Science and Technology K-6

Science & Technology K-6

Teachers' Kit

To assist teachers with the everyday classroom teaching of new syllabuses, the Board of Studies is producing for sale a teachers' kit to accompany the Science & Technology K-6 Syllabus. Use of this kit is entirely optional and the contents are suggestions only, however it is designed to assist teachers by providing high quality teaching resources and suggested lesson formats. The full K-6 Science & Technology Teachers' Kit comprises 39 separate booklets (see below), each targeted at one of the K-6 stages. Twenty-three of these booklets are now available; the remainder will be released soon.

STAGE 1
K-2

Available now

Getting About
Look Around You
Growing Up
Let's Communicate
What's Alive?
Kids Care
Back to Nature
A Place in Time
Sense of Direction

Available soon
Hot or Cold
Toyworld
Picture It
What's For Lunch?

STAGE 2
2-4

Available now

Out and About
Indoor, Outdoor
Mini-worlds
Keep in Touch
Cycles in Our World
Our Australia
Material World
A Look Inside

Available soon
Stuck on You
Making it Easy
Moving Pictures
Eating Out

STAGE 3
4-6

Available now

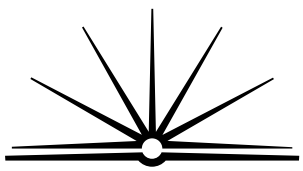
On the Move
The Best Place to Live
Out in Space
A Change for the Better
What's the Weather?
An Ancient Land
Environment Matters
Switched On

Available soon
Sailing, Sinking, Soaring
Light Up My Life
Visual Ventures
Food for the Tucker Box
Way Out Communication

BOARD OF STUDIES
NEW SOUTH WALES

For further information on the kit contact:
The Sales Clerk, Publications Branch, Board of Studies, PO Box 460, North Sydney 2059.
Phone: (02) 9927 8178

Science and Technology K-6 Syllabus and Support Document



BOARD OF STUDIES
NEW SOUTH WALES

Published by
Board of Studies
PO Box 460
North Sydney NSW 2059
Australia
Tel: (02) 9927 8111

ISBN 0 7305 8671 5

First printed May 1991
Second print June 1993
96215

Contents and overview

This syllabus is concerned with the teaching and learning of science and technology for the period of schooling from Kindergarten to Year 6. The document is arranged in two parts: the Syllabus and the Support Document.

The Syllabus

The syllabus describes the nature of science and technology teaching and learning and specifies the educational outcomes that should result from study in this Key Learning Area.
This section of the document is mandatory.

Assessment and evaluation 28

— provides advice on the means of gathering evidence of, and making judgements about, students' needs, strengths, abilities and achievements.
— provides advice on the means of collecting data and making judgements about the effectiveness of teaching programs, procedures and policies.

Support Document

The support document provides advice on the planning and programming of effective school courses.

Learning and teaching science and technology 35

— provides advice to be considered regarding the nature of the learner, principles of learning, and issues to be considered when programming learning experiences.

School planning 53

— provides guidance for teachers and schools on the organisation and implementation of a whole-school approach to teaching and learning science and technology.

Developing a teaching program 55

— provides suggestions and advice for teachers when developing class programs.

Units of work 57

— provides details of some sample units of work that can be used as a basis for programming science and technology and that illustrate how the learning outcomes can be addressed in each of the Stages 1 to 3.

Teaching strategies 141

— suggests a range of ideas that might be used in programming and teaching science and technology. The units of work refer to these teaching strategies but may be used also in the development of programs based on other approaches.

Suggested resources 228

— provides bibliographic information about book references suggested in the Support Document.

Parent Document

The Board of Studies will produce a parent document for the syllabus, aimed at strengthening the links between learning at home and learning in the classroom. This document will give parents information about science and technology education and why it is being taught. It will provide guidance about how parents can assist their children develop understanding and skills in this Key Learning Area.

Science and Technology K-6 Syllabus

The Board of Studies has developed
a general policy statement in relation
to the allocation of time across Key Learning
Areas which will be printed in
all primary syllabuses.

While the primary curriculum is divided into six Key Learning Areas, this is not to be interpreted as indicating that each Key Learning Area should have an equal time allocation. In line with NSW Government policy, the Board of Studies encourages schools to give greatest emphasis to English and Mathematics, and to adopt a responsible and reasonable approach which will provide each child with substantial access to each Key Learning Area in each Year.

Introduction

The primary curriculum

Science and Technology is one of the six Key Learning Areas of the primary curriculum. Each of the Key Learning Area syllabuses shares a similar format, is consistent with the other syllabuses in its use of terms and is based on a common set of learning principles.

Schools should adopt an approach which will provide each child with substantial access to the Science and Technology Key Learning Area continuously throughout each year of K-6. Schools should recognise that Science and Technology education has an essential place in the primary curriculum if students are to be adequately prepared for life in the 21st century. It is also necessary to recognise that the Key Learning Area of Science and Technology in K-6 leads to study in two of the eight Key Learning Areas in the secondary curriculum.

Science and Technology Key Learning Area

Science and Technology is the learning area in which all students learn about the natural and made environments by investigating, by designing and making and by using technology. Learning in Science and Technology will draw on and contribute to learning related to the other five Key Learning Areas.

The syllabus recognises the need for schools to address community values and to be responsive to local community concerns. It advocates that primary schools should actively promote close working relationships with parents and that they should strengthen their connections with the local community by seeking increased community involvement and participation.

Components of the Key Learning Area

The aim, objectives, learning experiences and learning outcomes of the Science and Technology syllabus are drawn from science education and technology education.

Science education

For the purpose of this syllabus, science is concerned with finding out about the world in a systematic way. Findings are accepted if they can be verified. Science is not just a body of knowledge but is also a process of investigation. Science seeks to be objective; nonetheless, as a human endeavour, it is affected by human values.

Scientific activity (testing and developing explanations) is generating knowledge at such a rate that even specialists can have difficulty in keeping abreast of developments in their area. Therefore part of science education must be to provide students with the processes and skills required to access this knowledge.

Science education assists students to understand themselves and the environment and provides opportunities for them to develop independent rational thought and responsible action. It emphasises first-hand experiences, investigating, designing, problem-solving and clarifying understandings.

Technology education

For the purpose of this syllabus, technology is concerned with the purposeful and creative use of resources in an effort to meet perceived needs or goals. It extends beyond the tools and technical inventions of a society and involves the application of human skills, knowledge, techniques and processes to expressive and practical problem-solving situations in all aspects of human life.

