Northern Ireland
Curriculum

Science

Key Stage 3 Non Statutory Guidance for Science

Contents

Section 01
Purpose of this Guidance

This guidance is part of the support and implementation package for the Revised Northern Ireland Curriculum (hereafter referred to as Northern Ireland Curriculum) already with your school that includes:

- The Statutory Curriculum at Key Stage 3: Supplementary Guidance; and
- The Curriculum Support and Implementation Box.

Both these resources and additional learning and teaching materials are also available at www.nicurriculum.org.uk.

Science is part of the minimum requirement for every pupil at Key Stage 3. This guidance seeks to build on good practice and to provide heads of department with information and practical approaches to help them plan and roll-out the requirements for Science in a manageable way. The guidance explains and provides interpretation of the statutory requirements for Science.

There are departmental questions and activities after each section which can help you and the members of your department to reflect on and evaluate your current practice and identify actions for departmental planning.

The questions and activities follow T*he 4A's Model for Planning* as documented in the booklet, *Planning for the Revised Curriculum at Key Stage 3*, in your school's Curriculum Support and Implementation Box. Working through this guidance and its accompanying activities means that your department will be well on course for rolling out the Northern Ireland Curriculum.

Section 02
Science in the Northern Ireland Curriculum

The Northern Ireland Curriculum seeks to empower pupils to achieve their potential and to make informed and responsible decisions throughout their lives. It is about helping pupils prepare for life and work:

- as individuals;
- as contributors to society;
- as contributors to the economy and environment.

Science has a significant role to play in this. It has developed as a body of knowledge and processes as successive generations have attempted to make sense of the world around them. Key Stage 3 Science aims to stimulate pupils' curiosity and enthusiasm to develop a sense of wonder in Science. Developing skills in scientific methods of enquiry can engage pupils to develop understanding of the processes of Science as well as content of scientific knowledge.

Using investigation and practical experiments to increase motivation, support collaborative working and connect learning about Science to the real world, pupils will develop their Thinking Skills and Personal Capabilities. Adopting a more enquiry-based and problem-centred approach will spur pupils' critical and creative thinking. This will encourage them to ask more questions to develop and evaluate explanations of phenomena and events in the world around them.

Within the Northern Ireland Curriculum, there is a greater emphasis on taking time to learn with understanding, to consolidate pupils' knowledge and to enable pupils in making connections both within Science and with other areas of learning. A greater focus on skills and capabilities aims to develop pupils as independent learners.

Meeting Curriculum Objectives

Science **develops pupils as individuals** by:

- helping pupils explore influences on their personal health and make choices for healthy living;
- equipping them to make personal decisions about moral and ethical issues, now and in the future.

Science **develops pupils as contributors to society** by:

- exploring the advantages and drawbacks of scientific and technological developments for industry, business, medicine and our overall quality of life;
- exploring how the media informs us about Science and science-related issues.

Science **develops pupils as contributors to the economy and environment** by:

- gaining an awareness of how the skills and knowledge developed in Science can be applied in life and work;
- exploring the Science behind everyday products, particularly those manufactured locally;
- gaining an appreciation of the role of Science in consumer issues;
- challenging pupils to explore the consequences of their interactions with the environment;
- becoming aware of the need for change to be sustainable and the importance of thinking globally, acting locally.

Questions for Departments

In order to contribute to the curriculum objectives during Key Stage 3, what do we want our pupils in Science to:

- know (knowledge and understanding);
- be able to do (skills);
- be like (attitudes and dispositions)?

Action

Section 03
Links to Key Stage 2 and Key Stage 4

3.1 Key Stage 2

Science and Technology is a contributory element to the The World Around Us along with Geography and History at Key Stages 1 and 2.

The World Around Us is organised under the following four interrelated strands:

- Interdependence;
- Place;
- Movement and Energy;
- Change Over Time.

The statutory requirements for The World Around Us at **Key Stage 2** are set out below.

Through the contributory elements of Science and Technology, History and Geography, teachers should enable pupils to develop knowledge, understanding and skills in:

Interdependence

Pupils should be enabled to explore:

- How they and others interact in the world;
- How living things rely on each other within the natural world;
- Interdependence of people and the environment and how this has been accelerated over time by advances in transport and communications;
- The effect of people on the natural and built environment over time.

Place

Pupils should be enabled to explore:

- How place influences the nature of life;
- Ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment;
- Features of, and variations in places, including physical, human, climatic, vegetation and animal life;
- Our place in the universe;
- Change over time in places;
- Positive and negative effects of natural and human events upon place over time.

Movement and Energy

Pupils should be enabled to explore:

- The causes and effect of energy, forces and movement;
- Causes that effect the movement of people and animals;
- How movement can be accelerated by human and natural events such as wars, earthquakes, famine or floods;
- Positive and negative consequences of movement and its impact on people, places and interdependence.

Change over Time

Pupils should be enabled to explore:

- How change is a feature of the human and natural world and may have consequences for our lives and the world around us;
- Ways in which change occurs over both short and long periods of time in the physical and natural world;
- The effects of positive and negative changes globally and how we contribute to some of these changes.

In fulfilling the statutory requirements, teachers should provide a balance of experiences across Science and Technology, Geography and History, and connect these where possible.

In addition, teaching in The World Around Us should provide opportunities for children as they move through Key Stages 1 and 2 to progress:

- **from** making first hand observations and collecting primary data **to** examining and collecting real data and samples from the world around them;
- **from** identifying similarities and differences **to** investigating similarities and differences, patterns and change;
- **from** recognising a fair test **to** designing and carrying out fair tests;
- **from** using everyday language **to** increasingly precise use of subject specific vocabulary, notation and symbols.

3.2 Key Stage 4

The flexible framework at Key Stage 3 allows:

- teachers to establish foundations for Key Stage 4 study by providing opportunities for pupils to demonstrate deeper understanding;
- pupils to become more independent learners who will be more adept and experienced in managing their own learning.

Key Stage 3 experiences should provide a robust basis for learning at Key Stage 4. The knowledge, understanding and skills outlined in the statutory requirements for Key Stage 3 Science provide a framework that enables teachers to tailor the breadth and depth of coverage to meet the needs and interests of pupils.

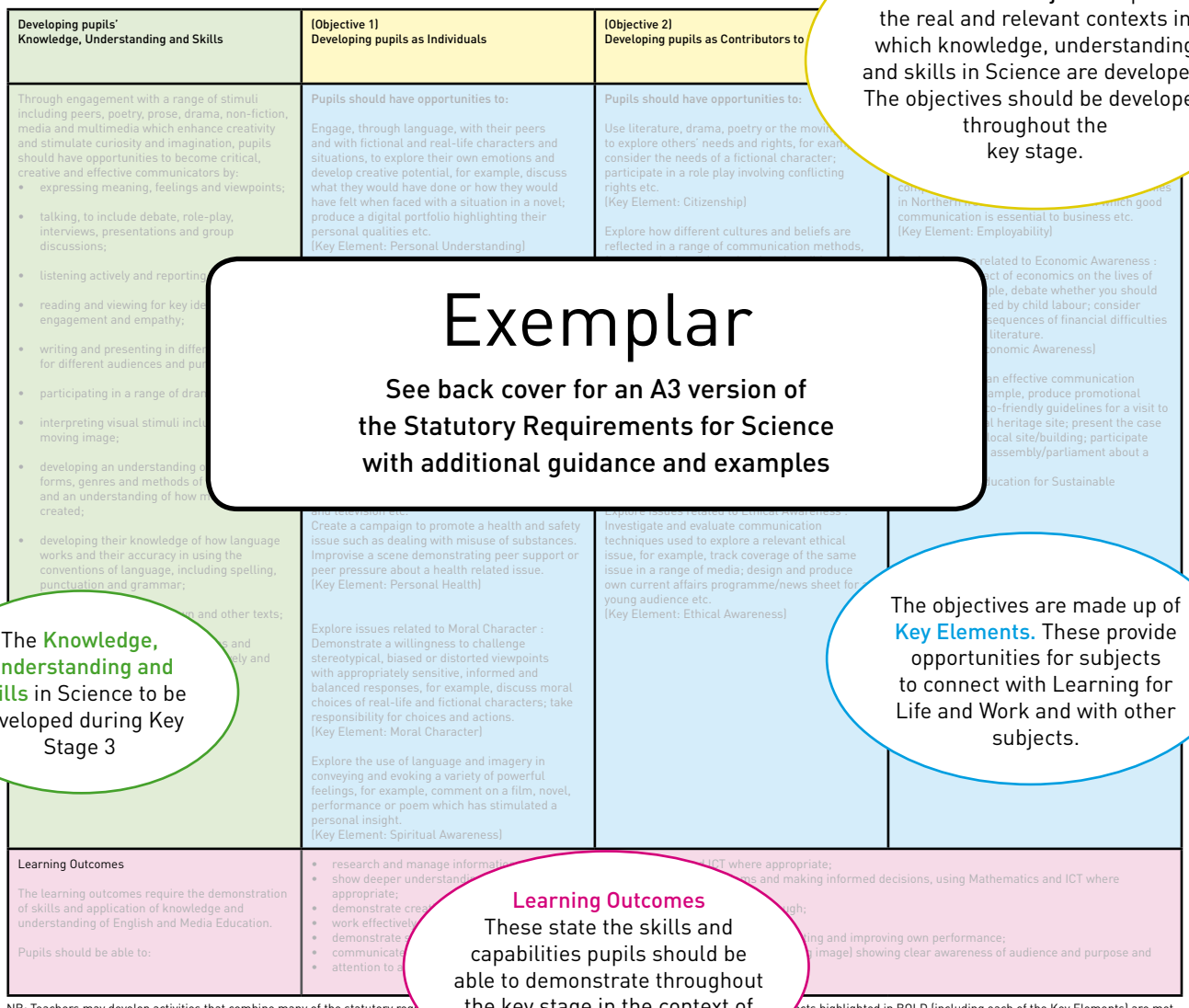
CCEA offers a range of qualifications, details of which are available on the CCEA website. At the time of writing, GCSE specifications in all subjects are currently being reviewed.

