curriculum for excellence: sciences

experiences and outcomes

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Experiences and outcomes

The sciences framework provides a range of different contexts for learning which draw on important aspects of everyday life and work.

Learning in the sciences will enable me to:

- develop curiosity and understanding of the environment and my place in the living, material and physical world
- demonstrate a secure knowledge and understanding of the big ideas and concepts of the sciences
- develop skills for learning, life and work
- develop the skills of scientific inquiry and investigation using practical techniques
- develop skills in the accurate use of scientific language, formulae and equations
- apply safety measures and take necessary actions to control risk and hazards
- recognise the impact the sciences make on my life, the lives of others, the environment and on society
- recognise the role of creativity and inventiveness in the development of the sciences
- develop an understanding of the Earth's resources and the need for responsible use of them
- express opinions and make decisions on social, moral, ethical, economic and environmental issues based upon sound understanding
- develop as a scientifically-literate citizen with a lifelong interest in the sciences
- establish the foundation for more advanced learning and future careers in the sciences and the technologies.

Planet Earth

	Early	First	Second	Third	Fourth
Biodiversity and interdependence Learners explore the rich and changing diversity of living things and develop their understanding of how organisms are interrelated at local and global levels. By exploring interactions and energy flow between plants and animals (including humans) learners develop their understanding of how species depend on one another and on the environment for survival. Learners investigate the factors affecting plant growth and develop their understanding of the positive and negative impact of the human population on the environment.	I have observed living things in the environment over time and am becoming aware of how they depend on each other. **SCN 0-01a**	I can distinguish between living and non living things. I can sort living things into groups and explain my decisions. **SCN 1-01a**	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**	I can sample and identify living things from different habitats to compare their biodiversity and can suggest reasons for their distribution. **SCN 3-01a**	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**
		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**	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** Through carrying out practical activities and investigations, I can show how plants have benefited society. **SCN 2-02b**	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**	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** 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**

Planet Earth (continued)

	Early	First	Second	Third	Fourth
Biodiversity and interdependence (continued)	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	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	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	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	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

Planet Earth (continued)

	Early	First	Second	Third	Fourth
Energy sources and sustainability Learners explore types, sources and uses of energy and develop their understanding of how energy is transferred and conserved. They consider the relevance of these concepts to everyday life. They explore the nature and sustainability of energy sources and discuss benefits and assess possible risks to form an informed view of responsible energy use.	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**	I am aware of different types of energy around me and can show their importance to everyday life and my survival. **SCN 1-04a**	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** 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**	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** 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**	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** 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**
			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**		

Planet Earth (continued)

	Early	First	Second	Third	Fourth
Processes of the planet Learners explore the changing states of matter and the physical and chemical processes which influence Earth's atmosphere and oceans. They learn about climate change as a natural process in time as well as the result of human activity. Through connections with collaborative studies of landscape, weather and climate in social studies they build up an integrated picture of the dynamic nature of Earth.	By investigating how water can change from one form to another, I can relate my findings to everyday experiences. **SCN 0-05a / SCN 1-05a**		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**	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**	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** 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**

Planet Earth (continued)

	Early	First	Second	Third	Fourth
Space Learners develop their understanding of the Earth's position within the universe while developing a sense of time and scale. They develop their understanding of how our knowledge of the universe has changed over time and explore ideas of future space exploration and the likelihood of life beyond planet Earth.	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**	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**	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**	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**	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**

Forces, electricity and waves

	Early	First	Second	Third	Fourth
Forces Learners first develop an understanding of how forces can change the shape or motion of an object, considering both forces in contact with objects and those which act over a distance. They investigate the effects of friction on motion and explore ways of improving efficiency in moving objects and systems. Study of speed and acceleration of an object leads to an understanding of the relationship between its motion and the forces acting on it. This is linked to transport safety. Learners develop their understanding of the concept of buoyancy force and density.	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**	By investigating forces on toys and other objects, I can predict the effect on the shape or motion of objects. **SCN 1-07a**	By investigating how friction, including air resistance, affects motion, I can suggest ways to improve efficiency in moving objects. **SCN 2-07a**	By contributing to investigations of energy loss due to friction, I can suggest ways of improving the efficiency of moving systems. **SCN 3-07a**	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** 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**
		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**	I have collaborated in investigations to compare magnetic, electrostatic and gravitational forces and have explored their practical applications. **SCN 2-08a**	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**	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**

Forces, electricity and waves (continued)

	Early	First	Second	Third	Fourth
Forces (continued)			By investigating floating and sinking of objects in water, I can apply my understanding of buoyancy to solve a practical challenge. SCN 2-08b		Through experimentation, I can explain floating and sinking in terms of the relative densities of different materials. SCN 4-08b

Forces, electricity and waves (continued)

	Early	First	Second	Third	Fourth
Electricity The learner's knowledge about electricity begins with knowing how to use it safely and this aspect is reinforced throughout their learning. They develop their understanding of electricity as a means of transferring energy by investigating circuits and building chemical cells. Learners develop their understanding of series and parallel circuits and of electrical and electronic components and apply their knowledge to the process of designing, constructing, testing and modifying.	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**	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**	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**	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**	Through investigation, I understand the relationship between current, voltage and resistance. I can apply this knowledge to solve practical problems. **SCN 4-09a** 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** 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**

Forces, electricity and waves (continued)

	Early	First	Second	Third	Fourth
Electricity (continued)			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	I can help to design simple chemical cells and use them to investigate the factors which affect the voltage produced. SCN 3-10a	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 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

