



### 1. THE SCIENTIFIC ENDEAVOUR

<b>Description</b>	This introduction builds on students' learning of Primary Science as a way of exploring and understanding the physical and natural world. It aims to deepen students' understanding of what Science is and how it is practised and applied, i.e. the nature of Science.	<b>Key Inquiry Questions in the Scientific Endeavour include:</b> <ul style="list-style-type: none"><li>▪ Why did this event, phenomenon or problem happen?</li><li>▪ What is Science?</li><li>▪ How does Science affect our lives?</li></ul>	
<b>Essential takeaways</b>	<b>SE 1:</b> Science is a study of the physical and natural world.	<b>SE 2:</b> Scientific knowledge is derived partly from systematic observation, experimentation and analysis and partly from human imagination and creativity. Scientific knowledge is subject to change.	<b>SE 3:</b> Scientific knowledge can be applied to bring benefits and harm.
<b>Learning Outcomes</b>	<ul style="list-style-type: none"><li>• Show an awareness that Science is not confined to the laboratory, but is manifested in all aspects of our lives</li><li>• Show a healthy curiosity about the natural and physical world.</li></ul>	<ul style="list-style-type: none"><li>• Show an appreciation of Science being a human endeavour, with scientific knowledge contributed by different civilizations over the centuries</li><li>• Understand how scientific knowledge is built from systematic collection and analyses of evidence and rigorous reasoning based on the evidence</li><li>• Show an awareness that scientific evidence is subject to multiple interpretations</li><li>• Recognise that scientific evidence can be quantitative or qualitative, and can be gathered through one's senses or instruments as extensions of one's senses</li><li>• Use scientific inquiry skills such as <u>posing questions, planning and carrying out investigations, evaluating</u> experimental results and <u>communicating</u> findings (<i>Estimation and measurement skills, knowledge of S.I units, and using appropriate units for the respective physical quantities, should be infused into the respective topics</i>)</li><li>• Show attitudes such as creativity, objectivity, integrity, open-mindedness and perseverance in carrying out scientific inquiry</li></ul>	<ul style="list-style-type: none"><li>• Discuss the uses and benefits of science and technology to society.</li><li>• Relate applications of science to some social and ethical issues</li><li>• State some current limitations of science and technology in solving societal problems</li><li>• Recognise the need to be responsible towards society and the environment in using technology and scientific knowledge.</li><li>• Demonstrate safety consciousness and adopt safe practices when carrying out investigations.</li></ul>

\*optional for Normal (Academic) syllabus





<p><b>Theme: Diversity</b>          There is a great variety of living and non-living things in the world. Such diversity in the natural and man-made world helps to maintain a balance in the ecosystem and provide Man with useful resources. This complexity may be organised through common characteristics and unifying factors to better understand the world we live in. The study of living and non-living things in terms of their properties and changes is greatly facilitated by putting them into groups.</p> <p><b>Essential Takeaways:</b>          - The diversity of the rich resources in the natural world is important for the continual survival of living things.          - Humans have to use the rich resources in nature responsibly and sustainably.          - Man continually seeks to understand the complexity in the natural world by studying it in a systematic manner.</p>	<p><b>Key Inquiry Questions in Diversity include:</b></p> <ul style="list-style-type: none"> <li>• How does the diversity of living and non-living things contribute to our lives?</li> <li>• How do we classify things in our world?</li> <li>• How do we find out the properties and characteristics of the things around us?</li> </ul>
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<b>Learning Outcomes</b>		
<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
<p><b>2. Exploring Diversity of Matter by their Physical Properties</b></p> <ul style="list-style-type: none"> <li>• explain the choice of the main classes of materials (metals, ceramics, glass, plastics, fibres) in the production of common household items, in terms of their properties, e.g.               <ul style="list-style-type: none"> <li>- density</li> <li>- strength</li> <li>- hardness</li> <li>- flexibility</li> <li>- electrical conductivity</li> <li>- thermal conductivity</li> <li>- boiling/melting point</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <u>make estimations</u> and <u>measure</u> accurately length, volume and mass (including volume and mass of liquids and solids but not of gases) of matter using appropriate instruments (metre rule, measuring tape, vernier calipers, measuring cylinder, displacement can, electronic balance) and methods</li> <li>• calculate density using the formula (density = mass/volume) and use the appropriate unit</li> <li>• <u>predict</u> whether an object will sink or float by comparing its density with that of its surrounding medium</li> <li>• <u>classify</u> a number of common everyday objects and recognise that there are many ways of classifying the same group of objects</li> <li>• use data on the properties of different materials to <u>evaluate</u> their uses</li> <li>• <u>communicate</u> their findings on classification and justify their reasons</li> </ul>	<ul style="list-style-type: none"> <li>• display the habit of sustainable use of materials, e.g. preferential choice of products made from biodegradable materials, practising the 3Rs: reduce, reuse, recycle</li> <li>• evaluate the environmental impact of excessive use of paper and disposal of plastics</li> <li>• demonstrate precision and accuracy in making measurements (taking into consideration parallax and zero errors)</li> </ul>

