



هيئة التعليم

EDUCATION INSTITUTE

Sample lesson plans for the State of Qatar

Science: Grades 1 to 12

Developed for the Education Institute by CfBT

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Introduction

Background to this document

The new Curriculum Standards for Arabic, English, mathematics and science lie at the heart of ‘Education for a New Era’, Qatar’s education reform initiative. The standards draw on international expectations of what students should know, understand and be able to do at each stage of their schooling, as well as on the current best practices in Qatar’s public schools.

The sample lesson plans in this publication have been developed for the Education Institute of the Supreme Education Council by the same team of curriculum experts that developed the standards, guided by the staff of the Institute. Working groups of local teachers and curriculum specialists have helped to ensure that the lesson plans reflect Qatari values and culture, and are relevant to the needs and interests of Qatari students.

The sample lesson plans for mathematics and science are offered in English and Arabic versions. The Arabic lesson plans are provided in Arabic, and the English lessons plans in English.

Conventions

The spelling conventions adopted in the English versions of the lesson plans are based on standard British English.

The units of measurement and abbreviations used are the *Système Internationale* (SI) units. They are written in their internationally recognised form: for example, the word *centimetre* and its abbreviation *cm* are used in both the Arabic and English language versions of the lesson plans.

In both the Arabic and English versions of the lesson plans, numbers and symbols, including chemical symbols, are written using Roman or Greek script. Mathematical and chemical equations and formulae are presented from left to right.

Schools will need to make their own decisions about the spelling conventions to use in lessons. They will also need to decide how to present numbers, symbols, equations and formulae to students, taking account of the language of instruction and the age of the students.

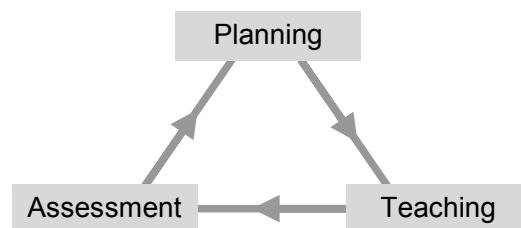
Planning, teaching and assessment

Decisions about how teachers might best teach the curriculum standards are left to schools. Each school can develop its own policies for lesson planning, teaching and learning, and assessment, so that as many students as possible achieve the standards expected for their grade.

This introductory section is intended to give some guidance about how schools might interpret and use the standards. It discusses the teacher's three main responsibilities: planning, teaching and learning, and assessment.

Planning

The cycle of planning, teaching and assessment is a continuous one. Good teaching is based on good planning, and good planning is informed by effective assessment.



Plans that are well constructed and informative are not necessarily written in full prose or elegantly word-processed, but they do need to be accessible to others. Their prime purpose is to outline what teachers should teach, when and how.

Long-term planning: a scheme of work

The first step in using the standards is to create a long-term plan or scheme of work. The scheme of work will then guide teachers when they create their short-term lesson plans.

There is no right or wrong way to set out a scheme of work. The main criterion is that teachers in the school find it helpful and can base their short-term or day-to-day lesson plans upon it. Creating it involves, for each grade:

- drawing the standards together into coherent, manageable teaching units;
- identifying any additional content that the school may wish to incorporate into the units;
- indicating the number of teaching hours or lessons for each unit;

- ordering the units across the two semesters of the school year so that they build on preceding work, link with other units and prepare students for the next grade;
- developing sufficient detail in each unit for teachers to be able to create their lesson plans from it.

The flow of the units reflects continuity and progression in students' learning throughout the school year. The sequence usually provides one or more opportunities to revisit particular standards or groups of standards throughout the course of the year. This gives students the chance to consolidate their learning in a range of contexts and to make connections between different aspects of the subject.

In creating the sequence of units, there may be practical matters to consider, such as ensuring that units for different grades involving the same sets of books or equipment do not coincide with each other. In science, schools will also need to take into account work that can only be done at particular seasons. This is particularly so for biological fieldwork.

A scheme of work for a grade in science should outline the units taught and their sequence throughout the year. Each unit should be a coherent set of lessons built around a particular topic. The topic may be drawn wholly from one of the strands or it may be a thematic topic (such as 'Energy' or 'Water') with elements drawn from more than one strand. Each unit will include the teaching of scientific enquiry skills.