Technology education assists students to manage and influence technological change and to gain greater control over their lives in an increasingly technological world. It emphasises first-hand experiences, investigating, problem-solving, designing and making and evaluation of technological activity.

Technology education embraces computer and communication technology. This syllabus recognises the need to provide students with experiences which assist them to:

- understand computers by using them;
- understand the nature of communication technology and to become competent mass media users.

In so doing students will appreciate that these technologies influence almost every facet of all our lives and are some of the most significant causes of change for people in the latter half of the twentieth century.

The relationship between science and technology

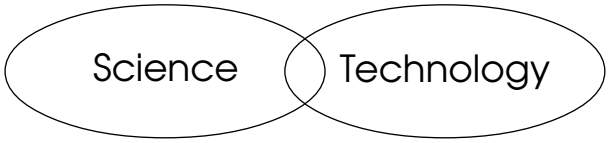
Implicit in the description of *technology* used in this syllabus is the manipulation of materials, energy and other resources. The manipulation of these resources requires scientific understandings, ie understandings of the natural world.

Science and technology are closely related, although the nature of this relationship can depend upon particular learning experiences.

The three examples which follow are provided to illustrate:

- the types of relationships that can exist between science and technology
- the scope of scientific and technological activity proposed in this Key Learning Area.

Example 1: Science and technology may not be closely related.



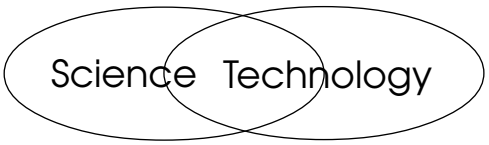
There can be scientific research for which no technological application is known or envisaged, eg searching for a new species of lizard.

There can be technological activity which does not require a particularly scientific understanding or skill, eg designing a logo which is aesthetically pleasing and functional.

In the Science and Technology Key Learning Area students can be involved in:

- *technological activities that are not intended to lead to particular scientific skills or understandings, eg the production of a class newsletter, the construction of character masks or the design of personal workspace*
- *scientific activities that are not intended to lead to particular technological skills or understandings, eg the exploration of types of animals found in freshwater streams or pools.*

Example 2: Science and technology may be somewhat related.



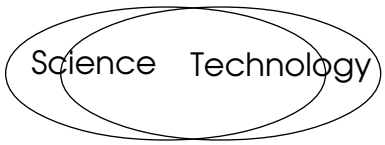
A significant amount of scientific research finds application in a range of technology, eg scientific research related to farming is resulting in changes in animal breeding and farming techniques.

Equally, a significant amount of technological activity draws on the special quality that scientific knowledge has, compared with other forms of knowledge. For instance, while constructing a TV program is a technology in itself, it also uses contributing technologies (such as video and sound recording techniques) and scientific knowledge (such as electronics and coloured lighting).

In the Science and Technology Key Learning Area students can be involved in:

- *technological activities that will also result in the development of scientific skills and understandings, eg the design of stage props that use electricity and lighting*
- *scientific activities that will also result in the development of technological skills and understandings, eg the use of a computer database to record and organise information as part of an investigation.*

Example 3: Science and technology may be virtually indistinguishable.



Science and technology can be indistinguishable when the quest for scientific understanding meets human needs or goals, or when technological activity generates scientific understanding or uses scientific methods.

A considerable proportion of recent research and development is part of industrial and military activity. Such activity can blur distinctions between 'pure' scientific research and particular technologies, eg developing drugs by genetic engineering, developing new plastics.

In the Science and Technology Key Learning Area students can be involved in:

- *activities that will result in the development of both scientific and technological skills and understandings, eg the investigation of the social habits of bees by designing an apparatus that can be used to study their behaviour.*

Science and technology learning experiences

Science and technology learning experiences should be based on the learning principles that underpin this syllabus and are common to other Key Learning Area syllabuses. These common learning principles are that:

- students learn when they are recognised and valued as individuals and social beings
- effective learning should involve the student in interacting, connecting, investigating, communicating, designing and making, doing, reflecting
- learning is enhanced by learning activities which are purposeful, appropriate, challenging, cooperative and rewarding
- learning is enhanced by learning environments which are secure, caring, supportive, structured and interesting.

Science and technology should recognise the nature of the learner and the needs of the diverse learner group. As well as common characteristics students have a number of characteristics that make them different. These differences and special needs are a result of:

- ethnicity
- language
- gender
- socio-economic background
- culture, including religious practices and beliefs
- geographic isolation
- learning difficulties
- special talents
- specific disabilities, eg intellectual, emotional, physical and behavioural.

Science and technology education is based on students experiencing and using the processes of science and technology. That is, the interrelated processes of investigating, designing and making, and using technology are central to science and technology and are experiences that particularly characterise learning in this Key Learning Area.

Within this Key Learning Area students will engage in these processes and as a result will develop their knowledge of a range of scientific and technological concepts. These concepts are embodied in each of the content strands of the syllabus. The content strands are:

- **Built Environments,** in which students learn about the structures and spaces that people construct, modify and adapt
- **Information and Communication,** in which students learn about communication technology and the ways people make, store, organise and transfer images and information
- **Living Things,** in which students learn about people, other animals and plants
- **Physical Phenomena**, in which students learn about phenomena related to energy, space and time
- **Products and Services**, in which students learn about goods and commodities, and the systems used to produce and distribute them
- **The Earth and its Surroundings**, in which students learn about the Earth and its environment, and how people use the resources it provides.

Learning about science and technology will occur in relation to each of the above strands.

Rationale

Science and technology are integral parts of the modern world. Dramatic and rapid change in these areas is a basic fact of life for all students. For personal, social, environmental and economic reasons, young people must be well equipped to be active participants in our scientific and technological society.

This syllabus will provide learning experiences in the areas of science and technology which will assist in meeting the needs and interests of both students and the wider community.

Meeting the needs and interests of students

Science and technology learning experiences assist students to:

- manage their everyday activities
- utilise opportunities for the development of creativity, flexibility and innovativeness
- understand their world and the things that influence it
- develop their understanding of scientific concepts
- evaluate and use the products of technology
- find, make judgements about and use information effectively
- understand that scientific and technological careers are equally appropriate for women and men
- make informed judgements in relation to issues concerning the natural and made environments
- accept a measure of responsibility for improving the quality of the environment
- more effectively resolve moral dilemmas associated with scientific and technological issues.

