Northern Ireland Assembly

Research and Information Service Briefing Paper

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James Stewart

Science in the Revised Curriculum

1. Summary

The revised curriculum for Northern Ireland was designed to promote the development of **skills** and **competences**. Implementation began in 2007 and the new structure gives teachers the authority and flexibility to teach content that they deem to be suitable for their pupils. However, members of the science community have expressed concerns about the less stringent statutory requirements with respect to **content**.

The concern is directed towards the Area of Learning known as the **World Around Us** (WAU) at Key Stage 2. Since the implementation of the revised curriculum, science, geography and history have been amalgamated to form the WAU. It is argued that teachers who do not feel confident in teaching science now have the licence to reduce the amount and type of science taught due to fewer statutory requirements with regard to content.

There has been little research carried out to investigate the impact of the revised curriculum on the teaching of science. This paper makes reference to the limited number of studies that have been undertaken in this area. It should be noted that the Education and Training Inspectorate will undertake an evaluation survey of the World Around Us. This will be complete in June 2014.

2. The History of the Curriculum

2.1. The Original Curriculum

The first Northern Ireland Curriculum was introduced in 1991. It was similar in structure to the English and Welsh curriculum, which had been recently established. The newly introduced curriculum designated science as a core subject. Prior to this, science had been taught at the discretion of schools. The original curriculum was soon deemed to be overloaded and, as a result, was revised by removing a significant amount of content in 1996.

2.2. The Revised Curriculum

In 1999 the Council for the Curriculum, Examinations & Assessment (CCEA) undertook a fundamental review of the statutory requirements of the curriculum. The revised curriculum, approved in 2004, was the culmination of 5 years of research and consultation.

CCEA began implementing the revised curriculum in 2007 which was designed to be more flexible, cross-curricular and relevant to the world outside school. The revisions mean that the curriculum is no longer structured in individual subjects. Instead, the curriculum is organised into 'Areas of Learning'.[1]

A significant change to the curriculum has been the removal of many statutory requirements relating to subject content. CCEA suggests that this empowers teachers to choose appropriate content for their pupils. It is also advised that curriculum is now more focused on the skills and competences rather than prescribing the content that is delivered.

Another significant revision is the creation of a new Foundation Stage comprising the first two years of schooling (See Figure1). CCEA suggest that the Foundation Stage was designed to promote open-ended, interactive and practical learning experiences.[2]

Figure 1: Years of Schooling

Key Stage	Age	Years
Foundation Stage	4 - 6	1 - 2
Key Stage 1	6 - 8	3 - 4
Key Stage 2	8 - 11	5 - 7
Key Stage 3	11 - 14	8 - 10
Key Stage 4	14 - 16	11 - 12

[1] Greenwood, R (2013) *Subject-based and cross-curricular approaches within the revised primary curriculum in Northern Ireland: teachers' concerns and preferred approaches* Belfast: Education 3-13: International Journal of Primary, Elementary and Early Years Education

[2] CCEA (2007) *The Northern Ireland Curriculum Primary* Belfast

3. Key Stage 2

3.1. Overview

Key Stage 2 covers years 5 – 7 of primary schooling (See Figure 1). The Key Stage 2 revised curriculum is broken into 7 'Areas of Learning':

- The Arts
- Language and Literacy
- Mathematics and Numeracy
- Personal Development and Mutual Understanding
- Physical Education
- The World Around Us
- Religious Education

The revised primary curriculum sees the amalgamation of science, geography and history into a single area of learning known as the **World Around Us** (WAU). This means that science is no longer a discrete subject within the curriculum with associated mandatory content requirements. **There is no statutory duty for teachers to spend an equal amount of time working on the components (science, geography and history) which make up the WAU**. The 'Big Picture' summary diagram of the Key Stage 2 curriculum can be found in Appendix 1.

The minimum content for WAU is divided into four **strands** known as:

- Interdependence
- Place
- Movement
- Energy

CCEA has suggested **non-statutory** learning intentions for each of the 4 strands, which can be found in the Appendix 2. The suggested learning intentions offer teachers guidance as to how learning across the four strands can be divided up to cover geography, history and science.