Section 04
Understanding the Statutory Requirements for Science

This section includes explanation of:

- The Layout of the Statutory Requirements;
- Knowledge, Understanding and Skills;
- Curriculum Objectives and Key Elements;
- Learning Outcomes;
- Thinking Skills and Personal Capabilities.

4.1 The Layout of the Statutory Requirements



NB: Teachers may develop activities that combine many of the statutory req ects highlighted in BOLD (including each of the Key Elements) are met.

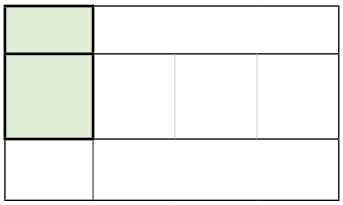
Objectives
The **curriculum objectives** provide the real and relevant contexts in which knowledge, understanding and skills in Science are developed. The objectives should be developed throughout the key stage.

Exemplar
See back cover for an A3 version of the Statutory Requirements for Science with additional guidance and examples

The **Knowledge, Understanding and Skills** in Science to be developed during Key Stage 3

The objectives are made up of **Key Elements.** These provide opportunities for subjects to connect with Learning for Life and Work and with other subjects.

Learning Outcomes
These state the skills and capabilities pupils should be able to demonstrate throughout the key stage in the context of Science.



4.2 Knowledge, Understanding and Skills

The first column in the statutory requirements for Science is headed "Developing Pupil's Knowledge, Understanding and Skills".

- Everything in this column is a statutory requirement for the key stage as a whole; not for individual years within the key stage.
- It is intended that schools interpret and develop these requirements as appropriate to their own context.
- The recursive nature of Science means that the bullet points in the 'Knowledge, Understanding and Skills' column are likely to be covered a number of times in each academic year within the key stage.

The following table seeks to explain, illustrate and expand on the bullet points under 'Knowledge, Understanding and Skills'.

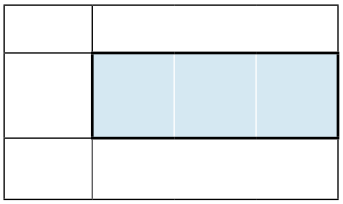
Developing pupils' Knowledge, Understanding and Skills	Supporting Notes
• develop skills in scientific methods of enquiry to further scientific knowledge and understanding: – planning for investigations – obtaining evidence – presenting and interpreting results	There is an emphasis on developing skills in scientific methods of enquiry. It may be useful to explore how these were developed so that pupils gain an insight into the history and philosophy of Science (Cultural Understanding). Pupils are given opportunities to plan investigations, obtain evidence, and present and interpret their results. These opportunities may be separate activities or combined to form a complete investigation. They may be based on investigating and exploring questions posed by the pupils.
• develop creative and critical thinking in their approach to solving scientific problems	Many of the issues addressed in Science have no single answer or solution and are rich contexts for pupils to develop their problem-solving and decision-making skills.
• research scientific information from a range of sources	Pupils have access to huge amounts of scientific information online as well as from newspapers, magazines, television and radio. They need to become discerning in their research and assess the reliability of the information; also to become aware that there is usually more than one way to view an issue.
• develop a range of practical skills, including the safe use of science equipment	Science is a practical subject. Pupils should have opportunities to use scientific equipment in engaging and relevant contexts, developing skills in accurately measuring and recording information.

Developing pupils' Knowledge, Understanding and Skills	Supporting Notes
Learn about: Organisms and Health • Interdependence of plants and animals • Cells, genes and reproduction • Healthy body and mind Chemical and material behaviour • Atoms and chemical changes • Structures, properties, uses of materials • Elements, compounds and mixtures Forces and energy • Forces and energy transfer • Using electricity • Sound and light Earth and Universe • The environment and human influences • The solar system and universe	Pupils develop their Science specific and cross-curricular skills as they increase their knowledge and understanding of Science through the study of : • organisms and health; • chemical and material behaviour; • forces and energy; and • the earth and universe. While covering the statutory requirements described, teachers have flexibility to follow both their own and pupil interests.

Questions for Departments

- What is the current balance between Science knowledge, understanding and skills in the department's provision?
- What are the implications for further learning and teaching at Key Stage 3?

Action



4.3 Curriculum Objectives and Key Elements

The curriculum objectives are broken down into key elements. The key elements are a vehicle for ensuring that Science directly connects to the whole curriculum objectives. The key elements also provide a means for connecting learning in Science to other subjects and Learning for Life and Work. Using Learning for Life and Work to make connections is explored further in 5.3 Connecting the Learning.

The table below shows how each curriculum objective is linked to specific key elements.

The Northern Ireland Curriculum should provide relevant opportunities to help each pupil develop as:		
Objective 1 An individual	**Objective 2** A contributor to society	**Objective 3** A contributor to the economy and the environment
Key Elements Personal Understanding Mutual Understanding Personal Health Moral Character Spiritual Awareness	**Key Elements** Citizenship Cultural Understanding Media Awareness Ethical Awareness	**Key Elements** Employability Economic awareness Education for Sustainable Development

For example, developing pupils as individuals (objective 1) will require a focus on the key elements of Personal Understanding, Mutual Understanding, Personal Health, Moral Character and Spiritual Awareness.

Each subject must contribute to all key elements across the key stage. Some subjects will have more naturally occurring opportunities to promote certain key elements.

The key elements that Science contributes to more fully are:

- Personal Understanding;
- Personal Health;
- Media Awareness;
- Ethical Awareness;
- Employability;
- Economic Awareness;
- Education for Sustainable Development.

For example, Science will have a leading role in learning about Personal Health and Education for Sustainable Development. Although every other subject will address aspects of these, a significant amount of what is covered in Science can be looked at through the lenses of 'Personal Health' and 'Education for Sustainable Development'.

The text within columns 2, 3 and 4 in the statutory requirements for Science relates to activities which contextualise some of the key elements. Some of the key elements are more significant than others in Science, and therefore, activities relating to a specific key element may be revisited often during Key Stage 3. Further detailed examples for how each key element may be addressed in Science are given in Appendix 3.

The key elements can help to make meaningful links with other subjects. They promote coherence across the whole curriculum, and facilitate more collaborative planning and teaching.

The following table gives examples of some of the questions which may help to explore and extrapolate what is meant by each key element in Science.