\*optional for Normal (Academic) syllabus



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**Learning Outcomes**

Knowledge, Understanding and Application	Skills and Processes	Ethics and Attitudes
<p><b>3. Exploring Diversity of Matter by its Chemical Composition</b></p> <ul style="list-style-type: none"> <li>recognise that substances can be classified as elements, compounds and mixtures</li> <li>distinguish among elements, compounds and mixtures</li> <li>state that elements are the basic building blocks of living and non-living matter</li> <li>recognise that elements are classified according to their properties</li> <li>show an understanding that compounds are substances consisting of two or more chemically combined elements</li> <li>show an understanding that mixtures are made up of two or more elements and/or compounds that are not chemically combined</li> <li>distinguish among solute, solvent and solution</li> <li>show an understanding that solutions and suspensions are mixtures</li> </ul>	<ul style="list-style-type: none"> <li><u>classify</u> elements as metals and non-metals based on their characteristic properties</li> <li><u>investigate</u> the factors that affect the solubility and rate of dissolving of substances</li> </ul>	<ul style="list-style-type: none"> <li>evaluate how the disposal of harmful pure substances (e.g. mercury) and mixtures (e.g. sewage) impact the environment</li> </ul>
<p><b>4. Exploring Diversity of Matter Using Separation Techniques</b></p> <ul style="list-style-type: none"> <li>show an awareness of basic principles involved in the following separation techniques: magnetic attraction, filtration, evaporation, distillation and paper chromatography</li> <li>explain how the constituents of a mixture can be separated based on their properties, using the following techniques: magnetic attraction, filtration, evaporation, distillation, paper chromatography.</li> <li>state some examples of the applications of the various separation techniques in everyday life and industries</li> <li>show an awareness of the techniques involved in</li> </ul>	<ul style="list-style-type: none"> <li>separate constituents of mixtures <u>using the appropriate separation techniques</u></li> </ul>	<ul style="list-style-type: none"> <li>show an appreciation of why water is a precious resource and the need to conserve it</li> <li>show objectivity and accuracy in systematic investigations involved in the separation of mixtures</li> </ul>

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<b>Learning Outcomes</b>		
<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
obtaining drinking water from non-potable sources (e.g. distillation of sea water in desalination plants, and filtration and *reverse osmosis of sewage water)		
<b>5. Understanding Diversity of Living Things</b> <ul style="list-style-type: none"><li>• show an awareness of biodiversity as the variety of life on earth, including variety within each species of plant and animal</li><li>• recognise that classifying living things into major taxonomic groups enables us to make sense of the biodiversity around us</li><li>• show an awareness that bacteria could have beneficial or harmful effects (e.g. bacteria in the digestive tract could help in digestion or cause infections)</li><li>• recognise the importance of biodiversity to the stability of natural systems, and its benefits to humans (provision of resources like food, medicine, raw materials, etc.)</li></ul>	<ul style="list-style-type: none"><li>• <u>construct and use simplified dichotomous keys in identifying and classifying living organisms</u></li></ul>	<ul style="list-style-type: none"><li>• discuss the reasons for the depletion or extinction of some plants or animals (e.g. hunting, disease, invasive species, changes to or destruction of habitat)</li><li>• show an awareness of how teamwork and perseverance are important in the study of biodiversity</li></ul>

