Key Stages 2–4

Science

in the National Curriculum for Wales

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Welsh Assembly Government

Science in the National Curriculum for Wales

Audience

Teachers, headteachers and governing bodies of maintained schools in Wales; local education authorities; initial teacher training providers; teacher unions and school representative bodies; church diocesan authorities; national bodies in Wales with an interest in education.

Overview

This document sets out the Welsh Assembly Government's requirements for science in the national curriculum for Wales. It is issued pursuant to the powers contained in Section 108 of the Education Act 2002 and which are vested in the Welsh Ministers. The Welsh Ministers form part of the Welsh Assembly Government.

Action required

Teachers, headteachers and governing bodies of maintained schools must ensure that the legal requirements set out in this document are implemented in line with the dates specified in the Foreword.

Further information

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Contents

Foreword

This document sets out the revised national curriculum for **science** in Wales.

The structure of the national curriculum

The national curriculum applies to pupils of compulsory school age in maintained schools. It is organised on the basis of three key stages, which are broadly as follows*:

	Pupils' ages	Year groups
Key Stage 2	7–11	3–6
Key Stage 3	11–14	7–9
Key Stage 4	14–16	10–11

In Wales, the following subjects are included in the national curriculum at the key stages shown:

Key Stage 2	English, Welsh, mathematics, science, design and technology, information and communication technology, history, geography, art and design, music and physical education.
Key Stage 3	As at Key Stage 2, plus a modern foreign language.
Key Stage 4	English, Welsh, mathematics, science and physical education.

For each subject, in each of the key stages listed above, programmes of study set out what pupils should be taught and, for Key Stages 2 and 3, attainment targets set out the expected standards of pupils' performance.

At the end of Key Stages 2 and 3, standards of pupils' performance are set out in eight level descriptions of increasing difficulty, with an additional description above Level 8 to help teachers in differentiating Exceptional Performance.

At Key Stage 4, external qualifications are the main means of assessing attainment in the national curriculum. The Welsh Assembly Government publishes annually the list of qualifications that, under Section 96 of the Learning and Skills Act 2000, are approved for use with pupils of compulsory school age.

* The key stages are defined precisely in Section 103 of the Education Act 2002.

Including all learners

The revised national curriculum contains a section on including all learners which clarifies learner entitlement and schools' responsibilities.

Implementation dates

The revised programmes of study and attainment target for **science** become legal requirements by means of an Order made by the Welsh Assembly Government and come into effect on:

- 1 August 2008 for Years 3, 4 and 5, Years 7 and 8 and Years 10 and 11 in Key Stage 4
- 1 August 2009 for Year 6 and Year 9.

From these dates the existing national curriculum for **science** is superseded.

Welsh Assembly Government
January 2008

Including all learners

Responsibilities of schools

Under the United Nations Convention on the Rights of the Child and the Welsh Assembly Government's overarching strategy document *Rights to Action*, all children and young people must be provided with an education that develops their personality and talents to the full. The Education Act 2002 further strengthens schools' duty to safeguard and promote the welfare of all children and young people.

The equal opportunities legislation which covers age, disability, gender, race, religion and belief and sexual orientation further places a duty on schools in Wales towards present and prospective learners to eliminate discrimination and harassment, to promote positive attitudes and equal opportunities and encourage participation in all areas of school life.

Schools should develop in every learner a sense of personal and cultural identity that is receptive and respectful towards others. Schools should plan across the curriculum to develop the knowledge and understanding, skills, values and attitudes that will enable learners to participate in our multi-ethnic society in Wales. Schools should develop approaches that support the ethnic and cultural identities of all learners and reflect a range of perspectives, to engage learners and prepare them for life as global citizens.

Schools must work to reduce environmental and social barriers to inclusion and offer opportunities for all learners to achieve their full potential in preparation for further learning and life. Where appropriate, schools will need to plan and work with specialist services to ensure relevant and accessible learning experiences.

For learners with disabilities in particular, they should:

- improve access to the curriculum
- make physical improvements to increase participation in education
- provide information in appropriate formats.

Schools should seek advice regarding reasonable adjustments, alternative/adapted activities and appropriate equipment and resources, which may be used to support the full participation of all learners including those who use a means of communication other than speech.

For learners whose first language is neither English nor Welsh, schools should take specific action to help them learn both English and Welsh through the curriculum. Schools should provide learners with material that is appropriate to their ability, previous education and experience, and which extends their language development. Schools should also encourage the use of learners' home languages for learning.