Developing the Key Elements through Science

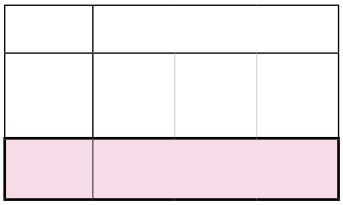
Developing pupils as ... individuals	... contributors to society	... contributors to the economy and environment
Personal Understanding What causes the emotional changes during puberty? Can understanding how my brain functions improve my learning? What learning strategies work best for me? What are my strengths when doing practical work? **Mutual Understanding** How can we work well together as a team? Who will perform different aspects of a task? How can we listen to everyone's ideas? Why do we not always agree with each other? **Personal Health** How can I look after my body to stay healthy? What is a healthy diet? How can we work safely in the lab? How can I reduce risks to my health? **Moral Character** Why look at the bigger picture? Why is it important not to jump to hasty conclusions? Why challenge over-simplistic interpretations of scientific issues? **Spiritual Awareness** What in the world inspires me? How has Science helped to explain the world around us? Why develop skills in critical and creative thinking?	**Citizenship** How do I know that scientific data/information is reliable? How is scientific information used in making decisions that affect society? Can you give examples? What are the different viewpoints when considering a problem? **Cultural Understanding** What is the history/story behind developments and theories in Science? Which discoveries have changed or had a major impact on our lives? How have scientific ideas and explanations changed over time? **Media Awareness** How are Science issues reported on and presented by the media? How does the general public find out about scientific issues? Are all sources of information trustworthy? Can you find the Science behind sensationalist headlines? How has the Internet changed how we find scientific information? **Ethical Awareness** How do our choices impact on: • others? • the environment? How can we use new scientific knowledge responsibly? What are the dilemmas that we face with new advances in Science? Is all scientific enquiry justified? What is the difference between objective and subjective?	**Employability** What skills do we develop in Science? Which careers are related to Science? How do scientists make a difference to our lives? **Economic Awareness** Does Science affect what we buy? How is Science used in making different products? Does the word 'scientific' on a product mean that it's better? **Education for Sustainable Development** How are living things dependent on each other? How can we affect the environment: • for the better? • for worse? How can we make a difference? How can we measure pollution? Why try to solve environmental problems? What are the long term implications of: • climate change? • reduced biodiversity?

Questions for Departments

- Which key elements do we :
  - address well;
  - need to focus more on;
  - not address at all?

- Are there any key elements that we could develop with another department to promote connected learning?

Action



4.4 Learning Outcomes

Learning Outcomes state the skills and capabilities pupils should be able to demonstrate throughout Key Stage 3 in each subject. These are similar across each area of learning and promote the infusion of the **cross-curricular skills** (Communication, Using Mathematics and Using ICT) (please refer to Appendix 1 for further guidance on the cross-curricular skills). The learning outcomes also promote the infusion of **Thinking Skills and Personal Capabilities** (also refer to Appendix 2 for further guidance on Thinking Skills and Personal Capabilities).

As with all subjects, it is statutory for teachers to provide opportunities for pupils to **acquire** and **develop** the cross-curricular skills and the Thinking Skills and Personal Capabilities in Science. Pupils should also be given opportunities to demonstrate their skills and application of knowledge and understanding of Science to meet the learning outcomes.

Evidence for Learning Outcomes

Evidence of the application of skills, knowledge and understanding for a learning outcome can be demonstrated at any point in the learning process. Learning outcomes can be based on process or product. They may be evidenced by teacher, pupil or peer assessment of a range of pupils' work and performance, including work generated using ICT. The nature of feedback on learning outcomes can be qualitative, quantitative, verbal or written to suit the purpose of the assessment.

Using and Recording Evidence

The number of occasions when learning outcomes are internally recorded, the system for internal recording and the use made of internal records is at the discretion of departments in line with whole school policy. Learning outcomes can be demonstrated through formal or informal assessment, formative and/or summative assessment.

Evidence of learning outcomes can be:
- recorded informally, that is, primarily for feedback to pupils and for teacher reference;
- recorded formally, that is, in line with departmental and internal whole school assessment policy requirements;
- used to inform reporting requirements, for example, in relation to Pupil Profile requirements.

Skills and the Learning Outcomes

The relationship between the learning outcomes and the cross-curricular skills and Thinking Skills and Personal Capabilities is set out in the table below.

Learning Outcomes	Cross-Curricular Skills/Thinking Skills and Personal Capabilities
Demonstrate a range of practical skills in undertaking experiments, including the safe use of scientific equipment and appropriate mathematical calculations	Using Mathematics
Use investigative skills to explore scientific issues, solve problems and make informed decisions	Thinking, Problem-Solving, Decision-Making
Research and manage information effectively, including Using Mathematics and Using ICT where appropriate	Managing Information Communication, Using Mathematics, Using ICT
Show deeper scientific understanding by thinking critically and flexibly, solving problems and making informed decisions, demonstrating Using Mathematics and Using ICT where appropriate	Thinking, Problem-Solving, Decision-Making Using Mathematics, Using ICT
Demonstrate creativity and initiative when developing ideas and following them through	Being Creative
Work effectively with others	Working with Others
Demonstrate self-management by working systematically, persisting with tasks, evaluating and improving own performance	Self-Management
Communicate effectively in oral, visual, written, mathematical and ICT formats, showing clear awareness of audience and purpose	Communication Using Mathematics Using ICT

Questions for Departments

- How can we plan for learning outcomes?
- How can our existing departmental assessment policy be amended to make reference to the learning outcomes?
- Which learning outcomes will be the most challenging for our department?

Action

4.5 Thinking Skills and Personal Capabilities

The Thinking Skills and Personal Capabilities framework consists of five overlapping strands:

- Managing Information;
- Thinking, Problem-Solving, Decision-Making;
- Being Creative;
- Working with Others;
- Self-Management.

Each strand is broken down into further detail (see appendix 2). These can facilitate lesson planning and provide criteria against which pupils' performances can be assessed and reported, for example, linking cause and effect, examining evidence, planning a task, etc.

Many of the skills are not new and are already being developed across a range of subjects. This single framework aims to make the development of Thinking Skills and Personal Capabilities more structured and explicit, to encourage application across a range of contexts and to provide a common language that pupils and teachers can use to talk about their thinking and learning.

There are a number of teaching strategies that will promote the development of Thinking Skills and Personal Capabilities generally, for example, setting open ended tasks, effective questioning, using thinking frames and diagrams, reflecting and talking about thinking and learning, providing meaningful opportunities for collaborative learning, etc. Many of these activities also support the principles of Assessment for Learning.

The big shift, however, is to focus on opportunities in Science where a specific thinking skill or personal capability can be used to deepen understanding of a particular concept or context in Science. The context used provides opportunities for the development and practice of the thinking skill or personal capability. This can lead to lessons where there is the parallel development of subject knowledge and understanding as well as the development of, for example, a particular mode of thinking. This approach is known as infusion; adding one thing to another to give it a new significance.

Planning for infusion involves, for example:

(a) looking across a series of units of work for Year 8 and identifying where the most appropriate contexts are to introduce and develop specific skills, such as, evaluating the most appropriate information, justifying opinions, reaching agreement within a group, etc.

(b) identifying the specific skills and capabilities best developed through Science and setting up contexts to introduce and practise them, such as, comparing and contrasting, examining options and weighing up pros and cons, taking turns, sharing and cooperating, etc.

This explicit approach to developing Thinking Skills and Personal Capabilities provides opportunities to observe, record, feedback and report on pupils' strengths and areas for future focus in terms of their development in Thinking Skills and Personal Capabilities. It also enables pupils to transfer particular thinking skills or personal/interpersonal skills to other contexts.

Progression in skills and capabilities is only made through their practice and application in a range of contexts and at increasing levels of challenge and demand.

Continuing Professional Development (CPD) materials have been developed to promote the infusion of Thinking Skills and Personal Capabilities across the curriculum. These materials are available at www.nicurriculum.org.uk.

Questions for Departments

- How can Science meaningfully develop each strand of the Thinking Skills and Personal Capabilities framework?
- Where are the key opportunities in Science for infusion?

Action

Section 05
Approaches to Learning and Teaching

5.1 Key Messages

Flexibility

Teachers now have the opportunity to use the statutory requirements to devise schemes and units of work in Science that follow the needs and interests of the pupil. This does not mean throwing out schemes of work that have been carefully developed over the years. It provides opportunities for teachers to build on those units that best engage and develop their pupils and replace or revitalise those units that did not engage the pupils so much.

Relevance

Teachers have opportunities to look for themes or issues that are real and relevant to the lives of pupils today. The Science specific skills and the concepts in the first column of the statutory requirements for Science can be developed through current science-related issues, in the media or locally, that pupils express an interest in.