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<p><b>Theme: Models</b> Models are representations of phenomena, constructed to facilitate understanding of processes and structures that cannot be observed directly, or to make reasonable predictions. Models used in the learning of science include physical, conceptual and mathematical models. As models are approximations of actual phenomena, they are inherently inexact. Thus, models of phenomena change as Man strives to improve the models for representing, explaining and predicting phenomena.</p> <p><b>Essential Takeaways:</b> - Models are simplified representations of phenomena. - Models are constructed to explain phenomena. - Models can be used to make predictions.</p>	<p><b>Key Inquiry questions in Models include:</b></p> <ul style="list-style-type: none"> <li>• Why are models important?</li> <li>• How do we know that the models used are good representations of the real system?</li> </ul>
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<b>Learning Outcomes</b>		
<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
<p><b>6. Model of Cells – the Basic Units of Life</b></p> <ul style="list-style-type: none"> <li>• show an understanding of the functions of the different parts of a typical cell, including the nucleus which contains genetic material that determines heredity.</li> <li>• recognise that in multicellular organisms (both plants and animals), cells are the basic building blocks that are organised into tissues, organs and systems</li> <li>• show an understanding that typical plant and animals cells are models used to represent their various forms</li> <li>• explain the significance of the division of labour, even at the cellular level</li> </ul>	<ul style="list-style-type: none"> <li>• <u>use the microscope</u> safely and correctly to identify the different parts of a typical cell (plant or animal) viz.               <ul style="list-style-type: none"> <li>• cell wall</li> <li>• cell membrane</li> <li>• cytoplasm</li> <li>• nucleus</li> <li>• vacuole</li> <li>• chloroplast</li> </ul> </li> <li>• <u>infer</u> whether an organism is an animal or a plant, based on its cellular composition</li> </ul>	<ul style="list-style-type: none"> <li>• show an awareness of the moral and social issues related to organ donation/sale and *application of genetic science</li> </ul>
<p><b>7. Model of Matter - The Particulate Nature of Matter</b></p> <ul style="list-style-type: none"> <li>• show an awareness that according to the Particulate Nature of Matter, matter is made up of small discrete particles which are in constant and random motion</li> <li>• show an understanding of the simple model of solids, liquids and gases, in terms of the</li> </ul>	<ul style="list-style-type: none"> <li>• <u>*use of models to explain</u> melting and boiling in terms of conversion of the three states of matter</li> <li>• <u>use of models to explain</u> expansion and contraction, and the conservation of mass during these processes</li> <li>• <u>compare</u> the properties of solids, liquids and gases (e.g. volume, shape, density,</li> </ul>	<ul style="list-style-type: none"> <li>• show an appreciation of how in practice, models are constructed to explain phenomena</li> <li>• show an appreciation of scientific attitudes such as creativity and open-mindedness in creating models to explain the fundamental nature of things and the willingness to re-examine existing models</li> </ul>

