Benchmarks

Sciences

Draft for consultation, October 2016

**Guidance on using the Benchmarks for Assessment**

**Please take time to read this introduction**

The two key resources which support teachers to plan learning, teaching and assessment are:

* **Experiences and Outcomes**
* **Benchmarks.**

The Benchmarks support teacher professional judgement of achievement of a level. They set out very clear statements about what children need to know and be able to do to achieve each level of the curriculum.

All eight significant aspects for learning for sciences are clearly embedded in the Benchmarks and provide the structure against which the Benchmarks have been developed.

The Benchmarks for the sciences therefore streamline a wide range of existing assessment guidance (including the significant aspects of learning and progression frameworks) into one key resource to support teachers’ professional judgement.

Assessment judgements should be made using the Benchmarks for each curriculum level. The Benchmarks describe the standards that children and young people need to meet to achieve a level.

Assessment is an on-going process to support learning. The Benchmarks should be used to help monitor progress towards achievement of a level and to support overall professional judgement of when a learner has achieved a curriculum level. They support professional dialogue, moderation and monitoring of progress in learning.

Evidence of progress and achievement will come from:

* observing day-to-day learning within, and outwith, the classroom
* coursework, including tests
* learning conversations
* planned periodic holistic assessments
* information from standardised assessments.

Achievement of a level is based on evidence and on overall professional judgement. Benchmarks should be used to review a body of evidence to determine if the standard has been achieved and the learner has:

* achieved a breadth of learning across the knowledge, understanding and skills as set out in the experiences and outcomes for the level
* responded consistently well to the level of challenge set out in the experiences and outcomes for the level and has moved forward to learning at the next level in some aspects
* demonstrated application of what they have learned in new and unfamiliar situations.

**It is not necessary for learners to demonstrate evidence of every aspect of learning within the Benchmarks before moving on to the next level. However, it is important that there are no major gaps in children's and young people's learning as they progress from one level to the next.**

**Bundling of Experiences and Outcomes**

As stated in the Curriculum for Excellence [statement](https://education.gov.scot/improvement/Pages/CfE-delivery-plan.aspx) (issued August 2016), practitioners should avoid overly bureaucratic, or tick box, approaches to learning, teaching and assessment. This includes in the use of these Benchmarks.

Practitioners are encouraged to bundle Experiences and Outcomes and Benchmarks in the sciences together where it is relevant and meaningful to do so to. This can promote a more holistic approach to planning learning, teaching and assessment and helps learners makes connections between different concepts, knowledge and skills in the sciences, and indeed, other curriculum areas. However, the bundling of Experiences and Outcomes, and respective Benchmarks, has largely been avoided in the development of these Benchmarks so as not to prescribe to schools and centres how this bundling should take place. This is best done by schools and centres to suit the needs of their learners and their local contexts. In a few places, however, very obvious and commonly used opportunities for linking or bundling Experiences and Outcomes have been identified. These are just suggestions and there is no requirement to take these on board.

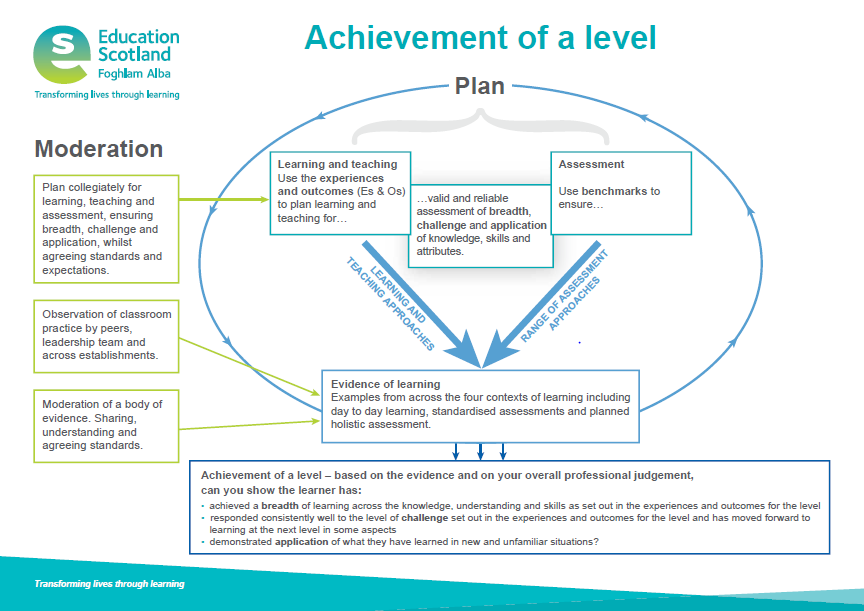
**Fourth Level Benchmarks**

There is no expectation that learners will overtake all the sciences benchmarks at Fourth Level. These should be used selectively by schools to meet the needs of their learners as they progress into different pathways in the senior phase. This will allow for appropriate specialisation within S3 to prepare learners for a seamless transition to the qualifications phase.

**Why have the benchmarks been issued in draft form?**

These Benchmarks have been developed in partnership with practitioners and published as drafts to allow for a national consultation process to take place in October 2016.

It is expected that further improvements and refinements to the Benchmarks will identified once they have been used by practitioners in different educational settings over a period of time. The benchmarks being published prior to Christmas 2016 will therefore also be issued as drafts. It is intended that the Benchmarks will be finalised sometime in 2017 following a period of use and further consultation with practitioners.



To download a copy of the achieving a level poster above, please visit the National Improvement Hub: <https://education.gov.scot/improvement/Pages/CfE-delivery-plan.aspx>

**Benchmarks for Assessment – Early Level Sciences**

|  |  |
| --- | --- |
| **Skills** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Inquiry and investigative skills** | *Plan and design scientific investigations and enquiries*   * Explores and observes through play. * Asks questions arising from play activities. * Makes simple predictions of what might happen. * Makes suggestions about what to do to answer the selected question.   *Carry out practical activities*   * Discusses obvious risks and takes appropriate steps to protect themselves and others. * Uses their senses to acquire information. * Measures using simple equipment and non-standard units.   *Analyse, interpret and evaluate scientific findings*   * Presents data and information, for example, using displays, photographs, simple charts and drawings. * Provides oral descriptions of what was done and what happened. * Recognises similarities, patterns and differences in the findings and links these to the original question. * Discusses, with support, how the experiment might be improved. * Relates findings to everyday experiences. * Identifies and discusses new knowledge and understanding.   *Presents scientific findings*   * Communicates findings to others verbally and through drawings, photographs, displays and simple charts. * Responds to questions about their investigation. |
| **Scientific analytical thinking skills** | * Demonstrates natural curiosity and shows development of basic skills of analysis in simple and familiar contexts. * Demonstrates creative thinking by offering suggestions and solutions to everyday problems. * Demonstrates reasoning skills by explaining choices and decisions. |
| **Skills and attributes of scientifically literate citizens** | * Talks about science showing developing understanding of risks and benefits. * Demonstrates respect for living things and the environment. * Demonstrates developing understanding of science in the world around them. * Explores the ways in which people use science and science skills as part of their job. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Curriculum Organisers** | | **Experiences and Outcomes**  **for planning learning, teaching and assessment** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Planet Earth** | **Biodiversity**  **and interdependence** | **I have observed living things in the environment over time and am becoming aware of how they depend on each other.**  **SCN 0-01a** | * Explores and sorts objects as living, non-living or once living. * Describes characteristics of livings things and how they depend on each other, for example young dependent on parents. |
| **I have helped to grow plants and can name their basic parts. I can talk about how they grow and what I need to do to look after them.**  **SCN 0-03a** | * Explores, observes and discusses basic needs of plants and what they need to grow including water, heat, sunlight and soil/nutrients. * Names basic structures of plants including roots, stem, leaves, and flowers. * Demonstrates understanding of how plants grow from seeds. |
| **Energy sources and sustainability** | **I have experienced, used and described a wide range of toys and common appliances. I can say ‘what makes it go’ and say what they do when they work.**  **SCN 0-04a** | * Explores and sorts different sources of energy to ‘make things go’, for example, batteries, sunlight, and wind. * Talks about how sources of energy can be used to provide heat, light or sound. |
| **Processes of the planet** | **By investigating how water can change from one form to another, I can relate my findings to everyday experiences.**  **SCN 0-05a** | * Investigates the different properties of water and can talk about what they experience. * Talks about how water is found naturally and in their everyday lives. * Identifies three main states of water: ice, water and steam. * Uses vocabulary such as melting, freezing and boiling to describe changes of state. |
| **Space** | **I have experienced the wonder of looking at the vastness of the sky, and can recognise the sun, moon and stars and link them to daily patterns of life.**  **SCN 0-06a** | * Identifies the sun, moon and stars through safe observation. * Describes how the presence or absence of the sun gives us day and night. * Explains that the number of daylight hours changes over the course of a year. |
| **Forces, electricity and waves** | **Forces** | **Through everyday experiences and play with a variety of toys and other objects, I can recognise simple types of forces and describe their effects.**  **SCN 0-07a** | * Explores and sorts toys and objects that need to be pushed and pulled. * Shows and recognises how the movement of an object is affected by the size of the force or the size of the object and that by applying a force can make an object stay still, start to move, speed up or slow down. |
| **Electricity** | **I know how to stay safe when using electricity. I have helped to make a display to show the importance of electricity in our daily lives.**  **SCN 0-09a** | * Explores and sorts objects that get electricity either from mains electrical sockets or alternative sources, for example batteries, solar cells. * Talks about the importance of electricity in their daily lives. * Identifies the risks that can be caused by electricity and demonstrates how to stay safe. |
| **Vibrations and waves** | **Through play, I have explored a variety of ways of making sounds.**  **SCN 0-11a** | * Creates a variety of different sounds by hitting, blowing, plucking and shaking different objects. * Investigates ways to make these sounds louder and softer, higher and lower pitched. * Identifies different sources of sound. * Uses vocabulary to describe different sounds, for example, loud, quiet, noisy, soft, hard and squeaky. |
| **Biological systems** | **Body systems and cells** | ***I am aware of my growing body and I am learning the correct names for its different parts and how they work.***  ***HWB 0-47b*** |  |
| **I can identify my senses and use them to explore the world around me.**  **SCN 0-12a** | * Names the five senses. * Identifies specific parts of the body related to each of the senses. * Uses their senses to find out about the world around them. * Gives examples of things they see, hear, smell, taste and feel. * Explores and talks about what senses allow them to experience in their everyday lives. |
| **Inheritance** | ***I recognise that we have similarities and differences but are all unique.***  ***HWB 0-47a*** |  |
| **Materials** | **Properties and uses of substances** | **Through creative play, I explore different materials and can share my reasoning for selecting materials for different purposes.**  **SCN 0-15a** | * Explores and sorts materials into different groups depending on their properties. * Uses vocabulary to describe properties of materials, for example, bendy, stretchy, strong, shiny, wet and dry, smooth and rough, floats and sinks. * Selects appropriate materials for different uses based on their physical properties. |
| **Topical science** | **Topical science** | **I can talk about science stories to develop my understanding of science and the world around me.**  **SCN 0-20a** | * Talks about topical science stories which affect them in their daily lives. * Recalls simple facts about how science impacts on their daily lives. * Explores through role-play how science and science skills are used in a variety of jobs. |