Integrated

Teachers have opportunities to combine aspects of Biology, Chemistry and Physics to inform units of work which help pupils gain a better understanding of the complexity of how the world around us works. For example, the air and breathing, light and how we see, etc.

Values Based

The key elements provide opportunities for pupils to reflect on moral, ethical, spiritual, social and cultural dimensions of Science issues relating to real people and real places and to consider their own views and opinions about them.

Action Orientated

Through enquiry-based learning, pupils develop skills in planning investigations and practical experimental activities. There are also opportunities for pupils to be challenged about individual and collective social and environmental responsibilities.

Future Focused

Pupils are challenged to think about the type of world they would like to share in years to come and how best to achieve it. They will also have opportunities to explore how the skills developed through Science might help them in the future.

5.2 Assessment for Learning

'Assessment for Learning' (AfL) is an approach that can support effective learning and teaching. Assessment for Learning focuses on the learning process (rather than the end product) and attempts not to prove learning but rather improve it. It is formative assessment. It is a way for us to take stock of learning during the process and it can help inform teachers of how the learning is progressing.

In 'Assessment for Learning':

- there is a high emphasis on *transferable learning*;
- assessment becomes a much more *transparent process* because it is based on critical information that is shared with the learners; and
- learners are able to *take responsibility* for their own learning, and for aspects of their assessment.

'Assessment for Learning' is not something extra or 'bolted on.' It integrates with existing classroom practice. Assessment for Learning involves the following key actions:

Sharing learning intentions	A learning intention is a description of what teachers want pupils to know, understand or be able to do by the end of an activity. It tells pupils what the focus for learning is going to be. It helps both teachers and pupils to focus on the learning rather than the activity, for example: Identify what pupils will be learning (We are learning to.....) Explain the reason for learning (We are learning this because.....)
Sharing and negotiating success criteria	Success criteria are statements that help pupils recognise if they have been successful in their learning. Pupils may be involved in deciding these. They summarise the processes or characteristics needed for success, and they always link directly to the learning intention. They essentially spell out the steps or ingredients required to achieve the learning intention, offering specific guidance on how to be successful.
Giving feedback to pupils	Quality feedback is essential for effective learning and teaching. Feedback can motivate pupils by building self-esteem and reinforcing the positive. To be truly formative the feedback must inform the next steps in the learning process. For example, when offering written feedback: 1.Find two occasions where they have achieved success (symbols can be used); 2.Identify an aspect of their work that they can immediately improve; 3.Provide them with a prompt or strategy on how to improve; 4.Give them time to make this improvement.
Effective questioning	Effective questioning is about asking questions in a way that elicits maximum feedback from pupils, which can then be used to evaluate, plan and extend learning, for example: • Ask better questions: ask 'open' questions or reframe questions where there is no single correct answer and pupils are rewarded for exploring options and sharing possible solutions; • Ask questions better: provide pupils with time to think; by increasing the wait time to 3 or 5 seconds between posing the question and asking for the answer, teachers can make a significant difference to the question's effectiveness.
Self and peer assessment	Pupil reflection promotes independent learning, communication and support in the classroom. Teachers can develop pupil reflection in the classroom through the use of peer and self-assessment and self-evaluation.

Continuing Professional Development (CPD) materials have been provided for schools to promote Assessment for Learning.

Questions for Departments

- Which of these Assessment for Learning key actions are part of our existing classroom practice?
- Which do we need to give more attention to?
- How do we do this?

Action

5.3 Connecting the Learning

The Northern Ireland Curriculum is designed to accommodate links across subjects. Many natural links exist, although they may be under-exploited. Where these links are identified and planned for, they have the potential to make learning more meaningful, informed and purposeful. Opportunities to connect learning range from small and informal to whole school and formally planned.

Any of the following may be used as drivers for connected learning between two or more subjects:

- Skills/Learning Outcomes;
- Key Elements;
- Themes;
- Concepts;
- Learning experiences;
- Key concepts within Learning for Life Work;
- Other suitable approaches.

Questions for Departments

- Which of these could best be used as a starting point to make meaningful connections with other subjects?

Action

(Examples of connecting learning across subjects are available in thematic units and one collaborative unit provided in the Curriculum Support and Implementation Box).

Connecting to Learning for Life and Work

One way of beginning to make connections is in Learning for Life and Work. The four subject strands within Learning for Life and Work (Home Economics, Local and Global Citizenship, Employability and Personal Development) contribute directly to the three curriculum objectives to develop the pupil as:

- an individual;
- a contributor to society;
- a contributor to the economy and environment.

The other areas of learning also contribute to the curriculum objectives and Learning for Life and Work. Well planned and organised work within subjects make a distinctive and natural contribution to Learning for Life and Work and help to strengthen and enrich its provision as a whole.

Teachers have flexibility to enhance the breadth and depth of their subject's contribution to Learning for Life and Work. Science teachers can therefore:

- raise awareness about Learning for Life and Work key concepts;
- develop more detailed understanding about Learning for Life and Work key concepts within their subject context;
- explore particular Learning for Life and Work key concepts. When delivered in sufficient depth, an area of learning/subject strand can take full responsibility for meeting a particular statement of requirement.

More detailed guidance in linking Science with Learning for Life and Work is provided in Appendix 4.

Questions for Departments

- Which aspects of our current practice promote connected learning?
- What are the issues around the management of connected learning?
- How will we know that pupils are learning to make connections?

Action

5.4 Active Learning

Engaging pupils in their learning and providing them with opportunities to demonstrate Thinking Skills and Personal Capabilities requires an approach beyond traditional didactic methods.

A glossary *Active Learning and Teaching Methods* is included in the Curriculum Support and Implementation Box and is available from www.nicurriculum.org.uk. This resource contains a wide range of active and experiential strategies to promote pupils' participation and engagement.

Science provides rich contexts in which to use a range of active learning strategies.

Questions for Departments

- Which active learning strategies would work for us?
- How does the climate in our classrooms support the use of active learning?
- What are the implications for classroom management?

Action

Section 06
Auditing and Planning

6.1 Conducting a Departmental Audit

When planning to carry out a departmental audit, refer to the training materials *Planning for the Revised Curriculum at Key Stage 3*. Used in conjunction with the following guidance, departments can decide how to evaluate existing and planned provision.

Audits are a starting point for the long term planning process. There are a number of possible 'ways-in' to carrying out an audit. Some of these are outlined in the table below. Further details are available at www.nicurriculum.org.uk.

Starting Point for Audit	Description of Process
Curriculum Objectives	**What** do we teach and **why**? Look at how the topics currently taught address the broad curriculum objectives. The objectives provide a rationale for the topic. The key elements can provide the footholds into the objectives.
Key Elements	Check where units of work contain aspects of the key elements, or could be re-focused to suit. Check for coverage across the key stage. Remove excessive duplication, add material to address any omissions.
Thinking Skills and Personal Capabilities	Starting with current units of work it is possible to audit the provision of Thinking Skills and Personal Capabilities using the statements from the "From – To Progress Map". After completing an audit in this way, gaps in provision can easily be detected and it will then be possible to develop opportunities to ensure overall coverage in a year and progression across the key stage.
Learning Experiences	List the categories of learning experience from the 'Big Picture' document in a column. Beside each, match the units of work in your scheme which fit with the category. Assess the coverage: is there a good mixture and variety of experience planned?
'Blue Skies'	Begin with aspirations for a completely new scheme of work, and work up details so as to match planned experiences with Northern Ireland Curriculum requirements.

6.2 Long, Medium and Short Term Planning

Long Term Planning

In producing long term plans or ***schemes of work***, you need to think about:

- how Science is delivered across the whole key stage;
- how Science links with the wider curriculum objectives;
- how and when to develop specific skills and capabilities across the key stage;
- how Science can actively link with other curricular areas;
- how Science aligns with whole school development/circumstances.

Medium Term Planning

In planning ***units of work***, you need to think about:

- identifying big questions/issues to engage pupils and support an enquiry based approach;
- the learning and teaching activities and strategies to best develop the skills;
- how to build in time for monitoring, evaluating and reviewing.

Short Term Planning

In *planning* ***a lesson or series of lessons***, you need to think about:

- making the learning intentions explicit to clarify what you want the pupils to know, understand and/or be able to do;
- agreeing and negotiating with the pupils what success in this task/activity will look like;
- using a launch activity to engage the pupils and develop their sense of enquiry;
- using a range of activities/challenges;
- supporting and prompting pupil performance;
- planning plenaries to feedback, reflect on thinking and learning, make connections to other learning and set up next lesson(s).