Once the flow of the units has been decided, each unit will need to be developed. Typically, the objectives for the unit, drawn from the standards, will be stated in a way that shows what different groups of students should be taught and what they might be expected to achieve over the course of the unit.

The unit will also need to describe briefly:

- how topics can be approached by teachers;
- suitable activities for students;
- the key vocabulary or technical terms that students need to know and use;
- which of the school's learning resources can best support students' work during the unit, including relevant parts of textbooks and any special arrangements, facilities or equipment that may be needed;
- any long-term preparation required, such as ordering equipment and materials, growing plants or arranging visits or visiting speakers;
- safety issues.

As teachers use and refine their scheme of work, they sometimes choose to add further details to it, such as:

- notes that will help teachers to interpret the scheme of work: for example, teaching points, references to information and communication technology (ICT), common misunderstandings, suggestions for extension activities and for homework;
- how activities can be differentiated to cater for students who are very able or who need extra support;
- how teachers can assess students' success with the work in the unit and whether students are ready to move on to the next unit;

- ways in which units can build on preceding work, link with other units and prepare students for the next grade;
- the links that can be made across subjects such as Arabic and English, or science and mathematics;
- the out-of-school activities that can enhance learning in school.

Short-term or lesson plans

The activities described in the unit go some way to helping teachers set out short-term plans or lesson plans. Lesson plans are teaching notes for one or more lessons, showing how the work will unfold to achieve its intended objectives. They are developed to match individual class requirements: for example, students' differing abilities and the resources available. The best lesson plans will also take account of the formative assessments that teachers have been making. They therefore cannot be finalised too far in advance of the lesson.

The objectives for the lessons are drawn from the standards, as indicated in the scheme of work. It is important not to have too many objectives in a particular lesson or block of lessons, so that the teacher and students can remember them. In addition to science content knowledge, most lessons will reflect one or more scientific enquiry skills in their objectives. Lessons may also have subsidiary objectives that do not need to be written down.

As with the scheme of work, there is no right or wrong way to set out a lesson plan. The main criterion is that it helps a teacher to teach the lesson.

Typically, lesson plans will:

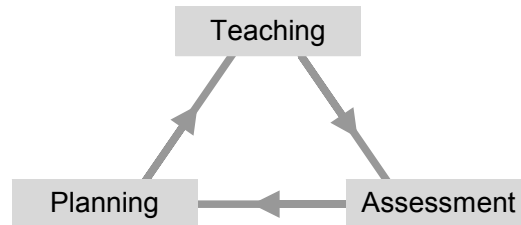
- indicate the objectives for the lesson or block of lessons;
- stress the relevant vocabulary and technical terms associated with the work in the unit;
- outline how the lesson will start;
- show how work will be developed through teaching input and student activities, with suggestions for differentiation where appropriate;
- indicate how lessons will be summarised and rounded off;
- where appropriate, suggest what homework will be set (most of the sample lesson plans in this booklet do not suggest homework because they are single examples taken out of sequence);
- identify links with other subjects;
- refer to relevant resources, such as equipment, chemicals, textbooks and ICT applications;
- include sample worksheets;
- include, where appropriate, a note on safety.

Teaching and learning

Each school can develop its own policies for lesson planning, teaching and learning, and assessment, so that as many of its students as possible achieve the standards expected for their grade.

Similarly, there are no prescribed textbooks or other teaching and learning resources. Each school can select from the very best that exist to suit the needs of its students.

Effective teaching results from careful planning and use of assessment information.



One of the purposes of the sample lesson plans in this document is to illustrate ways of teaching the standards effectively. Many of the characteristics of effective teaching are the same for all subjects. For example, an effective teacher:

- has clear objectives for each lesson and explains them to students;
- conveys to students an interest in and enthusiasm for the subject, and gives them confidence that they can succeed;
- introduces new topics in well-planned stages, using a combination of demonstration, modelling, instruction, explanation and discussion;
- interacts with students, questions them effectively, gives them time to think, and expects them to explain and justify their answers;
- offers students stimulating tasks that interest and involve them, including:
 - practical work and problem solving to develop students’ investigative and enquiry skills and ability to think for themselves;
 - oral and mental work to develop and secure students’ speaking and listening skills, their use of technical terms, their recall skills, and their abilities to imagine, visualise and predict;
 - varied reading and writing activities to consolidate and extend the teaching and to further students’ communication skills;
- ensures that students have balanced opportunities to work as a whole class, collaboratively in small groups or pairs, and independently as individuals;
- gives extension tasks or extra support to students who need them;
- makes effective use of a range of resources to support teaching and learning, including regular use of information and communication technology (ICT);
- makes links within science, to other school subjects and to the real world, to show students how ideas are often dependent on each other;
- gives all students time to reflect on their learning.

