

Safety and Technology Education

A Guidance Manual
for New Zealand Schools

Ministry of Education

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Foreword

Safety and Technology Education: A Guidance Manual for New Zealand Schools provides teachers and boards of trustees with the information necessary to establish sound health and safety policies and procedures for technology teaching.

This manual interprets and applies the Health and Safety in Employment Act 1992 as well as other relevant Acts and Regulations within the context of technology teaching in New Zealand schools. The manual also refers to other statements with which teachers and boards of trustees should be familiar, especially National Administration Guidelines 3 (iii) and 5.

The technology curriculum differs in several important ways to the syllabuses it replaces. While the traditional areas of food technology and materials (fabric, wood, and metal) technology are important elements of the new curriculum, the essential learning area of technology also includes biotechnology, electronics and control technology, information and communication technology, production and process technology, and structures and mechanisms technology. The curriculum, starting in year 1, involves much younger students in technology education, and an important focus is visits by school students to industrial and commercial sites. The increased scope of the technology curriculum means that teachers need to consider a much greater variety of potential hazards when developing programmes for students.

The statement *Technology in the New Zealand Curriculum* is based on a model of students learning technology by becoming involved in, and aware of, current technological practice. It is important to consider the safety of those who design and manufacture any technological product as well as that of the end-user of that product, system, or environment. In technology education, this means planning for the safety of students and teachers while they are involved in technological activities and also for that of people using their technological outcomes. This view is reflected in the curriculum statement itself, in Strand B, achievement objective 6b.

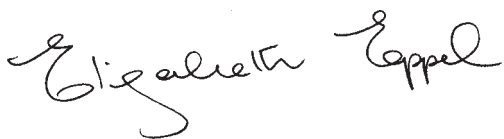
Within a range of technological areas and contexts, students should produce technological solutions. They will, with reference to identified needs and opportunities, produce technological outcomes to agreed quality standards, managing time, and using human and physical resources skilfully, safely, and effectively.

Technology in the New Zealand Curriculum, page 35

The purpose of this manual is to provide teachers with safety guidelines, safety information, and a process for building safety procedures into their technology programmes and practices. However, it should not be assumed that the warnings and precautions stated in this manual are all-inclusive. In some situations, teachers need to use their professional judgment and seek additional information to prevent unsafe classroom practices occurring.

Boards of trustees and principals will want to ensure that procedures and practices are developed within their school in keeping with the guidelines to ensure the health and safety of their students and staff.

I am grateful to all those who have contributed their experience and expertise to the development of these guidelines.



Elizabeth Eppel
Group Manager
Ministry of Education

Introduction

Safety and Technology Education: A Guidance Manual for New Zealand Schools was designed to help classroom teachers take an active role in planning for the safety of their students and themselves when involved in technology education activities. Planning for health and safety should be part of regular classroom practice. It is an integral part of technological practice. The curriculum statement *Technology in the New Zealand Curriculum* is based on a teaching model of students undertaking technological activities. In this way, students both learn technology and become aware of current technological practice. In compiling this manual, several approaches to safety planning in industry have been investigated and adapted to suit classroom situations and needs. Planning for safety in technology education should thus reflect current technological practice, as promoted by the Occupational Safety and Health Service of the Department of Labour and in the *New Zealand Chemical Industry Council Premises Inspection and Certification (PRINCE) Programme*, and be viewed as an integral part of planning for teaching and learning.

As teachers develop units of work in technology education, they should use this manual to develop a safety plan that identifies the hazards involved and strategies to deal with them. This safety plan should be attached to the unit of work and become part of its documentation. In this way, teachers revisiting the unit of work at a later date have the benefit of this planning and an opportunity to add to the safety plan.

The first two sections of this manual, Planning for Safety in Technology Education and Legal Requirements and Responsibilities, set a framework for aspects that teachers need to consider when planning for safety in classroom practice. The responses required from teachers are identified in a planning sheet that is reproduced as a template in Appendix One.

The remaining sections of the book:

- document issues that teachers should be aware of when planning for safety in the different areas of the technology curriculum;
- make recommendations for teachers and boards of trustees.

Teachers planning a unit of work should first read the general information of the section relevant to that unit and then refer to any specialist information that is applicable.

The definition of safety adopted in this manual is relatively wide. The manual highlights aspects of physical, mental and emotional, cultural, and environmental safety as well as the safety of the end-users of the products developed during technology education.

Physical safety is the most obvious aspect to be planned for. If they have experience with the materials and equipment they are using with students, teachers can identify potential physical hazards such as dangerous chemicals or materials, equipment, and activities that can cause cuts, burns, or abrasions. The key to planning for safety is knowing what the potential hazards are.

In situations where students are interacting with unknown people or unpredictable sources of information, aspects of mental and emotional safety may be important. Students searching for information, especially on the Internet, may be exposed to unsuitable information or people. Teachers should ensure that safeguards are in place to protect students from hazards in this area.

A vital component of technology education is the role that society plays in the development of technology. Students need to be made aware of the societal and cultural issues relevant to the work that they are doing. This might include understanding local Māori protocols, such as determining whether it is acceptable for both sexes to carry out traditional activities like carving or weaving. In one context, it may be acceptable for a whakapapa to be recorded in writing or for a picture of an ancestor to be used in a publication; in another situation, this may not be acceptable. Technology does not take place in isolation but in a cultural setting, and part of planning a unit of work in technology should address this aspect of safety. Students should be involved in exploring these issues.

Technology affects the environment, and teachers should consider the safety of the environment when planning technological activities, particularly:

- the availability of resources and alternatives to non-renewable resources;
- waste management that includes recycling, where possible, and minimising hazardous wastes.

SECTION 1

Planning for Safety in Technology Education

Planning for safety is an integral part of all technological practice. The Health and Safety in Employment Act 1992 and its Regulations specify the requirements for safety planning in places of work. This Act and its Regulations form the basis of this manual's recommendations.

If technology education is to reflect contemporary technological practice, methods of safety planning should reflect what happens in technological practice and the relevant Regulations and standards that underlie safe practice in the different technological areas.

1.1 Identifying and Managing Risk

The booklet *Three Steps to Make Your Business Safer and Healthier* available from the Occupational Safety and Health Service (OSH) of the Department of Labour, helps businesses plan for safety by identifying workplace hazards (materials or equipment) that can cause serious harm and by planning for ways to eliminate them. It identifies specific steps in effective safety planning.

When applied within an educational context, these steps include:

- **identifying** hazards and considering the educational justification for introducing each of them;
- **assessing** whether the hazard is significant and the consequences if something should go wrong;
- **eliminating** the hazard if possible (by selecting a safer alternative if one exists);
- **isolating** the hazard from students if it cannot be eliminated;
- **minimising** the risk to students if the hazard cannot be isolated.

Hazards may be associated with the equipment or materials that students will use or with students' actions.

"picture
unavailable"

Boards of trustees are required to take all practicable steps to manage hazards. Where teachers have identified a significant hazard that the board of trustees cannot deal with, the board is required to notify the Ministry of Education. If the board fails to notify the Ministry, the board will be liable for any penalties imposed. A sample notification document may be found in the *Health and Safety Code of Practice for State Primary, Composite, and Secondary Schools*.

A number of industrial approaches that have been taken to safety planning are also relevant in educational settings. One such approach is the Premises Inspection and Certification (PRINCE) programme of the New Zealand Chemical Industry Council, which identifies hazards associated with using and storing hazardous substances, including chemicals. This programme has a strong approach to the development of safe workplace attitudes and environments.

