Teacher Guide

Science

Cambridge
Secondary 1

CAMBRIDGE
International Examinations

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Contents

SECTION 1: INTRODUCTION

Welcome to the Cambridge Secondary 1 Teacher Guide for Science.

This guide is designed to provide a suggested approach to the implementation and management of Cambridge Secondary 1 in your school.

It offers:

- The educational philosophy of the Cambridge programme
- The Cambridge Secondary 1 Science curriculum framework
- Step-by-step guidance on the planning process, with exemplification at each point and helpful teacher training activities with resources
- Advice on differentiation and how to integrate this into your teaching
- Suggested techniques for implementing formative assessment and integrating this into your lesson planning
- Two sample lesson plans per stage with activities and resources to help get you started
- Advice on monitoring
- Advice on classroom practice
- Advice on resources
- Information on Progression Tests and Cambridge Checkpoint
- Guidance on support and training available from Cambridge
- Guidance on administration

A comprehensive scheme of work

In addition a full scheme of work covering the entire programme has been provided as a starting point. Full coverage is provided in this way to accommodate new schools starting at any stage in the programme. As we will explain, a scheme of work is a process rather than a rigid structure and these plans should be constantly amended in response to your own observations as a classroom teacher and other local considerations including the resources you may already have available at your school. These schemes of work are therefore in no way compulsory but simply offer a suggested starting point for covering the content of the curriculum within a suggested year of three terms of 10 weeks. These can be expanded to suit the number of weeks available in your own terms and the holiday arrangements at your school.

Also provided are two sample lesson plans for each stage, complete with activities and resources to help get you started immediately at whichever point you begin delivering the programme.

1.1 How to Use this Teacher Guide

This guide provides a general introduction to Cambridge Secondary 1 and its underlying educational philosophy. It also offers guidance and advice on the essential processes of implementing Cambridge Secondary 1. It is designed to cater for:

- Schools that are teaching a Cambridge programme for the first time and that need to move from a completely different system of planning
- Schools that already deliver one or more Cambridge programmes but are new to Cambridge Secondary 1

Schools new to Cambridge will find all sections of the Teacher Guide relevant to them. It provides a step-by-step guide through the process of implementing Cambridge Secondary 1, offering a suggested breakdown of the curriculum across the available teaching time, sample lesson plans and sample lessons to get you started.

Existing Cambridge schools may be more familiar with certain aspects covered in this guide, especially if they already deliver other phases of the Cambridge curriculum. This guide is written so that schools new to Cambridge Secondary 1 can make use of the sections most relevant to them (e.g. Section 2: Planning or Section 3: Teaching Approaches).

1.2 Cambridge Secondary 1

Cambridge Secondary 1 is an education programme which combines a world-class curriculum, high-quality support for teachers and integrated assessment. The programme has been developed by University of Cambridge International Examinations and is used in secondary schools around the world. Cambridge Secondary 1 helps schools develop learners who are confident, responsible, innovative and engaged.

Cambridge Secondary 1 is for learners aged 11–14 and covers:

- English
- English as a Second Language
- Mathematics
- Science

It provides curriculum frameworks and assessment for each subject.

Cambridge Secondary 1 provides a solid foundation for later stages of education.

It starts learners on an educational journey for their first years of secondary education, focusing on what they should be able to do at each stage of a lower secondary education. It develops skills, knowledge and understanding that will prepare them for a smooth transition to Cambridge Secondary 2 and beyond.

Cambridge Secondary 1 offers optional, integrated assessment.

The assessment structure tracks learner progression through the first years of secondary education. Learners taking Cambridge Checkpoint receive a Statement of Achievement and detailed feedback on strengths and weaknesses.

Cambridge Secondary 1 supports teachers in providing the best teaching and learning.

Schools adopting Cambridge Secondary 1 gain access to first-class support for teachers through publications, online resources, training and professional development.

Cambridge Secondary 1 is practical and flexible.

No part of the Cambridge Secondary 1 curriculum is compulsory, giving schools the flexibility to choose the elements that are right for their learners. This means that they can use Cambridge Secondary 1 while following their school or national curriculum, or offer the entire programme.

Cambridge Secondary 1 has been developed by University of Cambridge international Examinations, the world's largest provider of international education programmes and qualifications for 5–19 year olds. Our programmes and qualifications are taken in over 160 countries in 9000 schools and recognised by universities.

Cambridge international education programmes and qualifications	
Cambridge Primary (5–11 years*)	Cambridge Primary
	Cambridge Primary Checkpoint
Cambridge Secondary 1 (11–14 years*)	Cambridge Secondary 1
	Cambridge Checkpoint
Cambridge Secondary 2 (14–16 years*)	Cambridge IGCSE
Cambridge Advanced (16–19 years*)	Cambridge International AS and A Level
	Cambridge Pre-U

***Age ranges are for guidance only.**

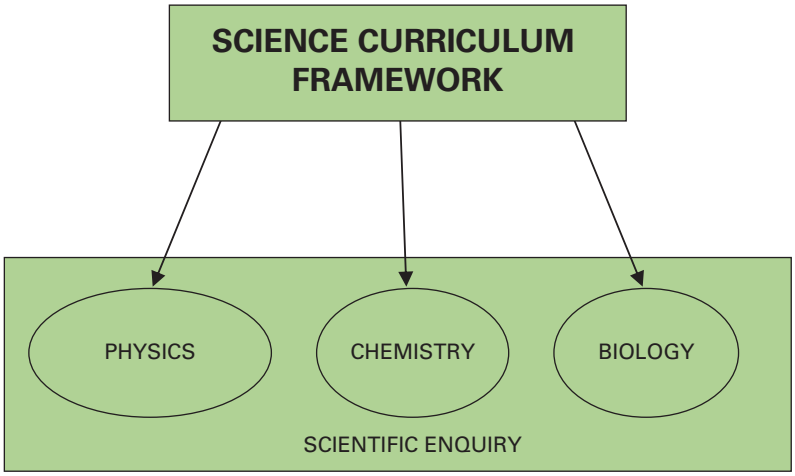
1.3 The Curriculum Framework

The Cambridge Secondary 1 Science framework provides a comprehensive set of learning objectives for Science. The objectives deal with what the learner should know and what they should be able to do in each year of lower secondary education. The function of the curriculum framework is to provide a structure for teaching and learning and a reference against which learners' abilities and understanding can be checked.

There are three stages. Each stage reflects the teaching targets for a year group. Broadly speaking, Stage 7 covers the first year of lower secondary teaching, when learners are approximately eleven years old. Stage 9 covers the final year of lower secondary teaching when learners are approximately fourteen years old. It may be appropriate to introduce this framework at slightly different ages to suit your own particular circumstances.

The Science framework is divided into four main areas called 'strands' which run through every stage: Scientific Enquiry, Physics, Chemistry and Biology.

Strands in the Curriculum Framework



Continuity, progression and balance

The Science curriculum framework allows for continuity and progression both within and between the stages. You can select any learning objective and trace its pathway clearly through the stages of the framework. This continuity allows the curriculum to be consistent and 'uninterrupted' between stages whilst progression ensures that students move forward steadily.

The table below shows how knowledge and skills can be traced through the framework.

An example of progression through the framework

STAGE 7	STAGE 9
Scientific Enquiry: Be able to talk about the importance of questions, evidence and explanations. **Biology:** Draw and model simple food chains. **Chemistry:** Show in outline how the particle theory of matter can be used to explain the properties of solids, liquids and gases, including changes of state. **Physics:** Describe the effects of forces on motion, including friction and air resistance.	**Scientific Enquiry:** Discuss and explain the importance of questions, evidence and explanations, using historical and contemporary examples. **Biology:** Explain and model food chains, food webs and energy flow. **Chemistry:** Explore and explain the idea of endothermic processes, e.g. melting of ice, and exothermic reactions, e.g. burning, oxidation. **Physics:** Know that forces can cause objects to turn on a pivot and understand the principle of moments.

The strands of the curriculum framework have been selected in order to provide balanced coverage of the fundamental skills, knowledge and understanding of Science at this level and they have also been designed to provide a sound foundation for IGCSE. Learners should be prepared at the end of Stage 9 to move smoothly on to Cambridge Secondary 2.

The selection of content in the framework at each level has been chosen to ensure a coherent progression for the learner. The curriculum framework has been designed to allow sufficient time for each learner to develop a true understanding of the skills and knowledge required. Teachers themselves are best placed to know the capabilities of their learners and can, of course, choose to supplement the framework as appropriate. What is within the curriculum framework is the content that will be assessed and analysed using the Cambridge Progression Tests on the Cambridge Secondary 1 support site. The content is also tested in the Cambridge Checkpoint tests for which feedback reports are provided.

Whilst it is important to be able to identify individual progressions through the curriculum, it is also essential for teachers to bring the different strands together into a logical whole so that their teaching makes learning meaningful, purposeful and enjoyable. This can be achieved through detailed planning and through the constant fine-tuning of the teaching to meet the needs of learners.

A decision about approaches to planning is essential so that the process is clear.

SECTION 2: PLANNING

2.1 Getting Started

This next section will look at the process of planning, ensuring that you cover all of the content of the curriculum for stages 7 to 9, given the teaching time you have available within each year.

We will start by identifying exactly **what** you need to plan:

- Complete coverage of the learning objectives for all of the stages, or those that you teach
- Progression and continuity of **Scientific Enquiry** and biology, chemistry and physics content
- The best order in which to teach the required units
- Detailed lessons, led by clear learning objectives that your learners will understand

And **why** you need to plan:

- To ensure appropriate timings are given to the different aspects of the curriculum
- To be clear about what can be assessed as a result of a lesson/unit of work
- To ensure a mix of teaching and learning styles in delivery – according to your learners' needs
- To ensure that all resources are available to deliver a successful lesson

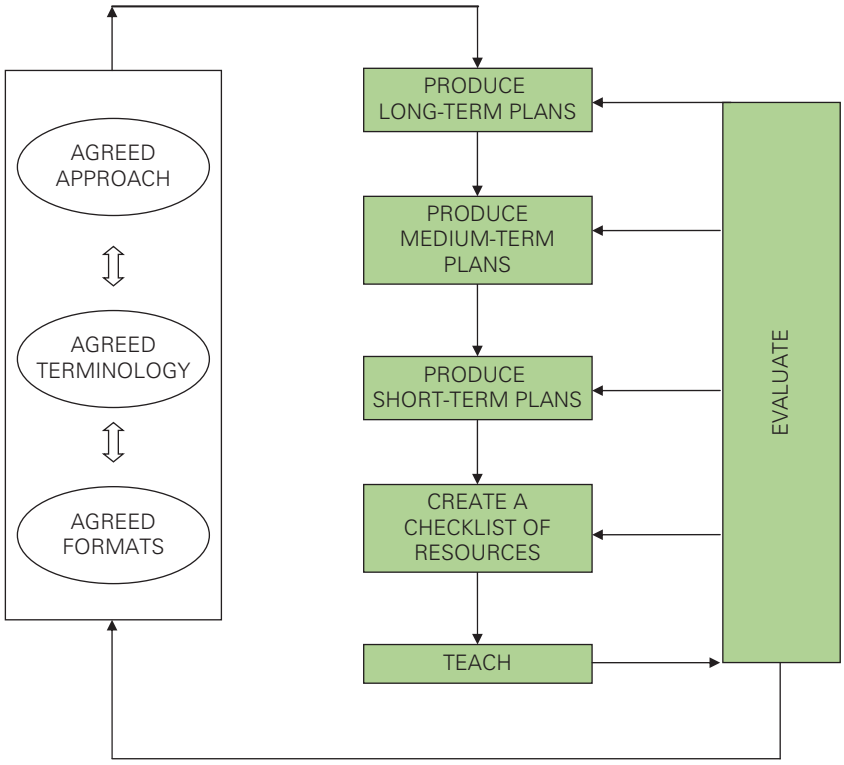
The following section lays out a step-by-step guide to the planning process including how you can build in flexibility to allow you to adapt coverage, delivery style and timing to suit your individual needs.

2.2 A Consistent Approach

Download the curriculum framework for Science **from** the Cambridge Secondary 1 support site **www.cambridgesecondary1.cie.org.uk** and familiarise yourself with the coverage and structure of the programme. We need to break the curriculum down and we can do this in three clear stages but first it is worth getting all the lower secondary Science teachers together to coordinate a consistent approach.

Look at the diagram below. As you can see, decisions about the **'white box'** issues are required first; approach, terminology and formats.

A pathway to implementation



Approach: The general approach will largely be decided by colleagues in management positions with everyone being consulted about their views. This, for example, may concern the whole curriculum and not just Science. Some schools merge subjects across the curriculum. For the purpose of this guide we shall assume that Science is going to be taught as a separate subject.

Terminology: Everyone involved needs to understand the terminology used so that, for example, 'long-term' plan means the same to all. This is true whatever the overall approach within a school.

Training Activity: Agreeing Terminology (Appendix A1)

In the appendices of this guide you will find an exercise that may be carried out by groups of teachers to reach an understanding of the planning terms:

Long-term [overview]

Medium-term [scheme of work]

Short-term [lesson plan]

It also includes other relevant terms. When the terminology has been agreed, planning can begin.

Formats: It is not vital to all use the same documentation for planning but it is very helpful for communication and common understanding. Templates for all stages are provided at the back of the guide in Appendix E. These will be discussed in more detail later.

Evaluation: Perhaps the most important box is the 'Evaluation' box. It is *always* a good idea to check how well something works. The diagram shows that this can be for any stage in the planning process. If there is a problem delivering a lesson, it is often assumed that there is something wrong with the lesson plan. This can be true but sometimes it may be because the medium or long-term plan that is being used needs changing in some way. The **'white box'** issues may also need to be revisited.

2.3 Descriptions of the Planning Stages

Long-term planning involves considering the **Science** curriculum for the whole school. This includes taking account of the school calendar for the academic year and allocating a specific percentage of time for Science to be taught throughout the school. This is generally carried out by senior management.

It requires pre-planning in terms of resources. Different subject areas will receive budget allocations in order to provide the equipment and written resources necessary for the successful delivery of the Science curriculum.

You will need to engineer a balance between Biology, Chemistry and Physics. Scientific Enquiry skills need to be ongoing and sequential.

Medium-term planning involves planning coverage of the curriculum by grouping learning objectives into teaching units across an entire stage. This includes taking account of seasons, school events and possible visits to enhance the learning process.

It also requires pre-planning in terms of required resources, whether these are shared, limited or need buying in. The most important consideration is timing, thinking about when you will be delivering a new unit and how often skills need to be re-visited throughout the year. You will need to think about the order in which knowledge and skills need to be learned.

Again you will need to engineer a balance between Biology, Chemistry and Physics. Scientific Enquiry skills need to be ongoing and sequential across all units taught.

Medium-term planning is usually broken down into individual terms. The Scheme of Work provided by Cambridge for each stage has assumed covering three units per term in an academic year structured as three terms, each of 10 weeks. Term length varies around the world so we have chosen a relatively compact approach so that you should be able to add further time as necessary.

The units of work can be arranged in various ways to provide a varied and interesting approach to delivery and to ensure coverage of the Science curriculum at each stage.

At this point in the process, planning generally considers specific units and the ***best order*** in which they can be taught, building on previous learning and developing knowledge and understanding throughout the year. Depending on what you decide, this permits units to be taught in isolation, or in a cross-curricular way particular to each school's policies. Over time, you will be able to adapt these plans according to resources and to the available teaching time, and in the light of your own particular teaching expertise and confidence.

> ***New Teacher's Tip****: If you are new to teaching and unsure about the length of time it takes to deliver a particular topic, then we have provided a comprehensive plan for all stages from which you can make a start. Do not expect your plan to be perfect first time, start with an estimate of how long you think a subject will take and adjust your long, medium and short-term plans as you go along so that next time you are delivering it you will be able to fine-tune it a bit more each time. You are the best judge of the capabilities of your learners and how long it will take them to understand each topic given their existing knowledge.*

Short-term planning is a lesson plan for a particular lesson. Most commonly this evolves into a weekly plan. This is a detailed, working document and is led by the relevant learning objective(s).

It provides:

- Essential information for all adults involved in the learning and considers the learning needs of all learners, including those with special educational needs (SEN) and/or gifted and talented
- Continuity in the absence of regular teaching staff, e.g. in times of absence
- An outline of resources, timings, working groups and assessment

The real value of a short-term plan is that it influences the next steps in the light of the student's response to the learning opportunities presented. Detailed examples and templates are provided in the appendices.

The following sections provide a step-by-step guide to the planning process including some advice about meeting the training needs of colleagues.

The steps of the planning process (1–8) outlined in the diagram overleaf are divided into three logical phases that form the sub-sections of this section of the guide:

2.4 Phase 1 – Creating a Long-term Plan (steps 1–4)

2.5 Phase 2 – Creating a Medium-term Plan (steps 5–6)

2.6 Phase 3 – Creating a Short-term Plan (steps 7–8)

The Planning Process

2.4 Phase 1
Creating a Long-term Plan

Step 1. Teaching time
Find out:
- how many hours there are to teach the subject
- how the teaching time is divided
- how many units you will be able to comfortably fit into a term.

Step 2. Approach
Think about:
- how you want to structure the teaching of the subject

Step 3. Allocate the strands
Allocate the strands for each stage across the number of units available per term. Think about the different proportion of work required for each strand.

→ **Look at Long-term Planning 1**
You can show the allocation of strands here across the terms.
Later you can use this grid to show how the units are allocated either for one stage or all six, by entering their titles instead.

Step 4. Learning objectives by term
- Look at the curriculum framework.
- Decide which learning objectives will be covered in each part of the year, e.g. each term within a stage.
- Decide which learning objectives will be covered on an ongoing basis throughout the year.
- Decide where you are going to fit in the Speaking and Listening.

You can mark up the curriculum framework (e.g. use a colour code) to show the results.

→ **Look at Long-term Planning 2**
You can use this to record your decisions on when each learning objective should be introduced in the year.

→ **Look at Long-term Planning 3**
You can use this to show the results of your decisions in Long-term Planning 2 term by term.

2.5 Phase 2
Creating a Medium-term Plan

Step 5. Creating Units
- Group ongoing and other learning objectives into topics and themes creating a logical, progressive sequence of learning including Speaking and Listening.
- Rearrange for challenge, balance, timing, pace and appeal.
- Organise the number of units to match the estimated time available from Step 1.

→ Print and cut out the individual learning objectives so you can try different arrangements on a separate sheet before finalising if it is helpful.

Step 6. Creating Medium-term Plans
Identify suitable activities and resources to deliver the learning objectives in each unit.
Indicate how the lesson is to be taught.

→ **Look at Medium-term Planning 1**
You can record your decisions with comments and timings on this template alongside the other information.
Medium-term Planning 2
does not have these additional columns.

2.6 Phase 3
Creating a Short-term Plan

Step 7. Creating Lesson Plans
Identify what you are going to teach and how you are going to teach it.

→ **Look at Short-term Planning**
Instructions are printed on the template on page 29 of the Planning section.

Step 8. Evaluate the lesson and the planning
Amend your scheme of work and lesson plans to best suit the needs of your learners.

2.4 Phase 1 – Creating a Long-term Plan

Step 1. Teaching Time

First you will need to establish the number of terms available, the length of the terms and the number of teaching units you will roughly be able to fit into each term. In this guide we will follow a structure of three terms of 10 weeks per stage.