Interactive teaching

One of the most important features of effective teaching is the interaction that takes place between the teacher and the class. It is vital that students engage actively with their learning, otherwise learning becomes superficial and is easily forgotten. The sample lesson plans in this document show how teachers can lead a variety of interactive activities in which students play an active part.

Organising students as a ‘whole class’ helps to maximise their contact with the teacher so that every student benefits from direct teaching for sustained periods. But intervention, direct teaching and interaction are just as crucial during individual, paired and group work as they are in whole-class work.

High-quality interactive teaching is oral, collaborative and lively. It is not achieved by lecturing the class, or by expecting students to teach themselves indirectly from books. It is a two-way process. Students play an active part by answering questions and expanding on their answers, contributing points to discussions, and explaining and demonstrating their work to others in the class.

Good interactive teaching will also involve creating opportunities for students to interact with each other through group problem solving, sharing their observations, justifying their arguments or methods to each other, debating the meaning of what they observe, discussing, sharing thoughts about what they are ultimately going to report back, and so on.

Effective interactive teaching is achieved by balancing a range of teaching approaches:

- **Directing and telling:** sharing teaching objectives with the class, ensuring that students know what to do, and drawing attention to points over which they should take particular care, such as how to ensure that one step follows from another in a scientific argument, the degree of accuracy to adopt when making a measurement, how to perform a practical exercise, how to set out a written record and how to structure a presentation ...
- **Demonstrating and modelling:** giving clear demonstrations using appropriate resources and visual displays: for example, showing how a specific item of equipment, such as a microscope, should be used; demonstrating a scientific concept, such as the half-life of a radio-isotope; showing how to set out a table of observations or results and perform related calculations; conducting a dissection ...
- **Explaining and illustrating:** giving accurate, well-paced explanations, and referring to previous work or methods: for example, explaining accepted theories of atomic structure, illustrating how properties on the macro-level can be explained by structures at the micro-level; illustrating links between biological structures and functions; explaining how to carry out an investigative procedure ...
- **Questioning and discussing:** questioning students in ways which ensure that they all take part; using open and closed questions, skilfully framed in appropriate language, adjusted and targeted to make sure that students of all abilities are involved and contribute to discussions; asking for explanations; giving students time to think before inviting an answer; listening carefully to students’ responses and responding constructively in order to take forward their learning; challenging students’ assumptions and making them think ...
- **Exploring and investigating:** asking students to identify and refine problems for scientific investigation, to plan investigations, to make and test predictions, to identify anomalous results, or identify exceptional cases; encouraging them to consider alternative ways of representing scientific observations in tabular, graphical or diagrammatic form, and to move from one form to another to gain a different perspective on a problem; teaching students the practical skills required to carry out investigations, including extending the range of ICT applications that they can use successfully in their work ...

- **Consolidating and embedding:** providing varied opportunities for students to apply their new knowledge and practise and develop newly learned skills, through a variety of activities in class and, where appropriate, well-focused homework; asking students either with a partner or as a group to reflect on and talk through their explanations of observations; inviting them to expand their ideas and reasoning, or to compare and then refine their explanations or investigative methods; encouraging them to apply their investigative skills to solve problems that they meet in other subjects and in everyday life, and to use their knowledge of mathematics and language skills in science ...
- **Reflecting and evaluating:** identifying students' alternative science ideas and using them as positive teaching points by talking about them and any misconceptions that led to them; discussing students' justifications of the methods or resources they have chosen; evaluating students' presentations of their work to the class; giving them oral feedback on their written work; encouraging them to make self-assessments of their work ...
- **Summarising and reminding:** reviewing during and towards the end of a lesson or series of lessons the science that has been taught and what students have learned; identifying and correcting misunderstandings; inviting students to present their work and picking out key points and ideas to help consolidate learning, sometimes listing the main points where everyone can see them; making links to other topics in science and work in other subjects; giving students an insight into the next stage of their learning ...