3.2. Key Stage 2 Science

There has been limited research carried out into how the revised curriculum has affected science teaching. In 2011 a survey of 29 teachers who took part in education programmes at W5 (Belfast's Interactive Discovery Centre) was carried out. The

evidence from this study suggests that the time allocated to science and amount of science content delivered has decreased since the revision of the curriculum.[3]

The paper argues that many teachers have found it challenging to integrate science into The World Around Us.[4] It is suggested the teaching of the physical sciences has declined in particular. Figure 2 illustrates the percentage of teachers who indicated that they now teach topics that were previously statutory requirements.

Figure 2: Frequency of Teaching Science Topics

Science topics that were formally statutory requirements	Percentage of respondents that now teach these topics (Sample size 29)
Ourselves	86.2
Plants and animals	69.0
Properties	62.1
Change	58.6
Environment	65.5
Forces and energy	65.5
Electricity	55.2
Sound	31.0

Whilst some primary school teachers are specialists in particular subjects, they work across a wide range of subject areas. Therefore many primary teachers can be described as generalists in terms of content knowledge.

The Royal Society "State of the Nation" report (2010) advised that 5% of primary teachers in England have a significant science or mathematics background. The General Teaching Council NI (responsible for maintaining records of the teaching workforce) does not currently register teachers according to subject specialism.[5]

However, in 2008 the GTCNI investigated the numbers of teachers on its register that hold one or more Science, Technology, Engineering and Mathematics (STEM) teaching qualifications, or other academic STEM qualifications.[6] The investigation found that:

- 10% of all teachers registered in Northern Ireland had a science or mathematics background
- 23% of STEM specialists worked in primary schools, and the numbers of physics specialists working in this sector was negligible

It is worth noting that the study carried out at W5 indicated that many primary teachers enjoy teaching science and the associated article recommends that the revised

[3] Johnson, A. (2013) *Is Science Lost in the World Around Us?* Belfast: Primary Science
[4] As above
[5] Royal Society (2010) *Science and mathematics education, 5–14. A 'state of the nation'* report. London: The Royal Society
[6] As above

curriculum has had a positive impact on teaching **methods.**[7] Indeed, research conducted by Stranmillis University College reveals a 'mostly positive' attitude from primary teachers in relation the thematic approach of the revised curriculum. It is advised that the revised curriculum opens up opportunities for confident teachers to teach science in a creative and engaging manner.

However, as **science is not a discrete subject with associated statutory requirements** teachers can reduce the amount of science taught if they do not feel confident with the subject area or are under time pressure.[8] Studies have indicated that a coping strategy for teachers with low confidence in a particular area is to "*teach as little of the subject area as the teacher can get away with*". The 2011 TIMSS (Trends in International Mathematics and Science Study) advised that teaching time for Year 6 pupils in Northern Ireland was 15% below the international average for science.

A need for substantial and effective in-service training tailored to the WAU is identified by Greenwood.[9] The Wellcome Trust has carried out studies which indicate that a lack of training, knowledge and confidence are the most frequently reported issue facing primary teachers in their science teaching. This research reveals that teachers who take part in professional development are significantly more assured to teach science than those who do not.[10]

CCEA has developed WAU support material for teachers. This includes Thematic Units which are designed to encourage children to make connections across the Areas of Learning. Thematic Units which focus on STEM are also available from the CCEA website:

http://www.nicurriculum.org.uk/key_stages_1_and_2/connected_learning/thematic_stem.asp

The Department of Education has advised the Education Committee that the Education and Training Inspectorate will undertake an evaluation survey of the World Around Us. This will be complete in June 2014.

4. Key Stage 3

4.1. Overview

Key Stage 3 refers to the first three years of post-primary education. In Northern Ireland they are known as Years 8, 9 and 10 (See Figure 1).

As a result of the revised curriculum, detailed 'programmes of study' have been replaced by 'minimum requirements' set within a curriculum and skills framework.