**Benchmarks for Assessment – First Level Sciences**

|  |  |
| --- | --- |
| **Skills** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Inquiry and investigative skills** | *Plan and design scientific investigations and enquiries*   * Collaborates with others to identify questions to find out more about a specific scientific concept, idea or issue. * Makes predictions about scientific investigation/enquiry being planned. * Contributes to the design of procedures.   *Carry out practical activities*   * Identifies risks and hazards and ensures safe use of all tools, equipment and procedures. * Collaborates to undertake investigations. * Observes and collects information and makes measurements using appropriate equipment and units.   *Analyse, interpret and evaluate scientific findings*   * Records and presents data/ information using a range of methods including tables, charts and diagrams, using labelling and scales. * Organises data or information and identify significant patterns and relationships. * Interprets findings and discuss links to the original question. * Reports on limitations of their investigation and possible improvements. * Relates findings to everyday experiences. * Identifies and discusses additional knowledge or understanding gained.   *Presents scientific findings*   * Reports in writing, orally or visually using a variety of media. * Structures a presentation or report, with support, to present findings in coherent and logical way. |
| **Scientific analytical thinking skills** | * Makes connections between what they know and the skills they require to solve scientific problems. * Provides creative solutions to scientific issues and problems. * Contributes to design processes and use of components to make models. * Demonstrates reasoning skills and draws on understanding of science concepts to make and test predictions. * Provides explanations, supported by evidence. |
| **Skills and attributes of scientifically literate citizens** | * Expresses informed views of scientific issues, both orally and in writing. * Makes connections between science and their own health and wellbeing. * Demonstrates awareness of people using science in their everyday lives in a variety of jobs roles and careers. * Discusses science topics in real-life contexts including in the media. * Demonstrates awareness of their own impact on the world. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Curriculum Organisers** | | **Experiences and Outcomes**  **for planning learning, teaching and assessment** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Planet Earth** | **Biodiversity**  **and interdependence** | **I can distinguish between living and non-living things. I can sort living things into groups and explain my decisions.**  **SCN 1-01a** | * Explains the difference between living, non-living and once living (taking into consideration movement, reproduction, sensitivity, growth, respiration, excretion and nutrition/feeding). * Sorts living things into plant and animal groups using a variety of features. * Creates their own criteria for sorting living and non-living things and can justify decisions. |
| **I can explore examples of food chains and show an appreciation of how animals and plants depend on each other for food.**  **SCN 1-02a** | * Explains that the sun is the main source of energy. * Explains that energy can be taken in by green plants to provide the major source of food for all living things. * Uses the terms ‘producer’ and ‘consumer’ correctly. * Uses vocabulary correctly including ‘predator’, ‘hunter’, ‘prey’ and ‘hunted’. * Uses and constructs a simple food chain showing energy flow. |
| **I can help to design experiments to find out what plants need in order to grow and develop. I can observe and record my findings and from what I have learned I can grow healthy plants in school.**  **SCN 1-03a** | * Designs and carries out experiments using fair testing to find out what plants need to grow and develop. * Observes and explains the outcomes from growing plants in different conditions, for example, light, water, air, soil/nutrients and heat. * Reports in writing, orally or visually using a variety of media. * Interprets findings and discusses what they have learned about how plants grow. |
| **Energy sources and sustainability** | **I am aware of different types of energy around me and can show their importance to everyday life and my survival.**  **SCN 1-04a** | * Names different energy sources, for example, sun, food, fuel, wind and waves. * Identifies different types of energy that we get from energy sources, for example, light, sound, heat, movement, electrical and chemical. * Explains the importance of different types of energy for everyday life and survival. |
| **Processes of the planet** | **By investigating how water can change from one form to another, I can relate my findings to everyday experiences.**  **SCN 1-05a** | * Expands on work at Early Level by using more complex vocabulary to describe changes of states of water, for example, condensation, evaporation and water vapour. * States that water boils at 100 °C, freezes at 0°C and that ice melts at 0°C. * Recognises factors that affect changes of state, for example, the size and shape of objects. * Describes the properties of water in each state, for example, liquid water is fluid, ice maintains shape and water vapour expands to fill vessel. * Provides examples from their everyday life of water changing state, for example at home and in nature. |
| **Space** | **By safely observing and recording the sun and moon at various times, I can describe their patterns of movement and changes over time. I can relate these to the length of a day, a month and a year.**  **SCN 1-06a** | * Describes the relative size of the Earth, Moon and Sun. * States the Earth is the planet we live on which orbits the Sun. * Explains that the Earth is round and spins around an imaginary line called its axis in 24 hours, providing us with days. * Explains how the rotation of the Earth causes day and night. * States that the Earth takes one year to completely orbit the Sun. * Explains that the tilt of the Earth on its axis as it circles the sun causes seasons. * Explains that the number of daylight hours changes with the seasons. * States that the Moon is a large rock which orbits the Earth approximately every 28 days (a lunar month). * Records, observes and explains why the Moon appears to have different shapes and positions in the sky at different times. * Records, through safe observation, that the sun changes position during the day and gives reasons for shadows changing. |
| **Forces, electricity and waves** | **Forces** | **By investigating forces on toys and other objects, I can predict the effect on the shape or motion of objects.**  **SCN 1-07a** | * Uses vocabulary to describe forces, for example, pushing, pulling, stretching, squashing and twisting. * Demonstrates understanding of how a force can make an object change speed, direction or shape. * Investigates balanced forces and can explain that if a push and pull are equal then there is no change in movement. * Investigates how shape is linked to motion and stability. |
| **By exploring the forces exerted by magnets on other magnets and magnetic materials, I can contribute to the design of a game.**  **SCN 1-08a** | * States that magnets exert a non-contact force on each other and attract certain materials. * States that magnets have a north and south pole. * Uses terms ‘attract’ and ‘repel’ to describe the pushing and pulling effects of magnets. * States that like poles repel and opposite poles attract. * Describes uses of magnets in everyday life. * Applies knowledge of magnets to create a game with others. |
| **Electricity** | **I can describe an electrical circuit as a continuous loop of conducting materials. I can combine simple components in a series circuit to make a game or model.**  **SCN 1-09a** | * States that an electrical circuit is a continuous loop of conducting material containing a power source. * Explains that electric current flows from one terminal of a power source to another. * Builds simple circuits containing bulbs, switches, bells and batteries. * States that switches can be used to start and stop flow of electrical current. * Identifies a variety of materials correctly as ‘insulators’ or ‘conductors’. * Combines simple components in a series circuit to create a game or model. |
| **Vibrations and waves** | **By collaborating in experiments on different ways of producing sound from vibrations, I can demonstrate how to change the pitch of the sound.**  **SCN 1-11a** | * Collaborates with others to investigate different ways of producing sound from vibrations. * Explains that sound is caused by a vibration in a material. * Demonstrates how sounds can be made higher or lower pitch by altering tightness, length, width or thickness or other physical characteristics of the sound source. |
| **Biological systems** | **Body systems and cells** | **By researching, I can describe the position and function of the skeleton and major organs of the human body and discuss what I need to do to keep them healthy.**  **SCN 1-12a** | * States that the skeleton gives us support and protects our organs. * Identifies the skull, spine, ribcage and some bones of the arms and leg. * States that our skin is an organ covering our whole body and holds our bodies and organs in place. * Describes the position and function of major organs including brain, heart, lungs, stomach, and bladder. * Investigates how to have a healthy lifestyle, for example, through a balanced diet, regular exercise, sufficient sleep and avoiding substance misuse. |
| **I have explored my senses and can discuss their reliability and limitations in responding to the environment.**  **SCN 1-12b** | * Uses their senses to detect information and explain how they help to keep people safe. * Investigates the reliability and limitations of the senses, for example, taste tests, limits of sound, optical illusions and blind-fold games. |
| **I know the symptoms of some common diseases caused by germs. I can explain how they are spread and discuss how some methods of preventing and treating disease benefit society.**  **SCN 1-13a** | * Describes some common diseases including colds, mumps, measles, chicken pox and flu. * Explains how diseases spread and that they can be prevented through good hygiene and vaccination. * Communicates how treating diseases benefits society. |
| **Inheritance** | **By comparing generations of families of humans, plants and animals, I can begin to understand how characteristics are inherited.**  **SCN 1-14a** | * Describes how genetic information is passed from one generation to the next. * Describes how genetic information can be seen in characteristics including body shape and colour of eyes and hair. * States that specific information corresponding to a given characteristic is called a gene. * States that within science a family is a group which shares the same genetic characteristics, for example, human family, cat family, dog family and flowering plants. * Demonstrates and shares understanding of the variations within each family group. |
| **Materials** | **Properties and uses of substances** | **Through exploring properties and sources of materials, I can choose appropriate materials to solve practical challenges.**  **SCN 1-15a** | * Classifies materials into natural and human-made (synthetic). * Uses terms ‘synthetic’ and ‘natural’ correctly to describe materials such as wood, fabric, ceramics, glass and polymers. * Identifies properties of different materials, for example, rigidity, flexibility, rough, smooth and waterproof, and their uses linked to their properties. * Solves practical challenges showing awareness of the properties of different materials. |
| **I can make and test predictions about solids dissolving in water and can relate my findings to the world around me.**  **SCN 1-16a** | * Explains and show understanding of the terms ‘soluble’, ‘insoluble’, ‘solution’ and ‘mixture’. * Predicts which substances will dissolve and carries out investigations. * Provides real-life examples of things that dissolve and things that don’t dissolve. * Explains how solubility is affected by energy, for example heat and stirring. |
| **Earth’s materials** | ***Throughout all my learning, I take appropriate action to ensure conservation of materials and resources, considering the impact of my actions on the environment.***  ***TCH 1-02a*** |  |
| **Topical science** | **Topical science** | **I have contributed to discussions of current scientific news items to help develop my awareness of science.**  **SCN 1-20a** | * Describes how people use science in their everyday lives. * Describes a variety of jobs and careers which require scientific knowledge and skills. * Discusses and expresses opinions about science topics in real-life contexts, including those featured in the media. |