Another publication that sets out a method for identifying hazards when dealing with students is *Education Outside the Classroom: Guidelines for Good Practice*. This book has a chapter on Risk Management Considerations which, although not specifically designed for classroom hazard control, is based around identifying hazards associated with a planned course of action with students. This document also incorporates safety of the environment in its wide definition of safety and planning.

In a school situation, hazards are often associated with inexperienced operators, either students or teachers, using equipment or materials in the process of teaching and learning.

Teacher Competence

Teachers need to be experienced enough in an area of technology to predict hazardous situations and skilled enough to prevent them. Teachers involved in general technology education activities, involving common equipment and techniques, should be expected to apply common sense in identifying hazards. Those teachers who work at a more advanced level in a particular technological area need to have a thorough knowledge in that area in order to identify the hazards associated with an activity and to plan effectively for student safety.

Student Competencies

Students need to be taught safe procedures to use when working with equipment in technology education. Ideally, students should receive training, and be assessed, in aspects relating to safety in any area of technological practice where they are working. One way to ensure student capability in practical areas of work is to design and award certificates of competency in skills that include recognising or demonstrating safety practices. An example could be in an area such as soldering.

As well as being comprehensive, instructions should be comprehensible to all students in the room, including students with special needs and those for whom English is a second language. Wherever possible, instructions to students should be:

- given orally;
- reinforced in a written record in the students' workbooks, on the blackboard, or in chart form on the classroom wall;
- modelled through teacher demonstration.

Planning for safety in technology education should be not only for classroom situations but also for educational activities outside the classroom, such as those with community and enterprise links.

1.2 A Method for Safety Planning in Technology Education

The following pages are reproduced in Appendix One on page 61 as a template for teachers to use when planning for safety in technology education.

This planning sheet is designed to help teachers to:

- identify potential hazards in planned technological activities;
- minimise risks for students and the environment.

The planning sheet is based on current industry practices which have been modified to address needs in the classroom. This planning process reflects technological practice. In filling out and following this plan, teachers will be meeting the intention of Section 15 of the Health and Safety in Employment Act 1992.

School: _____

Teacher: _____ **Date:** _____

Unit: _____

Year: _____ **Level:** _____

Technological Area(s): _____

Physical Safety

Classroom/teaching environment

In this unit, the following aspects of the teaching environment have been considered when planning for the safety of students and staff. Staff and students have been made aware of the safety aspects of this unit.

In the following form, the shaded text is an aid to teachers but is not included in the actual template in Appendix One.

	Tick or N/A	Details
Accident register checked for accident patterns?		Have you looked at the accident register to see whether any patterns of injury are associated with the activities you are planning? Only tick when you have done this. If there is a pattern, note this here and adjust your programme to avoid the activities associated with them.
Dust collection organised?		If students are involved in cutting or shaping materials, how have you arranged to collect dust from the atmosphere so that students do not breathe it in?
Electrical equipment checked?		Has the mains-powered electrical equipment to be used in these activities been checked for wear and for loose or exposed wires?
First-aid assistance available (see Regulation 4 on page 14)?		On this form, note the location of the nearest first-aid kit and whether you have checked its contents. If first aid is normally carried out by the school nurse, note this here and the times the nurse is available.

	<i>Tick or N/A</i>	<i>Details</i>
Handwashing facilities available (see Regulation 4 on page 14)?		Where are these facilities for staff and students located?
Hygiene considered?		If the activities, such as in food technology or biotechnology, require hygienic conditions with no contamination, how have you planned for this?
Lighting checked (see Regulation 4 on page 14)?		What lighting has been arranged for students working with small or intricate objects? Are computer screens sited to minimise glare?
Noise levels considered (see Regulation 11 on page 15)?		In the event of loud noise, how will you protect your own and your students' hearing?
Overcrowding considered (see Regulation 13 on page 15)?		If the space is inadequate for the number of students involved, how will you organise for all students to undertake the activity safely?
Raised objects secured (see Regulation 16 on page 15)?		If students or staff are working under heavy objects, how have you secured these objects?
Students with special needs planned for?		Are there any students who, for whatever reason, cannot participate easily or safely in the planned activities? (This includes students for whom English is a second language). If so, how do you plan to provide for their participation?
Telephone/emergency contact(s) available?		Note the location of the nearest phone and the names and numbers of appropriate emergency assistance. If no phone is available, note how you will get help in an emergency.
Tripping hazards minimised?		If electrical leads or bulky materials are needed, how will you minimise the risk of students tripping over these?
Ventilation organised (see Regulation 4 on page 14)?		If students are working with materials that produce toxic or unpleasant fumes, what ventilation arrangements have you made?
Others?		

Student personal safety equipment

Needed	Availability
List what equipment is required, such as earmuffs, safety glasses, dust coats, shoes, leather gloves, and so on.	Note where each of these items is kept, particularly if the equipment is not stored in the same area that the students will be working in.

Assessing hazards and managing risk

In the form in Appendix One, this section is in two parts. The first part is to help teachers identify hazards associated with the equipment students may use. The second is to help teachers identify hazards with the materials students may use.

The following hazards have been identified in this unit and safety has been planned for in the following ways.

Equipment or Materials

Item: Name the item of equipment or material that presents a hazard, for example, a hot-glue gun, a food processor, a bench grinder, or a restriction enzyme.
Hazard elimination/isolation/minimisation by: In this section, note how you will deal with this hazard. Will you eliminate it by substituting an alternative method or piece of equipment or material? Will you isolate it, possibly by using adults or more senior students who are competent to use this equipment or material? Will you minimise risk by undertaking a skills-teaching sequence with students to ensure that they all understand and can apply the necessary protocols of use, including the use and purpose of personal safety equipment, before using the equipment or material? If the hazard cannot be eliminated, isolated, or minimised, have you reported this in writing to the board of trustees?
Emergency procedures: Even when hazards are predicted and carefully planned for, an accident can happen. If an accident does occur with this hazard, what procedures will you take? Make sure that any resources needed to carry out these procedures are available.

Environmental Safety

General waste disposal How will you dispose of waste material from your activities? Can you reduce, reuse, recycle, or recover any waste? If so, how will you do this?
Hazardous-waste disposal This includes chemical and biological waste. How will you dispose of hazardous wastes, ensuring that you do not adversely affect the environment (or people)?

Approvals obtained

If you are using animals in your activities or are involved in producing genetically modified organisms, you require approvals from national bodies. Have you obtained these approvals?

	Tick or N/A		Tick or N/A
DNA transformations: ERMA New Zealand (see page 16)		Animals: Animal ethics advisory committee (see page 22)	

Mental and Emotional Safety

This is particularly important when students are dealing with people outside the school environment, such as when they communicate with people in industry or search the Internet. What procedures have you put in place to safeguard your students?

Cultural Safety

Have you considered the cultural aspects associated with the activities you have planned? Would any students consider some of these activities inappropriate? If so, how will you manage the class to take this into consideration?

Enterprise and Community Visits

This section is designed to ensure that teachers comply with the legislation relevant to such visits. Further information about each requirement is provided on the page numbers indicated.