Step 2. Approach

Next you will need to decide the overall approach you want to take to the teaching structure of the course. Here are a few helpful prompts to get you thinking along the right lines.

- Do I have a preferred way of working?
- Do the Science team prefer to teach a mixture of Biology/Chemistry/Physics?
- Do the Science team prefer to teach Biology/Chemistry/Physics as separate subjects?
- How are Science resources available in school? (If they are shared, this could dictate when you need to teach specific strands.)
- How can I ensure that I cover the whole curriculum for the stage during the year?
- How will I provide opportunities for Scientific Enquiry continuously throughout the year?
- How can I sensibly group learning objectives from the curriculum framework to incorporate them into meaningful units of study?

Different planning models may be useful in deciding the most effective way of meeting learners' needs. Models can be either linear (each topic delivered consecutively) or spiral (see below) or even a combination of both. In this guide and in the published Cambridge Scheme of Work (which is available on the Cambridge Secondary 1 support site to all registered centres), we have chosen a model in which a combination of the four strands are covered within each term. Scientific Enquiry objectives are worked in alongside every topic taught as these are ongoing skills that help reinforce a good scientific discipline.

Managing Scientific Enquiry in your Planning

Scientific Enquiry underpins work covered in the Biology, Chemistry and Physics strands. The skills of Scientific Enquiry are ongoing in each stage and across stages. This is sometimes referred to as **'the spiral curriculum'**.

The spiral curriculum incorporates the four main elements of Scientific Enquiry:

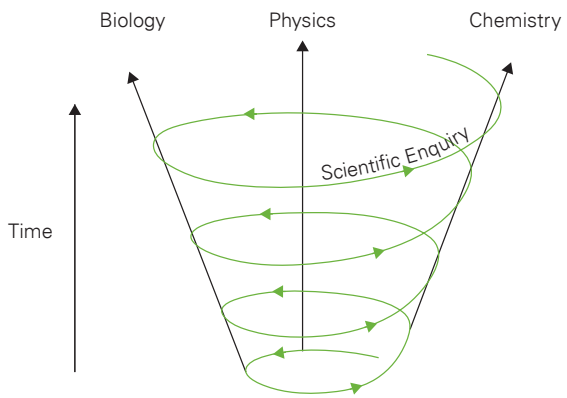
Ideas and evidence

Plan investigative work

Obtain and present evidence

Consider evidence and approach

Skills in each area re-visited and practised, building on previous knowledge, skills and understanding. As this is the case, we advise the use of a spiral planning model which permits a more holistic approach to delivery.



The Spiral Planning Model

The spiral model, shown here, provides a structure where the different strands, represented by the vertical arrows, are visited and then revisited in a continuous teaching and learning process that allows each strand to support progress and understanding in the other strands.

The practical nature of the skills and knowledge of the Scientific Enquiry strand means they form part of the substance *and structure* of that process.

Step 3. Allocate the Strands

Have a look at the curriculum framework. We are going to start by breaking down the framework broadly into the four major strands, Scientific Enquiry, Biology, Chemistry and Physics to form an overview for all stages. Scientific Enquiry objectives underpin all the other strands as we have mentioned above and so are delivered alongside them at the same time.

Stage	Scientific Enquiry	Biology	Chemistry	Physics
7	Ideas and evidence Plan investigative work Obtain and present evidence Consider evidence and approach	Living Things Microorganisms and Disease Habitats and the Environment Putting things into Groups	Solids, Liquids and Gases The Earth and Beyond Acids and Bases	Changing Energy Putting things into Groups The Earth and Beyond Forces and Their Effects
8	Ideas and evidence Plan investigative work Obtain and present evidence Consider evidence and approach	Obtaining Food Respiration and Circulation Reproduction and Growth	Elements, Mixtures and Compounds Metals, Non-metals and Corrosion Chemical Reactions	Light Sound Forces and Magnets
9	Ideas and evidence Plan investigative work Obtain and present evidence Consider evidence and approach	Photosynthesis and Plant Growth Sexual Reproduction in Flowering Plants Ecology The Energy Crisis and Human Influences	The Periodic Table and Preparing Salts Reactivity and Rates of Reaction Chemicals and Thermal Energy	Electrostatics and Electric Currents Moments, Pressure and Density Chemicals and Thermal Energy The Energy Crisis and Human Influences

This plan has been designed to provide a good balance between Biology, Chemistry and Physics in each stage with the development of Scientific Enquiry skills ongoing throughout.

You may prefer to teach separate terms of Biology, Chemistry and Physics according to the organisation and timetabling in your school. You will need to decide your approach collectively at the outset of the planning process.

Step 4. Learning Objectives by Term

Next you will need to work through all the learning objectives in the order in which they appear in the curriculum framework, writing alongside each one which term or terms (Term 1 (**T1**), Term 2 (**T2**), or Term 3 (**T3**)) you think each one should be delivered in. An objective may need to be revisited in subsequent terms so could appear in T1 and T3, for example. You will need to think about the order of learning difficulty in allocating the objectives. The template **Long-term Planning_2** has been produced to help you record term allocations. It has a column on the right-hand side in which you can write the appropriate timing for delivery.

You will find that some learning objectives relate to skills that apply to many strands as well as across the three terms. We have called them 'Ongoing' objectives in this guide. You will need to identify these in the curriculum framework and put an 'O' beside them in your list. See the completed example of Long-term Planning_2 included on page 15.

Next you will need to consider the Scientific Enquiry objectives. As explained in the introduction to this guide, these are designed to be addressed alongside the other strands and this means that they can easily be fitted into the content of your final teaching units.

Scientific Enquiry

Science teaching is not just about content; it has a highly applied nature through experimentation. It also includes the development of fundamental scientific skills, which are essential in creating your scientists who are capable of questioning, reasoning and seeking answers through investigation.

This guide will address how to incorporate these practical, investigative and thinking skills alongside delivery of the Science subject content of Physics, Chemistry and Biology. Scientific Enquiry, of course, is a strand in its own right. These skills need to be practised regularly and applied in familiar and new situations during practical sessions. As you will read later in this guide, Cambridge believes that learners gain a better conceptual grasp of new knowledge when that knowledge is set in a context provided by an activity. Scientific Enquiry lays down the main tenets of the scientific method by reiterating the accepted and proven procedures of investigation and reporting in each of the remaining strands.

Once you have allocated your learning objectives to a relevant term or terms, you might want to produce a document that separates these lists out into their individual terms. This way you can see when learning objectives are first introduced to learners. You can either include the relevant ongoing objectives within this list or make a separate list for them against each stage. You can use the template Long-term Planning _3 for this. Alternatively you can also keep the list all together and simply colour-code the times of first delivery, all those first delivered in Term 1, for example, then Term 2, then Term 3. A completed example of this has been included on page 18.

A completed example of Long-term Planning_2

Framework Code	Learning Objective	Ongoing (O) Term ref (T1,T2,T3)
	Ideas and evidence	
7Ep1	Be able to talk about the importance of questions, evidence and explanations.	O
7Ep2	Make predictions and review them against evidence.	O
	Plan investigative work	
7Ep3	Suggest ideas that may be tested.	O
7Ep4	Outline plans to carry out investigations, considering the variables to control, change or observe.	O
7Ep5	Make predictions referring to previous scientific knowledge and understanding.	O
7Ep6	Identify appropriate evidence to collect and suitable methods of collection.	O
7Ep7	Choose appropriate apparatus and use it correctly.	O
	Obtain and present evidence	
7Eo1	Make careful observations including measurements.	O
7Eo2	Present results in the form of tables, bar charts and line graphs.	O
7Eo3	Use information from secondary sources.	O
	Consider evidence and approach	
7Ec1	Make conclusions from collected data, including those presented in a graph, chart or spreadsheet.	O
7Ec2	Recognise results and observations that do not fit into a pattern, including those presented in a graph, chart or spreadsheet.	O
7Ec3	Consider explanations for predictions using scientific knowledge and understanding and communicate these.	O
7Ec4	Present conclusions using different methods.	O
	Plants	
7Bp1	Recognise the positions, and know the functions of the major organs of flowering plants, e.g. root, stem, leaf.	T1
	Humans as Organisms	
7Bh1	Explore the role of the skeleton and joints and the principle of antagonistic muscles.	T1
7Bh2	Recognise the positions an know the functions of the major organ systems of the human body. Secondary sources can be used.	T1
7Bh3	Research the work of scientists studying the human body.	T2
	Cells and Organisms	

(Continued)

Framework Code	Learning Objective	Ongoing (O) Term ref (T1, T2, T3)
7Bc1	Identify the seven characteristics of living things and relate these to a wide range of organisms in the local and wider environment.	T1, T2
7Bc2	Know about the role of micro-organisms in the breakdown of organic matter, food production and disease, including the work of Louis Pasteur.	T2
7Bc3	Identify the structures present in plant and animal cells as seen with a simple light microscope and/or a computer microscope.	T1, T2
7Bc4	Compare the structure of plant and animal cells.	T1
7Bc5	Relate the structure of some common cells to their functions. Secondary sources can be used.	T1
7Bc6	Understand that cells can be grouped together to form tissues, organs and organisms.	T1
	Living Things in their Environment	
7Be1	Describe how organisms are adapted to their habitat, drawing on locally occurring examples. Secondary sources can be used.	T3
7Be2	Draw and model simple food chains.	T3
7Be3	Discuss positive and negative influence of humans on the environment, e.g. the effect on food chains, pollution and ozone depletion.	T3
7Be4	Discuss a range of energy sources and distinguish between renewable and non-renewable resources. Secondary sources can be used.	T3
	Variation and Classification	
7Bv1	Understand what is meant by a species.	T2
7Bv2	Investigate variation within a species. Secondary sources can be used.	T2
7Bv3	Classify animals and plants into major groups, using some locally occurring examples.	T2
	States of Matter	
7Cs1	Show in outline how the particle theory of matter can be used to explain the properties of solids, liquids and gases, including changes of state.	T1
	Material Properties	
7Cp1	Distinguish between metals and non-metals.	T2
7Cp2	Describe everyday materials and their physical properties.	T2

(Continued)

Framework Code	Learning Objective	Ongoing (O) Term ref (T1,T2,T3)
	Material Changes	
7Cc1	Use a PH scale.	T3
7Cc2	Understand neutralisation and some of its applications.	T3
7Cc3	Use indicators to distinguish acid and alkaline solutions.	T3
	The Earth	
7Ce1	Observe and classify different types of rocks and soils.	T2
7Ce2	Research simple models of the internal structure of the Earth.	T2
7Ce3	Examine fossils and research the fossil record.	T2
7Ce4	Discuss the fossil record as a guide to estimating the age of the Earth.	T2
7Ce5	Learn about most recent estimates of the age of the Earth.	T2
	Forces and Motion	
7Pf1	Describe the effects of forces on motion, including friction and air resistance.	T3
7Pf2	Describe the effect of gravity on objects. Secondary sources can be used.	T3
	Energy	
7Pe1	Understand that energy cannot be created or destroyed and that energy is always conserved.	T1
7Pe2	Recognise different energy types and energy transfers.	T1
	The Earth and Beyond	
7Pb1	Describe how the movement of the Earth causes the apparent daily and annual movement of the Sun and the stars.	T2
7Pb2	Describe the relative position and movement of the planets and the Sun in the solar system.	T2
7Pb3	Discuss the impact of the ideas and discoveries of Copernicus, Galileo and more recent scientists.	T2
7Pb4	Understand that the Sun and other stars are sources of light and that planets and other bodies are seen by reflected light.	T2

A completed example of Long-term Planning_3

List of objectives colour-coded by term of first introduction:

Ongoing

Term 1

Term 2

Term 3

LEARNING OBJECTIVES – an overview

Framework Code	Learning Objective
	Ideas and evidence
7Ep1	Be able to talk about the importance of questions, evidence and explanations.
7Ep2	Make predictions and review them against evidence.
	Plan investigative work
7Ep3	Suggest ideas that may be tested.
7Ep4	Outline plans to carry out investigations, considering the variables to control, change or observe.
7Ep5	Make predictions referring to previous scientific knowledge and understanding.
7Ep6	Identify appropriate evidence to collect and suitable methods of collection.
7Ep7	Choose appropriate apparatus and use it correctly.
	Obtain and present evidence
7Eo1	Make careful observations including measurements.
7Eo2	Present results in the form of tables, bar charts and line graphs.
7Eo3	Use information from secondary sources.
	Consider evidence and approach
7Ec1	Make conclusions from collected data, including those presented in a graph, chart or spreadsheet.
7Ec2	Recognise results and observations that do not fit into a pattern, including those presented in a graph, chart or spreadsheet.
7Ec3	Consider explanations for predictions using scientific knowledge and understanding and communicate these.
7Ec4	Present conclusions using different methods.

(Continued)

Framework Code	Learning Objective
	Plants
7Bp1	Recognise the positions, and know the functions of the major organs of flowering plants, e.g. root, stem, leaf.
	Humans as Organisms
7Bh1	Explore the role of the skeleton and joints and the principle of antagonistic muscles.
7Bh2	Recognise the positions and know the functions of the major organ systems of the human body. Secondary sources can be used.
7Bh3	Research the work of scientists studying the human body.
	Cells and Organisms
7Bc1	Identify the seven characteristics of living things and relate these to a wide range of organisms in the local and wider environment.
7Bc2	Know about the role of micro-organisms in the breakdown of organic matter, food production and disease, including the work of Louis Pasteur.
7Bc3	Identify the structures present in plant and animal cells as seen with a simple light microscope and/or a computer microscope.
7Bc4	Compare the structure of plant and animal cells.
7Bc5	Relate the structure of some common cells to their functions. Secondary sources can be used.
7Bc6	Understand that cells can be grouped together to form tissues, organs and organisms.
	Living Things in their Environment
7Be1	Describe how organisms are adapted to their habitat, drawing on locally occurring examples. Secondary sources can be used.
7Be2	Draw and model simple food chains.
7Be3	Discuss positive and negative influence of humans on the environment, e.g. the effect on food chains, pollution and ozone depletion.
7Be4	Discuss a range of energy sources and distinguish between renewable and non-renewable resources. Secondary sources can be used.
	Variation and Classification
7Bv1	Understand what is meant by a species.
7Bv2	Investigate variation within a species. Secondary sources can be used.
7Bv3	Classify animals and plants into major groups, using some locally occurring examples.
	States of Matter
7Cs1	Show in outline how the particle theory of matter can be used to explain the properties of solids, liquids and gases, including changes of state.

(Continued)

Framework Code	Learning Objective
	Material Properties
7Cp1	Distinguish between metals and non-metals.
7Cp2	Describe everyday materials and their physical properties.
	Material Changes
7Cc1	Use a PH scale.
7Cc2	Understand neutralisation and some of its applications.
7Cc3	Use indicators to distinguish acid and alkaline solutions.
	The Earth
7Ce1	Observe and classify different types of rocks and soils.
7Ce2	Research simple models of the internal structure of the Earth.
7Ce3	Examine fossils and research the fossil record.
7Ce4	Discuss the fossil record as a guide to estimating the age of the Earth.
7Ce5	Learn about most recent estimates of the age of the Earth.
	Forces and Motion
7Pf1	Describe the effects of forces on motion, including friction and air resistance.
7Pf2	Describe the effect of gravity on objects. Secondary sources can be used.
	Energy
7Pe1	Understand that energy cannot be created or destroyed and that energy is always conserved.
7Pe2	Recognise different energy types and energy transfers.
	The Earth and Beyond
7Pb1	Describe how the movement of the Earth causes the apparent daily and annual movement of the Sun and the stars.
7Pb2	Describe the relative position and movement of the planets and the Sun in the solar system.
7Pb3	Discuss the impact of the ideas and discoveries of Copernicus, Galileo and more recent scientists.
7Pb4	Understand that the Sun and other stars are sources of light and that planets and other bodies are seen by reflected light.

Notes:

- *The number of lines in the table will match the total number of learning objectives for the stage.*
- *Framework codes will be entered in the order that they appear.*
- *Learning objectives will appear in full.*
- *The learning objectives can be colour coded:*
  - *Ongoing.*
  - *A different colour for each term – once only when it is first introduced.*

You are now ready to move on to creating your Medium-term Plans where you will need to organise your learning objectives for each term into groups based around topics and themes. We call these groups 'Units'.

2.5 Phase 2 – Creating a Medium-term Plan

You should already have decided roughly how much time is available for each teaching unit as part of your long-term planning. For example, it may be two weeks or it may be four depending on the length of time available in your terms.

Steps 5 Creating Units and 6 Medium-term Plans

The starting point for creating a medium-term plan is the list of objectives that you have allocated to each term. You need to order these now into themes and topics so that you have:

- A logical and progressive teaching sequence that takes into account prior learning and the ascending level of demand belonging to each skill
- Good timing so that the pace of learning is challenging and realistic for all learners
- Identified activities to deliver the objectives and resources
- Identified opportunities for ICT
- A variety of enjoyable and appealing learning opportunities for your learners

A set of questions can help to organise ideas. The table below shows some possibilities. The information (possible answers), given in the right-hand column shows what decisions have been made for the suggested medium-term plan provided by Cambridge. This is available to all registered centres on the Cambridge Secondary 1 support site.

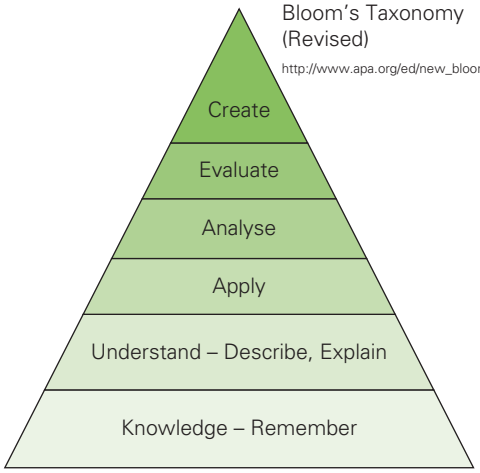
Questions	Approach taken in this guide
What do learners already know?	A consideration of prior knowledge gained from previous stages and units.
What skills (including practical skills) do I need to teach?	Check objectives to determine and list the skills for the unit. (Include ongoing element of the stage/unit.)
What knowledge do I need to teach?	As above but for knowledge.
Is there a natural order of teaching for these objectives?	The above information can be ordered so that skills and knowledge build up logically.
How long will my class need for learning to happen?	The time frame for the unit has already been decided. Consider the time required for teaching an objective/ group of objectives. The length of lessons will help here.
What resources are available in school? What purchases are required?	It is important that good quality resources are kept and used. They may need adapting. New resources may be identified and purchasing plans made. Remember Information Communication Technology (ICT).

To help you determine the order of learning by considering the level of difficulty of each required skill, the broad principles of Bloom's taxonomy may be helpful.

Look at the ascending hierarchy of skills indicated in the triangle and exemplified in the two tables. Think about the levels of skill required by the learner across and within your units. Are you asking learners to perform tasks that require a higher level of skill towards the end of the term, having built up their knowledge systematically in previous lessons? Are the skills and knowledge required by any given unit built up gradually to form a logical progression? A clear hierarchy of skills in planning and delivery sets a good example to your learners of how the learning process works.

