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 asses 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**.

Planning for progress from fundamental foundations to greater depth

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:

Cognitive Domain	Types of thinking	Nature of question	Types of tasks and questions
Basic	Low level cognitive demand. Involves following instructions.	Building knowledge of fundamental foundations	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.
Advancing	Higher-level cognitive demand beyond recall. Requires application involving some degree of decision making.	Applying fundamental foundations	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.
Deep	Cognitive demand involves non-standard, non-routine, inter-connected, multi-step thinking in problems with more than one possible solution. Requires reasoning and justification.	Inventively applying fundamental foundations	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.

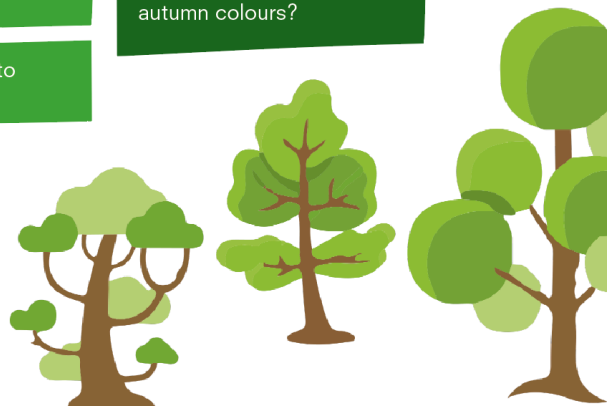
PoP tasks (Proof of Progress tasks)

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:

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

Basic	Advancing	Deep
What are the **names** of common wild plants?	What are the **similarities and differences** between deciduous and evergreen trees?	Could you **suggest** a garden **design** for someone who likes privacy and bright autumn colours?
What are the **names** of some common garden plants?	Think of some ways to **categorise** plants.	
What are the **names** of common trees?		
Which trees are evergreen and which are deciduous? **(name)**		



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.

Working scientifically

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:

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

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:

Object	Material	Started as
Bottle 	**Glass**	**Sand** 
Never alive	Sand is heated to a very high temperature until it becomes glass.	

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

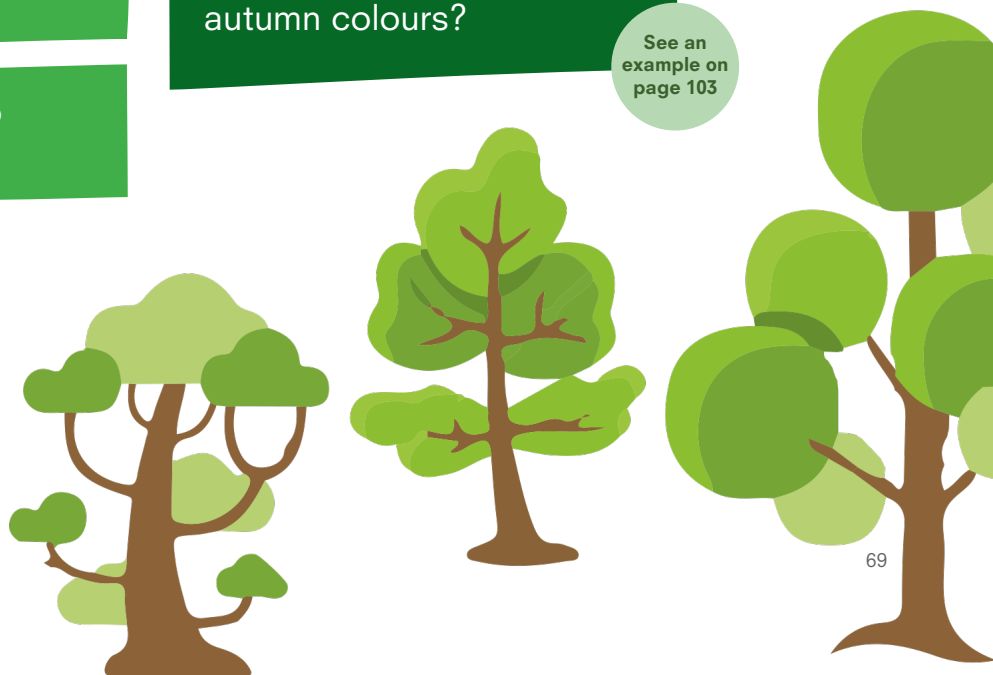
What are the **similarities and differences** between deciduous and evergreen trees?

