# TECHNOLOGY & ENTERPRISE

## Learning Area Statement



*In the Technology and Enterprise learning area, students apply knowledge, skills, experience and resources to the development of technological solutions that are designed to meet the changing needs of individuals, societies and environments. Students become innovative, adaptable and reflective as they select and use appropriate materials, information, systems and processes to create solutions that consider the short- and long-term impact on societies and environments.*

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# Definition & Rationale

*The Technology and Enterprise learning area relates to the processes of applying knowledge, skills and resources to satisfy human needs and wants, extending capabilities and realising opportunities.*

*Technology uses resources, including materials (both raw and processed), tools and machines, knowledge, skills and experiences, as well as investment of time, energy and money.  It involves systems for collecting, transporting and transforming materials, for storing and processing information and resources, and for communicating and marketing the outcomes.  Technology also includes the processes and products that result from the technological enterprise.  Enterprise involves the development and application of skills and attitudes that enable people to actively respond to and be involved in social and economic change.  Finally, technology has consequences, costs and benefits that need to be considered carefully and responsibly before decisions are made.*

Technology and enterprise are not new:  they are as old as human civilisation and developed from the fundamental needs of humans for food, shelter and clothing.  Their explicit inclusion in the school curriculum provides exciting opportunities for students to become involved in a range of learning experiences, set in relevant contexts with outcomes that have meaning in students' lives.

## Meeting the demands of a changing world
The Technology and Enterprise learning area provides opportunities for students to become actively involved in dealing with change and meeting the needs of individuals, families and societies.  They can develop confidence and competence in their use of equipment and processes and evaluate the appropriateness of technological innovations.  Technology influences all aspects of people's daily lives and transforms societies:  for example, a growing population and increased need for food resulted in human societies changing from hunting and gathering to fixed-site agriculture, and information technology and telecommunications have transformed the ways in which societies function, changing how and where people work, learn and run their lives.  Students acquire the knowledge, skills, understandings and values to actively deal with and contribute to such change and to operate in the built and natural world now and in the future.

## Developing skills and experiencing systems and processes
Students are able to experience the reality of technological systems and processes by bringing ideas from conception to fruition.  By responding to a range of challenges students try out their ideas for adapting or creating technology and operate in environments influenced by technology.  They work individually and collaboratively, carry out investigations into the issues related to a challenge, draw on understandings

from other disciplines to support hypotheses, and critically examine what others have achieved before them.  They ascertain what contributed to decisions made during processes of technological innovation. They evaluate the success of technology in contributing to individual, family and community well-being.  This research leads to a deeper understanding of the implications of challenges that informs the quality and repertoire of their ideas for innovation.  Students develop the practical skills needed to work with materials, systems and information.

A major focus of this learning area is students' understanding and effective use of information technologies and associated communication technologies.  Through continual use and adaptation of these technologies, students are able to refine their skills, transfer these to a variety of contexts and to respond critically, reflectively and effectively to the challenges of a rapidly-changing world.

## Being enterprising

Students are encouraged to develop and practise enterprising behaviours such as initiative, resourcefulness, responsibility, adaptability and enterpreneurship.  Through these behaviours they enhance their critical and creative thinking and organising, collaborative and team-building skills.  They identify needs, wants and opportunities and use, adapt, manage or develop a range of equipment, resources, processes, systems, services and environments to meet them.  These behaviours and skills are transferable across the curriculum and are valuable acquisitions for career and life experiences. Students also have the opportunity to develop an enterprising ethos in which the ethical and responsible realisation of opportunities is valued.  By practising enterprising skills and behaviours in a range of different contexts students become flexible and creative, both in their application of technologies and in the development of solutions to meet changing societal needs.

## Considering the social and environmental impact of solutions

In seeking solutions students select, adapt and develop technologies that make efficient use of resources and are effective in managing social and environmental impacts.  They understand the social, economic, political, cultural and environmental issues surrounding the use, development and disposal of technology.  They are aware that the development of solutions will have consequences other than those intended. Students understand that the creation, adaptation and application of technology is dependent on achieving a balance between the responsibilities of the designer and the developer, and the needs of the user.  Students consider their own attitudes, cultural beliefs and values and those of others, as well as long- and short-term consequences of innovations for individuals, families, communities and environments.  They come to understand that making decisions about technology often involves a complex mixture of consensus, conflict and compromise, as humans seek to meet needs and realise opportunities in a sustainable way.
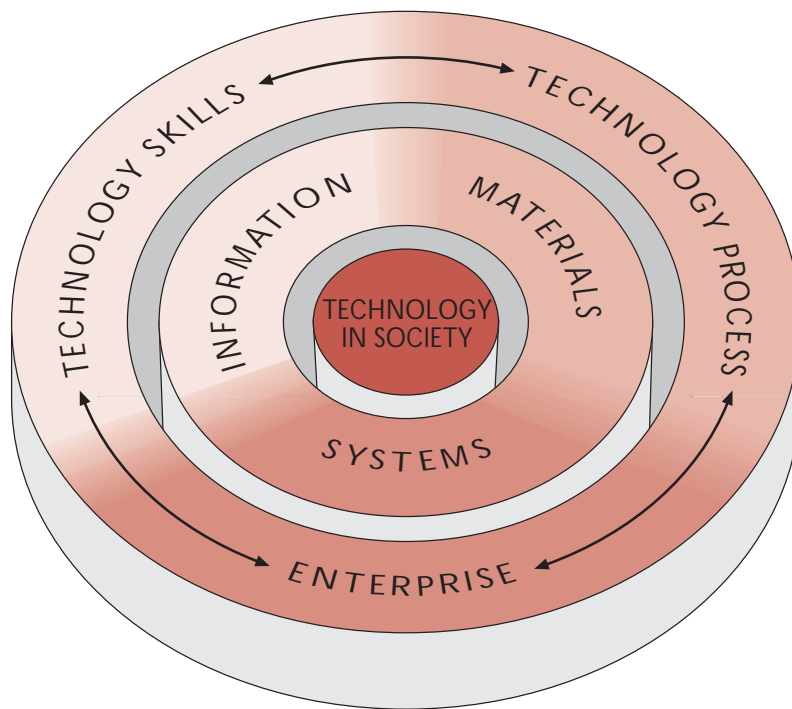
# Technology & Enterprise Learning Outcomes

## TECHNOLOGY PROCESS

**1.** Students apply a technology process to create or modify products, processes, systems, services or environments to meet human needs and realise opportunities.

## MATERIALS

**2.** Students select and use materials that are appropriate to achieving solutions to technology challenges.

## INFORMATION

**3.** Students design, adapt, use and present information that is appropriate to achieving solutions to technology challenges.

## SYSTEMS

**4.** Students design, adapt and use systems that are appropriate to achieving solutions to technology challenges.

## ENTERPRISE

**5.** Students pursue and realise opportunities through the development of innovative strategies designed to meet human needs.

## TECHNOLOGY SKILLS

**6.** Students apply organisational, operational and manipulative skills appropriate to using, developing and adapting technologies.

