discuss their ideas and communicate findings in ways that are appropriate for different audiences. Opportunities for working scientifically shall be provided across Years 3 and 4 to meet YCIS Learning Standards by the end of Year 4. Students are not expected to cover each aspect for every area of study.

**Skills:**

|  |  |
| --- | --- |
| 3S01 | Ask relevant questions and use different types of scientific enquiries to answer them. |
| 3S02 | Set up simple practical enquiries and comparative tests following instructions. |
| 3S03 | Make careful observations and take measurements using standard units. |
| 3S04 | Gather, record, classify and present data in a variety of ways to answer questions. |
| 3S05 | Record and organise data using labelled diagrams, keys and tables. |
| 3S06 | Use results to draw simple conclusions and suggest improvements. |
| 3S07 | Apply scientific concepts and skills to understanding daily life. |
| 3S08 | Use simple evidence to communicate scientific information. |

**Domain A: Life Processes and Living Things**

**Description:**

Students are introduced to the relationship between structure and function: the idea that every part has a job to do. They explore questions that focus on the role of the roots and stem in nutrition and support, leaves for nutrition, and flowers for reproduction. Note: Students are introduced to the idea that plants make their own food, but at this stage they do not need to understand how this happens.

Students work scientifically by: comparing the effect of different factors on plant growth, for example, the amount of light, the amount of fertiliser; discovering how seeds are formed by observing different stages of plant life cycles over a period of time. They can observe how water is transported in plants, for example by putting cut, white carnations into coloured water and observing how water travels up the stem to the flowers.

Students continue to learn about the importance of nutrition and are introduced to the main body parts associated with the skeleton and muscles, finding out how different parts of the body have special functions. Students explore issues that relate to food production and consumption (e.g. world hunger, obesity, equal distribution of resources).

Students work scientifically by: identifying and grouping animals with and without skeletons, observing and comparing their movements; exploring ideas about what would happen if humans did not have skeletons. They compare and contrast the diets of different animals (including their pets), and decide ways of grouping them according to what they eat. They research different food groups and how these keep us healthy, designing meals based on what they discover.

**Concepts:**

|  |  |
| --- | --- |
| 3LP101 | Living things grow, change and have offspring similar to themselves.   * Understand that many plants come from seeds. * Observe and describe how seeds and bulbs grow into mature plants. * Recognise and compare the external body parts of humans and other animals and how these change during growth. * Recognise that animals, including humans, have offspring which are similar to themselves and grow into adults. |
| 3LP102 | Living things require structures for growth and function.   * Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers and how these change during growth. * Classify animals into vertebrates and invertebrates using examples. * Identify that vertebrates (humans and some other animals) have skeletons and muscles for support, protection and movement. * Understand how invertebrates can function and grow without skeletons. |

Suggested Learning Experiences:

* + Explore how the bodies of different animals change as they grow.
  + Grow a seed (or seedling) in cotton wool and water over a time.
  + Explore the different types of skeletons that animals have.
  + Construct a chart showing the lifecycle of a plant from: seed dispersal, germination, growing and flowering, pollination, fertilisation and seed formation.

Suggested Assessment Instruments:

* + Label the parts of a flowering plant.
  + Identify animals as vertebrates or invertebrates.
  + Explain the ways that seeds can be spread.

Technology Integration:

* + Video camera to record a time lapse video of plants growing from seeds or seedlings.

**Domain B: Materials and Properties**

Students explore a variety of everyday materials and develop simple descriptions of the states of matter (e.g. solids hold their shape; liquids form a pool; gases escape from an unsealed container). Students observe water as a solid, a liquid and a gas, and note the changes to water when it is heated or cooled.

Students identify ways in which solids, liquids and gases can be pollutants and alter the environment, with specific local references. They investigate the importance of water conservation and means of saving water. Students recognise the importance of water conservation and means of saving water.

Students work scientifically by: grouping and classifying a variety of different materials; exploring the effect of temperature on substances such as chocolate, butter, cream (for example, making food such as chocolate crispy cakes and ice-cream for a party). They research the temperature at which materials change state, for example, when iron melts or when oxygen condenses into a liquid. They observe and record evaporation over a period of time, for example, a puddle in the playground or the clothes drying on a line; and investigate the effect of temperature on clothes drying or snowmen melting.

**Concepts:**

|  |  |
| --- | --- |
| 3MP101 | Matter can exist as solid, liquid or gas.   * Compare and group materials together according to whether they are solids, liquids or gases. * Explore the properties that matter has when it is a solid, liquid and gas. |
| 3MP102 | A change of state between solid and liquid can be caused by adding or removing heat.   * Investigate how liquids and solid respond to changes in temperature (eg. ice to water, melting chocolate). * Explore how changes from solid to liquid and liquid to solid can help us recycle materials. * Predict the effect of heat on different materials.   Note: Teachers should avoid using materials where heating is associated with chemical change, for example, through baking or burning. |

Suggested Learning Experiences:

* + Measure or research the temperature at which materials change state in degrees Celsius (°C).
  + Identify the part played by evaporation and condensation in the water cycle; associate the rate of evaporation with temperature

Suggested Assessment Instruments:

* + Identifying what state everyone substances are in at room temperature. Predicting what will happen to these objects as they are heated or cooled.
  + Recording the temperature as ice melts and organising the results in a data table.
  + Predicting the effects of global warming on various regions of the Earth.

Technology Integration:

* + Measuring and recording temperature using a data logger.

**Domain C: Physical Processes**

Students observe that magnetic forces can act without direct contact, unlike most forces, where direct contact is necessary (for example, opening a door, pushing a swing). They explore the behaviour and everyday uses of different magnets (for example bar, ring, button and horseshoe).

Students work scientifically by: comparing how different things move and grouping them; raising questions and carrying out test to find out how far things move of different surfaces, fathering and recording data to find answers to their questions. Students explore the strengths of different magnets and find a fair way to compare, sorting materials into those that are magnetic and those that are note, and looking for patterns in the way that magnets behaviour in relation to each other. They identify the effects of magnets, for example, the strength of a magnet, which pole faces another, how properties make magnets useful in everyday items, creative uses for different magnets.

**Content:**

|  |  |
| --- | --- |
| 3PP101 | Forces can be exerted by one object on another object through direct contact or from a distance.   * Observe and explain how forces on objects affect their movement: throwing, dropping, bouncing and rolling. * Compare how things move on different surfaces, exploring how friction can affect the movement of the object. * Identify that some forces need contact between two objects, but magnetic forces can act at a distance. * Describe magnets as having two poles. * Observe how magnets attract or repel each other and attract some materials and not others. * Predict whether two magnets will attract or repel each other, depending on which poles are facing. |

Suggested Learning Experiences:

* + Slide an object down a ramp made of different types of materials and explore how far it slides. Explain how the type of material had an effect on the distance.
  + Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet and identity some magnetic materials.
  + Explore the everyday and / or innovative uses of different magnets.

Suggested Assessment Instruments:

* + Explain what gravity is and what it does.
  + Identify in which situations two magnets will attract or repel each other.
  + Explain how a navigation compass works.
  + Naming friction as a force acting to slow or stop object moving.
  + Using a data table of results of sliding objects, explain what the results mean.

Technology Integration:

* + Using a compass for navigation and detecting the presence of magnetic fields. Mobile phones have a compass built-in.

**Domain D: Earth and Space Science**

Linked with work in Geography, students explore different kinds of rocks and soils, including those in the local environment.

Students work scientifically by observing rocks, including those used in buildings and gravestones, and exploring how and why they might have changed over time. They use a hand lens or microscope to identify and classify rocks according to whether they have grains or crystals, and whether they contain fossils. Students research and discuss the different kinds of living things whose fossils are found in sedimentary rock, and explore how fossils are formed. Students explore different soils and identify similarities and differences, and investigate what happens when rocks are rubbed together, or what changes occur when rocks are in water. Students raise and answer questions about the way soils are formed. When students study how humans make use of rock, they explore how obtaining these materials affect the environment and/or communities (e.g. the impact of mining on local and global environments and communities).

**Concepts:**

|  |  |
| --- | --- |
| 3ES101 | Rocks can be described by their characteristics which give them properties that make them useful to man.   * Compare and group different kinds of rocks on the basis of their appearance, formation, and simple physical properties. * Describe how humans use rocks. |
| 3ES102 | Soils and rock can contain previously living organisms.   * Recognise that soils are made from rocks and organic matter. * Describe in simple terms how fossils are formed when living things are trapped within rock. |

Suggested Learning Experiences:

* + Grouping rock samples based on observable characteristics or properties.
  + Telling the story of how a rock formed.
  + Observing simple fossils and identifying the animal or plant that formed them.

Suggested Assessment Instruments:

* + Write down the characteristics can be used to identify rocks.
  + Explain how rocks and fossils can be used to understand what happened in the past.

Technology Integration:

* + Testing rocks for conductivity.

**Year 4:**

Students in Year 4 are given a range of scientific experiences to enable them to raise their own questions about the world around them. They start to make their own decisions about the most appropriate types of scientific enquiries they might use to answer questions; recognise when a simple fair test is necessary, and help decide how to set it up. Students talk about criteria for grouping, sorting and classifying; and they use simple keys. Students begin to look for naturally occurring patterns and relationships and decide what data to collect to identify them. They help make decisions about what observations to make, how long to make them for and the type of simple equipment that might be used.

Students learn how to use new equipment, such as data loggers, appropriately. They collect data from their own observations and measurements, using notes, simple tables and standard units, and help to make decisions about how to record and analyse this data. With help, students look for changes, patterns, similarities and differences in their data in order to draw simple conclusions and answer questions. With support, they identify new questions arising from the data, making predictions for new values within or beyond the data collected, and find ways of improving what they have already done. They also recognise when and how secondary sources might help them to answer questions that cannot be answered through practical investigations. Students use relevant scientific language to discuss their ideas and communicate findings in ways that are appropriate for different audiences. Opportunities for working scientifically shall be provided across Years 3 and 4 to meet YCIS Learning Standards by the end of Year 4. Students are not expected to cover each aspect for every area of study.

**Skills:**

|  |  |
| --- | --- |
| 4S01 | Ask relevant questions and use different types of scientific enquiries to answer them. |
| 4S02 | Set up simple practical enquiries, comparative and fair tests following instructions. |
| 4S03 | Make systematic and careful observations and take accurate measurements using a range of equipment. |
| 4S04 | Gather, record, classify and present data in a variety of ways to provide support to answer questions. |
| 4S05 | Record and organise data using scientific conventions to pose solutions. |
| 4S06 | Use results to draw conclusions, raise further questions and suggest improvements. |
| 4S07 | Apply scientific concepts and skills to understanding daily life. |
| 4S08 | Use evidence to communicate scientific information and ideas. |

**Domain A: Life Processes and Living Things**

Students are introduced to the main body parts associated with the digestive system, for example, mouth, tongue, teeth, esophagus, stomach and small and large intestine. They explore questions that help them understand the special functions of each.

Students work scientifically by: comparing the teeth of carnivores and herbivores; suggesting reasons for differences; finding out what damages teeth and how to look after them. They draw conclusions and discuss ideas about the digestive system and compare with models or images. Students compare how people stay healthy in different locales and/or cultures, including their own local circumstances.

Students use the local environment throughout the year to raise and answer questions that help to identify and study plants and animals in their habitat. They identify how the habitat changes throughout the year, and explore possible ways of grouping a wide selection of living things that include animals, flowering plants and non-flowering plants. Students begin to put vertebrate animals into groups such as fish, amphibians, reptiles, birds, and mammals; and invertebrates into categories of snails and slugs, worms, spiders, and insects.

Students are encouraged to identify various charities that support environmental causes. Note: Plants can be grouped into categories such as flowering plants (including grasses) and non-flowering plants, such as ferns and mosses.

Students explore examples of human impact (both positive and negative) on environments, for example, the positive effects of nature reserves, ecologically planned parks, or garden ponds; and the negative effects of population and development, litter or deforestation. Students work scientifically by: using and making simple guides or keys to explore and identify local plants and animals; making a guide about local living things; raising and answering questions based on observations and discoveries about animals they have researched.