**Benchmarks for Assessment – Second Level Sciences**

|  |  |
| --- | --- |
| **Skills** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Inquiry and investigative skills** | *Plan and design scientific investigations and enquiries*   * Formulates questions and predictions (hypothesis), with assistance, based on observations and information. * Identifies the independent, dependent and controlled variables, with assistance. * Anticipates some risks and hazards.   *Carry out practical activities*   * Applies safety measures to control all risks and hazards identified. * Contributes to carrying out all the procedures. * Makes observations and collects information and measurements using appropriate units. * Controls identified controlled variables to ensure validity of results.   *Analyse, interpret and evaluate scientific findings*   * Identifies relationships between the independent and dependent variables. * Makes links to original questions or predictions. * Draws basic conclusions. * Evaluates the investigation and suggests one way of improving it if it was to be repeated.   *Presents scientific findings*   * Reports collaboratively using a range of methods. * Collates, organises and summarises findings, with assistance. * Uses appropriate scientific vocabulary and acknowledge sources, with assistance. |
| **Scientific analytical thinking skills** | * Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts. * Applies understanding of more than one science concepts to solve problems and provide solutions. * Demonstrates further development of creative thinking, including through the engineering processes of design, construction, testing and modification. * Analyses, synthesises and integrates their learning in the sciences. |
| **Skills and attributes of scientifically literate citizens** | *At Second Level, it is anticipated that learners will be able to demonstrate the skills below with assistance.*   * Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts. * Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations. * Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society. * Expresses informed views about the wider world, in relation to scientific and environmental issues based on evidence. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Curriculum Organisers** | | **Experiences and Outcomes**  **for planning learning, teaching and assessment** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Planet Earth** | **Biodiversity**  **and interdependence** | **I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction.**  **SCN 2-01a** | * Classifies living things into plants (flowering and non-flowering) and animals (vertebrates and invertebrates) through knowledge of their characteristics. * Constructs and uses a key which can be used to identify particular plants or animals. * Identifies characteristics of living things that have contributed to the survival or extinction of a species. * Explains how some plants have adapted to their environment, for example, for drought or living on water. * Explains how some animals have adapted to their environment, for example, flight/feeding mechanisms. * Suggests some reasons why some species are extinct/endangered. |
| **I can use my knowledge of the interactions and energy flow between plants and animals in ecosystems, food chains and webs. I have contributed to the design or conservation of a wildlife area.**  **SCN 2-02a** | * Identifies herbivores, carnivores and omnivores correctly. * Explains the difference between a food chain and a food web. * Explains how energy flows between plants and animals in food chains and webs and ecosystems, using arrows correctly to show energy flow. * Uses vocabulary such as ‘primary/secondary producers and consumers’, ‘interdependence’, ‘decomposers’ and ‘competition’ correctly. * Contributes to the design or conservation of a wildlife area. |
| **Through carrying out practical activities and investigations, I can show how plants have benefited society.**  **SCN 2-02b** | * Plans and carries out practical activities and investigations to show how plants benefit our society. * Provides examples of how plants have benefited society, for example, in food, medicine, dyes, paper, fuels, construction, prevention of soil erosion and the balance of gases in the air. |
| **I have collaborated in the design of an investigation into the effects of fertilisers on the growth of plants. I can express an informed view of the risks and benefits of their use.**  **SCN 2-03a** | * Uses findings from investigations to explain the effects of fertilisers on plant growth. * Describes the purpose of a fertiliser and what it may contain. * Evaluates the benefits and risks associated with fertilisers. * Explains simply the difference between organic and intensive farming methods. |
| **Energy sources and sustainability** | **By considering examples where energy is conserved, I can identify the energy source, how it is transferred and ways of reducing wasted energy.**  **SCN 2-04a** | * Demonstrates understanding of the law of conservation of energy (energy can be converted from one form to another but cannot be created or destroyed). * Identifies the energy transfers that occur in everyday appliances. * Explains that when energy transfers take place in everyday appliances energy is converted in to useful and wasted energy types, for example, in a light bulb converting electrical energy in to light and heat energy, the light energy is the useful and heat energy is wasted energy. * Suggests ways of reducing energy waste, for example, using more energy efficient appliances. |
| **Through exploring non-renewable energy sources, I can describe how they are used in Scotland today and express an informed view on the implications for their future use.**  **SCN 2-04b** | * Identifies renewable and non-renewable sources of energy and discusses how these are used in Scotland. * Uses the term fossil fuels to refer to coal, oil & natural gas. * Researches and expresses informed views about the positive and negative global impact of using non-renewable and renewable energy sources. * States that most of our electrical energy is supplied by power stations and is transferred to our homes through a network of connected power lines called the National Grid. * Suggests ways in which they can reduce their own energy use and live more sustainably. |
| ***I can investigate the use and development of renewable and sustainable energy to gain an awareness of their growing importance in Scotland or beyond.***  ***TCH 2-02b*** |  |
| **Processes of the planet** | **I can apply my knowledge of how water changes state to help me understand the processes involved in the water cycle in nature over time.**  **SCN 2-05a** | * Explains why water is one of the most important substances on the Earth. * States that water exists in three different states solid (ice), liquid (water), or gas (water vapour). * Explains that water evaporates when heated and water vapour condenses when cooled. * Investigates factors that affect the rate of change of state, for example, the volume and surface area of containers holding water. * Explains why the water cycle is a very important process in nature. * Annotates diagrams to demonstrate understanding of the mechanism of the water cycle. * Discusses the necessity of water for life, for example, growth of crops, drinking and river formation/flow. |
| **Space** | **By observing and researching features of our solar system, I can use simple models to communicate my understanding of size, scale, time and relative motion within it.**  **SCN 2-06a** | * States that the Sun is a star at the centre of our solar system and is made of hot gases. * Creates a model of our solar system, showing the eight major planets in orbit around the Sun. * Researches and records the key features of the planets including size, distance from the Sun, length of day, length of year, temperature, materials from which they are predominantly made and the number of moons. * States that any object that orbits a planet is called a satellite and that the moon is a natural satellite. * States that attractive gravitational force maintains the orbit of planets. * Explains how solar & lunar eclipses occur. * Describes our Solar System, and states that it is found in a Galaxy called the Milky Way. * Describes other bodies out in space such as asteroids, meteors, comets, satellites and stars. |
| **Forces, electricity and waves** | **Forces** | **By investigating how friction, including air resistance, affects motion, I can suggest ways to improve efficiency in moving objects.**  **SCN 2-07a** | * Investigates and can explain that friction is a force which opposes the motion of moving objects. * Describes friction as a force caused by either two solid surfaces rubbing against one another or a solid surface moving through air or water. * Describes ways in which friction can be reduced. * Describes air resistance (drag) as a type of friction. * States that air resistance depends on the speed of an object and the surface area exposed to the air. * Provides examples of how friction and air resistance can be a problem, for example, causing moving parts to wear or by causing drag on moving vehicles. * Provides examples of how friction and air resistance can be useful, for example, the role of friction in braking systems or to slow the descent of parachutes. * Investigates and can explain how to reduce air resistance by streamlining. |
| **I have collaborated in investigations to compare magnetic, electrostatic and gravitational forces and have explored their practical applications.**  **SCN 2-08a** | * Investigates and compares magnetic, electrostatic & gravitational forces and their effects on various objects. * States that all things are pulled towards the centre of the Earth and that this pull is caused by an attractive gravitational force. * Measures gravitational force with a force meter or newton meter and can state that force is measured in Newtons. * Explains that some objects may become electrically charged by rubbing two surfaces together and that the charges produce an electrostatic force. * States that there are two kinds of static charge – positive & negative. * States that magnets are mostly made from iron or iron alloys. * States that the magnetised needle in a compass points North because of the direction of the Earth’s magnetic field. * Investigates and demonstrates understanding that magnetic and electrostatic forces can both repel and attract. * Researches and describes the practical applications of magnetic, electrostatic and gravitational forces. |
| **By investigating floating and sinking of objects in water, I can apply my understanding of buoyancy to solve a practical challenge.**  **SCN 2-08b** | * Predicts whether or not an object will sink or float. * Explains why some objects will float in water while others will sink. * States that objects which float are said to be buoyant. * Uses the term ‘buoyancy’ to describe the upward pushing force (up-thrust) which causes objects to float. * Demonstrates through investigations that objects less dense than water will float and objects more dense than water will sink. * Explains that when an objects floats, the forces acting on it are balanced (up thrust force = force due to gravity). * Explains that when an object sinks, the forces acting on it are unbalanced (up thrust force < force due to gravity). * Describes some of the factors which affect floating, for example, density, the object’s shape and the type of liquid it is in. |
| **Electricity** | **I have used a range of electrical components to help to make a variety of circuits for differing purposes. I can represent my circuit using symbols and describe the transfer of energy around the circuit.**  **SCN 2-09a**  **To begin to understand how batteries work, I can help to build simple chemical cells using readily-available materials which can be used to make an appliance work.**  **SCN 2-10a** | * Describes, builds and draws an electrical circuit. * Demonstrates understanding of how to stay safe when using electricity. * States that an electric current is a flow of charged particles. * States that a complete circuit is required for electricity to flow and that the circuit must contain a power source. * Uses correct electrical symbols to denote, at the least, a bulb, switch, motor, bell, buzzer, wires, cell and a battery. * Describe how components in a circuit transfer energy. * Uses electrical symbols to draw circuit diagrams. * States that a switch can create a temporary gap in a circuit that can be opened or closed to control the flow of charged particles. * States that materials which are conductors allow the flow of charged particles. * Gives examples of important applications of insulators. * Describes how simple cells are made. * States that a battery (cell) is a portable power source which has a store of chemical energy. * Explains the process of energy transfer from battery (cell) to electrical components. * States that batteries (cells) have a positive (+) and a negative (-) terminal and that they must be connected (+) to (-) to allow the flow of charged particles. * Explains that in a circuit the electric current flows from one terminal to the other through connecting wires and components. * Builds simple batteries (cells) using readily available materials. |
| **Vibrations and waves** | **Through research on how animals communicate, I can explain how sound vibrations are carried by waves through air, water and other media.**  **SCN 2-11a** | * Describes how sound travels through different media. * Explains that sound travels by waves and that in order to transfer sound requires the vibration of particles in a solid, liquid & gas. * Explains that the denser the material, the faster the sound travels. * States that sound is produced by vibrations. * States that ears detect vibrations. * Explains that hearing is limited by a range of factors, for example, the size, position, and flexibility (direction). * Researches and records how various animals use sounds to communicate. |
