Introduction

Greater Depth in Science is a resource designed to help teachers:

- understand the concept of greater depth in science
- plan activities that will lead to progression from fundamental foundations to greater depth
- see examples of pupils’ work that show progression
- assess progress.

In addition, the book and accompanying CD provides professional development in the nature of the science curriculum and aims to develop the subject knowledge of teachers so that the purpose and aims of teaching science are brought out in the delivery of the science curriculum.

The resource is structured in the following way:

Section 1

- Understanding the nature of a ‘mastery curriculum’
- Defining ‘greater depth’
- Understanding the stages of development from fundamental foundations to greater depth
- Setting out sensible time-scales for when greater depth might be reasonably expected
- Understanding how greater depth fits within the wider purpose and aims of the science curriculum.
Section 2

Curriculum design considerations: making conscious connections and using continuous provision to secure greater depth.

Section 3

POP tasks (Proof of Progress tasks) that show teachers how to explicitly plan for and assess progress from fundamental foundations to greater depth. This section uses every statement from Chris Quigley’s Essentials curriculum and provides a comprehensive progression document. This is useful for teachers to plan and assess and leaders to set tangible expectations for progress. The POP tasks are split into three Milestones: Milestone 1 shows progression within Years 1 and 2; Milestone 2 shows progression for Years 3 and 4; Milestone 3 shows progression for Years 5 and 6.

Examples of pupils’ work appear at the end of each Milestone. The examples give a fantastic visual depiction of completed POP tasks that may be used by teachers to plan how pupils may record their work and for leaders to use to moderate teachers’ assessment judgements.

On the CD

The CD includes all sections of the resource in an electronic format for use within an individual school to aid professional development.
Why do we have the term ‘greater depth’?

The term greater depth is best understood by exploring why the old system of levels was abandoned: one of the main reasons for moving away from levels was that the expectation of ‘rapid progress’ through the levels was stopping pupils from gaining the depth of understanding necessary to prepare them for future stages of education. Instead of a ‘levels’ curriculum we now have a ‘mastery’ curriculum. The main differences between the two types of curricula are shown below:

**A ‘levels’ curriculum**

- Two aspects to the curriculum: content and levels.
  - Cover the content.
  - Use level descriptors to figure out the standard at which pupils are working.
  - Expected ‘rate’ of progress: at least 1 level every 2 years.

**A ‘mastery’ curriculum**

- One aspect to the curriculum: content.
  - Therefore understanding the content is the standard required.
  - **Repeat** the content as many times as necessary to ensure pupils are fluent in everything by the end of the key stage.
  - No expected ‘rate’ of progress: as long as pupils are fluent in everything by the end of the key stage they are meeting expectations. If they get there early, stick with the same content and secure a **greater depth** of understanding. The extent to which teachers repeat and deepen content is a **professional decision**.
To secure greater depth, it is important that teachers change the nature of tasks and questions as pupils move through the three cognitive domains. Below is a table that shows how the nature of tasks and questions should change in each domain:

<table>
<thead>
<tr>
<th>Cognitive Domain</th>
<th>Types of thinking</th>
<th>Nature of question</th>
<th>Types of tasks and questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic</strong></td>
<td>Low level cognitive demand. Involves following instructions.</td>
<td>Building knowledge of fundamental foundations</td>
<td>Name, describe, follow instructions or methods, complete tasks, recall information, ask basic questions, observe, use, match, report, measure, list, illustrate, label, recognise, tell, repeat, arrange, define, memorise, calculate, recite, draw, recall.</td>
</tr>
<tr>
<td><strong>Advancing</strong></td>
<td>Higher-level cognitive demand beyond recall. Requires application involving some degree of decision making.</td>
<td>Applying fundamental foundations</td>
<td>Apply skills to solve problems, explain methods, classify, infer, categorise, identify patterns, organise, modify, predict, interpret, summarise, estimate, compare, experiment, demonstrate, practise, show, arrange, point out, graph, separate.</td>
</tr>
<tr>
<td><strong>Deep</strong></td>
<td>Cognitive demand involves non-standard, non-routine, inter-connected, multi-step thinking in problems with more than one possible solution. Requires reasoning and justification.</td>
<td>Inventively applying fundamental foundations</td>
<td>Solve non-routine problems, appraise, explain concepts, hypothesise, investigate, cite evidence, design, create, prove, judge, recommend, justify, generalise, propose, discover, arrange, rate, evaluate, revise, conclude, formulate, construct, develop, connect, prioritise.</td>
</tr>
</tbody>
</table>
PoP tasks (Proof of Progress tasks)