## TECHNOLOGY IN SOCIETY

**7.** Students understand how cultural beliefs, values, abilities and ethical positions are interconnected in the development and use of technology and enterprise.
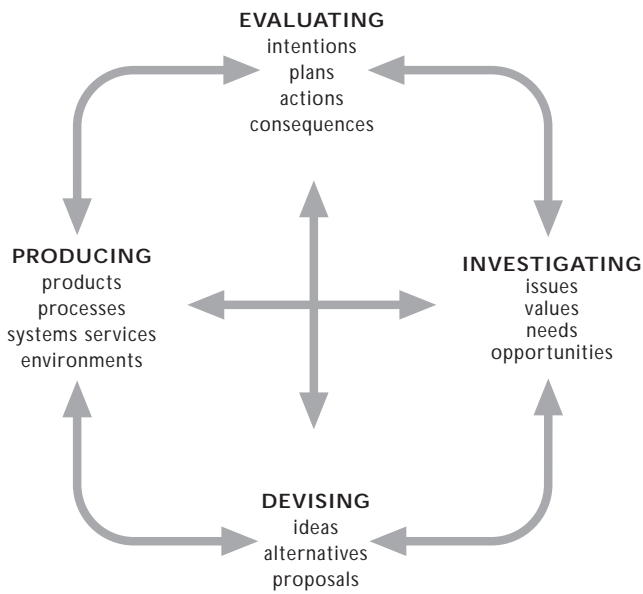
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## INTRODUCTION

*The Technology Process is fundamental to this learning area and integral to the achievement of all Technology and Enterprise Outcomes.  The statement of each outcome is accompanied by a more detailed description which includes selected examples showing how students may demonstrate achievement of the outcomes from kindergarten to year 12.  Any activity in which students engage will give them the opportunity to work towards a range of Technology and Enterprise outcomes, as well as contributing to the achievement of various outcomes in other learning areas.*

## TECHNOLOGY PROCESS

**1** Students apply a technology process to create or modify products, processes, systems, services or environments to meet human needs and realise opportunities.

### ELEMENTS OF A TECHNOLOGY PROCESS

**EVALUATING**
intentions
plans
actions
consequences

**PRODUCING**
products
processes
systems services
environments

**INVESTIGATING**
issues
values
needs
opportunities

**DEVISING**
ideas
alternatives
proposals

Through their versions of the technology process, students find out more through investigation and research, develop ideas to devise a range of solutions, select and produce a solution and evaluate both the results of their endeavours and the process they adopted. When meeting human needs and realising opportunities, students select how they use the elements of the technology process. They understand that the process can be both 'cyclic' and 'iterative' and that they may choose to revisit a particular element a number of times before they complete their solution: for example, as they develop a design, they may need to further investigate the properties of the materials they are using. In achieving this outcome, students demonstrate competence in the use of each element of the technology process and select and use all of them when developing a new or modified solution.

Students investigate by reflecting on what they already know about the problem or issue they are trying to solve or address. They locate and select data about materials, systems and information products and processes by, for example, surveying people, searching databases or observing or testing in real situations. They also consider the short- and long-term implications of the impact of technologies for societies and environments. As part of the process of investigation, students clarify what they are trying to achieve.

Students devise ways of creating or modifying existing technology based on their understanding of and experience with the materials, information products and processes, and systems they use. They devise solutions by developing a range of ideas that can take into account information they have gathered. They visualise consequences, think laterally, test ideas and represent or communicate to others a range of options.

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When producing or modifying products or processes students select and use skills and techniques appropriate to their understanding of the nature of materials, information and systems. They organise and manage production, adapting and adjusting procedures to develop models, prototypes, processes or products.

Students review and evaluate information, processes, products, ideas, skills and techniques, considering their potential for refinement. They assess the implications of these and their impacts on societies and environments. They reflect on individual and/or group decisions, ways they have proceeded and what they have accomplished.

As students create or modify a range of technological solutions, they enhance their ability to be enterprising, such as, flexibility, adaptability and innovation when seeking and realising opportunities.

Students may, for example, design and make products such as a nutritious snack for a pre-school child, a container to transport fragile items, a mask for a class celebration of an historical event or a piece of everyday jewellery; adapt a community-based waste-recycling system for use at school that incorporates the process of collecting and recycling materials from classrooms; identify a need, design and implement modifications to the classroom environment to reduce the effect of heat from the afternoon sun; evaluate accessibility and implement improved access to all areas in a school for a wheelchair-bound student; or devise and deliver a service to enhance the quality of social contact for the residents of a retirement village.

| Product | An artefact produced for a specific purpose, such as food, fibre, clothing, toy, furniture, brochure and plan. |
|---|---|
| Process | A planned series of steps for the achievement of practical purposes, such as a sequence for drying food, a plan for manufacturing or furniture a finishing method. |
| System | A combination of people and components that function together to achieve specified goals, such as for producing and processing vegetables; distributing or collecting resources; managing and using new information; or monitoring the number of people attending an event. |
| Service | The provision of a solution or support required by others to meet their needs or wants, such as repair of damaged or faulty technology; hiring out specialist equipment; helping, protecting or caring for others; essential public utility; or form of entertainment. |
| Environment | The purposeful organisation of surroundings to improve efficiency and effectiveness, such as the design of an organisation's reception area to make it more accessible; landscaping to minimise the impact of cliamtic extremes; use of virtual reality to simulate circumstances. |

## MATERIALS

**2** Students select and use materials that are appropriate to achieving solutions to technology challenges.

Students select and use the appropriate materials based on their knowledge and understandings of the properties of materials. They understand that in the development, use and service of technology, a wide range of materials can be utilised, including unprocessed and processed; old and new; resistant and compliant; common and uncommon. Cost, renewability, strength, availability, degradability and toxicity are some examples of what students consider when critically assessing materials. They also evaluate the social, environmental, legal and cultural implications of choosing and using materials, ensuring their use is ethically acceptable to society.

Students apply organisational, operational and manipulative skills when selecting and using materials. By understanding the nature of materials and their possible uses, students manage materials and select tools and techniques appropriate to the chosen materials and intended design requirements. When working with materials, students consider the importance of occupational health and safety requirements: for example, ensuring that adequate ventilation is available when using glues and toxic paints or using personal protective equipment when using noisy or dangerous machinery. Tools and equipment are used, stored and maintained in the appropriate manner and handled safely.

Students may, for example, select appropriate materials when designing and making a hand puppet; collect suitable recycled material to design and make a bird feeder for a school verandah; select and apply materials appropriate to protecting a surface exposed to the elements; or select the best method of making a watering device that is reliable, efficient and portable, and specify materials for each part of that device.

## INFORMATION

**3** Students design, adapt, use and present information that is appropriate to achieving solutions to technology challenges.

Students apply their knowledge of the form, structure and quality of information when developing creative and innovative solutions to challenges that meet individual or community needs. They locate and select information that is appropriate to a solution and are efficient in their retrieval, transformation, creation, storage, transmission and presentation of information in terms of managing time, methods and resources.