| **By exploring reflections, the formation of shadows and the mixing of coloured lights, I can use my knowledge of the properties of light to show how it can be used in a creative way.**  **SCN 2-11b** | * Demonstrates through practical investigations that light is reflected by shiny surfaces and curved faces distort the image. * Explains that most of the light is reflected back from reflective materials and describes possible applications of this effect. * Explains that the image in a mirror is created by the reflected light. * States that the position, shape and size of a shadow depend on where the object is in relation to the light source. * States that a shadow is not coloured. * Investigates light being broken up to show the colours of the visible spectrum, for example, as in seeing a rainbow. * Identifies the colours and order of the rainbow as red, orange, yellow, green, blue, indigo and violet. * Explains that we see objects because light rays enter our eyes from that object. * Explains that we recognise the colour of an object because it reflects that light wavelength and absorb the rest. * Describes, following practical investigations, the effect that coloured filters have on white light. * Explains that mixing light of different colours can produce another colour. |
| **Biological systems** | **Body systems and cells** | **By investigating some body systems and potential problems which they may develop, I can make informed decisions to help me to maintain my health and wellbeing.**  **SCN 2-12a**  **I have explored the structure and function of sensory organs to develop my understanding of body actions in response to outside conditions.**  **SCN 2-12b**  **I have contributed to investigations into the role of microorganisms in producing and breaking down some materials.**  **SCN 2-13a** | * Explains that body systems are groups of organs working together, for example, the circulatory system. * Identifies the basic structure and function of at least two body systems. * Investigates the potential problems which may develop in at least two body systems. * Can make informed decisions to the maintenance of their health and wellbeing in at least 2 body systems.   *Information below is for guidance and support only. As stated above, the expectation is that at least two of the following body systems will be studied at Second Level.*  Respiratory system   * Identifies the lungs, windpipe and bronchi as being part of the **respiratory system.** * Describes the function of the respiratory system, for example, gas exchange. * Discusses the main preventable causes of bronchitis, lung cancer and asthma, for example, smoking.   Circulatory system   * Identifies the heart and blood vessels as being part of the **circulatory system.** * Describes the function of the circulatory system, for example, transport of food, oxygen and waste materials. * Discusses the main preventable causes of heart disease or stroke, for example, obesity, lack of exercise, smoking and high (saturated) fat diet.     Digestive system   * Identifies the mouth, oesophagus, stomach, liver, small intestine, large intestine, rectum and anus as being part of the **digestive system.** * Describes the function of the digestive system, for example, breakdown of food and absorption of nutrients, minerals and water. * Discusses the main preventable causes of liver disease, for example, alcohol and drug misuse.   Reproductive system   * Identifies the penis, testes, sperm tube/duct, ovaries, egg tube/duct, uterus and vagina as belonging to the human r**eproductive systems.** * Describes the function of the reproductive system, for example, to make a baby. * Discusses some preventable causes of fertility problems, for example, alcohol misuse, anorexia and obesity.   Skeletal system   * Identifies the function of the **skeleton** support protection and movement. * Identifies the skull, spine, ribcage some bones of the arm and leg. * Discusses some common problems of bones (for example, arthritis, osteoporosis and breaks) and how their incidence can be reduced (for example, through calcium in the diet and weight-bearing exercise). * Lists the sensory organs and their function, for example, eyes for sight, ears for hearing. * Label the main components of at least 2 sensory organs. * Describes how light enters the eye through the pupil and states that the pupil changes size in dark/light conditions. * Explains that the light passes through a lens and lands on the back of the eye (retina) where a message is sent to the brain. * States that the eye is protected by the cornea. * States that the ear is involved in balance. * Describes how senses work individually or together to keep people safe from harm. * Designs investigations to find out how microbes can produce and break down some materials. * Uses the terms micro-organisms and microbes to describe microscopic living things. * Describes how microscopic living things include bacteria, viruses and fungi and multiply rapidly. * Describes how some micro-organisms can be beneficial to us and others that can cause disease. * Explains the action of some microscopic organisms used in food production, for example, yeast in bread and bacteria in yoghurt. * Describes how some micro-organisms break down food causing it to be inedible/harmful if digested, and others exist in the gut to break down food to aid digestion. * Describes how microscopic organisms are necessary for the process of decomposition (the breaking down of dead material – decay). |
| **Inheritance** | **By investigating the lifecycles of plants and animals, I can recognise the different stages of their development.**  **SCN 2-14a**  **By exploring the characteristics offspring inherit when living things reproduce, I can distinguish between inherited and non-inherited characteristics.**  **SCN 2-14b** | Plants   * Names the parts of a plant and their functions including root, stem, leaf and flower. * Names the parts of a flower including sepal, petal, stamen, anther, filament, stigma, style, ovary and ovule. * Names the reproductive cells in a flower including male (anther and pollen) and female (ovary and ovule). * Describes how pollination occurs when the male cell (pollen) lands on the stigma. * Describes how cross pollination is brought about by insects or wind. * Describes how fertilisation (sexual reproduction) occurs when the genetic information in the male cell fuses (joins) with the genetic information in the female cell. * Describes how the fertilised ovule develops into a seed and how the ovary ripens to form a fruit. * Describes how seeds are dispersed by wind, water, animals (eaten or caught in their coats) and mechanical movement. * Describes how some plants may reproduce asexually, for example, vegetative propagation in runners in a strawberry plant. * Describes how some plants (for example, ferns & mushrooms) are non-flowering and reproduce by spores. * Identifies the different parts of a seed including seed coat, food store and embryo. * Investigates and explains how a seed germinates into a plant using water, oxygen, a food store and warmth.   Animals   * Identifies and compares the two distinct groups in the animal kingdom ‒ vertebrates and invertebrates * Researches and shares their findings on the lifecycles of the five main types of vertebrates including fish (spawn), birds (eggs which are rigid but fragile), amphibians (spawn and metamorphosis), reptiles (leathery shelled eggs) and mammal (live young). * Compares the lifecycles of some invertebrates, for example, ladybird and spider. * Describes the journey from birth to death as part of the life cycle which can be different for each individual species. * Explains that characteristics can sometimes skip a generation * States that the study of inherited characteristics is genetics. * Explores and categorises characteristics into inherited (eye and hair colour, height and right/left handedness) and non-inherited (native language spoken and favourite colour). * States that inherited characteristics are carried on genes. * Explains how environmental factors such as diet can affect how a gene is expressed, for example, through weight, height and intelligence. * Describes how every living thing has its own DNA fingerprint. |
| **Materials** | **Properties and uses of substances** | **By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed.**  **SCN 2-15a**    **I have participated in practical activities to separate simple mixtures of substances and can relate my findings to my everyday experience.**  **SCN 2-16a**  **By investigating common conditions that increase the amount of substance that will dissolve or the speed of dissolving, I can relate my findings to the world around me.**  **SCN 2-16b** | * Explains that there are three states of matter – solid, liquid & gas and that they are all made up of particles. * States that solids stay the same volume and shape, liquids stay the same volume but the shape changes to fit the container and that gases change shape and volume to fill the container. * Uses the correct terms to describe changes of state such as, ‘melting’ (solid to liquid), ‘freezing’ (liquid to solid), ‘evaporating’ (liquid to gas), ‘condensing’ (gas to liquid). * Identifies and investigates physical changes to the properties of materials which are reversible and can easily be changed back, for example, salt dissolving in water, chocolate melting and water freezing. * Identifies and investigates chemical changes to the properties of materials which are irreversible, for example, cooking, rusting and striking a match. * Observes and identifies some of the signs of a chemical reaction, for example, production of bubbles, colour/texture change and heat given out/taken in. * Gives examples of everyday substances (chocolate, bread, candles and glass) and their changes of state. * Uses the terms soluble, insoluble, dissolve, solution, and solvent correctly. * Demonstrates through practical activity that a mixture of solids of different sizes can be separated using a sieve or magnet, for example, sand and peas, salt and iron filings. * Explains that insoluble solids of different sizes can be separated by filtering (or sieving). * Explains that dissolved materials (soluble solids) cannot be separated by filtering but can be separated by evaporation. * Relates findings of practical investigations about dissolving to everyday experiences. * Explains that the quantity of substance that dissolves is affected by a range of conditions – temperature, time, amount of substance and amount of solvent. * States that that stirring can speed up dissolving. * Explains that powder will dissolve faster than big lumps. * Explains that the quantity of substance that can be dissolved can be increased up to a point by heating. * Relates learning about the quantity and rate of dissolving to everyday examples such as dissolving sugar in tea or salt in water (granules or big crystals, hot or cold liquid, stirred or not stirred). |
| **Earth’s materials** | **Having explored the substances that make up Earth’s surface, I can compare some of their characteristics and uses.**  **SCN 2-17a** | * States that the Earth’s structure comprises of the core, mantle and the crust. * States that the three main types of rocks are sedimentary, igneous and metamorphic and describes how they are formed and their different properties and uses. * Describes that soil is a mixture of tiny pieces of rock and organic material (humus), living organisms, airspaces and water. * Explains that the composition of soil depends on the type of rock materials and the kinds of organisms present. * States that the three main types of soil are clay, sandy and loam and describes their properties. * Investigates and sorts minerals by their characteristics and can suggest some of their uses. |
| **Chemical changes** | **I have investigated different water samples from the environment and explored methods that can be used to clean and conserve water and I am aware of the properties and uses of water.**  **SCN 2-18a**  ***Possible link to SCN 2-05a*** | * Explains the amount of water on the Earth has always remained the same as it is continually being re-cycled through the water cycle. * States why water should be clean before being safely consumed. * Investigates and presents findings on different water samples, for example, comparing sea water, rain water and tap water. * States why waste water must be cleaned before returning to the sea. * States that waste water is a mixture of safe and unsafe substances mixed together but still physically separate. * Investigates and can discuss the methods used to clean water, for example, sedimentation, filtration, evaporation, desalination and the addition of chemicals such as chlorine. * Explains that many countries in the developing world do not have water treatment plants and how diseases such as typhoid & dysentery are transmitted by dirty water. * Describes and demonstrates the many methods used to conserve water within the home, school and globally. * Discusses the many uses of water, for example, is necessary for all living things, in preservation (ice) and to generate electricity. |
| **I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made.**  **SCN 2-19a** | * States that burning is a chemical reaction and can name the new substances are produced. * States that a chemical reaction often involves an energy change. * States that a new substance is always produced during a chemical reaction. * Identifies when a chemical reaction has occurred to produce a new substance. * Collaborates with others to safely demonstrate simple chemical reactions, for example, effervescence. |
| **Topical science** | **Topical science** | **Through research and discussion I have an appreciation of the contribution that individuals are making to scientific discovery and invention and the impact this has made on society.**  **SCN 2-20a** | * Researches & discusses historic and contemporary scientists of both genders and their scientific discoveries. * Describes the impact that science has had on the development of human civilisations, for example, in design, medicine and agriculture. * Demonstrates understanding of how science impacts on every aspect of our lives. * Suggests ways that science and scientific skills are used in a wide variety of Science, Technology and Engineering and Mathematics (STEM) careers. |
| **I can report and comment on current scientific news items to develop my knowledge and understanding of topical science.**  **SCN 2-20b** | * Researches items of current scientific interest within the school, local community, nationally or in the global media and discusses and reports on these findings. * Shares opinions about a variety of topical scientific issues considering, for example, moral, ethical, societal, cultural, economical and environmental aspects. |