Health and Safety in Employment Regulations 1995, Regulation 59

Presence of young persons on a worksite (see page 15)

Allowance under subclause 2

a	b	c	d	e
---	---	---	---	---

Health and Safety in Employment Act 1992, Section 16 (as amended in 1998)

Duties of persons with control of places of work (see page 14)

Warning of significant hazards in the workplace given

by: _____ (name the person giving the warning)

to: _____ (name the person in charge of the students to whom the warning was given)

Consumer Safety

Health and Safety in Employment Regulations 1995, Regulations 66 and 67

Duties of designers, manufacturers, and suppliers of plant (see page 15)

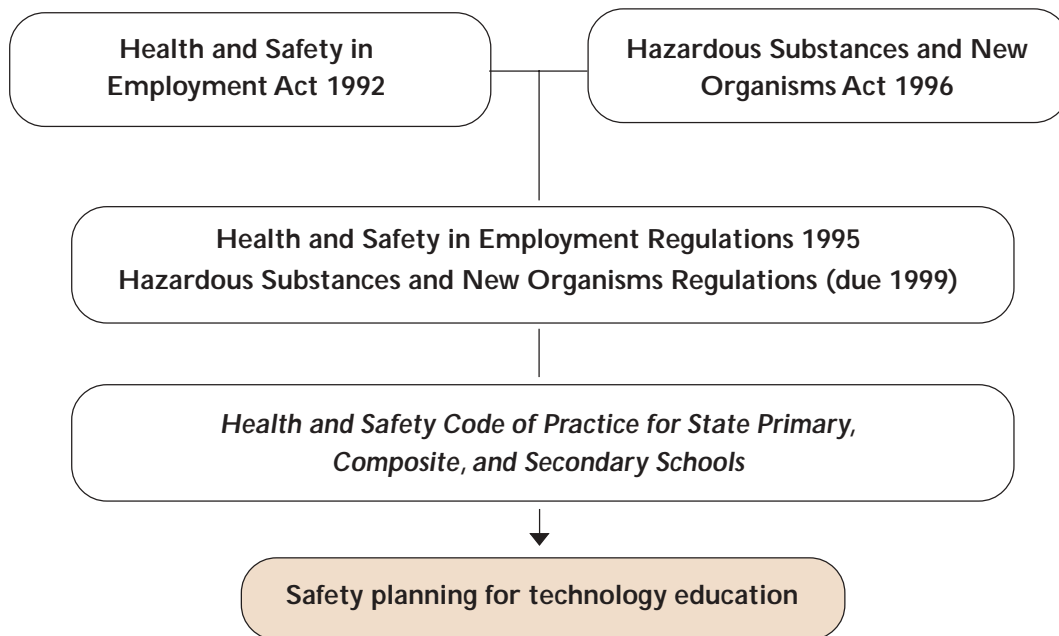
_____ (What procedures will be undertaken to meet these requirements?) _____

SECTION 2

Legal Requirements and Responsibilities

The legal requirements and responsibilities of schools for the safety of their students are incorporated in several pieces of legislation. These include the Health and Safety in Employment Act 1992 and its subsequent amendments, the Health and Safety in Employment Regulations 1995, the Hazardous Substances and New Organisms Act 1996, the Hazardous Substances and New Organisms Regulations (due in 1999), and *Health and Safety Code of Practice for State Primary, Composite, and Secondary Schools*.

The relationship between these different pieces of legislation is complex, and there are different opinions on which legislation takes precedence. The Acts of Parliament and their Regulations form the framework for safety planning in this area. *Health and Safety Code of Practice for State Primary, Composite, and Secondary Schools* interprets the Acts and their Regulations (which were designed for industrial situations) and gives guidelines on how their requirements can be fulfilled in an educational setting.



2.1 Legislation Affecting Technology Education

The following summaries identify sections of the Acts and Regulations that impact on safety in all areas of technology education.

The Health and Safety in Employment Act 1992

The Occupational Safety and Health Service (OSH) of the Department of Labour administers this Act to provide for the prevention of harm to employees at work and to promote excellence in health and safety management by employers.

Every employer shall take all practicable steps to ensure the safety of employees while at work; and in particular shall take all practicable steps to

- Provide and maintain for employees a safe working environment; and
- Provide and maintain for employees while they are at work facilities for their safety and health; and
- Ensure that plant used by any employee at work is so arranged, designed, made, and maintained that it is safe for the employee to use; and

- Ensure that while at work employees are not exposed to hazards arising out of the arrangement, disposal, manipulation, organisation, processing, storage, transport, working, or use of things –
 - (i) In their place of work; or
 - (ii) Near their place of work and under the employer’s control; and
 - Develop procedures for dealing with emergencies that may arise while employees are at work.
- Health and Safety in Employment Act 1992, Section 6

Although the Health and Safety in Employment Act 1992 was established primarily for application in industrial settings, it also applies to schools. In the school setting, the employer, at a management level, is deemed to be the board of trustees, and the employee is any adult paid by the board.

The health and safety of students is legislated for in two sections of the Act. The safety of students in classroom situations is covered by Section 15, while Section 16 covers students in education outside classroom situations, such as while on enterprise and community visits.

Section 15 Duties of employers to people who are not employees

This section of the Act states that:

Every employer shall take all practicable steps to ensure that no action or inaction of any employee while at work harms any other person.

This section applies to students while they are on the school premises.

Section 16 Duties of persons with control of places of work

Section 16 of the Act extends to and covers other people (not necessarily employees) in a workplace and also people in the vicinity of a workplace. The implications of this provision, in terms of technology education, are mainly when students are outside the school visiting workplaces.

Originally the Act placed responsibility for the safety of visitors to a worksite on the owner of the business, and so, understandably, businesses became less and less willing to take student visits. An amendment to the Act, passed in March 1998, made it potentially easier to arrange community and enterprise visits to places of work. Section 16 now places responsibility on employers to warn visitors of significant hazards present on the worksite. This warning needs to be only verbal and given once. If this is done, responsibility for the safety of visitors is passed to the visitors themselves. In a situation where a group of students is visiting an enterprise site, the warning needs to be given only to the person in charge of that group.

Section 25 Recording and notification of accidents and serious harm

Recording accidents and serious incidents that have affected staff and students is mandatory under Section 25(a) of the Health and Safety in Employment Act 1992 and is a requirement of the National Education Guidelines. Refer to page 19 of this manual for information on recording, reporting, and investigating accidents.

The Health and Safety in Employment Regulations 1995

These Regulations outline details of the safety responsibilities that employers have to their employees in the workplace, but many are not relevant to a school situation. While some are general and relevant in all workplaces, the following Regulations have a direct bearing on technology education practice.

Regulation 4 Duties in respect of facilities at every place of work

Regulation 4 sets out the requirements of employers to supply:

- handwashing facilities;
- first-aid facilities;
- lighting facilities that enable employees to perform their work and move about the place of work safely;

- ventilation providing either fresh or purified air;
- facilities for controlling atmospheric conditions, including air velocity, radiant heat, and temperature;
- facilities to control any atmospheric contaminants as closely as possible to their source;
- facilities for treating or carrying off any atmospheric contaminants to minimise the likelihood of its harming any employee.

Regulation 11 Noise

The Regulations include a technical definition of the maximum noise level that employees may be subjected to. The limit is defined in terms of both volume and length of exposure to noise. This states that employers must ensure that:

No employee is exposed to noise above the following levels.

- (a) A noise level equivalent to 85 dB for 8 hours.
- (b) A peak noise level of 140 dB.

If noise levels rise above these limits, personal hearing protection devices, such as earmuffs, must be worn. Most schools, however, do not have the equipment to measure noise levels, and the level of noise may sometimes exceed these limits. Schools should promote safe work practices and encourage the wearing of earmuffs in any situation where the noise level makes it difficult for people to hear each other.