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**Learning Outcomes**

Knowledge, Understanding and Application	Skills and Processes	Ethics and Attitudes
arrangement and movement of the particles	compressibility) in terms of the arrangement and movement of the particles	
<b>8. Model of Matter - Atoms and Molecules</b> <ul style="list-style-type: none"><li>describe an atom as an electrically neutral entity made up of a positively charged nucleus (protons and neutrons) with negatively charged electrons moving round the nucleus</li><li>show an awareness that atoms of an element have a unique number of protons</li><li>recognize that atoms have mass that is contributed by the mass of nucleus</li><li>show an understanding that a molecule is a group of two or more atoms chemically combined together</li><li>state the number and types of atoms, given the chemical formula of a compound (writing of chemical formula is not required)</li></ul>	<ul style="list-style-type: none"><li><u>compare</u> the relative size of an atom to other objects</li><li><u>compare</u> atoms and molecules</li></ul>	<ul style="list-style-type: none"><li>show an appreciation of how in practice, models are constructed, justified and continuously revised as they are used to probe new phenomena and collect additional data (e.g. the various atomic models)</li><li>show an appreciation of scientific attitudes such as creativity and open-mindedness in creating models to explain the fundamental nature of things and the willingness to re-examine existing models</li><li>show an awareness that technologies resulting from knowledge of the atom have created social and ethical issues, risks and costs (e.g. atomic bomb)</li></ul>
<b>9. Ray Model of Light</b> <ul style="list-style-type: none"><li>show an understanding that the ray model represents the path taken by light</li><li>recognise that light travels in a straight line, forming shadows when blocked (e.g. eclipse)</li><li>explain how reflection is affected by a smooth and rough surface using the ray model of light</li><li>describe the effects and uses of reflecting surfaces (e.g. plane and curved)</li><li>*show an understanding that the change in the</li></ul>	<ul style="list-style-type: none"><li><u>investigate</u> the effects of reflection and *<u>refraction</u> in practical activities and <u>make inferences</u> through observations in everyday life (e.g. as the moon orbits the earth, different parts of it reflects light from the sun, resulting in different moon phases)</li><li>investigate the characteristics of the image formed by a plane mirror</li></ul>	<ul style="list-style-type: none"><li>evaluate the impact of light produced by technology, on society and the environment (e.g. city lights can improve night visibility but cause light pollution, disorientation of birds, and use up a lot of electrical energy)</li></ul>

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<b>Learning Outcomes</b>		
<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
speed of light in different media causes refraction (calculation of angles not required) <ul style="list-style-type: none"><li>• describe some effects of refraction</li><li>• describe the dispersion of white light by a prism using the ray model of light</li><li>• *explain how we see the colour of objects in <b>white</b> light and coloured light such as red, blue and green</li></ul>		

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<p><b>Theme: Systems</b> Systems are defined by placing boundaries around inter-related entities to make them easier to study. There are systems in nature as well as man-made systems. Any change to a part of the system could affect the rest of the system to different extents. That is, a part of the system may not work (well) if another is missing or not working (well). Conversely, when the parts are put together, they can perform functions that cannot be carried out by the parts alone.</p> <p><b>Essential Takeaways:</b> - A system is a whole consisting of parts that work together to perform a function. - Parts of a system can influence one another and hence the whole system. - Inputs to a system can determine the outputs of the system.</p>	<p><b>Key Inquiry questions in Systems include:</b></p> <ul style="list-style-type: none"> <li>• How do parts of a system or different systems work together to perform a function?</li> <li>• How could parts of a system affect the function of other parts?</li> </ul>
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<b>Learning Outcomes</b>		
<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
<p><b>10. Transport System in Living Things</b></p> <ul style="list-style-type: none"> <li>• *explain the need for a transport system in multi-cellular organisms</li> <li>• identify the parts of the human circulatory system and their respective functions (include heart, blood vessels and blood)</li> <li>• state how diffusion facilitates the transport of substances in animals (e.g. diffusion of digested food molecules and oxygen from blood to tissues)</li> <li>• show an awareness of how the various parts of the plant transport system work together to transport useful substances within the plant</li> <li>• state how diffusion facilitates the transport of substances in plants (e.g. diffusion of gases and mineral salts into and out of plant cells)</li> <li>• state how osmosis facilitates the absorption of water at the roots</li> </ul>	<ul style="list-style-type: none"> <li>• <u>infer from investigations</u> that particles move from a region of where they are of higher concentration to a region of lower concentration</li> </ul>	<ul style="list-style-type: none"> <li>• show curiosity in exploring how different systems (digestion, respiratory and excretory) work with the transport system in transporting useful substances in the body and transporting waste substances from the body to be removed</li> </ul>