**Benchmarks for Assessment – Third Level Sciences**

|  |  |
| --- | --- |
| **Skills** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Inquiry and investigative skills** | *Plan and design scientific investigations and enquiries*   * Demonstrates initiative and increasing independence in identifying a number of key questions and in formulating aims and hypotheses based on information, observations and knowledge. * Designs procedures to test a hypothesis and identifies the independent, dependent and controlled variables, with limited assistance. * Anticipates most risks and hazards. * Demonstrates increased levels of collaboration and initiative in decision-making about samples, measurements, equipment and procedures to use.   *Carry out practical activities*   * Applies safety measures to control all risks and hazards identified. * Collects increasingly complex data and information using a range of methods, for example, data loggers (where available) and software analysis tools. * Controls identified controlled variables to ensure validity of results.   *Analyse, interpret and evaluate scientific findings*   * Interprets data and information to establish relationships between the independent and dependent variables and links to the original hypothesis. * Establishes links between the findings, aim and hypothesis. * Uses understanding of science concepts to explain the findings. * Devises a conclusion based on results gathered and related to the aim. * Evaluates the investigation and suggests at least two ways of improving the work, if repeated.   *Presents scientific findings*   * Presents data/information using an increasing range of ways, choosing appropriately from an extended range of tables, charts, diagrams and graphs and using suitable scales, with limited assistance. * Communicates effectively in a range of ways, for example, orally and through scientific report writing. * Presents findings using appropriate formats for audiences including. * Provides supporting evidence, quotes and acknowledges sources with limited assistance. |
| **Scientific analytical thinking skills** | * Applies scientific analytical thinking skills, with increasing independence, working with less familiar and more complex contexts. * Applies understanding of an increasing range of science concepts to solve problems and provide solutions. * Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification. * Analyses, synthesises and integrates their learning in the sciences. |
| **Skills and attributes of scientifically literate citizens** | *At Third Level, it is anticipated that learners will be able to complete the benchmarks below with limited assistance.*   * Demonstrates understanding of the impact of science on society. * Discusses the moral and ethical implications of some scientific developments. * Expresses informed views about topical scientific issues, including those featured in the media, based on evidence. * Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts. * Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations, including Science, Technology and Engineering and Mathematics (STEM) careers. * Demonstrates increased awareness of creativity and inventiveness in science and the use of technologies in the development of sciences. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Curriculum Organisers** | | **Experiences and Outcomes**  **for planning learning, teaching and assessment** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Planet Earth** | **Biodiversity**  **and interdependence** | **I can sample and identify living things from different habitats to compare their biodiversity and can suggest reasons for their distribution.**  **SCN 3-01a** | * Uses the terms habitat, ecosystem and biodiversity correctly. * Samples living things using different collection methods, for example, quadrats and pit-fall traps. * Identifies living things using biological keys. * Uses the term ‘abiotic factor’ correctly and can list examples of these. * Uses simple equipment to measure abiotic factors. * Suggests reasons for the distribution of organisms within different habitats. |
| **I have collaborated on investigations into the process of photosynthesis and I can demonstrate my understanding of why plants are vital to sustaining life on Earth.**  **SCN 3-02a** | * Collaborates with others to investigate the process of photosynthesis. * Describe the process of photosynthesis, using the word equation, in terms of raw materials and products. * States that green plants make their own food (glucose) which is stored as starch. * States that green plants convert light energy to chemical energy using chlorophyll. * Investigates and presents information on how plants help to sustain life, for example, by providing oxygen, food, habitat, raw materials, and medicines. |
| **Through investigations and based on experimental evidence, I can explain the use of different types of chemicals in agriculture and their alternatives and can evaluate their potential impact on the world’s food production.**  **SCN 3-03a** | * States that fertilisers can be used to increase plant yield or increase nutrients levels in the soil. * Investigates, by experiment, the effects of fertilisers on plant yield. * Researches an agricultural method, for example, chemical fertilisers, herbicides, pesticides, organic methods, GM and biological control to evaluate their impact on food production. * Explains how different types of chemicals can be used in agriculture and describe their impact on the world’s food production. * Explains how organic farming and GM crop species can be used in agriculture and describe their impact on the world’s food production. |
| **Energy sources and sustainability** | **I can use my knowledge of the different ways in which heat is transferred between hot and cold objects and the thermal conductivity of materials to improve energy efficiency in buildings or other systems.**  **SCN 3-04a** | * Uses the terms ‘temperature’, ‘heat’, ‘degree Celsius’, and ‘heat loss’ correctly. * Explains how heat is transferred by conduction, convection and radiation. * Classifies materials according to their thermal properties, for example, conductors and insulators. * States that heat loss in buildings depends upon the temperature difference between inside and outside of the building. * Uses the term ‘energy efficiency’ correctly. * Gives examples of how materials can be used in a building to improve its thermal energy efficiency. |
| **By investigating renewable energy sources and taking part in practical activities to harness them, I can discuss their benefits and potential problems.**  **SCN 3-04b** | * Explains the differences between renewable and non-renewable energy sources. * Describes through involvement in practical activities how to harness different types of renewable energy sources. * Presents research findings on the advantages and disadvantages associated with the use of renewable energy sources. |
| **Processes of the planet** | **By contributing to experiments and investigations, I can develop my understanding of models of matter and can apply this to changes of state and the energy involved as they occur in nature.**  **SCN 3-05a**  **I can explain some of the processes which contribute to climate change and discuss the possible impact of atmospheric change on the survival of living things.**  **SCN 3-05b** | * Identifies solids, liquids and gases correctly and describes their properties. * Describes, using the kinetic theory of matter, the properties of solids, liquids and gases. * Explains changes of state in terms of energy being gained or lost by a substance. * Explains some of the processes that contribute to climate change. * Demonstrates an understanding, through discussion, of the possible impact of climate change on the survival of living things. * States that when fossil fuels (hydrocarbons) burn in a plentiful supply of air they produce carbon dioxide and water. * Explains how carbon dioxide in the atmosphere has increased over time, for example, respiration of organisms, deforestation and increased combustion of fuels. * Describes how carbon dioxide in the atmosphere contributes to the greenhouse effect. * Describes some of the potential effects of global warming on living things and the human population. |
| **Space** | **By using my knowledge of our solar system and the basic needs of living things, I can produce a reasoned argument on the likelihood of life existing elsewhere in the universe.**  **SCN 3-06a** | * Explains that habitable environments provide organisms with a dependable supply of the basic needs for life, for example, liquid water, nutrients, oxygen and energy. * Produces a reasoned argument on the likelihood of life existing elsewhere in the universe including factors such as: the distance of planets from their stars, the number of stars in the universe and the availability of liquid water, nutrients and energy. |
| **Forces, electricity and waves** | **Forces** | **By contributing to investigations of energy loss due to friction, I can suggest ways of improving the efficiency of moving systems.**  **SCN 3-07a** | * Explains through investigation, situations where friction works against movement, and how this can result in an energy loss and therefore lower efficiency. * Understands, through investigation, how lubrication, streamlining and other methods can be used to reduce friction, reducing the energy lost and improving efficiency. * States, from experience, where friction is useful in restraining movement, for example, grips, tyres, parachutes or brakes. |
| **I have collaborated in investigations into the effects of gravity on objects and I can predict what might happen to their weight in different situations on Earth and in space.**  **SCN 3-08a** | * Understands that the quantity of matter which makes up an object is called its mass, measured in *kg*. * States that weight is a force caused by the Earth’s (or other planet’s) gravitational pull on an object, measured in Newtons. * Uses the formula *W = mg* to calculate weight. * Predicts, through research, the effects on the weight of an object due to the gravitational field strength in different positions in the Universe, for example, at different altitudes on earth, on different planets and in deep space. |
| **Electricity** | **Having measured the current and voltage in series and parallel circuits, I can design a circuit to show the advantages of parallel circuits in an everyday application.**  **SCN 3-09a** | * Describes current as the movement of electrical charge around a circuit. * Describes voltage as a measure of the energy given to the charges. * Uses electrical symbols for an ammeter and voltmeter appropriately. * Describes the features of series and parallel circuits. * Explains the differences in the operation of series and parallel circuits. * Measures voltages and currents in series and parallel circuits using the appropriate equipment and units. * Designs a circuit to demonstrate advantages of parallel circuits in an everyday application. |
| **I can help to design simple chemical cells and use them to investigate the factors which affect the voltage produced.**  **SCN 3-10a** | * Uses the terms electrode and electrolyte correctly and understand their functions in a simple chemical cell. * Discovers, through investigating with others, that electricity can be produced when different metals are used as electrodes, with an electrolyte between them. * Designs a simple chemical cell. * Investigates the effect of a factor, for example, combination of metal electrodes, the electrolyte used, the electrolyte concentration, the distance between electrodes and surface area of electrodes, on the voltage produced by a simple chemical cell. * Demonstrates an understanding of how the design of the cell will affect the voltage produced. |
| **Vibrations and waves** | **By exploring the refraction of light when passed through different materials, lenses and prisms, I can explain how light can be used in a variety of applications.**  **SCN 3-11a** | * Demonstrates through practical investigation that refraction causes a change in direction of light as it passes from one material to another. * Investigates, by experiment, the refraction of light as it passes from air to glass and glass to air. * Explores, by describing their effect on parallel rays of light, the use of converging and diverging lenses. * Researches the use of refraction in everyday situations, for example corrective lenses in glasses, magnifying glasses, optical instruments. * Investigates dispersion and describes the production of a visible spectrum as light passes through a prism. |
| **By exploring radiations beyond the visible, I can describe a selected application, discussing the advantages and limitations.**  **SCN 3-11b** | * Describes the electromagnetic spectrum as a family of waves including Gamma Rays, X-Rays, Ultraviolet, Visible Light, Infra-red, Microwaves, Television and Radio. * Researches at least one application of an electromagnetic wave beyond the visible in everyday life, giving advantages and limitations of that application. |