Regulation 13 Overcrowding

Overcrowding can become a safety issue when too many people or things are gathered in one area. Teachers should manage technology education classroom spaces so that students are not put at risk of an accident by too many people trying to move around the room or be in one part of the room. Similarly, work materials and classroom materials can become a safety issue if too many are crowded into a space where students are expected to work. One example is when extension cords are used in the classroom. See *Safety and Science: A Guidance Manual for Schools*, page 21, for information about using electrical leads in classrooms. *Health and Safety Code of Practice for State Primary, Composite, and Secondary Schools*, Section 24, describes standards for overcrowding in teaching areas.

Regulation 16 Raised objects

In any situation where students or teachers work under a heavy object that has been raised off the ground, supports must first be placed under it to ensure that the object cannot drop while someone is underneath.

Regulation 18 Woodworking and abrasive machinery

This type of machinery must be fitted and used with safety devices. Details of the types of machinery and their safety devices are listed in Appendix Two on page 67.

Regulation 59 Presence of young persons

This Regulation has implications when teachers are planning community and enterprise visits, because it prohibits the presence, at any time, of persons under the age of 15 years in an area where goods are being prepared or manufactured for trade or sale. There are exemptions to this Regulation, however, as specified under subclause 2 which allows young people in these areas if:

- (a) they are in any part of the area to which the public generally has access;
- (b) they are under the direct supervision of an adult in that area;
- (c) they are on a guided tour of that area;
- (d) they are in any office in that area;
- (e) they are in any part of the area used only for selling goods or services.

Regulations 66 and 67 Duties of designers, manufacturers, and suppliers of plant.

In the area of technology education, these two provisions become important when students design and manufacture a product for sale. The responsibilities implied in the Regulation come into force when the product is sold, because the product must be safe for the end-user.

Regulation 66 (1) states that:

Every designer of plant shall take all practicable steps:

- (a) to design any plant in accordance with applicable ergonomic principles, including (without limitation) any such principles in relation to the placement of any power control; and
- (b) to design any plant in such a way that, if the plant is:
 - i manufactured in accordance with the design; and
 - ii used for the purpose for which it was designed; and
 - iii installed, adjusted, used, cleaned, maintained, repaired, and dismantled in accordance with the designer's instructions;there is no likelihood that the plant will be a cause or source of harm to any person, or the likelihood that the plant will be such a cause or source of harm is minimised as far as practicable.

In short, any product that students design must be safe for the intended end-user. Regulations 66 and 67 are a good example of the requirements of Strand B, achievement objective 6b, of the curriculum.

The Hazardous Substances and New Organisms Act 1996

The purpose of this Act is to protect the environment and the health and safety of people and communities by preventing or managing the adverse effects of hazardous substances and new organisms. The Act is administered by the Ministry for the Environment and implemented by the Environmental Risk Management Authority New Zealand (ERMA New Zealand). The Regulations that support the Act are being developed for publication in 1999.

Hazardous substances

A hazardous substance is any material that can harm people or the environment. Dishwash detergents, methylated spirits, bleaches, and petrol can all be dangerous or poisonous.

When written, the Regulations will:

- define a hazardous substance;
- set acceptable levels of exposure to hazardous substances;
- specify requirements controlling hazardous substances, including identification, disposal, emergency management, and staff training;
- specify controls on compressed gases.

Safe procedures with chemical substances

Many technological investigations involve the use of chemicals. Section 4 of *Safety and Science: A Guidance Manual for New Zealand Schools* gives details relating to senior secondary school students' use of specialised chemicals; of safe and correct storage, handling, and operating practices; and of the disposal of unwanted residues. On pages 58–59, it also describes forbidden chemical procedures. Technology teachers should become familiar with this information before planning any related teaching sequence.

New organisms

The Act requires approval to be sought from ERMA New Zealand for all school biotechnology investigations that involve transgenic manipulation. This approval needs to be sought for the genetically modified organism that will be produced, not the technique used to produce it. Information about how to seek approval for new organisms can be obtained from the New Zealand Biotechnology Association, which acts as the agency for schools to apply for approval from ERMA New Zealand. The current contact address of the New Zealand Biotechnology Association can be obtained from Technology Education New Zealand (TENZ).

As biotechnological transgenic procedures are developed that work effectively in schools, TENZ will notify schools. TENZ also holds a register of the transgenic organisms that have been approved by ERMA New Zealand as being suitable for production in schools. The contact address for TENZ is:

Technology Education New Zealand;
1695 Western Line Road
Wanganui
Ph: (06) 342 1704
Mobile ph: 025 285 7085
Fax: (06) 342 1758
e-mail: tenz@rsnz.govt.nz

When the Hazardous Substances and New Organisms Regulations that support the Act are published, they will:

- define a genetically modified organism;
- specify methods to assess the level of risk from developing various types of genetically modified organisms.

Health and Safety Code of Practice for State Primary, Composite, and Secondary Schools

This code of practice forms part of the occupancy documents of the board of trustees and should be present in all schools. It is written for boards of trustees as managers of schools and further defines their obligations in health and safety matters. The code recognises that schools are different from other places of work and prescribes specific health and safety standards necessary for them to comply with the Health and Safety in Employment Act 1992.

Section 2 of *Health and Safety Code of Practice for State Primary, Composite, and Secondary Schools* covers areas of relevance to technology education, such as:

- the provision and use of protective equipment (4:24);
- lighting (3:5);
- ventilating systems (3:6), specifically in workshops (3:6.2);
- heating (3:7);
- removing of steam, fumes, and dust (3:8);
- eating and drinking in certain rooms (3:17);
- first-aid facilities (3:18);
- safe means of access to and exit from rooms (4:20);
- overcrowding (4:23);
- storing dangerous substances (4:25);
- general storage of materials (4:26);
- persons working under loads (4:28);
- carrying heavy loads (4:29);
- safety in confined spaces (4:30);
- safety in relation to explosive, flammable vitriolic, and dangerous substances (4:32);
- protection from harmful noise (4:33).

Section 1 covers:

- duties of employers to non-employees (12);
- employee duties (13).

As the safety specifications outlined in the code are binding over all school practices, teachers need to understand them.

2.2 Other Legislation and Regulations

Because technology education covers a wide variety of subjects and experiences, the requirements of a number of other Acts and Regulations may also be relevant and should be read as well as the legislation described above. These Acts and Regulations include:

- The Food Act 1981 and amendments;
- The Food Hygiene Regulations 1974;
- The Food Regulations 1984 and amendments 1–13.

Local Authorities

Some local authority by-laws made under the Local Government Act 1974 also apply to issues of health and safety in technology education in schools. Because these by-laws vary from place to place, boards of trustees and teachers should consult their own local authority for advice.

New Zealand Standards

Many New Zealand and Australian standards also cover aspects of practice in technology education as well as applying to general classroom practice.

Electrical equipment (mains powered)

AS/NZS 3760:1996 *In-service Safety Inspection and Testing of Electrical Equipment* requires all mains-powered electrical equipment used by people in a classroom to have an annual safety check. All electrical equipment, including plugs, sockets, and extension leads, should be in serviceable condition. Electrical equipment borrowed from another source for short periods of time should also be checked before use.

Wherever practicable, the mains electrical supply should be drawn through an isolating transformer or residual current device (RCD) to provide safety extra-low voltage (SELV). If portable power boards are used, these should be protected from overloading. Switches, sockets, and associated power supply fixtures in the room should be regularly checked for damage, such as shorting, cracks, and exposed wiring. All flexes and cords should be routinely examined before use to ensure they are not cracked or burnt.