Meeting the needs and interests of the wider community

These learning experiences also help to prepare students for making a positive contribution to the future social, environmental and economic welfare not only of Australia, but of the wider world. As informed and educated people they will be required to:

- participate in shaping our future
- respond appropriately to local, national and global, social, economic, environmental and ethical issues
- assess critically the developments in the area of science and technology
- contribute to the continued development of science and technology
- make appropriate career choices.

Learning about science and technology

The syllabus specifies that students will engage in learning experiences which involve both scientific and technological content and processes.

This approach is necessary if students are to be equipped to respond to the growth of scientific and technological knowledge, together with the rapidly changing nature of the world. The curriculum content and teaching methodologies proposed in the syllabus encourage students to be active and flexible learners.

More particularly such an approach will:

- recognise the individual differences of students and accordingly provide them with learning experiences which further develop their scientific and technological understandings and skills

- guarantee that all students will experience a representative sampling of the various content areas which constitute this Key Learning Area
- provide students with a means of better understanding the world through the process of investigation
- allow students to explore how human needs can be met through the designing and making process
- equip students with the skills necessary for selecting and using a wide range of tools, equipment and materials when investigating, designing and making
- ensure students have the skills to access information which is most appropriate for their purpose
- enable students to pose problems and reach appropriate solutions by employing a range of strategies
- capitalise on the fact that students learn best when they are actively engaged in the learning process. The provision of cooperative, hands-on, problem solving activities will assist students to develop strategies for dealing with new and unexpected circumstances and issues.

This approach will also encourage students to express their understandings imaginatively and creatively while acquiring a broad range of practical skills.

Aim and objectives

Aim of the syllabus

The aim of this syllabus is to develop in students competence, confidence and responsibility in their interactions with science and technology leading to:

- an enriched view of themselves, society, the environment and the future and
- an enthusiasm for further learning of science and technology.

Objectives

Knowledge and understanding

Students will develop their knowledge and understanding of:

- Built Environments
- Information and Communication
- Living Things
- Physical Phenomena
- Products and Services
- Earth and its Surroundings
- the process of investigation that people use in order to develop reliable understandings of the natural and made environments
- the process of designing and making that people use in order to satisfy their wants and needs
- the technologies people select and use; how these technologies affect other people, the environment and the future.

Skills

Students will be able to:

- investigate natural phenomena and made environments
- design and make products, systems and environments to meet specific needs
- assess, select and use a range of technologies.

Values and attitudes

Students will engage in learning experiences which will enable them to develop positive and informed values and attitudes:

- towards themselves
- towards others
- towards science and technology.

Learning outcomes

Statements of learning outcomes

Outcomes are the specific, observable indications of learning to be expected of students at the end of a particular stage of a course.

Statements of outcomes clarify the student performance to be assessed, are concrete ways of establishing whether or not an objective has been achieved and can be used to communicate instructional intent to students, parents, employers and the community.

The learning outcomes as described in this section have been developed from the syllabus objectives and are presented in categories corresponding to three overlapping stages of primary schooling:

- Stage 1 (K-2)
- Stage 2 (2-4)
- Stage 3 (4-6).

While the syllabus requires that these outcomes be addressed it should be noted that not all learning outcomes will be achieved by all students at the same time. For example, many students between the years of Kindergarten and Year 2 will achieve and demonstrate Stage 1 learning outcomes. However, some students will be able to demonstrate these outcomes when they begin school, while others may not exhibit these behaviours until later in the primary years.

Statements of learning outcomes have been organised in the following groupings.

Knowledge and understanding of:

- *Built Environments*
- *Information and Communication*
- *Living Things*
- *Physical Phenomena*
- *Products and Services*
- *Earth and its Surroundings*
- *Investigating*
- *Designing and making*
- *Using technology.*

Skills in:

- *Investigating*
- *Designing and making*
- *Using technology.*

Values and attitudes:

- *Towards themselves*
- *Towards others*
- *Towards science and technology.*

Use of the learning outcomes

The learning outcomes can have a number of purposes. They can be used:

- to ensure scope, balance and sequence when **programming** learning experiences
- as a basis for the **assessment** of student development toward the general objectives of the syllabus
- to identify areas of learning that require particular emphasis when programming.

Comprehensive school programs of science and technology will address each of the specified outcomes for each of the Stages 1, 2 and 3.

Objective	Outcomes
Knowledge and understanding: Content strands	Stage One
Students will develop their knowledge and understanding of:	Students will know and understand that:
Built Environments	• people organise spaces by assembling and arranging components to meet particular needs. • people alter their environment in response to natural conditions.
Information and Communications	• there are different ways of communicating with others. • information can be stored for later use.
Living Things	• all living things are different. • living things grow, reproduce, move, need air, take in nutrients and eliminate wastes. • the senses are used to receive messages from all around.
Physical Phenomena	• pushes and pulls can make things move and stop. • living things and machines need energy to do things. • some things feel hotter and some things feel colder than our bodies.
Products and Services	• products can be created to fulfil specific purposes. • products can be made, processed or grown.
Earth and its Surroundings	• time can be measured through change and regular events. • the weather can have a powerful effect on people. • some living things change according to the seasons.

Stage Two	Stage Three
Students will know and understand that:	Students will know and understand that:
• people create specialised environments to meet specific needs.	• people try to control the conditions in the environments they build.
• structures are built from natural and processed materials and components.	• people live in communities and build environments to service their common needs.
• environments are sometimes modified to fulfil new and different requirements.	• both aesthetic and functional factors need to be considered when people make changes to their environments.
• computers are machines that store and process information.	• information can be represented in a number of different forms, including graphics, sounds and texts.
• people use different technologies to organise and communicate information in different ways.	• technologies continually offer new ways of creating and sending messages.
• production technologies have changed over time.	
• plants and animals live in environments that supply their needs.	• living things show variation within a species.
• change occurs throughout the lifetime of living things.	• the activities of people can change the balance of nature.
• living things depend on other living things to survive.	• groups of living things have changed over long periods of time.
• simple machines can make moving loads easier.	• there are various forms of energy.
• magnets attract some materials but not others.	• a complete circuit is needed for an electrical device to work.
• sounds are produced by vibrating objects and can travel through materials.	• the sun is the source of most of the energy on the Earth.
	• light can pass through some materials and not others, and when it does not shadows form.
• materials and resources are used to produce goods and commodities.	• there are environmental consequences of production and consumption.
• manufacturing processes convert raw materials into useful products.	• systems are designed to provide particular services.
• materials are joined, formed, shaped and finished.	• systems are used to deliver and distribute goods.
• most natural resources are limited and so need to be used wisely.	• there are many physical phenomena which change the environment.
• there are benefits and problems associated with human changes to the physical environment.	• there are various parts to the physical environment, eg stars, planets, earth, air and water.
• most materials come from the Earth and its surroundings.	• environments on Earth have been affected by technology.