| **Biological systems** | **Body systems and cells** | **I have explored the structure and function of organs and organ systems and can relate this to the basic biological processes required to sustain life.**  **SCN 3-12a** | * Identifies the structure of at least three of the major organ systems, for example, Respiratory, Circulatory, Digestive, Excretory, Reproductive and Skeletal. * Explain the functions of at least three major organ systems in relation to sustaining life. |
| **I have explored the role of technology in monitoring health and improving the quality of life.**  **SCN 3-12b** | * Uses a variety instruments to monitor aspects of health, for example, pulse rate, blood pressure and recovery rate. * Gives examples of other aspects of health that may be monitored, for example, cholesterol and BMI. * Researches at least one way that a condition is screened for (for example, bowel cancer, macular degeneration and diabetes) and describes its symptoms. |
| **Using a microscope, I have developed my understanding of the structure and variety of cells and of their functions.**  **SCN 3-13a** | * Uses a microscope to study a variety of cells. * Describes cells as the basic unit of life. * Identifies the structures found in plant and animal cells and their functions. * Describes the main similarities and differences between plant and animal cells. * Explores, through research, and can describe the structure and function of a specialised cell, for example, nerve, root hair, red blood cell, sperm and egg. |
| **I have contributed to investigations into the different types of microorganisms and can explain how their growth can be controlled.**  **SCN 3-13b** | * Gives examples of micro-organisms (including a selection of bacteria and fungi). * Describes the essential resources that micro-organisms need to grow and reproduce, for example, food, water, warm temperature and a suitable pH. * Investigates and describes the conditions and chemicals that can promote and restrict growth, including temperature, antibiotics and antifungals. |
| **I have explored how the body defends itself against disease and can describe how vaccines can provide protection.**  **SCN 3-13c** | * Explains how microbes, for example, bacteria and viruses, can cause disease and infection. * Describes the barriers to infection as a first line of defence, for example, skin, mucus and stomach acids. * States how the immune system protects the body against disease if the first line of defence is breached, for example, white blood cells and production of antibodies. * Explores and explains how vaccinations can protect individuals and populations from disease. |
| **Inheritance** | **I understand the processes of fertilisation and embryonic development and can discuss possible risks to the embryo.**  **SCN 3-14a** | * States that a sex cell (gamete) contains half the genetic information needed to a make a complete individual. * States that fertilisation is the process of fusing the nuclei of an egg and a sperm (sex cells). * States that the fertilised egg divides repeatedly to form an embryo. * Identifies the main structures within the pregnant womb (for example, placenta, amniotic fluid and umbilical cord) and describes their function. * States that substances such as nutrients, oxygen, carbon dioxide, toxins, waste and viruses move across the placenta. * Gives examples of toxins which can cross the placenta from the mother to the embryo and demonstrates understanding of the potential damage to the embryo, for example, foetal alcohol syndrome. |
| **I have extracted DNA and understand its function. I can express an informed view of the risks and benefits of DNA profiling.**  **SCN 3-14b** | * Participates in the extraction of DNA from living cells. * States that DNA is found in the nucleus of most cells. * States that DNA contains the instructions for the development and function of living things and state that this is called the genetic code. * States that a gene is a piece of DNA which control specific characteristics in an individual. * States that every individual has a unique combination of genes. * Explains that DNA profiling is a way of analysing DNA to see a unique pattern for an individual. * Presents arguments on some of the applications of DNA profiling, for example, paternity tests and forensics. * Discusses the ethical implications of collection, processing, storage and ownership of genetic information or DNA profiles.   ***Possible links to Topical Science 3-20b*** |
| **Materials** | **Properties and uses of substances** | **I have developed my knowledge of the Periodic Table by considering the properties and uses of a variety of elements relative to their positions.**  **SCN 3-15a** | * Identifies metals and non-metals on the Periodic Table. * Investigates and describes properties of metals and non-metals, for example, appearance, conductivity of electricity and their uses linked to their properties. * States that elements are organised in the Periodic Table by atomic number, each with its own unique symbol. * States that elements with similar chemical properties are placed together in vertical groups. * Identifies and names the groups alkali metals, halogens and noble gases. * Describes reactivity of alkali metals, halogens and noble gases. |
| **Having contributed to a variety of practical activities to make and break down compounds, I can describe examples of how the properties of compounds are different from their constituent elements.**  **SCN 3-15b** | * Investigates and describes at least three examples of compounds with properties that are different from their constituent elements, for example, hydrogen explosion and electrolysis of water. * Constructs names of two-element compounds which are derived from the names of the elements, from which it is formed, with a suffix of –ide. * Constructs word equations for simple reactions, for example, carbon reacting with oxygen: carbon + oxygen  carbon dioxide. |
| **I can differentiate between pure substances and mixtures in common use and can select appropriate physical methods for separating mixtures into their components.**  **SCN 3-16a** | * Identifies elements present from simple molecular formulae. * Names examples of pure substances and mixtures from everyday life. * Identifies pure substances and mixtures from particle diagrams. * Investigates and describes appropriate physical methods to separate mixtures into their components, for example, distillation, filtration and chromatography. |
| **I have taken part in practical investigations into solubility using different solvents and can apply what I have learned to solve everyday practical problems.**  **SCN 3-16b** | * Investigates and describes the solubility of substances in different solvents, for example, water and acetone/propanone. * Uses terms solute, solvent and solution correctly in context. * Describes how changing the relative quantity of solute or solvent changes the concentration of a solution. |
| **Earth’s materials** | **Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rocks.**  **SCN 3-17a** | * Describes the rock cycle to include the formation and characteristics of sedimentary, igneous and metamorphic rocks. * Describes at least one use each of sedimentary, igneous and metamorphic rocks. * Describes at least one characteristic of loam, sand and clay soil types. * States uses of soil, for example, in agriculture and in building and beauty products. * Researches the formation, characteristics and uses of at least two common minerals, for example quartz or gypsum. |
| **I can participate in practical activities to extract useful substances from natural resources.**  **SCN 3-17b** | * Investigates and describes the extraction of at least one useful substance from natural resources, for example, metal from mineral ores, dyes from plants and oils from plants. |
| **Chemical changes** | **Having taken part in practical activities to compare the properties of acids and bases, I have demonstrated ways of measuring and adjusting pH and can describe the significance of pH in everyday life.**  **SCN 3-18a** | * States the names and uses of at least two everyday acids and bases. * Describes at least two differences between acids and bases. * States that indicators, such as universal indicator, are chemicals which produce different colours when placed in acid and bases. * Investigates and describes the colour changes of indicators when added to acid/bases. * Describes the pH scale as a continuous coloured number scale from below zero to above fourteen. * Investigates and describes the pH of some everyday substances. * Identifies substances as acidic (pH of less than 7), alkaline (pH greater than 7) or neutral (equal to 7). * Investigates and describes what happens to the pH when and acid is added to an alkali. |
| **Through experimentation, I can identify indicators of chemical reactions having occurred. I can describe ways of controlling the rate of reactions and can relate my findings to the world around me.**  **SCN 3-19a** | * Identifies chemical reactions by changes in appearance of a substance including colour change, precipitate formation, release of gas, and / or a detectable energy change. * Gives examples of everyday chemical reactions, for example, rusting, neutralisation and combustion. * States that a physical change does not result in a new substance being formed. * Gives examples of at least two physical changes, for example, changes of state, dissolving, distilling and crystallisation. * Describes the difference between a chemical reaction and a physical change. * Investigates and describes the effect of particle size, concentration and temperature on the rate of a reaction. * States that decreased particle size, increased concentration and increased temperature can increase the speed of a reaction. * States that catalysts are substances that speed up a chemical reaction but can be recovered unchanged. * Provides at least one example of a reaction involving a catalyst, for example, manganese dioxide on the breakdown of hydrogen peroxide. * States that an enzyme is a biological catalyst which allows chemical reactions to occur quickly in living organisms. * Provides at least one example of a reaction involving an enzyme, for example, amylase on starch. * Describes the economic importance of catalysts to industry, for example, reducing energy costs. |
| **I have helped to design and carry out practical activities to develop my understanding of chemical reactions involving the Earth’s materials. I can explain how we apply knowledge of these reactions in practical ways.**  **SCN 3-19b** | * Describes chemical reactions involving the Earth’s materials including metal corrosion and carbonate rocks reacting with acid. * States that corrosion is a chemical reaction involving a metal, oxygen and water. * States that rusting is a form of corrosion involving iron corroding. * Investigates and describes the factors that influence the speed of corrosion. * Provides at least one example of the economic implication of corrosion, for example, the cost of slowing corrosion on car bodies. * Investigates and describes at least three practical ways of preventing corrosion, for example, painting, oiling, anodising, galvanising and electroplating. * Investigates and describes the effect of acid rain on different types of rocks. * Describes the consequences of the reaction of acids and carbonate rocks. * Constructs simple word equations for the processes of corrosion and the reaction of carbonate rocks with acid. |
| **Topical science** | **Topical science** | **I have collaborated with others to find and present information on how scientists from Scotland and beyond have contributed to innovative research and development.**  **SCN 3-20a** | * Collaborates with others to research how scientists, and those who use science in their jobs, have contributed to the development of scientific ideas. * Communicates findings in a suitable way to give an example of how scientists have contributed to innovative research and development. * Gives examples of how skills developed through science are used in a wide variety of jobs and careers including Science, Technology and Engineering and Mathematics (STEM) careers. |
| **Through research and discussion, I have contributed to evaluations of media items with regard to scientific content and ethical implications.**  **SCN 3-20b** | * Researches and discusses scientific issues featured in the media. * Demonstrates understanding of bias and can separate fact from opinion taking into account a range of reasons for bias, for example, selective sampling and political views. * Evaluates the scientific content and ethical implications of the scientific issue. |