Learner entitlement

Schools in Wales should ensure that all learners are engaged as full members of their school communities, accessing the wider curriculum and all school activities and working wherever possible alongside their peers. Schools should teach all programmes of study and frameworks in ways appropriate to learners' developing maturities and abilities and ensure that learners are able to use fully their preferred means of communication to access the curriculum. In order to extend their learning, learners should experience a variety of learning and teaching styles.

To enable all learners to access relevant skills, knowledge and understanding at an appropriate level, schools may use content from earlier phases or key stages within the curriculum. Schools should use material in ways suitable for the learners' age, experience, understanding and prior achievement to engage them in the learning process.

For learners working significantly below the expected levels at any key stage, schools should use the needs of the learner as a starting point and adapt the programmes of study accordingly. Sufficient flexibility exists within the curriculum to meet the needs of learners without the need for disapplication. In exceptional cases, individual learners may be disapplied, usually on a temporary basis, but group or large-scale disapplications should not be used.

Where it is not possible to cover the content of all of the programmes of study for each key stage, the statutory requirement to provide a broad, balanced curriculum can be met by selecting appropriate topics/themes from the curriculum as contexts for learning.

For more-able and talented learners working at higher levels, schools should provide greater challenge by using material in ways that extend breadth and depth of study and opportunities for independent learning. The level of demand may also be increased through the development and application of thinking, and communication, ICT and number skills across the curriculum.

Schools should choose material that will:

- provide a meaningful, relevant and motivating curriculum for their learners
- meet the specific needs of their learners and further their all-round development.

Learners of all abilities should have access to appropriate assessment and accreditation.

Skills across the curriculum

A non-statutory *Skills framework for 3 to 19-year-olds in Wales* has been developed in order to provide guidance about continuity and progression in developing thinking, communication, ICT and number for learners from 3–19.

At Key Stages 2 and 3, learners should be given opportunities to build on skills they have started to acquire and develop during the Foundation Phase. Learners should continue to acquire, develop, practise, apply and refine these skills through group and individual tasks in a variety of contexts across the curriculum. Progress can be seen in terms of the refinement of these skills and by their application to tasks that move from: concrete to abstract; simple to complex; personal to the 'big picture'; familiar to unfamiliar; and supported to independent and interdependent.

For 14–19 learners, the framework should provide the basis for making effective progress in these skills, which can be assessed through a range of qualifications, including Key Skills.

Developing thinking

Learners develop their thinking across the curriculum through the processes of **planning**, **developing** and **reflecting**.

In **science**, learners follow the processes of planning, developing and reflecting in all areas of Enquiry, through which the Range is taught. Focused paired/group work allows such processes to be articulated within lessons so that learning and thinking strategies can be developed and applied to new situations leading to high quality outcomes.

Developing communication

Learners develop their communication skills across the curriculum through the skills of **oracy**, **reading**, **writing** and **wider communication**.

In **science**, learners communicate ideas, information and data in a variety of ways depending on the nature of the task, audience, purpose and the learners' own preferences. Communication can take a wide variety of forms, including the use of IT at times, and with increasing maturity should show progression in the use of scientific terminology, symbols and conventions and a more logical, systematic approach.

Developing ICT 

Learners develop their ICT skills across the curriculum by **finding**, **developing**, **creating and presenting information and ideas** and by using a wide range of equipment and software.

In **science**, learners use ICT for a number of purposes. They search for, access, collect, process and analyse relevant scientific evidence, information, ideas and data. They use ICT to present their evidence, information, ideas and data in the most appropriate form.

Developing number 

Learners develop their number skills across the curriculum by **using mathematical information**, **calculating**, **and interpreting and presenting findings**.

In **science**, learners work quantitatively to estimate and measure using non-standard and then standard measures, recording the latter with appropriate S.I. units. They use tables, charts and graphs to record and present information. With increasing maturity they draw lines of best fit on line graphs, use some quantitative definitions and perform scientific calculations.

Learning across the curriculum

At Key Stages 2 and 3, learners should be given opportunities to build on the experiences gained during the Foundation Phase, and to promote their knowledge and understanding of Wales, their personal and social development and well-being, and their awareness of the world of work.

At Key Stage 4, learners' knowledge and understanding should be developed and applied within the contexts of their individual 14–19 pathways including the Learning Core.