Students understand the impact of information, and are able to apply their understanding in meeting the requirements and specifications of challenges. They are effective in their management of information and have a clear purpose for finding, using and presenting it. Students are ethical in their application of information and

critically evaluate the quality of a wide range of information from local and international sources. They are effective in their development and distribution of information products that may include textual, graphical, manual and electronic elements.

Students understand the importance of access to information by local, national and other communities, and the systems that support access. They understand that access to information (for example, access to the Internet) is not uniform throughout the world. Students apply operational, manipulative and organisational skills when accessing, developing and using information. They value information as a resource and appreciate how important its ease of exchange is to particular groups, such as scientists, communities, police or media. Presentation methods should take into account purpose and audience.

Students may, for example, locate information on air-cooling systems from a variety of sources, select and organise the material to be included and present this in the form of a visual display to support a proposed solution for cooling a classroom. They could design and create posters to advertise a school play, or publish a review of a production in a community newsletter. Students also could survey residents when they design and present to the local council a proposal, with plans, for upgrading a public-recreation area.

## SYSTEMS

**4** Students design, adapt and use systems that are appropriate to achieving solutions to technology challenges.

Students understand that systems are combinations of elements that include people and components functioning together to achieve specified goals. They explain and work with systems that are mechanical, electrical, electronic or environmental, as well as manufacturing, organisational, financial, service and managerial systems.

Students apply their understanding of concepts associated with systems such as inputs, processes and outputs; feedback; control mechanisms; efficiency; or open and closed loops, to the selection, use, adaptation and control of systems. Students identify and understand the cause-and-effect relationships within systems and the complexities of assembling or combining tangible or intangible components that interact in an organised way for a particular purpose.

They apply these understandings and relevant mathematical and scientific principles to the development and operation of systems, and consider management, operating and maintenance requirements when designing or modifying their technology. They show awareness of the implications for energy efficiency and conservation when applying organisational, operational and manipulative skills to access, develop and use systems. Students evaluate local and global past practices and their impact on environmental, social and economic factors in meeting needs associated with the development, construction, maintenance, modification and disposal of systems.

Students may, for example, design and construct a marble track; use a wheel-and-axle system when making a vehicle; assemble, adapt and create different systems using a wide range of construction sets or kits; analyse the effectiveness of a club treasurer's methods of accounting for cash and adapt this system for another purpose; organise and manage a stall at the school fête to raise money for the class; or organise tasks to ensure efficient screen printing of T-shirts.

### ENTERPRISE

**5** Students pursue and realise opportunities through the development of innovative strategies designed to meet human needs.

While actively pursuing opportunities, students apply persistence, resourcefulness, creativity and boldness. They use an appropriate technology process to identify, create, initiate and successfully manage personal, business, work and community opportunities as appropriate to the school context. Using critical and lateral thinking, they assess risk and review progress as they seek better ways of accomplishing tasks.

While engaged in the technology process, students work towards common and changing goals. As they communicate and negotiate with others about ideas and solutions, they effectively influence the outcome of the technology process. In doing this, they select and adapt techniques and ideas from other disciplines when developing solutions.

Students participate in a competitive environment and have an understanding of the importance of maintaining a competitive local, national and international advantage. They understand the importance of technology in progressively bringing about change and consider the local and international effects of change on others and the environment.

Students may, for example, construct boats suitable for use in a pre-primary canal system; plan and organise a performance of a traditional tale in order to raise money for an excursion; recognise and act on an opportunity to develop an area conducive to quiet reading in a classroom; negotiate school rules or individual contracts for behaviour or learning; or establish a marketing venture to repair and sell superseded school computers.

## TECHNOLOGY SKILLS

**6** Students apply organisational, operational and manipulative skills appropriate to using, developing and adapting technologies.

When students use, develop and adapt technologies, they are highly proficient at integrating organisational, operational and manipulative skills. They apply organisational skills when, for example, planning, communicating and managing resources and activities. They apply operational skills when they arrange and use equipment and work areas: for example, a sand pit, oxy-acetylene equipment or sewing machines. They apply manipulative skills in a purposeful and controlled way when, for example, they dig in a sand pit, cut steel with oxy-acetylene equipment, or use a sewing machine to join fabric.

Students show competence and confidence with computers and acquire operational skills, knowledge and understanding of computer technologies in a systematic and structured way. They select appropriate computer-related skills for use in other aspects of their learning and lives. They use computers in the technology process, in manipulating digital materials, in creating information-based products or as part of a specific system.

Students operate and manipulate technology in a safe and healthy working environment. They demonstrate application of appropriate health and safety procedures when working with technology and are aware of their personal limitations when selecting and using technology.

Students may, for example, select and use specialised equipment to shape and join materials when carrying out their designs; use suitable equipment and safety procedures to cut, slice and peel fruit; apply soldering techniques when joining links to pendants and earrings to make durable and appealing joints; or produce screens for a computer game.



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## TECHNOLOGY IN SOCIETY

**7** Students understand how cultural beliefs, values and ethical positions are interconnected in the development and use of technology and enterprise.

When exploring the potential of technology and enterprise, students identify and take into account the cultural beliefs, value systems, abilities and ethical positions that affect the development and use of technologies. They examine and develop their own beliefs, values and attitudes, while also using their understanding of those held by individuals, families, groups and society.  They account for these and their interconnectedness when making decisions that ensure solutions are ecologically sustainable and meet the needs of all stakeholders.

Students are aware that technological developments inevitably have consequences. They evaluate the appropriateness of technologies on ethical and moral grounds, as well as considering economic advantage and the suitability of products, processes, systems, services and environments for individuals and groups at local, national and international levels.  They understand that suitability may be affected by the beliefs and abilities of individuals, or the cultures and values of groups within society.

Students may, for example, discuss reasons why particular groups in the community may wear certain types of clothing and assess the implications for designers; examine issues concerning 'plastic money' in society; analyse how fast-food advertising may influence family values and household expenditure; or simulate a recycling program to predict effects on the environment and waste disposal processes.

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# Scope of the Curriculum

## PHASES OF DEVELOPMENT

*In this section, the scope of the curriculum is described at four overlapping phases of development, with information on how student learning in Technology and Enterprise may develop from kindergarten to year 12. The learning and teaching described in each phase typify the experiences most students should have. Examples are provided under the outcome headings 'Technology Process', 'Materials', 'Information' and 'Systems' and incorporate Technology Skills, Enterprise and Technology in Society, reflecting the integrated way in which learning experiences should be developed.*

*As students progress through the phases, it is important that they be provided with challenges that entail increasing complexity and sophistication. Ultimately, students should develop a holistic view of Technology and Enterprise that encompasses an awareness of its impact on individuals, societies and environments. By considering this section, teachers obtain an increased awareness of the types of learning experiences which enhance students' achievement of outcomes in each phase of development.*

## EARLY CHILDHOOD
### (typically kindergarten to year 3)

Children in the early childhood years display curiosity about many aspects of their world, including about how things work. They develop a growing awareness of themselves as members of families and communities. The dependence of people on technology is familiar to young children and many come to school having experienced technologies commonly available in their homes and immediate communities. Young children use their toys to imitate the systems they see around them. They come to school with a wide knowledge of what technology can do, but with much less knowledge about how it works and is developed, created or modified. Children's personal levels of competence need to be nurtured and stimulated to help them make connections between their existing knowledge, skills and experiences and new knowledge, skills and experiences.