**Benchmarks for Assessment – Fourth Level Sciences**

*At Fourth Level, it is anticipated that learners will demonstrate these skills independently.*

|  |  |
| --- | --- |
| **Skills** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Inquiry and investigative skills** | *Plan and design scientific investigations and enquiries*   * Devises an experimental aim. * Identifies the independent, dependent and controlled variables. * Selects an appropriate method for measuring the dependent variable. * Anticipates almost all risks and hazards and plans for them. * Designs a procedure for carrying out the investigation independently. * Selects a suitable range of values for the independent variable.   *Carry out practical activities*   * Applies safety measures to control all risks and hazards identified. * Collects accurate measurements using appropriate method identified. * Uses correct units for measurements. * Records data in an appropriate way.   *Analyse, interpret and evaluate scientific findings*   * Makes use of suitable graph or diagram to look for trends in the data. * Interprets and analyses data and information to establish relationships between the independent and dependent variables and links to the original hypothesis. * Describes any trend in the data collected. * Links the trend(s) in the results to the aim of the investigation and formulates an appropriate conclusion with supporting data. * Evaluates the investigation giving at least two ways of improving the work if repeated, with justification. * Recognises anomalous results and suggests possible sources of error.   *Presents scientific findings*   * Shares their scientific findings in an appropriate manner taking into account their audience. * Summarises data and information from a minimum three sources as supporting evidence, for example, quotes. * Acknowledges all sources used in an appropriate format, for example, full URLs. |
| **Scientific analytical thinking skills** | * Applies scientific thinking skills while working with unfamiliar and complex contexts. * Applies knowledge and understanding from different areas of science together to solve problems. * Makes use of the engineering process in practical work to design, construct a model, test and modify the design to improve the solution. * Provides explanations supported by evidence and includes discussion of anomalous results. |
| **Skills and attributes of scientifically literate citizens** | *Although these mirror the skills at Third Level it is anticipated that learners would demonstrate these independently. Also, at this level, it would be expected that the content and arguments would be more complex and sophisticated.*   * Demonstrates understanding of the impact of science on society. * Discusses the moral and ethical implications of some scientific developments. * Expresses informed views about topical scientific issues, including those featured in the media, based on evidence. * Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts. * Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations, including Science, Technology and Engineering and Mathematics (STEM) careers. * Demonstrates increased awareness of creativity and inventiveness in science and the use of technologies in the development of sciences. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Curriculum Organisers** | | **Experiences and Outcomes**  **for planning learning, teaching and assessment** | **Benchmarks**  **to support teachers’ professional judgement of achievement of a level** |
| **Planet Earth** | **Biodiversity**  **and interdependence** | **I understand how animal and plant species depend on each other and how living things are adapted for survival. I can predict the impact of population growth and natural hazards on biodiversity.**  **SCN 4-01a** | * Uses the terms ‘population’, ‘community’, ‘niche’ and ‘species’ correctly. * States that plants and animals depend on each other for food, shelter and pollination. * Explains the possible effects of removal or addition of one species upon other species * Describes the consequences to biodiversity of food webs being disrupted. * Provides examples of structural, physiological and behavioural adaptations which lead to species survival. * Provides an example of a natural hazard and describes its effect on biodiversity. * Describes the effects of the increasing world population on biodiversity and food security. |
| **I have propagated and grown plants using a variety of different methods. I can compare these methods and develop my understanding of their commercial use.**  **SCN 4-02a** | * Uses both natural and artificial techniques to propagate plants, for example, seeds, bulbs, cuttings and other plant parts. * Compares the results of these methods to suggest commercial uses, for example, food production and food security. |
| **I can contribute to the design of an investigation to show the effects of different factors on the rate of aerobic respiration and explain my findings.**  **SCN 4-02b** | * Designs and carries out an experiment to investigate the effect of different factors on the rate of respiration, for example, temperature. * Explains, using experimental findings, the effect of different factors on the rate of respiration. |
| **Through investigating the nitrogen cycle and evaluating results from practical experiments, I can suggest a design for a fertiliser, taking account of its environmental impact.**  **SCN 4-03a** | * Describes the Nitrogen cycle and explains the importance of each stage. * Uses an experiment to show the importance of Nitrogen for plant growth, for example algal growth * Uses information about essential plant nutrients to design a fertiliser * States possible impacts of the use of fertilisers, for example, eutrophication and algal blooms. |
| **Energy sources and sustainability** | **By contributing to an investigation on different ways of meeting society’s energy needs, I can express an informed view on the risks and benefits of different energy sources, including those produced from plants.**  **SCN 4-04a** | * Investigates and discusses the risks and benefits of different energy sources including at least one energy source derived from plants. |
| **Through investigation, I can explain the formation and use of fossil fuels and contribute to discussions on the responsible use and conservation of finite resources.**  **SCN 4-04b** | * Describes the formation of fossil fuels from the decayed and fossilised remains of plants and animals that lived millions of years ago. * Explains that fossil fuels are a finite resource. * Discusses, through research, the use for and need to conserve supplies of fossil fuels. |
| **Processes of the planet** | **I have developed my understanding of the kinetic model of a gas. I can describe the qualitative relationships between pressure, volume and temperature of gases.**  **SCN 4-05a** | * States the definition of the term ‘pressure’. * Calculates the pressure exerted by a force over an area using the relationship *P = F / A.* * Describes, from experimental observation, the relationships between pressure, volume and temperature for a gas. |
| **Through exploring the carbon cycle, I can describe the processes involved in maintaining the balance of gases in the air, considering causes and implications of changes in the balance.**  **SCN 4-05b** | * Describes the sequence of processes in the carbon cycle. * Explains how processes, for example, respiration, photosynthesis and burning carbon-based fuels, affect the balance of gases in the air. * Explores and describes, through research, the effects of changes in the balance of gases in the air. |
| **Space** | **By researching developments used to observe or explore space, I can illustrate how our knowledge of the universe has evolved over time.**  **SCN 4-06a** | * Describes the operation of an optical telescope, for example, reflecting or refracting telescopes. * Researches and describes advances in techniques for viewing the Universe, for example, radio telescopes, emission spectra and gravitational wave detection. * Gives some advantages of placing optical telescopes in orbit, for example, larger range due to less absorption and less interference (atmospheric distortion). * Discusses, following research, how discoveries made through observations have improved our knowledge of the Universe. |
| **Forces, electricity and waves** | **Forces** | **I can use appropriate methods to measure, calculate and display graphically the speed of an object, and show how these methods can be used in a selected application.**  **SCN 4-07a** | * Uses data, from experiments, to produce speed time graphs. * Interprets speed time graphs to accurately describe motion. * Calculates acceleration and distance travelled from a speed time graph. |
| **By making accurate measurements of speed and acceleration, I can relate the motion of an object to the forces acting on it and apply this knowledge to transport safety.**  **SCN 4-07b** | * Produces, by experiment, measurements of speed and acceleration. * Explains the motion of objects in situations involving constant acceleration, using Newton’s Second Law. * Applies knowledge of Newton’s Second Law to transport safety, for example, braking distances, seatbelts, airbags and other design features. |
| **I can help to design and carry out investigations into the strength of magnets and electromagnets. From investigations, I can compare the properties, uses and commercial applications of electromagnets and supermagnets.**  **SCN 4-08a** | * Investigates a range of factors affecting the strength of electromagnets, for example number of coils, size of current, core material or dimensions. * Compares model electromagnets with those used in real life applications looking for similarities and differences. * Discusses uses of supermagnets, for example, in MRI machines, computer hard drives, electric and hybrid motors, audio speakers, electric guitars, and race car engines. |
| **Through experimentation, I can explain floating and sinking in terms of the relative densities of different materials.**  **SCN 4-08b** | * Calculates the density of a range of materials using the relationship *Density = mass / volume.* * Investigates the densities of materials to explain their ability to float or sink. |
| **Electricity** | **Through investigation, I understand the relationship between current, voltage and resistance. I can apply this knowledge to solve practical problems.**  **SCN 4-09a** | * Investigates the electrical properties of at least one fixed resistor to determine the relationship R = V / I. * Applies the relationship R = V / I to solve practical problems in circuits. |
| **By contributing to investigations into the properties of a range of electronic components, I can select and use them as input and output devices in practical electronic circuits.**  **SCN 4-09b** | * Demonstrates understanding of the properties of input devices, for example, variable and light dependent resistors, thermistors and switches. * Demonstrates understanding of the operation of output devices, for example, bulbs, LEDs, motors and relays. |
| **Using my knowledge of electronic components and switching devices, I can help to engineer an electronic system to provide a practical solution to a real-life situation.**  **SCN 4-09c** | * Demonstrates understanding of the properties of switching devices, for example, transistors and logic gates. * Designs and constructs an electronic circuit, using appropriate electronic components and switching devices, to solve a practical problem. |
| **Using experimental evidence, I can place metals in an electrochemical series and can use this information to make predictions about their use in chemical cells.**  **SCN 4-10a** | * Investigates simple electrochemical cells using paired metals to compare voltage and direction of electron flow. * Constructs an electrochemical series using the voltage difference between pairs of metals. * Selects appropriate metals for a practical application of an electrochemical cell. |