Bloom's Taxonomy (Revised)

http://www.apa.org/ed/new_blooms.html



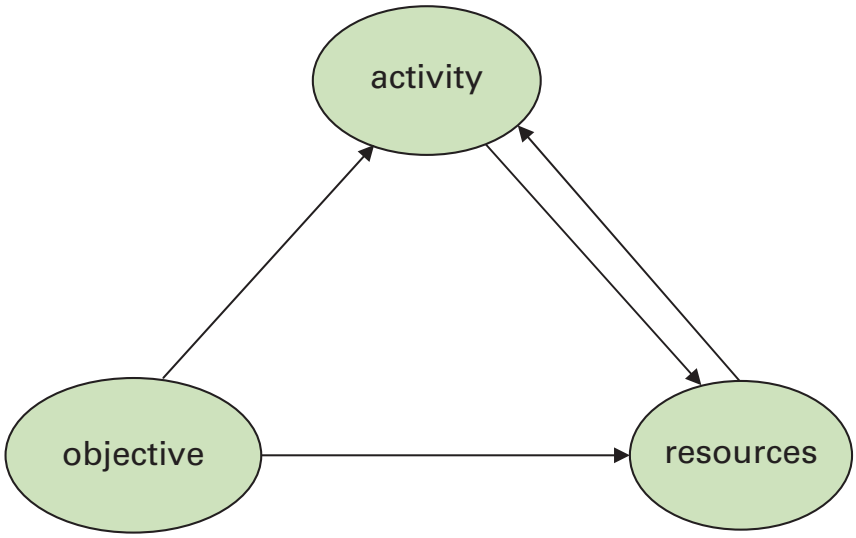
Based on an APA adaptation of Anderson, L.W. & Krathwohl, D.R. (Eds.) (2001)

Consider alternative conclusions that could be made from scientific evidence and explanations.
Critically examine conclusions by making scientific judgements about validity of evidence.
Examine and break information into parts – make inferences; find supporting evidence for generalisations.
Solve problems in new situations by using knowledge from learning outcomes in a different context. Link knowledge from different areas to explain observations or results.
Organise, interpret, and explain directly from learning outcomes.
Recall or describe facts and basic concepts directly from learning outcomes.

Possible questions that illustrate each level

Suggest other ways Farmer A could increase her crop yields.
Look at the information given about the yields of three crops of lettuce. Farmer A thinks she can increase her yields by adding more fertiliser to her soil. What other information will she need before she can make a decision about adding more fertiliser?
Describe three ways a farmer growing lettuces in a greenhouse can increase yield. Explain your answers.
Suggest why a leaf cell from a plant growing in the shade has more chloroplasts than a leaf growing in a sunny place.
Explain why plant cells have cell walls.
Describe the differences between a plant cell and an animal cell.

Remember, when it comes to choosing activities and resources, it is important that the activities are objective-led. Choose the objective first, decide the activity from that and the resources needed will then become apparent.



Decisions about units, activities and resources should be recorded as a medium-term plan. A blank template is available in Appendix E of this guide for you to create your own medium-term plans or scheme of work.

A comprehensive set of medium-term plans (or schemes of work) is provided on the Cambridge Secondary 1 support site.

Extracts from the full Scheme of Work are provided in Appendix B of this guide.

A completed example of medium-term planning is included overleaf.

A completed example of Medium-term Planning_2

STAGE 7

UNIT 1A: Living Things

In this unit, pupils build on their previous knowledge of living things and the senses to develop their knowledge of the following:

- The characteristics common to all living things, and their importance to survival of the organism
- That all living things are made of cells, the structure and typical cells, how cells are adapted to their function
- How cells are organised in tissues, organs and organ systems to efficiently carry out the functions of life

Scientific Enquiry work focuses on:

- Carefully observing and describing living things
- Recording accurately in a variety of ways, e.g. drawing, using tabular forms
- Communicating their ideas supported by evidence
- Making and presenting conclusions by bringing together evidence from different sources

Vocabulary: organism, nutrition, movement, excretion, growth, reproduction, sensitivity, function, microscope, magnification, cell, nucleus, cell membrane, cell wall, vacuole, chloroplast, tissue, organ, organ system

Stage 7: Unit 1A, Living Things

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
7Bc1	Identify the seven characteristics of living things and relate these to a wide range of organisms in the local and wider environment	Compare different animals, real (if appropriate) or pictures, e.g. bird, cat, fish and write down all the things they have in common. Present your findings to other groups	Photos of animals eating, running/swimming, and with their young	Use small group discussion allowing each pupil to voice their ideas on observations, followed by whole class work to encourage confidence in expressing Science ideas backed by evidence	2 hr
7Ei1	Be able to talk about the importance of questions, evidence and explanations	Discuss the ways nutrition is obtained by different animals			
7Eo1	Make careful observations including measurements	Breathe through a straw into lime-water to show carbon dioxide is produced	Drinking straws, lime-water, test-tubes or small beakers to hold lime-water		
7Eo2	Present results in the form of tables, bar charts and line graphs	Discuss the difference between breathing and respiration			
		Discuss the difference between growth and reproduction			
		Discuss why movement is essential for survival (finding shelter, avoiding danger, finding food)			
		Detect different flavours using taste only and compare with ease of detection when also using nose	Different flavoured crisps or fruits to taste blindfold and nose clips (or ask pupils to shut eyes and hold nose while tasting)		
		Describe texture of a variety of different materials	Various materials with different textures, e.g. wool, paper, metal		

Steps 1 and 2	Complete the framework codes and learning objectives straight from the Science curriculum framework and/or the scheme of work or long-term planning templates
Step 3	Allocate the timings – use the suggestions given in the scheme of work as a guide.
Step 4	Outline activities that would address the learning objective. This can include a list of suggestions; you may later choose to only do a selection of activities depending on the time you have in class.
Step 5	Consider the resources that would be needed to be able to carry out your suggested activities. Some will need pre-preparing or even buying in.
Step 6	Consider ways you might be able to assess the learning objective. You might need to plan a visit for a particular activity. You might need to think about other provision for Special Educational Needs (SEN) learners. Write these thoughts in the 'Comments' column.

Once you have arranged and ordered your objectives around the themes, you can give meaningful titles to each group or 'Unit'. You should then be able to arrange these units to fit into the timings you decided on earlier. In this guide we have opted for three units per term and three terms per stage or year. A different time structure or the limitation of having to use shared resources might have an effect on the order in which you deliver the curriculum.

2.6 Phase 3 – Creating a Short-term Lesson Plan

Short-term plans are for teachers to use in the classroom when delivering their lessons.

A blank template that can be used for either a single or a weekly lesson plan is provided in appendix E. Producing lesson plans for single lessons is particularly useful when first introducing the framework. However, when teachers have become confident in their teaching, have a sound knowledge of the subject matter and know the best way to deliver it in the classroom, daily plans can become weekly.

In order to introduce the template to teachers it might be helpful to run a training exercise like the one below to familiarise all staff with the format and help them understand its requirements. It would also serve to reinforce what teachers already know about planning lessons.

Training Activity: Producing a Lesson Plan Format (Appendix A2)

This activity describes an exercise that may be carried out by groups of teachers to explore what a short-term plan (for a single lesson) should contain. They can then experiment with a format to include all that they decide would be useful.

Step 7. Creating your Lesson Plan

On page 29 you will find a copy of the Cambridge Short-term Planning template which contains the instructions for filling in each section of the plan. Spend a little time familiarising yourself with the different components.

The lesson plan is like a recipe. The quality of the ingredients will directly affect the quality of the overall outcome. In this case, good planning makes for successful teaching and an enjoyable learning experience.

Make sure that your lesson plans describe:

- What is to be taught, and
- How it is to be taught

Sample short-term plans are available in Appendix C of this guide.

An example of a completed short-term plan can be seen on page 30.

Step 8. Evaluating your Planning

Remember that your plans are a working document. You will need to be responsive to your learners and adapt your teaching as required. Here are a few things to consider regarding the creation and maintenance of lesson plan:

- Teachers need to keep in touch with learners' needs and ensure learning is of good quality and that skills and knowledge are retained
- 'Over-planning' of a whole week's work can lead to inflexibility
- Sometimes lessons need to speed up, on other occasions it may be necessary to revisit an aspect of learning
- Teachers must be prepared to amend plans from lesson to lesson
- If the pupils' work is poor or they have struggled during the lesson, it might be sensible to revisit the work and not rush on to the next objective
- Plans need to be helpful to teachers and they need to be used
- Plans should not just 'sit' in a neat folder. A good set of plans may have notes written all over them to show what went well and what might need adjustment for next time

There is a need to try and keep 'on track', or keep up, with planned work but teachers should not stick so firmly to their plans that they cannot follow an idea that is unplanned. Quite often, excellent lessons result when something happens to stop the planned lesson – a local or national event, an individual brings something into school – and the learners are interested. Learning takes place when learners are motivated and enthusiastic.

Whilst it is true that 'unplanned' activities should not lead the teaching, it may be possible for teachers to revisit both short and medium-term plans to see if any objectives can be met. In this way, a certain amount of flexibility can be allowed. At the same time it should be remembered that the time allowed for a term's units is 10 weeks – therefore, an unplanned activity could happen *in addition to* the intended plan.

Further advice on how to monitor the success of your teaching can be found in Section 3: Teaching Approaches and Section 4: Assessment. The techniques discussed can help you work active learning and formative assessment in to your lessons which will improve the feedback on your teaching.

The lesson plan format below will be used as a basis for the following discussion of the content of short-term plans. Agreed formats may be different so the points may be adapted to suit a slightly different purpose.

Short-term Plan Instructions

Week beginning: gives a date reference; daily plans should add the day				**UNIT: The title of the unit of work**		**CLASS: The class to be taught**	
Time	**Ref**	**Learning Objectives**	**Success Criteria**	**Activities** **Will have a description and how they will be organised**		**Resources**	**Achievement**
				Description	**W/G/I**		
Breaks the total lesson time down, showing how long is to be spent on each activity	This is the code taken from the medium-term plan which is from the framework document	These are selected for each lesson; there is often more than one	These are questions or statements that will be used to measure achievement (success) – see Section 4 on Assessment	Description of the activity	W=whole class; G=group; I=individual or independent work	Materials that will be needed for the activity	A code shows what kind of evidence the teacher will use to decide if the success criteria have been met and the objective has been achieved. (See Section 4: Assessment) **Q&A**: question/answer **D**: discuss'n **O**: observ'n **M**: marked work
Organisation: Details of differentiation/groups/adult role (linked to activities)				**Notes/extension opportunities/homework**			
How the class will be organised; this may be just for certain activities; it should include details of differentiation/groups/adult role (linked to activities).				This is where any comments should be made about how the lesson has been and whether the next session plans need to be amended. Before the lesson, as part of the planning, extension activities and homework can be listed here.			

A completed example of a Short-term plan

Stage 7: Unit 1A, Living Things

Week beginning: Term 1 Week 1			UNIT: 1A Living Things			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;		Resources	Evidence of achievement
				Description	W/G/I		
1 hr	7Bc1	Identify the seven characteristics of livings things and relate these to a wide range of different organisms in the local and wider environment.	A list of things all living things have in common: they eat, breathe, move, get rid of waste, grow, sense, and have young.	Compare different animals, real (if appropriate) or pictures, e.g. bird, cat, fish and write down all the things they have in common. Present your findings to other groups.	G W	Photos of animals eating, running/ swimming with their young to stimulate discussion.	Q&A
30 min	7Eo2	Present results in the form of tables, bar charts and line graphs.	Introduce the terms nutrition, excretion, respiration, reproduction and growth.	Discuss the ways nutrition is obtained by different animals.	G W		Q&A
30 min	7Eo1	Make careful observations including measurements.	Pupils should appreciate that excretion removes poisonous substances from the body through the lungs, the sweat glands and urine.	Breathing through a straw into lime-water to show carbon dioxide is produced.	I or G W	Drinking straws, lime-water, test-tubes or small beakers to hold lime-water.	O D
15 min				Discuss the difference between breathing and respiration.	G and W	Photos of animals with their young. Photos / specimens of	D
30 min				Discuss the difference between growth and reproduction.			

(Continued)

Week beginning: Term 1 Week 1			UNIT: 1A Living Things			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;		Resources	Evidence of achievement
				Description	W/G/I		
30 min			Extension of ideas about movement in animals.	Discuss why movement is essential for survival (finding shelter, avoiding danger, finding food)		young and mature plants	D **D and Q&A**
Organisation: details of differentiation/groups/adult role (linked to activities)				**Notes/extension opportunities/homework**			
Encourage the active learner by organising the class into groups to discuss their observations and ideas. Whole class discussion can then be used to bring together ideas and develop confidence in articulating such to the rest of the class. Differentiation: Pupils could record their understanding by writing short sentences about living things or worksheets requiring simple answers could be prepared. Word searches and crosswords could be prepared to consolidate vocabulary. Care must be taken in the practical work to ensure safe practice in exhaling through lime-water.				Compare how two different groups of animals replace older members with young, e.g. frogs and elephants. Vocabulary: organism, nutrition, movement, excretion, growth, reproduction			**Q&A**: question/ answer **D**: discuss'n **O**: observ'n **M**: marked work

SECTION 3: TEACHING APPROACHES

This section considers some of the different ways that you may choose to deliver particular activities throughout the year.

There are as many ways to teach as there are teachers. We all have our own preferences – and ways in which we feel most comfortable teaching. However, it is important to remember that learners have different learning styles and we need to appeal to all of them in our teaching.

Training Activity: Planning and Delivering a Lesson (Appendix A3)

In the appendices of this guide you will find a useful training exercise that helps to draw out just how many of these approaches teaching staff already practise and simply do not notice from familiarity.

3.1 Sharing the Learning Intention

Making objectives clear to learners is an essential part of giving them power over (and responsibility for) their own learning. Knowing how the objectives link together over time as an articulated whole in the medium and long term provides a kind of learning landscape, a route along which learners are travelling. The short-term plan will have selected objectives for the lesson. When delivering the lesson, the objectives need to be shared with the learners. It is at this stage that a further breakdown of the objective is needed.

When objectives, or learning intentions, are shared learners become more involved, have a better understanding of what they have to do and can comment on their own learning.

- Understanding what is meant to be learned is vital for learners
- Each lesson should have its objectives clear from the start
- The learning objectives should be displayed throughout the lesson
- Conversion to 'child-speak' may be necessary

Training Activity: Sharing Learning Intentions (Appendix A4)

In the appendices you will find a suggested training activity that has some details about how this might be done with different groups of learners. This can also help with marking.

The framework makes the objectives clear at each stage. To make objectives clearer to learners the words need to be changed.

The table below gives examples of verbs that could be used when re-wording objectives. They are *only* examples with some alternatives listed, too.

***'knowledge'* = to know...**	***'concepts'* = to understand...**
– to recall – to recognise – to describe	– to explain – to present – to suggest – to compare
***'skills'* = to be able to...**	***'attitude'* = to be aware of...**
– to investigate – to use – to make observations – to discuss – to control – to decide	– to identify – to assess – to look critically – to be able to discuss – to evaluate

Example of re-wording an objective

Objective: 8Cc2 Describe chemical reactions which are not useful.

Words used: We're going to find out why an iron nail goes rusty if it's left out in the rain.

Explaining the learning intention takes very little time. Finding the right words will improve with practice and need not be written in the lesson plan. A sheet of notes may be useful though. It is easier provided the learning intentions in the medium-term plan are clear. The words used will also relate closely to the 'success criteria' (more on these below).

Making the wording of the objectives accessible to learners will need to be done by individual teachers as they know their learners best.

Delivery of subject content in Science is heavily dependent on specific scientific vocabulary. To assist you with this, a vocabulary list has been included at the start of each unit. It sometimes helps to present the learning intention as a question:

e.g. How will keeping the nail dry affect how quickly it rusts?

This question then helps learners establish the relevant success criteria.

Creating Success Criteria

The learners' understanding of the learning intention is developed much more fully if it is followed by an invitation to them to create **'success criteria'**. These success criteria provide a way for teachers and learners to know at what point a learning objective has been achieved.

There are many ways that this can be done.

- Whole class discussion
- Group discussion followed by feedback to whole class
- Individual learner followed by feedback to group
- Individual learner followed by feedback to teacher/adult

The learning outcome and the success criteria should be displayed throughout the lesson.

Learners now all understand what they have to do.

Giving learning objectives and success criteria a central role in lessons and allowing learners to produce them:

- Helps learners to gain a deeper understanding of what to do
- Gives learners ownership of the criteria
- Gives learners a basis for self-evaluation and peer-evaluation
- Enables learners to become active learners

See the section on Assessment for how the creation of success criteria fits into formative assessment techniques

Group Working

Working in small groups can create a very positive atmosphere in the classroom as learners find themselves working with different people – people they do not know very well. Teachers can decide how to organise working groups in either a structured or random way.

Combinations of members can include anyone in the class, they are all inclusive. Indeed this can often have benefits for learners with special educational needs. In addition, the use of groups can result in increased tolerance and respect, improved behaviour and increased self-esteem.

3.2 Active Learning

Learner-centred learning or 'active learning' recognises that the focus in teaching is getting learners to 'do' rather than 'listen'. Learning by doing attaches real meaning to whatever related knowledge is being taught. Being told how to swim is, after all, not the same as being able to do it, and as thinking is an action too, we need to put it into a context, connect it to our emotions as we discover its applications. Understanding requires belief and these three simple points are a neat reminder of how that deeper learning is accessed through activity.

- I listen – I forget
- I see – I believe
- I do – I understand

It is clear that a range of different teaching strategies will be needed to provide the correct environment in which learners can develop their skills, knowledge and understanding. Included in these are methods that encourage active learning, thinking skills and independent work. The role of the teacher in planning, providing and adapting learning experiences to cover a range of learning abilities (differentiation) is central to promoting skills and knowledge development. Good differentiation is the key.

It is vital that we as teachers know exactly where our learners are in terms of what they know, understand and can do. This affects how we plan, and how we will cater for all individual learning needs.

The introduction to each unit of work provided in the Cambridge Scheme of Work outlines what should have been covered previously. For less able learners, this may mean looking at previous units of work to find activities more suited to them. For more able learners, this might entail looking at units from stages further ahead in order to meet their higher-level learning needs.

There are several ways in which the needs of students can be met. Planning learning opportunities in this way is known as differentiation.

3.3 Differentiation

Differentiation is when a teacher reflects on the needs of learners and matches the teaching methods, learning tasks, resources or environment to individual learners or groups of learners. There is a variety of reasons for the range in learners' needs, but the key principle is that through differentiation all learners can become successful learners.

The main reasons for the need for differentiation in the classroom are:

- **The learner's level of ability** – this is both for supporting the less able as well as challenging the most able
- **Personal styles of learning** or pace of work

How to differentiate

There are many ways in which teachers can create or adapt teaching methods or materials to give every child the opportunity for challenge and success. Some ways of differentiating are:

- **By using ability groups.** The most common way of differentiation is where students are placed in high, average or low ability groups for some subjects. This can be the most effective way to help the teacher match the work to the different levels, but it sometimes causes the less able students to develop a poor self-image, especially if groupings are rarely reviewed.
- **By using mixed-ability groups.** An alternative to this method might be to group students according to gender, age, friendship, or other criteria. This prevents stigmatisation and

research has shown that less able students work better in mixed-ability groups. However, more able students may not reach their potential and will not necessarily be as challenged as they are in same ability groups.