### Technology Process

Although students have the ability to design things, they do not, in the early stages of this phase, perceive discrete stages in designing. Their use of the technology process is a mixture of thought and action. Learning and teaching programs should include opportunities for design tasks to result from play situations and for students to produce approximations of their original intentions using a range of strategies. Knowledge of technology also can be developed through play: for example, play with blocks or recycled materials can be used to develop students' understandings of shape, form and structure in the built environment.

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Students need to be encouraged to continue to use trial-and-error to generate ideas. They will use drawings and models to present ideas and to explain to others what they have done. As they develop, students should be guided to apply the technology process in more deliberate and planned ways. They begin to recognise that needs and opportunities can be met through technology. Learning and teaching programs should encourage students to recognise that there are stages in production, such as collecting the materials needed, cutting the shapes required and joining them together to complete a design.

When guided through questioning, students can explain how their products work, make suggestions for improvements to their designs and technology processes and tell others how they feel about what they have done. When evaluating their solutions, they recognise that these are identifiable with their original intentions.

Learning and teaching programs develop skills for the use of tools such as scissors, paint brushes, hand-held saws, hammers, drills, staplers, cool glue guns, sewing machines or cooking equipment. Students begin to develop understanding of how to use tools carefully and safely. They may, for example, perform simple equipment maintenance, such as cleaning after use, or develop an understanding of the need to use, store and care for equipment so that it works properly and safely. They also learn to share materials and equipment and understand that resources and materials may be limited. Students begin to recognise the importance of recycling materials and disposing of technology in appropriate ways.

## Materials

Students need to practise the selection and use of common materials, such as clay, plastics, metals, paper, cardboard, wood, fabrics, building blocks or string. They use these to build models or products that perform specific functions: for example, movement, decoration, support or sound production. Learning and teaching programs should enable students to investigate the properties of materials readily available in their homes, schools and communities. Through this they develop an understanding of materials, by handling, identifying and classifying everyday items.

Students select materials for particular purposes on the basis of such features as texture, flexibility, strength, smoothness or shape. They identify different parts of objects and the materials from which they are made from. They can explain and understand why some materials are more appropriate for particular functions than others. Students begin to display initiative by modifying designs when they find more suitable materials than those originally selected. They need to practise manipulating materials by shaping, moulding, joining, colouring and finishing in ways appropriate to their designs, production methods and intended uses.

## Information

Students need opportunities to find, gather and store information. They use oral language, text and simple images such as diagrams, maps and photographs, audiotapes and videotapes and analogue or digital displays. Students develop skills that allow them to specify, gather, sort and analyse information. These skills help them to identify and investigate how technologies can help people. They examine how people use information at work, at home and for recreation and, through this, recognise the importance of information in their lives.

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Students will require opportunities to use appropriate techniques when accessing, recording and presenting information from a variety of sources, such as sounds, words and graphics. They require guidance in their operation of information technologies such as telephones, calculators, cameras, videocassette recorders or computers. Learning and teaching programs should enable students to describe simple ways in which people use, construct, present, store and transmit information and begin to access, record, use and manage information when producing information products.

## Systems

Students should be given opportunities to identify, assemble, use and control simple systems. Examples include systems involved in making models or sewing a storage container, or when building and testing mechanisms that create movement in toys. To enhance their understanding of systems, students, with guidance, identify and investigate systems in their immediate environment. They may consider communication, energy, mechanical, management, transport and cooking systems.

Students should be able to describe the basic parts of systems, their functions and the relationship between their components. When investigating the role of systems in society, students talk about their importance and relate examples of systems, such as a postal service, to their lives. They evaluate the importance of people in systems by examining the roles of, for example, medical personnel, crosswalk attendants or retail staff. Students should have opportunities to control simple systems to, for example, record sounds with a tape recorder. They also identify simple causes of system failure, such as human error, broken parts or power loss.

## MIDDLE CHILDHOOD
### (typically years 3 to 7)

Students at this phase can differentiate between fantasy and ideas that might be realised in the real world. They require encouragement to maintain and develop the ability to speculate, while being provided with a framework of knowledge, constraints and practical limitations. Students want to know how things work and want to make things that work, so it is important that the technology process has a practical and real-life focus. Enterprise is encouraged through students' work with real products, materials, information and systems and application of the technology process to the development of real solutions.

### Technology Process

With teacher guidance, students develop their own version of the technology process to produce and evaluate solutions to challenges they have identified. Solutions should meet functional and aesthetic requirements. Students need to use a range of design strategies, including diagrams, computer graphics, scale models, prototypes, discussion and written instructions, to generate designs that can be used by others. Students recognise the different elements of the technology process through opportunities to complete elements step-by-step: for example, investigate, devise, produce and evaluate.

Students develop the understanding that elements of the technology process are interdependent but do not necessarily occur in a particular sequence. They should work in an environment that continues to support divergent thinking and the development of a variety of solutions through the promotion of imagination and enterprising attitudes and behaviours. Learning and teaching programs should provide structured opportunities for students

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to develop technology skills when engaged in the technology process, using, for example, hand-held tools such as saws, hammers or drills, staplers, kitchen utensils, gardening tools, glue guns or computer hardware and software. They need to receive guidance in taking appropriate precautions and adopting safe work practices.

Through opportunities to explore a wide range of past and present technologies, students identify key design features and functional aspects of technologies. These may include aesthetics, environmental effects, balance, symmetry, colour, line, shape, size, ease of handling and cleaning or effective operation. They recognise that technologies have applications and effects in environments other than their own. They begin to identify advantages and disadvantages of technologies, in terms of, for example, energy used, by-products, operation and disposal. Students begin to justify their design selections on the basis of suitability to environments and lifestyles. They understand that technologies appropriate for one community, culture or environment may not be appropriate for another. Students select products and processes that minimise impact on the environment and take people's needs and wants into account.

**Materials**

Students need opportunities to practise selecting materials, relating their properties to design and matching properties to intended use. They examine the properties and alternative uses of a range of materials, describing the ways in which materials can be altered. They select tools, equipment and techniques that are appropriate to altering materials, effectively manipulating, finishing and using them with increasing accuracy to achieve their specifications for function and aesthetics. Students need opportunities to trace the origin and development of materials to enhance their understanding and informed selection when developing technologies appropriate to individuals, communities and environments.

When considering design requirements, students test materials for their functional and aesthetic properties as well as their suitability for different environments. They represent findings in a variety of ways appropriate to their development, using, for example, text, diagrams, tables, charts or computer displays. Learning and teaching programs should provide students with opportunities to identify innovation and creativity in the development of materials, and to identify potential for further refinement and development of materials in response to changing needs.