| **Using a variety of sources, I have explored the latest developments in chemical cells technology and can evaluate their impact on society.**  **SCN 4-10b** | * Researches and demonstrates awareness of the developments in cell technology for example, in relation to fuel cells. * Communicates findings from research into an application of chemical cells and its impact on society. |
| **Vibrations and waves** | **By recording and analysing sound signals, I can describe how they can be manipulated and used in sound engineering.**  **SCN 4-11a** | * Records and analyses sound wave traces on an oscilloscope or similar. * Interprets sound wave traces to describe changes in amplitude/volume and frequency/pitch. * Describes how sound signals can be used in sound engineering. |
| **By carrying out a comparison of the properties of parts of the electromagnetic spectrum beyond the visible, I can explain the use of radiation and discuss how this has impacted upon society and our quality of life.**  **SCN 4-11b** | * Researches a non-visible member of the electromagnetic spectrum finding its common properties (speed, propagation), its individual properties (range of frequencies/wavelengths/energies) and its uses. * Uses information on other members of the electromagnetic spectrum to compare their common properties, ranges and uses in society. * Discusses benefits and risks for at least one use of a member of the electromagnetic spectrum. |
| **Biological systems** | **Body systems and cells** | **I can explain how biological actions which take place in response to external and internal changes work to maintain stable body conditions.**  **SCN 4-12a** | * Describes the changes in the body in response to an external stimuli, for example, change in temperature. * Describes the changes in the body in response to an internal change, for example, water balance and the kidneys and the action of insulin in relation to the regulation of glucose. * Explains the importance of these changes on the normal working conditions of the body (homeostasis). |
| **Through investigation, I can explain how changes in learned behaviour due to internal and external stimuli are of benefit to the survival of species.**  **SCN 4-12b** | * Describes methods of learned behaviour in organisms, for example, the effect of light on the behaviour of woodlice, and can explain how this behaviour contributes to their survival. |
| **By researching cell division, I can explain its role in growth and repair and can discuss how some cells can be used therapeutically.**  **SCN 4-13a** | * Describes the process of cell division. * Explains why cell division is required for growth and repair in organisms. * Describes the basic features of a stem cell. * Researches and describes at least one therapeutic use of stem cells. |
| **I have taken part in practical activities which involve the use of enzymes and microorganisms to develop my understanding of their properties and their use in industries.**  **SCN 4-13b** | * Describes the properties and industrial uses of at least one micro-organism, for example, the use of yeast in brewing or the production of biofuels, bacteria used for yogurt production. * Describes the properties of at least one enzyme used in industry, for example, enzymes within biological detergents and stain removal or pectinase in the breakdown of plant material to release juice. |
| **I can debate the moral and ethical issues associated with some controversial biological procedures.**  **SCN 4-13c** | * Formulates an argument, using correct scientific vocabulary, to debate moral and ethical issues of the chosen controversial biological procedure, for example, the collection and use of stem cells and DNA profiling.   *Possible links with SCN 4-20b, and skills* |
| **Inheritance** | **Through investigation, I can compare and contrast how different organisms grow and develop.**  **SCN 4-14a** | * Investigates and researches the life cycles of at least two organisms and can compare and contrast their related to their growth and development. |
| **Through evaluation of a range of data, I can compare sexual and asexual reproduction and explain their importance for survival of species.**  **SCN 4-14b** | * Evaluates data and identifies differences in organisms that practice sexual reproduction (for example, differences between internal and external fertilisation) and can explain their importance for survival of species. * Evaluates and compares data and information on sexual and asexual reproduction (for example, rate of reproduction and numbers of organisms) and can explain the importance of both methods for survival of species. |
| **I can use my understanding of how characteristics are inherited to solve simple genetic problems and relate this to my understanding of DNA, genes and chromosomes.**  **SCN 4-14c** | * Uses the terms ‘DNA’, ‘genes’ and ‘chromosomes’ correctly. * States that the genetic information received from parent(s) determines our physical characteristics. * Describes the importance of dominant and recessive genes. * Produces a worked example to solve a simple genetic problem, for example, a monohybrid cross to show the passage of genes from parents to offspring. |
| **Materials** | **Properties and uses of substances** | **Through gaining an understanding of the structure of atoms and how they join, I can begin to connect the properties of substances with their possible structures.**  **SCN 4-15a** | * Describes the structure of an atom to include protons, neutrons and electrons each with a specific charge, mass and position within the atom. * States atoms do not have an electric charge and are said to be neutral. * Constructs diagrams and models to illustrate the sharing of outer electrons in covalent bonds between non-metal atoms when forming molecules. * States that ionic compounds form when metals bond with non-metals by transferring electron(s) from the metal to the non-metal. * States ions are charged particles and an ionic bond is the electrostatic attraction between positively charged metal ions and negatively charged non-metal ions. * Constructs diagrams and models to illustrate that ionic compounds exist as a crystal lattice. * Identifies from temperature data the relationship between melting and boiling points, and the state at room temperature for covalent and ionic compounds. * Investigates and describes electrical conductivity for covalent and ionic compounds. * Identifies the most likely type of bonding in a compound based on its properties, for example, melting and boiling points and electrical conductivity. |
| **I have carried out research into novel materials and can begin to explain the scientific basis of their properties and discuss the possible impacts they may have on society.**  **SCN 4-16a** | * Gives examples of at least two novel materials. * Explains the relationship between the uses of a novel material and their properties. * Describes a recent application of a novel material and its possible impact on society. |
| **Through evaluation of experimental results, I can demonstrate my understanding of conservation of mass.**  **SCN 4-16b** | * Investigates and describes weighing the mass of reactants and products of at least two chemical reactions, for example, burning iron wool, making magnesium oxide or precipitation of ionic salts. * States that mass is never lost or gained in chemical reactions and that mass is always conserved. |
| **Earth’s materials** | **I have explored how different materials can be derived from crude oil and their uses. I can explain the importance of carbon compounds in our lives.**  **SCN 4-17a** | * States that crude oil is a mixture of compounds called hydrocarbons, containing only carbon and hydrogen. * Investigates and describes fractional distillation as a process of separating crude oil into ‘fractions’. * States that ‘fractions’ are groups of compounds with similar boiling points. * Names at least two distilled crude oil fractions and their uses. * Identifies and describes at least three everyday substances that are made from hydrocarbons, for example, petrol for fuel, camping gas or plastics. |
| **Chemical changes** | **I can monitor the environment by collecting and analysing samples. I can interpret the results to inform others about levels of pollution and express a considered opinion on how science can help to protect our environment.**  **SCN 4-18a** | * Describes how samples can be collected from the environment, for example, air, water or soil, in order to monitor pollution. * Analyses and communicates findings from environmental sample data to identify the quantities of pollutants present, and identify the harm caused to the environment. * Gives at least one reason for the presence of a pollutant in an environmental sample. * Describes at least one environmental change which may occur as a result of the presence of a pollutant. |
| **I can collect and analyse experimental data on chemical reactions that result in an obvious change in energy. I can apply my findings to explain the significance of the energy changes associated with chemical reactions.**  **SCN 4-19a** | * Investigates and describes at least one experiment where the measured   temperature change of a reaction is found to be increasing.   * States that an exothermic chemical reaction gives out energy. * Investigates and describes at least one experiment where the measured temperature change of a reaction is found to be decreasing. * States that an endothermic chemical reaction takes in energy. * Identifies, on at least two occasions, where a chemical reaction as either exothermic or endothermic from analysis of temperature data. |
| **Having carried out a range of experiments using different chemicals, I can place metals in an order of reactivity, and relate my findings to their everyday uses.**  **SCN 4-19b** | * Investigates and describes at least four metals reacting with oxygen to produce oxides, with water to produce hydroxides and with a dilute acid to produce hydrogen gas and aqueous salts. * Uses data from experiments involving metals reacting with oxygen, water and a dilute acid to list metals in order of reactivity. * Constructs simple formulae equations describing reactions of metals with oxygen, water and a dilute acid. * Investigates and describes three methods of extracting metals from their compound ores as: * Heating alone, for example, with silver oxide * Heating with carbon, for example, with copper oxide * Electrolysis, for example, lead bromide (possible demonstration). * Identifies the appropriate extraction method for a metal depending on the position of the metal in the reactivity series. * Investigates and explains through experiments how the rate of corrosion of iron can be changed by with another metal. * Describes situations where metals above iron in the reactivity series are used to sacrificially protect iron from corrosion. |
| **Topical science** | **Topical science** | **I have researched new developments in science and can explain how their current or future applications might impact on modern life.**  **SCN 4-20a** | * Researches and communicates developments in science, explaining how current and future applications might impact on life. * Gives examples of how skills developed through the sciences are used in a wide variety of jobs and careers including Science, Technology and Engineering and Mathematics (STEM) careers. |
| **Having selected scientific themes of topical interest, I can critically analyse the issues, and use relevant information to develop an informed argument.**  **SCN 4-20b** | * Selects and analyses scientific content of topical interest from a range sources, including the media. * Identifies examples of bias in sources and can justify decisions in separating fact from opinion. * Critically analyses the scientific issue and gives consideration to the ethical, moral, environmental, social or political implications of the scientific theme selected to develop an informed argument. |