

# Renewing the Framework for secondary science

Spring 2008 subject leader development  
meeting: Sessions 2, 3 and 4

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## Renewing the Framework for secondary science

Spring 2008 subject leader development meeting:  
Sessions 2, 3 and 4



# **Renewing the Framework for secondary science**

**Spring 2008 subject leader development meeting:  
Sessions 2, 3 and 4**

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# Renewing the Framework for secondary science

## Spring 2008 subject leader development meeting: Sessions 2, 3 and 4

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<b>CD-ROM</b>	
Copies of all generic and science training materials (in PDF format)	
Science Key Stage 3 and Key Stage 4 programmes of study (in PDF format)	
Presentations for use in science departments (in PowerPoint format)	
Notes for delivering science department sessions (in Word format)	
National Curriculum website demonstration	
NSC Postcard (in PDF format)	
Renewed Frameworks flier (in PDF format)	



## Session 2 presentation handouts

### What's changed in my subject?

#### Slide 2.1

The National Strategies  
Secondary

**What's changed in my subject?**

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and science departments

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#### Slide 2.2

The National Strategies  
Secondary

**Objectives**

- To identify the changes to the programme of study
- To explore the relationship between the new programmes of study and *How science works*
- To recognise the implications for change in your science curriculum

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#### Slide 2.3

The National Strategies  
Secondary

**Outcomes**

Participants will:

- be familiar with the layout of the new programme of study
- have clarified the relationship between *How science works* and the new programme of study.

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### Slide 2.4

The National Strategies  
Secondary

**Discussion**



Why is it important for all pupils to study science?

- How would you answer this question if it were posed by the chair of governors? Discuss and agree three reasons.
- How well does the opening paragraph of the programme of study match this shared view?

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### Slide 2.5

The National Strategies  
Secondary

**The importance of science**



'The study of science fires pupils' curiosity about phenomena in the world around them and offers opportunities to find explanations. It engages learners at many levels, linking direct practical experience with scientific ideas. Experimentation and modelling are used to develop and evaluate explanations, encouraging critical and creative thought. Pupils learn how knowledge and understanding in science are rooted in evidence.'

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### Slide 2.6

The National Strategies  
Secondary

**The importance of science (cont.)**



'They discover how scientific ideas contribute to technological change – affecting industry, business and medicine and improving quality of life. They trace the development of science worldwide and recognise its cultural significance. They learn to question and discuss issues that may affect their own lives, the directions of societies and the future of the world.'

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### Slide 2.7

The National Strategies  
Secondary

**Science programmes of study – structure**

- **Key concepts (KC)** deepen and broaden pupils' knowledge, skills and understanding.
- **Key processes (KP)** are essential skills and processes in science.
- **Curriculum opportunities (CO)** are integral to pupils' learning and engagement with the concepts, processes and content of the subject.

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### Slide 2.8

The National Strategies  
Secondary

**Science programmes of study – structure (cont.)**

- **Range and content (RC):**
  - Organisms, behaviour and health
  - Chemical and material behaviour
  - Energy, electricity and forces
  - The environment, Earth and the universe

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### Slide 2.9

The National Strategies  
Secondary

**Bringing these parts together**

Less prescribed content and an increased focus on essential ideas, skills and ways of thinking:

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**Slide 2.10**

The National Strategies  
Secondary

**Task A**

- Compare the strengths and weaknesses of the onion and pentagon models as a way of showing the relationship between the components of the new programme of study.
- Do some areas need greater emphasis than others?

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**Slide 2.11**

The National Strategies  
Secondary

**Programme of study and Framework**

Programmes of study: KC KP CO RC

Framework: HSW, RC

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**Slide 2.12**

The National Strategies  
Secondary

**Yearly learning objectives**

- Same structure for all core subjects
- Exemplify progression with milestones
- Assume broadly typical progression
- Year 7 to 'extension'

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### Slide 2.13

The National Strategies  
Secondary

**Yearly learning objectives (cont.)**

- Not in levels
- No break between Key Stages 3 and 4
- Use to develop long- and medium-term plans, not individual lessons
- Identify where pupils are on the progression
- Will link to Assessing Pupils' Progress (APP) in science

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### Slide 2.14

The National Strategies  
Secondary

**How science works substrands**

1. Explanations, argument and decisions:
  - Scientific thinking – three threads
  - Applications, implications, cultural understanding
  - Communication for audience and with purpose
2. Practical and enquiry skills – six threads

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### Slide 2.15

The National Strategies  
Secondary

**Task B**

How do KC, KP and CO relate to HSW?

**KC, KP, CO, RC and GCSE HSW** Use the cut-up cards of these statements

**Framework HSW** Place the cards where they fit best

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### Slide 2.16

The National Strategies  
Secondary

#### Changes to the PoS structure

Old	New
Curriculum aims	Curriculum aims
Importance statement	Importance statement
<ul style="list-style-type: none"><li>• Knowledge skills and understanding</li><li>• Breadth of study</li></ul>	<ul style="list-style-type: none"><li>• Key concepts</li><li>• Key processes</li><li>• Range and content</li><li>• Curriculum opportunities</li></ul>
Attainment target	Attainment target

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### Slide 2.17

The National Strategies  
Secondary

#### Range and content (cont.)

- Chemical and material behaviour:
  - 3.1 Particle models
  - 3.2 Chemical reactions
  - 3.3 Patterns in chemical reactions

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### Slide 2.18

The National Strategies  
Secondary

#### Range and content (cont.)

- Energy, electricity and forces:
  - 4.1 Energy transfer and electricity
  - 4.2 Forces

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**Slide 2.19**

**The National Strategies**  
Secondary

**Range and content (continued)**

- The environment, Earth and the universe:
  - 5.1 Changing environment and sustainability
  - 5.2 Changing Earth
  - 5.3 Earth, space and beyond

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**Slide 2.20**

**The National Strategies**  
Secondary

**Task C**

Spot the difference:

- Identify any objectives on handout 2.5 that are new or in a different sequence from those in the existing programme of study.
- Share these key differences.