2.3 School Policies and Procedures

Boards of trustees and teachers should be aware that the National Education Guidelines also make reference to health and safety. National Administration Guideline 3 (iii) states that according to legislation on financial and property management, each board of trustees is required to:

Comply with the negotiated conditions of any current asset management agreement, and implement a maintenance programme to ensure that the school's buildings and facilities provide a safe, healthy learning environment for students.

National Administration Guideline 5 states that each board of trustees is also required to:

- Provide a safe physical and emotional environment for students.
- Comply in full with any legislation currently in force or that may be developed to ensure the safety of students and employees.

Boards of trustees should have a policy that ensures the health and safety of staff and students involved in technology activities. This policy should refer to others existing within the school, such as those for:

- accident reporting;
- animal ethics;
- education outside the classroom;

- hazard identification and assessment;
- waste disposal.

School staff are required to adopt safety policies and procedures that have been developed in conjunction with the board of trustees. In turn, boards of trustees are required to provide adequate safety training, safety facilities, and safety resources, and to allow time for safety procedures to be implemented.


It is important that all technology staff accept the agreed policies, practices, and procedures to promote safety. In all safety situations, common sense should prevail.

Accident Recording, Reporting, and Investigating

The main benefit for schools in recording accidents is to identify patterns. If small accidents occur often in a particular work situation, this can be a sign that some aspect of safety planning has not been addressed adequately, and safety procedures can be reviewed before a more serious accident occurs. For this reason, students and teachers should be encouraged to report all accidents.

Guidelines for recording accidents may be obtained from OSH. Workplace accident registers to meet the requirements of the Health and Safety in Employment Act 1992 can be found in most bookshops or obtained from OSH.

Refer to pages 7–8 of *Safety and Science: A Guidance Manual for New Zealand Schools* for further information relating to recording, reporting, and investigating accidents.



OCCUPATIONAL SAFETY & HEALTH SERVICE

Notice or record of accident / serious harm

Complete this form and forward it to your nearest OSH office within 7 days of incident. Keep a copy for your own records.

DEPARTMENT OF LABOUR
TE Kaitiaki Take Kōwhiri

1 Particulars of employer: (Business name and address)

2 Location of place of work:

Shop, shed, unit no., floor, building: Street no and name : Locality / suburb

3 Personal data of injured person:

Name _____

Residential address _____

Date of birth: _____ Sex (M/F) _____

4 Occupation or job title of injured person:

5 Period of employment of injured person:

1st week 1st month 1-6 months

6 months - 1 year 1-5 years Over 5 years

non-employee

6 Treatment of injury:

Nil First aid Doctor (not hospitalised)

Hospitalised

7 Time and date of accident / serious harm:

Time: _____ am / pm

Date: _____

Shift: Day Afternoon Night

Hours worked since arrival at work: _____

8 Mechanism of accident / serious harm:

Fall, trip or slip Hitting objects with part of the body

Sound or pressure Being hit by moving objects

Body stressing Heat, radiation or energy

Biological factors Chemicals or other substances

Mental stress

9 Agency of accident / serious harm:

Machinery or (mainly) fixed plant

Mobile plant or transport

Powered equipment, tools or appliances

Non-powered handtools, appliances and equipment

Chemical or chemical products

Material or substance

Environmental agency

Animal, human or biological agency (not bacteria or virus)

Bacterial or virus

10 Body part:

Head Neck Trunk

Upper limb Lower limbs Multiple locations

Systemic (internal organs)

11 Nature of injury or disease: (specify all) Fatal

Fracture of spine Puncture wound

Other fractures Poisoning and toxic effects

Dislocation Multiple injuries

Sprain or strain Damage to artificial aid

Head injury Disease, nervous system

Internal injury of trunk Disease, musculoskeletal system

Amputation, incl. eye Disease, skin

Open wound Disease, digestive system

Superficial injury Disease, infectious or parasitic

Bruising or crushing Disease, respiratory system

Foreign body Disease, circulatory system

Burns Tumour (malignant or benign)

Nerves or spinal cord Mental disorder

12 Where and how did the accident / harm happen?
If not enough room, attach separate sheet or sheets

13 Has an investigation been carried out? yes/no

Was a significant hazard involved? yes/no

Completed by: Employer or employer's representative (delete which is not applicable)

Name and position: _____ Signature: _____ Date: _____

Emergency Procedures

General

Teachers need to be prepared for such emergencies as minor chemical spills, small contained fires, electric shock, and students injuring themselves. The school should have policies and procedures for dealing with these problems and guidelines for when to contact emergency services. All students and staff should clearly understand the correct procedure to follow in response to a specific accident. OSH recommends that a telephone with unrestricted access, capable of dialling emergency services and contacting other parts of the school, be readily available. Emergency telephone numbers or instructions must be posted by each telephone. These should include:

- Fire service
- Ambulance
- Hospital
- Police
- National Poisons Information Centre, Dunedin

Urgent information: (03) 474 7000

Non-urgent information: (03) 479 1200

Fax: (03) 477 0509

e-mail: national-toxicology-group@otago.ac.nz

For hazardous materials, including chemicals, these may also include:

- NZ Safety Ltd Safeline
Ph: 0800 100 014 (between 8 a.m. and 5 p.m., Monday to Friday)
- National Emergency Response Service of the New Zealand Chemical Industry Council
0800 CHEMCALL
Ph: 0800 243 622 (24 hours a day, every day)

First-aid kits should be present in all technology classrooms, and teachers should be trained in first aid. In larger schools, where a nurse is present, classroom first-aid kits need be only minimal, with any serious injury being referred to the nurse for treatment. Suggested contents of a first-aid kit can be found in the *Health and Safety Code of Practice for State Primary, Composite, and Secondary Schools* or on page 67 of *Safety and Science: A Guidance Manual for New Zealand Schools*.

Fire

The Fire Safety and Evacuation of Buildings Regulations 1992 require schools to have a fire evacuation scheme. Teachers should be aware of the school's policy and the procedures to be followed in the event of a fire. Boards of trustees are responsible for ensuring that the fire-safety equipment in classrooms meets minimum standards. Appropriate signs must be provided for all fire equipment in classrooms, and teachers must take responsibility for ensuring that fire equipment used to extinguish small fires is refilled and/or replaced immediately.

Natural disasters

Boards of trustees are required to have policies and procedures in place in case of a natural disaster, such as an earthquake or a flood. Teachers should be aware of the school's policy and the procedures to be followed in such an event.

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3.1 Information for All Teachers

The curriculum statement *Technology in the New Zealand Curriculum* defines biotechnology as involving:

... the use of living systems, organisms, or parts of organisms to manipulate natural processes in order to develop products, systems, or environments to benefit people. These may be products, such as *foods, pharmaceuticals, or compost*; systems such as *waste management* or *water purification*; or environments, such as *hydroponics*. Biotechnology also includes genetic or biomedical engineering.

Technology in the New Zealand Curriculum, page 12

Teachers planning for safety in biotechnology should have thorough knowledge and experience in this area. If this is not the case, teachers should seek advice from a specialist in this technological area. This is especially important when culturing micro-organisms, where teachers should have some training in microbiological techniques.

All electrical equipment used in biotechnology should be maintained according to the guidelines noted in Section 2 on page 18 of this manual and in *Safety and Science: A Guidance Manual For New Zealand Schools*, Section 2.1. Teachers should encourage students to examine all electrical equipment before it is used, including all plugs, sockets, extension leads, and other electrical equipment used for biotechnology activities, such as bread makers, dehydrators, computer data-logging equipment, and digital balances. This also applies to any electrical equipment borrowed from various sources for short periods of time. Careful positioning of electrical extension leads and equipment within the classroom can minimise the potential for accidents.