[7] Johnson, A. (2013) *Is Science Lost in the World Around Us?* Belfast: Primary Science
[8] As above
[9] Greenwood, R (2013) *Subject-based and cross-curricular approaches within the revised primary curriculum in Northern Ireland: teachers' concerns and preferred approaches* Belfast: Education 3-13: International Journal of Primary, Elementary and Early Years Education
[10] Wellcome Trust (2005) *Primary horizons*. Wellcome Trust: London, UK.

Mirroring the revisions at Key Stage 2, there has been a substantial reduction in the amount of prescribed content.[11] CCEA states that this ethos allows greater freedom for teachers to tailor learning within an agreed entitlement.

4.2. Key Stage 3 Science

Unlike Key Stage 2, Science and Technology is designated as a discrete Area of Learning at Key Stage 3. A major difference between primary and post-primary science is that the subject is taught (in general) by science specialists. The statutory requirements state that pupils should have opportunities to:

- Develop skills in scientific methods of enquiry to further scientific knowledge and understanding. This includes planning for investigations, obtaining evidence, presenting and interpreting results.
- Develop creative and critical thinking in their approach to solving scientific problems. Research scientific information from a range of sources; develop a range of practical skills, including the safe use of science equipment.
- Learn about: Organisms and Health; Chemical and material behavior; Forces and energy; the Earth and Universe.

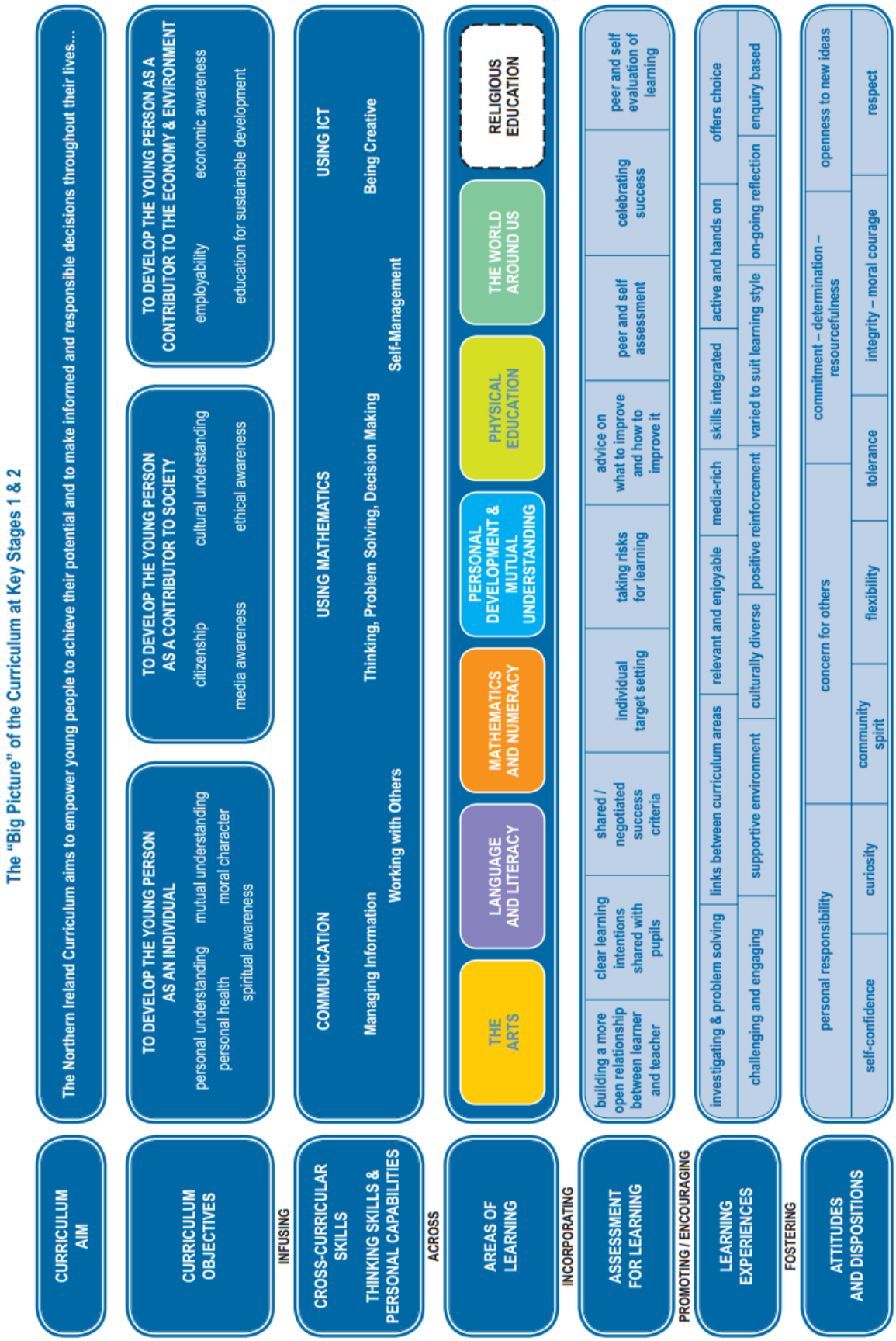
The non-statutory guidance for science outlined by CCEA cites *flexibility* as one of the 'key messages'. This means that teachers now have authority to devise schemes of work tailored to the interests and needs of their pupils. Teachers must cover the statutory requirements but CCEA states that teachers have been given freedom to build on the units that best engage students and revitalize those which have been less engaging.