Curriculum Cymreig (7–14) and Wales, Europe and the World (14–19)

Learners aged 7–14 should be given opportunities to develop and apply knowledge and understanding of the cultural, economic, environmental, historical and linguistic characteristics of Wales. Learners aged 14–19 should have opportunities for active engagement in understanding the political, social, economic and cultural aspects of Wales as part of the world as a whole. For 14–19 learners, this is a part of their Learning Core entitlement and is a requirement at Key Stage 4.

Science contributes to the Curriculum Cymreig by the use of contexts that are relevant to learners' lives in Wales. The rich and varied environment around learners gives the basis for fieldwork. Learners have the opportunity to study recycling, sustainability and the impact of humans within their locality and further afield.

Personal and social education

Learners should be given opportunities to promote their health and emotional well-being and moral and spiritual development; to become active citizens and promote sustainable development and global citizenship; and to prepare for lifelong learning. For 14–19 learners, this is a part of their Learning Core entitlement and is a requirement at Key Stage 4.

Science contributes to learners' personal and social education by helping them to make sense of issues within their lives and others' lives. It gives background evidence to health and well-being, sex and relationships, recycling and the sustainability of both materials and energy. With increasing maturity learners compare their lives with that in developing countries and review the impact of humans on the Earth.

Careers and the world of work

Learners aged 11–19 should be given opportunities to develop their awareness of careers and the world of work and how their studies contribute to their readiness for a working life. For 14–19 learners, this is a part of their Learning Core entitlement and is a requirement at Key Stage 4.

Science contributes to careers and the world of work by enabling learners to study a range of applications of science, medicine and technology in their everyday life and in the wider world. This gives learners insight into how scientists work and also develops experimental and generic skills needed for the world of work.

Progression in science

Knowledge and Understanding of the World in the Foundation Phase (embracing science)

Children should experience the familiar world through enquiry, investigating the indoor and outdoor environment in a safe and systematic way. They should be given experiences that help them to increase their curiosity about the world around them and to begin to understand past events, people and places, living things, and the work people do. Using all their senses, they should be encouraged to enjoy learning by exploration, enquiry, experimentation, asking questions and trying to find answers. They should learn to demonstrate care, responsibility, concern and respect for all living things and the environment. They should develop and communicate an increasing range of appropriate vocabulary. They should learn to express their own ideas, opinions and feelings with imagination, creativity and sensitivity. The children's skills should be developed across all Areas of Learning through participation in experiential learning activities and through using sources such as stories, photographs, maps, models and ICT.

Science at Key Stage 2

At Key Stage 2, learners should be given opportunities to build on the skills, knowledge and understanding acquired during the Foundation Phase. They should develop their skills through the range of Interdependence of organisms, The sustainable Earth and How things work. Learners should be taught to relate their scientific skills, knowledge and understanding to applications of science in everyday life, including current issues. They should be taught to recognise that scientific ideas can be evaluated by means of information gathered from observations and measurements. Teaching should encourage learners to manage their own learning and develop learning and thinking strategies appropriate to their maturity. They should be taught to value others' views and show responsibility as local citizens.

Activities should foster curiosity and creativity and be interesting, enjoyable, relevant and challenging for the learner. They should enable learners to initiate, explore and share ideas, and extend, refine and apply their skills, knowledge and understanding in new situations. They should allow time for thinking, peer discussion and reflection.

Science at Key Stage 3

At Key Stage 3, learners should be given opportunities to build on the skills, knowledge and understanding acquired at Key Stage 2. They should develop their skills through the range of Interdependence of organisms, The sustainable Earth and How things work. Learners should be taught to apply their scientific skills, knowledge and understanding to design strategies, solve problems and offer explanations, relating scientific ideas to the information about them, including current issues. They should be given opportunities to study the work of scientists and to recognise the role of experimental data, creative thinking and values in their work and in developing scientific ideas. Teaching should encourage learners to manage their own learning and further develop learning and thinking strategies. They should be taught to take different perspectives, value others' opinions and be responsible global citizens.

Activities should foster curiosity and creativity and be interesting, enjoyable, relevant and challenging for the learner. They should enable learners to initiate, explore and share ideas. Activities should enable learners to extend, refine and apply their skills, knowledge and understanding in new and more abstract situations. They should allow time for thinking, peer discussion and reflection.