- **By varying the task.** This is when students cover the same work or meet the same objectives but in different ways. For example, when students are working on the Periodic Table, some might use partly completed blank tables whilst others might be able to work with completely blank tables and posters of the Periodic Table. The most able might make up their own tables from the results of their experiments.
- **By varying the outcome.** This is when students are expected to reach different standards by learning through adapted learning styles or resources. For example, if the class task is to present their conclusions to the whole class some students whose written language is weak might give a verbal presentation; some students with ICT skills might produce basic powerpoint presentations; others, whose communication and ICT skills are well developed might produce a combination of verbal, powerpoint and demonstrations in their presentation.
- **By varying the use of resources.** This is when learners have activities planned which provide for their concrete or abstract understanding. Learners at a lower level of understanding will need to work with more physical, hands-on models (that soften the level of abstraction). Learners with a higher level of comprehension will be able to work with 2D models or written information and diagrams much more readily.

  Written work or homework can be adapted to suit particular needs if a learner needs more help with understanding the written word. Enlarged print, illustrations which provide clues to the meaning of the words or audio resources can be used.

For example, when finding out about the skeleton and antagonistic muscles and how they work, some learners will need to look at and move a model skeleton to aid their understanding. Others will remember what they have observed or seen and be able to relate it to discussions and further written work.

- **By giving open-ended tasks.** This is often the case when giving learners an investigation. They usually start with a question to which there are several possible answers. For example, 'How can you speed up evaporation?' This prompts a variety of responses to how the answer might be found and engages the learners more as they are directing their own learning when they are allowed to work in this way.
- **By giving extension activites.** These should be based on the same learning objective as the rest of the class and need to be very high but with realistic expectations. Challenge learners to take responsibility and be independent and active and to question and evaluate their learning.

The important thing to remember is that you as teacher are aiming for the learners in your care to make progress at their own particular level throughout the year. There may be in-school targets that have to be met but it is your job to demonstrate that all those you teach have improved knowledge, understanding and practical skills by the end of the year. This will only be possible if there is evidence of good differentiation in your lessons. This will enable you to plan for individual learning needs and to promote challenge and success for all learners in all your classes.

The following page illustrates how a lesson plan can include differentiated tasks.

Example of incorporating differentiation into a short-term plan

Stage 9: Unit 1B, The Periodic Table and Preparing Salts, Week 2

Week beginning: Term 1 Week 2			UNIT: 1B The Periodic Table and Preparing Salts			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;		Resources	Evidence of Achievement
				Description	W/G/I		
15 min	9Cp3	Describe trends in groups and periods.	To recognise similarities between elements in the same group.	Research the properties, including reactivity of two elements in the same group in the Periodic Table, e.g. inert gases, alkali metals, halogens.	G	Periodic Tables	Q & A and M
10 min	9Cc5	Explain how to prepare some common salts by the reactions of metals and metal carbonates and be able to write word equations for these reactions.		Make predictions about the next member of the group.	G		D
20 min				Compare predictions with the actual properties of the element. Demonstrate reaction of sodium and lithium with water.	G W demo	Safety goggles must be worn by pupils and teacher and screens used for sodium and lithium.	D and M

(Continued)

Week beginning: Term 1 Week 2			UNIT: 1B The Periodic Table and Preparing Salts			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;		Resources	Evidence of Achievement
				Description	W/G/I		
	9Ep7	Decide which measurements and observations are necessary					
15 min		and what equipment to use.		Recognise Groups by colouring in blank Periodic Table according to the properties of the elements. Also identify metals and non-metals.	I		M
	9Eo1	Make sufficient observations and measurements to reduce error and make results more reliable.					
30 min				Relate atomic structure to Periods. Use diagrams to			
	9Ec8	Explain results using scientific knowledge and understanding		show the electron shells and relate these to position of elements in the Periodic Table.	W and I		M
10 min				Discuss the elements in carbonate and sulphate			
			Understand that carbonate and sulphate	ions.	W		Q & A and D
20 min			ions contain more than one type of element.	Demonstrate the preparation of crystals of			
				chloride or sulphate salts from carbonates and acids. Excess carbonate is added to dilute acid until no more dissolves. The excess is filtered off. Evaporate until some solid appears and then leave to cool. Filter.	W	calcium carbonate, magnesium carbonate, copper carbonate, dil HCl soln, dil H_2SO_4	Q & A

(Continued)

<table>
<tr><td colspan="3">Week beginning: Term 1 Week 2</td><td colspan="3">UNIT: 1B The Periodic Table and Preparing Salts</td><td colspan="2">CLASS:</td></tr>
<tr><td rowspan="2">Timing</td><td rowspan="2">Framework Ref:</td><td rowspan="2">Learning Objectives</td><td rowspan="2">Success Criteria</td><td colspan="2">Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;</td><td rowspan="2">Resources</td><td rowspan="2">Evidence of Achievement</td></tr>
<tr><td>Description</td><td>W/G/I</td></tr>
<tr><td>40 min</td><td></td><td></td><td>Be able to carry out practical work safely and with precision.</td><td>Prepare an appropriate salt such as calcium chloride, magnesium nitrate, copper sulfate.
Assess the risks involved in the preparation.
Discuss ways of producing different sized crystals.</td><td>G and I</td><td></td><td>O and M

D and Q&A

Q&A: question/ answer
D: discuss’n
O: observ’n
M: marked work</td></tr>
<tr><td colspan="4">Organisation: details of differentiation/groups/adult role (linked to activities)</td><td colspan="4">Notes/extension opportunities/homework</td></tr>
<tr><td colspan="4">Practical work needs to be carefully planned so that pupils can carry out work safely. Adults can help with measurements and apparatus if appropriate but it should be remembered that practical skills are an integral part of Science and all pupils must be given the opportunity to develop in this area.
There should be no more than two pupils in each group to ensure that everyone has access to developing such skills.
Preparing models of different atoms may help less able pupils understand the structure of the elements.
Questions such as ‘Which element has two more protons than an oxygen atom?’
‘How many electrons does this element contain?’ can be differentiated according to pupils’ level of understanding.</td><td colspan="4">Link elements to compounds and complex ions.
Word equations must be used.

Extension/homework: plan the preparation of zinc nitrate. Discuss ways of producing different sized crystals.</td></tr>
</table>

SECTION 4: ASSESSMENT

4.1 What is Assessment?

As with planning, it is useful to think of assessment as three connected levels: short-term assessments which are an informal part of every lesson; medium-term assessments which are used to review and record the progress learners are making over time in relation to the key outcomes; and long-term assessments which are used at the end of the school year in order to track progress and attainment against school and external targets.

Types of assessment

Formative:	to establish whether learners have met the learning outcome or are on track to do so. (These are both short and medium term.)
Summative:	to sum'up' what learners have achieved. (These are long term.)

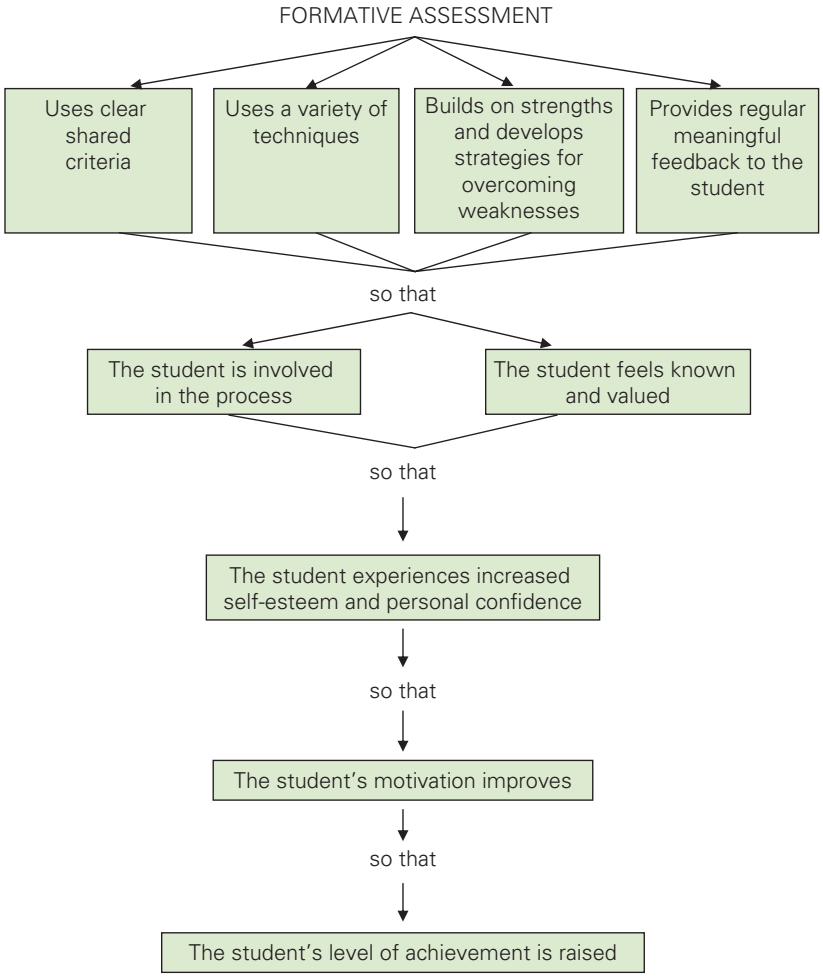
Functions

Formative Diagnosis:	To identify why learners do not understand or have difficulty with some topic or idea and to use this information to take appropriate action to correct mistakes or misconceptions.
Formative Evaluation:	to determine whether the action following the diagnosis has resolved the learner's difficulties.
Summative Evaluation:	to establish what general level of ability the learner has attained in terms of understanding, selecting and applying the knowledge and skills they have been taught. This kind of assessment is used as a means of reporting to other establishments and to parents on the actual attainments of learners.

Formative assessment is the process by which we analyse and review what a learner has learned and how they have learned it. For most teachers this process is inseparable from the actual teaching process in which everyday observations in the classroom can help build up a fully rounded picture of an individual's progress over time. Effective formative assessment involves evaluating learners' progress and making decisions about the next steps that will be required to address their development needs.

4.2 Using Formative Assessment to Raise Achievement

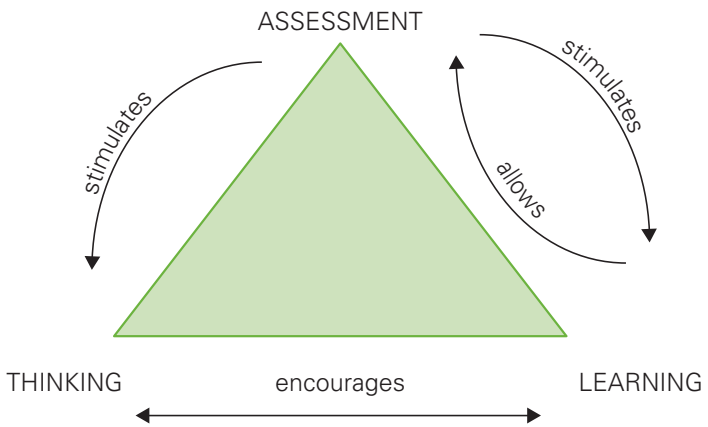
The following is a summary of what has been said so far about formative assessment.



Assessment makes a difference to learning. Furthermore, it can make a positive difference when learners are actively involved with their learning.

The influence of assessment

In Science, thinking, learning and assessment can be linked together in a creative and integrated way. The figure below attempts to show this relationship.



Thinking encourages learning which allows assessment to take place. In turn, assessment motivates both thinking and learning.

Think back to the earlier sections of this guide and consider how some of the things we have talked about, such as involving learners in their own learning, sharing learning intentions and creating success criteria, making use of learner-centred learning etc. can be combined with the general and informal kinds of assessment you use in the classroom.

The purpose of assessment is to provide information for a variety of audiences.

Below is a summary of when and how assessment can take place.

- During a lesson: direct questioning
  interaction / discussion
  observation
- End of lesson: quick revision test (yes/no, etc)
- After lesson: marking work
  homework task
- End of Unit: test or focused task (homework)
- End of Year: progress tests/achievement tests

Formative assessment is therefore an integral part of teaching and learning and should not be 'bolted' on to activities. It helps to give the curriculum meaning for each learner. Furthermore, it enables each learner's learning to progress at the optimum rate.

Assessment results, whether in the short, medium or long-term view, should give direct information about learners' achievements in relation to objectives. Whether you are considering the steps required to reach a single objective or achievement of objectives over time, they should be criterion referenced (an agreed measurement or standard that needs to be reached – such as the 'success criteria' discussed earlier).

Such criteria should be clear and well established. The ways in which criteria are set up and used should reflect traceable routes of educational development which offer continuity to a learner's assessment at different ages: assessments should relate to progression. At the informal level, for example, you might want to measure how well individuals have grasped the content of a unit or lesson.

At a larger scale, say end-of-year tests, assessment results should be capable of comparison between classes and schools so that colleagues may share a common language and agree standards: assessments should be moderated.

Perhaps most importantly, learners should have a role in their own assessment. They should know exactly what is expected of them and also be able to offer a personal view of their performance. This involvement of learners is described fully in sub-section 3.2 Active Learning.

Learners need to know:

- Where they are in their learning
- Where they are going
- How to get there

Core principles of formative assessment:

- Share learning goals and success criteria, both long and short term
- Activities must match the learning intentions
- Develop success criteria with learners
- Make the focus of the success criteria how they will achieve the learning intention
- Effective questioning needs to fit the purpose, giving learners thinking time
- Learners should be actively involved in self-evaluation

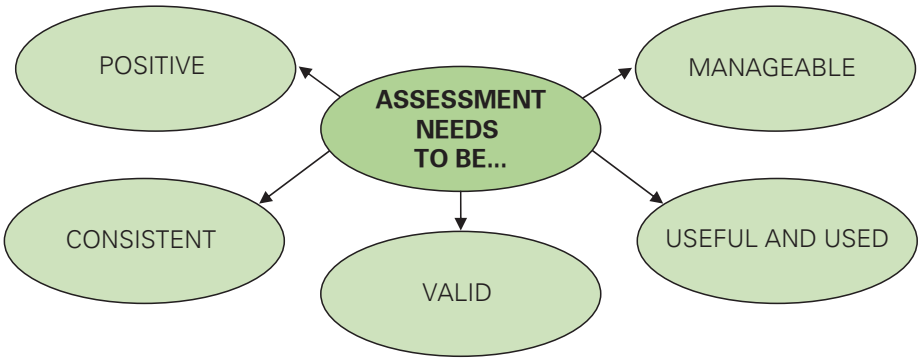
Assessment for Learning

'Assessment for learning' brings all the above ideas together as a conceptual approach. A good working outline of the concept was provided by England's Qualifications and Curriculum Authority. It has become widely accepted and runs as follows:

1. The provision of effective feedback to learners
2. The active involvement of learners in their own learning
3. Adjustment of teaching to take account of the results of assessment
4. Recognition of the profound influence assessment has on the motivation and self-esteem of learners, both of which are critical influences on learning
5. The need for learners to be able to assess themselves and understand how to improve

4.3 Developing Assessment in the Classroom

This sub-section is concerned with developing strategies for assessment in the classroom. The diagram below shows the essential properties of a functioning classroom assessment.



To support development of assessment in the classroom, teachers need to build their own skills and knowledge so that it becomes an integral part of classroom practice. The following training

activity enables you to identify the extent to which formative assessment is already being practised in your school.

Training Activity: Taking Stock of Formative Assessment Skills (Appendix A6)

- Take stock of what formative assessment skills already exist amongst staff – this gives everyone a chance to consider the elements of formative assessment. It is a valuable audit tool.
- You can then complete a summary sheet to show which areas you feel you need to support. (At the same time the audit also provides an opportunity for you to celebrate the skills that staff have developed already.)
- Finally, school managers can use the resulting information from the audit of skills to plan training needs for the whole school – some of these may be met by expertise already in school (shown on the individual summary sheets) or some may be met by the provision of an external trainer.

4.4 Assessment Techniques

There are many ways to approach formative assessment. You can identify the most appropriate ways at the planning stage and indicate them on your plans.

The amount of assessment that can realistically be carried out will be partially dependent on the assessment techniques chosen and the suitability of the task for assessment. You will need to know that key aspects of the learning have been grasped in order to move on to the next lesson or unit and you will have to decide on the best techniques for assessing these.

Assessment techniques generally fall into two broad categories:

Product – The learner must work alone for effective assessment to be made and the assessment is made after the task has been completed.

Process – The learner works alone but the process of learning is assessed and therefore the assessments must be done at the time that learning is taking place.

Or The learner works in a collaborative group. Issues arise concerning how to identify the contribution of one learner, especially when the exercise depends on a co-operative effort by all.

We will look at assessing the Process first.

1. Question and answer

Closed questions – these require definite answers. They may be 'yes' or 'no' responses and require very little description or explanation.

e.g. Question: What piece of equipment do we use to measure forces with?

Answer: A forcemeter

Open questions – these allow a range of responses and require the student to think for themselves, make suggestions and plan appropriately to find answers.

e.g. Question: How can you lift a very heavy load?

Answer: Here detail can be teased out by further questions such as 'Why?' 'How could you find out?' 'What equipment might you need?'

Questioning provides good opportunities for differentiation. Different levels of question can be pitched at pupils of different abilities and matched to their level of reasoning. It is good to include key questions in lesson plans.

2. Observation

Think about what we have said concerning active learning and how it gives meaning to knowledge by placing it in the context of a rounded experience. Think about how this experience and knowledge can be linked to a wider continuum of knowledge by allowing learners to understand where they are on their learning journey.

Active and experiential learning gives you, as the teacher, the opportunity to approach a topic in many different ways at once. It also gives you the opportunity to observe how individual learners learn, which topics they learn best and in what particular way they learn best. This can inform your planning in terms of their development and also in terms of improving your own delivery over time.

Think what makes an impact on a young learner's mind:

seeing?* hearing?* thinking?* doing?*

These might translate approximately into:

Demonstrations

Investigation

Problem solving

Presenting research findings

You will need to consider how any observation is to take place, such as:

The physical location of the teacher

- The teacher sitting with a group of learners where any participatory role is 'outside' the assessment to be made
- The teacher sitting with a group of learners where the role is passive and understood by the learners. Should any intervention be necessary to extend explanations etc., then it must take place because assessment is NOT about creating a threatening situation that may prove intimidating for a young mind. It is about being part of a positive learning experience. (The assessment may continue even if adjustments have to be made to the main objective and anticipated outcomes.)
- The teacher sitting away from the learners but in a situation that can fulfil the requirements of the assessment

The learners being assessed

- Learners must be involved, as with all assessments, with the relevant criteria at the outset of the activity
- Issues concerning collaboration must be addressed positively. As a means of promoting learning, learners need to interact and this should not be dismissed in terms of making valid assessments. Attention may be focused so that these issues are not perceived as a problem but as a positive contribution to the learning process. In this respect, the professional judgement of the teacher plays a crucial role in determining what each learner has achieved

Techniques 1 and 2 (question and answer, and observation) are of the 'Process' type where concentration on a single learner or small group is required for a short time. The number of assessment decisions is restricted to one or a small number of objectives.

Technique 3 (giving feedback) below is of the 'Product' type. Much of it can take place outside the classroom. This allows recording of decisions away from the restrictions of the classroom. A larger number of objectives may be tackled. At the same time it must be emphasised that marking work **with** the learner can be an example of excellent practice.