**Concepts:**

|  |  |
| --- | --- |
| 4LP101 | Animals process food for energy and growth.   * Understand that animal get energy from breaking down their food. * Describe the simple functions of the basic parts of the digestive system in humans and other mammals. * Describe the nature of different types of teeth in humans and other mammals and describe their function. |
| 4LP201 | Living things interact with each other and their environment in a number of different ways.   * Identify how living creatures are interdependent. * Recognise that living things can be grouped in a variety of ways. * Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment. * Construct and interpret a variety of food chains, identifying producers, predators and prey. * Recognise that environments can change (naturally or by human intervention) and that this can sometimes have positive and negative impact on living things. * Identify endangered and extinct species and discuss the causes and implications of this. * Explore human beings’ responsibility towards animals and living things in the environment. |

Suggested Learning Experiences:

* + Design and explain a healthy regimen of diet, exercise and dental care.
  + Label a diagram of the digestive system.
  + Identify the different types of teeth and their different purposes when eating.
  + Constructing a classification key for animals and/or plants based on observable features.
  + Using a list of animals and plants within a particular habitat, identifying the producers, predators and prey.

Suggested Assessment Instruments:

* + Collecting data on your own diet during the week. Recording and present the main food groups in a chart.
  + Using a given classification key to identify a particular animal or plant.
  + Constructing a food chair of producers, predators and prey in a particular habitat.

Technology Integration:

* + Virtual tour through the human digestive system.
  + Constructing a diagram using an appropriate multimedia system.
  + Understanding how sensors monitoring an environment can collect data to understand how living organisms live and grow.

Real-life and STEAM Connections:

* + Using data loggers to measure and record changes to environmental factors that may lead to challenges for survival of some species.
  + Explore programmes that build public awareness of endangered species.

**Domain B: Materials and Properties**

Students in Year 4 identify the properties of materials used to make common objects and assess whether they are man-made or naturally produced. Student develop their vocabulary of terms used to describe the properties. They explore how these types of materials and their properties make them useful for specific purposes.

Students learn to make decisions on which materials would be good to use for different purposes and support their decisions with information about the properties of those materials. Students can explore uses such as: packaging, clothing, construction, cooking and eating utensils, furniture, etc.

**Concepts:**

|  |  |
| --- | --- |
| 4MP101 | Natural and processed materials have different properties.   * Describe a range of common materials, such as, metals or plastics. * Investigate a particular property across a range of materials. |
| 4MP102 | Natural and processed materials have a range of physical properties that can influence their use.   * Describe the uses of a range of common materials and explain why they are useful. * Select materials for uses based on their properties. * Consider how the properties of materials affect the management of waste or can lead to pollution. |

Suggested Learning Experiences:

* + Investigating the different types of materials used in commercial packaging (eg. cardboard, plastic, foil, paper).
  + Exploring how some materials can be easily recycled, but others are more difficult to recycle or must be disposed of.
  + Perform simple tests on materials to determine if they can conduct electricity, conduct heat, if they can bend easily,

Suggested Assessment Instruments:

* + Discuss the properties that make the packaging materials suitable for their purpose.
  + What properties make some materials good for recycling?

Technology Integration:

* + Developing an electronic design portfolio of the design of a new type of packaging.

STEAM Connections:

* + Designing a new type of package that provided style with strength for protecting the contents involving measurement, assessment of build material, artistic design the package and construction.

**Domain C: Physical Processes**

Students explore and identify the way sound is made through vibration in a range of different musical instruments from around the world; and discover how the pitch and volume of sounds can be changed in a variety of ways.

Students work scientifically by finding patterns in the sounds that are made by different objects such as saucepan lids of different sizes or elastic bands of different thicknesses. They make things, such as earmuffs, from a variety of different materials to investigate which provides the best insulation against sound. Students are encouraged to make and play their own instruments by using what they discover about pitch and volume.

This unit could link with Music, sounds and music from other cultures, or learning about noise pollution.

Students learn to construct simple series circuits, trying different components, for example, bulbs, buzzers and

motors, and including switches; using their circuits to create simple devices. Students draw the circuit as a pictorial representation, not necessarily using conventional circuit symbols at this stage. Note: Students may use the terms current and voltage, but these should not be introduced or defined formally at this stage. Students must learn about precautions for working safely with electricity.

Students work scientifically by observing patterns, for example, that bulbs get brighter if more cells are added, that metals tend to be conductors of electricity, and that different materials can or cannot be used to connect across a gap in a circuit.

**Content:**

|  |  |
| --- | --- |
| 4PP101 | Sound is generated by vibrating air that originates from a resonating source.   * Identify how sounds are made, associating some of them with something vibrating. * Recognise that vibrations from sounds travel through a medium to the ear. * Find patterns between the pitch of a sound and features of the object that produced it. * Find patterns between the volume of a sound and the strength of the vibrations that produced it. * Recognise that sounds get fainter as the distance from the sound source increases. |
| 4PP201 | Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources.   * Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. * Identify whether or not a lamp will light in a simple series circuit based on whether or not the lamp is part of a complete loop with a battery. * Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit. * Recognise some common conductors and insulators, and associate metals with being good conductors. * Identify renewable and non-renewable electrical energy sources. |

Suggested Learning Experiences:

* + Identify sounds made by different instruments and methods.
  + Listen to different pitched volumes and identify the difference.
  + Observe the movement of a bass speaker and compare that to a tweeter speaker.
  + Identify common appliances that run on electricity.

Suggested Assessment Instruments:

* + Identify electrical component symbols.
  + Understand that when a drawing of a switch if off in a circuit diagram, the light will not be on.
  + Name two ways that electricity can be generated by renewable and non-renewable means.
  + Identify which appliances at home run on the main electricity and which require batteries.
  + Predict what will happen to the brightness of a lamp when more batteries are added in series.
  + Write a simple hypothesis about why a connected circuit is not working.
  + Reading a data table of results from testing various materials (eg. wood, paper, copper, plastic ruler, paper clip) to see if they light up a lamp when connected in a circuit, identifying the variables and noticing what the materials that do light the lamp have in common.

Technology Integration:

* + Online simulations for designing and testing circuits can be used.
  + Using Excel to record results in a data table.

Real-life and STEAM Connections:

* + Generating sounds using GarageBand on an iPad and using them to add effects to a short video clip.
  + Exploring the job a foley artist who creates sound effects for movies.
  + Record the sounds that different species of birds make. Discuss how birds use these sounds to communicate.

**Year 5:**

Students in Years 5 use science experiences to: explore ideas and raise different kinds of questions; select and plan the most appropriate types of scientific enquiries to answer scientific questions; recognise when and how to set up comparative and fair tests; and explain which variables need to be controlled and why. They use and develop keys and other information records to identify, classify and describe living things and materials; and identify patterns that might be found in the natural environment. They make their own decisions about what observations to make, what measurements to use and how long to make them for, and whether to repeat them.

Students choose the most appropriate equipment to make measurements and explain how to use it accurately. They decide how to record data from a choice of familiar approaches; look for different causal relationships in their data; and identify evidence that refutes or supports their ideas. Students use their results to identify when further tests and observations might be needed; recognise which secondary sources will be most useful to research ideas; and begin to separate opinion from fact. They use relevant scientific language and illustrations to discuss, communicate, and justify their scientific ideas; and research how scientific ideas have developed over time. The science experiences in Year 5 include investigative projects.

**Skills:**

|  |  |
| --- | --- |
| 5S01 | Plan scientific enquiries to answer questions, including recognising and controlling variables as necessary. |
| 5S02 | Perform practical enquiries, comparative and fair tests following instructions. |
| 5S03 | Perform measurements using scientific equipment taking repeated readings as appropriate for improved reliability. |
| 5S04 | Record data and results using scientific diagrams and labels, classification keys, data tables and scatter graphs to show relationships. |
| 5S05 | Use test results to identify relationships (including cause and effect), understand simple systems and make predictions. |
| 5S06 | Identify scientific evidence from experiments and research that can be used to support or refute scientific ideas. |
| 5S07 | Apply the scientific method, scientific concepts and skills to improving daily life and problems. |
| 5S08 | Use evidence to communicate scientific arguments, explore solutions and work collaboratively. |

**Domain A: Life Processes and Living Things**

Students build on their learning from Years 3 and 4 about the main body parts and internal organs (skeletal, muscular and digestive system) to explore and answer questions that help them understand how the circulatory system enables the body to function.

Students learn how to keep their bodies healthy and how their bodies might be damaged, and how some drugs and other substances can be harmful to the human body.

Students work scientifically by experimenting with the effects of exercise on heart rate, breathing, etc. They investigate how exercise and diet affects health.

Students explore the work of scientists and scientific research about the relationship between diet, exercise, drugs, lifestyle and health. They study sustainability of organic foods, grain fed cattle, chickens & antibiotics, associated benefits and costs.

Students in Year 5 study and raise questions about the local environment throughout the year. They observe life-cycle changes in a variety of living things, for example, plants in a vegetable garden or flower border, and animals in the local environment. They learn about the work of naturalists and animal behaviourists such as David Attenborough and Jane Goodall.

Students learn about different types of reproduction, including sexual and asexual reproduction in plants, and sexual reproduction in animals. Students identify perspectives of different cultures towards age, and associated responsibilities that accompany different ages. They look for patterns in the structure of fruits that relate to how the seeds are dispersed.

Students work scientifically by: observing and comparing the life cycles of plants and animals in their local environment with other plants and animals around the world (in the rainforest, in the oceans, in desert areas, and in prehistoric times), asking pertinent questions and suggesting reasons for similarities and differences. Students are encouraged to grow new plants from different parts of a parent plant, for example, seeds, stem and root cuttings, tubers, bulbs. They observe changes in an animal over a period of time (for example, the hatching and rearing of chicks if appropriate), comparing how different animals reproduce and grow.

**Concepts:**

|  |  |
| --- | --- |
| 5LP101 | Living things have systems that help them to function.   * Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood. * Describe the ways in which nutrients and water are transported within animals, including humans. * Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function. |
| 5LP102 | Living things have structural features and adaptations that help them to survive in their environment.   * Give reasons for classifying plants and animals based on specific characteristics. * Identify how these specific characteristic and structural features in an organism help it to survive. * Explain how adaptations can support an organise to survive in its environment. |
| 5LP103 | Living things go through changes as a part of their lifecycle.   * Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird. * Describe the life process of reproduction in some plants and animals. * Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal. * Describe the changes as animals or humans develop to old age. |

Suggested Learning Experiences:

* + Constructing a 3D poster of the circulatory system and describing the function of each component.
  + Exploring the adaptations of animals in different habitats including: tundra, marine, freshwater, savanna, rainforest, etc.
  + Creating a classification key for plants or animals based on their physical characteristics.

Suggested Assessment Instruments:

* + Use a classification key to identify specific animals or plants based on their characteristics.
  + Describe, with sketches, the ways in which plants reproduce.

Technology Integration:

* + Construct a stop-motion animation of the lifecycle of frog.
  + Fitting an aquarium with sensors to monitor pH, salinity and other variables.

Real-life and STEAM Connections:

* + Understanding the importance of testing water quality and its effect on the health and ability of water life to reproduce.

**Domain B: Materials and Properties**

Students explore the three main states of matter: solid, liquid and gas. Changing from one state to another is achieved by heating or cooling substances and different subjects will change state at different temperatures and can be explored using water as a solid, liquid and gas.

The basic properties of each state of matter will be investigated and how these properties might be useful in every-day life. Properties include: whether they have change to suit the shape of a container, whether they can flow,

**Concepts:**

|  |  |
| --- | --- |
| 5MP101 | Solids, liquids and gases have different observable properties and behave in different ways.   * Recognise that substances exist in different states depending on the temperature. * Observe that gases have mass (do not use the term “weight”) and take up space (called “volume”). * Explore the way solids, liquids and gases change under different situations such as heating and cooling. |
| 5MP102 | Materials in different states can be used in different ways depending on their properties.   * Identify the properties of each state of matter for water. * Recognise that not all substances can be easily classified on the basis of their observable properties. * Investigate how changing states can be useful in real-world scenarios. |

Suggested Learning Experiences:

* + Demonstrations using liquid nitrogen and dry ice to show the effects of freezing air and water.
  + Making ice-cream using liquid nitrogen or dry ice.
  + Demonstrate the melding of gallium metal using a heat or body temperature.
  + Observing that air has mass through balloons.

Suggested Assessment Instruments:

* + Design a poster to identify the different states of matter and the role that heat plays in changing states.
  + Investigating the temperatures that different substances melt at.
  + Identifying the state of matter of common household substances.