Objectives	Outcomes
Knowledge and understanding: Learning processes	Stage One
Students will develop their knowledge and understanding of the process of investigation that people use to develop reliable insights into the natural and made environments.	Students will: • state the purpose of an investigation. • give examples of the ways the different senses can be used in observing. • recognise that discoveries can be made through play, exploring and experimenting. • demonstrate that tools and equipment can be used to aid observation.
Students will develop their knowledge and understanding of the process of designing and making that people use in order to satisfy their wants and needs.	Students will: • name possible needs and wants of people. • give examples of how people plan to make in order to provide for their own and others' needs. • recognise that people plan and make changes in many aspects of their daily lives.
Students will develop their knowledge and understanding of the technologies people select and use; how these technologies affect other people, the environment and the future.	Students will: • recognise that technological activity affects people and their environments. • show that equipment should be used with care and safety. • give examples from their immediate environment that show how resources can be conserved.

Outcomes

Stage Two

Students will:
- demonstrate that investigation can take many forms.
- recognise that the results of investigations can lead to more questions.
- show that designing and making can lead to the need for investigations.
- give examples of predictions that are sometimes supported, sometimes disproved.

Students will:
- recognise that designs are constrained by time, skills, tools and materials.
- identify the forms and components used in the production of a design.
- relate planning and evaluating to each stage of designing and making.
- relate the particular properties of materials to end uses.

Students will:
- explain that technology can be used to help people learn.
- justify the selection of processes, tools, equipment, materials, products and software to meet the requirements of the task.
- understand that the use of tools, equipment, software etc. requires the development of specific skills.
- show that technology can enable people to gain access to, organise and use information.

Stage Three

Students will:
- recognise that investigations may be conclusive/inconclusive.
- describe the social, environmental or economic implications of the investigation of new materials and processes.
- identify investigations which involve discoveries leading to unexpected outcomes.
- show some relationship between the process of investigation and the process of designing and making.
- describe the process of investigation which can involve exploring and discovering phenomena and events, proposing explanations, initiating investigations, predicting outcomes, testing, modifying and applying understanding.

Students will:
- describe the factors that influence design.
- justify the decisions made in designing and making.
- justify the combination of materials and techniques in relation to the properties required for specific end uses.
- explain the need for safe, ergonomically sound work environments.
- identify that new technologies increase the options for designing and making.
- describe the process of designing and making which can involve identifying needs and wants, defining a design task, generating and selecting ideas, assembling or constructing products, systems or environments, and evaluating outcomes.

Students will:
- explain that the future must be considered when making choices of particular technologies.
- evaluate technological activity in terms of social and environmental costs and benefits.
- explain that particular technologies are significant causes of change in the way people live.
- describe ways in which resources can be conserved.

Objectives	Outcomes
Skills	**Stage One**
Students will be able to investigate natural and made environments.	Students will: • observe, using all the senses. • explore how things work and engage in guided play. • undertake an investigation as a result of individual curiosity or as a means of solving problems. • interpret data and explain their observations.
Students will be able to design and make products, systems and environments to meet specific needs.	Students will: • name possible needs and wants of people. • make practical changes that could modify existing products or processes. • present ideas as to what they might plan as a design proposal. • combine a variety of materials and images to make simple models, drawings and structures. • describe to others the strengths and limitations of a design.
Students will be able to select and use a range of technologies.	Students will: • choose classroom materials and tools appropriate to the activity. • identify and use with safety the correct tools for specific purposes. • recognise their own use of technology in the school and home environment. • maintain and care for equipment in their immediate surroundings and organise their immediate environment.

Stage Two

Students will:

- make accurate observations and describe these observations, or record them as diagrams, tables of data and graphs.
- state the issue or area to be investigated.
- propose explanations using simple observations.
- make a prediction based on data collected by themselves or others.
- devise ways of checking or testing predictions.

Students will:

- describe needs and wants of people in relation to design activities.
- use graphics, models and written data to record the exploration of different ideas for design proposals and to assist making.
- suggest modifications to design proposals to improve the original design.
- organise systems for small scale mass production.
- evaluate materials and processes used.

Students will:

- recognise the appropriate use of tools, equipment, hardware and software.
- use basic construction tools, materials and computerised data bases to refine observations.
- report on the social and environmental costs and benefits of familiar technology.
- show how the technologies in the classroom affect coexistence and cooperative learning.

Stage Three

Students will:

- make detailed observations using appropriate technologies.
- discuss the factors that might affect an investigation.
- devise fair tests.
- identify data which support a particular prediction.
- devise a test that will support or disprove a prediction.
- modify and apply their understanding in the light of their investigation.

Students will:

- use investigation techniques to identify opportunities for design activities.
- develop a design proposal by selecting and refining ideas and justifying choices.
- select, reject or modify as appropriate the elements of design to evaluate the procedures and outcomes of a design task.
- produce a model, prototype, product or procedure to meet a specific design brief.
- test, or propose ways of testing, the extent to which a product satisfies the design intentions.

Students will:

- select appropriate tools, hardware, materials, equipment or software on the basis of their specific function and in order to gather information.
- use appropriate equipment and tools to carry out a particular task, and understand the technology involved to record and present ideas.
- use resources with consideration for the environment and adopt procedures which minimise waste.
- identify and report unsafe conditions.
- record the economic, moral, social and environmental consequences of advances in technology.

Objectives	Outcomes
Values and Attitudes	Stage One
Students will engage in learning experiences which will enable them to develop positive and informed values and attitudes.	
Values and attitudes towards themselves.	Students will: • demonstrate confidence in themselves. • have a positive view of themselves. • persevere with activities to their completion.
Values and attitudes towards others.	Students will: • be honest in their dealings with others. • respect the rights and property of others. • work cooperatively in groups. • show fair treatment for all.
Values and attitudes towards science and technology.	Students will: • show informed commitment to improving the quality of their immediate environment. • be curious about the natural and made environment. • gain satisfaction from their efforts to investigate, to design and make, and to use technology.