3. Giving Feedback

Feedback may be oral or written. All feedback should be positive and meaningful to learners. We are constantly giving our learners feedback. Our response to their contributions in questioning sessions or discussions may be oral but it can also be non-verbal – a smile or a gesture. There are countless examples of when we do this – a smile at the beginning of a lesson, a nod of the head. Below are listed a number of different techniques of giving feedback.

a. Oral feedback

Oral feedback is potentially the most effective form of feedback. Getting students to talk together before answering questions increases their achievement. It is the most natural and frequent feedback experience for students. The language of the classroom has an enormous impact on the students, and should create an ethos where speaking freely about learning is positive. Teachers' oral feedback needs to be focused mainly around the learning outcome of the lesson, and is therefore focused. Feedback can be given to an individual, to a group or to the whole class. Where verbal feedback has been used to give a response to written work, the task could be annotated V.F. (verbal feedback) and initialled by the marker.

b. Non-verbal feedback

This is very effective and really motivates reluctant learners in all stages. It takes the form of a positive sign to show that the teacher is pleased with a learner's response(s), for example, a smile.

c. Distance marking feedback

This should be positive, clear and appropriate in its purpose – it needs to offer positive benefits to staff and learners, and the outcomes need to be fed back into planning. Most effective feedback occurs when the work is shared together face-to-face, but if this does not occur and the work is looked at away from the learner, the following should be considered:

Can the learner read your comments?

Can the learner understand your comments?

Do you allow them time to read your written comments?

Do you allow time for some improvement on the work to be made before moving on to the next activity, or do you expect them to be able to transfer your improvement suggestions to another piece of work in a new context?

d. Acknowledgement marking feedback

This is a courtesy look at the work, and may include a tick or an initial. It implies that some dialogue took place during the lesson, which will have had an impact on the learner's learning. The acknowledgement simply informs others that the work has been dealt with orally, in a group or whole-class setting.

e. Closed exercise marking feedback

This is where the work is marked together, and therefore fewer examples of the work have been given. Learning is the priority, and misconceptions or errors are shared and not reinforced. Answer cards may be given to the students to mark their own work, if it has been differentiated. Where this method has been used in class time, the student marking the work will annotate it with their initial.

f. Motivational marking

Some learners seek confirmation from the teacher that they are achieving. We need to encourage intrinsic motivation where the learner can identify their own successes first, then celebrate them. As a general rule this marking should be as positive as possible.

g. Quality marking

This is when success and improvement needs are highlighted against the learning outcome. Asking for some small improvement is rich in its impact on students' work and their attitude to improvement and learning. This would not take place for every piece of work, and with training and modelling by the teacher, students can be encouraged to mark their own and each other's work using this approach. This approach can be oral as well as written.

h. Self and peer assessment

Learners should be involved as far as possible in the analysis and constructive criticism of their own work. We should encourage students to use self-evaluation continually, so that reflection, pride in success, modification and improvement become a natural part of the process of learning.

Peer assessment and self assessment are much more than students marking their own or each other's work. To improve learning, it must be an activity that engages students with the quality of their work and helps them reflect on how to improve it. Peer assessment enables students to give each other valuable feedback so they learn from and support each other. It

adds a valuable dimension to learning: the opportunity to talk, discuss, explain and challenge each other enables students to achieve beyond what they can learn unaided. Peer assessment helps develop self assessment, which promotes independent learning, helping students to take increasing responsibility for their own progress.

Further advice on marking

Time spent marking must lead to improving students' work. Sometimes a frustrating aspect can be when students keep repeating the same errors all the time. Marking strategies need to make marking quicker and more effective.

Written feedback has other key functions.

- It can show what needs to be taught next. Often, the same error may be identified – perhaps this can form the basis of a whole class discussion. Feedback from marking should be planned into the next session. Students need to become used to feedback as a way of learning. They can often make improvements straight away to their work.
- It also shows teachers how successful their teaching has been – it is easy to identify when a lesson or activity has not contributed to the learning!

When giving written feedback on work:

- A highlighter pen can show where the writing has been particularly successful.
- If the learning objective or success criteria have been written, pages of work can become more meaningful both for the student and for the teacher when reviewing the work at a later date. A comment directed to the student is important. *For example, 'This is a very well researched report on the work of Rutherford, well done!'*
- Where the learning intention is not written down, a marking comment at the end of the work needs to be written that includes the wording of the learning intention, e.g. '*You have managed to research the methods and discoveries of Rutherford very well.*'

Many of the strategies described above, especially in self and peer assessment, are examples of where active learning and assessment can happen.

4.5 Assessment Available from Cambridge

As part of Cambridge Secondary 1, end of stage tests (Progression Tests) are provided for Stages 7–9. These are available from the Cambridge Secondary 1 support site.

Progression Tests

These are for use within the classroom to measure the *progress* of the learners and identify *strengths and weaknesses*.

The tests are designed to be flexible and can be used to:

Assess the performance of the learners against the learning objectives in the curriculum framework. The Progression Tests are produced to precise specifications to ensure a representative coverage of skills and knowledge. The tests assess learning objectives from the

entire stage and so should be used when teaching is complete. However, it is preferable that they are used when there is still time left in the term to provide learners with feedback, help them reflect on their achievements and consolidate the year's work.

Diagnose strengths and weaknesses. The results of the tests should be fed back to the learners. It is important that they know their strengths as well as being aware of the areas where they are weak. Feedback should always be constructive and should include practical advice on how to improve areas of weakness.

Examine progress from one year to the next. The Progression Tests can help you see whether learners are progressing at a steady rate or better or worse than expected. The comparison against an external standard means that even the weakest learners can show progress, which may have been overlooked if these learners were always compared with their stronger peers. Similarly, lower than expected performance in an able learner can be identified and investigated.

Inform planning. The results of the tests can be used to reflect on their teaching over the year and prompt changes for subsequent years. If there are areas where the entire class appears to be strong or weak, the teacher should consider the strategies used for those areas and adapt them as necessary. The data from the test will also be of value to the following year's teachers to provide them with information about prior knowledge of the learners entering their classes. Alternatively, it is possible to give the test for the previous stage at the beginning of the next stage to determine the 'starting point' of the learners and identify any areas of weakness that need to be addressed.

Assist reporting to parents. The results of the Progression Test can be combined with the teacher's own observations to produce informative reports to parents. Parents want to know how their child is doing and the results of the tests provide quantitative evidence of this. Reports should include areas of strength as well as areas where improvement is needed.

Administering the Progression Tests

You can administer the progression tests through the Cambridge Primary support site (https://cambridgesecondary1.cie.org.uk). The site allows you to:

- set up different learner groups
- access the Progression Test papers and store marks
- generate reports to track learners' progress by comparing individual results against the rest of the class, the school or other schools around the world
- compare results on a year-by-year basis
- generate reports to help you reflect on your teaching practice, making relevant changes to focus your efforts where they're needed most
- download, print or email your analysis reports to share with other teaching staff and parents
- access your account on different devices

Making use of the reports

These are useful analyses to gain an overview of the strengths and weaknesses in the whole group. They enable teachers to consider factors that might affect this. It is always a good idea to begin by reviewing the planning for the objectives where the weakness was shown, for example:

- Was a reasonable amount of time allowed for delivering the objectives?
- What do the notes say on the planning following the lessons?
- Was a balance achieved between whole class and differentiated tasks?
- Were there any activities which could be described as favouring either boys or girls (gender bias)?

It may be that the planning check alone does not directly reveal the possible reasons for any weaknesses shown in the reports. If this is the case, we need to consider the response of the learners and their performance in class. This could still lead back to planning.

It is possible that the content of a lesson was too difficult for some learners. If so, some amendments should be made to the original plans. Doing this does increase pressure on 'finishing' the set of lessons for the objectives in question. However, time spent revising materials can save time when new objectives are introduced because they will be delivered on a firmer base of understanding.

It is also important to check the areas that were strengths because some 'extra' time could be gained by reducing the input for these areas. This has to be carefully judged as you do not want to reduce the standard in those areas.

A content review for areas of weakness may show that the chosen activities were not as stimulating as others. This will affect learners' responses quite significantly.

All of this analysis will provide information that can help you improve the planning and teaching for the following year. Although groups of learners will vary from year to year – the review process needs to be ongoing to allow learners to gain a firm grasp of concepts and methods and should not be seen as a procedure that simply follows the tests.

The tests assess learning objectives from the entire stage and so should be used when teaching is near completion. Lessons following the test period will need careful planning so that learners can target the particular weaknesses identified in the reports. Differentiation is the key to the success of these lessons. The reports may show similar problems for groups of learners which will help with organisation – groupings created for this may change from lesson to lesson. Using adult support is essential.

More able learners can have a set of lessons prepared that extend their skills and understanding whilst ensuring that their areas of weakness are picked up as well.

Learners can have their own set of targets. These should be set up as part of regular practice in class. Setting up success criteria will support this as well as other self-assessment tools so that learners are involved at all times.

For target setting to be successful they should be **S**pecific, **M**easurable, **A**chievable, **R**ealistic and **T**ime-bound (i.e.'SMART'). They also need to focus upon key priorities.

Cambridge Checkpoint Tests

Cambridge Checkpoint tests are additional end of secondary 1 tests available to Cambridge Secondary 1 centres. These are intended for learners at the end of their final year of secondary 1 education, when they are around 14 years old. They provide an assessment of learning objectives from Stages 7–9 of the framework.

They provide a form of detailed, diagnostic feedback that is a central feature of Cambridge Checkpoint.

Feedback is provided at the level of individual learners, teaching groups and whole school.

Details about Cambridge Checkpoint (including Specimen Papers) are available from **www.cambridgesecondary1.cie.org.uk**

SECTION 5: INFORMATION COMMUNICATION TECHNOLOGY (ICT) AND SCIENCE

ICT is a valuable resource which should be used appropriately to help develop learners' scientific knowledge, skills and understanding. It is important however, to consider where ICT may add value to the learning over other non-ICT resources.

Planning

As with all planning, start with the objectives.

Questions about ICT linked to the objective might follow:

- Will using ICT develop the activity?
- What software is available that can be matched to the objective?
- Is it age-appropriate?
- How will using ICT affect the pace of learning?
- Will I use it for the whole class?
- What about differentiation?
- Will it be better for groups or individuals to work on differentiated tasks?
- Do I need to be involved with a group working on an activity on the computer?

These are just examples of the questions you may think of. The answer to the final one is an interesting one as learners need support with all assignments – careful planning should show how your movements during the lesson can include this for some or all of the participants just like any non-ICT activity.

Your answers will reflect what is available in terms of hardware. One computer per class? An interactive whiteboard (IWB)? A computer suite?

Example 1 – a Stage 7 knowledge-based objective:

7Bp1: Recognise the positions and know the functions of the major organs of flowering plants, e.g. root, stem, leaf.

At the planning stage, you will have asked similar questions to these:

What skills and/or knowledge does this objective require?

What activity/activities would best fulfil this objective?

Now you also need to ask:

Would using ICT add any value to this activity?

(Remember – the learning objective is the driver for the lesson, not the activity.)

This is ***your*** planning and you choose the best ways to present activities.

The opportunities for ICT in the secondary 1 Science framework suggestion for objective 7Bp1 are:

Use simple simulation software to identify and label the common parts of a plant.

Now you need to ask:

Is this suggestion useful for the activities I am planning?

Can I use it for introduction/explanation/demonstration/assessment?

It could be that you have decided to have the children looking at different kinds of flowering plants (real and imitation) and that you decide that this first-hand activity is better than that offered in the ICT suggestions.

However, the ICT suggestion ***could*** provide an activity for a less able group working with an adult to be able to achieve the objective after they have done the practical activity.

Another alternative to incorporating this ICT suggestion is for it to be used as a quick assessment activity for individuals/groups in the plenary at the end of your lesson.

So the suggestions given are for you to consider in the light of your own teaching – and to use them selectively and flexibly.

The same process can be applied for any learning objective –

Example 2 – a Stage 7 skills-based objective

7Bp3: Identify the structures present in plant and animal cells as seen with a simple light microscope and/or a computer microscope.

At the planning stage, you will have asked similar questions to these:

What skills and/or knowledge does this objective require?

What activity/activities would best fulfil this objective?

Now you also need to ask:

Would using ICT add any value to this activity?

(Remember – the learning objective is the driver for the lesson not the activity – look back to section 2.6 Creating a Short-term Plan.)

This is ***your*** planning and you choose the best ways to present activities.

The suggestions for this objective in Opportunities for ICT in the Secondary 1 Science Framework are:

> *Use digital microscopes and visualisers with increasing accuracy to observe still and moving materials etc. under magnification. Capture images to create a record and review them in a variety of ways, including presenting to others.*

Now you need to ask:

Is this suggestion useful for the activities I am planning?

Can I use it for introduction/explanation/demonstration/assessment?

It could be that you have decided to have the pupils observing cells in microscope slides they have prepared themselves.

The use of a digital microscope as an introduction to the activity would avoid much confusion in the interpretation of cells which the pupils view under their microscope.

Opportunities for ICT in the Cambridge Secondary 1 Framework

Appendix D of this guide lists ICT opportunities and suggestions for use within Science. Please note that the activities in the scheme of work have been written to be carried out without needing ICT facilities.

SECTION 6: CREATING A POSITIVE LEARNING ENVIRONMENT

6.1 Classroom Organisation

There are many different ways of organising the classroom when teaching Science. A mix of all the approaches outlined below will prove most suitable over time – depending on the nature of the work being undertaken, available resources (including time), the abilities of the learners, and the teacher's personal preference.

Strategies for the Effective Management of Learning

Classroom Organisation	Advantages	Limitations
Whole Class Teaching Discussion Demonstration Watching DVD/TV	Easy to organise. Economical in terms of resources required.	No opportunities for first-hand experience. Not matched to the students' abilities. Difficult to involve the whole class.
Practical Work Working in small groups doing similar tasks. Resource demands are known.	Easy to plan ahead. Provides opportunities for first-hand experiences. May need a lot of equipment. Can be matched to the children's abilities. Easy to compare observations between groups. Facilitates easy record-keeping.	Follow-up may prove difficult.
Circus of Experiments Small groups rotate around classroom during the lesson, trying out a variety of activities.	Easy to plan ahead. Offers opportunities for first-hand experiences. Less demanding in terms of resources.	Activities cannot be sequential. Assumes equal time for all activities and all groups. Makes record-keeping more difficult.

(Continued)

Classroom Organisation	Advantages	Limitations
Thematic Approach Small groups work independently to contribute to the whole theme or topic.	Students work at their own pace. Provides opportunities for first-hand experience. Leads to good communication.	Difficult to arrange a balanced experience of Science. Difficult to ensure coherence. Difficult to ensure that the rest of the class understand.
Individual Topics Individuals or small groups work on items selected by themselves.	High motivation. First-hand experience. Pupils work to own potential. Good for a Science Club.	Demanding on teacher. Structured framework necessary. Difficult for lower-ability students. Stretches resources.

Use your discretion to choose which of the above approaches will best suit the learning situation for the activity planned. This will enable the classroom to be managed, with learning opportunities facilitated in different ways – according to desired outcome.

Once the organisational method for the activity has been chosen, it is important for you to decide how to support, guide and assess during the session and to *identify this in the lesson plan for each session.*

How can I support learners during an activity?

This needs to form the basis of your lesson plan.

Here is a list of things to think about when planning

Can I support and guide by:

- Working 1:1 with an individual?
- Working with a small ability group and asking relevant questions to scaffold their thinking?
- Differentiating work by giving different groups different outcomes to work to?
- Organising them to work in mixed ability groups, where more able learners help less able learners?
- Providing appropriate worksheets/recording sheets to facilitate easier recording?
- Giving them different activities?
- Using any other available adults to work alongside particular individuals/groups?
- Moving between groups and acting as facilitator?
- Challenging more able learners to extend their thinking?

Can I assess by:

- Observing and recording individual responses?
- Questioning a particular group, e.g. boys, middle ability learners?
- Giving immediate verbal feedback?
- Giving written feedback on their work?
- Setting questions in the same context and asking them to apply what they have learned in a new situation?
- Giving a formal test?

These decisions need to be included in your lesson plan so that any other adult who needs to be involved in the lesson can be included and is made aware of their role.

6.2 Creating a Positive Atmosphere

All of the above should set the classroom scene. The role of the teacher in creating the atmosphere in the classroom is central to everything that happens to promote teaching and learning.

Teaching approaches should be consistent. Students will struggle to engage in active learning where they work with talk partners and groups if they are usually discouraged from talking. Creative thinking would be difficult in a classroom where this is not encouraged. Working in a group is not easy if students are used to working individually.

Excellent active learning activities resulting in such positive assessment practices will not take place in a 'non-productive' atmosphere.

The best assessment for learning will happen where the teacher creates an environment where everyone is comfortable and familiar with routines. Students will respond to all kinds of activities if the atmosphere is one that encourages them to participate fully in developing their learning.

The role of the teacher will be to:

- Ensure that students take an active role in the learning process
- Show appreciation of everyone's ideas
- Encourage students to give good reasons for their ideas
- Involve everyone in discussions
- Inspire confidence in students to test their own ideas
- Make sure students have enough time to explore ideas properly
- Help students to work together and share their ideas with others and to appreciate the ideas of others
- Encourage students to make their own decisions
- Use varied questioning techniques and encourage students to think of their own questions
- Make learning Science enjoyable and fun

SECTION 7: SUPPORT AND RESOURCES

7.1 Resources from Cambridge

Cambridge Secondary 1 centres receive access to a range of resources when they register. The Cambridge Secondary 1 website **https://cambridgesecondary1.cie.org.uk** – is a password protected website that is the source of the majority of Cambridge-produced resources for the programme. Included on this website are:

- Curriculum frameworks
- Progression Tests and analysis tools (see Section 4)
- Schemes of Work – these give a recommended course outline where teaching objectives are organised in a recommended teaching order. A brief outline of activities to achieve these objectives is provided. Some resources are recommended here
- Editable versions of the planning templates

7.2 Training Available from Cambridge

Online Training Opportunities

An online introductory course is available free to Cambridge Secondary 1 centres. Details including the enrolment key and instructions on how to access the course are sent to the main Cambridge Secondary 1 Co-ordinator at your centre upon registration and are also available from the Cambridge Secondary 1 support site.

The course is self-study and as such can be completed at any time when you first register for Cambridge Secondary 1. It provides an introduction to Cambridge Secondary 1, the Cambridge educational philosophy and the services and resources available to Cambridge Secondary 1 centres.

Additional online tutor-led courses are also available. These courses will be advertised on the events page of the Cambridge public website at **www.cie.org.uk** as they become available through the year.

Face-to-face Training Opportunities

Face-to-face training is available in the form of workshops and lectures covering structure, planning and teaching strategies. To see what training courses are currently available in your region go to **www.cie.org.uk/events**

If you would like to discuss bespoke training please contact our Training Services Team at **trainingservices@cie.org.uk**. Face-to-face training can be arranged to meet your individual School's requirements. This bespoke training will be tailored to the particular training needs of your staff.

7.3 Support with Administration for Cambridge Checkpoint

There are three key documents that will be sent to your Cambridge Secondary 1 Co-ordinator on an annual basis.

- Handbook for Centres
- Cambridge Checkpoint Administrative Guide
- Procedures for the Submission of Entries booklet

These documents are made available on CIE Direct.

CIE Direct **https://direct.cie.org.uk** is the online tool for Cambridge Examinations Officers and Administrators/Co-ordinators to submit and amend your Cambridge Checkpoint entries.