Technology Integration:

* + Using data loggers to measure the temperature of ice as it melts or freezes.

Real-life and STEAM Connections:

* + Understanding the effects of climate change, such as the melting of the polar ice caps.

**Domain C: Physical Processes**

Students explore falling objects and raise questions about the effects of air resistance; and they explore the effects of air resistance by observing how different objects such as parachutes and gliders. Students experience forces that make things begin to move, get faster or slow down. They explore the effects of friction on movement and find out how it slows or stops moving objects, for example, by observing the effects of a brake on a bicycle wheel. Students explore the effects of levers, pulleys and simple machines on movement. Students research how scientists such as Galileo Galilei and Isaac Newton helped to develop the theory of gravitation.

Students work scientifically by exploring falling types of paper planes/darts; designing and making a variety of parachutes; and carrying out fair tests to determine which designs are the most effective. They explore resistance in water by making and testing boats of different shapes; and they design and make products that use levers, pulleys, gears and/or springs and explore their effects.

**Concepts:**

|  |  |
| --- | --- |
| 5PP101 | Gravity and friction act as forces that affects the motion of falling objects.   * Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object. * Identify the effects of air resistance, water resistance and friction, that act between moving surfaces. |
| 5PP102 | Simple machines can be used to enable forces to have a greater effect.   * Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. |

Suggested Learning Experiences:

* + Investigating the effects of dropping objects with different shapes to explore the effect of air resistance on falling objects.
  + Measuring the force on objects being pulled through the air, water and oil.
  + Experiment using different types of levers (first, second, and third class levers).
  + Researching how gravity was discovered and how our understanding of gravity has changed over time.
  + Designing an effective paper plane or parachute.

Suggested Assessment Instruments:

* + Predicting the effect of water and air resistance has on the motion of different shaped objects.
  + Identifying the different classes of levers and how they are used to assist us in everyday objects like: a wheelbarrow, pliers, nutcracker, etc.

Technology Integration:

* + Measuring the force exerted by different devices that are built on the principles of the lever.

Real-life and STEAM Connections:

* + Construct and testing of a simple catapult.

**Domain D: Earth and Space Science**

Students are introduced to a model of the Sun and Earth that enables them to explain day and night. They learn that the Sun is a star at the centre of our solar system, and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a ‘dwarf planet’ in 2006). Students learn that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones).

Note: Students should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses.

Students learn about how the moon causes tides. They discover the way that ideas about the solar system have developed; and understand how the geocentric model of the solar system gave way to the heliocentric model by considering the work of scientists such as Ptolemy, Alhazen and Copernicus. Students relate this to the time in China compared to the time in their home country, including understanding of jet lag. Students learn about space exploration, including Chinese space exploration and collaborative projects.

Students work scientifically. Methods include comparing the time of day at different places on the Earth through internet links and direct communication; creating simple models of the solar system; constructing simple shadow clocks and sundials, calibrated to show midday and the start and end of the school day

**Content:**

|  |  |
| --- | --- |
| 5ES101 | The Solar System consists of planets that orbit the Sun.   * Describe the movement of the Earth, and other planets, relative to the Sun in the solar system. * Describe the movement of the moon relative to the earth. * Describe the Sun, Earth and Moon as approximately spherical bodies. |
| 5ES102 | The relative movements of the Earth, Moon and Sun causes changes on the Earth.   * Use the idea of the Earth’s rotation to explain day and night and the apparent movement of the Sun across the sky. * Explain why we have different seasons in reference to the tilt of the earth and its movement around the Sun. |

Suggested Learning Experiences:

* + Label a diagram of the solar system showing all the planets in order from the Sun.
  + Constructing a model for the solar system.
  + Using a torch and globe to illustrate the time of day and phases of the Moon.
  + Observing the constellations in the night sky or looking at star charts to identify the planets near the Earth.
  + Using a telescope to observe the night sky (where possible).
  + Constructing a pinhole camera to observe the Sun.

Suggested Assessment Instruments:

* + State the time that it takes for the …
    - Earth to spin on its axis,
    - Moon to go around the Earth,
    - Earth to go around the Sun.
  + Explain why countries get more daylight in Summer compared to Winter.
  + Suggest places to put solar panels for generating electricity, giving justification for your suggestions.
  + Using a map of the Earth to identify the differences in the amount of sunlight that different countries get.
  + Reading a data table of solar energy supply in different countries and answering questions that require identifying the correct information, adding up totals and identifying simple trends.

Technology Integration:

* + Researching data on the movement of the planets, the Moon or the Earth around the Sun.

Real-life and STEAM Connections:

* + Design and construct of a working telescope.

**Year 6:**

Students in Year 6 use science experiences to: explore ideas and raise different kinds of questions; select and plan the most appropriate types of scientific enquiries to answer scientific questions; recognise when and how to set up comparative and fair tests; and explain which variables need to be controlled and why. They use and develop keys and other information records to identify, classify and describe living things and materials; and identify patterns that might be found in the natural environment.

Students make their own decisions about what observations to make, what measurements to use and how long to make them for, and whether to repeat them. Students choose the most appropriate equipment to make measurements and explain how to use it accurately. They decide how to record data from a choice of familiar approaches; look for different causal relationships in their data; and identify evidence that refutes or supports their ideas. Students use their results to identify when further tests and observations might be needed; recognise which secondary sources will be most useful to research ideas; and begin to separate opinion from fact. They use relevant scientific language and illustrations to discuss, communicate, and justify their scientific ideas; and research how scientific ideas have developed over time. The science experiences in Year 6 include investigative projects.

**Skills:**

|  |  |
| --- | --- |
| 6S01 | Plan scientific enquiries to answer questions, including recognising independent and dependent variables and controlled variables as necessary. |
| 6S02 | Design and perform practical enquiries, comparative and fair tests with guidance. |
| 6S03 | Perform measurements using a range of scientific equipment, with increasing precision, taking repeat readings as appropriate. |
| 6S04 | Record data and results of increasing complexity using scientific diagrams and labels, classification keys, data tables and scatter graphs. |
| 6S05 | Use test results to identify relationships, understand systems and make predictions with evaluation of results and simple justification. |
| 6S06 | Identify scientific evidence from experiments and research that can be used to support or refute scientific ideas, approaches and thinking. |
| 6S07 | Apply the scientific method, scientific concepts and skills to improving daily life and problems. |
| 6S08 | Use evidence to communicate scientific arguments, make predictions, explore solutions and work collaboratively. |

**Domain A: Life Processes and Living Things**

Students build on their learning about grouping living things by looking at the classification system in more detail. They are introduced to the idea that broad groupings, such as micro-organisms, plants and animals can be subdivided. Students focus on the local impact of viruses (e.g. Sars-cov-2, swine/bird flu, HFMD etc.). Through direct observations where possible, students classify animals into commonly found invertebrates such as insects, spiders, snails, worms; and vertebrates such as fish, amphibians, reptiles, birds and mammals. They discuss reasons why living things are placed in one group and not another.

Students learn about the significance of the work of scientists such as Carl Linnaeus, a pioneer of classification.

Students work scientifically by: using classification systems and keys to identify some animals and plants in the immediate environment. They research unfamiliar animals and plants from a broad range of other habitats and decide where they belong in the classification system.

Building on what they learned about fossils in the topic on rocks in Year 3, students discover more about how living things on earth have changed over time. They are introduced to the idea that characteristics are passed from parents to offspring, for instance by considering different breeds of dogs, and what happens when, for example, Labradors are crossed with Poodles. They learn that variation in offspring over time can make animals more or less able to survive in particular environments, for example, by exploring how giraffes’ necks got longer, or the development of insulating fur on the arctic fox. Students research the work of paleontologists such as Mary Anning, and how Charles Darwin and Alfred Wallace developed their ideas on evolution.

With regards to sustainability, students learn about pollution and long-term effects on the local environment and lifestyles. They recognise ways in which our planet can be sustained for future generations, and ways in which all living things can continue to grow and thrive.

Students work scientifically by: observing and raising questions about local animals and how they are adapted to their environment; comparing how some living things are adapted to survive in extreme conditions, e.g. cactuses, penguins and camels. They analyse the advantages and disadvantages of specific adaptations, such as being on two feet rather than four, having a long or a short beak, having gills or lungs, tendrils on climbing plants, brightly coloured and scented flowers.

**Concepts:**

|  |  |
| --- | --- |
| 6LP101 | Living things get their characteristics from their parents. These characteristics can be used to classify animals and plants.   * Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals. * Identify similarities and differences between human parents and children. * Understand inheritance as a process by which characteristics of parents are passed to their children. * Consider examples of inheritance in other species: mammals, fish, birds, reptiles, amphibians, insects and some plants. * Explore how this is different to species where the child is identical to the parent: bacteria, some plants. * Investigate the classification system based on species physical characteristics to form a dichotomous key to identify organisms. |
| 6LP102 | The characteristics of living things change over time due to inheritance and processes like natural selection and migration.   * Recognise that living things have changed over time, and that fossils provide information about living things that inhabited the Earth millions of years ago. * Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents. * Identify how all living things are adapted to suit their environment in different ways (natural selection), and that adaptation may lead to the survival of a species as it is better suited to its environment.   Note: At this stage, students are not expected to understand genes and chromosomes. |

Suggested Learning Experiences:

* + Constructing a dichotomous classification key for animals and plants.
  + Observing micro-organisms using magnifying glasses and microscopes.
  + Taking a swap of hands and growing bacteria on agar plates.
  + Examination of the fossil record to identify features common to modern species.

Suggested Assessment Instruments:

* + Construct a poster of the work of Carl Linnaeus reading the classification and naming of species.
  + Collect and classify leaves from various plants around a particular area or the school and construct a classification key based on the key physical characteristics of the leaves.

Technology Integration:

* + Construct an electronic chart showing the relationship between species.
  + Design an animation to show the migration of animals within a specific habitat.

Real-life and STEAM Connections:

* + Exploring the hunt to find patient zero from viral outbreaks.

**Domain B: Materials and Properties**

Students build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials, including relating these to what they learnt about magnetism in Year 3 and about electricity in Year 4. Students explore reversible changes, including, evaporating, filtering, sieving, melting and dissolving, recognising that melting and dissolving are different processes. Students also explore changes that are difficult to reverse, for example, burning, rusting and other reactions such as vinegar with bicarbonate of soda.

Students are not required to make quantitative measurements about conductivity and insulation at this stage. It is sufficient for them to observe that some conductors produce a brighter bulb in a circuit than others, and that some materials feel hotter than others when placed against a heat source.

Safety guidelines must be taught and followed when burning materials and handling hot objects.

**Concepts:**

|  |  |
| --- | --- |
| 6MP101 | Properties of different materials can be used to identify the material.   * Compare and group everyday materials on the basis of their properties, including hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets. * Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic. |
| 6MP102 | Changes to materials can be reversible or irreversible.   * Identify that some materials dissolve in liquid to form a solution, and describe how to recover a substance from a solution. * Use knowledge of solids, liquids and gases to decide how mixtures might be separated, e.g. filtering, sieving and evaporating. * Demonstrate that dissolving, mixing and changes of state are reversible changes. * Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, e.g. changes associated with burning and the action of acid on bicarbonate of soda. |

Suggested Learning Experiences:

* + Testing a range of common objects (made of metal, wood, plastic, ceramic, paper, graphite, etc.) for their properties:
    - Hardness
    - Solubility
    - Transparency
    - Electrical conductivity (using an electrical circuit)
    - Thermal conductivity (allowing heat to move along the substance)
    - Magnetic
  + Discussing what is a fair test and how to ensure the tests above are fair.
  + Constructing a poster of the state and processes of state changes.
  + Investigating a range of simple experiments:
    - Combining vinegar and baking soda (acid-base reaction)
    - Burning a match
    - Dissolving sugar and allowing the water to evaporate (reversible reaction)
    - Filtering a mixture and solution
    - Allowing rust to form on an iron nail

Suggested Assessment Instruments:

* + Researching chemists who created new materials, such as Spencer Silver who invented the glue for sticky notes, or Ruth Benerito who invented wrinkle-free cotton.
  + Practical investigation of the properties of an unknown substance to identify it.
  + Defining terms such as: permeable, flexible, absorbent, transparent, flammable, etc.
  + Identifying the properties of materials that common objects are made out of and explain how these properties help make these objects useful.
  + Using lists of the properties of common materials to make selections for use in designing solutions to real-world problems.
  + Identifying which substances will readily dissolve in water.
  + Listing the steps in an investigation to discover the properties of a particular material.