CCEA has provided teachers with **subject specific guidance** to assist them in planning lessons and interpreting the minimum content requirements. The CCEA resource material includes a website dedicated to STEM at Key Stage 3; STEMworks has been developed to support learning and teaching of STEM related subjects it can be accessed at the following URL: http://www.nicurriculum.org.uk/STEMWorks/

The STEM-NI Report suggests that there is a need for greater curricular coordination for STEM.[12] It is argued that there is little **joint planning between primary and post-primary schools** in the STEM subjects. The report claims that this leads to repetition and insufficient emphasis on the relevance of STEM at a time which is considered to be critical in forming a child's interest.

[11] Royal Society (2010) *Science and mathematics education, 5–14. A 'state of the nation'* report. London: The Royal Society
[12] Department for Employment and Learning / Department of Education (2009) *Report of the STEM Review* Belfast

Appendix 1: The Big Picture of the Curriculum at Primary



Appendix 2: Key Stage 2 WAU Statutory Requirements and Learning Intensions

The World Around Us

Key Stage 2

Rewarding Learning

Teachers should enable pupils to develop **knowledge, understanding and skills** in:

STRAND 1: Interdependence

Statutory Requirements Pupils should be enabled to explore:	**Suggested Learning Intentions** Children are learning:
How they and others interact in the world;	• how lifestyle choices can affect the health of themselves and others (S&T); • how people used to live, including roles and responsibilities in society, and how this has shaped our lives today (H); • to be aware of the global economy and that different countries rely on one another for goods, services and knowledge (G);
How living things rely on each other within the natural world;	• about the variety of living things and the conditions necessary for their growth and survival (S&T); • to understand the interdependency that exists in simple food chains and webs (S&T); • about the interrelationships between animals and plants in a habitat (S&T); • to understand some of the ways in which living things rely on common landscape features (G)
Interdependence of people and the environment and how this has accelerated over time by advances in transport and communications;	• to be aware of how modern technology has influenced design and production of everyday objects (S&T); • how people in the past interacted with their environment for transport and communications (H); • how advances in technology have changed the ways we live, work, travel and use our leisure time (G)
The effects of people on the natural and built environment over time.	• that some waste materials can be recycled and that this can be of benefit to the environment (S&T); • about the effects that people's actions have on the natural environment (S&T) (G); • to be aware of the changes in their local environment over time (H); • some of the ways people affect the built and natural environment (G); • about issues associated with the conservation, preservation and regeneration of the environment (G).