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**Learning Outcomes**

Knowledge, Understanding and Application	Skills and Processes	Ethics and Attitudes
<p><b>11. Human Digestive System</b></p> <ul style="list-style-type: none"><li>• explain the importance of the digestive system</li><li>• identify the main parts of a digestive system and how they work together to perform a function</li><li>• describe how a digestive system helps in digestion of food and the part played by enzymes in digestion (Only classes of enzymes such as amylase, protease and lipase are needed. Specific names of enzymes not required.)</li></ul>	<ul style="list-style-type: none"><li>• <b>infer</b> that the end products of digestion are used for cellular processes like respiration, growth and tissue repair</li></ul>	<p>show an awareness of the importance of hygiene habits and food handling practices in preventing food-borne diseases</p>
<p><b>12. Human Sexual Reproductive System</b></p> <ul style="list-style-type: none"><li>• recognise that the sexual reproductive system facilitates heredity (the transfer of genetic information from one generation to another)</li><li>• recognise that the union of the nuclei of an egg and a sperm (inputs of a system) forms a new individual (output of a system)</li><li>• recognise that a new individual formed through sexual reproduction receives a unique combination of genetic information from its mother (via the egg) and its father (via the sperm), resulting in variation between individuals.</li><li>• state some of the physical changes that occur during puberty and early adolescence as a result of the effect of hormones on other systems (details of hormonal system NOT required)</li><li>• describe briefly the structures of human male and female reproductive systems and how they work together for fertilisation to take place</li><li>• describe how each part of the female reproductive system is involved in the menstrual cycle</li><li>• outline how temporary and permanent birth control methods prevent conception by disrupting certain processes and/or disrupting the functions of</li></ul>	<ul style="list-style-type: none"><li>• <b>evaluate</b> the consequences and issues relating to:<ul style="list-style-type: none"><li>- <b>abortion</b></li><li>- <b>pre-marital sex</b></li></ul></li></ul>	<ul style="list-style-type: none"><li>• show an appreciation of the social and moral issues relating to abortion and pre-marital sex</li><li>• suggest reasons for the world's growing human population (e.g. advances in medicine, improved sanitation)</li></ul>

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<b>Learning Outcomes</b>		
<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
<p>certain organs in the reproductive system</p> <ul style="list-style-type: none"><li>state the harmful consequences of infections that are transmitted through sexual reproductive system, i.e. sexually transmitted infections (STIs) like syphilis, gonorrhoea and AIDS</li><li>state that some bacterial STIs can be cured by antibiotics, but not viral STIs</li></ul>		

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**Learning Outcomes**

Knowledge, Understanding and Application	Skills and Processes	Ethics and Attitudes
<p><b>13. Electrical Systems</b></p> <ul style="list-style-type: none"> <li>• explain what is meant by current, potential difference and resistance of an electrical system, stating their units</li> <li>• draw and interpret circuit diagrams and set up circuits containing electrical sources, switches, lamps, resistors (fixed and variable), ammeters and voltmeters</li> <li>• *explain how arrangement of the components of an electrical system affects the outputs of the system (e.g. how series or parallel arrangement of resistors affects the brightness of the bulb)</li> <li>• explain qualitatively the chemical, heating and magnetic effects of an electric current and list some applications</li> <li>• explain what is meant by power, relate it to an output of an electrical system and state its S.I. unit</li> <li>• state how changes made to an electrical system can cause some electrical hazards</li> <li>• state some precautionary measures to ensure the safe use of electricity in the home</li> </ul>	<ul style="list-style-type: none"> <li>• <b>*investigate</b> the effect of varying resistance on the current in the circuit using fixed or variable resistors</li> <li>• <b>*solve simple problems</b> on the cost of using electrical appliances, using kilowatt-hour as a unit of electrical energy consumption</li> </ul>	<ul style="list-style-type: none"> <li>• discuss the importance for Singapore, which has no natural resources of her own, to conserve energy and how this could help reduce contribution to global warming</li> <li>• demonstrate precision and accuracy in making measurements (taking into consideration parallax errors)</li> </ul>