Technology Integration:

* + Using data logging equipment to test the thermal and electrical conductivity of substances.
  + Construct and formatting an Excel data table of results from the tests of properties.

Real life and STEAM Connections:

* + Identifying the effects of changing materials on the climate and environment (e.g. coal burning, acid rain, non-biodegradable plastics).

**Domain C: Physical Processes**

Students build on their study of light in previous years, exploring the way that light behaves, including light sources, reflection and shadows. They talk about what happens and make predictions.

Students work scientifically by deciding where to place rear-view mirrors on cars; designing and making a periscope and using the idea that light appears to travel in straight lines to explain how it works. They investigate the relationship between light sources, objects and shadows by using shadow puppets. They investigate the effects of light travelling through different materials by using prisms and by looking a range of phenomena including rainbows, colours on soap bubbles, objects looking bent in water and coloured filters.

Building on their study of electricity in previous years, students construct simple series circuits, to help them answer questions about what happens when they try different components, e.g. switches, bulbs, buzzers and motors. They learn how to represent a simple circuit in a diagram using recognised symbols.

Note: Students are expected to learn only about series circuits, not parallel circuits. Necessary precautions for working safely with electricity must be taught and followed.

Students work scientifically by systematically identifying the effect of changing one component at a time in a circuit; designing and making a set of traffic lights, a burglar alarm, or some other useful circuit.

**Concepts:**

|  |  |
| --- | --- |
| 6PP101 | Light from a source can be absorbed, reflected and reflected.   * Recognise that light appears to travel in straight lines. * Use the concept that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye. * Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes. * Use the concept that light travels in straight lines to explain why shadows have the same shape as the objects that cast them. * Investigate the effects of light travelling through different materials, including transparency and opacity, and refraction. |
| 6PP102 | Electric circuits enable energy to be transferred and transformed through connections and components.   * Understand the basic components of a circuit: power source, wires, lamps, motors, buzzers. * Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit. * Compare and give reasons for variations in how components function, including: the brightness of bulbs, the loudness of buzzers and the on/off position of switches. * Use recognised symbols when representing a simple circuit in a diagram. * Compare and contrast renewable and non-renewable sources of energy. |

Suggested Learning Experiences:

* + Using a light box to explore the simple reflection of light by mirrors.
  + Construct a simple circuit using a circuit diagram and test it.
  + Predicting if lamps will be lit or not based on switches being on or off in various types of circuits.
  + Demonstrate how the brightness of a lamp will change with changes in the voltage applied to it.

Suggested Assessment Instruments:

* + Investigate and report on the effect of adding lamps in series.
  + Identify common symbols of electrical components.
  + Compare and contrast renewable and non-renewable sources of energy.

Technology Integration:

* + Electric circuits can be simulated using online tool for designing, putting together and testing simple circuits.

Real-life and STEAM Connections:

* + Application of mirrors in headlamps and lamp shades.

**Year 7:**

Students in Year 7 learn to apply the scientific method to investigating real-life phenomena. Starting with working through instructions for conducting experiments in a lab setting, students then develop the scientific language and structure of a simple lab report with an appropriate: aim, introduction, equipment list, method, results and conclusion. Students will be introduced to thinking of a hypothesis and discussion will be added to further excel students. Students learn the importance of being able to communicate effectively such that a reader might be able to repeat the steps and achieve the same results.

Continued emphasis on the appropriate use of scientific terminology and language is important at this stage. Students will start to encounter a much wider range of scientific vocabulary and slowly learn to write in a more scientific manner and start to learn to avoid the use of personal pronouns, personal opinions without factual basis and colloquial language. Students are encouraged to build their vocabulary lists and scientific writing throughout the course.

Collecting and analysis of data becomes a significant component of the course now, requiring students to organise data into data tables and present appropriate graphs that show trends between variables. The identification of dependent and independent variables, along with controlled variables in an experiment needs to be done for each experiment to slowly build student understanding of these key factors. The use of both hand-drawn graphs and computer-generated graphs (Using Excel or Number) to display results must be included throughout units and should be linked to work being completed in Mathematics.

Basic research using websites should be conducted to expand student scientific vocabulary and writing using appropriate terminology. A simple source analysis should be included to emphasise the importance of selecting credible sources for scientific research.

**Skills:**

|  |  |
| --- | --- |
| **Scientific Attitudes:** | |
| 7S01 | Understand the need for using the scientific method, identifying clearly the importance of controlled experiments to determine scientific relationships. |
| 7S02 | Demonstrate objectivity by concern for accuracy and repeatability in experimental design. |
| 7S03 | Evaluate risks by exploring lab safety. |
| **Measurement:** | |
| 7S11 | Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature appropriate to the topics covered in Year 7. |
| 7S12 | Use and derive simple equations and carry out appropriate calculations. |
| 7S13 | Perform simple conversions calculations of units. |
| **Experimental Skills and Investigations:** | |
| 7S21 | Ask questions and develop a line of enquiry based on observations of simple real-world phenomena, building on prior knowledge and experience. |
| 7S22 | Perform appropriate types of scientific enquiries to test simple hypotheses. |
| 7S23 | Identify independent, dependent and controlled variables in experimental investigations. |
| 7S24 | Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, identifying simple risks. |
| 7S25 | Collect and record observations and measurements using a range of methods for different investigations. |
| 7S26 | Apply sampling techniques and statistical approaches to summarise data, including averaging results. |
| **Analysis and Evaluation:** | |
| 7S31 | Apply mathematical concepts and calculate results. |
| 7S32 | Present observations and data using appropriate methods, including data tables and graphs. |
| 7S33 | Interpret observations and data by identifying patterns and draw conclusions. |
| 7S34 | Present reasoned explanations by explaining data in relation to hypotheses. |
| 7S35 | Evaluate data, showing awareness of possible sources of error. |
| 7S36 | Identify further questions arising from an investigation. |
| 7S37 | Evaluate the reliability of method used in an investigation. |
| **Secondary Research Skills:** | |
| 7S41 | Conduct basic research of online and printed to produce summaries of keys ideas and evidence. |
| 7S42 | Organise multiple sources of information into subtopics related to the main task related to the main line of enquiry. |
| 7S43 | Construct a simple source analysis to show the reliability of the sources used (typically around 2 – 5 sources for a research assignment). |

**Domain A: Life Processes and Living Things (Biology)**

Students will explore cells as the basic building block of all life. Cell structure and components of plant and animal cells are identified and the function of each component (organelle) is explained. The combination of cells to form multicellular organisms is developed through from tissues, organs, organ systems and organisms.

Over the next few years, students will then explore different organ systems. In Year 7, the skeletal and muscular systems are examined with particular attention to learning the components of the system and understanding their function as support and facilitating movement and producing blood cells.

At the highest level, ecosystems are investigated for organisms living and functioning together within their habitat. Food chains, and simple food webs, are researched for particular habitats and students challenged to predict the effects of dramatic population changes of a particular species within a habitat of the rest of the ecosystem. Similarly, the environment effects such as: climate change, pollution and deforestation, are examined with reference to actual case studies.

**Concepts:**

|  |  |
| --- | --- |
| 7LP101 | Cells are the basic units of living things and contain specialised structures and functions.   * Identify cells as the fundamental unit of living organisms. * Identify the functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplast. * Recognise the similarities and differences between plant and animal cells. * Know the role of diffusion in the movement of materials in and between cells. * Identify the structural adaptations of some unicellular organisms. * Knowing the parts of the microscope and their function to observing cells. |
| 7LP102 | Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive, grow and reproduce.   * Recognise the hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms. * Explore the contribution of organs and organ systems to organism survival, growth and reproduction. |
| 7LP201 | Vertebrates use skeletal and muscular systems to provide support and facilitate movement.   * Identify the structure and functions of the human skeleton, to include support, protection, movement and making blood cells. * Know the function of muscles and examples of antagonistic muscles. * Demonstrate understanding of biomechanics as the interaction between skeleton and muscles, including the measurement of force exerted by different muscles. |
| 7LP301 | Interactions between organisms, including the effects of human activities, can be represented by food chains and food webs.   * Constructing and interpreting food webs to show relationships between organisms in an environment. * Recognising the role of microorganisms play within food webs. * Demonstrate understanding of the interdependence of organisms in an ecosystem, including food webs and insect pollinated crops. * Know the importance of plant reproduction through insect pollination in human food security. * Identify how organisms affect, and are affected by, their environment, including the accumulation of toxic materials (eg. deforestation, agriculture and the introduction of new species). |

Suggested Learning Experiences:

* + Test for carbon dioxide, water and heat in exhaled breath with limewater, cobalt chloride and thermometer.
  + Observation of prepared microscope slides of animal and plant cells.
  + Preparation and observation of a microscope slide of a human cheek cell or onion cell.
  + Demonstration of movement of a human skeleton model and the need for complementary muscles such as biceps and triceps.
  + Dissection of a chicken wing to identify the bones, tendons and muscles that make it up.
  + Demonstrate how to observe, interpret and record cell structure using a light microscope.
  + Construct a model plant and animal cell, labelling the major organelles and explaining their function.
  + Drawing the components of the skeletal and muscular systems and labelling the key components.
  + Construction of a food chain or food web given a list of organisms within a particular habitat.

Suggested Assessment Instruments:

* + Lab report on the dissection of chicken wing with labelled anatomical drawings.
  + Practical test on the preparation of a microscope slide and sketching of what is observed.
  + Construction of a food web based on a series of related food chains.

Technology Integration:

* + Virtual tour of the cell.
  + Using a microscope camera to observe and share slides of cells.
  + Construction of a robot hand to explore the skeletal structure, and location and function of muscles for movement of the fingers. This can be done using cardboard, drinking straws, string and beads.
  + Using data loggers to measure environmental conditions in the field or around the school. Sensors for light levels, temperature, humidity, soil pH, wind levels, rain levels can be used to collect and analyse data.
  + Augmented reality (AR) apps simulating the effect on the environment of installing a dam in a valley.

Real-life and STEAM Connections:

* + Genetic engineering of cells, such as genetically modified organisms, can be discussed and debated.
  + Data collected from the local environment can be compared with big data for that particular environment (where available) and pattern, trends and disparities identified and explored.
  + Investigation on the effects of human impact on ecosystems in a particular environment.
  + Artistic forms of nature.
  + Use of skeletal and muscular structures in construction animations for movies.
  + Role of skeletal and muscular structures in playing sports such as basketball.

**Domain B: Materials & Properties (Chemistry)**

Building on an understanding of reversible and irreversible reactions and properties of materials in Year 6, students explore these aspects in terms of particle models. Using the particle model of substances, process such as mixing, dissolving, state changes and diffusion are explained. These concepts are then used to build a model of elements and molecules as comprising atoms of the same of different types respectively.

Building on this understanding, students will then investigate physical and chemical properties, using these to identify types of substances, including: acids and alkalis.