Curriculum development is a process which requires ongoing evaluation.
It is useful to think about why some lessons work, while others don't succeed as we would like.

For any scheme of work/lesson or series of lessons, it may be useful to ask:

- How well did the pupils respond to that?
  - Did they enjoy it?
  - Did they see the relevance?
  - Were they motivated to learn?
- How well did they achieve?
  - What evidence of achievement was there?
  - Was there evidence of deep learning?
  - How do I know this?
  - How did I collect it?
- What modifications could I make
  - In the content?
  - In the learning resources/materials?
  - In the learning activities?
- When did I last experience a "buzz" in the classroom?
  - What theme/issue were the pupils learning about?
  - What was the big enquiry/key question?
  - What activity(ies) were they doing?
  - What was the purpose of their learning?
  - Why did I choose these particular resources to use with those pupils?

Appendices

Appendix 1
Cross-Curricular Skills

Communication Across the Curriculum

Communication is central to the whole curriculum. Pupils should be able to communicate in order to express themselves socially, emotionally and physically, to develop as individuals, engage with others and contribute as members of society.

Pupils should be given opportunities to engage with and demonstrate the skill of Communication and to transfer their knowledge about communication concepts and skills to real-life meaningful contexts across the curriculum.

The modes of communication include talking and listening, reading and writing. However, effective communication also includes non-verbal modes of communication, wider literacy and the use of multimedia and ICT technologies which may combine different modes. Pupils are therefore encouraged to become effective communicators by using a range of techniques, forms and media to convey information and ideas creatively and appropriately.

The requirements for Communication are set out below.

Across the curriculum, at a level appropriate to their ability, pupils should be enabled to develop skills in:

Talking and Listening

Pupils should be enabled to:

- listen to and take part in discussions, explanations, role-plays and presentations;
- contribute comments, ask questions and respond to others' points of view;
- communicate information, ideas, opinions, feelings and imaginings, using an expanding vocabulary;
- structure their talk and speak clearly so that ideas can be understood by others;
- adapt ways of speaking to audience and situation;
- use non-verbal methods to express ideas and engage with the listener.

Reading

Pupils should be enabled to:

- read a range of texts* for information, ideas and enjoyment;
- use a range of strategies to read with increasing independence;
- find, select and use information from a range of sources;
- understand and explore ideas, events and features in texts*;
- use evidence from texts* to explain opinions.

* Texts refer to ideas that are organised to communicate and present a message in written, spoken, visual and symbolic forms.

Writing

Pupils should be enabled to:

- talk about, plan and edit work;
- communicate information, meaning, feelings, imaginings and ideas in a clear and organised way;
- develop, express and present ideas in a variety of forms and formats, using traditional and digital resources, for different audiences and purposes;
- write with increasing accuracy and proficiency.

Using Mathematics Across the Curriculum

Using Mathematics is the skill of applying mathematical concepts, processes and understanding appropriately in a variety of contexts. Ideally these should be in relevant real life situations that require a mathematical dimension.

Pupils are likely to acquire and consolidate their mathematical knowledge, concepts and skills within the area of learning for Mathematics and Numeracy. However, they should be given opportunities to transfer their understanding, as appropriate, to other contexts across the curriculum. Pupils can demonstrate their mathematical knowledge, understanding and skills in a variety of ways to communicate, manage information, think critically, solve problems and make decisions.

The requirements for Using Mathematics are set out below.

Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:

- choose the appropriate materials, equipment and mathematics to use in a particular situation;
- use mathematical knowledge and concepts accurately;
- work systematically and check their work;
- use mathematics to solve problems and make decisions;
- develop methods and strategies, including mental mathematics;
- explore ideas, make and test predictions and think creatively;
- identify and collect information;
- read, interpret, organise and present information in mathematical formats;
- use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain way of working;
- develop financial capability;
- use ICT to solve problems and/or present their work.

Using Information and Communications Technology Across the Curriculum

Using Information and Communications Technology (ICT) provides powerful tools and contexts to support meaningful learning and has the potential to transform and enrich pupils' learning experiences and environments across the curriculum. The creative use of ICT can empower learners to become independent, self-motivated and flexible, helping in turn to develop self-esteem and positive attitudes to learning, with which to realise their full potential. It also provides opportunities to collaborate within and beyond the classroom to pose questions, take risks and respond positively to 'what if' questions.

To help develop skills in researching, handling and communicating information pupils should have opportunities, using ICT, to engage in genuine research and purposeful tasks set in meaningful contexts. They should be encouraged to re-work information, present and exchange their ideas and translate their thinking into creative products and productions which show an awareness of audience and purpose.

The requirements for Using ICT are set out below.

Across the curriculum, at a level appropriate to their ability, pupils should be enabled to develop skills to:

Explore

Pupils should be enabled to:

- access and manage data and information;
- research, select, process and interpret information;
- investigate, make predictions and solve problems through interaction with digital tools;
- understand how to keep safe and display acceptable online behaviour.

Express

Pupils should be enabled to:

- create, develop, present and publish ideas and information using a range of digital media;
- create information and multimedia products using a range of assets.

Exchange

Pupils should be enabled to:

- communicate using a range of contemporary methods and tools;
- share, collaborate, exchange and develop ideas digitally.

Evaluate

Pupils should be enabled to:

- talk about, review and make improvements to work, reflecting on the process and outcome;
- consider the sources and resources used.

Exhibit

Pupils should be enabled to:

- manage and present their stored work;
- showcase their learning across the curriculum.

Cross-Curricular Skills in Science

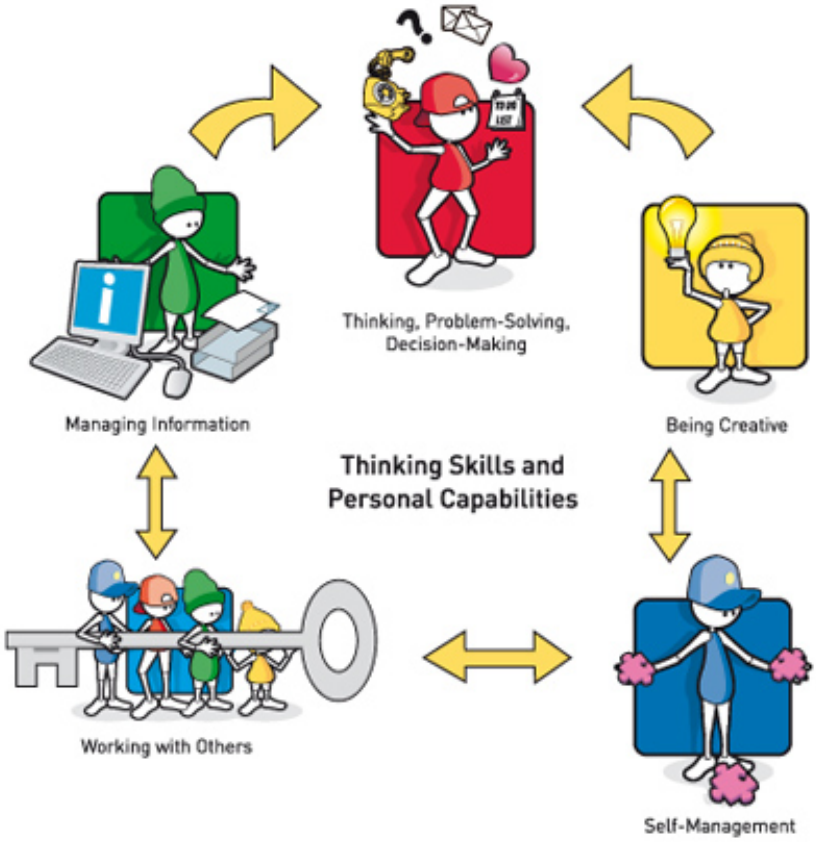
Cross-curricular skill	Communication	Using Mathematics	Using ICT
Purpose	To provide opportunities for pupils to acquire, develop and demonstrate the cross-curricular skill of Communication	To provide opportunities for pupils to acquire, develop and demonstrate the cross-curricular skill of Using Mathematics	To provide opportunities for pupils to acquire, develop and demonstrate the cross-curricular skill of Using ICT
Examples of processes	Discussion, presentation, demonstration, asking questions, reading text for information, using evidence from text to explain opinion, communicate information in a clear and organised way, present ideas in a variety of formats for different audiences and purposes, etc.	Use mathematical knowledge and concepts, use mathematics to solve problems and make decisions, mental mathematics, make and test predictions, data handling, using statistics, developing financial capability, etc.	Explore information using electronic tools, create, develop, present and publish ideas using a range of digital media, communicate electronically, etc.
Examples of contexts in Science	• Discuss and explain their opinions and views on science-related issues • Debate and argue both sides of an issue before reaching their own conclusion • Talk about their work in Science, using correct scientific terminology, as appropriate • Discuss and write plans for Science investigations • Write reports on practical work/ Science investigations	• Measurement Choose appropriate units and apparatus to record accurate measurements Convert between different metric units, for example, metres to cm • Handling data Use mean, mode, median and range where appropriate Understand how repeating measurements and taking an average improves/confirms the accuracy of the results in an investigation • Constructing and interpreting graphs • Constructing and reading information from tables • Using formulae Rearranging equations	• Creating multimedia presentations which allow pupils to become their own directors/ editors/artists/musicians/camera operators /researchers/script writers/actors • A Power Point presentation with sets of images on a science-related topic • Record large sets of information/data using data logging equipment • Organise and present data (e.g. graphs, tables, charts databases) in order to search and sort data in answer to an enquiry question • Use a spreadsheet to process data recorded in Science investigations • Use electronic methods to communicate and share information, for example, using *Science Across the World* www.scienceacross.org, to explore Science topics and share findings with other schools