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<p><b>Theme: Interactions</b>  Interactions exist between the living world and the environment at various levels: (i) within organisms, (ii) between organisms, (iii) within the environment, and (iv) between organisms and the environment. These interactions are often accompanied by the transfer of energy between matter, application of forces between matter, or transfer/exchange of matter. As a result of interactions, changes can occur. These changes could be small or big, fast or slow, reversible or irreversible, predictable or erratic.</p> <p><b>Essential Takeaways:</b>  - Interactions occur through the transfer of energy and/or matter, as well as the application of forces.  - Interactions can lead to changes or stability in the system.  - The interaction of Man with his environment drives the development of Science and Technology. At the same time, Science and Technology influences the way Man interacts with his environment.</p>	<p><b>Key Inquiry questions in Interactions include:</b></p> <ul style="list-style-type: none"> <li>• How does knowledge of interactions between and within systems help Man better understand his environment?</li> <li>• What are the interactions between physical phenomena and life processes?</li> </ul>
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<b>Learning Outcomes</b>		
<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
<p><b>14. Interactions through the application of forces</b></p> <ul style="list-style-type: none"> <li>• state that forces can <ul style="list-style-type: none"> <li>- change the state of rest or motion of a body</li> <li>- change the size and/or shape of a body</li> <li>- bring about turning effects in objects (e.g. levers)</li> <li>- exert pressure on objects</li> </ul> </li> <li>• identify some examples of contact forces (e.g. frictional force) and non-contact forces (e.g. gravitational force and magnetic force) and <b>predict</b> their effects on an object (e.g. how tides are caused by gravitational interaction between the oceans and the moon)</li> <li>• relate pressure to force and area, using appropriate everyday examples (e.g. high heel shoes, cutting edge of a knife)</li> <li>• *show an appreciation of some daily life phenomena associated with atmospheric <b>pressure</b> (e.g. use of suction cups, drinking from straws) and pressure due to liquid (e.g. submarines <b>have</b> depth limits)</li> </ul>	<ul style="list-style-type: none"> <li>• <u>compare</u> mass and weight</li> <li>• <u>make measurements</u> of (length, time) mass and force, using their respective S.I. units</li> <li>• *<u>investigate</u> pressure using the formula, <math>\text{pressure} = \text{force}/\text{area}</math></li> <li>• <u>solve problems</u> of objects in motion using the concept of speed</li> </ul>	<ul style="list-style-type: none"> <li>• demonstrate precision and accuracy in making measurements (taking into consideration parallax errors)</li> <li>• show curiosity about the destructive power of forces of nature (e.g. tsunamis, volcanoes, earthquakes, hurricane/typhoon)</li> </ul>