Structuring lessons

Effective lessons have clear objectives so that students are sure about what is expected of them. They will also be structured so that they flow smoothly from beginning to end. The pace may vary as a lesson develops, perhaps brisk at first then modifying to allow more time for reflection, or reflective at first working up to a faster pace at the end.

Schools have different timetables so the structure and timing of lessons will differ. In many schools, the timetable arrangements may require some double-period lessons for older students to ensure sufficient time for practical investigations.

Most lessons will provide a beginning, a middle and an end in which the teacher prepares students for what they are to learn, teaches them, then helps them to consolidate their learning and to recognise what they have achieved. This structure allows a variety of patterns of teaching methodology and organisation, depending on a lesson's objectives and its position in a series of lessons.

For example, with four 50-minute lessons each week, the first lesson might begin with an introductory activity of 12 to 15 minutes, with brisk two- or three-minute introductions on the remaining days. In the longer introductory activity, students might start to consider a science idea or work on an investigative problem, giving feedback on their initial thoughts after 5 or 10 minutes.

In the main part of the lesson, in particular, there is scope for considerable variety and creativity, with a different interplay of work with the whole class, groups, pairs and individuals on different days, although each lesson is likely to include some direct teaching and interaction with students, and activities in which students play an active part. It is expected that some kind of hands-on

class practical work will frequently feature significantly in this part of the lesson.

Scientific investigations, such as a study of the corrosion of metals, may frequently last for more than one lesson and some, such as the study of plant growth, may last for weeks or months, with brief observations made at regular intervals. This will require careful planning, not least because it is likely to result in more than one topic being studied in the same period.

The purpose of practical work in science should be carefully considered and the nature of any practical work carefully tailored to the expected outcomes. For example, if the sole or main outcome is a deeper understanding of the theoretical principle underlying the work, then the chances of misunderstandings arising from ambiguous results should be minimised and a clear demonstration by the teacher may be regarded as most appropriate. If the main outcome is for students to obtain a feel for the topic being studied through personal involvement, then individual or group practical work is required, as it is when the main purpose is the development of investigative skills.

A theme that runs throughout the standards is a study of the interaction of science and society, and this makes demands on the nature of some of the work in the main parts of lessons. This might, for example, include field work in environmental science to study habitats and their degradation and protection. It may demand an industrial visit to learn about the commercial application of a process studied in the classroom. These are lessons that require carefully structured preparation and follow-up work in the classroom.

Appropriate homework is important to learning. It prepares for, consolidates, applies and extends schools learning. In setting homework, consideration should be given to practical activities as well as text-based tasks, written exercises and information gathering.

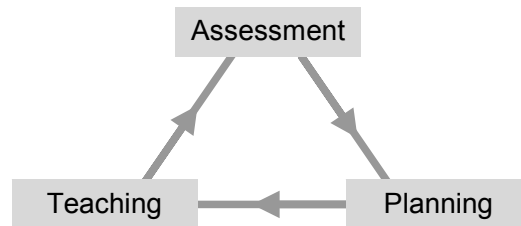
At the end of a unit of work it can be useful to use the consolidation phase to look back with the whole class over a number of lessons to draw together what has been learned and to identify key points and methods that you want students to remember and use in the future. For this kind of plenary, you may need a much longer time than usual.

Assessment

As with planning and teaching, the standards do not prescribe how schools should assess and record students' progress. Each school can develop its own assessment policy to help teachers to plan and improve teaching and learning through good assessment. The only requirement is that every student participates in the annual national tests based on the standards.

Assessment and recording of students' progress have to be manageable if the information they yield is to be useful. The best assessment has an immediate impact on teaching and learning. It alerts teachers when students are falling behind or exceeding expectations. It helps them to maintain the pace of learning by informing teaching plans, in a continuous cycle of planning, teaching and assessment. The feedback that teachers give students, and the self-assessments

that students are encouraged to make, are crucial in helping students to know how to improve their work.



Formative assessments

Formative assessments are part of day-to-day lessons. They include informal observations, oral questioning, written exercises and occasional tests or special activities designed to judge students' progress. Their purposes are:

- to check that students have grasped the main teaching points in a particular lesson or unit of work, whether they have any misunderstandings or misconceptions that you need to put right, and whether they are ready to move on;
- to help you to give students feedback, set targets for them to achieve, plan the next stage of work and brief any support staff about which students to assist;
- to help students to learn how to evaluate their own work and how to improve it.