7.4 Enquiries

Ask CIE

Ask CIE is an online bank of answers to frequently asked questions about Cambridge examinations and services. The next time you have a question about administering Cambridge examinations, just go to Ask CIE. Simply type your question into the search box, or use the menu to guide you. There is also a Noticeborad on the Ask CIE homepage to alert you to important announcements. You can find Ask CIE on our website at **www.cie.org.uk**, or go direct to **http://ask.cie.org.uk**

Customer Services

You can also email us via **info@cie.org.uk** or call us on **+44 1223 553554** or on **01223 553554** if you are in the UK.

7.5 Resources Recommended by Cambridge

The Cambridge Secondary 1 support site gives details of materials currently endorsed or recommended by Cambridge. These materials have been approved to support the delivery of the Science framework and their content has been checked against the framework. Recommended schemes are useful as a set of resources from which teachers can select appropriate activities. Endorsed schemes are able to support Cambridge Secondary 1 comprehensively in all aspects. As publishers create new or updated materials, we review them and list these items on the website. Please note these items must be bought direct from the publisher or from a bookseller.

APPENDIX A: TEACHER TRAINING ACTIVITIES

The following pages include training activities referred throughout the guide.

A1 Agreeing Terminology

A2 Producing a Lesson Plan Format

A3 Preparing and Delivering a Lesson

A4 Sharing Learning Intentions

A5 Taking Stock of Formative Assessment Skills

Training Activity A1: Agreeing Terminology

Workshop session to agree terminology.

This is a very short activity which should lead towards a discussion that reaches an understanding of the different levels of planning.

Objectives:

- To identify different levels of planning
- To identify their purpose
- To obtain an oversight of different terminology

Instructions:

Explain activity using Training Activity A1: Handout sheet (photocopiable overleaf).

- Consider all of the terms used in planning and display them

  e.g. long-term
  medium-term
  short-term
  scheme of work
  unit of work
  framework
  lesson plan

- Individuals or groups use the sheet to make notes identifying different planning levels and terminology and what they mean
- Discuss at end to reach agreement

The value of this activity is in working through the task and not so much the outcome. The discussion will make the levels of planning clearer.

At the end, leaders of the activity may wish to share the definitions as given in this guide. A shared understanding will make the guide easier to follow.

Training Activity A1: Handout

Objectives:

- To identify different levels of planning
- To identify their purpose
- To obtain an oversight of different terminology

Long-term Planning

Medium-term Planning

Short-term Planning

Training Activity A2: Producing a Lesson Plan Format

Objective:

To produce a format for lesson plans.

Instructions:

- Handout 1: invite colleagues to list as many inclusions as possible
- Collate ideas on flip chart to gain some kind of consensus
- On A4 paper work out a possible format to include all of vital material
- Distribute Handout 2 with more details either during activity or as part of plenary
- Distribute Handout 3 as a sample format following discussion

Possible inclusions that may be suggested:

Objective(s)

Success criteria – statements that support assessment (whether or not an objective has been achieved – see section on Assessment)

Activity (activities)

Organisation

Any special arrangements/groups

Roles of different adults (including teacher)

Resources etc.

Training Activity A2: Handout 1

Objective:

To produce a format for lesson plans.

LESSON PLAN FORMAT

WHAT SHOULD IT INCLUDE?
• • • • • • • • •

What could it look like?

Design a format for lesson plans. Include all of the appropriate headings and spaces for completion.

Training Activity A2: Handout 2

Information for formatting short-term plans

Activity/lesson plans (for a single lesson or related lessons in a subject, taught over the course of a week) should show:

- Detail of the planned activity, including points to be covered by the teacher in introducing tasks and supporting the pupils' learning during and after each lesson
- Key questions to be covered/addressed during each activity
- A breakdown of specific tasks in detail (steps the pupils need to go through, rather than the overall activity)
- Differentiation and grouping of the pupils, and any relevant staffing details
- Details showing how the lesson(s) will link to existing provision for special educational needs, such as learning support assistants or individual education plans
- Information about hours needed for the activity
- Resources needed for the activity
- Learning objectives
- Expected learning outcomes
- Success criteria – descriptions/statements to measure whether the learning objective has been achieved
- Assessment opportunities
- Space for notes about specific group or individual performances

Annotating the short-term plan should also support the teacher in preparing subsequent activities in the medium-term plan, in response to the pupils' performances or the outcomes of tasks.

Training Activity A2: Handout 3

Week beginning:			UNIT:			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of achievement
							Q&A: question/ answer **D**: discuss'n **O**: observ'n **M**: marked work
Organisation: details of differentiation/groups/adult role (linked to activities)				Notes/extension opportunities/homework			

Training Activity A3: Preparing and Delivering a Lesson

Objective:

This is a motivational exercise to share experience and build confidence.

Instructions:

Distribute sticky labels or 'post-it' notes. Ask colleagues to think of all the different things they do when preparing and delivering a lesson. Invite them to write each one on a separate label or note and stick it on a large sheet of paper displayed for all to see. The following discussion can be very entertaining but it has a serious side too in recognising all of the skills that a teacher has to practise in the classroom.

The list below is just a sample that might come from Activity 3.

It is not presented in order of importance:

- Preparing lesson/resources
- Instructing a class
- Letting learners talk
- Making tasks accessible to all
- Sharing achievements
- Giving praise and rewards
- Asking questions
- Setting tasks
- Marking work
- Leading discussions
- Sharing learning intentions (objectives)
- Setting homework
- Setting targets
- Letting learners take the lead
- Observing learners
- Discussing with groups
- Discussing with individuals
- Helping an individual
- Explaining things
- Answering questions
- Offering reassurance

The list can go on.

Good management of time, resources and, most importantly of all, the learners means all of these actions are possible even within a single lesson.

Training Activity A4: Sharing Learning Intentions

Objectives:

- To learn how to convert a range of learning objectives into learner-friendly language
- To learn how to write appropriate success criteria
- To be made aware of the many ways in which learning intentions can be presented to learners

Instructions:

1. Refer back to pages 33 and 34 in Section 3: Teaching Approaches. Select a range of learning objectives from the curriculum framework that clearly represent the following categories of activity:
   - To describe
   - To understand
   - To research
   - To compare
2. Ask teachers to re-word these objectives using learner-friendly terms.
3. Refer back to page 35 of Section 3: Teaching Approaches and ask teachers to suggest appropriate success criteria for each objective.
4. Give out Handouts 1 and 2. Ask teachers to suggest a range of methods in which learning intentions can be presented to a whole class, differentiated groups, younger and older learners etc. A list of possible methods can be found below.
   - Verbally – not always as successful as a visual method which remains available throughout the session
   - Writing on a black/whiteboard/flipchart – the simplest way (learners may copy this into their books)
   - Completing a chart and displaying for all to see
   - Saving it on a computer for display on an interactive whiteboard

Charts or posters might look something like those suggested in Handouts 1 and 2.

Training Activity A4: Handout 1

Today we are learning to

write learning outcome here

We'll know we've done this because

list success criteria here

Training Activity A4: Handout 2

Learning Intention

A more formal approach may appeal to older learners

We will know we have achieved this because. . .

Success Criteria

Training Activity A5: Taking Stock of Formative Assessment Skills

Take stock of what formative assessment skills already exist amongst staff – this gives everyone a chance to consider the elements of formative assessment. It is a valuable audit tool or checklist. You will find the elements listed helpfully in a document below.

You can then complete a summary sheet to show which areas you feel you need to support. (At the same time the audit also provides an opportunity for you to celebrate the skills that colleagues have already developed.)

Finally school managers can use the resulting information from the audit of skills to plan training needs for the whole school – some of these may be met by expertise already in school (shown on the individual summary sheets) or some may be met by the provision of an external trainer.

Notes on the survey form.

- This form is to enable teachers and schools to consider which elements of formative assessment they feel most comfortable with and also to help identify where further training would be helpful.
- The prompts are generic to suit teachers of all year groups and some may not be relevant to the Foundation Stage, for example. If this is the case, please put "not applicable" in the comments box.

Desirable Outcomes	Always	Sometimes	Never	Comments
I write clear learning outcomes in my medium-term planning.				
I write clear learning outcomes for each Science lesson on my weekly plans.				
I write clear learning outcomes for every lesson or activity I plan to do.				
I share my learning outcomes with the learners both verbally and in writing.				
My learning intentions are put into "pupil speak" so they can be understood.				

Desirable Outcomes	Always	Sometimes	Never	Comments
I identify the success criteria for the lesson and share them with the learners.				
The learners identify the success criteria when the learning intentions have been shared.				
Learning outcomes and success criteria are clearly displayed.				
Sharing learning outcomes has become an expectation for the learners in the class.				
I tell the class the reason for doing the activity (the aside).				
Class write the learning outcomes in their books (where appropriate).				
Learners are able to say the learning outcomes to each other or the teacher.				
I am using the learning outcomes and success criteria as part of my feedback strategy.				
I take time to teach learners to be self-evaluative.				
Learners are involved regularly in evaluating their own success.				
I give oral feedback during the lesson based specifically on the learning outcomes.				
In my marking, I indicate where the learner has met the success criteria.				
I show where some improvement can be made.				

Desirable Outcomes	Always	Sometimes	Never	Comments
I write a 'closing the gap' prompt to help learners make the improvement.				
Learners are given time to identify their own improvement.				
I give learners specific time to read my written feedback and respond to it.				
All the learners in my class have Science targets.				
The learners are involved in setting and discussing their own targets				
Targets are visual, e.g. using target cards, on display or in books.				
Targets are SMART so that learners know when they have met them.				
Targets are shared with parents.				

Your View	Yes	No	Unsure	Comments
I think that sharing learning outcomes has had a positive impact on learning.				
I think that giving oral and written feedback based on success criteria has had a positive impact on learning.				
I think the use of individual writing targets has had a positive impact on learners' learning.				
I think that parents understand our approach to providing feedback and marking.				

Teacher Summary Sheet

Your name ..... School .....

Stage taught .....

I feel really confident about these aspects of using formative assessment:

✓

✓

✓

I'd like further support with these aspects:

✓

✓

✓

Support to be given by:

School Summary Sheet:

To be completed from the teacher summary sheets

School name: .....

Staff at this school feel really confident about –

✓

✓

✓

We would like further support with –

✓

✓

✓

We can offer expertise to other schools in –

✓

✓

✓

✓

Agreed action points following discussion:

APPENDIX B: SAMPLE SCHEMES OF WORK

The following pages contain extracts from the comprehensive scheme of work provided on the Cambridge Secondary 1 support site.

They include:

- Stage 7:Unit 1A, Living Things
- Stage 8: Unit 1C, Light
- Stage 9: Unit 1B, The Periodic Table and Preparing Salts

Stage 7: Unit 1A, Living Things

In this unit, pupils build on their previous knowledge of living things and the senses to develop their knowledge of the following:

- The characteristics common to all living things, and their importance to survival of the organism
- That all living things are made of cells, the structure and typical cells, how cells are adapted to their function
- How cells are organised in tissues, organs and organ systems to efficiently carry out the functions of life

Scientific Enquiry work focuses on:

- Carefully observing and describing living things
- Recording accurately in a variety of ways, e.g. drawing, using tabular forms
- Communicating their ideas supported by evidence
- Making and presenting conclusions by bringing together evidence from different sources

Vocabulary: organism, nutrition, movement, excretion, growth, reproduction, sensitivity, function, microscope, magnification, cell, nucleus, cell membrane, cell wall, vacuole, chloroplast, tissue, organ, organ system

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
7Bc1	Identify the seven characteristics of living things and relate these to a wide range of organisms in the local and wider environment.	Compare different animals, real (if appropriate) or pictures, e.g. bird, cat, fish and write down all the things they have in common. Present your findings to other groups.	Photos of animals eating, running/ swimming, and with their young.	Use small group discussion allowing each pupil to voice their ideas on observations, followed by whole class work to encourage confidence in expressing science ideas backed by evidence.	2 hr
7Ep1	Be able to talk about the importance of questions, evidence and explanations.	Discuss the ways nutrition is obtained by different animals.			
7Eo1	Make careful observations including measurements.	Breathe through a straw into lime-water to show carbon dioxide is produced.	Drinking straws, lime-water, test-tubes or small beakers to hold lime-water.		
7Eo2	Present results in the form of tables, bar charts and line graphs.	Discuss the difference between breathing and respiration.			
		Discuss the difference between growth and reproduction.			
		Discuss why movement is essential for survival (finding shelter, avoiding danger, finding food).			
		Detecting different flavours using taste only and compare with ease of detection when also using nose.	Different flavoured crisps or fruits to taste blindfold and nose clips (or ask pupils to shut eyes and hold nose while tasting).		
		Describe texture of a variety of different materials.	Various materials with different textures, e.g. wool, paper, metal.		

(Continued)

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
7Bp1	Recognise the positions, and know the functions of the major organs of flowering plants, e.g. root, stem, leaf.	Identify the root, stem and leaf of different flowering plants. Consolidate understanding of characteristics of living things by relating plant structures and their functions to the characterstics, e.g. leaf and feeding.	Photos / specimens of young and mature plants.		50 min
7Bh2 7Eo3	Recognise the positions and know the functions of the major organ systems of the human body. Use information from secondary sources.	Draw an outline of a body. Draw on it the positions of the named organs. Share results with whole class.	Large sheets of paper, pens/markers.	Can be used as a 'fun' competition with a prize for the most accurate group.	50 min
7Bc3 7Eo1	Identify the structures present in plant and animal cells as seen with a simple light microscope and/or a computer microscope. Make careful observations including measurements.	Observe prepared microscope slides of cells. Prepare and focus a good specimen without being misled by air bubbles or dust on the cover slip. Observe and identify the nucleus, cytoplasm (and, in plant cells, the cell vacuole and cell wall). Record sketch diagrams of the cells.	Microscopes, prepared slides of animal cells. Any available prepared slides could be used to practise focusing. Onion or other bulbs (the thin skin from between the fleshy areas of an onion is ideal).	Time spent on a demonstration will avoid frustration and possible damage to microscopes. Using graph paper will help to illustrate the magnification. Newsprint will show inversion.	2 hr

(Continued)

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
7Bc4 7Eo2	Compare the structure of plant and animal cells. Present results in the form of tables, bar charts and line graphs.	Compare observed cells with labelled diagrams for secondary sources and explain why the cell membrane is not visible in the prepared slides.		Assess using table of differences between plant and animal cells.	50 min
7Bc5 7Ec1	Relate the structure of some common cells to their functions. Make conclusions from collected data, including those presented in a graph, chart or spreadsheet.	Write about how some named cell types you have investigated are adapted to their function, e.g. plant leaf cells (chloroplasts), root hair cells, blood cells (red and white), nerve cells.	Microscopes, prepared slides, photos, micrographs, diagrams of specialised cells.		50 min
7Bc6 7Ec4	Understand that cells can be grouped together to form tissues, organs and organisms. Present conclusions using different methods.	Discuss that cells of the same type group together to form tissues. Different types of tissues grouped together can make an organ and organs can group together to make an organ system. Organ systems are necessary to form a complex organism, e.g. flowering plant or human.		Relate this work on cells to the previous work on major organ systems.	50 min

Stage 8: Unit 1C, Light

In this unit, pupils build on their previous knowledge of different types of energy and energy transfers to develop their knowledge of:

- How light travels and the formation of shadows
- How non-luminous objects are seen
- Reflection at a plane surface and using the law of reflection
- Refraction at the boundary between air and glass or air and water
- The dispersion of white light
- Colour addition and subtraction, and the absorption and reflection of coloured light

Scientific Enquiry work focuses on:

- Planning investigations to test ideas
- Making predictions using scientific knowledge and understanding
- Taking appropriately accurate measurements
- Using a range of equipment correctly
- Presenting results as appropriate in tables and graphs
- Identifying trends and patterns in results (correlations)
- Comparing results with predictions
- Discussing explanations for results using scientific knowledge and understanding

Vocabulary: scatter, shadow, reflection, refraction, dispersion, absorption, prism

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
8Pl1 8Ec6	Use light travelling in a straight line to explain the formation of shadows and other phenomena. Discuss explanations for results using scientific knowledge and understanding. Communicate these clearly to others.	Observe sources of light – candles, bulbs etc and suggest how it is possible to see them. Cut off the light with a screen with a hole in and look for an illuminated spot. Pass light through a glass sided box containing smoke to show a ray of light. Ask pupils to suggest how they see objects which are not luminous.	Sources of light Smoke box, paper screens.	Introduce the idea that a ray of light can be indicated as a straight line with an arrow.	60 min
8Pl1 8Ec2	Use light travelling in a straight line to explain the formation of shadows and other phenomena. Identify trends and patterns in results (correlations).	Investigate shadows and how they form, e.g. size and sharpness.	A clearly defined object and bright light.		60 min
8Pl1 8Ep4 8Ep6 8Eo1 8Eo2	Use light travelling in a straight line to explain the formation of shadows and other phenomena. Plan investigations to test ideas. Make predictions using scientific knowledge and understanding. Take appropriately accurate measurements. Use a range of equipment correctly.	Make and use a pinhole camera. A simple box can be made light-tight and have a pin-hole in the centre of a sheet of black paper at one end and a screen at the other. If the hole is pointed towards a fairly bright light source the image of the light source will be seen inverted on the screen. Students can predict the effect of making several holes, enlarging one hole and placing a convex lens in front of the enlarged hole and then investigate practically.	Box, e.g. shoe box, sheets of black paper, light source, convex lenses, photographic film (optional).	Diagrams with light rays should be used to show why the image is inverted. It is possible to take pictures with such a simple device. The screen is replaced with a piece of film which can be developed to give a negative. A trial run is necessary to estimate time of exposure.	60 min

(Continued)

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
8Pl3	Describe reflection at a plane surface and use the law of reflection.	Study images in plane mirrors. Investigate the law of reflection by directing rays of light at a plane mirror. Make a simple periscope from cardboard tubes and small plastic or aluminium mirrors. The distance of the image can be investigated using a Pepper's ghost model.	Plane mirrors, cardboard tubes, small plastic mirrors, light ray boxes.	Always use the word image to refer to what is seen in the mirror. Diagrams should be used to show the directions of the rays of light.	60 min
8Pl4 8Eo1	Investigate refraction at the boundary between air and glass or air and water. Take appropriately accurate measurements.	Observe refraction by the 'disappearing coin trick' at the bottom of a pan which is slowly filled with water or seeing a ruler 'bending' in water. They can investigate the effects by looking through a glass block and observing apparent depth. The swimming pool is a good context to use if appropriate. Plotting the passing of rays through glass blocks, rectangular and semi-circular, enables students to link to ray diagrams.	Glass blocks (rectangular and semi-circular), light ray boxes,	Diagrams should be used to show the directions of the rays of light.	60 min

(Continued)