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Learning Outcomes

Knowledge, Understanding and Application	Skills and Processes	Ethics and Attitudes
<p><b>15. Energy and Work Done</b></p> <ul style="list-style-type: none"> <li>• identify energy as the ability to do work</li> <li>• show understanding that work is done when object moves in the same direction as the force is applied</li> <li>• show understanding that energy is transferred when work is done</li> <li>• show an awareness that energy is conserved when it is converted from one form to another</li> <li>• state the S.I. unit of work as the joule</li> </ul>	<ul style="list-style-type: none"> <li>• <b>infer</b> that energy can be transformed from one form to another</li> <li>• <b>compare</b> between situations involving forces where work is done and where work is not done</li> </ul>	<ul style="list-style-type: none"> <li>• show an appreciation of the uses of various sources of energy (e.g. geothermal energy is used for heating; biofuels are used to power vehicles; fossil fuels, solar, hydro-electric, wind energy are used to generate electricity) and their impact on the environment</li> <li>• demonstrate precision and accuracy in making measurements (taking into consideration parallax errors)</li> </ul>
<p><b>16. Transfer of Sound Energy through Vibrations</b></p> <ul style="list-style-type: none"> <li>• explain that sounds are produced due to interactions between molecules of a medium caused by a vibrating source</li> <li>• recognise that sound transfers energy and that it takes different lengths of time to travel from one point to another through different media</li> <li>• *identify sounds of different pitch and relate the pitch to their frequencies</li> <li>• outline how the ear detects sounds in terms of the vibrations of the eardrum and ear bones, and the subsequent interpretation of sound by the brain</li> </ul>	<ul style="list-style-type: none"> <li>• <b>infer</b> that the loudness of sounds can be changed by changing the size of vibrations and *pitch by the frequency</li> </ul>	<ul style="list-style-type: none"> <li>• recognise the importance of sound in our society (e.g. for communication, music for pleasure, ultrasound in medicine) and the adverse effect of noise in our environment</li> <li>• demonstrate precision and accuracy in making measurements (taking into consideration parallax errors)</li> </ul>
<p><b>17. Effects of Heat &amp; its Transmission</b></p> <ul style="list-style-type: none"> <li>• describe some effects and applications of expansion and contraction in everyday life</li> <li>• state the S.I. unit of temperature and use the appropriate unit for it</li> <li>• explain what is meant by conduction, convection and radiation</li> </ul>	<ul style="list-style-type: none"> <li>• <b>infer</b> that generally, solids, liquids and gases expand when heat is absorbed and contract when heat is given out</li> <li>• <b>infer</b> that thermal expansion results in a change in volume of the substance and therefore the density of the substance</li> <li>• <b>infer</b> from experiments that different materials</li> </ul>	<ul style="list-style-type: none"> <li>• show open-mindedness in becoming aware of the various proposed causes (man-made and natural) of the recent climatic change – global warming</li> <li>• demonstrate precision and accuracy in making measurements (taking into consideration parallax errors)</li> </ul>

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**Learning Outcomes**

<b>Knowledge, Understanding and Application</b>	<b>Skills and Processes</b>	<b>Ethics and Attitudes</b>
<ul style="list-style-type: none"><li>• identify and explain applications of heat conduction and convection (e.g. in cooling, heating and insulation)</li><li>• show an understanding that the rate of heat loss or gain by a body through radiation is affected by the (i) nature of its surface and (ii) temperature difference between the body and its surroundings</li><li>• identify and explain applications of heat radiation (e.g. radiant heaters, solar radiation)</li></ul>	<p style="text-align: center;">have different rates of heat flow</p>	
<p><b>18. Chemical Changes</b></p> <ul style="list-style-type: none"><li>• identify a change which leads to formation of <b>new</b> product(s) as a chemical change.</li><li>• show an awareness that there are different <b>types</b> of chemical reactions such as combustion, <b>thermal</b> decomposition, oxidation (e.g. cellular respiration) and <b>neutralisation</b></li><li>• use word equations to represent chemical reactions</li><li>• show an awareness that chemical reactions involve a rearrangement of atoms, which are <b>not</b> created or destroyed</li></ul>	<ul style="list-style-type: none"><li>• <b>infer</b> that mass is conserved during a <b>chemical reaction</b></li><li>• <b>Investigate</b> the changes that <b>matter</b> (i.e. <b>element, compound or mixture</b>) undergoes through<ul style="list-style-type: none"><li>- mixing</li><li>- heating</li><li>- exposure to light (e.g. photosynthesis)</li><li>- passing of an electric current</li><li>- oxidation (e.g. rusting)</li></ul></li><li>• <b>investigate</b> the following chemical reactions/changes:<ul style="list-style-type: none"><li>- effect of acidic, alkaline and neutral solutions on indicators (include litmus paper, Universal Indicator and natural indicators obtained from plants)</li><li>- reactions between acids and alkalis; acids and metals; and acids and carbonates</li></ul></li></ul>	<ul style="list-style-type: none"><li>• show an awareness of how chemical reactions can benefit our lives (e.g. cooking, respiration) and cause harm to our health and environment (e.g. rusting, decay and burning), as well</li></ul>