Think of some ways to **categorise** plants.

Deep

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

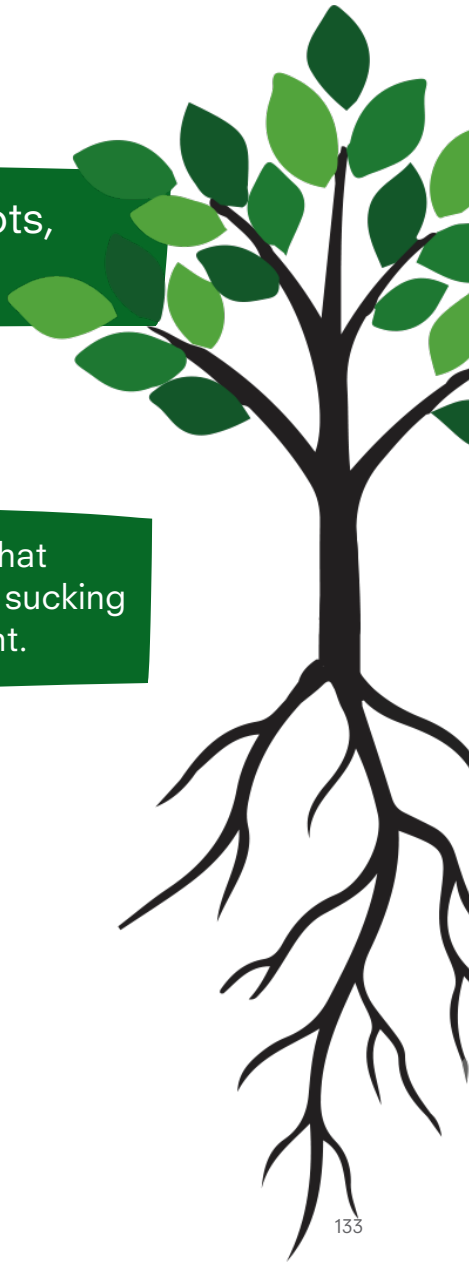
See an example on page 103



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

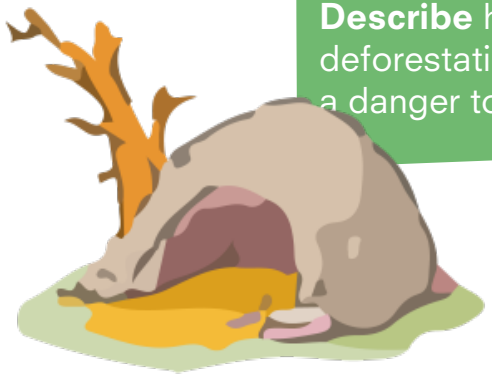
Recognise that environments can change and that this can sometimes pose dangers to specific habitats.

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.



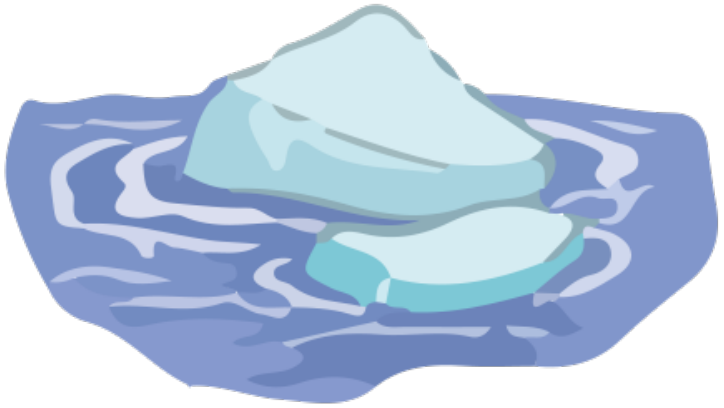
Advancing

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?

See an example on page 192

Investigate the flooding of the river Nile in ancient Egyptian times and **relate** this to your knowledge of soils.