## Information

Students need opportunities to create information products and processes designed for particular audiences:  for example, they may develop safety, care and maintenance instructions for a carer of enclosed animals. Through examination of a range of information products and processes, students come to understand that the meaning made by audiences is influenced by specific forms, structures, styles and presentations.  When preparing to develop information products and processes for intended audiences, students need opportunities to select and use appropriate techniques to access, record, use and manage information that enable them to be critical when making choices to achieve desired effects:  for example they use a digital camera, computer and appropriate software to prepare a report for the school newsletter about students' success at an inter-school athletics carnival.

By adopting recognised procedures, languages and conventions, students enhance the quality of their information products and processes and their impact on specified audiences. By investigating the impact of information technologies on society, students begin to examine some ethical and legal issues related to, for example, plagiarism, copyright and censorship.

## Systems

Students need opportunities to develop and test systems, select and use appropriate resources, equipment and techniques:  for example, they organise and assemble the components of a public address system for the school fête, ensuring that the placement of speakers and the system's volume enable announcements to be heard by all. Students investigate the origin, nature and operation of a range of human and physical systems (such as communication, energy, mechanical, structural, electronic, organisational or entertainment systems) determining how cause-and-effect relationships occur among the systems' elements.

Learning and teaching programs should provide students with opportunities to develop models of systems and explain how systems or components of systems work together to achieve an intended outcome. In doing so, students have opportunities to apply concepts and skills from other disciplines and learning areas, and to organise systems in order to realise opportunities, such as fund raising for school excursions.  They develop the understanding that feedback mechanisms exist between the inputs and outputs of a system and can be controlled to manage the system's performance:  for example, when they design and build a labelled storage system for class resources, they incorporate features that indicate when it is full and identify missing resources.

MIDDLE CHILDHOOD

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## EARLY ADOLESCENCE
### (typically years 7 to 10)

Students at this stage appreciate the factors that determine technological development such as social attitudes, research and development, controls and regulations. They critically assess many aspects of their technological world, understand the effects of actions on others and develop reasoned arguments related to ethical and practical issues, such as cloning. They are objectively critical of their work and make comparisons with similar commercial products.

Students' approaches to Technology and Enterprise are more diverse than in previous phases, as their interests and knowledge of their future lives, including potential career choices, are expanding. Students will increasingly specialise in particular contexts, including agriculture, business, computing, design and technology and home economics. As a result of this exposure, they begin to show interest in and aptitude for specific technologies and, within these contexts, students recognise the need to work collaboratively to achieve more complex technological goals.

While continuing to demonstrate enterprising behaviours, students recognise the relationship between technology and enterprise, and gain experience in the nature and operations of business. They can acquire enterprising behaviours through the simulated conduct of a business in an educational environment, or similar activities.

**Technology Process**

Students further develop their understanding of investigating, devising, producing and evaluating through opportunities to apply more complex versions of the technology process in sequences designed to achieve optimal results and develop products to specified standards. They understand the significance of the relationship between parts of the technology process, and apply the process to the development of solutions.

Students should be encouraged to maintain the capacity to think creatively and to devise multiple solutions for technology challenges when applying the technology process. They continue to develop their ideas in an environment in which they have increasing control over their selection and application of elements of the technology process, particularly design. All ideas are accepted and valued as they work towards devising and evaluating a range of solutions and means of realising opportunities. When making products, students should work to specified standards. They should continue to develop technology skills when engaged in the technology process, using, for example, electric hand tools and powered implements such as rotary hoes, lathes, welders, soldering irons, sewing machines, fax machines, scanners, digital cameras or graphics calculators.

Learning and teaching programs should provide opportunities for students to understand that technology is pervasive in society and that many types of technology are used and valued. By investigating how technologies are developed, adapted and used by different individuals and communities, students come to understand that needs are met in different ways.

Through these understandings they recognise the significance of individual and group values in determining how technologies are used, developed and modified to meet needs. Students examine the relationships between individual, family or community needs and the availability, types and costs of resources when analysing the development and application of particular technologies.

## Materials

Students need to examine how the properties of materials used in products meet the functional, aesthetic and environmental requirements of particular communities. When exploring alternatives, students apply knowledge of the properties of materials to achieve planned results and effects. They exercise choice by applying their understandings of the physical, chemical and aesthetic properties of materials when engaged in the technology process. Students further develop their understandings of the physical and chemical properties of materials through detailed investigation. They also critically examine the social and environmental impacts and consequences of the use of a wide range of materials. These investigations contributes to students' abilities to use materials to work to specified standards.

## Information

Students should have opportunities to explain how different ways of presenting and transferring information affect how it is used and the impact it has on the recipient. Issues they consider include time available to locate and view information and the amount, value and complexity of information. Students also explain how the effectiveness of information transfer is determined by a range of factors, including rate, creativity, impact and interest.

Students identify a variety of forms of information and understand how the structure of particular forms is developed. They examine needs and opportunities and use information technology and techniques appropriate to them. Opportunities to develop and apply information skills are accessed across all learning areas and students develop a level of computer literacy that enables them to function efficiently and effectively in their home, school and community environments. They develop skills and understandings in the operation of computers that provide a basis for application in future workplace environments.

## Systems

Learning and teaching programs should provide students with opportunities to investigate the elements, structures, sequences, operation and control of systems and determine how these influence the way people interact with systems and their environments. When considering the operation and maintenance of systems, students examine their impacts on individuals, communities and the environment, focusing on their principles, structure, logic, organisation and control and considering how and why different systems have been developed.

Students investigate the components of systems and how they have been developed in an attempt to improve quality of life by saving time, energy, materials and resources. Students evaluate the positive impact of systems on individuals, communities and environments as well as identifying unexpected and harmful impacts. They investigate changing patterns of resource use in relation to innovative systems; the requirements for developing, distributing and marketing systems; and the resulting changes in lifestyles, work patterns and wealth distribution.

## LATE ADOLESCENCE/ YOUNG ADULTHOOD (typically years 10 to 12)

Technology and Enterprise outcomes at this phase will be achieved through a range of delivery structures and pathways. These may include schools, industry, structured work-based learning, universities, TAFE and other vocational education and training (VET) providers. This allows young adults, who are becoming increasingly independent, to exercise control over their learning environment and pursue interests that are relevant to them. It also provides avenues for students to continue to learn about enterprise through real contacts with businesses. Enterprise at this phase will feature a high degree of experiential and ethical behaviour and the development of credibility that maximises success.

Students' interests and aptitudes in Technology and Enterprise at this stage are significantly modified by general or specific vocational aspirations. Some will choose to continue their studies in this area because of a recognition of its importance to their future lives and careers. Others will choose vocations that are technological in nature and so continue to advance their level of technological literacy and capability through work within a range of institutions. Students' development, use and modification of materials, systems and information will be in the context of the programs of study they select on the basis of their interests and aptitudes.

Students develop a world view that reflects concern for the interplay among technology, society and the environment. They understand the implications of technologies and critically examine the potential of emerging technologies. They recognise that technology is not value neutral and appreciate the extent of the constructive or destructive impacts of technology. They understand how markets and enterprises can be manipulated by and for technological activity.

**Technology Process**

At this level students' use of the technology process is complex and sophisticated. They examine ideas by means of scientific, mathematical and social analysis. Students should be further empowered to control their selection of challenges and opportunities in a learning environment in which they can select and apply elements of the technology process largely autonomously. Development of solutions involves consideration of a range of functional and aesthetic requirements, research into and recognition of client and market needs, and the social and environmental consequences and ethical implications of proposals.