To plan for progress, different types of tasks may be created that prove to the teacher that pupils are gaining a deeper understanding of the same content.

The example below shows how pupils working in Milestone 1 may progress from a BASIC to an ADVANCING and then DEEP understanding of an aspect of the science curriculum by completing the PoP tasks:

Notice the importance of fundamental foundations in each task: it would be impossible to complete the advancing and deep tasks without the fundamental foundations of the basic task. It is, therefore, important not to rush through the cognitive domains. The wider a pupils’ fundamental foundations, the more chance there is of securing greater depth at a later stage.
Keeping in mind the goal of becoming scientists

Chris Quigley’s Essentials Curriculum defines the Essential Characteristics of a scientist and these traits are the basis for creating the PoP tasks in Section 3 of this resource. The Essential Characteristics are that pupils:

- Think independently and raise questions about working scientifically and the knowledge and skills that it brings.
- Are confident and competent in the full range of practical skills, taking the initiative in, for example, planning and carrying out scientific investigations.
- Demonstrate excellent scientific knowledge and understanding in written and verbal explanations, solving challenging problems and reporting scientific findings.
- Show high levels of originality, imagination or innovation in the application of skills.
- Undertake practical work in a variety of contexts, including fieldwork.
- Passionate about science and its application in past, present and future technologies.
All of the POP tasks in Section 2 involve one or more of the Working Scientifically objectives of the English national Curriculum. As a reminder, the working scientifically objectives are:

<table>
<thead>
<tr>
<th>Milestone 1</th>
<th>Milestone 2</th>
<th>Milestone 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years 1 and 2</td>
<td>Years 3 and 4</td>
<td>Years 5 and 6</td>
</tr>
<tr>
<td>Ask simple questions.</td>
<td>Ask relevant questions.</td>
<td>Plan enquiries, including recognising and controlling variables where necessary.</td>
</tr>
<tr>
<td>Observe closely, using simple equipment.</td>
<td>Set up simple practical enquiries, comparative and fair tests.</td>
<td>Take measurements, using a range of scientific equipment, with increasing accuracy and precision.</td>
</tr>
<tr>
<td>Perform simple tests.</td>
<td>Make accurate measurements using standard units, using a range of equipment, for example thermometers and data loggers.</td>
<td>Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, bar and line graphs, and models.</td>
</tr>
<tr>
<td>Identify and classify.</td>
<td>Gather, record, classify and present data in a variety of ways to help in answering questions.</td>
<td>Report findings from enquiries, including oral and written explanations of results, explanations involving causal relationships, and conclusions.</td>
</tr>
<tr>
<td>Use observations and ideas to suggest answers to questions.</td>
<td>Record findings using simple scientific language, drawings, labelled diagrams, bar charts, and tables.</td>
<td>Present findings in written form, displays and other presentations.</td>
</tr>
<tr>
<td>Gather and record data to help in answering questions.</td>
<td>Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.</td>
<td>Use test results to make predictions to set up further comparative and fair tests.</td>
</tr>
<tr>
<td></td>
<td>Use results to draw simple conclusions and suggest improvements, new questions and predictions for setting up further tests.</td>
<td>Use simple models to describe scientific ideas identifying scientific evidence that has been used to support or refute ideas or arguments.</td>
</tr>
<tr>
<td></td>
<td>Identify differences, similarities or changes related to simple scientific ideas and processes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use straightforward scientific evidence to answer questions or to support their findings.</td>
<td></td>
</tr>
</tbody>
</table>

Some of the ‘higher order’ working scientifically objectives are embedded in the advancing and deep tasks which are suggested for the second phase of each Milestone.
Continuous Provision activity ideas

Where did I begin?