The main elements of formative assessments are:

- using a range of questions during lessons to assess students' understanding, the extent to which they are able to engage in the work, and whether they can use and apply what they have learned in new contexts;
- making conscious observations of particular students during teaching or while they work on activities to assess their responses and progress;
- holding brief impromptu or planned discussions with students to follow up any surprises in their responses when they were being taught;
- discussing with students their response to oral work, assignments and practical tasks to identify and correct any errors and misconceptions, to assess their level of skill, and to make sure that they understand what they need to do to improve their performance;
- analysing and marking students' written work, to identify any common errors or misconceptions, and giving comments orally and in writing to guide students on how they can improve their work and make progress;
- conducting occasional short recall tests with planned questions, to assess quickly with students their knowledge and speed of recall, involving, for example, recall of facts or spellings;
- organising brief review tests that draw upon what has been taught previously to assess what might need revision or re-teaching;

- encouraging students to evaluate their own work, to review their own achievements and progress and to think about what they need to do to improve their work or to plug any gaps;
- asking pairs or small groups of students, with or without the teacher, to determine what they know and can do, what they still find challenging and what the targets for their learning should be.

These elements of formative assessment should be part of day-to-day teaching. Some of the lesson plans in this document show how formative assessment, or assessment for learning, can happen in practice. For example, in some of the concluding plenaries of lessons, students reflect on and evaluate their learning. In other plenaries, one or two students explain their experimental observations to others, allowing the teacher to judge how effectively students have tackled the work.

The crucial feature of formative assessment is that it helps to inform and improve teaching and learning. The overarching purpose is to determine what students have learned so that informed decisions can be taken about teaching and the next steps in students' learning.

The assessment of scientific enquiry skills

While many scientific enquiry skills are amenable to pencil-and-paper testing, most are not and appropriate assessment mechanisms should be developed and agreed between teachers. Many procedures can be used and it is desirable that a wide variety are adopted. A simple assessment mechanism is a tick list that indicates when a particular skill, such as reading a dial or using a burette correctly, has been mastered. More complex mechanisms involve the assessment of generic investigative skills against carefully developed criteria during practical lessons. Others may involve the assessment of a procedure by proxy, through the assessment of an output of the procedure. The acquisition of scientific communication skills can, for example, be assessed directly from the output.

Targets for individual students

Setting students personal targets helps them to focus on what they need to learn to meet the standards. Have regular discussions with students to review their targets and set new ones where appropriate. You may want to arrange your discussion with some students on an individual basis – for example, students who would benefit from a degree of privacy – but for most of them you can organise the discussion in groups as part of an ordinary lesson. Ask students to suggest two or three improvements to work on over the next few weeks, and make a note of these for future checking. You could also offer students some practical advice on the steps they might take to achieve their targets, and give them an occasional opportunity to work on their targets as part of one or more homework tasks.

Individual targets will usually be linked to the objectives for your teaching over the next few weeks. They may be very specific: for example, to make accurate observations and appropriate records. For some students a target may need to be broken down into stages: for example, to learn to read the volume of liquid in a measuring cylinder and record the reading using appropriate units. For a few

students, it may be appropriate to choose a target linked to the standards for the grade below or above to help them to consolidate or extend their learning. Whatever the targets, they need to be straightforward and few in number, so that students understand them and can focus on them.

Summative assessments

Summative assessments are long-term. They are made at the end of a block of work. This might be at the end of a grade or part way through a grade. Schools will have to decide the frequency of use of summative assessments. The purposes of summative assessments are:

- to assess individual students' work against the key performance standards;
- to help schools and the Education Institute to review students' overall progress and attainment against the performance standards;
- to give supplementary information about individual students' attainment and progress for schools to report to parents and the next teacher or the next school.

Summative assessments include end-of-year tests or examinations and teacher assessments. They also include assessments by teachers of aspects of the standards that cannot be assessed in written tests, such as investigative and practical skills, and students' use of ICT.

Before teacher assessments are made, it is helpful if all staff teaching the subject in a school assess a sample of students' work from each grade. This helps to make sure that judgements against the performance standards are consistent throughout the school. The adoption of criterion-referenced assessment techniques also helps to ensure consistency.

Using the sample lesson plans for science

This section is addressed to teachers who intend to make use of the sample lesson plans.