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**Slide 2.21**

**The National Strategies**  
Secondary

**The Science Timeline**

	Sept 08 Phase 1	Sept 09 Phase 2	Sept 2010	May 2011 1st assessment	2010/11	2011/12	2012/13
Year 7	KS2	KS2					
Year 8	KS2	KS2	KS2				
Year 9	KS2	KS2	KS2	KS2			
Year 10	KS2	KS2	KS2	KS2	KS2 on Challenge		
Year 11	KS2	KS2	KS2	KS2	KS2 on Challenge	KS2 on Challenge	

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## Using the Framework to promote powerful learning

### Slide 3.1

The National Strategies  
Secondary



**Using the Framework to promote powerful learning**

Information for subject leaders and science departments

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### Slide 3.2

The National Strategies  
Secondary



**Objectives**

- To increase familiarity with the yearly learning objectives
- To explore various ways in which the yearly learning objectives can be used to:
  - support effective planning
  - promote powerful learning

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### Slide 3.3

The National Strategies  
Secondary



**Outcomes**

Participants will:

- feel more confident with the yearly learning objectives
- have experienced different ways of using the yearly learning objectives to support planning and promote powerful learning.

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### Slide 3.4

The National Strategies  
Secondary

**Discussion**



- What do you think is meant by 'powerful learning'?
- Is there a difference between a scheme of work and a scheme of learning?

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### Slide 3.5

The National Strategies  
Secondary

**Task D: Reviewing a unit of work**



Use the Year 7 and 8 yearly learning objectives from handouts 2.3 and 2.5 to review a unit from your current scheme of work.

- Do some of the *How science works* objectives fit more easily to your chosen unit?
- How could you identify other opportunities to bring in less familiar aspects of *How science works*?

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### Slide 3.6

The National Strategies  
Secondary

**Reflection on Task D**



- Discuss some of the strengths and weaknesses of using this process to review a scheme of work
- Could this process change a scheme of work into a scheme of learning?

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**Slide 3.7**

**The National Strategies**  
Secondary

**Task E**

Select an area of range and content that you are familiar with and the Year 7–9 objectives only.

- Write a Year 6 yearly learning objective.
- Identify the key differences between one objective and the next.
- Identify some learning activities to move pupils from one objective to the next.

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**Slide 3.8**

**The National Strategies**  
Secondary

**Task F: Route 1**

Led by progression in range and content

Range and content    Teaching sequence    How science works

The diagram shows a vertical column of four orange boxes on the left labeled 'One thread'. Arrows point from each box to a vertical column of four white boxes labeled '1', '2', '3', and '4' in the middle, labeled 'Teaching sequence'. From each of these white boxes, arrows point to a vertical column of four green boxes on the right labeled 'From many threads'. The top two white boxes point to the top two green boxes, and the bottom two white boxes point to the bottom two green boxes.

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**Slide 3.9**

**The National Strategies**  
Secondary

**Task G: Route 2**

Led by progression in *How science works*

Range and content    Teaching sequence    How science works

The diagram shows a vertical column of four white boxes on the left labeled 'From many threads'. Arrows point from each box to a vertical column of four white boxes labeled '1', '2', '3', and '4' in the middle, labeled 'Teaching sequence'. From each of these white boxes, arrows point to a vertical column of four white boxes on the right labeled 'One thread'. A box labeled 'Other subjects' has arrows pointing to boxes 2 and 3 in the teaching sequence column.

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### Slide 3.10

The National Strategies  
Secondary

#### Task H: Route 3

Led by progression in both *How science works* and range and content

Range and content	Teaching sequence	How science works
□	1	□
□	2	□
□	3	□
□	4	□

One thread                      One thread

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### Slide 3.11

The National Strategies  
Secondary

#### Reflection

- As you were carrying out this task, what kind of conversations did you have?
- What are the strengths and weaknesses of each approach?
- Would it be possible to have a scheme of learning that had different units planned using the different routes?
- Are there other planning models to consider?

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### Slide 3.12

The National Strategies  
Secondary

#### Plenary

Revisit your department planner.

- Are there further areas of focus to add to this after the last session?

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# Designing compelling learning experiences

## Slide 4.1

The National Strategies  
Secondary



**Designing compelling learning experiences**

Information for subject leaders and science departments

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## Slide 4.2

The National Strategies  
Secondary



**Objectives**

- To clarify what is meant by a compelling learning experience
- To explore how to design a compelling learning experience
- To consider some of the possible issues and solutions

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## Slide 4.3

The National Strategies  
Secondary



**Outcomes**

Participants will have:

- clarified what is meant by a compelling learning experience
- considered some solutions to possible issues in their schools.

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### Slide 4.4

The National Strategies  
Secondary

**Discussion**



- What is a compelling learning experience in science?

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### Slide 4.5

The National Strategies  
Secondary

**Task 1**



**In groups, discuss and map out a single compelling learning experience that would address either:**

- gaps you identified in your existing unit of work
- or
- areas of development in aspects of *How science works*.

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### Slide 4.6

The National Strategies  
Secondary

**Scenario 1**



Your department has a KS3 scheme of work based loosely on a commercial package. It has not been revised for three years.

Cells is the first unit of study in Year 7.

The YLOs suggest the starting point for learning is the whole organism and it is from this concrete and familiar experience that pupils construct the increasingly abstract concepts of organ systems, organs, tissues and then down to cells.