Outcomes	Outcomes
Stage Two	**Stage Three**
Students will: • demonstrate confidence in themselves and willingness to make decisions. • have a positive view of themselves and their capabilities. • show responsiveness to ideas. • persevere with activities to their completion.	Students will: • demonstrate confidence in themselves and willingness to make decisions and to take responsible actions. • have a positive view of themselves and their capabilities. • exhibit self-direction in their own learning. • show flexibility and responsiveness to ideas and evidence. • initiate and persevere with activities to their completion.
Students will: • be honest and open in their dealings with others. • respect the rights and property of others. • work cooperatively in groups. • show a commitment to fair treatment for all.	Students will: • be honest and open in their dealings with others. • respect the rights and property of others. • work cooperatively in groups. • show a commitment to fair treatment for all. • respect different viewpoints and ways of living.
Students will: • show informed commitment to improving the quality of the local environment. • be curious about and appreciate the natural and made environment. • gain satisfaction in their efforts to investigate, to design and make, and to use technology. • appreciate the scientific and technological contributions made by Australians.	Students will: • show informed commitment to improving the quality of society and the environment. • be curious about and appreciate the natural and made environment. • develop rational and creative thinking. • gain satisfaction in their efforts to investigate, to design and make, and to use technology. • appreciate education as a continuing process. • appreciate the scientific and technological contribution made by Australians and members of other societies and cultures.

Content

Content strands

The Science and Technology Syllabus has six content strands:

- Built Environments
- Information and Communications
- Living Things
- Physical Phenomena
- Products and Services
- The Earth and its Surroundings.

Learning outcomes are specified in relation to each strand. These represent the outcomes that should be achieved during each stage. The content strands provide:

- **contexts** for learning about science and technology
- a means by which teachers can ensure **scope** and provide **balance** in the selection and organisation of learning experiences for students
- a means by which students can develop their own understanding about the relationship between science and technology.

Built Environments

People create, construct, modify and adapt structures and spaces for a wide range of purposes. The environments they build are an important part of our communities and cultures.

The Built Environment strand is concerned with:

- buildings and the spaces within and surrounding these buildings, eg homes, schools, community facilities and factories, parks and gardens
- natural environments that have been modified to suit particular needs, eg land cleared for farming and altered waterways
- transport systems, eg railways, roads, shipping ports and airports
- the people and organisations that change environments
- the effects of change on made and natural environments
- services provided to communities, eg electricity, water, etc
- aesthetic and functional qualities of built environments
- systems used to control conditions in built environments
- methods used to construct buildings and environments
- the variety of characteristics of refined and processed materials and how these affect their uses.

Information and Communications

Information and communications are fundamental to most human activity. They can be used to collect, store and organise data and so assist in solving problems.

The Information and Communications strand is concerned with:

- the nature of communications
- methods of communicating between individuals, groups and communities, eg personal conversation, telephones, satellite link-ups
- systems of information storage and transfer, eg databases, computer systems, videotape libraries, microfiche
- the people and organisations who produce, use, consume or are affected by information and communications technologies
- structures and products that exist to access, promote and distribute information, eg

magazines, television, films, computer networking, telecommunications

- changes to information and communication technology over time.

Living Things

Living things interact with each other and affect their environments in complex ways. Understanding of people, other animals and plants are fundamental to a wide range of human activity.

The Living Things strand is concerned with:

- the similarities and differences between living things
- the way that living things interact with one another
- the processes that occur within living things
- the way living things adapt to their environments
- the human body as a complex system that needs to be understood and cared for
- the ways people use and manipulate other living things to address their own needs and wants
- how living things change over a lifetime
- how groups of living things change over long periods of time
- how natural environments are affected by technological activities
- the beneficial and detrimental effects of technology on living things
- how environments provide for the needs of living things.

Physical Phenomena

Energy can exist in various forms and can be used to meet specific needs. A considerable proportion of human activity depends on understanding of physical phenomena related to energy, space and time.

The Physical Phenomena strand is concerned with:

- relationships between time, space and movement
- how physical phenomena are used by people to address particular needs
- forces and their effects
- sources of energy
- light and some of its characteristics
- sound and some of its characteristics
- heat and some of its characteristics
- electricity and some of its characteristics
- magnetism and some of its characteristics
- availability of energy resources and the uses people make of the various forms of energy, eg solar and wind
- electrical circuits and their uses
- the systems that exist and the environmental cost of supplying different forms of energy.

Products and Services

People make, distribute, use and consume an enormous quantity and variety of goods and commodities. A considerable proportion of human activity is aimed at providing these products and services.

The Products and Services strand is concerned with:

- the processes people use to produce goods, commodities and services
- products people make, process or grow
- the organisations people develop to produce goods or products
- means of delivery and distribution
- systems designed to provide particular services, eg transport, health, education
- the effect of various products and services on people and organisations
- the management of materials and resources including waste disposal and recycling
- the means by which products are marketed
- the materials and resources used to produce goods and commodities
- the way in which the characteristics of naturally occurring materials affect their use

- how production technologies have changed over time
- how materials are shaped, joined, formed and finished
- the environmental consequences of production and consumption.

Earth and its Surroundings

The Earth is part of a changing system. It is also itself a changing system. In order to preserve life on Earth, there is a growing need to develop understanding of the Earth's characteristics and how people interact with their environments.

The Earth and its Surroundings strand is concerned with:

- the solar system, planets, Earth, moon and stars
- aspects of the physical environment, eg the Earth's crust, its oceans and atmosphere
- natural changes that occur, such as soil erosion, volcanic eruption, climatic changes and movement of water
- the passing of time and the natural events that make people aware of this passing, eg daily cycles, lunar cycles and seasons
- the variety and characteristics of naturally occurring materials
- the methods people use to obtain and process materials
- the methods people use to manage natural resources
- limitations to resources available on Earth
- renewable resources.

Learning processes

Science and technology education requires that students learn about and engage in:

- the process of investigating
- the process of designing and making
- the use of technology.

Investigating

All people engage in the activity of investigating. It is an activity that capitalises on and develops curiosity. It is a core process whereby students develop understandings about natural and made environments.

In the process of investigating the students should develop the following skills.

Exploring and discovering phenomena and events

Exploring and discovering are closely related, are interactive and foster curiosity.