**Concepts:**

|  |  |
| --- | --- |
| 7MP101 | Mixtures, including solutions, contain a combination or pure substances that can be separated using a range of techniques.   * Recognise the difference between pure substances and mixtures. * Identify the solute and solvent in solutions. * Investigating and using a range of physical separation techniques (such as: filtration, decantation, evaporation, crystallisation, chromatography and distillation). * Demonstrate understanding of the concept of a pure substance. * Recognise mixtures, including the dissolving of mixtures. |
| 7MP102 | Differences between elements, compounds and mixtures can be described at a particle level.   * Identify atoms and molecules as particles. * Model the arrangement of particles in elements and compounds. * Recognise that elements and simple compounds can be represented by symbols and formulas. * Locating elements on the Periodic Table. * Understand that diffusion can be explained in terms of the particle model. |
| 7MP103 | Properties of different states of matter can be explained in terms of motion and arrangement of particles (particle theory).   * Identify the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure. * Identify changes of state in terms of the particle model. * Demonstrate the conservation of material and of mass, and reversibility, in melting, freezing, evaporation, condensation, sublimation, deposition, and dissolving. * Identify similarities and differences, including density differences, between solids, liquids and gases. * Understand the process of Brownian motion in gases. * Know that diffusion in liquids and gases is driven by differences in concentration. * Identify changes with temperature in motion and spacing of particles. * Know that internal energy is stored in materials. |
| 7MP201 | Chemical changes involve substances reacting to form new substances.   * Recognise the differences between chemical and physical changes. * Identify differences in arrangements, in motion and in closeness of particles. * Explain changes of state, shape and density, the anomaly of ice-water transition. * Identify common chemical reactions, including acid-base reactions. |
| 7MP202 | Acids and alkalis are types of chemical substances that have specific chemical and physical properties.   * Define acids and alkalis in terms of their physical and chemical properties. * Use the pH scale for measuring acidity/alkalinity; and indicators. * Know that neutralisation occurs when an acid and alkali are combined. |

Suggested Learning Experiences:

* + Lab on separating a mixture (of water, sand, salt, iron filings, plastic bits) using simple techniques (filter, magnets, sedimentation/centrifuge, tweezers).
  + Chromatography of inks.
  + Exploring and comparing separation methods used in the home.
  + Law of Conservation of Mass – students design an experiment given a specific quantity of vinegar (CH3COOH) and baking soda (NaHSO4).
  + Modelling atoms, molecules and mixtures as particles.
  + Learning periods 1 and 2 of the Periodic Table (first 2 rows, 10 elements).
  + Making a red cabbage indicator and using it to test household chemicals.
  + Acid and alkali tests using pH indicator (Universal Indicator or red cabbage indicator).

Suggested Assessment Instruments:

* + Investigation of how pH of an acid or alkaline solution is affected by the addition of water.
  + Lab Report on the conservation of mass.
  + Design a poster / animation / website to show the states of matter, changes to the states of matter and use of these changes in industry.
  + Design and evaluation of a first aid kit using household chemicals for neutralising bites and stings.

Technology Integration:

* + Computer simulation of states of matter basics.
  + Virtual lab of acid-base neutralisations (PhET).
  + Computer simulation of diffusion, Brownian motion, effects of temperate on particle motion (PhET).
  + Use of Excel to construct data tables and graphs.

Real-Life and STEAM Connections:

* + Acids and alkalis in daily life: cooking, cleaning.
  + Soil chemistry and plants - testing leaves, fruits, etc.
  + Acids and alkali drinks, electrolytes, fruits.
  + Acid rain.
  + Stings and bites.
  + Stomach acid, digestion and antacids.

**Domain C: Physical Processes (Physics)**

Forces acting between objects are investigated using a range of simple situations and experiments to develop a foundational understanding what forces are and how they can be characterized. A simple understanding of the relationships (qualitative only) is established through experience and experimental investigation of phenomena. How forces affect the shape and motion of objects is also explored to build the preliminary understanding required in future years as we move towards Newton’s laws of motion and concepts involving energy, momentum and impulse.

Students build on their understanding of energy in electric circuits by exploring how electricity is generated, transferred, transformed and used. Different types of power stations are explored, including: fossil fuel, nuclear, geothermal, tidal, wind, hydroelectric, fuel cell, solar cell and thermal with particular attention to the similarities and differences between each type of power station. Common components such as the use of heat from different sources (coal, nuclear, geothermal, thermal) to produce pressurized steam to turn turbines should be identified.

**Concepts:**

|  |  |
| --- | --- |
| 7PP101 | Forces are pushes or pulls that act in pairs due to the interaction between two objects.   * Demonstrate forces as pushes or pulls, arising from the interaction between two objects. * Demonstrate that forces are needed to cause objects to stop or start moving (qualitative only). * Demonstrate that forces are needed to cause objects to change speed or direction of motion (qualitative only). * Recognise that change in motion depends on the direction of the force and the size of the object. * The effect of forces can be changed by simple machines such as first, second and third class levers. * Demonstrate understanding that simple machines give bigger force but at the expense of smaller movement (and vice versa): product of force and displacement unchanged. |
| 7PP102 | Forces affect the shape or motion of an object.   * Identify opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface. * Identify forces associated with deforming objects: stretching and squashing – springs. * Identify forces associated with rubbing and friction between surfaces. * Identify forces associated with pushing things out of the way; resistance to motion of air and water. * Identify forces measured in newtons and measurements of stretch or compression as force is changed. * Identify force-extension linear relation (Hooke’s Law as a special case). * Identify a moment as the turning effect of a force. * Demonstrate understanding of work done and that energy changes on deformation. * Recognise non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity. |
| 7PP201 | Electricity can be generated in a variety of ways that involve chemical reactions (batteries, nuclear solar cells or fuel cells) or by magnets (burning fossil fuels, wind, tidal, geothermal, thermal).   * Define the term, energy and its unit of measurement. * Understand the different types of energy and how it can be transferred or transformed. * Know the law of conservation of energy. * Describe the difference between a renewable and a non-renewable energy resource. * Describe how electricity is generated in different types of power stations. * Explain the difference between energy and power. * Describe the link between power, fuel use, and the cost of using domestic appliances. |

Suggested Learning Experiences:

* + Use force arrows in diagrams to add forces in one dimension, balanced and unbalanced forces.
  + Demonstration of Hooke’s Law using a spring, mass and retort stand.
  + Exploration of simple machines (eg. lever, spring, car) to explore forces.
  + Determining whether forces are unbalanced or balanced. For example:
    - Hanging masses
    - Floating test tube
    - Toy car on ramp
    - Two magnets
    - Magnet and paperclip
    - Masses on a pulley
  + Dropping different weights off a retort stand with a spring attaching. Measuring the fall and the height that the spring returns to.
  + Making a first, second, and third class levers.
  + Balancing different size masses on a 1st class lever.
  + Measuring the weight (force) of different mass objects to determine the relationship (F = ma).
  + Explore relationship between energy types with various generation methods: solar cells, hand generators, hydroelectric generators, number of batteries (in series), wind turbine, etc. (qualitative relationships only).
  + Explore the advantages and disadvantages of different types of power stations.

Suggested Assessment Instruments:

* + Design a parachute to drop an egg from a height to the ground without it breaking. Example materials could include: 1A4 paper, 1 plastic bag, 2 straws, 20cm of tape and 1m of string.
  + Construct a model of a power station and describe the main components.
  + Research report, infographic, poster or debate to examine the use of renewable versus non-renewable resources.
  + Examine and discuss data from research (primary or secondary) of the effectiveness of energy transformations in different types of power stations.

Technology Integration:

* + Simulation of the effect of forces on objects (PhET).
  + Using a Newton-meter to measure the force on an object when pulling or pushing it.
  + Use of data loggers to measure the light intensity, wind speed, water flow and subsequent voltage or current produced by various generators.
  + Construction of bridges using online tools that can simulate different loads and forces.
  + Conduct a virtual tour of an electricity generation station using online resources.

Real-life and STEAM Connections:

* + Application of design thinking to simple machines for assistive devices in design and technology.
  + Construction of model bridges and testing forces and mass that it can handle. Bridges can be constructed from uncooked spaghetti or paper.
  + Environmental effects of adding a particular type of power station in a specific location.

Students explore the structure and composition of the Earth to identify common types of rocks (sedimentary metamorphic and igneous) and the natural processes that produce them in the rock cycle. These rocks have specific characteristics and properties that make them useful to humans in construction, jewelry, agriculture and extraction of ores for producing metals and other chemicals.

Common rocks and their properties (including: colour, hardness, lustre, grain size, cleavage) can be use to identify and classify rocks. Some properties are a result of the natural processes that were involved in producing the particular rock or rock type.

The atmosphere of the Earth is a key factor that makes our planet inhabitable. Exploring the nature and composition of the atmosphere and its role in the carbon cycle through respiration and photosynthesis provides us with a deeper understanding of the how the Earth sustains life. The effects of human activity on the atmosphere and climate change are explored.

**Concepts:**

|  |  |
| --- | --- |
| 7ES101 | The main types of rocks on Earth are produced by natural processes as part of a rock cycle.   * Know the structure of the Earth. * Know the composition of the Earth. * Demonstrate understanding of the rock cycle and the formation of igneous, sedimentary and metamorphic rocks and their key properties. |
| 7ES102 | Rocks can be classified based on their characteristics and physical and chemical properties.   * Classifying rocks based on their characteristics. * Exploring the physical and chemical properties of common rocks. * Describe the Earth as a source of limited resources and the efficacy of recycling. |
| 7ES201 | The atmosphere of the Earth involves a cycle of carbon and has an impact of climate.   * Know the composition of the atmosphere. * Demonstrate understanding of the carbon cycle. * Describe the production of carbon dioxide by human activity and the impact on climate. |

Suggested Learning Experiences:

* + Building a model of the layers of the Earth.
  + Various chemical tests of various rocks (eg. acid on limestone).
  + Constructing a model of the rock or carbon cycle.
  + Performing chemical tests on rocks (reaction with acids) to identify their composition.
  + Explore the processes of respiration and photosynthesis to understand the flow of carbon around the carbon cycle.
  + Use of seismic waves to understand the composition of the interior of the Earth.

Suggested Assessment Instruments:

* + Research assignment on rock cycle and applications of different types of rocks in construction (eg. granite, basalt, slate).
  + Using various testing methods to classify rocks based on their properties (eg. hardness, colour, cleavage, lustre, etc.)
  + Construction of a classification key for rocks.

Technology Integration:

* + Computer simulation of plate tectonics (PhET) to understand the formation of volcanoes and hence igneous rocks on the surface of the planet.
  + Measurement of seismic waves using vibration sensors.

Real-life and STEAM Connections:

* + Use of the properties of different types of rocks in the construction industry.
  + The extraction of colour from specific rock to make specific paint pigments.
  + The extraction of ores to produce metals and other chemicals.

**Year 8:**

Students in Year 8 learn to apply the scientific method to design investigations of real-life phenomena. Starting with preset experiments, a hypothesis and discussion become a more significant component of the investigation and lab report with a structure: aim, introduction, hypothesis, equipment list, method, results, discussion and conclusion. Students strengthen their use of formal scientific language and terminology and will continue to encounter a wide range of scientific vocabulary. Further emphasis on writing using a scientific genre and avoiding unsubstantiated opinions and colloquial language is worked on to develop scientific thinking and communication. Students are encouraged to continue to build their vocabulary lists and scientific writing throughout the course.

Collecting reliable data through repeated trials and deeper analysis of results becomes more significant at this stage. Students should continue to design appropriate data tables and graphs to organise and present data and explore trends between the independent and dependent variables. Discussion of the results is introduced by describing the basic trends between data and writing statements as to whether the data supports the hypothesis or does not the hypothesis. It is important that students learn experiments of this nature do not “prove” relationships. The use of both hand-drawn graphs and computer-generated graphs (Using Excel or Number) to display results must be included throughout units and should be linked to work being completed in Mathematics. Students will validate their findings with research, identifying any anomalies.

Research skills become a more significant aspect of the course in Year 8. Students should be exposed to scientific articles from popular science and other age-appropriate sources to build their reading and comprehension skills, along with expanding their scientific vocabulary. Further work on a source analysis should be done to emphasise the need for assessing sources of information for reliability and credibility.