The aims of the science standards

Between them, the sample lesson plans are designed to show you how effective teaching and use of resources can achieve the aims of the science standards.

These are that students should:

- develop and sustain an interest in science and its applications;
- have an understanding of scientific methods and the way that science has developed;
- appreciate the human endeavours that have led to our current understanding of science;
- be proficient in the use of a range of scientific methods and techniques and in handling apparatus;
- use ICT effectively in the pursuit and communication of science;
- apply scientific enquiry skills to both familiar and unfamiliar situations and communicate the outcomes of their enquiries in appropriate ways;
- have a sound and systematic knowledge of important scientific facts, concepts and principles, and possess the skills needed to apply these in new and changing situations in a range of personal, domestic, industrial and environmental contexts;
- recognise the importance of the application of scientific knowledge in the modern world and be aware of the moral, ethical, social and environmental implications;
- be aware of both the potential of science to explain natural phenomena and its limitations;
- understand and communicate clearly a range of fundamental concepts that underpin branches of modern science;
- select, organise and communicate science clearly and logically, using appropriate scientific terms and conventions.

The purposes of the sample lesson plans

The sample lesson plans for science are intended to illustrate:

- some ways in which lessons can be structured;
- different ways of organising a class so that students have balanced opportunities to work as a whole class, in small groups, as pairs or individually;

- how teaching can include exposition, demonstration and explanation, accompanied by whole-class discussion and questioning;
- the range of activities that can motivate students' learning, including problem solving, critical evaluation, research, enquiry and practical work (nearly every lesson will include at least one activity of this type);
- how learning is achieved through a balance of reading, writing, speaking and listening activities, and how most lessons can include a mix of these activities;
- the range of activities that can help students to consolidate and practise their developing skills, including investigative and practical skills, written tasks, and occasional textbook exercises;
- how field work can be integrated into science teaching;
- how some activities can be differentiated to cater for the differing learning needs of the students in the class;
- the use of different kinds of teaching and learning resources, including information and communication technology (ICT).

The science lessons are single examples to illustrate different teaching and learning activities. There is no intention that they should be taught as a sequence, one after the other. They are drawn from different topics and points in the teaching year to show spread rather than sequence.

What the lesson plans include

The sample lesson plans in this document include most of the details listed on page 9 of this document:

- the lesson's objectives, drawn from the standards for the relevant grade;
- relevant vocabulary and technical terms;
- an outline of how the lesson will start, how it will developed through teaching input and student activities, and how it will be consolidated and rounded off;
- relevant resources, such as equipment lists, textbooks, ICT applications and sample worksheets;
- where appropriate, a note on safety.

The sample lesson plans do not refer to specific texts (although some may suggest how specific texts can be used in a lesson) or textbooks, or describe specific homework tasks, since these will vary from school to school according to each school's policies.

How the science lesson plans are structured

In general, the sample lessons include one or more short activities to start the lesson, one or more main activities and a consolidation and reflection phase. Where necessary, notes are given that amplify the purpose of each part of the lesson to guide you, or give answers to tasks set in the resource materials.

Introductory activities (about 5 to 10 minutes)

Most of the lessons start with setting the scene and a short activity to help students to tune in, interest them and engage their attention.

Setting the scene involves clarifying the objectives and explaining the purpose of the lesson in words that students understand (not the wording of the standards). You might want to look back, discuss homework and, when the main activity spans more than one lesson, consider how a lesson develops from the previous one. You might outline the flow of the lesson so that students know what to expect, and say why a certain problem is to be tackled or a particular activity is to be done. All this helps students to understand why they are learning these new ideas and to make connections.

Short, stimulating introductory activities, either before or after the scene setting, help to get the lesson off to a brisk start and prepare students for the main activity. Between them, the sample lessons illustrate a range of introductory activities. These include:

- posing a simple scientific problem and seeking solutions;
- repeating, in a different way, a key practical element of the previous lesson;
- showing pictures or video clips that are related to the topic as taught so far, or that suggest an investigative question that may be pursued in the lesson.

The main activity (usually about 25 to 40 minutes)

Building on the introduction, the main activities in the lesson plans are characterised by high levels of direct, interactive teaching and probing questioning, regardless of whether students are working as a whole class, in groups or individually, or whether the lesson consists of practical tasks, problem solving or written work.