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### Slide 4.7

The National Strategies  
Secondary

**Scenario 2**



Your school has identified the development of thinking skills as a whole - school priority.

Your science department has just completed a question level analysis and identified the interpretation of evidence and explanations as two areas of weakness.

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### Slide 4.8

The National Strategies  
Secondary

**Scenario 3**



Your department has planned regular whole investigations across KS3 but you feel this is not really developing pupils' skills.

You are clear that *How science works* is not about whole investigations but this is not understood by all your department.

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### Slide 4.9

The National Strategies  
Secondary

**Scenario 4**



Numeracy is a whole - school priority. You have been charged with the task of mapping this into the new Year 7 science curriculum in time for September 2008.

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**Slide 4.10**

The National Strategies  
Secondary

**Plenary**



Revisit your department planner.

- Identify further key actions for the next few months.

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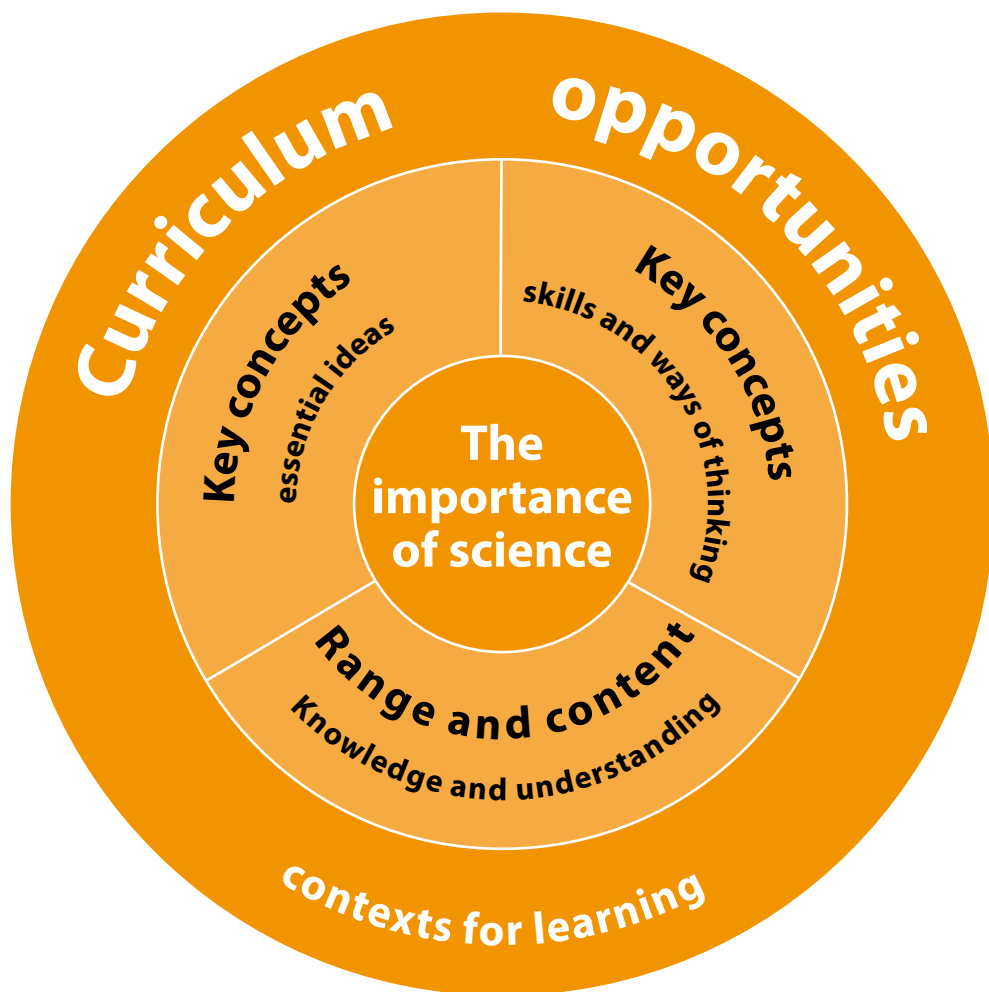
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# Handout 2.1

## Onion model







## Handout 2.4 (1 of 6)

### KC, KP, CO and HSW card sort

Copy each of the four sections onto different coloured card and cut them up.

#### Key concepts

Using scientific ideas and models to explain phenomena and developing them creatively to generate and test theories	KC
Critically analysing and evaluating evidence from observations and experiments	KC
Exploring how the creative application of scientific ideas can bring about technological developments and consequent changes in the way people think and behave	KC
Examining the ethical and moral implications of using and applying science	KC
Recognising that modern science has its roots in many different societies and cultures, and draws on a variety of valid approaches to scientific practice	KC
Sharing developments and common understanding across disciplines and boundaries	KC

## Handout 2.4 (2 of 6)

### KC, KP, CO and HSW card sort

#### Key processes

Pupils should be able to use a range of scientific methods and techniques to develop and test ideas and explanations	KP
Pupils should be able to assess risk and work safely in the laboratory, field and workplace	KP
Pupils should be able to plan and carry out practical and investigative activities, both individually and in groups	KP
Pupils should be able to obtain, record and analyse data from a wide range of primary and secondary sources, including ICT sources, and use their findings to provide evidence for scientific explanations	KP
Pupils should be able to evaluate scientific evidence and working methods	KP
Pupils should be able to use appropriate methods, including ICT, to communicate scientific information and contribute to presentations and discussions about scientific issues	KP