Appendix 2
Thinking Skills and Personal Capabilities

Thinking skills are tools that help pupils to go beyond the acquisition of knowledge in order to search for meaning, apply ideas, analyse patterns and relationships, create and design something new and monitor and evaluate their progress.

Personal and interpersonal skills and capabilities underpin success in all aspects of life. It is important, therefore, that pupil's self-esteem and self-confidence are explicitly fostered along with the ability to understand and manage their own emotions and to interact effectively with others.

Teachers should help pupils to develop Thinking Skills and Personal Capabilities by focusing on the following areas.



Thinking Skills and Personal Capabilities in Science

Thinking skills and Personal Capabilities strands	Managing Information	Thinking, Problem-Solving, Decision-Making	Being Creative	Working with Others	Self-Management
Purpose	To develop learners' abilities in an information intensive environment	To engage pupils in active learning so that they can go beyond mere recall of factual information and the routine application of procedures	To encourage personal response of the learner by promoting dispositions for curiosity, exploration, experimentation and invention	To enable learners to engage in collaborative activities and to make the most of their learning when working with others	To help learners to become more self-directed so that they can manage their learning in new situations and in the longer term
Examples of processes in which pupils are involved	Accessing, selecting, recording, integrating, communicating	Searching for meaning, deepening understanding, coping with challenges	Imagining, generating, inventing, taking risks for learning	Being collaborative, being sensitive to others' feelings, being fair and responsible	Evaluating strengths and weaknesses, setting goals and targets, managing and regulating self
Examples of contexts in Science	Be aware of and consider a range of possible sources of information; when planning for a Science investigation, consider the question 'Has anything like this been done before?' Purposeful information finding Justify the usefulness of the information; is it reliable, current and free of bias? Use scientific knowledge to critically assess validity of information	Put objects/materials into groups; decide on classifications; learn about groupings used in Science such as living and non-living, man-made and natural materials, metals and non-metals, etc; use a key to classify objects; design a key for this purpose Sequence events and be able to explain the order of the sequence, for example, stages in a life cycle or stages in manufacturing products such as iron/steel	Pupils pose questions to stimulate their curiosity Develop hypotheses to explain events and phenomena in the world around them Come up with ideas; debate and discuss them; test ideas out Take an idea and develop it; build on each other's ideas Consider other approaches when doing investigative work Deal with unexpected results; be open to new challenges and face new problems	Group work as part of Science investigations and other practical work In group contexts, distribute tasks/roles; take turns; negotiate who does what; share information with each other; each pupil takes a role in decision making; all opinions are valued; pupils learn to deal with disagreements and reach a compromise Meet agreed deadlines	Be aware of safety and risks in the lab Work through an investigation or experiment in an ordered/structured way Manage time when doing practical activities; take into account simultaneous activities when planning, for example, 'while the water is heating, I will ...' Know who/when/where to ask for advice or assistance especially when doing practical investigations

Thinking skills and Personal Capabilities strands	Managing Information	Thinking, Problem-Solving, Decision-Making	Being Creative	Working with Others	Self-Management
Examples of contexts in Science	When selecting the most appropriate method for sourcing information, consider a range of possible sources: own measurements; collecting data using, for example, a questionnaire, an external source	Describe similarities and differences and state which are the most important; spot and describe any patterns behind them Develop a hypothesis as the starting point for a scientific investigation; make predictions Design a fair test. Pupils decide: what they will change; what they will keep the same; what they will measure and how often Examine experimental evidence using the following questions: How reliable is it? Were the measurements taken accurately? How many repeats were used to inform the average? Are there any anomalous results? Are the results reasonable? Make connections between two sets of data or events and describe the relationship between them in own words, for example, exercise and heart rate, speed and braking distances, etc; how would the relationship be affected if something changed	Learn about mistakes/ failures which led to scientific breakthroughs, for example, the discovery of penicillin		

Appendix 3
Key Elements in Science

This appendix provides a range of examples for addressing the key elements in Science. The examples are mapped to the first column of the statutory requirements for Science (i.e. Knowledge, Understanding and Skills).

Examples of developing pupils' Knowledge, Understanding and Skills through the Key Elements of ...

Knowledge, Understanding and Skills	Personal Understanding	Mutual Understanding
Develop skills in scientific methods of enquiry to further scientific knowledge and understanding: – planning for investigations – obtaining evidence – presenting and interpreting results.	Structure their way of working. Developing their planning skills. Goal setting.	Work collaboratively to plan investigations. Trust each other to take measurements and record observations. Share a common goal/aim/plan. Respect others' opinions when interpreting results.
Develop creative and critical thinking in their approach to solving scientific problems.	Developing their capacity to understand and see a problem from various viewpoints and consider benefits and disadvantages.	Learn to evaluate ideas and suggest improvements without being offended or causing offence. Deal with conflicting information.
Research scientific information from a range of sources.	Find out about the brain and learning.	Find out about how different countries are approaching a scientific issue.
Develop a range of practical skills, including the safe use of science equipment.	When working in the science laboratory, be aware of their strengths and the areas that they need to focus on for improvement.	Awareness of safety of others. Agreed strategies for safe practice and reducing risk in the lab.

Knowledge, Understanding and Skills	Personal Understanding	Mutual Understanding
Learn about: Organisms and Health; Chemical and material behaviour; Forces and energy; Earth and Universe.	Make a personal DNA necklace. Emotional and physical changes at puberty. **Cells, genes and reproduction** Explore ways of improving own learning by finding out how the brain functions. **Healthy body and mind** Sources of everyday materials that you use, for example, lycra, polythene, etc. **Structures, properties, uses of materials** Elements, compounds and mixtures that make up the body. **Elements, compounds and mixtures** Food as an energy source. How we use energy. **Forces and energy transfer**	Reproduction in context of caring secure relationship. **Cells, genes and reproduction**

Examples of developing pupils' Knowledge, Understanding and Skills through the Key Elements of ...

Knowledge, Understanding and Skills	Personal Health	Moral Character
Develop skills in scientific methods of enquiry to further scientific knowledge and understanding: – planning for investigations – obtaining evidence – presenting and interpreting results.	Planning for safe investigations. Identify risks and suggest/take steps to mitigate these.	When obtaining evidence, assess all results, not just the ones that support their hypothesis. Look at whole picture when interpreting results – not jumping to hasty conclusions.
Develop creative and critical thinking in their approach to solving scientific problems.	Using scientific information, adopt a sensible approach to looking after their health.	Challenge over-simplistic interpretations of scientific issues.
Research scientific information from a range of sources.	Research an aspect of 'Keeping Healthy'.	Find out the Science behind a sensational headline.
Develop a range of practical skills, including the safe use of science equipment.	Handle chemicals and equipment in a safe manner. Be aware of risks. Know procedures in case of accident.	Obtain scientific results fairly and genuinely.