All phenomena and events can be explored. Students can explore in many ways — through the processes of observation, manipulation, discussion, research and directed play.

Exploring is a key element of investigation. It can involve playing and tinkering, thinking, vocalising, pooling information, discussing, internalising, experimenting, designing, manipulating, making.

Exploration may lead to discovery. It involves finding or realising something that was previously unknown to the learner. In an educational setting, discoveries will be a direct result of the students' exploration. These discoveries will often act as a stimulus to further investigation and discovery.

Investigating can be initiated as a result of:

- a sense of curiosity
- a desire to understand, or
- a need for understandings that can be used as a basis for further action.

An integral part of this process is the need to clarify an area of investigation by:

- stating the phenomena or events to be explored
- recognising limitations that may be placed on the investigative process.

Proposing explanations

Students will be required to propose explanations for discoveries they have made. A proposed explanation or inference involves providing a tentative explanation for an observation or set of observations.

In scientific terms a proposed explanation is not an assumption, a supposition or a theory. These proposed explanations should be able to be tested and should state what is to be observed during testing if the proposed explanation is to be supported.

Predicting outcomes

Students will make predictions as part of a search for understanding. Predicting involves making suggestions that something will happen. Predictions are based on selected information and can be an end in themselves.

To predict accurately, careful observations should be made about the relationships between observed events.

Testing and modifying understanding

Challenging and testing predictions is carried out to clarify, or identify, likely outcomes. The results of this process will:

- establish support for a prediction or proposed explanation, or
- disprove a prediction or proposed explanation.

Testing can be carried out in a variety of ways. It is important that students be encouraged to consider and select appropriate means of carrying out tests.

As a result of testing, understandings can be changed or modified. In some cases this process will lead to further exploration and discovery.

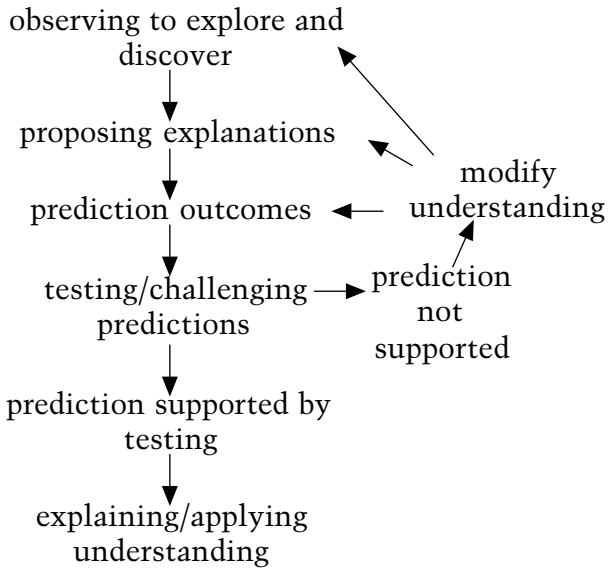
Explaining and applying understanding

Explaining understanding is the interpretation of observations to establish relationships and patterns between them.

Explanations may take the form of written reports or talks and can be supported by a variety of media.

In applying understandings that have been developed as a result of investigation, the student will develop appropriate problem solving strategies. These strategies can be used to solve increasingly more complex/ sophisticated problems. Applying understandings encourages lateral thinking and incidental learning.

The flow chart below shows a possible sequence of the investigating process.



It is important to ensure that students are provided with opportunities at each stage of the investigative process to reflect upon their actions, their learning and how such learning relates to other situations.

Designing and making

Designing is an activity in which all people engage. It is a core process through which students try to identify needs and propose practical means by which these needs can be addressed.

Designing and making will involve students in the following activities.

Identifying needs and wants and defining a design task

Design activity can result from:

- an examination of social or environmental issues
- an exploration of needs in the student's learning or living environment
- the analysis of existing products of technology.

An integral part of this process is the statement of a design task. This statement may include:

- objectives of the task
- limitations that apply to the designing and making activity
- criteria to be used for evaluation.

As a result of this activity students should value the tasks they undertake.

Generating and selecting ideas to best meet the design task objectives

This may involve:

- lateral and imaginative thinking
- representing ideas by modelling and drawing
- developing an understanding of space and form
- investigating and selecting appropriate materials, processes and equipment.

It will require:

- predicting possible outcomes for people affected by the proposal
- proposing and evaluating possible solutions
- assessing environmental costs
- testing alternatives
- making decisions.

Using resources to assemble or construct products, systems or environments

This will require:

- detailing a proposal by making further drawings or models
- planning a logical order for implementing the design
- planning a timeline for the task
- organising the tools, equipment, materials, workspaces, human and other resources
- manipulating materials, tools, machines and other resources.

Design activities in the classroom may result in a model, a one-off media product or a procedure for carrying out some task. In some cases it may extend to small–scale mass production.

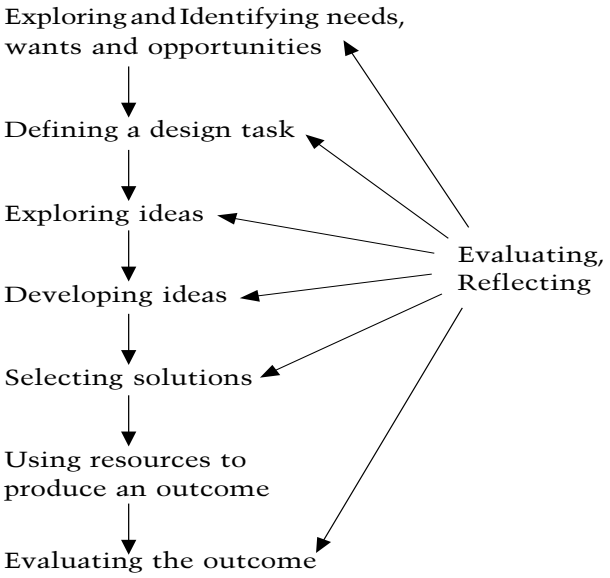
Evaluating the outcome including processes, products and their social and environmental effects

Students will evaluate their work throughout the designing and making activity and make changes as necessary. This will involve:

- reviewing the adequacy of each stage of their work
- judging the outcome according to the objectives they have established
- predicting the effects on the environment, on users of the product and on other people.

Students may well report to the class on their design and invite the class to help evaluate it. The evaluation should canvass people's feelings about the outcome and possible consequences.

The flow chart below shows a possible sequence of the design process.