## Handout 2.4 (3 of 6)

### KC, KP, CO and HSW card sort

#### Curriculum opportunities

Research, experiment, discuss and develop arguments	CO
Pursue an independent enquiry into an aspect of science of personal interest	CO
Use real real-life examples as a basis for finding out about science	CO
Study science in local, national and global contexts and appreciate the connections between these	CO
Experience science outside the school environment, including in the workplace, where possible	CO
Use creativity and innovation in science, and appreciate their importance in enterprise	CO
Recognise the importance of sustainability in scientific and technological developments	CO
Explore contemporary and historical scientific developments and how they have been communicated	CO

## Handout 2.4 (4 of 6)

### KC, KP, CO and HSW card sort

#### How science works

<p><i>Pupils should be taught:</i></p> <p>1a. how scientific data can be collected and analysed</p>	HSW
<p><i>Pupils should be taught:</i></p> <p>1c. how explanations of many phenomena can be developed using scientific theories, models and ideas</p>	HSW
<p><i>Pupils should be taught:</i></p> <p>1b. how interpretation of data and using creative thought provide evidence to test ideas and develop theories</p>	HSW
<p><i>Pupils should be taught:</i></p> <p>1d. that there are some questions that science cannot currently answer, and some that science cannot address</p>	HSW
<p><i>Pupils should be taught:</i></p> <p>2a. to plan to test a scientific idea, answer a scientific question, or solve a scientific problem</p>	HSW
<p><i>Pupils should be taught:</i></p> <p>2c. to work accurately and safely, individually and with others, when collecting first-hand data</p>	HSW

(continued)

## Handout 2.4 (5 of 6)

### KC, KP, CO and HSW card sort

#### *How science works (cont.)*

<p><i>Pupils should be taught:</i> 2b. to collect data from primary or secondary sources, including using ICT sources and tools</p>	HSW
<p><i>Pupils should be taught:</i> 2d. to evaluate methods of collection of data and consider their validity and reliability as evidence</p>	HSW
<p><i>Pupils should be taught:</i> 3a. to recall, analyse, interpret, apply and question scientific information or ideas</p>	HSW
<p><i>Pupils should be taught:</i> 3c. to present information, develop an argument and draw a conclusion, using scientific, technical and mathematical language, conventions and symbols, and ICT tools</p>	HSW
<p><i>Pupils should be taught:</i> 3b. to use both qualitative and quantitative approaches</p>	HSW
<p><i>Pupils should be taught:</i> 4a. about the use of contemporary scientific and technological developments and their benefits, drawbacks and risks</p>	HSW

(continued)

## Handout 2.4 (6 of 6)

### KC, KP, CO and HSW card sort

#### *How science works (cont.)*

*Pupils should be taught:*

4c. how uncertainties in scientific knowledge and scientific ideas change over time and about the role of the scientific community in validating these changes

HSW

*Pupils should be taught:*

4b. to consider how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions

HSW

## Handout 2.5 (1 of 11)

### Range and context yearly learning objectives

## 2 Organisms, behaviour and health

### 2.1 Life processes

	Year 7	Year 8	Year 9	Year 10	Year 11	Extension
	<ul style="list-style-type: none"> <li>describe the role of organ systems in plants and animals that can contribute to the seven life processes</li> </ul>	<ul style="list-style-type: none"> <li>explain how the organs and tissues in plants and animals function to support the seven life processes in a healthy organism</li> </ul>	<ul style="list-style-type: none"> <li>explain how the specialisation of cells in plants and animals support the seven life processes in a healthy organism</li> <li>explain how chemical, physical and biological factors can disrupt the seven life processes</li> </ul>	<ul style="list-style-type: none"> <li>explain how individual intracellular and extracellular processes and structures in plants and animals support the seven life processes</li> <li>explain why certain chemical, physical and biological factors can disrupt the seven life processes</li> </ul>	<ul style="list-style-type: none"> <li>explain how the different intracellular and extracellular processes work together to support life in familiar contexts</li> <li>evaluate the impact of chemical, physical and biological factors and explain their effects on the life processes</li> </ul>	<ul style="list-style-type: none"> <li>use and apply their understanding of how life processes in organisms work together in unfamiliar contexts</li> <li>critically evaluate the relative impact of chemical, physical and biological factors and their effect on life processes in unfamiliar contexts</li> </ul>



## Range and context yearly learning objectives

### Handout 2.5 (2 of 11)

#### 2.2 Variation and interdependence

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>describe how organisms can vary and how this may lead to their survival in changing environments</li> <li>describe how the major taxonomic groups are classified</li> <li>use a combination of food chains within a habitat to produce food webs</li> </ul>	<ul style="list-style-type: none"> <li>explain how variation has benefits and limitations for the survival of organisms in specific habitats</li> <li>describe some examples of variation arising from inherited and environmental factors</li> <li>explain energy transfer in food chains and webs and relate this to the abundance of organisms</li> </ul>	<ul style="list-style-type: none"> <li>explain how variation in organisms can be artificially induced and the effect of these organisms on the environment</li> <li>explain how internal and external factors can affect energy transfer in food chains and webs</li> </ul>	<ul style="list-style-type: none"> <li>explain how the combined effects of changes to genes and environmental change can lead to variation in a species</li> <li>explain the fluctuations in distribution and population size using:               <ul style="list-style-type: none"> <li>energy flow</li> <li>pyramids of number and biomass</li> <li>predator/prey relationships</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>apply and use their knowledge of variation and interdependence to explain:               <ul style="list-style-type: none"> <li>natural selection</li> <li>the applications and implications of artificial selection</li> <li>evolutionary and ecological relationships</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>apply and use their extensive knowledge of variation and interdependence to explain and critically evaluate the impact of human activity on evolutionary and ecological relationships</li> </ul>