Knowledge, Understanding and Skills	Personal Health	Moral Character
Learn about: Organisms and Health; Chemical and material behaviour; Forces and energy; Earth and Universe.	Health benefits of plants. Using plants for pharmaceuticals. **Interdependence of plants and animals** Knowledge of menstrual cycle. Aspects of reproductive health. Factors for a healthy pregnancy. **Cells, genes and reproduction** How effective are your hand washing methods? Investigate! **Healthy body and mind** Awareness of harmful materials and effects on health, for example, Carbon Monoxide, etc. Awareness of substances necessary for health: water, air, minerals such as iron and calcium, etc Use of chlorine to purify water supply. **Elements, compounds and mixtures** Amount of energy used in different activities. **Forces and energy transfer** Imagine life without electricity. **Using electricity** How we see. How we hear. Medical equipment which use sound and light, for example, ultrasound scans and optical fibre scopes. **Sound and light** How will global warming and the hole in the ozone layer affect our health? Avoiding skin cancer. Diseases caused by pollution. **The environment and human influences**	Take responsibility for choices and actions. **Cells, genes and reproduction** Take responsibility for current behaviour which may affect future health. **Healthy body and mind** Make informed personal choices to reduce impact on the environment. **The environment and human influences**

Examples of developing pupils' Knowledge, Understanding and Skills through the Key Elements of ...

Knowledge, Understanding and Skills	Spiritual Awareness	Citizenship
Develop skills in scientific methods of enquiry to further scientific knowledge and understanding: – planning for investigations – obtaining evidence – presenting and interpreting results.	Awareness of the scientific method as an objective means to test and find out more about the world around us.	Realising that the scientific method underpins all scientific research.
Develop creative and critical thinking in their approach to solving scientific problems.	Develop creative and critical thinking as a personal strength.	Critically assess the source and quality of data used for solving scientific problems.
Research scientific information from a range of sources.	Compare scientific information with faith beliefs.	Assess reliability of sources of scientific information.
Develop a range of practical skills, including the safe use of science equipment.	Be aware of the amazing things that we can find out using scientific equipment; how it can make a difference to our lives.	Develop skills to collect reliable data.

Knowledge, Understanding and Skills	Spiritual Awareness	Citizenship
Learn about: Organisms and Health; Chemical and material behaviour; Forces and energy; Earth and Universe.	Awareness that our genes have been passed down to us through generations in the past; through our children, they will be passed to generations in the future. Similarities and differences between cells. **Cells, genes and reproduction** Complexity and diversity of living things: – How organisms become more complex from one celled creatures to humans. – How similar creatures develop differently when separated, for example, finches on Galapagos Isles. **Cells, genes and reproduction** **Interdependence of plants and animals** Awareness of how many atoms could fit into a full stop. **Atoms and chemical changes** Scale of forces in , for example, a hurricane, atomic bomb, etc. **Forces and energy transfer** Sense of wonder at, for example, a rainbow, dispersing and reforming white light using a prism, Newton wheels, observing Newton's rings. **Sound and light** Vastness of solar system and universe. Concept of light year. How sky at night is how stars looked thousands of years ago. **The solar system and universe**	The story of how the scientific method was used to determine the structure of DNA. **Cells, genes and reproduction**

Examples of developing pupils' Knowledge, Understanding and Skills through the Key Elements of ...

Knowledge, Understanding and Skills	Cultural Understanding	Media Awareness
Develop skills in scientific methods of enquiry to further scientific knowledge and understanding: – planning for investigations – obtaining evidence – presenting and interpreting results.	How scientific methods of enquiry were developed from Renaissance times, for example, through the work of Descartes.	Look at a news article describing a recent advance in science. Are any aspects of the scientific method mentioned? Present the results and conclusions of an investigation in the format of a news article.
Develop creative and critical thinking in their approach to solving scientific problems.	Stories of critical and creative thinkers in the past who challenged accepted theories of the time, for example, Galileo and Wegener.	Compare and contrast how a scientific issue is covered in two or more newspapers. Role play a radio/TV interview about a scientific issue.
Research scientific information from a range of sources.	Awareness of how knowledge and information about a scientific issue has evolved and developed over time.	Explore how a scientific issue/ problem is dealt with through a range of media.
Develop a range of practical skills, including the safe use of science equipment.	Stories of how the Bunsen burner and microscope were invented. Awareness of how scientific techniques and ideas were developed; how the different stages can be demonstrated in the classroom.	Use the Internet to source instructions for science experiments.

Knowledge, Understanding and Skills	Cultural Understanding	Media Awareness
Learn about: Organisms and Health; Chemical and material behaviour; Forces and energy; Earth and Universe.	Development of animal husbandry and use of artificial selection. **Interdependence of plants and animals** Story of Mendel's observations which led to theories about inheritance. **Cells, genes and reproduction** Find out how the work of scientists such as Pasteur, Jenner and Harvey have contributed to our knowledge of the human body. **Healthy body and mind** How oxygen was discovered. Importance of iron and plastics in our lives. How iron has been extracted from its ore throughout the ages. **Structures, properties, uses of materials** How different elements, compounds and mixtures have influenced or changed our lives, for example, using sulphur to vulcanise rubber for tyres, development of carbon fibre to make canoes and bicycles, etc. **Elements, compounds and mixtures** Story of Eddison inventing light bulb. Faraday and his discoveries about electricity. **Using electricity** Story of Bell inventing telephone. Fibre optics. Story of first transatlantic telegraph cable. **Sound and light**	Biodiversity issues in the news. **Interdependence of plants and animals** How developments in genetics and cell biology are reported in the news. How advances in reproduction are reported. **Cells, genes and reproduction** News articles on health issues. **Healthy body and mind** Reports on new materials and how they will affect our lives. **Structures, properties, uses of materials** How new technology is reported, for example, developments in fibre optics. **Sound and light** Environmental issues in the news. **The environment and human influences** Space exploration and related technological developments in the news. **The solar system and universe**

Examples of developing pupils' Knowledge, Understanding and Skills through the Key Elements of ...

Knowledge, Understanding and Skills	Ethical Awareness	Employability
Develop skills in scientific methods of enquiry to further scientific knowledge and understanding: – planning for investigations – obtaining evidence – presenting and interpreting results.	Is all scientific enquiry justified? Are there some areas that should be left alone?	Industry link with the Research and Development department of a firm. Consider how skills in scientific methods of enquiry could be useful in a range of careers. Develop enterprise skills by thinking of possible investigations.
Develop creative and critical thinking in their approach to solving scientific problems.	Distinguish between subjective and objective viewpoints when approaching problems.	Consider how critical and creative thinking would be useful in a range of careers.
Research scientific information from a range of sources.	Make responsible choices using scientific information available.	Awareness of science journalism as a career. Consider how skills in researching information would be useful in a range of careers.
Develop a range of practical skills, including the safe use of science equipment.	Ethical dilemmas with practical work in Science. Respect for living creatures cared for or examined in Science class.	Imagine you are using scientific skills in an employment context, for example, forensic scientist. Consider how scientific skills would be useful in a range of careers.

Knowledge, Understanding and Skills	Ethical Awareness	Employability
Learn about: Organisms and Health; Chemical and material behaviour; Forces and energy; Earth and Universe.	Stem cell research. Abortion. GM crops. **Cells, genes and reproduction** Is animal research to find cures for diseases justified? Risks of people taking part in drugs trials. **Healthy body and mind** Debate: 'Are chemicals always bad?' **Structures, properties, uses of materials** **Elements, compounds and mixtures** Discuss if appropriate to use deserts in developing countries for solar power. **Using electricity** Pirating music, burning CDs, etc. Responsible use of scanners etc. **Sound and light** Choices for protecting the environment. **The environment and human influences** Is amount spent on space research justified? **The solar system and universe**	How DNA technology is used in crime investigation. **Cells, genes and reproduction** Explore careers of: Polymer Chemist; Research and Development Scientist. **Structures, properties, uses of materials** Basic electrical knowledge such as fitting a plug and changing a fuse. Explore career of an electrician. **Using electricity** Explore careers of: Optician; Lighting and sound technicians; Photographer. **Sound and light**

Examples of developing pupils' Knowledge, Understanding and Skills through the Key Elements of ...