**Skills:**

|  |  |
| --- | --- |
| **Scientific Attitudes:** | |
| 8S01 | Understand the need for using the scientific method, using independent, dependent and controlled variables to “tell the story” of the investigation. |
| 8S02 | Demonstrate objectivity by concern for accuracy, precision and repeatability in experimental design. |
| 8S03 | Evaluate risks by exploring lab and chemical safety. |
| **Measurement:** | |
| 8S11 | Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature appropriate to the topics covered in Year 8. |
| 8S12 | Use and derive equations and carry out appropriate calculations for theoretical and experimental tasks. |
| 8S13 | Perform conversions calculations of units in measurement and use equations. |
| **Experimental Skills and Investigations:** | |
| 8S21 | Design effective questions and develop a line of enquiry based on observations of real-world phenomena, building on prior knowledge and experience. |
| 8S22 | Select, plan and carry out appropriate types of scientific enquiries to test hypotheses. |
| 8S23 | Identify relationships between independent and dependent variables through experimental methods whilst controlling variables. |
| 8S24 | Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, identifying risks and ways to minimise risk. |
| 8S25 | Design effective questions and develop a line of enquiry based on observations of real-world phenomena, building on prior knowledge and experience. |
| 8S26 | Select, plan and carry out appropriate types of scientific enquiries to test hypotheses. |
| **Analysis and Evaluation:** | |
| 8S31 | Apply mathematical concepts and calculate results to compare experimental and theoretical results and tasks. |
| 8S32 | Present observations and data using appropriate methods, including data tables, graphs and trendlines. |
| 8S33 | Interpret observations and data by identifying patterns and draw conclusions with justification. |
| 8S34 | Present reasoned explanations by considering results and theory in relation to hypotheses. |
| 8S35 | Evaluate data, showing awareness of possible sources of systematic error in experimental procedures. |
| 8S36 | Generate further questions arising from an investigation and suggest improvements. |
| 8S37 | Evaluate the reliability, accuracy and precision of methods used in an investigation and suggest improvements. |
| **Secondary Research Skills:** | |
| 8S41 | Conduct research of multiple online and printed materials to produce organised summaries of key ideas and evidence. |
| 8S42 | Organise and evaluate multiple sources of information into concise subtopics related to the main line of enquiry. |
| 8S43 | Construct a detailed source analysis to show the reliability of a variety of sources used (typically around 3 to 6 sources in a research assignment). |

**Domain A: Life Processes and Living Things / Biology**

Building on the understanding of cells, students now explore the dietary and nutrient needs of animals and humans. Key components of a healthy and balanced diet include: carbohydrates, lipids, proteins, vitamins and minerals, dietary fibre and water are all essential components and should be consumed following recommended daily consumption levels. The purpose and function of each nutrient, fibre and water in the human body is explored and consequences of imbalances explored. An exploration is done of the digestive system and the process of breaking down food into the basic element required by the body.

Similarly, an investigation into how plants produce food for growth through photosynthesis is done and the role that is plays in the carbon cycle. Students will recognize that carbon from carbon dioxide in the air is used to produce of the bulk of more plant cells, in combination with nutrients from the soil and water. A word equation of photosynthesis and respiration should be developed, clearer identifying the movement of carbon through the cycle.

Whilst much of the nutrients and energy from food is used to produce new cells, repair cells and provide energy to the organism, another key use is reproduction. The lifecycles of animals and plants is explored with a particular focus on the methods of reproduction.

**Concepts:**

|  |  |
| --- | --- |
| 8LP101 | Animals have processes to obtain nutrients and produce energy from food to function and grow.   * Explain the content of a healthy human diet. * Demonstrate understanding of why carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water are all needed in a healthy diet. * Demonstrate understanding of the consequences of imbalances in the diet, including obesity, starvation and deficiency diseases. * Identify the tissues and organs of the human digestive system, including adaptations to function. * Demonstrate how the digestive system digests food (enzymes simply as biological catalysts). * Recognise the importance of bacteria in the human digestive system. |
| 8LP102 | Plants have processes to obtain nutrients and produce energy to function and grow.   * Know that plants gain mineral nutrients and water from the soil via their roots. * Know that plants make carbohydrates in their leaves through photosynthesis. * Demonstrate understanding of the reactants in, and products of, photosynthesis, and a word summary for photosynthesis. * Recognise that almost all life on Earth is dependent on the ability of photosynthetic organisms, such as plants and algae. * Demonstrate how photosynthetic organisms use sunlight in photosynthesis to build organic build organic molecules that are an essential energy store for maintaining levels of oxygen and carbon dioxide in the atmosphere. Respiration occurs in plant when in darkness. * Recognise the adaptations of leaves for photosynthesis. |
| 8LP201 | Production processes enable plants and animals to develop offspring.   * Demonstrate understanding of reproduction in humans (mammals). * Recognise the structure and function of the male and female reproductive systems. * Demonstrate understanding of the menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth. * Recognise the effect of maternal lifestyle on the foetus through the placenta. * Demonstrate understanding of reproduction in plants. * Identify the structure of a flower. * Identify wind and insect pollination, fertilisation, seed and fruit formation and dispersal. |

Suggested Learning Experiences:

* + Construct a labelled model of the human digestive systems and explore how animals can have different digestive systems.
  + Testing foods for the presence of specific molecules (eg. using iodine solution to test for the presence of starch, Benedict’s solution + heat for testing for glucose, baking paper to test for oils, conductivity to test for salts, biuret test for the presence of peptides (proteins), etc.)
  + Conduct calculations of energy requirements in a healthy daily diet.
  + Conduct quantitative investigation of some dispersal mechanisms.
  + Demonstration of photosynthesis using water plants and a lamp.
  + Testing the germination of seeds over an extended period of time.
  + Dissection of a flower to identify reproductive organs.
  + Compare energy values of different foods (from labels) (kJ).

Suggested Assessment Instruments:

* + Designing a brochure of the benefit of healthy eating and how the nutrients in a balanced diet help to aid the human body.
  + Lab report on the effects of amylase on the break-down of starch to glucose.
  + Lab report on the burning of food to measure the amount of energy contained in chemical bonds (can be related back to the amount of carbohydrate and/or lipid in the food).
  + Lab report on the rate of photosynthesis based on the light levels for water plants.
  + Students can design different experiments to test the effect on plants of different mineral deficiencies over a longer period of time.
  + Experimental investigation on the optimum conditions for growing a particular species of plant (soil nutrients, soil pH, water levels, light colour, etc.)
  + Researching a particular reproductive strategy used by a species of animal or plant.

Technology Integration:

* + Using data loggers to measure the nutrients in soil and/or testing water.
  + Measuring the levels of dissolved oxygen in the water with water plants present.
  + Virtual tour through the digestive system online of using virtual reality (VR).

Real-life and STEAM Connections:

* + Connection between food nutrients and organic chemistry.
  + The role that nutrient supply and reproduction play in populations changes and hence economic systems.

**Domain B: Materials & Properties / Chemistry**

Students continue to deepen their understanding of the models of matter by exploring the Dalton model of the atom and subatomic particles (protons, neutrons and electrons). Using this model, the Periodic Table is explored and the connection between physical and chemical properties investigated to understand the purpose and potential of the Periodic Table.

Chemical reactions are then explored with respects to the rearrangement of atoms and ions that make up the reactants and products in the reaction. Typical reactions with acids, single and double displacement, exothermic and endothermic redactions and combustion are investigated. Each reaction considers the breaking on bonds in the molecules that make up the reactants to form new bonds that make up the molecules in the products.

**Concepts:**

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| --- | --- |
| 8MP101 | All matter is made of atoms that are composed of protons, neutrons and electrons.   * Identify the simple (Dalton) atomic model. * Describe and model the structure of the atom in terms of nucleus, protons, neutrons and electrons. * Compare the mass and charge of protons, neutrons and electrons. * Recognise that the number of protons defines the type of element. |
| 8MP102 | Atoms can gain or lose electrons and become charged ions to form ionic bonds.   * Explore common atoms and their ionic forms through the gaining and loss of electrons. * Learn simple monatomic ions based on their position in the Periodic Table: H+, Li+, Na+, K+, Mg2+, Ca2+, F-, Cl-, O2-, N3-. * Oppositely charged ions can form ionic bonds. |
| 8MP103 | Elements have a range of physical and chemical properties predicted by the Periodic Table.   * Identify chemical symbols and formulae for elements and compounds. * Identify the varying physical and chemical properties of different elements. * Demonstrate understanding of the principles underpinning the Mendeleev Periodic Table. * Recognise the Periodic Table: periods and groups; metals and non-metals. * Demonstrate how patterns in reactions can be predicted with reference to the Periodic Table. * Demonstrate understanding of the properties of metals and non-metals. |
| 8MP201 | Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction mass is neither created nor destroyed.   * Identify the reactants and products in chemical reactions. * Model chemical reactions in terms of rearrangement of atoms. * Describe observed reactions using word equations. * Consider the role of energy in chemical reactions. * Recognise that the conservation of mass in a chemical reaction can be demonstrated by simple chemical equations. * Recognise safety aspects of chemical reactions. |
| 8MP202 | Chemical reactions, including combustion and the reactions of acids, involve energy transfer, the rate of which can be influenced by various factors.   * Investigate reactions of acids with metals, bases and carbonates. * Investigate a range of different reactions to classify them as exothermic or endothermic. * Recognise the role of oxygen in combustion reactions and comparing combustion with other oxidation reactions. * Compare respiration and photosynthesis and their role in biological processes. * Describe how the products of combustion reactions affect the environment. * Identify the chemical properties of metal and non-metal oxides with respect to acidity. * Explain the effect of concentration, particle size and temperature on the rate of reaction. * Understand the role that catalysts (and enzymes) play in speeding up chemical reactions. |

Suggested Learning Experiences:

* + Burning of magnesium metal in a crucible to demonstrate conservation of mass.
  + Determine the rate of a chemical reaction by changing the temperature (eg. collecting the gas from a reaction of calcium carbonate CaCO3 with 0.1M HCl over time).
  + Burning carbonates and measuring how long it takes for limewater to turn cloudy, indicating the presence of CO2.
  + Colour a handout of the Period Table to identify specific groups (Alkali Metals, Alkine Earth Metals, Transition Metals, Halogens and Nobel Gases), trends (metals, metalloids, non-metals), states (solid, liquid and gas at room temperature).
  + “Market Your Elements” from the Period Table (eg. something unique about your element, uses of your element).
  + Demonstration of exothermic and endothermic reactions.
  + Investigating the properties of metals and non-metals (eg. conductivity, solubility, physical appearance, malleability, reaction with an acid).
  + Demonstration of metal oxide and non-metal oxide with water to produce acids or bases (eg. Na2O + H2O 🡪 NaOH + H2 pH = 10-11, P4O10 + 6H2O 🡪 4H3PO4 pH = 2).
  + Balancing of simple chemical equations.
  + Lab on the effect of a catalyst on a reaction (eg. KMnO4 on H2O2).

Suggested Assessment Instruments:

* + Research report on a particular group of elements on the Period Table and their chemical and physical properties.
  + Practical exam or lab reports on chemical reaction between metals and acids, and metal carbonates and acids (eg. Mg + HCl or MgCO3 + HCl).
  + Test on identifying reactants and products in experimental demonstrations or practical experiment stations around the lab.
  + Students will manipulate the variables in an assigned experiment (varying one of concentration, particle size and temperature) and measure the rate of the reaction.
  + Balancing of simple chemical equations based on the types of experiments in this topic.

Technology Integration:

* + Virtual labs involving the simulation of chemical reactions (eg. app called Beaker).
  + Balancing simple chemical equations using online systems.

Real life and STEAM Connections:

* + Suitability of materials, based on their chemical and physical properties, for their use in human activities.
  + Identification of unknown substances in forensic science and crime investigation using chemical tests.
  + Use of fuels in industry and assessment of their energy content versus environmental impact.

**Domain C: Physical Processes / Physics**

Students start to explore the laws of motion with the relationship between distance, time and average speed that is accelerating or the instantaneous speed of an object that is no accelerating. Using graphs and equations, students will learn to calculate the average speed and derive its units of measurement. They will relate the motion of objects in the real world with their corresponding graphs.

Speed is then explored for energy travelling as a wave. Both longitudinal waves such as sound and transverse waves such as light are examined with respects to their characteristics and behavior as they enter different media and through convex and concave lenses and mirrors. The basic processes of: transmission and absorption, reflection and refraction are explained and observed. Students are encouraged to investigate how waves change both visually, graphically and using parameters such as frequency, period and amplitude.

**Concepts:**

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| --- | --- |
| 8PP101 | The motion of objects can be explained and predicted by laws relating speed to distance and time.   * Calculate speed and identify the quantitative relationship between average speed, distance and time (speed = distance ÷ time). * Illustrate the representation of a journey on a distance-time graph. * Calculating average speed from the slope of distance-time graph. * Identify relative motion: trains and cars passing one another. |
| 8PP201 | Sound energy transfer through a medium can be explained and understood as a longitudinal wave with specific characteristics and behaviours.   * Demonstrate understanding of sound as produced by vibrations of objects. * Demonstrate understanding that sound waves are longitudinal. * Demonstrate understanding that waves can be reflected and add or cancel (superposition). * Identify frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound. * Demonstrate understanding that sound needs a medium to travel. * Understand how the speed of sound changes in air, water, and solids. * Recognise that sound in a speaker is detected by its effect on the microphone diaphragm and the eardrum. * Recognise that microphone transform sounds waves into to electrical signals and speakers transform electrical signals into sound waves. |
| 8PP202 | Light energy transfer can be explained and understood as a transverse wave with specific characteristics and behaviours.   * Identify waves on water as undulations that travel through water with transverse motion. * Identify the similarities and differences between light waves and waves in nature. * Recognise that light waves travel through a vacuum. * Know the speed of light. * Demonstrate understanding of the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface. |

Suggested Learning Experiences:

* + Creating distance-time graphs based on movement of an object.
  + Demonstration of longitudinal and transverse waves using a slinky or large spring. Amplitude and frequency can be demonstrated also.
  + Using a light box to explore reflection, refraction, transmission and absorption.
  + Calculating the magnification of a lens using a light box and 5-slit filter and simple bi-convex lens.
  + Exploration of a model eardrum and explanation of how it works.
  + Dissection of the eye to explore the various components that process light for the brain.
  + Construct a simple speaker using magnets, solenoids, cardboard and balloon diaphragm.