## Range and context yearly learning objectives **Handout 2.5 (3 of 11)**

### 2.3 Behaviour

Year 7	Year 8	Year 9	Year 11	Year 11	Extension
<ul style="list-style-type: none"> <li>describe simple learned and innate behaviours in response to internal and external stimuli and how these aid survival</li> </ul>	<ul style="list-style-type: none"> <li>explain how changes in learned behaviour due to internal and external stimuli are of benefit to the organism</li> </ul>	<ul style="list-style-type: none"> <li>make links between observed social behaviours and the benefit to the survival of the species</li> </ul>	<ul style="list-style-type: none"> <li>explain how chemical and electrical signals enable body systems to respond to internal and external changes and the effect of this on behaviour</li> </ul>	<ul style="list-style-type: none"> <li>explain the effects of natural and artificial substances on chemical and electrical signals within the body, and possible effects on behaviour</li> </ul>	<ul style="list-style-type: none"> <li>evaluate evidence from different sources about the impact of natural and artificial substances on behaviour</li> </ul>

## Handout 2.5 (4 of 11)

## Range and context yearly learning objectives

## 3 Chemical and material behaviour

## 3.1 Particle models

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>describe matter using a simple model and use it to explain changes of state</li> <li>recognise the link between heating and cooling and changes of state</li> <li>use the simple particle model to explain the physical characteristics of solids, liquids and gases</li> </ul>	<ul style="list-style-type: none"> <li>apply and use the particle model to describe a range of physical observations</li> <li>apply and use the particle model to describe a range of separation techniques</li> </ul>	<ul style="list-style-type: none"> <li>evaluate and refine the particle model to explain a range of physical observations</li> <li>evaluate and refine the particle model to explain a range of separation techniques</li> </ul>	<ul style="list-style-type: none"> <li>apply particle models in unfamiliar contexts, and begin to evaluate the strengths and weaknesses of the model</li> <li>refine the particle model to explore the structure of atoms, including protons, neutrons and electrons</li> </ul>	<ul style="list-style-type: none"> <li>use the particle model and ideas from science and across disciplines to explain phenomena and evaluate the use of the model</li> </ul>	<ul style="list-style-type: none"> <li>use the particle model and ideas from science and across disciplines to explain complex phenomena and make critical evaluations to justify the use of a 'good enough' model</li> </ul>

## Handout 2.5 (5 of 11)

### Range and context yearly learning objectives

#### 3.2 Chemical reactions

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>● sort some reactions into reversible and irreversible</li> <li>● recognise that new materials are made during chemical reactions</li> </ul>	<ul style="list-style-type: none"> <li>● recognise that materials can be made up of one or more kinds of particles</li> <li>● describe the type and arrangement of atoms in elements, compounds and mixtures</li> <li>● describe and develop a particle model to explain the differences between the terms <i>atoms</i>, <i>elements</i>, <i>compounds</i> and <i>mixtures</i></li> </ul>	<ul style="list-style-type: none"> <li>● use a particle model to construct predictions for simple chemical reactions and to produce word equations</li> </ul>	<ul style="list-style-type: none"> <li>● use a particle model to construct predictions for chemical reactions and to produce symbol equations</li> <li>● explain the evidence that a chemical reaction has taken place in terms of energy transfer and rearrangements of bonds between atoms</li> </ul>	<ul style="list-style-type: none"> <li>● use a particle model to predict the outcome of chemical reactions and to produce balanced symbol equations</li> <li>● explain the evidence that a chemical reaction has taken place in terms of rearrangements of bonds between atoms, using the model of the differences of electron structure between elements</li> </ul>	<ul style="list-style-type: none"> <li>● use a particle model to predict the outcome of complex chemical reactions and to produce balanced symbol equations and ionic half-equations when appropriate</li> <li>● explain the evidence that a chemical reaction has taken place (in a system at equilibrium) in terms of energy transfer and rearrangements of bonds between atoms</li> </ul>

## Handout 2.5 (6 of 11)

### Range and context yearly learning objectives

#### 3.3 Patterns in chemical reactions

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>describe, record and group observations from chemical reactions</li> </ul>	<ul style="list-style-type: none"> <li>describe patterns in a range of chemical reactions</li> </ul>	<ul style="list-style-type: none"> <li>link experimental and numerical data to illustrate a range of patterns in chemical reactions</li> </ul>	<ul style="list-style-type: none"> <li>explain properties and patterns in reactivity in terms of a particle model for atomic structure</li> </ul>	<ul style="list-style-type: none"> <li>apply knowledge of patterns of reactivity in the periodic table to predict the outcomes of reactions from a range of familiar contexts</li> </ul>	<ul style="list-style-type: none"> <li>apply knowledge of patterns of reactivity in the periodic table to evaluate critically a range of domestic and industrial processes including systems at equilibrium</li> </ul>