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
8Pl5 8Eo1 8Eo2 8Eo4 8Ec2 8Ec6	Explain the dispersion of white light. Take appropriately accurate measurements Use a range of equipment correctly. Present results as appropriate in tables and graphs. Identify trends and patterns in results (correlations). Discuss explanations for results using scientific knowledge and understanding. Communicate these clearly to others.	A spectrum can be demonstrated using a good prism. They can also be observed using cheap diffraction gratings. They can be compared with a rainbow to try to emphasise that light is a mixture of all the colours.	Prism, light ray box, diffraction gradients.	Diagrams should be used to show the directions of the rays of light through the prism.	60 min
8Pl6 8Ec6	Explain colour addition and subtraction, and the absorption and reflection of coloured light. Discuss explanations for results using scientific knowledge and understanding. Communicate these clearly to others.	Investigate filters and explain that some colours are absorbed and some transmitted. Demonstrate seeing coloured objects using a shiny white board and primary coloured felt pens. In a well darkened room the shapes light up or disappear. You can try writing a message which has a different meaning depending on the colour of light falling on it.	Different coloured filters, light ray boxes,		70 min
8Pl6	Explain colour addition and subtraction, and the absorption and reflection of coloured light.	A demonstration of adding colours (lights not dyes) uses three lights with red, green and blue filters in a circuit with a rheostat. Being able to fade out / in the different colours enables cyan, magenta and yellow to be obtained (on a white board) and even white when all three are mixed.	Colour filters, light sources, rheostats.		50 min

Stage 9: Unit 1C, Electrostatics and Electric Currents

In this unit, pupils build on their previous knowledge of different types of energy and energy transfers to develop their knowledge of:

- Electrostatics and the concept of charge, including digital sensors
- Simple series and parallel circuits
- How common types of component, including cells (batteries), affect current
- How current divides in parallel circuits
- Measuring current and voltage

Scientific Enquiry work focuses on:

- Choosing apparatus and deciding which measurements and observations are necessary
- Assessing any hazards and controlling risk
- Obtaining reliable results
- Making conclusions using scientific knowledge and understanding

Vocabulary: electrostatic, charge, positive, negative, insulator, attraction, repulsion, ammeters, voltmeters, parallel circuits, series circuits, circuit diagrams

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
9Pm1 9Eo3 9Ec2	Describe electrostatics and the concept of charge, including digital sensors. Make observations and measurements. Interpret results using scientific knowledge and understanding.	After charging by rubbing, plastic rulers pick up small pieces of paper, strips of cling film spring apart, balloons stick to walls, plastic rods deflect a steady stream of water etc. Explain that only negative charges move in these circumstances and that by moving away from a neutral site they leave a net positive charge. They can also induce opposite charges on neutral material. The effect is only noticeable on insulators because conductors allow negative charge to pass to the hand and then to earth.	Plastic rulers, balloons, plastic rods, pieces of cloth e.g. duster/ t-shirt.	Time spent ensuring the concept of charge is understood will greatly benefit the understanding of electric circuits.	30 min
9Pm1 9Eo3 9Ec2	Describe electrostatics and the concept of charge, including digital sensors. Make observations and measurements. Interpret results using scientific knowledge and understanding.	Investigate the laws of attraction and repulsion. Establish that there seem to be only two types of charge (only two effects are seen). Suspending one charged item and approaching with another shows that similar charges repel and unlike charges attract.			20 min
9Pm1 9Eo3 9Ec2	Describe electrostatics and the concept of charge, including digital sensors. Make observations and measurements. Interpret results using scientific knowledge and understanding.	The electrostatic generator. This machine for generating electrostatic charge usually provides a memorable lesson. Even a simple one can build up several thousand volts and cause lightning flashes, hair to rise, neon lights to light up, windmills to turn etc.	Electrostatic generator, insulating material (to stand on).		40 min

(Continued)

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
9Pm1	Describe electrostatics and the concept of charge, including digital sensors.	Pupils investigate some problems and some advantages about electrostatics using secondary sources. Presentation of findings to whole class.	Secondary sources.	Spray painting, risk of explosions with fuels, and combustible powders.	50 min
9Pm2	Interpret and draw simple parallel circuits.	Make a simple series electric circuit with switch, bulb and battery. Draw the circuit diagram. Discuss the advantages of circuit diagrams. Make a simple parallel circuit by including a second bulb. Draw the circuit diagram. Give a variety of circuit diagrams or circuits and decode if they are parallel or series circuits.	Low voltage power supplies (e.g. batteries), connecting wires, switches, bulbs (at least 2 per circuit) NB **Mains electricity should never be used directly for any of these types of investigation.**	Link to Stage 7, Unit 2C metals conduct electricity. A step-by-step approach is recommended to ensure all Learners have a sound understanding.	60 min
9Pm3 9Ep2	Model and explain how common types of components, including cells (batteries), affect current. Test explanations by using them to make predictions and then evaluate these against evidence.	Investigate the flow of charge in a circuit. Emphasise that batteries produce charge which flows from one end to the other round a circuit. Students can suggest ways of increasing the rate of flow of charge (more batteries, easier path). Let pupils test this explanation by using a variable resistor to dim / brighten a bulb.	Low voltage power supplies (e.g. batteries) (at least 2 per circuit) connecting wires, switches, bulbs, variable resistor. NB **Mains electricity should never be used directly for any of these types of investigation.**		60 min

(Continued)

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
9Pm5 9Ep4 9Ep8 9Eo2 9Ec4 9Ec5	Measure current **using ammeters** and voltage using voltmeters, including digital meters. Select ideas and produce plans for testing based on previous knowledge, understanding and research. Decide which apparatus to use and assess any hazards in the laboratory, field or workplace. Use a range of materials and equipment and control risks. Draw conclusions. Evaluate the methods used and refine for further investigations.	Investigate the current in series and parallel circuits using a number of identical lamps. Use an ammeter to measure current in different parts of the circuit. Pupils to make conclusion about the current in series circuits and parallel circuits.	Low voltage power supply (e.g. batteries), connecting wires, switches, bulbs, ammeters. NB **Mains electricity should never be used directly for any of these types of investigation.**	Apparently identical bulbs will have different brightness so it is worth exchanging them or selecting matching ones.	60 min
9Pm5 9Ep4 9Ep8 9Eo2 9Ec4 9Ec5	Measure current **using ammeters** and voltage using voltmeters, including digital meters. Select ideas and produce plans for testing based on previous knowledge, understanding and research. Decide which apparatus to use and assess any hazards in the laboratory, field or workplace. Use a range of materials and equipment and control risks. Draw conclusions. Evaluate the methods used and refine for further investigations.	Investigate the effect of adding various lengths of resistance wire, a variable resistor, lamps, and ammeters.	Low voltage power supply (e.g. batteries), connecting wires, switches, bulbs, ammeters, variable resistors, resistance wires of various lengths. NB **Mains electricity should never be used directly for any of these types of investigation.**	Students must be warned that short lengths of wire will get hot. Symbols for these components must be given.	60 min

(Continued)

Framework Codes	Learning Objective	Activities	Resources	Comments	Time
9Pm3 9Ep4 9Ep8 9Eo2 9Ec4	Model and explain how common types of components, including cells (batteries), affect current. Select ideas and produce plans for testing based on previous knowledge, understanding and research. Decide which apparatus to use and assess any hazards in the laboratory, field or workplace. Use a range of materials and equipment and control risks. Draw conclusions.	Understand the effects of further components by finding out about 'mystery' components such as diodes, buzzers, motors and reed switches. Learners can establish which are 'one-way' devices but, of course, must be warned about any that may be broken by passing a current in the wrong direction.	Low voltage power supply (e.g. batteries), connecting wires, switches, bulbs, diodes, buzzers, motors, reed switches, ammeters.	Learners could be challenged to protect a box from being opened by designing a buzzer alarm.	40 min
9Pm5 9Ep4 9Ep8 9Eo2 9Ec4 9Ec5	Measure current **using ammeters** and voltage using voltmeters, including digital meters. Select ideas and produce plans for testing based on previous knowledge, understanding and research. Decide which apparatus to use and assess any hazards in the laboratory, field or workplace. Use a range of materials and equipment and control risks. Draw conclusions. Evaluate the methods used and refine for further investigations.	Use a voltmeter to measure the voltage across a component. Learners should be shown that a voltmeter measures the voltage output of a cell, two cells, etc. It can then be used to measure the voltage across any two points in a circuit. They should also try putting the meter in series to show that the circuit then does not 'work'. The voltage across a home-made cell can be detected using two different metals and a solution or simply a fruit. Students could investigate the effect of different metals and different fruit / vegetables.	Fruit, e.g. apple, orange, vegetable, e.g. potato, connecting clips, metal electrodes, voltmeters, low voltage power supply (e.g. batteries), connecting wires, bulbs		60 min

APPENDIX C: SAMPLE LESSON PLANS

- Stage 7 Unit 1A, Living Things, Week 1
- Stage 7 Unit 1A Week 2
- Stage 8 Unit 1C, Light, Week 1
- Stage 8 Unit 1C Week 2
- Stage 9 Unit 1B, The Periodic Table and Preparing Salts, Week 1
- Stage 9 Unit 1B Week 2

Stage 7 Unit 1A: Living Things, Week 1

Week beginning: Term 1 Week 1			UNIT: 1A Living Things			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of Achievement Q&A: question/ answer D: discuss'n O: observ'n M: marked work
1hr	7Bc1	Identify the seven characteristics of living things and relate these to a wide range of different organisms in the local and wider environment.	A list of things all living things have in common: they eat, breathe, move, get rid of waste, grow, sense, and have young.	Compare different animals, real (if appropriate) or pictures, e.g. bird, cat, fish and write down all the things they have in common. Present your findings to other groups.	G W	Photos of animals eating, running/ swimming with their young to stimulate discussion.	Q&A
30 min	7Eo2	Present results in the form of tables, bar charts and line graphs.	Introduce the terms nutrition, excretion, respiration, reproduction and growth.	Discuss the ways nutrition is obtained by different animals.	G	Drinking straws, lime-water, test-tubes or small beakers to hold lime-water.	Q&A
30 min	7Eo1	Make careful observations including measurements.		Breathe through a straw into lime-water to show carbon dioxide is produced.	W		O
15 min				Discuss the difference between breathing and respiration.	I or G	Photos of animals with their young.	
30 min			Pupils should appreciate that excretion removes poisonous substances from the body through the lungs, the sweat glands and urine.	Discuss the difference between growth and reproduction.	W	Photos / specimens of young and mature plants	D D
30 mins			Extension of ideas about moving in animals.	Discuss why movement is essential for survival (finding shelter, avoiding danger, finding food)	G and W		D

Organisation: details of differentiation/groups/adult role (linked to activities)	Notes/extension opportunities/homework
Encourage the active learner by organising the class into groups to discuss their observations and ideas. Whole class discussion can then be used to bring together ideas and develop confidence in articulating such to the rest of the class. Differentiation: Learners could record their understanding by writing short sentences about living things or worksheets requiring simple answers could be prepared. Word searches and crosswords could be prepared to consolidate vocabulary. Care must be taken in the practical work to ensure safe practice in exhaling through lime-water.	Compare how two different groups of animals replace older members with young, e.g. frogs and elephants. Vocabulary: organism, nutrition, movement, excretion, growth, reproduction

Stage 7 Unit 1A: Living Things, Week 2

Week beginning: Term 1 Week 2			UNIT: 1A Living Things			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of Achievement Q&A: question/ answer D: discuss'n O: observ'n M: marked work
40 mins	7Bc1	Identify the seven characteristics of living things and relate these to a wide range of different organisms in the local and wider environment.	Extension of ideas about sensitivity in animals including functions of skin, eye, ear, tongue and nose.	Detecting different flavours using taste only and compare with ease of detection when also using nose	G	Different flavoured crisps or fruits to taste / blindfolds and nose clips (or ask learners to shut eyes and hold nose while tasting	M (experiment write up)
	7Eo1	Make careful observations including measurements.				Various materials with different textures, e.g. wool, paper, metal	
20 mins	7Ec4	Present conclusions using different methods		Describe texture of a variety of different materials	I		M (experiment write up)
30 min			Be able to identify the position of the brain, stomach, lungs, liver, heart and kidneys in the human body.	Draw an outline of a body. Draw on it the positions of the named organs. Share results with whole class	G and W		D
	7Bh2	Recognise the positions and know the functions of the major organ systems of the human body.					
1hr + homework			Be able to know the major organs of the circulatory, digestive, respiratory, nervous and sensory, excretory, and skeletal systems.	Each group should use book, internet etc to find out about the organs that make up one of the organ systems listed and their function within the organ system and the overall function of the system. Each group to produce a presentation on their organ system to the whole class.	G and W and I		M and O

(Continued)

Organisation: details of differentiation/groups/adult role (linked to activities)	Notes / extension opportunities/homework
Allow learners to develop and articulate their ideas within a small group and then use whole class discussion to share ideas. To encourage the active learner it is important that everyone's ideas are given due consideration and developed to encourage confidence in whole class situations. In practical work be aware that some learners will have more sensitive senses than others. The practical work on touch can be used to develop vocabulary in producing descriptions of different textures. Teachers and adult helpers should ensure that the individual takes an active part in the group work and that each individual's contribution to the group presentation is recognised.	Vocabulary: sensitivity, irritability, texture. Research and preparation for the presentation on the organ systems provides a good opportunity for homework and ensures that each member of the group takes an active part in the work. This work can be marked to assess the contribution of the individual.

Stage 8 Unit 1C: Light, Week 1

Week beginning: Term 1 Week 1			UNIT: 1C Light			CLASS:	
Timing	**Framework Ref:**	**Learning Objectives**	**Success Criteria**	**Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;**		**Resources**	**Evidence of Achievement Q&A: question/ answer D: discuss'n O: observ'n M: marked work**
				Description	**W/G/I**		
15 min	8Pl1	Use light travelling in a straight line to explain the formation of shadows and other phenomena.	Understand that light travels in a straight line and be able to show a ray of light as a straight line with an arrow.	Observe sources of light (candles, bulbs etc) and suggest how it is possible to see them.	I and W	Sources of light, smoke box, paper screens, a clearly defined object, bright light, box, e.g. shoe box, sheets of black paper, convex lenses, photographic film	M and D
15 min	8Ec6	Discuss explanations for results using scientific knowledge and understanding. Communicate these clearly to others.		Cut off the light with a screen with a hole in and look for an illuminated spot.	I and W		M and D
15 min				Pass light through a glass sided box containing smoke to show a ray of light.	I and W		M and D
	8Eo1	Take appropriately accurate measurements.					
15 min	8Eo2	Use a range of equipment correctly.		Ask learners to suggest how they see objects which are not luminous.			
	8Ep4	Plan investigations to test ideas.			I and W		M and D
60 min				Investigate shadows and how they form, e.g. size and sharpness.	G		Q & A, O and M
	8Ep6	Make predictions using scientific knowledge and understanding.	Be able to explain the formation of shadows.				
40 min			Know about the pinhole camera and how it works.	Make and use a pinhole camera. A simple box can be made light-tight and have a pin-hole in the centre of a sheet of black paper at one end and a screen at the other. If the hole is pointed towards a fairly bright light source the image of the light source will be seen inverted on the screen.	W and I or G		O
20 min				Pupils predict the effect of making several holes, enlarging one hole and placing a convex lens in front of the enlarged hole.			M

(Continued)

Organisation: details of differentiation/groups/adult role (linked to activities)	Notes/extension opportunities/homework
For each of the first four activities, demonstrate the phenomena, ask learners to write down their own ideas about what is happening and then allow whole class discussion to result in best scientific ideas. Inform the class that this is also the method used by scientists to determine scientific reasons for observations. When investigating shadows, shadow puppet theatre productions can give an excellent context for this activity. Adults should not give direction (other than safety issues) to the activity but need to be sure each group member is taking full part and give guidance. Groups size should be 2–4. In the pinhole camera activity, group size should be no more than two. If enough materials are available, each learner should make their own camera. Note that testing predictions takes place in the following week.	The idea that a ray of light can be indicated as a straight line with a directional arrow is not easily understood by learners. Worksheets could be prepared to give practice at drawing light rays and answering questions to show how light travels from a source to an object.

Stage 8 Unit 1C: Light, Week 2

Week beginning: Term 1 Week 2			UNIT: 1C Light			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of Achievement Q&A: question/ answer D: discuss'n O: observ'n M: marked work
30 min	8PI1	Use light travelling in a straight line to explain the formation of shadows and other phenomena.	Test predictions made about pinhole cameras.	Discuss what results show. Diagrams with light rays should be used to show why the image is inverted.	W I	A clearly defined object, bright light, box, e.g. shoe box, sheets of black paper, convex lenses, photographic film	Q & A,O and M
	8Ec6	Discuss explanations for results using scientific knowledge and understanding. Communicate these clearly to others.					
	8Eo1	Take appropriately accurate measurements.					
	8Eo2	Use a range of equipment correctly.					
	8PI3	Describe reflection at a plane surface and use the law of reflection.	Understand reflection and be able to draw light ray diagrams showing reflection at a plane surface.			Plane mirrors, cardboard tubes,	
15 min				Study images in plane mirrors. Discuss how the image compares to the original.	W	small plastic mirrors, light ray boxes, proctractors.	Q & A
	8PI4	Investigate refraction at the boundary between air and glass or air and water.				Glass blocks (rectangular and	
20 min				Investigate the law of reflection by directing rays of light at a plane mirror.	G	semi-circular), light ray boxes.	O
	8Eo1	Take appropriately accurate measurements.					
25 min				Make a simple periscope from cardboard tubes and small plastic or aluminium mirrors.	G or I		O and M

(Continued)

Week beginning: Term 1 Week 2			UNIT: 1C Light			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of Achievement Q&A: question/ answer D: discuss'n O: observ'n M: marked work
15 min 30 min 15 min			Understand refraction and be able to draw light ray diagrams showing refraction at the boundary of two different materials.	Demonstrate refraction by the 'disappearing coin trick' at the bottom of a pan which is slowly filled with water or seeing a ruler 'bending' in water. Groups investigate the effects by looking through a glass block and observing apparent depth. Learners plot the passing of rays through glass blocks (rectangular and semi-circular).	W G I		Q & A M M

Organisation: details of differentiation/groups/adult role (linked to activities)	Notes/extension opportunities/homework
For reflection and refraction work group size should be no more than four. Each member of the group should record and explain their results and observations. The plotting of rays and drawing of light ray diagrams may require adult help. Working on white sheets of paper in dimmed room lighting allows learners to see light rays more easily.	Take pictures with the pinhole camera. Replace the screen with a piece of film which can be developed to give a negative. A trial run is necessary to estimate time of exposure. Always use the word image to refer to what is seen in the mirror. For reflection, the distance of the image can be investigated using a Pepper's ghost model. The swimming pool (if available) is a good context to use to demonstrate refraction. Diagrams should be used to show the directions of the rays of light.