G - Geography
H - History
S&T - Science and Technology

The World Around Us

Key Stage 2

Rewarding Learning

Teachers should enable pupils to develop **knowledge, understanding and skills** in:

STRAND 2: Movement and Energy

Statutory Requirements Pupils should be enabled to explore:	**Suggested Learning Intentions** Children are learning:
The causes and effect of energy, forces and movement;	• that dark is the absence of light (S&T); • that light travels through some materials and not others (S&T); • how shadows are formed and can be changed (S&T); • about how the use of light has evolved over time (H); • that there are different ways to make sounds (S&T); • that when an object vibrates, sound is produced (S&T); • ways in which sound and light are used to communicate safety and danger (S&T); • that a complete circuit is needed for a device to work (S&T); • that some materials do not allow electricity to pass and these are called insulators (S&T); • that some materials do allow electricity to pass and these are called conductors (S&T); • about the safe use of mains electricity and the dangers associated with electricity in their locality (S&T); • about the influence of some inventors in the development of electricity (H); • push and pull forces can make things start and stop moving (S&T); • push and pull forces can change the shape of objects (S&T); • that different surfaces affect how easily things move over them (S&T); • to recognise the development of renewable energy sources over time (G) (H) • the advantages and disadvantages of renewable and non-renewable energy sources (G); • about global energy issues (G);
Causes that affect the movement of people and animals;	• that the human body has joints to help it move (S&T); • how seasonal change causes animals to move (S&T); • how human activities affect habitats and ecosystems (S&T) (G); • how technological change is affecting the movement of population (G) (H); • about some of the causes of movement of people in the past (H); • about the impact of explorers and conquerors through time (H); • how natural disasters and extreme weather cause the movement of people and animals (G);

G - Geography
H - History
S&T - Science and Technology

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The World Around Us

Key Stage 2

Rewarding Learning

Teachers should enable pupils to develop **knowledge, understanding and skills** in:

STRAND 2: Movement and Energy

Statutory Requirements Pupils should be enabled to explore:	**Suggested Learning Intentions** Children are learning
How movement can be accelerated by time and natural events such as wars, earthquakes, famine and floods;	• how natural events can impact on the environment and habitats of animals (S&T) (G); • about the impact of famine, floods, wars, migration and emigration on the everyday lives of people in place (H); • the effects of natural disasters and / or extreme weather on places and people who live there (G); • how the lack of basic resources impacts on the lives of people in different countries (G); • about the impact of significant natural disasters in the past (H);
Positive and negative consequences of movement and its impact on places, people and interdependence.	• how explorers and/or conquerors had both positive and negative impact on the communities affected (H); • that the journey of a product can affect the environment both locally and globally (G); • about the goods that are imported and/or exported by our country and other countries (G). • that people move for economic or social reasons and this has an impact on localities (G)

G - Geography
H - History
S&T - Science and Technology

The World Around Us

Key Stage 2

Rewarding Learning

Teachers should enable pupils to develop **knowledge, understanding and skills** in:

STRAND 3: Place

Statutory Requirements Pupils should be enabled to explore:	**Suggested Learning Intentions** Children are learning:
How place influences the nature of life;	• about some of the plants and animals in a chosen habitat locally or elsewhere (G); • the conditions necessary for life in a variety of places (S&T); • how place affects the plant and animal life there (S&T); • about simple food chains in different places (S&T); • how weather affects the lives of people and animals here and elsewhere (G); • about the similarities and differences in places (G); • how places locally and globally, influence identity, way of life and culture (H); • about the lifestyles of people in the past in a variety of places (H); • about the position of the major organs in the body and their importance for life (S&T);
Ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment;	• about the habitats of a range of living things (S&T); • how some living things can change in order to adapt and survive in their environment and that there are places where living things cannot survive (S&T); • how animals grow, feed and use their senses in a variety of places (S&T); • about the origins of materials (S&T); • how the use of materials relates to their properties (S&T); • that features and materials in places impacted on settlements there (H); • to recognise some of the uses of materials in the past (H); • about the natural resources of Northern Ireland and of other places (G); • about the importance and use of natural resources locally and globally (G); • how locations in Northern Ireland can depend on one another (G);
Features of and variations in places, including physical, human, climatic, vegetation and animal life;	• how seasonal change affects the behaviour of animals and plants (S&T); • how variations in place affects the growth of plants (S&T); • how place impacted on the lives and lifestyle of people in the past (H); • that extreme weather affects the lives of people here and elsewhere (G); • that the landscape locally differs from that elsewhere (G); • that there are differences between rural and urban lifestyles (G); • about the jobs people do to provide goods and services (G);