\*optional for Normal (Academic) syllabus

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**Learning Outcomes**

Knowledge, Understanding and Application	Skills and Processes	Ethics and Attitudes
<p><b>19. Interactions within Ecosystems</b></p> <ul style="list-style-type: none"> <li>• show an understanding of an ecosystem as the interactions between a community and its physical environment</li> <li>• explain the importance of various physical factors like air, water, temperature, light, minerals and acidity/alkalinity, to the life of the organisms</li> <li>• recognise how adaptive traits (structural or behavioural) and changes in environmental conditions can affect the survival of organisms</li> <li>• show an understanding of the interrelationship among the various organisms in a community (Examples of interrelationships are predator-prey relationship, mutualism and parasitism)</li> <li>• explain the importance of conserving the environment</li> <li>• show an understanding of how respiration and photosynthesis are related to the flow of energy through food chains and food webs</li> <li>• describe how nutrients trapped in living organisms are recycled within the environment, through the actions of decomposers</li> </ul>	<ul style="list-style-type: none"> <li>• <u>investigate</u> an environment using measurement instruments such as datalogger probes to collect data on physical quantities such as pH, temperature and light intensity</li> <li>• <u>compare</u> photosynthesis and respiration</li> <li>• <u>compare</u> respiration and breathing in terms of the roles they play in the interactions between living things and their environment</li> <li>• <u>infer</u> the role of decomposers in recycling of nutrients in the environment</li> </ul>	<ul style="list-style-type: none"> <li>• *show an awareness of how some cultures practise sustainable living through their interactions with the environment</li> <li>• evaluate the impact of human activities and technologies on the environment (e.g. motor vehicles and modern lifestyle)</li> </ul>

\*optional for Normal (Academic) syllabus

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## GLOSSARY OF TERMS

<b>S/No</b>	<b>Term</b>	<b>Description of Terms</b>
1.	calculate	to give a numerical answer based on a given formula with working shown
2.	classify	to group things based on common characteristics
3.	compare	to identify similarities and differences between objects, concepts or processes
4.	construct	to write or form something not by factual recall but by using given information
5.	deduce	to draw a conclusion based on the general rules or given information
6.	describe	to state in words (using diagrams where appropriate) the main points of a topic
7.	determine	to obtain the quantity by calculation, substituting measured or known values of other quantities into a standard formula
8.	discuss	to give a critical account of the points involved in the topics
9.	distinguish	to identify and understand the differences between objects, concepts and processes
10.	evaluate	to consider all factors relating to the object/event before making a judgement
11.	explain	to give reasons or make some reference to theory
12.	identify	to select and/or name the object, event, concept or process
13.	infer	to draw a conclusion based on observations
14.	investigate	to find out by carrying out experiments
15.	list	to give a number of points or items without elaboration
16.	outline	to give the main or essential points of the concepts or processes
17.	predict	to state a likely future event based on the given information or rules
18.	recognise	to identify facts, characteristics or concepts that are critical (relevant/appropriate) to the understanding of a situation, event, process or phenomenon
19.	relate	to identify and explain the relationships between objects, concepts or processes
20.	show an appreciation	to recognise and explain the value of a concept or situation
21.	show an awareness	to have superficial knowledge of the concepts or processes
22.	show an understanding	to recall, explain and apply information
23.	state	to give a concise answer with little or no supporting argument