Forces, electricity and waves (continued)

	Early	First	Second	Third	Fourth
Vibrations and waves Learners explore the nature of sound, light and radiations in the electromagnetic spectrum. They use musical instruments to explore the relationship between vibrations and sounds produced. They develop their understanding of the properties of light and other forms of electromagnetic radiations. They explore how different waves relate to the environment and how we make use of them in health, medicine and communications.	Through play, I have explored a variety of ways of making sounds. **SCN 0-11a**	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**	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** 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**	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** By exploring radiations beyond the visible, I can describe a selected application, discussing the advantages and limitations. **SCN 3-11b**	By recording and analysing sound signals, I can describe how they can be manipulated and used in sound engineering. **SCN 4-11a** 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**

Biological systems

	Early	First	Second	Third	Fourth
Body systems and cells Learners develop their knowledge and understanding of the structure and function of organs of the body, including the senses. They learn about cells as the basic units of life, and their organisation to form familiar body systems. Through observation, research and practical investigation learners explore the risk and impact of microorganisms in relation to health, and then in industrial processes. They experience the use of technology in monitoring health and improving the quality of life and develop informed views on the moral and ethical implications of controversial biological procedures.	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**	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** I have explored my senses and can discuss their reliability and limitations in responding to the environment. **SCN 1-12b**	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 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** I have explored the role of technology in monitoring health and improving the quality of life. **SCN 3-12b**	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** 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**
		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**	I have contributed to investigations into the role of microorganisms in producing and breaking down some materials. **SCN 2-13a**	Using a microscope, I have developed my understanding of the structure and variety of cells and of their functions. **SCN 3-13a** I have contributed to investigations into the different types of microorganisms and can explain how their growth can be controlled. **SCN 3-13b**	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** 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**

Biological systems (continued)

	Early	First	Second	Third	Fourth
Body systems and cells (continued)				I have explored how the body defends itself against disease and can describe how vaccines can provide protection. SCN 3-13c	I can debate the moral and ethical issues associated with some controversial biological procedures. SCN 4-13c

Biological systems (continued)

	Early	First	Second	Third	Fourth
Inheritance Starting with observations of similarities and differences between individuals, learners develop their understanding of how organisms develop and pass on genetic information to the next generation. They begin to develop their knowledge of genetics and of the role of DNA and examine moral and ethical questions which arise from technological developments.	I recognise that we have similarities and differences but are all unique. **HWB 0-47a**	By comparing generations of families of humans, plants and animals, I can begin to understand how characteristics are inherited. **SCN 1-14a**	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**	I understand the processes of fertilisation and embryonic development and can discuss possible risks to the embryo. **SCN 3-14a** 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**	Through investigation, I can compare and contrast how different organisms grow and develop. **SCN 4-14a** 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** 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**

Materials

	Early	First	Second	Third	Fourth
Properties and uses of substances By exploring the properties of different substances and how they can be changed, learners gradually develop their understanding of the connection between structure and properties. They explore the development of new substances which have useful properties, and begin to relate physical and chemical properties to models of atomic structure. Learners begin to use symbols and chemical formulae as a way of communicating information about elements and compounds.	Through creative play, I explore different materials and can share my reasoning for selecting materials for different purposes. **SCN 0-15a**	Through exploring properties and sources of materials, I can choose appropriate materials to solve practical challenges. **SCN 1-15a**	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 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** 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**	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**
		I can make and test predictions about solids dissolving in water and can relate my findings to the world around me. **SCN 1-16a**	I have participated in practical activities to separate simple mixtures of substances and can relate my findings to my everyday experience. **SCN 2-16a**	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**	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**

Materials (continued)

	Early	First	Second	Third	Fourth
Properties and uses of substances (continued)			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	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	Through evaluation of experimental results, I can demonstrate my understanding of conservation of mass. SCN 4-16b

Materials (continued)

	Early	First	Second	Third	Fourth
Earth's materials Learners develop their knowledge and understanding of substances that make up the Earth's surface. Properties, uses and methods of extraction of such materials are explored. Opportunities exist to discuss the importance of carbon compounds derived from crude oil to our lives.		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**	Having explored the substances that make up Earth's surface, I can compare some of their characteristics and uses. **SCN 2-17a**	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** I can participate in practical activities to extract useful substances from natural resources. **SCN 3-17b**	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**

Materials (continued)

	Early	First	Second	Third	Fourth
Chemical changes Learners gradually develop an understanding of chemical changes. They consider processes which take place in the environment and in the laboratory, and develop their understanding of the environmental impact of some changes. They develop their understanding of energy changes in chemical reactions and some of the factors affecting the rates of reactions. Learners develop the use of chemical names, formulae and equations as a way of conveying information about 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**	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**	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**
			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**	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** 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**	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** 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**

Topical science

	Early	First	Second	Third	Fourth
Topical science By considering current issues of science, learners increasingly develop their understanding of scientific concepts and their capacity to form informed social, moral and ethical views. They reflect upon and critically evaluate media portrayal of scientific findings.	I can talk about science stories to develop my understanding of science and the world around me. **SCN 0-20a**	I have contributed to discussions of current scientific news items to help develop my awareness of science. **SCN 1-20a**	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** I can report and comment on current scientific news items to develop my knowledge and understanding of topical science. **SCN 2-20b**	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** Through research and discussion, I have contributed to evaluations of media items with regard to scientific content and ethical implications. **SCN 3-20b**	I have researched new developments in science and can explain how their current or future applications might impact on modern life. **SCN 4-20a** 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**