Students' application of the technology process increasingly draws on concepts and knowledge from other disciplines. They should have exposure to a range of solutions widely accepted and recognised by society as meeting human needs and realising opportunities. They should continue to develop the capacity to develop and adapt technologies and realise opportunities. Students should work in an environment in which there are no predetermined solutions and the development and application of the technology process is valued highly.

Their emphasis is on the completion of the processes and the evaluation of solutions and products as a means of identifying further challenges and opportunities. Students' activities in achieving goals meet occupational health and safety requirements and the products developed equate to commercial standards of quality, presentation and performance. Students develop technology skills when engaged in

the technology process, using a range of industrial equipment with the exception of chain saws and nail guns.

## Materials

Students investigate how the form and structure of both new and traditional materials relate to their functional, aesthetic and environmental properties and apply their understanding to conservation and recycling issues. They also apply complex techniques and skills to process materials and produce results to a commercial standard of quality and presentation that meets the requirements of clients or intended users.

## Information

Students' modelling of ideas can be sophisticated and they use a range of media to present ideas and trial solutions. Plans and reports are produced in a form appropriate to the intended audience and information is critically evaluated in terms of stated requirements and commercial standards. Students develop and use specialised techniques to create and transmit information.

Student proposals for technological development reflect a sense of innovation and contain detailed specifications, presented in appropriate graphical and technical language and complying with the relevant conventions.

## Systems

Students analyse complex systems, such as cellular telephone networks or life support systems, in order to critically evaluate or justify the development and application of specific systems, and to consider their social and cultural effects. They become skilled in using integrated and programmable systems and develop, test and build models of systems; operate and modify systems that achieve commercial standards; and investigate causes and effects within them. They may use qualitative and quantitative methods to analyse their performance in terms of, for example stress, or outputs, and seek to improve the efficiency and effectiveness of systems on the basis of these performance data.

# Learning, Teaching & Assessment

*This section outlines principles of learning, teaching and assessment that are applicable to the Technology and Enterprise learning area. The outcomes of this learning area are best achieved in an integrated way by providing students with opportunities to address challenges that satisfy their individual needs and relate to their environments and phases of development.*

## LEARNING AND TEACHING

### ■ *Opportunity to learn*

**Learning experiences should enable students to observe, select and use the actual processes, products, skills and values that are expected of them.**

Students need to work on open-ended tasks as they investigate, evaluate, create, adapt, select and use technologies. They should see technology as something that is designed to meet real-life needs and have access to a range of examples that clearly demonstrate this aspect of technology. Students will require opportunities to evaluate the impact of technologies in the context of history and to integrate learning within the learning area as well as to apply learning from other disciplines, subjects and learning areas. Enterprising skills and behaviours will be developed largely through the realisation of opportunities. Students also will need opportunities to observe, practise, select and use a range of skills, equipment and techniques. Teacher modelling of safe and effective use of equipment (for example, a bandsaw, a glue gun or a sewing machine) will be useful in this respect, as will modelling of strategies such as those related to safety, quality control, decision making, finding and using information, and creative and critical thinking. Wherever possible, learning should be directly related to the technology process so that the relevance of skills is evident to students.

### ■ *Connection and challenge*

**Learning experiences should connect with students' existing knowledge, skills and values while extending and challenging their current ways of thinking and acting.**

Challenges most likely to extend students' current ways of thinking, acting and valuing in relation to Technology and Enterprise will be those that are directly related to their life experiences. Students will require opportunities to connect new experiences and ideas about technology and enterprise to what they already know, reconstructing their knowledge when necessary. This means that the conceptions of individuals need to be taken into account in facilitating challenges for students: for example, in examining issues related to the disposal of technologies, students' initial perceptions of the ultimate value of such items as television sets, computers or cars may need to be readdressed. Students will more readily extend their capabilities

through the development of challenges that increase their range of experience in contexts ranging from personal to family, community and society. Through examination of technologies in such contexts, students' learning is extended from meeting their own needs to meeting the needs of others.

### ■ *Action and reflection*

**Learning experiences should be meaningful and encourage both action and reflection on the part of the learner.**

A key principle of Technology and Enterprise is that students will engage in and learn about the processes of discovery and idea construction in order to develop solutions and realise opportunities. While some activities may centre on strategies that are guided by the teacher, it is essential for students to have opportunities to develop their own challenges and solve them in their own ways. Activities should give students opportunities to develop cognitive skills such as creativity, problem solving, idea generation, reflection and evaluation. Development may be supported by strategies such as explicit teaching, modelling, group work and individual research. Students also require guidance to constantly question their thinking and results when implementing the technology process. Teachers can assist students by, for example, asking them 'What's next?', 'What is...?' or 'How can you do that differently?'

### ■ *Motivation and purpose*

**Learning experiences should be motivating and their purpose clear to the student.**

Students will be more highly motivated to learn when they can see the purpose and relevance of activities and are able to understand what is expected of them. Involvement of students in planning learning experiences is a useful way of ensuring high levels of motivation and clarity of purpose and expectations. Students' learning will be enhanced when they are able to implement the technology process in response to challenges that are relevant and real to them. It should be made clear to students that, when they are engaged in the technology process, development of their ability to implement this process is at least of equal value to the resulting products. When they are encouraged to apply critical and creative thought to open-ended tasks, students will have optimum opportunities to achieve the outcomes of the learning area. That these tasks are open ended and will require considerable thought, inquiry and discussion needs to be made clear to students so that they are well aware of the purpose of technology challenges and are motivated to develop and implement the technology process to meet such challenges.

■ *Inclusivity and difference*

**Learning experiences should respect and accommodate differences between learners.**

Providing students with opportunities to select the ways of solving their own challenges and problems allows them to adopt their preferred learning styles and for individual differences to be accommodated.  In doing so, teachers should note that students will need varying amounts of support and guidance to successfully implement the technology process.  They will require encouragement to focus on the process as well as on their products.  Teachers should be aware that culture is a key determinant in technological needs.  The cultural backgrounds of students should be accommodated as they identify needs and apply the technology process.  Through their activities, students learn to value and respect diversity, and to be critical, analytical and constructive about different points of view.  They also can use their understandings of similarities and differences to advantage when generating ideas designed to meet needs and realise opportunities in ethical and responsible ways.

■ *Autonomy and collaboration*

**Learning experiences should encourage students to learn both independently and collaboratively.**

It is necessary for individuals to develop their own solutions to technology problems, as this helps to ensure a personal grasp of concepts, processes and skills and is important in the development of qualities such as initiative and self-reliance.  Students also need to work extensively in groups to encourage the development of enterprising behaviours, such as flexibility and innovation, and the ability to work cooperatively with others.  Working with peers allows for ideas to be challenged and clarified and provides opportunities for collaborative appraisal of processes and products.  Family, community members and other people can provide valuable resources that allow students to identify needs outside the immediate environment of the school, as well as supplying expertise and resources.  The development of such links is important in establishing new contexts and increasing the relevance of student learning.  Through a wider involvement students appreciate that they can learn from all individuals and groups in the community.  This will help them to gain a broader perspective and understanding of the attitudes, values and achievements and processes adopted by others.