Suggested Assessment Instruments:

* + Report on the measurement of sound intensity given different thicknesses or types of sound insulation materials.
  + Sketching of light rays and description of images for basic convex and concave mirrors and lenses.
  + Constructing a distance-time graph of the motion of any object in different scenarios and calculating the average speed using different sections of the graph.

Technology Integration:

* + Using a motion sensor to explore types of graph based on different types of motion.
  + Simulations of light and sound (PhET).
  + Using data loggers to measure sound and light levels.
  + Use of Excel to construct data tables, graphs and linear trendlines.

Real life and STEAM Connections:

* + Use of sound in medicine as ultrasound imaging.
  + Use of pressure of sound waves for ultrasonic cleaning.

**Domain D: Earth and Space Science**

Students explore the concept of weight as gravitational force and calculate it based on a object’s mass and acceleration due to gravity. The change in weight on different planets, where the acceleration due to gravity is different to Earth, is similarly investigated. The effects of the Sun, like other stars, on Earth is investigated to give reasoning to the days and seasons on Earth and some other planets within the solar system.

**Concepts:**

|  |  |
| --- | --- |
| 8ES101 | Weight in Science is considered a measure of gravitational force and is dependent on the mass of the planet and other objects.   * Identify gravitational force as weight which is equal to mass x gravitational field strength (g); on Earth g can be estimated as 10 N/kg. * Recognise that gravitation forces are different on other planets and stars; gravitational forces between Earth and Moon, and between Earth and Sun (qualitative only). |
| 8ES201 | The Sun, like other stars, has an effect on planets depending on their distance and rotation speed.   * Identify our Sun as a star, other stars in our galaxy, and other galaxies. * Identify the seasons and the Earth’s tilt, day length at different times of year, and in different hemispheres. |

Suggested Learning Experiences:

* + Construct a model of the solar system, either physically or virtually, taking into account the distances between the Sun and planets using scientific notation.
  + Identifying the distance between our Sun and the nearest star deriving light-years as a unit of astronomical distance.
  + Construct a model of the movement of the Sun over the Earth at different times of the year.
  + Explaining the movement of tides based on the position of the Moon.
  + Exploring phases of the Moon using simple round objects and a torch.

Suggested Assessment Instruments:

* + Calculating the weight of an object on different planets.
  + Calculating the acceleration due to gravity by measuring mass and calculating weight.

Technology Integration:

* + Virtual tour of the solar system and universe using online resources or virtual reality (VR).
  + Simulation of the orbit and rotation of the Earth to explain the days and seasons.

STEAM Connections:

* + Space and deep space travel, exploration and communication.
  + Inspiration of the universe on science-fiction stories and movies.
  + Movie representation of gravity and the laws of motion (eg. Gravity 2013).

**Year 9:**

Students in Year 9 learn to design and apply experiments to explore real-life phenomena using the scientific method. Building on the structure of a lab report: aim, introduction, hypothesis, equipment list, method, results, discussion and conclusion, further work is done on developing links to established theory in the introduction and discussion sections of the report. Students strengthen their use of formal scientific language and terminology and should be encouraged to read a wider range of scientific vocabulary using scientific journals and research papers, and popular science articles. Students are encouraged to continue to build their vocabulary lists and scientific writing throughout the course.

Collecting reliable data through repeated trials and deeper analysis of results becomes more significant at this stage. Students should continue to design appropriate data tables and graphs to organise and present data and explore quantitative trends between the independent and dependent variables, applying linear trendlines, where appropriate. Links between the equation of the trendlines and background should now be explored. Discussion of the results by describing the significance of the trend and trend equation should now become a focus and with further analysis of sources of errors and the influence of imperfect experiment design.

Students will validate their findings with research, identifying any anomalies and further work that may need to be done to explore the relationships discovered through empirical exploration.

Research skills become a more significant aspect of the course in Year 9. Students should continue to be exposed to range of scientific articles and other information sources to build their reading and comprehension skills, along with expanding their scientific vocabulary. Further work on a source analysis should be done to emphasise the need for assessing sources of information for reliability and credibility.

**Skills:**

|  |  |
| --- | --- |
| **Scientific Attitudes:** | |
| 9S01 | Understand the need for using the scientific method, using independent, dependent and controlled variables to develop reasoned conclusions based on sound scientific approaches and theory. |
| 9S02 | Demonstrate objectivity by concern for accuracy, precision, repeatability and reproducibility in experimental design and approach to validating empirical data. |
| 9S03 | Evaluate risks by exploring lab and chemical safety through scientifically accepted risk assessment and management approaches. |
| **Measurement:** | |
| 9S11 | Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature appropriate to the topics covered in Year 9. |
| 9S12 | Use and derive equations and carry out appropriate calculations for theoretical and experimental tasks involving the combination of simple equations. |
| 9S13 | Perform conversions calculations of units in measurement and use equations with unit analysis. |
| **Experimental Skills and Investigations:** | |
| 9S21 | Design insightful questions and develop a line of enquiry based on observations of the real-world phenomena, building on theoretical research. |
| 9S22 | Design, plan, implement and evaluate appropriate types of scientific enquiries to test hypotheses. |
| 9S23 | Identify, and verify by underlying theory, the relationship between independent and dependent variables through experimental methods and understand the effects that uncontrolled variables may have on the results. |
| 9S24 | Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, identifying risks using an appropriate risk management approach. |
| 9S25 | Collect and record observations and measurements using a range of methods for different investigations using digital measurements with consideration to the precision and possible problems using digital equipment in measurement. |
| 9S26 | Apply sampling techniques and statistical approaches to summaries data, including measures of central tendency, measures of spread and identifying and explaining anomalies. |
| **Analysis and Evaluation:** | |
| 9S31 | Apply mathematical concepts and calculate results in complex and challenging questions arising from theoretical and experimental analysis. |
| 9S32 | Present observations and data using appropriate methods, including data tables, graphs and trendlines and their equations (and simple r2 values as a measure of model fit to the data). |
| 9S33 | Interpret observations and data by identifying patterns, draw conclusions and make predictions with justification. |
| 9S34 | Present reasoned explanations by considering results and theory in relation to hypotheses and predictions. |
| 9S35 | Evaluate data, explaining the effects that potential sources of systemic errors might have on the conclusion. |
| 9S36 | Generate further questions arising from an investigation, suggest improvements and potential benefits to further results. |
| 9S37 | Evaluate the strengths and limitations of primary and secondary research, assessing for reliability of methods and data, and suggesting possible improvements and further research. |
| **Secondary Research Skills:** | |
| 9S41 | Conduct research of multiple science articles, websites, books and scientific articles to produce organised summaries of key ideas and evaluate evidence. |
| 9S42 | Organise, evaluate and generate multiple sources of information into concise subtopics related to the main line of enquiry. |
| 9S43 | Construct a detailed source analysis to show the reliability and credibility of a variety of sources used (typically around 4 to 7 sources in a research assignment). |

**Domain A: Life Processes and Living Things / Biology**

Students explore the respiratory system in animals recognize its links to the circulatory system that provides a method of gas exchange with all cells within the body. The gas exchange systems within plants are also explored through identifying various components of plant anatomy and physiology. The impact of pollution and poor lifestyle choices on breathing and lung health is also investigated to understand its effect on the human body.

Aerobic and anaerobic respiration are investigated to understand the differences in efficiency and products in producing energy for the body (no need to discuss ATP at this stage of learning). The effects on the organism for each type of respiration are examined and students are encouraged to link their prior understanding of chemistry to understand the similarities and differences.

Students then go onto explore how genetic information is passed from parents to offspring. The course starts by understanding the building blocks of genetic information, the double helix, deoxyribonucleic acid (DNA) stands within the cell. The imperfect copying of the DNA or the combination of DNA from two parents can lead to variations in the genetic makeup of the offspring. These genetic variations produce change in physical appearance or function of the body, sometimes improving and declining in how well an organism can survive in its environment. Where an organism is better “adapted” to an environment by its genetic makeup, it is more likely to survive and reproduce, hence driving the process of natural selection.

Changes to the environment and genetic pool within an ecosystem drives adaptations over several generations that support populations to better survive the challenges of a particular environment. More sudden changes in the environment are less frequency and present more challenges to the ecosystems, but can be accelerated by human activity, climate change, migration and spread of viruses and bacteria. This may have an impact on the biodiversity and may even lead to extinction.

**Concepts:**

|  |  |
| --- | --- |
| 9LP101 | Most animals and plants exchange gases with the environment.   * Identify the structure and functions of the gas exchange system in humans (the respiratory system), including adaptations to function. * Demonstrate understanding of the mechanism of breathing to move air in and out of the lungs, using a pressure model to explain the movement of gases. * Identify the impact of exercise, asthma and smoking on the human gas exchange system. * Know the role of leaf stomata in gas exchange in plants. |
| 9LP102 | Aerobic and anaerobic respiration processes enable organisms to extract energy from food.   * Demonstrate understanding of aerobic and anaerobic respiration in living organisms. * Know that the breakdown of organic molecules enables all other chemical processes necessary for life. * Identify the process of anaerobic respiration in humans and microorganisms, to include fermentation. * Know the differences between aerobic and anaerobic respiration in terms of the efficiency of the process, the quantity of products formed and the implications for the organism. |
| 9LP201 | Genetic information is passed from parents to offspring, giving them specific characteristics.   * Identify a simple model of chromosomes, genes and DNA in heredity. * Identify differences between species. * Identify the variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation. * Understand that heredity is the process by which genetic information is transmitted from one generation to the next. * Identify the variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection. |
| 9LP202 | Ecosystems are affected by changes in the genetics within the population and the environment in which they live.   * Understand that changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction. * Recognise the importance of maintaining biodiversity and the use of gene banks to preserve hereditary material. |

Suggested Learning Experiences:

* + Identify the contributions of Watson, Crick, Wilkins and Franklin in the development of the DNA model.
  + Using a model lung to observe breathing using a diaphragm and negative pressure.
  + Measuring heart rate before and after exercise.
  + Conduct simple measurements of lung volume.
  + Construct a model of the respiratory system.
  + Examine a model of the interior of the lungs.
  + Produce word equations for aerobic and anaerobic respiration.
  + Fermentation of sugar using yeast.
  + Observation of stomata in plant leaves under the microscope.
  + Collecting data on eye colour, hair colour, hand span, connect earlobes, widow’s peak, PTC taste, etc. within the class or year level. Using Excel graphs to explore any patterns or trends against gender, birthplace, etc.

Suggested Assessment Instruments:

* + Research the long-term effects of smoking and/or pollution on human health.
  + Lab report on the extraction of DNA from fruit such as strawberries.
  + Research report on the contributions of Charles Darwin or other prominent researchers in the development of our understanding of inheritance.

Technology Integration:

* + Virtual tour of the respirator system or inside of the lungs.
  + Using a microscope camera to examine the DNA of a cell during mitosis.
  + Collecting big data of environmental changes (eg. pollutant levels, temperature, humidity) and exploring trends and effects on populations and health.

Real-life and STEAM Connections:

* + Exploring genetically modified organisms (GMOs) and their benefits and costs to agriculture and horticulture.
  + Determining mathematical models of populations over time as the environment changes.

**Domain B: Materials & Properties / Chemistry**

Students extend their understanding of the atom by exploring the Bohr model with electron shells. Using this model, a deeper understanding of the Periodic Table is further developed and used to predict chemical and physical properties. Interactions between the electrons in an atom can be used to understand the type of bonding that occurs between atoms.