In this ongoing challenge, pupils identify objects, the materials from which they are made and what they started as. For example, a book is made from paper, which started as a tree.

This helps pupils to distinguish between an object and the material from which it is made and the origins of the material.

Use the template provided below:

<table>
<thead>
<tr>
<th>Object</th>
<th>Material</th>
<th>Started as</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottle</td>
<td>Glass</td>
<td>Sand</td>
</tr>
<tr>
<td>Never alive</td>
<td>Sand is heated to a very high temperature until it becomes glass.</td>
<td></td>
</tr>
</tbody>
</table>
Learning Objective(s):

- To work scientifically
- To investigate materials

Milestone standard(s):

- Ask simple questions.
- Identify and classify.
- Gather and record data in order to answer questions.
- Distinguish between an object and the material from which it is made.
- Identify and name a variety of everyday materials, including wood, plastic, glass, metal, water and rock.
- Identify and compare the uses of a variety of everyday materials, including wood, metal, plastic, glass, brick/rock and paper/cardboard.

How to organise this activity

A number of options are available, such as:

- During unstructured time when pupils select an activity of their choice.
- Homework
Milestone 1 - Biology
To understand plants

Identify and name a variety of common plants, including garden plants, wild plants and trees and those classified as deciduous and evergreen.

**Basic**
- What are the **names** of common wild plants?
- What are the **names** of some common garden plants?
- What are the **names** of common trees?
- **Which** trees are evergreen and which are deciduous? (name)

**Advancing**
- What are the **similarities and differences** between deciduous and evergreen trees?
- Think of some ways to **categorise** plants.

**Deep**
- Could you **suggest** a garden **design** for someone who likes privacy and bright autumn colours?

See an example on page 103
Milestone 2 - Biology
To understand plants

Identify and describe the functions of different parts of flowering plants: roots, stem, leaves and flowers.

**Basic**
Describe and Illustrate the functions of different parts of flowering plants.

**Advancing**
Explain how leaves are important in creating food for a plant.

**Deep**
Prove or disprove that roots act like straws sucking up water for the plant.
Milestone 2 - Biology
To investigate living things

Recognise that environments can change and that this can sometimes pose dangers to specific habitats.

**Basic**
- **Name** and **describe** a range of different habitats.
- **Identify** and **label** specific plants and animals in these habitats.
- **Describe** how (for example, deforestation in rainforests) is a danger to specific habitats.

**Advancing**
- **Compare** changes in two or more habitats and **categorise** the effects of the changes.

**Deep**
- **Explain the concept** of conservation and how groups are trying to preserve habitats.

See an example on page 186
Recognise that soils are made from rocks and organic matter.

**Basic**
- **Observe** and **describe** the properties of soils.
- **Observe** and **name** different types of soils.
- **Find out about** and **describe** how soil is formed from rocks and organic matter.
- **Name** the ‘parent’ materials of different types of soils.

**Advancing**
- **Explain** how weathering contributes to the formation of soils.
- **Compare** and **contrast** different types of soils.
- **Categorise** soils using a range of different criteria.
- **Test** soils in various ways in order to **identify** them.

**Deep**
- **Recommend** plants for different soil conditions.
- **True or false?** Alluvial soils are richer in nutrients than most other soils?
- **Investigate** the flooding of the river Nile in ancient Egyptian times and **relate** this to your knowledge of soils.

See an example on page 192.