Many investigations involving biotechnology can be carried out successfully in general classrooms with typical facilities for years 1 to 7 students. The multipurpose nature and architecture of general classrooms, however, presents some health and safety concerns. It is desirable to have a separate area in the school for biotechnological investigations, or to have an area of the classroom set aside for the duration of the project. Investigations involving biotechnology are often of an ongoing nature, necessitating material being set up over lengthy periods of time, which can create problems with care, hygiene, and security.

Schools using specialist materials for biotechnological investigations must have effective policies and practices for the storing, handling, and disposing of those materials. This includes a policy for disposing of unwanted micro-organisms and chemical residues, both of which are classed as hazardous wastes.

It is also important, when working with living material, to prevent cross-contamination with pathogenic (disease-causing) organisms. In some situations, it may be necessary to establish a workspace where sterile conditions can be maintained. The following guidelines should be followed to minimise the risk of contamination.

- Only work with material of known biological characteristics.
- Never work with unknown living material.
- Never culture pathogenic (disease-causing) organisms.
- Prevent contamination of culture material by establishing and following sterile work procedures.
- Dispose of material carefully and thoroughly, ensuring that living material cannot reproduce.

Animals

There are a number of teaching situations where animals could be included in a technological setting. Students may wish, for example, to develop some convenience pet food, food packaging, or feeding container and trial its suitability with certain animals.

Schools should have an animal ethics policy that meets the legal requirements of the Animals Protection (Codes of Ethical Conduct) Regulations 1987 (or any other subsequent legislation), and any procedure that involves interfering with the normal physiological, behavioural, or anatomical integrity of any vertebrate animal requires approval from an animal ethics committee. When animals are used in any biotechnology investigation, students must adhere to the *Code of Ethical Conduct for the Care and Use of Animals in School Programmes* and apply to their local animal ethics committee before starting any such investigation. Details of this process can be obtained from:

National Animal Ethics Advisory Committee
c/o Ministry of Agriculture and Forestry
PO Box 2526
Wellington
Ph: (04) 474 4129 or (04) 474 4100
Fax: (04) 474 4133
e-mail: naeac@maf.govt.nz

Care for animals must include:

- a secure cage or container, with space for the animal to move around freely;
- adequate food, water, and shelter;
- placing the animal away from draughts and direct sunlight;
- providing adequate, clean bedding and changing it regularly;
- removing, and seeking veterinary attention for, unhealthy animals;
- appropriate weekend and holiday care;
- checking that, when animals go home with students, responsibility is taken for the animals' security and welfare.

The Ministry of Agriculture, in conjunction with the Ministry of Education and the Animals in Schools Education Trust (New Zealand Veterinary Association), is preparing guidelines for the care and use of animals in schools for publication in 1999.

Schools must not keep animals caught in the wild without a permit. They may be carrying diseases such as tuberculosis. It is good practice to encourage students to wear disposable gloves when handling animals. If students do not use gloves, they must wash their hands before and after handling any animals, and existing cuts and abrasions should be covered to prevent the risk of infection.

Under the Wildlife Act 1953, it is illegal to keep any species of native animals without a permit from the Department of Conservation.

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Food-related Biotechnology

In some instances, biotechnology can be approached through the area of food technology, as in the production of yoghurt, bread, and cheese. Where this is the case, the work should be carried out in the area of the school or classroom designated for food technology, and this area should be kept quite separate from areas set aside for other aspects of biotechnology. Any biotechnological investigation linked with food technology poses additional safety concerns. Teachers planning work relating to both these technological areas should also be familiar with the safety guidelines in Section 5 of this manual on page 31.

Non-food related aspects of biotechnology must not take place in food production areas.

Whenever food tasting is likely to take place, the teacher must be confident that the food is safe to eat. Guidelines for food consumption are given in Section 5 on page 32.

Micro-organisms

Many biotechnology investigations make use of a range of micro-organisms. The major groups of micro-organisms are algae, protozoans, fungi, bacteria, and viruses, and the two groups most commonly used in school biotechnology are fungi and bacteria. Teachers need to take particular care and attention when students work with micro-organisms.

Only named and identified species from a reliable source should be used. Teachers or students should never culture unknown species, especially bacteria.

Brewer's and baker's yeast available from supermarkets, yoghurt-forming bacteria cultured from existing yoghurt, or fungi cultured from cheese are all good starting points. A list of micro-organisms suitable for use in schools can be found in Appendix Three on page 67. More specialised strains of micro-organisms can be obtained from suppliers such as:

Resource Centre
Private Bag 1909
Dunedin
Ph: (03) 479 3791
Fax: (03) 477 5289.

Safety and Science: A Guidance Manual for New Zealand Schools has a section on culturing micro-organisms on pages 33–35. Teachers should be aware of and follow these guidelines. They include instructions for collecting, handling, culturing, and disposing of micro-organisms.

Many fungi are significant in the biotechnology and food industries. Care should be taken when collecting or handling fungi because many, including toadstools, mushrooms, moulds, and puffballs, may be poisonous. Spores released from many species can also cause allergic reactions in some people.

When culturing micro-organisms, biotechnology teachers should be aware of the following guidelines.

- Do not use human or animal sources of micro-organisms.
- Do not take samples from toilets and toilet areas, including sinks and door handles.
- Do not take samples from rubbish bins and drinking taps.
- Cultures originating from skin surfaces may be used only if the cultures remain sealed.
- Use sterile swab sticks to inoculate plates.
- Wash hands thoroughly after working with micro-organisms.
- Label each culture clearly with the student's name, the date, and the source of the micro-organism sample.

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- If petri dishes are used to culture micro-organisms, cover and seal them to prevent contamination and the spread of spores. Use adhesive tape or cling film to seal these dishes securely, and incubate the cultures upside down.
 - To pipette culture samples, use only automated pipettes, never mouth-operated pipettes.
 - Transfer microbiological material from one culture to another in sterile conditions. Always wear safety glasses.
 - Incubate microbiological cultures at temperatures of 25 degrees Celsius (°C) or below to avoid the risk of culturing pathogenic organisms.
- If using glassware for fermentation investigations, never seal it because the build up of pressure could cause an explosion. Either lightly plug containers with cotton wool or cover them with aluminium foil. If using plastic drink bottles as simple fermentors, as in the production of ginger beer, be aware that considerable pressure can build up in sealed bottles to the point of explosion.

Bioremediation (waste management)

Before teachers set up small-scale experiments to illustrate waste breakdown by micro-organisms, they must be aware that unknown pathogens could be present. Small-scale fermentors must be designed to ensure that gas pressure does not accumulate as the build-up of flammable biogas could be dangerous.

Clean up and disposal of biotechnological wastes

Many waste materials from biotechnology are classed as hazardous wastes and so they must be disposed of in a way that does not endanger people or the environment. Chemical wastes should be disposed of in accordance with local by-laws.

All microbiological cultures must be sterilised before disposal. This can be achieved by using one of the following methods:

- heating in a pressure cooker for at least 20 minutes;
- soaking in a 10 percent bleach solution for three days;
- incinerating (with the incinerator very hot).

The person responsible for this may need training. This person could be a teacher or an ancillary staff member, but not a student. If a culture material is spilled, a teacher wearing disposable gloves must deal with it immediately. Cover the broken container and/or spilled culture material with a cloth soaked in a disinfectant of 10 percent bleach (100 millilitres [mL] of bleach in a litre of water) for at least 10 minutes. Then clear away the spillage using disposable paper towels and a dustpan. Place the contaminated material in a separate bag for disposal, along with the gloves, and disinfect the dustpan.