Various types of chemical reactions are explored to understand the rearrangement of the atoms that make up the reactants and products. The molar ratios of these atoms and ions are used to understand and predict products ratios for each of the types of reactions explored.

**Concepts:**

|  |  |
| --- | --- |
| 9MP101 | The atomic structure and properties of elements are used to organise them in the Periodic Table and that atomic and chemical structure give rise to specific physical and chemical properties.   * Identify the Bohr atomic model with electron clouds and shells. * Recognise that elements in the same group of the Periodic Table have similar properties. * Describe the structure of atoms in terms of electron shells. * Explain how the electronic structure of an atom determines its position in the Periodic Table and its properties. * Investigate the chemical activity of metals. * Know the properties of ceramics, polymers and composites (qualitative). |
| 9MP102 | Chemical bonds join atoms together by the interaction of their electrons.   * Ionic bonds are formed by the electrostatic attraction between negatively and positively charged ions. That is, metals and non-metals. * Covalent bonds are formed by the sharing of electrons. That is, non-metals and non-metals. * Metallic bonds are formed by the arrangement of nuclei surrounded by delocalised electrons. |
| 9MP201 | Different types of chemical reactions can be used to produce a range of products.   * Identify chemical reactions as the rearrangement of atoms. * Predict the products of different types of simple chemical reactions, including single and double displacement reactions. * Identify reactions of acids with metals to produce a salt plus hydrogen. * Identify reactions of acids with alkalis to produce a salt plus water. * Identify the use of carbon in obtaining metals from metal oxides. * Demonstrate understanding of combustion, thermal decomposition, oxidation and displacement reactions. |
| 9MP202 | Chemical reactions can occur at different rates depending on various physical and chemical factors.   * Investigate the effect of a range of factors, such as temperature and catalysts, on the rate of chemical reactions. * Know the order of metals and carbon in the reactivity series. |
| 9MP203 | The molar ratios of atoms and ions that make up the reactants and products in a balanced chemical reaction are constant.   * Introduce the concept of a mole of a substance and know the calculation for converting between mass and moles of a particular substance. * Represent chemical reactions using formulae and chemical equations. * Balance chemical equations to predict molar ratios. * Know that the conservation of mass changes of state and chemical reactions. |

Suggested Learning Experiences:

* + Investigate how chemistry can be used to produce a range of useful substances such as: fuels, metals and pharmaceuticals.
  + Investigating the types of reactions: combustion (eg, Bunsen burner flame – propane gas burning), decomposition (eg. heating CuCO3), single displacement (eg. KI + Cl2 🡪 KCl + I2), double displacement (eg. AgNO3 + NaCl 🡪 AgCl + NaNO3), oxidation (eg. burning Mg in a test tube).
  + Burning metals in air to observe oxidation reactions (eg. Cu, Fe, Zn, Mg).
  + Demonstration of Group I metal reactions with water to produce metal hydroxides (or video demonstration using Brainiac).
  + Lab reacting metals and acids to produce metal salt and hydrogen gas (Mg + 2HCl 🡪 MgCl2 + H2).
  + Lab reacting acids and alkali to produce salt and hydrogen gas (NaOH + HCl 🡪 NaCl + H2O).
  + Using Molymod kits to build molecules and compounds and to illustrate types of bonding and structures.
  + Extracting a metal from its metal oxide using carbon (eg. 2Fe2O3 + C 🡪 4Fe + 3CO2).

Suggested Assessment Instruments:

* + Experimental investigation on determining the reactivity series of a range of metals (Eg. Cu, Fe, Zn, Mg, Ag, Sn, Pb reacting with a set of their nitrates and distilled water).
  + Practical test of a range of different experiment types to identify the type of reactions and how they can test to identify the products.
  + Identifying unknown substances using a range of chemical tests.

Technology Integration:

* + Using data logging equipment to measure changes in the temperature, pH and/or other physical properties during chemical reactions to explore their effect on the rate of reaction.
  + Simulation of chemical bonding and formation of products from reactions.

Real-life and STEAM Connections:

* + Use chemical methods for the restoration and conservation of maritime artefacts. Use of sacrificial anodes for protecting boats and other marine structures.
  + Production and use of polymers including a range of different plastics for use in everyday life.

**Domain C: Physical Processes / Physics**

Students build on prior understanding of electricity to understand it as the flow of charge. Charge can be built up on a surface to create a static electric field or can flow around a conductive loop as an electric current. The build-up of static electric charge gives rise to electrostatic forces of attraction and repulsion depending on the polar nature of the charges.

Electric circuits involve the flow of current in closed loops. Key terms, including current, voltage and resistance should be defined within a circuit application. Ohm’s law, V = IR, can be used to calculate the voltage, current or resistance in a circuit when the other variables are known or measured. Students learn how to connect ammeters in series to measure current through devices and voltmeters in parallel to measure voltage over devices. Students then experiment with series and parallel circuits to understand how current flows through the circuit and its effect on the voltage over various section of the circuit. Domestic energy use, calculated as power consumption, can be determined for houses with multiple appliances.

The basics of electromagnets are investigated using coils of wire with a current passing through. The effects of more coils and higher voltages on the magnetic field strength can be explored. Students will explore how a DC motor and generator work.

**Concepts:**

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| --- | --- |
| 9PP101 | Electricity, the flow of charge, can be controlled and used by electric circuits involving series and parallel components.   * Identify the separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects. * Know the idea of electric field, forces acting across the space between objects not in contact. * Demonstrate understanding of electric current, measured in amperes, in series and parallel circuits. * Understand that currents add where branches meet and current as flow of charge. * Identify potential difference, measured in volts, battery and bulb ratings. * Identify resistance, measured in ohms, as the ratio of potential difference (pd) to current, and perform calculations using Ohm’s law (V = IR). * Identify differences in resistance between conducting and insulating components (quantitative). |
| 9PP102 | Energy usage can be determined and calculated in electrical appliances.   * Compare power ratings of appliances in watts (W, kW). * Compare amounts of energy transferred (J, kJ, kW, kWh). * Demonstrate understanding of domestic fuel bills, fuel use and costs. |
| 9PP201 | Magnetic fields are formed by the flow of electric current through coils.   * Demonstrate understanding of the forces of repulsion and attraction for like and unlike magnetic poles respectively. * Illustrate magnetic fields by plotting with compass, representation by field lines. * Under the basic principles of an electromagnet. * Know the principles of the magnetic effect of a current, electromagnets, and DC motors. * Understanding that rotating magnetic fields can generate an electric current. |

Suggested Learning Experiences:

* + Exploration of the energy transformations in various devices, such as: kettle, electric motor, radio, torch, candle, toy car rolling down a ramp, lamp, speaker, etc.
  + Using iron fillings and small compasses to observe magnetic fields around magnetics of different shapes.
  + Generating static electricity using a Van der Graff generator and/or rubbing different material rods with different fabrics and testing using an electroscope.
  + Constructing series and parallel circuits and measuring the voltage and current around the circuit using a multimeter (or voltmeter and ammeter).
  + Calculating the resistance of a component based in the voltage across it and the current flowing through it (applying Ohm’s law).

Suggested Assessment Instruments:

* + Adding wires, switches, lamps and motors to a model house, car, plane or train to demonstrate domestic supply, series and parallel wiring. Multimeters can measure current draw from the battery and be used to calculated power consumption.
  + Determine the resistance of a device based on measurements of voltage and current for different voltage outputs of the power supply. Students would construct a data table and graph and use the gradient of the graph to determine the resistance.
  + Constructing an electromagnet and investigating the effect that the number of coils and voltage has on the strength of the magnetic field.

Technology Integration:

* + Designing, building and testing circuits using online simulations.
  + Use of data loggers to measure voltage, current and magnetic field strength.
  + Use of Excel to construct data tables, graphs and linear trendlines.

Real-life and STEAM Connections:

* + Exploring the wiring and use of domestic electricity supply around the house and power usage of various domestic appliances.
  + Use of electric circuits in robotics and control systems.
  + Use of magnets in propulsion like maglev trains.

**Domain D: Earth and Space Science**

Students explore how the changes in height or depth of the atmosphere, ocean and interior of the Earth increase in pressure and affect temperature. The Earth’s surface is largely affected by the processes such as convection currents within the mantle and radiation of energy between the surface of the earth and the layers of the atmosphere. Many of these processes can lead, or contribute, to natural disasters such as volcanoes, tsunamis and climate change.

**Concepts:**

|  |  |  |
| --- | --- | --- |
| 9ES101 | Energy can be transferred through processes such as conduction, convection and radiation that help us to understand the dynamics of the Earth’s interior, oceans and the atmosphere.   * Know that total energy in a closed system has the same value before and after a change. * Demonstrate understanding of heating and thermal equilibrium: temperature difference between two objects leading to energy transfer from the hotter to the cooler one, through contact (conduction), flow (convection) or radiation. * Recognise that transfers of energy tend to reduce the temperature difference to achieve equilibrium. The use of insulators can restrict equalisation of temperature. * Applying the flow of energy to understand the dynamics of the interior of the Earth or the atmosphere. |  |
| 9ES201 | The core, mantle and atmosphere of the Earth act fluids and follow the laws of fluid dynamics.   * Define fluids as including gases and liquids and recognise that semi-solids can exhibit fluid behaviour. * The thickness of a fluid is characterised by its viscosity. * Recognises that atmospheric pressure decreases with increase of height, as weight of air above decreases with height and that subterranean pressure increases with depth into the Earth. * Recognises pressure in fluids, increasing with depth; up-thrust effects, floating and sinking. * Recognises that pressure is measured by ratio of force over area – acting normal to any surface. |  |

Suggested Learning Experiences:

* + Demonstration of conduction, convection and radiation using various demonstrations (conduction rings, heating a beaker with dye dropped in, evaporation at the surface of hot water, etc.)
  + Explore energy transfer through radiation within the atmosphere of the Earth.
  + Applying an understanding of convection to understanding the dynamics of the mantle movements of semi-solid rock.
  + Explaining how the fluid motion of mantle leads to movement of the Earth’s tectonic plates causing earthquakes, volcanoes, formation of mountain ranges and rift valleys.
  + Exploring energy, pressure and fluid dynamics within folds, faults and other rock formations.

Suggested Assessment Instruments:

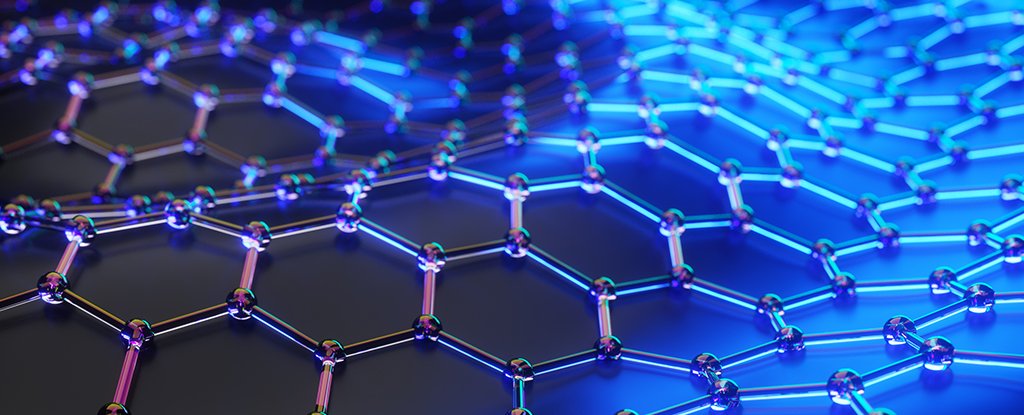
* + Construct a model showing how the energy is stored and released in Earth dynamics.
  + Research case studies of particular geothermal events or natural disasters and identify the factors that led to them in terms of the energy storage and dissipation, transfer and transformations and pressure.

Technology Integration:

* + Using Excel to graph depth and pressure tables for the Earth, ocean and atmosphere.
  + Modelling Earth interior dynamics using simulations to predict natural disasters.
  + Creating an animation of the dynamics of the Earth that lead to different types of surface formations.

Real-life and STEAM Connections:

* + Exploring geothermal springs and how pressure and depth lead to the heating of water.
  + Applying fluid dynamics to understanding how planes work.
  + Modelling wind and ocean currents.



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