## Range and context yearly learning objectives

### Handout 2.5 (7 of 11)

## 4 Energy, electricity and forces

### 4.1 Energy transfer and electricity

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>describe how energy can be stored, e.g. food, fuels and electrical cells</li> <li>describe how energy is transferred in simple contexts such as heating, food and cooling, food chains and simple circuits</li> <li>recognise that quantitative measures of energy transfer are needed to inform decisions, e.g. about lifestyles</li> <li>describe how energy stored in a range of energy resources, e.g. food, biomass, oil, gas, wind and waves, can be usefully transferred</li> </ul>	<ul style="list-style-type: none"> <li>use a simple model of energy transfer to describe common observations</li> <li>explain why quantitative measures of energy transfer should also be considered when making informed decisions, e.g. building wind farms</li> <li>explain how electricity is generated using a variety of energy resources</li> </ul>	<ul style="list-style-type: none"> <li>develop more complex models of energy transfer mechanisms (incorporating ideas about particles or waves)</li> <li>use energy-accounting systems, including Sankey diagrams, to track energy transfers</li> <li>apply the idea of energy conservation and dissipation to simple biological, chemical and physical systems</li> <li>use quantitative measures of energy transfer to support informed decision-making</li> </ul>	<ul style="list-style-type: none"> <li>apply the concept of conservation of energy to energy efficiency calculations in living and non-living systems</li> <li>develop the idea of energy dissipation in a variety of contexts</li> <li>evaluate the economic costs and environmental effects of energy use through the measurement of energy transfers and efficiency calculations</li> <li>describe the effects of energy transfer to living systems by electromagnetic and nuclear radiation</li> </ul>	<ul style="list-style-type: none"> <li>use quantitative measures and the concept of energy conservation to evaluate a range of strategies to conserve limited energy resources</li> <li>use and apply complex models of energy transfer to a wide range of phenomena</li> <li>explain a wide range of complex phenomena using the principle of conservation of energy and appropriate wave or particle models</li> </ul>	<ul style="list-style-type: none"> <li>apply broader or deeper knowledge and understanding of energy in explanations of observations and phenomena</li> <li>use valid and rational argument to offer solutions to problems arising from the applications and implications of energy</li> </ul>

## Handout 2.5 (8 of 11)

## Range and context yearly learning objectives

## 4.2 Forces

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>● recognise the forces acting on an object in different situations</li> <li>● distinguish between situations involving balanced and unbalanced forces</li> <li>● recognise that forces can combine or wholly or partly cancel each other out and their size and direction can be represented using arrows</li> <li>● recognise that there are contact forces and forces that act at a distance</li> </ul>	<ul style="list-style-type: none"> <li>● apply ideas about balanced and unbalanced forces to explain the way objects move</li> <li>● investigate situations where forces are applied over large and small areas or have a turning effect</li> <li>● recognise that forces at a distance get weaker as the distance increases</li> </ul>	<ul style="list-style-type: none"> <li>● recognise how simple quantitative relationships can be applied to the way objects move (including balanced and unbalanced forces)</li> <li>● recognise how simple quantitative relationships can be applied to situations where forces are applied over large and small areas or have a turning effect</li> </ul>	<ul style="list-style-type: none"> <li>● use simple quantitative relationships to make predictions in more complex situations</li> <li>● use simple relationships involving more complex quantities to make predictions in more complex and unfamiliar situations</li> </ul>	<ul style="list-style-type: none"> <li>● use relationships involving more complex quantities to make quantitative predictions in more complex and unfamiliar situations</li> </ul>	<ul style="list-style-type: none"> <li>● apply knowledge and understanding of forces in explanations of observations and phenomena to complex and unfamiliar contexts</li> <li>● use valid and rational argument to offer solutions to problems arising from the applications and implications of forces</li> </ul>

## Handout 2.5 (9 of 11)

### Range and context yearly learning objectives

## 5 The environment, Earth and the universe

### 5.1 Changing environment and sustainability

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>describe how natural and human processes have changed the atmosphere over time</li> </ul>	<ul style="list-style-type: none"> <li>explain some of the changes that have led to the composition of the current atmosphere</li> <li>recognise simple ideas of sustainable development</li> </ul>	<ul style="list-style-type: none"> <li>use one or more models, such as the carbon cycle or food webs, to explain some of the consequences of changes in the environment</li> </ul>	<ul style="list-style-type: none"> <li>use primary and secondary forms of evidence to describe and explain the impact of human actions at a local, regional and global level</li> </ul>	<ul style="list-style-type: none"> <li>evaluate the accuracy and validity of primary and secondary evidence in relation to human impact on the biosphere</li> <li>describe and analyse how complex data could be represented or misrepresented to justify decisions taken to manage sustainability</li> </ul>	<ul style="list-style-type: none"> <li>link and synthesise data and evidence from a range of sources to explain human impact on the biosphere</li> <li>describe how evidence and arguments from different political and economic perspectives have been used to justify decisions taken to manage sustainability</li> </ul>



## Handout 2.5 (10 of 11)

### Range and context yearly learning objectives

#### 5.2 Changing Earth

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>recognise the processes involved in the formation of rocks</li> </ul>	<ul style="list-style-type: none"> <li>describe the processes involved in the formation of sedimentary, metamorphic and igneous rocks and use the characteristics of the rocks to explain how they formed</li> </ul>	<ul style="list-style-type: none"> <li>use the rock cycle as a model to explain the cyclical nature of rock-forming processes and the timescales over which they operate</li> </ul>	<ul style="list-style-type: none"> <li>use the theory of plate tectonics to explain some of the major slow (long-term) changes and the distribution and nature of active zones on the surface of the Earth</li> </ul>	<ul style="list-style-type: none"> <li>link plate tectonic theory to its supporting geological evidence</li> </ul>	<ul style="list-style-type: none"> <li>apply and use the theory of plate tectonics to explain related geological phenomena</li> </ul>

## Handout 2.5 (11 of 11)

### Range and context yearly learning objectives

#### 5.3 Earth, space and beyond

Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<ul style="list-style-type: none"> <li>describe the apparent movement of the Sun across the sky and the pattern in the changing appearance of the Moon</li> </ul>	<ul style="list-style-type: none"> <li>describe the position of the Earth in relation to the position of other bodies in the Solar System and use this to explain some phenomena</li> <li>recognise that astronomy and space science provide evidence about the Solar System</li> </ul>	<ul style="list-style-type: none"> <li>apply models and use scientific data to explain the relative movement of the celestial bodies in the Solar System</li> <li>describe how astronomy and space science provide evidence of the Solar System and galaxy</li> </ul>	<ul style="list-style-type: none"> <li>explain some methods used to explore the Solar System and galaxy (both from the Earth and from space)</li> <li>explain how the electromagnetic spectrum can inform the study of the stars in our galaxy (and universe)</li> </ul>	<ul style="list-style-type: none"> <li>evaluate the available evidence and explain why it favours an expanding universe as the current consensus model</li> </ul>	<ul style="list-style-type: none"> <li>explain, using available evidence and models of the universe, why the ultimate fate of the universe is difficult to predict</li> </ul>