Science at Key Stage 4

At Key Stage 4, learners should be given opportunities to build on the skills, knowledge and understanding acquired at Key Stage 3. They should learn about the way that science and scientists work within society. They consider the relationship between data, evidence, theories and explanations and develop their practical, problem-solving and enquiry skills, working individually and in groups. They evaluate enquiry methods and conclusions both qualitatively and quantitatively, and communicate their ideas with clarity and precision. Learners develop their ability to relate their understanding of science to their own and others, decisions about lifestyles, and to scientific and technological developments in society.

Activities should promote peer discussion and reflection when thinking about tasks and problems, in deciding about approaches, and in revising them. Some activities should help learners consolidate their own learning through applying their skills and knowledge in other contexts and situations.

Skills

Communication

Pupils should be given opportunities to:

1. search for, access and select relevant scientific information, from a range of sources, including ICT
2. communicate clearly by speech, writing, drawings, diagrams, charts, tables, bar charts, line graphs, videos, and ICT packages, using relevant scientific vocabulary
3. use standard measures and S.I. units, *e.g. kg, s, N, m.*

Enquiry

Pupils should be given opportunities to carry out different types of enquiry, *e.g. pattern-seeking, exploring, classifying and identifying, making things, fair testing, using and applying models*, by:

Planning

Pupils turn ideas suggested to them, and their own ideas, into a form that can be investigated. They outline the planned approach/method recognising, deciding upon and giving some justification for each of the following when appropriate:

1. the choice of success criteria
2. predictions using some previous knowledge and understanding
3. where and how to find relevant information and ideas

Range

Interdependence of organisms

Pupils should use and develop their skills, knowledge and understanding by investigating how animals and plants are independent yet rely on each other for survival.

They should be given opportunities to study:

1. the names, positions, functions and relative sizes of a human's main organs
2. the need for a variety of foods and exercise for human good health
3. the effect on the human body of some drugs, *e.g. alcohol, solvents, tobacco*
4. through fieldwork, the plants and animals found in two contrasting local environments, *e.g. identification, nutrition, life cycles, place in environment*
5. the interdependence of living organisms in those two environments and their representation as food chains
6. the environmental factors that affect what grows and lives in those two environments, *e.g. sunlight, water availability, temperature*
7. how humans affect the local environment, *e.g. litter, water pollution, noise pollution*.

4. when carrying out a fair test, the key variables that need to be controlled and how to change the independent variable whilst keeping other key variables the same
5. the observations or measurements that need to be made
6. the equipment and techniques required for the enquiry
7. any hazards and risks to themselves and others.

Developing

Pupils follow the planned approach/method, revise it where necessary, and where appropriate:

1. use apparatus and equipment correctly and safely
2. make careful observations and accurate measurements, using digital and ICT equipment at times
3. check observations and measurements by repeating them in order to collect reliable data
4. make comparisons and identify and describe trends or patterns in data and information
5. use some prior knowledge to explain links between cause and effect when concluding

The sustainable Earth

Pupils should use and develop their skills, knowledge and understanding by comparing the Earth with other planets, investigating materials around them and considering the importance of recycling.

They should be given opportunities to study:

1. the daily and annual movements of the Earth and their effect on day and year length
2. the relative positions and key features of the Sun and planets in the solar system
3. a comparison of the features and properties of some natural and made materials
4. the properties of materials relating to their uses
5. how some materials are formed or produced
6. a consideration of what waste is and what happens to local waste that can be recycled and that which cannot be recycled.

6. consider different interpretations and distinguish between 'facts', beliefs and opinions, giving reasons and begin to recognise bias
7. form considered opinions and make informed decisions.

Reflecting

Pupils think about what they have done in order to consolidate learning and transfer skills, knowledge and understanding to other contexts by:

1. beginning to evaluate outcomes against success criteria
2. deciding whether the approach/method was successful
3. describing any amendments made to the planned approach/method
4. suggesting how the approach/method could have been improved
5. describing how they have learned and identifying the ways that worked the best
6. linking the learning to similar situations, within and outside school.

How things work

Pupils should use and develop their skills, knowledge and understanding by investigating the science behind everyday things, *e.g. toys, musical instruments and electrical devices,* the way they are constructed and work.

They should be given opportunities to study:

1. the uses of electricity and its control in simple circuits
2. forces of different kinds, *e.g. gravity magnetic and friction, including air resistance*
3. the ways in which forces can affect movement and how forces can be compared

4. how different sounds are produced and the way that sound travels
5. how light travels and how this can be used.

Fold out for more of the Key Stage 2 Programme of Study.