G - Geography
H - History
S&T - Science and Technology

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The World Around Us

Key Stage 2

Rewarding Learning

Teachers should enable pupils to develop **knowledge, understanding and skills** in:

STRAND 3: Place

Statutory Requirements Pupils should be enabled to explore:	**Suggested Learning Intentions** Children are learning
Our place in the universe;	• about how shadows are formed (S&T); • that the earth orbits the sun (S&T); • that the earth's rotation helps give day and night (S&T); • the direction the sun appears to rise and set (G); • about the development of space travel (H);
Change over time in places;	• how changes in state can be brought about (S&T); • that some changes can be controlled (G, S&T); • how people from the past affected the place where they live (H); • about the impact of different people over time on places (H); • that some buildings have been used in the past for different purposes (H); • about the jobs people have done in the past in different places (H); • that weather can cause change over time (G); • how natural and human events / disasters can cause changes to the landscape and environment (G);
Positive and negative effects of natural and human events upon place over time.	• how human activities create a variety of waste products (S&T); • about the importance of recycling and its benefits (S&T); • that some materials decay naturally while others do not (S&T); • that there are differences between renewable and non-renewable energy sources (S&T); • that human events in the past have brought about change in places (H); • about the effects of natural disasters on a place and how they can bring about and affect change (G ,H); • how developments, such as farming and industry, impacted on places in the past (H); • about some positive and negative changes in the locality caused by human/natural events (H); • that some human events in the past impacted globally (H); • about the ways in which people may conserve and change the environment both locally and globally (G).

G - Geography
H - History
S&T - Science and Technology

The World Around Us

Key Stage 2

Rewarding Learning

Teachers should enable pupils to develop **knowledge, understanding and skills** in:

STRAND 4: Change Over Time

Statutory Requirements Pupils should be enabled to explore:	**Suggested Learning Intentions** Children are learning
How change is a feature of the human and natural world and may have consequences for our lives and the world around us;	• to understand the importance of developing a healthy lifestyle (S&T); • about the relevance of the water cycle (S&T) (G); • about the life cycles of some plants and animals (S&T); • about the environmental benefits of reducing, reusing and recycling (S&T); • about how materials are changed to make new materials (S&T); • about organisations who work to protect the environment and wildlife (G); • about the impact of significant changes which have taken place in their locality (H); • about how developments in technology have affected life now and in the past (H); • that locations / buildings need conservation / preservation (H); • how long or short term climatic changes are impacting on our environment (G) (S&T); • how changes in industry can affect people both locally and globally (G); • the changes brought about to a community by a natural disaster (G);
Ways in which change occurs over both short and long periods of time in the physical and natural world;	• about the effects of heating and cooling (S&T); • that some substances dissolve and others do not (S&T); • how materials used to make products have changed over time (H); • how properties of materials relate to how they are used (S&T); • to recognise the continuity and change in lifestyles over time (H); • about how changes in the climate have been brought about (G); • about the depletion of the world's resources and how this has occurred (G); • that some things decay naturally while others do not (S&T);
The effect of positive and negative changes globally and how we contribute to some of these changes;	• about the importance of conserving the environment including protection of habitats and wildlife (G); • that there are things we can do to prevent pollution and the production of waste (G); • about the role they have in conserving energy (G) (S&T); • some of the major changes in the past which have affected our lives today (H); • how developments in communication and transport have impacted on our world (H); • about desirable and undesirable change at home and in the environment (S&T).

G - Geography
H - History
S&T - Science and Technology