# Handout 3.1

## Year 7 and Year 8 *How science works* yearly learning objectives

1 <i>How science works</i>	Year 7	Year 8
<b>1.1a1 Scientific thinking: developing explanations using ideas and models</b>	<ul style="list-style-type: none"> <li>● use an existing model or analogy to explain a phenomenon</li> <li>● recognise and explain the value of using models and analogies to clarify explanations</li> </ul>	<ul style="list-style-type: none"> <li>● describe more than one model to explain the same phenomenon and discuss the strengths and weaknesses of each model</li> <li>● describe how the use of a particular model or analogy supports an explanation</li> </ul>
<b>1.1a2 Scientific thinking: challenge and collaboration in the development of explanations</b>	<ul style="list-style-type: none"> <li>● recognise that scientists of all disciplines and nationalities often work together to develop explanations</li> <li>● recognise that science cannot yet explain everything</li> </ul>	<ul style="list-style-type: none"> <li>● recognise that science is a communal, and therefore fallible, human activity and that different explanations can arise from individual bias</li> <li>● recognise questions that the scientific process cannot yet answer</li> </ul>
<b>1.1a3 Scientific thinking: developing argument</b>	<ul style="list-style-type: none"> <li>● identify a range of scientific data and other evidence to back an argument and the counterclaim in less complex and/or familiar contexts, e.g. establishing a wind farm</li> <li>● recognise that scientific evidence can be used to support or disprove theories</li> </ul>	<ul style="list-style-type: none"> <li>● identify a range of scientific data and other evidence to back an argument and the counterclaim in more complex and/or less familiar contexts, e.g. use of antibiotics</li> <li>● describe how scientific evidence from different sources carries different weight in supporting or disproving theories</li> </ul>

<p><b>1.1b Applications, implications and cultural understanding</b></p>	<ul style="list-style-type: none"> <li>● describe some benefits and drawbacks of scientific developments with which they are familiar</li> <li>● recognise that decisions about the use and application of science and technology are influenced by society and individuals</li> </ul>	<ul style="list-style-type: none"> <li>● explain some issues, benefits and drawbacks of scientific developments with which they are familiar</li> <li>● recognise that decisions about the use and application of science and technology are influenced by society and individuals, and how these could impact on people and the environment</li> </ul>
<p><b>1.1c Communication for audience and with purpose</b></p>	<ul style="list-style-type: none"> <li>● use key scientific vocabulary and terminology in discussions and written work</li> <li>● identify and use the conventions of various genres for different audiences and purposes in scientific writing</li> </ul>	<ul style="list-style-type: none"> <li>● use a range of scientific vocabulary and terminology consistently in discussions and written work</li> <li>● adapt the stylistic conventions of a range of genres for different audiences and purposes in scientific writing</li> </ul>
<p><b>1.2a Using investigative approaches: planning an approach</b></p>	<ul style="list-style-type: none"> <li>● describe an appropriate approach to answer a scientific question using a limited range of information and making relevant observations or measurements</li> </ul>	<ul style="list-style-type: none"> <li>● describe an appropriate approach to answer a scientific question using sources of evidence and, where appropriate, making relevant observations or measurements using appropriate apparatus</li> </ul>
<p><b>1.2b Using investigative approaches: selecting and managing variables</b></p>	<ul style="list-style-type: none"> <li>● recognise the range of variables involved in an investigation and decide which to control</li> </ul>	<ul style="list-style-type: none"> <li>● describe and identify key variables in an investigation and assign appropriate values to these</li> </ul>

<p><b>1.2c Using investigative approaches: assessing risk and working safely</b></p>	<ul style="list-style-type: none"> <li>● explain how action has been taken to control obvious risk and how methods are adequate for the task</li> </ul>	<ul style="list-style-type: none"> <li>● explain how to take action to control the risks to themselves and others, and demonstrate competence in their practical techniques</li> </ul>
<p><b>1.2d Using investigative approaches: obtaining and presenting primary evidence</b></p>	<ul style="list-style-type: none"> <li>● describe and record observations and evidence systematically</li> <li>● recognise that the presentation of experimental results through the routine use of tables, bar charts and simple graphs makes it easier to see patterns and trends</li> </ul>	<ul style="list-style-type: none"> <li>● explain how the observation and recording methods are appropriate to the task</li> <li>● describe ways in which the presentation of experimental results through the routine use of tables, charts and line graphs makes it easier to see patterns and trends</li> </ul>
<p><b>1.2e Working critically with primary evidence</b></p>	<ul style="list-style-type: none"> <li>● describe patterns and trends in results and link this evidence to any prediction made</li> <li>● describe and suggest how planning and implementation could be improved</li> </ul>	<ul style="list-style-type: none"> <li>● describe how the patterns and trends in the results link to the conclusions drawn and whether the evidence is sufficient</li> <li>● describe and suggest, with reasons, how planning and implementation could be improved</li> </ul>
<p><b>1.2f Working critically with secondary evidence</b></p>	<ul style="list-style-type: none"> <li>● describe patterns and trends in secondary evidence and link these to the prediction or conclusion drawn</li> <li>● recognise that different conclusions may be drawn from secondary data</li> </ul>	<ul style="list-style-type: none"> <li>● describe what needs to be considered in the collection and manipulation of simple secondary evidence to evaluate the conclusion or interpretation made</li> <li>● recognise that the selection, ordering or rejection of secondary data could lead to different conclusions</li> </ul>