Note: Household bleach solutions may not be strong enough to ensure sterilisation.

Plants

Biotechnological investigations using plants may include working with whole plants, plant parts, or plant cells. Because many plants are poisonous, teachers should help students identify those to be used in technological investigations. Care must also be taken with the development of plant extracts because many known drugs and poisons originate from them.

During their investigations, students may well make use of plants or plant material of cultural significance. They should be made aware of any such significance associated with the use of particular plants, for example, harakeke, heritage potato, and various ferns.

Tissue culture

Many kinds of biotechnological investigations may involve simple tissue culture practice. Several practices that students can carry out illustrate basic techniques that have been developed further in industry. Many tissues, such as cauliflower curd, carrot, pine seeds, or willow leaf can be simply propagated from small pieces of material, either in fluid or gel media.

3.2 Safety in Specialist Areas

Most safe practice for biotechnology education of students in years 10 to 11 is outlined in *Safety and Science: A Guidance Manual for New Zealand Schools* or in 3.1 Information for All Teachers above.

Teachers of students in years 12 to 13 need to consider a number of safety practices for using specialist equipment, chemicals, and procedures. Recent New Zealand science, technology, and biology curriculum statements recognise the growing significance of biotechnology, particularly micro-organism biotechnologies and genetic modification, in our everyday lives, such as in food derivatives, medicines, pharmaceuticals, and environmental remediation. Senior secondary school students are encouraged to carry out increasingly sophisticated investigations. Facilities, equipment, chemicals, enzymes, micro-organisms, and advice are readily available from a number of supply firms.

There is a growing number of specialist school facilities for teaching biotechnology. Such facilities, however, often vary considerably in their design and equipment. Teachers should carefully consider where equipment being used for a biotechnological investigation is placed, because many (such as fermentation and growth investigations) are ongoing while other groups of students and teachers are using the room for other purposes. For security and safety, other staff and students should be made aware of such ongoing investigations.

Equipment often found in specialist classrooms could include controlled plant-growth facilities, autoclaves (for example, pressure cookers), incubators, fermentors (often modified plastic bottles), refrigerators, dehydrators, and computers, all of which require regular general and electrical maintenance. Regular checking by teachers should ensure that these are maintained in a safe state.

Pressure cookers can be a hazard if not used and maintained properly. Check the rubber seal and safety valve every time the pressure cooker is used. Never overfill a pressure cooker, and always ensure that items are placed securely inside it. If foil or plastic becomes loose and lodges on the inside of the safety vent, the pressure cooker may explode. Always ensure that a pressure cooker cools naturally before opening it.

Teachers who are unsure about any practice should obtain information and instruction from other local teachers or science advisers before attempting any unfamiliar procedure or using unfamiliar equipment.

Many chemicals associated with biotechnological investigations are toxic. Copper sulfate, a chemical commonly used as a fungicide and for growing crystals, is poisonous and can cause serious eye damage. Student access to it should be limited and supervised. Refer to Section 5 of *Safety and Science: A Guidance Manual for New Zealand Schools* for information about substances and chemical procedures that are forbidden in New Zealand schools.

Bacteriogenetic Methods and Practices

When using micro-organisms for teaching biotechnology, teachers should obtain known safe species and strains from reliable supply firms. Generally soil bacteria, such as *Bacillus subtilis*, are relatively safe, as are genetically-crippled strains of *Escherichia coli*. The fungus *Saccharomyces cerevisiae* (baker's yeast), including its many strains, is not only very safe but can be used for a variety of investigations.

A number of bacteria, such as *Serratia marcescens*, have known carcinogenic properties and should not be used; neither should the gut bacteria *Escherichia coli* unless genetically

crippled. When culturing micro-organisms, take care not to inhale their reproductive spores. These spores, in particular from the cultures of *Mucor*, *Penicillium*, or *Aspergillus*, can affect people with asthma and allergies. Student laboratory practice should keep to that detailed in *Safety and Science: A Guidance Manual for New Zealand Schools*.

Investigations identifying cultures of micro-organisms, such as *Escherichia coli* K12, that are resistant to antibiotics (such as penicillin or streptomycin) are basically harmless.

In schools, the safest method for inducing mutations in micro-organisms is by using ultraviolet (UV) radiation. Students should wear UV-protective glasses.

Do not attempt to induce mutations in cells by using X-rays or carcinogenic chemicals, such as acridine orange or nitrous acid, because of the risk to human tissue.

Investigations using bacteriophages, such as those that attack *Escherichia coli* and lactic acid bacteria, are harmless both to humans and to the environment.

Enzymes

A common technique for investigations that isolate deoxyribonucleic acid (DNA) involves using enzymes and sodium dodecyl sulfate (SDS). The DNA is extracted and then usually precipitated by using chloroform in a fume cupboard. However, as chloroform is a banned substance in schools (see *Safety and Science: A Guidance Manual for New Zealand Schools*, page 57), a safer procedure involves isolating DNA after treatment with washing-up liquid, followed by the enzyme lysozyme, and then ethanol. An alternative is to autolyse dried yeast in an alkaline solution at 40°C, filter, concentrate by dialysis, and precipitate with ethanol.

Chemicals that are supplied by manufacturers in powder form, such as enzymes and sodium dodecyl sulfate, need careful handling because of their effects on living tissue. An experienced teacher or technician should prepare these reagents in a force-ventilated space, such as a fume cupboard. Always wear a face mask when handling powdered enzymes. Specialist biotechnology facilities may contain electrophoresis equipment. DNA from bacteria can be broken into fragments with restriction enzymes and then separated electrophoretically in a gel. Take care when choosing a stain to allow the fragments to be viewed because the stain nipogen is a known carcinogen, and ethidium bromide is banned in schools (see *Safety and Science: A Guidance Manual for New Zealand Schools*, pages 57–60). Methylene blue is the recommended safe stain for this application.

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Transgenic manipulations

All school biotechnological investigations that involve transgenic DNA manipulation will, by law, require approval from ERMA New Zealand. This organisation has the role of approving all new genetically modified organisms in New Zealand.

The practice of students inserting genes into plants by using a gene gun, to illustrate disease resistance or herbicide resistance, is currently outside any school programme. However, students could visit industries where such practices occur, and natural methods of DNA transformation, such as gall formation by the common vector *Agrobacterium*, can be easily induced in a variety of plant tissue in the laboratory. *Agrobacterium* can be obtained by extracting live samples from active galls on such trees as willow or lacebark.

Teachers in any doubt about a planned activity involving transgenic procedures can seek advice from either the subject association, TENZ, or the New Zealand Biotechnology Association.

SECTION 4

Safety and Electronics and Control Technology

4.1 Information for All Teachers

The curriculum statement *Technology in the New Zealand Curriculum* defines electronics and control technology as including:

... knowledge and use of electrical and electronic systems and devices, as well as their design, construction, and production. These may be simple electrical circuits or complex integrated electronic circuits, or robotics. Control technologies may be electronic, pneumatic, hydraulic, or mechanical.

Technology in the New Zealand Curriculum, page 12

Teachers planning for safety in electronics and control technology should have thorough knowledge and experience in this area. If this is not the case, teachers should seek advice from a specialist in this technological area.

In general classrooms, activities relating to electronics and control technology do not need to include soldering or the use of specialist chemicals. The types of activity undertaken at any particular year of schooling depend more on teacher confidence and experience than on any coherent programme for the progressive development of skills. If programmes that include activities such as soldering and printed circuit board (PCB) manufacture are considered appropriate, then full safety precautions and procedures, as outlined on page 29 of this section, must be followed.