Skills

Communication

Pupils should be given opportunities to:

1. search systematically for, process and analyse information for a specific purpose, including ICT as appropriate
2. communicate logically by speech, writing, drawings, diagrams, charts, tables, bar charts, line graphs, videos and ICT packages using a wide range of scientific vocabulary, terms, symbols and conventions
3. work quantitatively, using appropriate mathematical conventions and using S.I. units appropriate to their work, *e.g. kg, s, N, m, J, w.*

Enquiry

Pupils should be given opportunities to carry out different types of enquiry, *e.g. pattern-seeking, exploring, classifying and identifying, making things, fair testing, using and applying models,* by:

Planning

Pupils decide on the most suitable type of enquiry to carry out and outline the planned approach/method, recognising, deciding upon and justifying each of the following when appropriate:

1. the choice of success criteria
2. predictions using previous knowledge, understanding and preliminary work

Range

Interdependence of organisms

Pupils use and develop their skills, knowledge and understanding by investigating how humans are independent yet rely on other organisms for survival, applying this to life in countries with different levels of economic development.

They should be given opportunities to study:

1. the basic structure and function of some cells, tissues, organs and organ systems and how they support vital life processes
2. how food is used by the body as fuel during respiration and why the components of a balanced diet are needed for good health
3. the beneficial and detrimental effects of some drugs on the organs of the human body and other consequences of their use, *e.g. insulin, steroids, paracetamol, caffeine*
4. the interdependence of organisms and their representation as food webs, pyramids of numbers and simple energy-flow diagrams
5. how and why food webs are affected by environmental factors, *e.g. light intensity, water availability, temperature,* and their fluctuations
6. how human activity affects the global environment, *e.g. acid rain, greenhouse effect,* and the measures taken to minimise any negative effects and monitor them, *e.g. by Earth observation satellites*
7. applications of science, medicine and technology that are used to improve health and the quality of life, including those in countries with different levels of economic development.

3. a range of options as to where and how to find relevant information and ideas
4. when carrying out a fair test, control variables appropriately and identify any variables that cannot readily be controlled
5. the number of observations or measurements that need to be made and their range and values to ensure reliability of evidence
6. the equipment and techniques required for the enquiry
7. any potential hazards in their work.

Developing

Pupils follow the planned approach/method, revise it where necessary, and where appropriate:

1. use a range of apparatus and equipment safely and with skill, taking action to control the risks to themselves and others
2. make sufficient relevant observations and accurate measurements, using ICT as appropriate, to a degree of precision appropriate to the enquiry
3. identify, describe and explain trends, patterns and relationships

The sustainable Earth

Pupils use and develop their skills, knowledge and understanding by investigating the materials in the Earth and its atmosphere and how they can change, and apply this in contemporary contexts.

They should be given opportunities to study:

1. the properties of solids, liquids and gases and how the particle model can be used to explain these properties
2. the physical and chemical properties of some elements, compounds and mixtures and how mixtures can be separated by simple techniques
3. the differences between physical and chemical changes using some common examples
4. investigations into the patterns of behaviour of elements and compounds and their use to describe and predict their behaviour in chemical reactions
5. the properties of sustainable materials and how these are related to their uses in everyday life, *e.g. in the construction and manufacturing industries,* and the importance of sustainability.

4. use scientific prior knowledge to explain links between cause and effect when concluding
5. consider whether there is sufficient information to enable firm conclusions to be drawn, taking account of uncertainties/anomalies
6. identify and assess bias and reliability
7. consider others' views to inform opinions and decisions.

Reflecting

Pupils think about what they have done in order to consolidate their learning and transfer skills, knowledge and understanding to another context by:

1. evaluating how far outcomes reflect success criteria
2. justifying any improvements made to the planned approach/method
3. identifying the learning/thinking strategies they have used
4. linking the learning to dissimilar but familiar situations, within and outside school.

How things work

Pupils should use and develop their skills, knowledge and understanding by investigating the science involved in a range of contemporary devices/machines and evaluate different energy resources and possibilities.

They should be given opportunities to study:

1. the behaviour of current in electrical circuits
2. the conservation of energy and ways in which energy can be stored
3. how familiar devices/machines work by using electricity, light, sound and other energy transfers
4. the forces in devices and their relationship to work done and power
5. how renewable and non-renewable energy resources are used to generate electricity and the implications of decisions made about their use
6. technologies under development, which may lead to more efficient use of energy resources or using them in new ways, *e.g. hydrogen-powered cars, using cooking oil/gasohol, as replacements for diesel/petrol.*

Fold out for more of the Key Stage 3 Programme of Study.