### ■ *Supportive environment*

**The school and classroom setting should be safe and conducive to effective learning.**

Students will feel more confident in implementing the technology process to develop solutions if they are able to assess and then take risks without fear of failure. They will be encouraged to try, evaluate or develop technologies and adapt them to new uses. When students work on open-ended tasks with no preconceived solutions they will have greater opportunities to become successful autonomous learners. This will lead to better implementation of the technology process in a range of settings in the future. Such learning environments also will support and foster the development of an enterprising ethos. Students need to work in safe and adequately-supervised environments that meet occupational, health and safety regulations. Because they will use of a wide range of tools, materials, systems and information, students need to be sufficiently competent in handling them to minimise the risk of injury or breaches of copyright and legal constraints.

# ASSESSMENT

## ■ *Valid*

**Assessment should provide valid information on the actual ideas, processes, products and values that are expected of students.**

Professional judgments about individual student performance will be valid when they are based on a range of measures that clearly document processes and solutions, and use a wide variety of evidence. Assessment should focus on students' development, adaptation and application of solutions that meet needs and realise opportunities; and their progress in attaining the knowledge and practical skills that support this process. Suitable assessment would include student self-evaluation; student journals; teacher reflection on interaction with individual students (e.g. records of interviews and annotations); and the students' interactions with other components of the learning environment (e.g. group interactions and attitudes displayed). Ultimately the validity of the assessment centres on teachers' knowledge of students, so assessment should not be confined to checklists and numerical analysis. As much learning in Technology and Enterprise incorporates group experiences, the contribution and attainment of individuals is likely to vary and it is important to encourage reflective thinking and to include a degree of self-and peer-evaluation in assessment practices.

## ■ *Educative*

**Assessment should make a positive contribution to students' learning.**

Assessment is integral to development of the technology process and can be used both formatively and summatively as well as for diagnostic purposes. Summative evaluation should be reported with reference to the context of learning. Assessment should emerge naturally from the tasks in which students are engaged, rather than being an additional feature of curricula or directing curricula. Assessment activities should be educationally valuable in their own right, such as when evaluating students' technological processes and products. They should contribute directly to encouraging long-term learning, encourage risk-taking within negotiated parameters and the gathering of formative data, and be based on a close relationship between teachers and students.
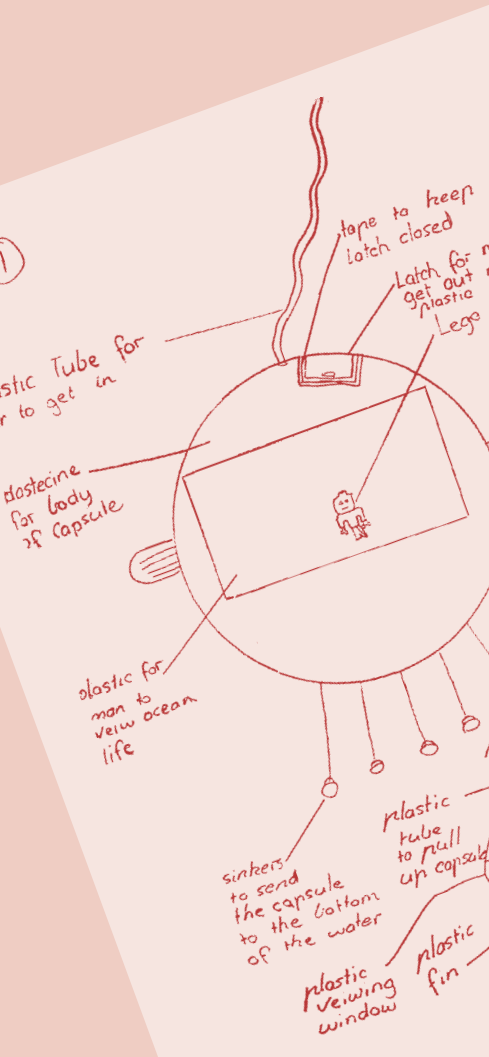
■ *Explicit*

**Assessment criteria should be explicit so that the basis for judgements is clear and public.**

Students benefit from receiving clearly-stated and visible assessment criteria before commencing an activity. These criteria should reflect outcomes and increase the focus on student-based learning, empowering students by increasing their awareness and enabling them to reflect on how their individual learning is proceeding. Students should be afforded opportunities to negotiate assessment with teachers as they develop their own technology processes to solve challenges or realise opportunities. When assessment is negotiated in this way it will more closely reflect individual students' learning.

■ *Fair*

**Assessment should be demonstrably fair to all students and not discriminate on grounds that are irrelevant to the achievement of the outcome.**

Assessment should be based on public criteria and should contribute to ensuring that each individual reaches his or her potential, regardless of circumstances. Assessment should be demonstrably fair to all students and not disadvantage some students on irrelevant grounds such as ethnicity, gender or disability. Students' differing cultural backgrounds will contribute to their meeting a range of technology challenges and assessment that is fair will take into account such differences. Fair assessment also will ensure that students are not disadvantaged as a result of differing abilities that are not relevant to what is being assessed.

■ *Comprehensive*

**Judgements on student progress should be based on multiple kinds and sources of evidence.**

Assessment of individual student performance should be based on a range of measures that use a wide variety of evidence and clearly document the process and the solution. Teachers should maintain comprehensive documentation that enables them to reflect on student learning across a range of activities. Measures used should provide an accurate portrait of the student and form a detailed portfolio of assessment that enables teachers to make initial holistic judgements and then refine these judgements. Thinking and decision making processes are important aspects of learning in this area. The only way the teacher can see (and hence evaluate) this process is for the students to record their thoughts (in written or graphic form) as they proceed. This record of thinking gives the teacher the opportunity to map students' cognitive development and plan tasks to promote this development, and may include journals, diaries, interviews and portfolios.
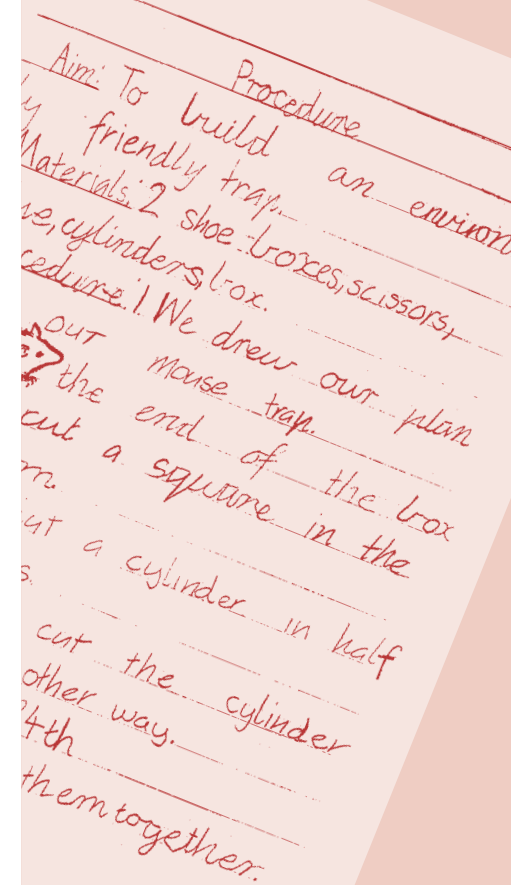
# Links Across the Curriculum