The main part of the lesson provides time to introduce a new topic, or consolidate previous work and develop it further. The principal feature of most main activities is a practical engagement in a scientific problem. This may be to develop an intuitive understanding of the problem, to develop investigative and problem-solving skills, to deepen the intellectual understanding of its theoretical foundations or to develop an appreciation of how it is applied in daily life.

These activities can take on a wide variety of forms, from research to role play, from discovery to demonstration methods, and the plans have been written to illustrate this diversity. It is desirable to match the student tasks and activities to their previous attainment and your objectives for the lesson. You may want to allow some choice here. Ensure that over time students have opportunities to work in small groups, in pairs or individually. Encourage discussion and cooperation between students. Ensure that students with particular needs are supported effectively.

Effective lessons can have several cycles of main activity and mini-plenaries to allow misconceptions to be identified and dealt with at the appropriate time, or to provide further teaching. Throughout the main activity, encourage students to make predictions. Look for gains in their understanding. Use opportunities to report back, review and clarify. Ask students to offer their methods, observations and explanations to the whole class for discussion. Check whether

such inputs show evidence of misunderstandings or fundamental misconceptions.

Consolidation and reflection (usually about 5 to 10 minutes)

Short plenaries may take place during the main activity. The consolidation and reflection at the end of a lesson is far more than ‘clearing up’ after a practical session and should be just as dynamic as the introductory activity. It is an opportunity to round off or summarise the lesson, so that students reflect on the lesson, say what was important about it and consider the progress they have made. Draw out from them and highlight the key learning points, such as facts, ideas and vocabulary. This part of the lesson is also a time to look forward to the next stage of learning.

Get students to think about how they might apply new ideas, by showing them how the ideas can be used and where they fit in. This is also a time when you can relate science to work in other subjects.

Any homework that you set should help students to consolidate, apply or extend what they have learned, or to prepare for the next lesson.

This part of the lesson may be extended by the inclusion of some additional short individual or group work. This is designed to reinforce particularly important elements of learning, or to allow students to develop ideas on how to present the ideas graphically or diagrammatically, or perhaps to assist in the development of language or mathematics related to the topic.

Teaching time for the lessons

Each lesson plan has enough material to support at least 45 minutes of teaching, and longer in Grades 10 to 12. Some of them may require double periods of up to 90 minutes to cover a lengthy practical activity. You may need to supplement the activities with simpler or more challenging tasks if the students in your class have a range of attainment. You could choose from activities in textbooks or from your own resources. If you wish, different tasks can be given to different groups of students, according to their needs.

There may be too much material in the lesson plan, since this will depend on the class. In this case, you could designate one of the activities in the lesson as homework, or carry it forward to the next lesson. Be selective about which activity to cut – it does not have to be the last one merely because it comes at the end.

Other uses for the lesson plans

An alternative use for the lesson plans is to stimulate ideas about your own teaching. An individual teacher could read and reflect on them, or a group of teachers could choose to read one or more of the lesson plans and then discuss them together.

You may decide to start with the lesson plans for the grade that you teach. As you read through them, think about these questions.

- Most of the lesson plans have more than one objective. Would students ‘learn’ what is intended in a single lesson, or would the objective need to be part of other lessons during the year?
- How do I normally structure my lessons? How do they start? How do they develop? To what extent is my practice the same as or different from what is described in the sample lesson plans? Do I need to modify my practice in any way?
- What kinds of activities are offered to students in the lesson plans? Are any of these activities collaborative, in which students are expected to do things together? Do any of the activities require them to discuss with a partner? Do the tasks that I normally give my students require collaboration? Do I need to include a wider range of activities in the future?
- What kinds of questions do teachers ask in the lessons? Are they open questions, for which a range of answers is possible, or closed questions, for which only one answer is possible? Are students expected to give one-word answers, or to explain and justify their arguments and reasons in a sustained way? Do I need to think more carefully about the questions that I put to students during my lessons?
- What is the main purpose of the practical activity proposed for the lesson and how likely is it to result in the anticipated outcomes. Are the practical exercises appropriate to the needs of the students and to the demands of the standards? How do such activities match my current practice?
- How do the lessons described in the plans end? What happens? What discussions take place? What activities do students do? What kinds of questions are they asked? How do my own lessons normally end? Do I allow time for students to reflect on what was important? Do I help them to crystallise the key learning points? Do I need to adapt the way that my lessons end?

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Sample lesson plans for science

Grades 1 to 12