Level descriptions

The following level descriptions describe the types and range of performance that pupils working at a particular level should characteristically demonstrate. In deciding on a pupil's level of attainment at the end of a key stage, teachers should judge which description best fits the pupil's performance. Each description should be considered in conjunction with the descriptions for adjacent levels.

By the end of Key Stage 2, the performance of the great majority of pupils should be within the range of Levels 2 to 5, and by the end of Key Stage 3 within the range 3 to 7. Level 8 is available for very able pupils and, to help teachers differentiate Exceptional Performance at Key Stage 3, a description above Level 8 is provided.

Level 1

Pupils listen and respond to scientific ideas and react appropriately. They take part in simple activities and through a variety of experiences explore the world around them. They observe and describe simple features of organisms, objects, materials and events through talking, drawing, mark-making or writing simple words. They recognise and name a range of common organisms, objects, materials, light sources and sound sources.

Level 2

Pupils choose from given options where to find evidence, information and ideas. They talk about the steps needed to carry out their enquiries and what is needed to be successful.

They make enough observations to be able to sort, group and compare organisms, objects, materials, and events. They make simple records of their findings by talking, drawing, writing simple sentences, constructing tally charts or pictograms. They describe the basis for their groupings using simple differences between organisms, objects, materials and physical phenomena.

They respond to questions about what worked and what didn't.

Level 3

Pupils suggest where to find evidence, information and ideas and plan, with support, the method to be used for their enquiries. They talk about their ideas and using their everyday experience they make simple predictions. They agree on some basic success criteria.

They follow a simple series of instructions safely to gather their findings, and where appropriate make observations that they could measure using simple equipment. They begin to organise their findings and display them in a given format, to include simple tables and bar charts. They begin to identify simple patterns and trends. They begin to distinguish between scientific 'facts', beliefs and opinions. They give an explanation, based upon their everyday experiences, for their findings, including any patterns. They give simple explanations for differences between and changes to organisms, objects, materials and physical phenomena. They say what they have found out from their work and make their own decisions by weighing up pros and cons.

They link outcomes to success criteria and identify what worked and what didn't, beginning to think about how the method could be improved. They link the learning, with support, to familiar situations.

Level 4

Pupils find and use a variety of evidence, information and ideas. They use scientific knowledge and skills to plan their enquiries and predict outcomes. In a fair test enquiry, they recognise, with support, the variables to change and measure and those to be kept the same. They decide upon some basic success criteria.

They follow the planned method making amendments where necessary. They make qualitative observations and use standard equipment to measure within a given range using S.I. units. They organise and communicate their findings using relevant scientific language and display these in tables, bar charts and in simple line graphs when the axes and scales are given. They identify patterns and trends. They distinguish between 'facts', beliefs and opinions and begin to recognise bias. They use some scientific knowledge and understanding to explain their findings and differences between, or changes to organisms, materials and physical phenomena. They begin to draw conclusions, form considered opinions and make informed decisions.

They decide whether their method was successful by referring to their success criteria and say how they could improve it. They describe how they have learned and identify the ways that worked the best. They link the learning to similar situations.

Level 5

Pupils find and use relevant evidence, information and ideas. They systematically plan their enquiries, making predictions based on scientific knowledge and understanding, including simple models. When planning a fair test, they identify key variables and distinguish between independent and dependent variables and those that they will keep the same. They give some justification for their success criteria.

They select measuring instruments that allow them to make a series of accurate measurements. They regularly check progress and revise the method where necessary. They organise and communicate their findings integrating different forms in various presentations and record these systematically, using S.I. units where appropriate. They select the most appropriate type of graph or chart to display data. They can use a line graph to describe relationships between two continuous variables. They identify bias and start to consider reliability. They use scientific knowledge and understanding, including simple models, when explaining their findings and differences between, or changes to organisms, materials and physical phenomena. They draw conclusions that are consistent with the findings and consider others' views to inform opinions and decisions.

They begin to evaluate how far success criteria fully reflect successful outcomes. They identify the learning/thinking strategy they have used and link the learning to dissimilar but familiar situations.

Attainment target

Level 6

Pupils suggest a variety of methods or strategies for their enquiries. They make predictions using abstract scientific ideas. In a fair test enquiry, they plan how to control the variables that they need to keep the same and make decisions about the range and values of the independent variable. They justify their success criteria.