Knowledge, Understanding and Skills	Economic Awareness	Education for Sustainable Development
Develop skills in scientific methods of enquiry to further scientific knowledge and understanding: – planning for investigations – obtaining evidence – presenting and interpreting results.	Find out how much is spent on an aspect of scientific enquiry/research. Do you think it is worthwhile? Consider value of possible benefits. Consider cost when planning investigations. Investigate a product to determine best value, for example, content of vitamin C in different brands of orange juice – is there a link between vitamin C content and price?	Plan an investigation in an environmental context/on an environmental issue. Investigate the effects of pollution.
Develop creative and critical thinking in their approach to solving scientific problems.	Discuss and debate cost-effective solutions to scientific problems.	Use critical and creative thinking to suggest possible solutions to an environmental issue. Think through long term implications of, for example, climate change and reduced biodiversity.
Research scientific information from a range of sources.	Costs of different methods of researching information. If there is a school restriction on number of printouts, how best can you manage your information gathering?	Research an environmental issue using a range of sources.
Develop a range of practical skills, including the safe use of science equipment.	Find creative ways of carrying out low cost investigations.	Recycle paper in the lab – 'making Chinese paper'. Use consumables in the lab in a sustainable manner.

Knowledge, Understanding and Skills	Economic Awareness	Education for Sustainable Development
Learn about: Organisms and Health; Chemical and material behaviour; Forces and energy; Earth and Universe.	Ability to make products more cheaply. **Structures, properties, uses of materials** Costing of different methods of generating electricity. Efficiency in transporting electricity – reducing losses due to heat. **Using electricity** Debate: 'Is it too expensive to protect the environment?' **The environment and human influences** Consider the advantages of space exploration and research: – satellite TV – mobile phones – satellite navigation – weather forecasting – Google Earth **The solar system and universe**	Importance of biodiversity. **Interdependence of plants and animals** GM Crops. **Cells, genes and reproduction** **Healthy body and mind** Impact of synthetic materials on the environment. **Structures, properties, uses of materials** The impact of generating electricity on the environment. **Using electricity** Sound and light pollution. **Sound and light** Specific measures to improve and protect the environment. Investigate what can be done to conserve and promote biodiversity. **The environment and human influences** Use of satellites to monitor environmental factors, for example, integrity of ozone layer. **The solar system and universe**

Appendix 4
Linking Science with Learning for Life and Work

Personal Development

Aspects of Personal Development can be addressed in Science through the key elements of Personal Health and Personal Understanding and through learning about Organisms and Health.

Within the key concept of Personal Health:

- investigate the influences on physical and emotional/mental personal health;
- develop understanding about, and strategies to manage, the effects of change on body, mind and behaviour;
- investigate the effects on the body of legal and illegal substances and the risks and consequences of their misuse.

Within the key concept of Relationships:

- explore the implications of sexual maturation;
- explore the emotional, social and moral implications of early sexual activity.

Home Economics

Aspects of Home Economics can be addressed in Science through the key element of Personal Health and through learning about Organisms and Health.

Within the key concept of Healthy Eating:

- explore ways to achieve a healthy diet.

Local and Global Citizenship

Through discussion and debate in the Science classroom there are opportunities to contribute to the key concept of Democracy and Active Participation:

- investigate an issue from a range of viewpoints and suggest action that might be taken to improve or resolve the situation.

Education for Employability

Opportunities to contribute to the key concept of Enterprise and Entrepreneurship:

- demonstrate initiative and creativity in organising a task or resolving a problem.

Opportunities to contribute to the key concept of Career Management:

- assess personal skills and achievements to date; identify areas of interest and set targets for self-improvement;
- use a range of ICT resources to investigate a variety of both familiar and unfamiliar jobs.

Science and Technology: **Science**

The minimum content is set out below. The statutory requirements are set out in **bold** under **Knowledge, Understanding and Skills** in column 1, under the **Curriculum Objectives** and **Key Elements** in columns 2, 3 and 4 and in the **Learning Outcomes** at the bottom. Additional non-statutory guidance and suggestions are set out in plain text and italics.

Developing pupils' Knowledge, Understanding and Skills	(Objective 1) Developing pupils as Individuals	(Objective 2) Developing pupils as Contributors to Society	(Objective 3) Developing pupils as Contributors to the Economy and the Environment
Pupils should have opportunities, through the contexts opposite, to: develop skills in scientific methods of enquiry to further scientific knowledge and understanding: • 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 • Interdependence of plants and animals • Cells, genes and reproduction • Healthy body and mind Chemical and material behaviour • Atoms and chemical changes • Structures, properties, uses of materials • Elements, compounds and mixtures Forces and energy • Forces and energy transfer • Using electricity • Sound and light Earth and Universe • The environment and human influences • The solar system and universe.	Pupils should have opportunities to: **Explore emotional development,** for example, *the changes associated with puberty.* **Investigate ways of improving own learning by finding out how the brain functions.** (Key Element: **Personal Understanding**) **Explore physical, chemical and biological effects on personal health,** for example, *inherited characteristics, exercise and nutrition, misuse of chemicals, loud sound, etc.* (Key Element: **Personal Health**) **Explore issues related to Mutual Understanding** Respect and co-operate with others in the process of scientific enquiry, for example, *work effectively as part of a team in investigative work.* (Key Element: **Mutual Understanding**) **Explore issues related to Moral Character** Recognise and challenge over-simplistic or distorted generalisations about science with informed and balanced responses and take responsibility for choices and actions. (Key Element: **Moral Character**) **Explore issues related to Spiritual Awareness** Develop a sense of wonder about the universe, for example, *the scale from the smallness of the atom to the vastness of outer space; the complexity, diversity, and interdependence of living things.* (Key Element: **Spiritual Awareness**)	Pupils should have opportunities to: **Investigate how the media** (internet, television, radio, newspapers) **help inform the public about science and science related issues.** Explore some of the strengths and limitations of these sources of information, for example, *maintain a journal of science issues in the news; compare and contrast different approaches to dealing with scientific issues.* (Key Element: **Media Awareness**) **Explore some ethical dilemmas arising from scientific developments,** for example, *testing of new chemical products for weapons development; growing genetically modified crops.* (Key Element: **Ethical Awareness**) **Explore issues related to Citizenship** Consider factors that need to be taken into account when assessing statements that claim to be based on scientific research into issues affecting society, for example, *the nature, quality and source of the data.* (Key Element: **Citizenship**) **Explore issues related to Cultural Understanding** Consider how the development of scientific ideas or theories relate to the historical or cultural context, for example, *the development of the heliocentric model of the solar system, Jenner's work on vaccination, etc.* (Key Element: **Cultural Understanding**)	Pupils should have opportunities to: **Identify how skills developed through science will be useful to a wide range of careers,** for example, *jobs involving animal welfare, building and construction, education, electrical work , engineering, environmental management, financial services, food and farming, forensics, information and communications technology, journalism, plumbing, technology, pharmaceuticals, medicine, etc.* (Key Element: **Employability**) **Investigate a product of economic importance to determine the science behind it,** for example, *explore a successful local product and generate ideas for a product of their own.* Investigate a product to determine best value, for example, *compare performance and cost of an economy and branded product, consumer product testing, etc.* (Key Element: **Economic Awareness**) **Investigate the effects of pollution,** for example, *water, air, land, sound etc.* **and specific measures to improve and protect the environment,** for example, *renewable energy, efficient use of resources, waste minimisation, etc.* **Explore the importance of biodiversity, how it impacts on our lives and how it is affected by human activity.** **Investigate what can be done to conserve and promote biodiversity,** for example, *school wildlife gardens/ wilderness areas, anti-pollution strategies, habitat management, etc.* (Key Element: **Education for Sustainable Development**)
Learning Outcomes The learning outcomes require the demonstration of skills and application of knowledge and understanding of Science. Pupils should be able to:	• demonstrate a range of practical skills in undertaking experiments, including the safe use of scientific equipment and appropriate mathematical calculations; • use investigative skills to explore scientific issues, solve problems and make informed decisions; • research and manage information effectively, including Using Mathematics and Using ICT where appropriate; • show deeper scientific understanding by thinking critically and flexibly, solving problems and making informed decisions, demonstrating Using Mathematics and Using ICT where appropriate; • demonstrate creativity and initiative when developing ideas and following them through; • work effectively with others; • demonstrate self management by working systematically, persisting with tasks, evaluating and improving own performance; • communicate effectively in oral, visual, written, mathematical and ICT formats, showing clear awareness of audience and purpose.		

NB: *Teachers may develop activities that combine many of the statutory requirements, provided that,* ***across the key stage****, all of the statutory aspects highlighted in* ***BOLD*** *(including each of the* ***Key Elements****) are met.*

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