It is important to ensure that students are provided with opportunities at each stage of the designing and making process to reflect upon their actions, their learning and how such learning relates to other situations.

Using technology

A significant proportion of human activity involves the use of technologies. As a result of science and technology education students will learn to use a wide variety of tools, hardware, materials, equipment and software appropriately and safely.

In this Key Learning Area, technology will be used:

- as a tool in the learning process. Appropriate technology can extend student capabilities and this enables them to engage more fully in understanding concepts and processes
- as a resource to enable students to develop cooperative skills, risk-taking and a sense of control over technology
- within a context for investigation to allow artificial or restricted worlds to be constructed and explored
- to provide a stimulus for further investigation
- to act as a stimulus for students to design, to modify technologies and to explore alternative uses of particular technologies.

In most instances activities will involve learning about the use of technology, not for its own sake, but as a probable means to an end. During investigating and designing/making activities opportunities arise where the use of technology enhances the learning process. The use of technologies is becoming an increasingly important part of investigation. Designing and making will often involve the use of technology as an integral part of the process. Using technology can also give stimulus for further investigation or act as stimulus to design and make something.

Specific technological knowledge and skills are becoming redundant in increasingly shorter periods of time and there is little value in teaching such knowledge and skills in isolation.

In carrying out investigating or designing/making tasks with the aid of technology, students will need to do the following things.

Understand the nature of the task

This requires setting the task which needs to be accomplished by using technology, in the light of the designing and making or investigating activity.

Select the appropriate technology

This means assessing the needs of the task:

- by understanding the potential and limitations of the technology
- by exploring the alternatives, ie tools and their applications
- by effective decision-making.

Such decision-making should recognise that choices can be made and that some options may be more appropriate than others.

Develop the necessary skills to use the technology

Students will need to develop:

- basic operational skills such as operating equipment, tools and machinery for a clearly defined purpose, eg being able to cut, join and shape materials; use simple computer software packages; create images
- the ability to organise information in a variety of forms and communicate with/to others
- organisational and managerial skills which will involve careful planning of the task, being able to follow correct procedures, developing an appropriate sequence in both time and events, being able to acquire resources, eg where to go, who to make inquiries to, what to purchase or get etc
- skills in caring for tools and equipment as well as for the safety, health and well being of themselves, others and the environment. Aspects that could be considered in this area are:
  - work habits that reflect the need to care for and maintain tools, equipment, machines and materials
  - recognising the need to conserve and preserve resources
  - development of work practices related to the conservation, reusing and recycling of materials and other resources
  - an appreciation of the potential damage that particular technologies can cause to oneself and others.

Evaluate the possible benefits of technology in relation to the personal, social and economic effects of its use

This will require:

- assessment of the immediate benefits and costs of particular technologies
- assessment of longer-term benefits, and costs, to society and the environment.

It is important to ensure that students are provided with opportunities at each stage of the process of using technology, to reflect upon their actions, their learning and how such learning relates to other situations.

Links with other Key Learning Areas

Science and technology education involves learning that is unique to each of these component areas. It also will require that students draw upon, develop and apply learning that is associated with other Key Learning Areas. For instance, when students 'investigate', 'design and make', and 'use technology' they will be required to use:

- mathematical skills and understandings
- communication skills and understandings
- understandings of people, societies, environments etc
- practical and creative skills.

Activities in this syllabus will provide opportunities for integration with the following Key Learning Areas.

Mathematics

Mathematical skills are essential for solving scientific and technological problems. Such problems frequently involve concepts of space, number and measurement. The learning activities suggested in the Science and Technology syllabus will provide students with many opportunities to apply mathematical concepts.

Human Society and its Environment

Scientific and technological activity is carried out by people in response to their needs, ie the need to understand, the need to create, the need to solve practical problems. There is an increasing demand that such activity takes into account effects on society and the environment. Learning in Science and Technology seeks to develop in students an appreciation of the relationships between science, technology, society and the environment.

Personal Development, Health and Physical Education

In Science and Technology, students will develop understandings of people, the human body and the technologies used to promote and maintain health. The learning activities will enable students to appreciate the potential effects of scientific and technological activity on themselves and on others, particularly in respect to safety.

English

Scientific and technological activities are essentially social activities and therefore demand use of language. Students will use language to pose questions, clarify ideas and communicate understandings.

Learning activities in the Science and Technology area will reflect the need to understand and use a wide range of scientific and technological language.

Creative and Practical Arts

Scientific and technological activity is both creative and practical in nature. Such activity draws upon qualities and understandings fostered in the arts. In particular, scientific and technological problem-solving is enhanced by lateral thinking, sensitivity to the characteristics of materials and environments, and skills in the control and manipulation of materials and other resources. Learning activities in the Creative and Practical Arts area can be complementary and closely related to those suggested in this syllabus.

In the Science and Technology Key Learning Area, students will be required to make decisions in which they must reconcile such objective considerations as quality, function and cost with more subjective considerations, such as ethics and appearance. In so doing, students will apply all types of learning, and will practise making the types of decisions required of all people in all stages of life.

Assessment and evaluation

Assessment and evaluation are carried out in order to determine the effectiveness of teaching and learning. For the purpose of this syllabus:

- assessment is the process of gathering evidence of and making judgements about students' needs, strengths, abilities and achievements.
- evaluation is the process of gathering data and making judgements about the effectiveness of teaching programs, policies and procedures.

Student assessment

Assessment of student progress is an integral part of teaching and learning, forming the basis for all further action by both teacher and student. Assessment involves the process of observing student learning before, during and after programmed activities, making judgements and deciding on a course of subsequent action. It may be informal, as part of daily teaching strategies, or formalised through activities that indicate student achievement and progress. Both informal and formal assessment need to be systematic and planned.

Continuous appraisal of progress towards the objectives of the program should underpin all activity in the Science and Technology Key Learning Area. Usually it involves the measurement of the degree of student achievement of the syllabus objectives in terms of the outcomes for the stage of the course being assessed. This will involve consideration of students' competence before activities are undertaken, and at all stages of the investigating and designing and making processes.

A range of strategies should be employed to ensure information is gathered regarding:

- ideas being formed and knowledge being gained
- the skills being developed
- the attitudes, values and feelings demonstrated.

Strategies should be appropriate to the range of objectives and be supportive of the learning process.

Practical activities give students the opportunity to apply understandings, knowledge and skills and to allow them to show resourcefulness, interest, ingenuity, originality, creativity, appreciation and perseverance.