They make precise observations and accurate measurements using equipment with fine divisions. They regularly check progress, make ongoing revisions when necessary and begin to justify any amendments or improvements made. They organise and communicate their findings in a variety of ways fit for purpose and audience. They use appropriate axes and scales for graphs to show data effectively and begin to use some quantitative definitions. When considering their findings they assess bias, consider reliability and offer some explanations for any anomalies. They use abstract scientific knowledge and understanding, including models, when explaining their findings and differences between, or changes to organisms, materials and physical phenomena. They recognise that a number of factors and/or processes may have to be considered when explaining changes. They consider a wider range of perspectives to inform opinions and decisions.

They evaluate how far success criteria fully reflect successful outcomes. They identify the learning/thinking strategies being used and link the learning to unfamiliar situations.

Level 7

Pupils give some justification for the methods and strategies they plan to use. They make qualitative predictions using linked scientific knowledge and understanding gained from a variety of sources. They identify key variables that may not be readily controlled explaining why this is the case.

They systematically observe and measure, justifying any amendments made to the method/strategy. They draw lines of best fit on line graphs. They use some quantitative definitions and perform calculations using the correct units. They begin to evaluate their findings in order to gauge bias, reliability and validity. They explain to what extent their findings are consistent with scientific knowledge and understanding, using abstract ideas at times. In explanations they apply abstract ideas and make links between processes or systems. They begin to use their explanations to make predictions. They describe how they might collect more information in order to check the validity of their conclusions.

They refine success criteria in the light of experience for future occasions. They review their strategies in light of results obtained or the information gathered and link the learning to more abstract situations.

Level 8

Pupils justify their methods and strategies in view of the reliability of the information and/or the data to be gathered and the accuracy of the equipment to be used. They identify any possible problems with the method/strategy. They make quantitative predictions, where appropriate, using detailed scientific knowledge and abstract ideas.

They evaluate their findings in order to gauge levels of bias, reliability and validity. They identify and explore uncertainties and explain anomalies. They explain to what extent their findings are consistent with abstract scientific ideas. They explain the impact of one system on another. They draw conclusions showing an awareness of the degree of uncertainty and a range of views.

They suggest alternative learning/thinking strategies and link the learning to make further predictions.

Exceptional Performance

Pupils justify their methods and strategies making multiple links to prior learning and independent research and taking account of possible problems. They justify their predictions by making multiple links between scientific models, theories and systems. They plan to track changes in more than one dependent variable.

They develop an organised system to record findings clearly conveying points of interest. They use complex abstract ideas or combinations of models/systems to explain their findings. They use their knowledge and understanding to critically evaluate predicted effects on systems. They use detailed evidence to form consistent conclusions/opinions.

They evaluate the likely effectiveness of alternative strategies and refine learning/thinking strategies for future occasions.

National curriculum outcomes

The following national curriculum outcomes are non-statutory. They have been written to recognise the attainment of pupils working below Level 1. National Curriculum Outcomes 1, 2 and 3 align with the Foundation Phase Outcomes 1, 2 and 3.

Foundation Phase	National Curriculum
Foundation Phase Outcome 1	National Curriculum Outcome 1
Foundation Phase Outcome 2	National Curriculum Outcome 2
Foundation Phase Outcome 3	National Curriculum Outcome 3
Foundation Phase Outcome 4	National Curriculum Level 1
Foundation Phase Outcome 5	National Curriculum Level 2
Foundation Phase Outcome 6	National Curriculum Level 3

The national curriculum outcomes describe the types and range of performance that pupils working at a particular outcome should characteristically demonstrate. In deciding on a pupil's outcome of attainment at the end of a key stage, teachers should judge which description best fits the pupil's performance. Each description should be considered in conjunction with the descriptions for adjacent outcomes.

Outcome 1

Pupils explore their immediate and familiar environment and use words, signs or symbols to communicate their observations. They recognise themselves and familiar people in pictures and stories and show knowledge of daily routines. Pupils begin to use basic tools and assemble familiar resources.

Outcome 2

Pupils begin to group objects together, recognising similar characteristics. They handle and explore the use of a range of tools and materials safely to make simple constructions. Pupils make straightforward choices and respond to questions (what, where) about recent events and familiar stories. They offer their own ideas, sometimes making connections to earlier experiences. Pupils begin to match specific activities to certain times of day or week and show some appreciation of differences between present and past. They gain confidence in finding their way in familiar surroundings, developing knowledge of roles of familiar people in school and the local community.