*It is important that the Technology and Enterprise Learning Area is considered in the context of the other learning areas and that learning programs are implemented that reflect a holistic view of the curriculum.*

## LINKS TO THE LEARNING OUTCOMES IN THE OVERARCHING STATEMENT

Links to the Overarching outcomes occur as follows:

**1**

*Students use language to understand, develop and communicate ideas and information.*

■ It is necessary to communicate design ideas and implementation instructions using language which is both sufficiently rich to do so efficiently and sufficiently simple to ensure a broad acceptance.  (Outcomes:  direct 1; indirect 2, 3, 4, 5, 6, 7)

**2**

*Students select, integrate and apply numerical and spatial concepts and techniques.*

■ The technology design process requires students to select and apply spatial and/or numerical concepts and techniques.  (Outcomes:  direct 1, 2, 3, 4, 5, 6)

**3**

*Students recognise when and what information is needed, locate and obtain it from a range of sources and evaluate, use and share it with others.*

■ The technologies for handling information are both a focus for the learning area and necessary for the technology design process:  in particular, the use of computers to locate, obtain, manipulate and publish information is fundamental.  Also, the technology process requires students to use, evaluate and share information when designing and developing products to meet human needs.
(Outcomes:  direct 1, 3; indirect 2, 4, 5, 7)

**4**

*Students select, use and adapt technologies*

■ A major focus is that of students making use of technologies and developing technologies by adaptation. By gaining familiarity with and competence in the use of a range of technologies, students make decisions about when to use a technology to meet a human need.  (Outcomes:  direct 1, 2, 3, 4, 5, 6, 7)

**5**

*Students describe and reason about patterns, structures and relationships in order to understand, interpret, justify and make predictions.*

■ In making decisions about technology, students consider logical and physical patterns, structures and relationships.  In creating their own designs, they make predictions based on these considerations.
(Outcomes:  direct 1, 2, 3, 4, 5, 6; indirect 7)

■ Students develop enterprising behaviours and understandings that allow them to recognise opportunities. They then apply design processes (including lateral thinking, visualisation and the evaluation of alternatives) to realise the potential of those opportunities. (Outcomes: direct 1, 5, 7; indirect 2, 3, 4, 6)

■ Understanding and appreciating the technological world, and employing skills and understandings to make decisions about the development and use of technologies is fundamental to the Technology and Enterprise learning area. The technology design process requires many decisions to be made that are based upon understandings of technologies and the environments within which they are implemented. (Outcomes: direct 1, 2, 3, 4; indirect 5, 7)

■ It is important that students understand their social and cultural worlds in making decisions about the development and use of technologies. In many situations, they are involved in the design and development of solutions to problems in their local environment. (Outcomes: indirect 1, 2, 3, 4, 5, 7)

■ Technologies are developed and used by most peoples of the world but their implementation may vary between cultural groups. The development of communication technologies has led to the concept of a global community. Students use these technologies to interact with and contribute to this community in the design and development of solutions. (Outcomes: indirect 1, 3, 6, 7)

■ The design, development and use of technology require students to engage in creative activity and build on the intellectual work of others.
(Outcomes: direct 1, 5; indirect 2, 3, 4, 7)

■ Students live in a society characterised by new and changing technologies. Understanding them and developing expertise in selecting, using, creating and adapting them safely and carefully assist students to make informed decisions, have a positive self-image and remain safe and healthy. (Outcomes: direct 7; indirect 6)

■ Technology is designed, developed and used individually and collaboratively. The technology design process encourages students to be self-motivated and they develop confidence as they bring their designs to fruition. (Outcomes: direct 1, 5, 7).

■ Students understand that individuals and communities have different attitudes towards particular technologies and respect the rights of those who have attitudes different from their own. They design and develop solutions in collaborative environments which respect the ideas and wishes of others. When using, developing or adapting technology, they use techniques, tools and equipment and take appropriate precautions to ensure that they, others. and the environment remain safe and healthy. (Outcome: direct 7)

## LINKS WITH OTHER LEARNING AREAS

The Technology and Enterprise learning area can contribute to, and gain from, the learning outcomes in other learning areas. It is envisaged that students may often be provided with experiences which allow them to demonstrate achievement in Technology and Enterprise learning outcomes and one or more of the other learning areas. These links to the other learning areas are complementary in that:

• Technology and Enterprise understandings may be required by students in their demonstration of learning outcomes in other learning areas;

• the technology process involves the application of skills and understandings which are applied and reinforced across other learning areas;

• social values and implications can be further clarified and analysed in the contexts of other learning areas; and

• students use technologies, particularly those based on computers, in learning activities provided by other learning areas.

**The Arts**  ■ Technology and Enterprise links to The Arts in the following ways:

• in music, media, multimedia, art, craft and stagecraft in particular;

• a range of materials and technologies is applied to the development and support of artistic outputs; and

• a strong focus on design principles and processes is shared between the two learning areas.

■ Technology and Enterprise links to English in the following ways:

- the collection, evaluation, management and communication of information is important in the technology process, which relies on skills and understandings primarily developed in the English learning area; and

- the outcomes in Technology and Enterprise are enhanced by the inclusion of technology-related language.

■ Health and Physical Education outcomes, including a concern for nutrition, personal growth (physical, emotional, intellectual, and emotional), health and safety and the development of interpersonal skills may be enhanced by learning activities provided by Technology and Enterprise. The Technology Process and Technology Skills can be applied when achieving Health and Physical Education outcomes.

■ The LOTE learning area has outcomes concerned with cultural understanding and the development of communication skills which have close links with the technology in society outcome in Technology and Enterprise.

■ In Mathematics, students develop understandings and skills in problem solving, spatial concepts, measurement and analysis which enhance outcomes associated with the technology process, materials and systems in Technology and Enterprise.

■ Technology and Enterprise links to Science in the following ways:

- scientific knowledge is applied to the development and use of technology;

- an understanding of the properties of materials, systems, energy supply, transfer and control, and organisms is applied in developing technology to meet human needs;

- the manipulation of resources, such as natural and synthetic materials and energy, is enhanced by a knowledge of the relationships among properties, materials and energy and their use; and

- an understanding of how organisms grow, reproduce and change is used in the development of a range of technologies and in evaluating the impact of technology on the environment.

**Society and Environment**

Technology and Enterprise links to Society and Environment in the following ways:

- both areas include outcomes related to the use of resources, impacts on the environment and working in enterprising ways; and

- the process of technology includes evaluation in terms of environmental and social impacts. When considering particular technological solutions, students assess the short- and long-term consequences of a technology on the environment, society and culture for which is was designed.