# Handout 3.2

## Year 7 and Year 8 range and content yearly learning objectives

2 Organisms, behaviour and health	Year 7	Year 8
2.1 Life processes	<ul style="list-style-type: none"> <li>describe the role of organ systems in plants and animals that can contribute to the seven life processes</li> </ul>	<ul style="list-style-type: none"> <li>explain how the organs and tissues in plants and animals function to support the seven life processes in a healthy organism</li> </ul>
2.2 Variation and interdependence	<ul style="list-style-type: none"> <li>describe how organisms can vary and how this may lead to their survival in changing environments</li> <li>describe how the major taxonomic groups are classified</li> <li>use a combination of food chains within a habitat to produce food webs</li> </ul>	<ul style="list-style-type: none"> <li>explain how variation has benefits and limitations for the survival of organisms in specific habitats</li> <li>describe some examples of variation arising from inherited and environmental factors</li> <li>explain energy transfer in food chains and webs and relate this to the abundance of organisms</li> </ul>
2.3 Behaviour	<ul style="list-style-type: none"> <li>describe simple learned and innate behaviours in response to internal and external stimuli and how these aid survival</li> </ul>	<ul style="list-style-type: none"> <li>explain how changes in learned behaviour due to internal and external stimuli are of benefit to the organism</li> </ul>
3 Chemical and material behaviour	Year 7	Year 8
3.1 Particle models	<ul style="list-style-type: none"> <li>describe matter using a simple model and use it to explain changes of state</li> <li>recognise the link between heating and cooling and changes of state</li> <li>use the simple particle model to explain the physical characteristics of solids, liquids and gases</li> </ul>	<ul style="list-style-type: none"> <li>apply and use the particle model to describe a range of physical observations</li> <li>apply and use the particle model to describe a range of separation techniques</li> </ul>



<b>3.2 Chemical reactions</b>	<ul style="list-style-type: none"> <li>● sort some reactions into reversible and irreversible</li> <li>● recognise that new materials are made during chemical reactions</li> </ul>	<ul style="list-style-type: none"> <li>● recognise that materials can be made up of one or more kinds of particles</li> <li>● describe the type and arrangement of atoms in elements, compounds and mixtures</li> <li>● describe and develop a particle model to explain the differences between the terms <i>atoms</i>, <i>elements</i>, <i>compounds</i> and <i>mixtures</i></li> </ul>
<b>3.3 Patterns in chemical reactions</b>	<ul style="list-style-type: none"> <li>● describe, record and group observations from chemical reactions</li> </ul>	<ul style="list-style-type: none"> <li>● describe patterns in a range of chemical reactions</li> </ul>
<b>4 Energy, electricity and forces</b>	<b>Year 7</b>	<b>Year 8</b>
<b>4.1 Energy transfer and electricity</b>	<ul style="list-style-type: none"> <li>● describe how energy can be stored, e.g. food, fuels and electrical cells</li> <li>● describe how energy is transferred in simple contexts such as heating and cooling, food chains and simple circuits</li> <li>● recognise that quantitative measures of energy transfer are needed to inform decisions, e.g. about lifestyles</li> <li>● describe how energy stored in a range of energy resources, e.g. food, biomass, oil, gas, wind and waves, can be usefully transferred</li> </ul>	<ul style="list-style-type: none"> <li>● use a simple model of energy transfer to describe common observations</li> <li>● explain why quantitative measures of energy transfer should also be considered when making informed decisions, e.g. building wind farms</li> <li>● explain how electricity is generated using a variety of energy resources</li> </ul>

<p><b>4.2 Forces</b></p>	<ul style="list-style-type: none"> <li>● recognise the forces acting on an object in different situations</li> <li>● distinguish between situations involving balanced and unbalanced forces</li> <li>● recognise that forces can combine or wholly or partly cancel each other out and their size and direction can be represented using arrows</li> <li>● recognise that there are contact forces and forces that act at a distance</li> </ul>	<ul style="list-style-type: none"> <li>● apply ideas about balanced and unbalanced forces to explain the way objects move</li> <li>● investigate situations where forces are applied over large and small areas or have a turning effect</li> <li>● recognise that forces at a distance get weaker as the distance increases</li> </ul>
<p><b>5 The environment, Earth and the universe</b></p>	<p><b>Year 7</b></p>	<p><b>Year 8</b></p>
<p><b>5.1 Changing environment and sustainability</b></p>	<ul style="list-style-type: none"> <li>● describe how natural and human processes have changed the atmosphere over time</li> </ul>	<ul style="list-style-type: none"> <li>● explain some of the changes that have led to the composition of the current atmosphere</li> <li>● recognise simple ideas of sustainable development</li> </ul>
<p><b>5.2 Changing Earth</b></p>	<ul style="list-style-type: none"> <li>● recognise the processes involved in the formation of rocks</li> </ul>	<ul style="list-style-type: none"> <li>● describe the processes involved in the formation of sedimentary, metamorphic and igneous rocks and use the characteristics of the rocks to explain how they formed</li> </ul>
<p><b>5.3 Earth, space and beyond</b></p>	<ul style="list-style-type: none"> <li>● describe the apparent movement of the Sun across the sky and the pattern in the changing appearance of the Moon</li> </ul>	<ul style="list-style-type: none"> <li>● describe the position of the Earth in relation to the position of other bodies in the solar system and use this to explain some phenomena</li> <li>● recognise that astronomy and space science provide evidence about the solar system</li> </ul>





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