Whatever assessment strategies are used, it is important that teachers ensure that tasks are accessible to all students. The language used needs to be suitable for all students including those from non-English speaking backgrounds, and activities should not disadvantage students from Aboriginal backgrounds.

In assessing students from language backgrounds other than 'standard' English, teachers should be aware that these students may be hampered in revealing the full extent of their abilities because of their limited capacity in English.

Assessment strategies

Observation

While students are working in groups or individually, the teacher has the opportunity to observe and note aspects of student learning. Things to look for include:

- choices students make in regard to those with whom they work, the equipment they use and the activities they prefer
- attitude to work, eg perseverance, willingness to address difficulties, organisation, cooperation, independence
- interaction with other students
- gross and fine motor skills
- the degree of care shown in the use of equipment
- the approaches students take to solving problems.

Listening

It is important that teachers listen to what students say and give them time to respond. What students say to the teacher or to other students provides many clues to their understandings and attitudes. Things to listen for include:

- the tone of voice
- the accuracy of language used
- student explanations which often provide immediate feedback on understanding
- requests for help.

Teachers should consider how best to elicit responses from students. Teachers' questions might address:

- problem posing: 'What would happen if... ?'
- fact finding: 'What is it?'
- reason seeking: 'Why does this happen?'
- routine: 'Where do I put this?'
- reassurance seeking: 'Is this right? Is this how you do it?'
- perception seeking: 'What does "energy" mean to you?'

Structured interviews

Structured interviews can provide the teacher with specific information on how the student thinks in certain situations. The student's responses will often reveal strengths, weaknesses, misunderstandings, level of understanding, interest, attitude and abilities. The following are suggestions for improving the quality of structured interviews.

- Talk to students in their classroom so that they are able to respond in a known environment.
- Let the student do the talking. Do not interrupt.
- Try not to use leading questions.
- Ask for explanations rather than facts.
- Listen carefully to responses.
- Give time for answers. Avoid rephrasing the question.
- Encourage verbalisation of thoughts.

Student–teacher discussions

These differ from the structured interviews in that the student's talk is not limited or directed by the teacher's questions and may be initiated by the student.

- Let the student provide the direction for the discussion.
- Do not feel obliged to fill in gaps in the flow of conversation.
- Listen carefully.

Student explanation and demonstration

Provide opportunities for students to give an explanation or demonstration of a particular facet of science and technology to the teacher alone, to another student, to a group of students or the whole class. Teachers should take note of:

- how the student organises the material
- the language used, including both vocabulary and structure
- the depth and breadth of the treatment
- clarity
- the student's confidence.

Samples of student work

This is a technique for assessment commonly used by teachers. Samples should be collected at regular intervals and dated, forming a cumulative file on the student. A careful study of the student's work provides information on:

- the level of understanding
- logical thought processes
- any difficulties experienced
- the need for remediation
- the need for consolidation and/or extension work
- the amount of work completed
- the quality of what the student has done.

Pen and paper tests

These tests are a means of assessing how well older students have acquired certain understandings, knowledge and skills. It is relatively easy to construct tests to assess recall of facts and basic skills. It is more difficult, however, to construct test items that assess:

- the understanding of a concept, eg concept map
- problem-solving abilities.

If these tests are used in the early school years, they should be supplemented by other assessment strategies.

Recording student assessment information

The primary function of assessment is to use this information to improve the quality of both the teaching and learning. This information must therefore be fed back to all those involved: the student, the teacher and the parents. This can be achieved in a number of ways, whether it be formal or informal. The assessment, whatever methods are to be used, needs to include:

- what the student has done and to what extent goals have been achieved
- what follow-up is required to achieve these ends, and
- suggestions for future directions.

The emphasis here will depend on the audience for this information. Strategies should therefore be developed in the school's evaluation policy to facilitate this communication to all those involved.

Reporting to parents is most important because it enables them to understand and participate in their child's learning. The emphasis is on reporting individual progress stating what has been achieved and what direction further progress will take.

Teachers should keep an ongoing record of each student's performance and application in Science and Technology. Assessment procedures should be designed to assist teachers with this task.

Ideally the system of recording information should be manageable, should give a clear indication of the student's development in understandings, knowledge and skills, and should be available to teachers in the following year.

The recording of assessment information is carried out at two levels:

The class level

- Test results and checklists
- Student records of their own work
- Anecdotal information.

The school level

- To provide a basis for reporting on the student's progress
- To provide an indication of where each student/class is in the school's Science and Technology program so that there is an efficient transition from year to year
- To provide some indication of the suitability of the school's Science and Technology program.

Here the nature of the records kept will depend on, and be linked to, the school's Science and Technology assessment and evaluation policies.

Program evaluation

Evaluation should be ongoing.

Students and parents as well as teachers, executive teachers and principals should be involved in this process. Evaluation focuses on the teaching and learning of objectives and processes. It is used to modify the teaching program and procedures.

The evaluation process involves:

- determining the purpose of the evaluation
- deciding on the focus of the evaluation
- deciding on the information to be collected and the methods of collection
- interpreting the information
- using the interpretation to plan for further action
- taking the action planned.

Evaluation processes enable the teacher to make informed decisions leading to more effective teaching. The results of evaluation will assist the teacher in:

- considering the appropriateness of the program
- deciding whether the learning outcomes have been met by the teaching program
- setting student assignments and projects
- grouping the students
- selecting and using resources
- assigning additional work for individual students
- providing opportunities for students to work cooperatively
- pacing the teaching
- providing opportunities for creativity
- recognising other areas where decisions need to be made about teaching and learning
- reporting on student progress
- involving the community.

Sample evaluation questions

Some examples of questions that teachers may address when evaluating teaching programs in science and technology are as follows:

- Does the activity consolidate previous work?
- Is the content appropriate?
- What learning outcomes have been met?
- How effective is the teaching approach?
- Are opportunities provided for students to discuss their science and technology?
- Is the classroom environment conducive to cooperation and supportive behaviour?
- What elements in the classroom are barriers to student learning?
- How is student understanding to be determined?
- Are cultural and individual differences recognised and catered for?
- Are the materials available free of cultural or gender bias?
- Are girls and boys equally involved in all activities?
- Is grouping effective for a particular activity?
- Are the resources appropriate?
- Are the materials and equipment accessible and utilised?
- Can school and community personnel be involved in classroom activities?