Outcome 3

Pupils sort objects and materials according to simple criteria, and with help safely cut, shape and assemble these to make simple products that are meaningful to them. They communicate their developing knowledge of items in everyday use and often ask 'how' and 'why?'. Pupils may suggest where to find information and begin to record their observations and intentions using symbols, pictures, drawings or simple phrases. They take part in the planning of future activities and begin to make predictions by thinking about and talking through earlier experiences. Through enquiry, pupils are able to identify changes in their environment and in materials, natural features, pictures and artefacts. They are able to follow simple instructions and sequence events in stories and creative activities. Pupils are beginning to use everyday terms about their surroundings and the passing of time, remembering significant events in the past and anticipating events in the future.

Key Stage 4

Learning Pathways 14–19

For learners at Key Stage 4, science will be part of each individual's learning pathway. The course of study followed should be designed to encourage both the abilities of young people as learners and their desire to access future learning opportunities. In particular, the course should contribute as widely as possible to the four aspects of learning as identified in the 14–19 Learning Core.

Science at Key Stage 4

At Key Stage 4, learners should be given opportunities to build on the skills, knowledge and understanding acquired at Key Stage 3. They should learn about the way that science and scientists work within society. They consider the relationship between data, evidence, theories and explanations and develop their practical, problem-solving and enquiry skills, working individually and in groups. They evaluate enquiry methods and conclusions both qualitatively and quantitatively, and communicate their ideas with clarity and precision. Learners develop their ability to relate their understanding of science to their own and others, decisions about lifestyles, and to scientific and technological developments in society.

Activities should promote peer discussion and reflection when thinking about tasks and problems, in deciding about approaches, and in revising them. Some activities should help learners consolidate their own learning through applying their skills and knowledge in other contexts and situations.

Skills

Communication skills

Pupils should be given opportunities to:

1. recall, analyse, interpret, apply and question scientific information or ideas
2. use both qualitative and quantitative approaches
3. present information, develop an argument and draw a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools.

Enquiry and practical skills

Pupils should be given opportunities to:

1. plan to test a scientific idea, answer a scientific question, or solve a scientific problem
2. collect data from primary or secondary sources, including using ICT sources and tools
3. work accurately and safely, individually and with others, when collecting first-hand data
4. evaluate methods of collection of data and consider their validity and reliability as evidence.

Range

Pupils should build on their previous experiences and be taught within the context of the skills section. They should have particular regard to:

- scientific enquiry
- scientific and technological developments, their benefits, drawbacks and risks
- ethical, social, economic and environmental issues and their interaction with science.

Organisms and health

1. Organisms are interdependent and adapted to their environments.
2. Variation within species can lead to evolutionary changes and similarities and differences between species can be measured and classified.
3. The ways in which organisms function are related to the genes in their cells.
4. Chemical and electrical signals enable body systems to respond to internal and external changes, in order to maintain the body in an optimal state.
5. Human health is affected by a range of environmental and inherited factors, by the use and misuse of drugs and by medical treatments.

Data, evidence, theories and explanations – links between ideas and information in science

Pupils should be given opportunities to:

1. explore how scientific data can be collected and analysed, and how interpretation of data, using creative thought, provides evidence to test ideas and develop theories 
2. appreciate how explanations of many phenomena can be developed using scientific theories, models and ideas
3. recognise that scientific knowledge changes over time, and that there are some questions that science cannot currently answer or address.

Chemical and material behaviour

1. Chemical change takes place by the rearrangement of atoms in substances.
2. There are patterns in the chemical reactions between substances.
3. New materials are made from natural resources by chemical reactions.
4. The properties of a material determine its uses.

Environment, Earth and universe

1. The effects of human activity on the environment can be assessed using living and non-living indicators.
2. The surface and the atmosphere of the Earth have changed since the Earth's origin and are changing at present.
3. The solar system is part of the universe, which has changed since its origin and continues to show long-term changes.

Energy, electricity and radiations

1. Energy transfers can be measured and their efficiency calculated, which is important in considering the economic costs and environmental effects of energy use. 
2. Electrical power is readily transferred and controlled, and can be used in a range of different situations.
3. Radiations, including ionising radiations, can transfer energy.
4. Radiations, in the form of waves can be used for communication.

Notes