Stage 9 Unit 1B: The Periodic Table and Preparing Salts, Week 1

Week beginning: Term 1 Week 1			UNIT: 1B The Periodic Table and Preparing Salts			CLASS:	
Timing	**Framework Ref:**	**Learning Objectives**	**Success Criteria**	**Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;**		**Resources**	**Evidence of Achievement Q&A: question/ answer D: discuss'n O: observ'n M: marked work**
				Description	**W/G/I**		
30 min	9Cp2	Compare the structures of the first twenty elements of the Periodic Table.	Be able to recognise the symbols for the first 20 elements.	Revise the symbols for the first 20 elements. Use a quiz format, e.g. 'What is the symbol for…' with a prize for the winning team/learner.	G or I	Blank Periodic Tables, sets of cards of first 20 elements (including atomic numbers).	Q & A and M
	9Cp1	Describe the structure of an atom and learn about the methods and discoveries of Rutherford.					**D and Q&A**
40 min			Be able to place the first 20 elements in the correct position on a blank Periodic Table.	Arrange the first 20 elements with atomic (proton) numbers into a simple Periodic Table. A game of cards can be played. Each card has a symbol and as they are drawn from a pile they are laid out on a blank copy of the table. The winner completes their table first.	G		
	9Ep1	Discuss and explain the importance of questions, evidence and explanations, using historical and contemporary examples.					
	9Ep3	Discuss the way that scientists work today and how they worked in the past, including reference to experimentation, evidence and creative thought.					
20 min			Know the basic structure of an atom.	Develop learners' ideas of particles to explain the structure of the atom, i.e. protons, neutrons and electrons.	D		
30 min				Look at the information given for each element on the Periodic Table and relate this to atomic structure. Diagrams show the arrangement of electrons in their shells around the nucleus. Learners should learn to build them up with increasing atomic number.	G or I		

(Continued)

Week beginning: Term 1 Week 1			UNIT: 1B The Periodic Table and Preparing Salts			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of Achievement
50 min			Learn about the work of Rutherford and other scientists associated with the development of atomic structure and the Periodic Table e.g. Mendeleev and Bohr.	Use secondary sources to find out about the methods and discoveries of Rutherford. Prepare a poster or a presentation about Rutherford.	I		

Organisation: details of differentiation/groups/adult role (linked to activities)	Notes/extension opportunities/homework
Revising the 20 symbols by setting a quiz with a small prize for the winning team motivates learning. Working in groups allows less able pupils to also achieve success. The prize can be as simple as being allowed to leave class first at the end of the lesson. Research work on Rutherford requires access to the Internet where possible.	The basic structure of the atom must be taught before the structure of the atoms of different elements can be fully understood. Groups could produce display on atomic structure of different elements or groups of elements.

Stage 9 Unit 1B: The Periodic Table and Preparing Salts, Week 2

Week beginning: Term 1 Week 2			UNIT: 1B The Periodic Table and Preparing Salts			CLASS:	
Timing	Frame-work Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of Achievement Q&A: question /answer D: discuss'n O: observ'n M: marked work
15 min	9Cp3	Describe trends in groups and periods.	To recognise similarities between elements in the same group.	Research the properties, including reactivity of two elements in the same group in the Periodic Table, e.g. inert gases, alkali metals, halogens.	G	Periodic Tables	Q & A and M
10 min	9Cc5	Explain how to prepare some common salts by the reactions of metals and metal carbonates and be able to write word equations for these reactions.		Make predictions about the next member of the group.	G		D
20 min				Compare predictions with the actual properties of the element. Demonstrate reaction of sodium and lithium with water.	G	Safety goggles must be worn by learners and teacher and screens used for sodium and lithium.	D and M
15 min	9Cc5	Explain how to prepare some common salts by the reactions of metals and metal carbonates and be able to write word equations for these reactions.		Recognise groups by colouring in blank Periodic Table according to the properties of the elements. Also identify metals and non-metals.	W demo		
30 min				Relate atomic structure to Periods. Use diagrams to show the electron shells and relate these to position of elements in the Periodic Table.	I		M
10 min	9Ep7	Decide which measurements and observations are necessary and what equipment to use.		Discuss the elements in carbonate and sulphate ions.	W and I		M
20 min	9Eo1	Make sufficient observations and measurements to reduce error and make results more reliable.		Demonstrate the preparation of crystals of chloride or sulfate salts from carbonates and acids. Excess carbonate is added to dilute acid until no more dissolves. The excess is filtered off. Evaporate until some solid appears and then leave to cool. Filter.	W	Calcium carbonate, magnesium carbonate, copper carbonate,	Q & A and D
	9Ec8	Explain results using scientific knowledge and understanding.	Understand that carbonate and sulphate ions contain more than one type of element.		W		Q & A

(Continued)

Week beginning: Term 1 Week 2			UNIT: 1B The Periodic Table and Preparing Salts			CLASS:	
Timing	Frame-work Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual;		Resources	Evidence of Achievement Q&A: question /answer D: discuss'n O: observ'n M: marked work
				Description	W/G/I		
40 min			Be able to carry out practical work safely and with precision.	Prepare an appropriate salt such as calcium chloride, magnesium nitrate, copper sulfate. Assess the risks involved in the preparation. Discuss ways of producing different sized crystals.	G and I	dilute HCl solution, dilute H_2SO_4	O and M **D and Q&A**
Organisation: details of differentiation/groups/adult role (linked to activities).				**Notes/extension opportunities/homework**			
Practical work needs to be carefully planned so that learners can carry out work safely. Adults can help with measurements and apparatus if appropriate but it should be remembered that practical skills are an integral part of Science and all learners must be given the opportunity to develop in this area. There should be no more than two learners in each group to ensure that everyone has access to developing such skills. Preparing models of different atoms may help less able learners understand the structure of the elements. Questions such as 'Which element has two more protons than an oxygen atom?' How many electrons does this element contain?' can be differentiated according to learner's level of understanding.				Link elements to compounds and complex ions. Word equations must be used. Extension/homework: Plan the preparation of zinc nitrate. Discuss ways of producing different sized crystals.			

APPENDIX D: OPPORTUNITIES FOR ICT IN CAMBRIDGE SECONDARY 1 SCIENCE

ICT is a valuable resource which should be used appropriately to help develop learners' scientific knowledge, skills and understanding.

The following suggestions are not exhaustive. They are designed to be illustrative and demonstrate a range of opportunities where ICT can be utilised in the teaching of Science.

General

There is potential for the use of ICT throughout the Science curriculum and the ideas presented in this section can be applied to most areas. In addition, where an approach is particularly relevant to the aspect being studied, it is listed against that aspect.

Online activities and resources*:* There is a wealth of relevant materials designed to target different aspects of the curriculum. Not all are free, but most subscription sites have free resources. These are given on the resources sheet, categorised by area of learning.

Interactive whiteboard hardware and software*:* This resource is available in many educational settings and has huge potential, which is not always tapped. The software can be installed on learners' computers and used away from the board to support teaching and learning. Even where the physical board is not available, there are often "lite" or open source versions of the software, which can be installed and used:

1. The interactive whiteboard provides a very useful way of displaying scientific ideas etc. The tools can be used to highlight elements, as well as to drag and drop text etc. This supports the creation of simple activities to support Science learning
2. Most interactive whiteboard software has banks of Science resources, ranging from still images and text, to animations, flash-based activities and sound files. These are a useful support in teaching, but could also be used by learners working independently. Teachers are strongly advised to explore these before looking elsewhere
3. All interactive whiteboard software has the potential to combine text,

graphics and sound in a simple way, allowing learners to match words to pictures and/or sounds by dragging and dropping. Such activities can be used to support teaching of varied Science concepts as well as being used independently by learners to consolidate their understanding

4. As the software allows hyperlinks to be included, this can be used to guide learners to a specific website or resource for an activity or further study. Learners can also use simple tools within the software to capture any resources they have been using online

5. As interactive whiteboard software is very simple to use, learners can develop their own games and activities to support an area of learning and then use these with their peers. As learners have to understand the teaching point to develop the activity, this can be an excellent approach to help consolidate learning

6. Sound files (normally MP3) can easily be attached to writing or an image using interactive whiteboard software. This can be used to support learners in understanding Science concepts. For example, a bean seed could describe what it needs to germinate

Handheld devices/tablets*:* There are an increasing number of handheld devices and tablets on the market that either have their own bespoke software or can run apps, which can be downloaded for free or for a small charge from the internet. There is a huge number of such apps, some of which provide excellent support for learners and their learning, although there are many which are not so appropriate and time needs to be taken to ensure quality. The management of handheld devices in a classroom would also need to be considered carefully, with potential issues around charging and syncing the devices.

Class response systems*:* If the educational setting has such hardware, it will normally be linked to the interactive whiteboard and the software can be used by teachers and learners to assess scientific understanding around a certain topic, as well as in a more open way to support investigative work. There are now software options some of which use the learners' own handheld devices, which could provide an alternative to dedicated hardware.

Visualisers*:* Where these are available, they can be used to share work, model Science activities and capture still and moving images in the class during discussions and investigations.

Dataloggers*:* These devices can be used to capture data by monitoring the physical environment (for example, sound, light and noise levels, motion and speed). The data can be downloaded, reviewed, and copied to a spreadsheet for further analysis. Such devices are particularly relevant in joint Mathematics and Science investigations and support the development of data handling in Science.

Spreadsheets: This software can be used to record and analyse scientific data, supporting learners in the understanding of the results of experiments and investigations. It is also helpful in supporting data handling activities, especially with the use of embedded charts.

Databases*:* This software provides essential support in data handling, enabling learners to search and sort data and create reports and charts from the information. Learners can also create and use databases exploring object properties in specific areas of Science.

Organisational tools*:* Mind mapping software can be used to develop ideas and plan for experiments and investigations activities. Word processing software, interactive whiteboard and spreadsheet software can all be used to collect and organise information around an area of

Science work. This approach supports learners in capturing their ideas and approaches during experiments and investigations and investigative activities.

Cartoons: Creating cartoons can help learners explore Science rules, strategies and concepts, providing an engaging way for them to record their thinking and understanding.

Sound recording: Sound can help young learners and those with limited English writing skills to express and share scientific concepts. Much standard software, MS Windows, Apple Mac OS etc, has the capability to record sound direct to a computer. Alternatively MP3 player/ recorders, able to capture and playback sound as well as download to the computer, are generally available. There are also many quick capture devices able to record a few seconds of sound, which are useful for short activities. Recorders, microphones etc can be sourced from general electronics suppliers. See resources list for open source sound editing software.

Digital still and film capture: Still and film cameras can be used by learners to capture their learning, especially in investigations and other activities. Learners can also make short films around certain scientific concepts and share them with their peers to support their learning.

Image animation software: Animating images, avatars and vokis and writing and recording scripts for them provides good opportunities for learners to rehearse their scientific understanding around a specific topic. (Bespoke software is normally needed for this.)

Other multimedia software: Generic and/or open source resources exist to combine pictures into slide shows, and/or to animate the picture and graphic elements. These can be used to support learners in presenting their learning or sharing ideas as well as being used by both teachers and learners to create resources to support learning.

Online spaces: There are many generally available online spaces for saving, sharing and commenting on materials. The educational setting may have its own learning platform or VLE. If this is not the case, teachers will need to ensure that the space is safe and reliable before encouraging learners to use it. Learners should also be taught to respect others, work online, understanding the rules for copyright, ownership and safe and responsible use. Learners' activity on the site/s should be monitored to ensure the rules for safe and responsible use are being applied.

1. Learners can be encouraged to save and share work online, providing the opportunity to discuss, review and improve their work
2. Learners and teachers can create blogs to explore and develop ideas around a topic or theme
3. Groups of learners can create wikis around an area of Science learning or to support an investigation or problem-solving activity
4. Learners can engage in online discussion around a topic or idea, or use a discussion board to develop an investigation

Opportunities for ICT in Stage 7

SCIENCE Opportunities for ICT:		
		Learners should
Stage 7		1. Use digital microscopes and visualisers with increasing accuracy to observe still and moving materials etc under magnification. Capture images for recording and review in a variety of ways, including presenting to others 2. Use time lapse photography to capture changes during experiments and changes in plants and other physical objects 3. Capture and utilise digital still and moving images, using these in their reports and presentations 4. |Use hand-held digital meters and dataloggers, selecting and using the appropriate device with some accuracy to record such environmental conditions, e.g. monitor light intensity testing leaf material for starch produced. Use a spreadsheet and graphs to support analysis of the data. Use results to confirm and predict 5. Use ICT to record and communicate, considering appropriate multimedia resource and the needs of their audience, e.g. describe plans for an investigation including the equipment, how they will measure and what variables they will measure, vary and control 6. Use simple data handling software, recording and manipulating data and sorting results for analysis 7. Use secondary sources (e.g. online/electronic), e.g. to research the life and discoveries of great scientists such as Galileo 8. Use online/electronic simulation resources to model aspects of science, e.g. the behaviour of light reflected by mirrors, for example, varying the angle of incidence

Opportunities for ICT in Stage 8

SCIENCE Opportunities for ICT:		
		Learners should
Stage 8		1. Use digital microscopes and visualisers accurately to observe still and moving materials etc under magnification, e.g. different types of roots in plants. Capture images for recording and review in a variety of ways, including presenting to others 2. Use time lapse photography to capture changes during experiments and changes in plants and other physical objects. Discuss the changes and use this data in presenting findings 3. Capture and utilise digital still and moving images, e.g. make a short movie about the effects on the human body of smoking 4. Use hand-held digital meters accurately to record environmental conditions to support an investigation, e.g. investigate the reflection and dispersion of white light 5. Use datalogging in investigations, e.g. use light gates to time the descent of different vehicles on a track to investigate the relation-ship of height dropped and velocity at different points on a slope 6. Use a spreadsheet and graphs to support analysis of collected data. Use results to confirm and predict, feeding into further enquiry

(Continued)

SCIENCE Opportunities for ICT:		
		Learners should
		7. Use ICT to record and communicate, considering appropriate multimedia resources and the needs of their audience, e.g. communicate their findings to others in another school using online space and/or email etc 8. Use simple data handling software, recording and manipulating data, sorting results for analysis and searching within and across fields of data 9. Use secondary sources (e.g. online/electronic), e.g. research aspects of plant growth such as photosynthesis 10. Use online/electronic simulation resources to model aspects of Science, e.g. compare and suggest improvements of models of plant and animal cells

Opportunities for ICT in Stage 9

SCIENCE Opportunities for ICT:		
		Learners should
Stage 9		1. Observe and capture images/film using digital microscopes and visualisers, e.g. features of anther, filament etc in a flowering plant 2. Capture and utilise digital still and moving images, e.g. evidence of effects of human activity on the environment 3. Use time lapse photography to capture changes during experiments and changes in plants and other physical objects. Discuss the changes and use this data in presenting findings. Use multimedia software to annotate, commenting on the changes which are displayed 4. Use hand-held digital meters such as digital Newton meter, e.g. to measure forces by levers of different lengths 5. Use dataloggers to support an investigation, e.g. the relative efficiency of forms of thermal transfer such as convection and conduction 6. Use a spreadsheet and graphs to support analysis of collected data. Use results to confirm and predict, feeding into further enquiry 7. Use ICT to record and communicate, considering appropriate multimedia resources and the needs of their audience, e.g. communicate their findings to others using online space and/or email etc and/or present a paper to parents about their recent Science to be posted on the school website 8. Use simple data handling software to record changes in current in circuits that vary the flow of current 9. Use secondary sources (e.g. online/electronic), e.g. research the methods and discoveries of Rutherford 10. Use online/electronic simulation resources to model aspects of science, e.g. model the operation of levers

APPENDIX E: PLANNING TEMPLATES

This contains planning templates with accompanying notes as referred to in Section 2 of the guide.

- Long-term Planning_1
- Long-term Planning_2
- Long-term Planning_3
- Medium-term Planning_1
- Medium-term Planning_2
- Short-term Planning

Long-term Planning Template_1

Scheme of Work – An Overview

Stage

TERM 1	TERM 2	TERM 3
1A	2A	3A
1B	2B	3B
1C	2C	3C

Notes:

- *The current model of nine units per stage is recommended – three per term. Fewer would give too large a group of objectives to address in one unit, although this may vary with the subject. More would be too fragmented to give coherence to the overall scheme*
- *Terminology can vary although consistency is recommended within a school*
- *An audit of the learning objectives for the whole stage is recommended to ensure coverage* [1]
- *Each objective may be revisited in different ways in different units to continue to develop new skills in different contexts*
- *Some learning objectives will be ongoing throughout the stage – a grid to show this is recommended* [2]
- *Detail of the ongoing objectives may be given in an outline plan* [3]

[1] See audit tool.
[2] See table of ongoing objectives.
[3] See table of ongoing work.

Long-term Planning Template 2

Learning Objectives – An Audit Tool

Framework Code	Learning Objective	Ongoing (O) Term ref (T1, T2, T3)

Notes:

How to complete the sheets:

- *Objectives and framework codes will be entered in the order that they appear in the framework*
- *Learning objectives will appear in full*
- *The final column will give a clear overview of coverage. Where an objective is addressed in more than one unit, all of the relevant units will be listed. If it is an ongoing objective then it will appear as 'O'*

How to use the information collected on the sheets:

- *The right-hand column will show how often an objective appears in the whole scheme*
- *For other objectives, how often each one appears in the whole scheme will be recorded. Some objectives will be taught more than once (but not as often as 'ongoing' ones!)*
- *The whole audit will help to achieve a balance, ensuring that coverage is sufficient and/or not too frequent at the expense of others*
- *A final adjustment may be required to make sure that all objectives are taught for, and at, an appropriate time*
- *Also, by doing this alongside the long-term planning of units, the grouping of objectives can be changed before too much work has been done on medium-term plans*

Long-term Planning Template 3

Learning Objectives – An Overview

Framework Code	Learning Objective

Notes:

How to complete the sheets:

- *Objectives and framework codes will be entered in the order that they appear*
- *Learning objectives will appear in full*
- *The learning objectives can be colour-coded:*
  - *Ongoing*
  - *A different colour for each term – once only when it is first introduced:*

    Term 1

    Term 2

    Term 3

How to use the information collected on the sheets:

- *The resulting overview is another kind of checklist to ensure coverage. It also shows whether too much is being introduced in the first term which may not be a balanced way of delivering the framework*
- *By doing this alongside the long-term planning of units, the grouping of objectives can be changed before too much work has been done on medium-term plans*

Medium-term Planning Template 1

Stage

UNIT: Title:

Framework Codes	Learning Objective	Activities	Resources	Comments	Time

Notes:

- *There may be more than one framework code in each block, e.g. if scheme considers weekly blocks within the whole unit. Objectives will be listed to match the first column*
- *The activities are given in outline only*
- *Main resource needs are required to enable strategic planning, e.g. spending*
- *This plan will require a statement in the opening rationale regarding prior knowledge*
- *Comments will highlight specific details*
  - *Where something requires advance preparation*
  - *Where different assessment strategies may be in place, e.g. opportunities for active assessment (details will be in short-term (lesson) plans)*

Medium-term Planning Template 2

Stage

UNIT: Title:

Framework Codes	Learning Objective	Activities	Resources

Notes:

- *There may be more than one framework code in each block. It may make sense to address certain objectives together*
- *The activities are given in outline only*
- *Main resource needs are required to enable strategic planning, e.g. spending*
- *No time budget is given for obvious reasons*
- *This plan will require a statement in the opening rationale regarding prior knowledge*

Short-term Planning Template

Week beginning:			UNIT:			CLASS:	
Timing	Framework Ref:	Learning Objectives	Success Criteria	Activities (see notes below re: differentiation details, etc) W: whole class; G: group; I: individual; Description	W/G/I	Resources	Evidence of Achievement Q&A: question/ answer D: discuss'n O: observ'n M: marked work
Organisation: details of differentiation/groups/adult role (linked to activities)				Notes/extension opportunities/homework			

Notes:

- *The plan can be formatted to view a week at a time and not every lesson – **this is important to support manageability***
- *Most of the plan is self-explanatory. It seeks to include most of the desirable elements. It is possible to expand the format to A3 but this risks the planning process taking too long for the time frame – also sometimes the detail required will be brief*
- *Class organisation is crucial to the plan working properly including differentiation and the role of additional adults. Plans can be shared to make expectations clear*
- *SUCCESS CRITERIA:*

  These are an essential part of planning and should be clear and manageable

  These may be part of active assessment activities where learners determine the criteria. In planning, teachers need to write a broad outline of anticipated suggestions

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