Generally, electronics and control activities involve simple circuit connections using separate components and basic connecting techniques, such as crocodile clip leads, screwposts, and banana plugs. A number of commercially available electronic kits and control technology kits have components that are simple to join and that are disassembled easily. Because most electronic components are small, these should be mounted on a larger, more easily handled insulator base made of wood or plastic. This can help to prevent young children swallowing components or being injured by sharp points. It can also make components easier to handle and minimise losses.

Dry-cell batteries can power most electrical circuits. “C” size or larger batteries are easy to handle and last well. They should be of a non-toxic composition and should never be cut open or penetrated. When batteries are not in use, remove them from the circuit or device to prevent the battery casing from breaking down and leaking corrosive chemicals. This is especially important when equipment is stored for long periods of time.

It is recommended that students should not use any power supply over 30 volts (V) and have a circuit breaker (fuse) of no more than 10 amperes (A).

Teachers, and senior students under close supervision, may use a high-voltage supply with an output current limited to 5 milliamperes (mA).

Hazards

Examples of hazards in the area of electronics technology are:

- burns from soldering;
- fumes from soldering;
- chemical stains and burns from PCB etching;
- electric shock (where mains equipment is used);
- cuts from broken equipment, such as light bulbs;
- injury by high-pressure air, for example, from pneumatics;
- injury by high-pressure oil or water, for example, from hydraulics.

4.2 Safety in Specialist Areas

Electronics and control programmes in the specialist classroom may include various circuit-building technologies, such as soldering and PCB manufacture. Techniques such as these introduce hazards that must be controlled.

Burns

Small but painful burns can occur from contact with a hot soldering iron or, more rarely, from contact with a hot wire, such as when a short circuit has occurred. First-aid facilities should be available.

Compressed Air and Hydraulic Fluids

Air and hydraulic fluids used in control systems can be hazardous when under pressure. Air-pressure systems should be regulated and have a working pressure of not more than 320 kilopascals (kPa). Never aim high-pressure air at any part of the body. Compressed hydraulic fluids, such as oil and water, can cause harm if they escape under pressure.

Cuts and Lacerations

When broken, light bulbs produce sharp glass slivers that can lacerate hands and feet. Keep a soft brush and pan to clean up breakages, and then completely remove all fragments with a vacuum cleaner. The teacher should personally screw light bulbs into their sockets rather than leave this to students, who may overtighten them and break the glass top off the bulb.

Allowing students to use sharp blades for cutting materials such as thick cardboard or veroboard is not recommended. If the teacher has any doubt about students' abilities to carry out these tasks safely with hazardous equipment, alternative methods should be used.

Electricity

Refer to New Zealand Standards, Electrical equipment (mains powered) on page 18.

For electronic circuits, 15 V of direct current (DC) is generally an appropriate maximum voltage.

Commercial appliances, such as soldering irons and oscilloscopes that are manufactured to recognised safety standards, can be operated from the mains with the usual safeguards. Both staff and students should know where the safety cut-out switch is and how to operate it so that all electrical power can be quickly turned off if an accident occurs.

Guidelines for operating electrical equipment safely, as outlined in Section 2.1 of *Safety and Science: A Guidance Manual for New Zealand Schools*, should be adhered to. A carbon dioxide fire extinguisher should be kept on hand to extinguish electrical fires.

Printed Circuit Board (PCB) Manufacture

Handling all chemicals for practical work in electronics should conform to the guidelines in Section 4 of *Safety and Science: A Guidance Manual for New Zealand Schools*. In particular, using strong ferric chloride or ammonium persulfate solutions in the manufacture of printed circuit boards should be done only in a force-ventilated space, such as a fume cupboard. Students should wear safety glasses and protective clothing. Water should be readily available to dilute spillages, and waste solutions should be disposed of in accordance with accepted environmental procedures.

Soldering

If soldering is to be a common feature of the programme, the classroom should have a suitable soldering facility positioned away from taps, basins, gas outlets, and flammable materials, such as curtains. The bench material should be both heat and chemical resistant, with a place provided to store the hot soldering iron. The hot iron needs to be rested in a suitable soldering station isolated from materials that are flammable or likely to be damaged by heat, and where students will not touch it accidentally.

Students should be taught to routinely examine the supply flexes of soldering irons, before switching them on, to ensure that they are not cracked or burned, and to report to the teacher any damage that occurs during use. The risk of cords melting and exposing the wires will be minimised if the non-burn variety of soldering iron flexes are fitted. For most student work, soldering irons of no more than 25 watt (W) capacity should be used. Temperature-controlled units are more versatile and may be an option if finance permits. After use, soldering irons should be unplugged and allowed to cool before storage. The cooling process may require removing the irons to a safe area in the room so that students do not touch them accidentally.

All students should be taught how to use a soldering iron safely, including the correct way to plug and unplug them without putting stress on the leads. Another danger is in the practice of flicking the iron to remove excess accumulated solder. This may cause molten metal burns to the clothing, the skin or, more seriously, the eye. All students using soldering irons in the classroom should be taught how to remove excess solder without flicking or shaking their soldering iron. Also, when using a soldering iron or when near another person using one, students and other observers should wear suitable safety glasses, preferably of the ventilated sort with side protection.

Solder contains a mixture of metals, including lead, which is a known cumulative poison in the human body. It is not absorbed easily through the skin, and it is not vaporised much when solder is melted. Lead can, however, be transferred to the fingers during the process of handling solder. From there, it may be transferred to food and swallowed, so facilities must be available for students to wash their hands after soldering.

Because chemical reactions in the heated flux produce fumes and potential irritants, there should be enough ventilation in the room to prevent fumes from building up during soldering. Where natural ventilation is not sufficient to eliminate fumes, suitable extraction equipment should be obtained from a reputable electronic supplier. This could consist of an extractor fan rated for the volume of the room, vacuum extractor equipment to draw fumes directly from the soldering iron, or portable extractor fans with active filters attached.

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5.1 Information for All Teachers

The curriculum statement *Technology in the New Zealand Curriculum* defines food technology as including:

... understanding and using safe and reliable processes for producing, preparing, presenting, and storing food and the development, packaging, and marketing of foods.

Technology in the New Zealand Curriculum, page 12

Teachers planning for safety in food technology should have thorough knowledge and experience in this area. If this is not the case, teachers should seek advice from a specialist in this technological area.

Any safety requirements for using equipment should be demonstrated to students before they use equipment independently. This includes the use of small non-electrical equipment, such as egg-beaters, peelers, and knives.

In general classrooms, preparing and cooking consumable food should, if possible, occur in a teaching space specifically designated for food technology. However, if a specialist area is not available, facilities in a school hall or staffroom may be used. Alternatively, an area of the classroom could be set aside for food technology for the duration of the work. This environment should contain:

- handwashing facilities;
- separate dishwashing facilities, such as a sink, a hot and cold water supply, detergent, and tea towels;
- non-porous workbenches or tables;
- adequate lighting and ventilation;
- cleaning agents, such as a broom, a mop, a brush and shovel, detergent, and disinfectant;
- rubbish-disposal facilities.

Never carry out food processing in an area designated for science (especially chemistry) because of the danger that toxic or harmful chemicals could contaminate food products.

Elements of a food technology unit that are non-food related, such as the design, packaging, and marketing aspects of food technology, should take place in a teaching and learning space separate from the food preparation area.

Do not set up or use electrical equipment near water supplies, and do not allow students to handle electrical appliances with wet hands. Electrical appliances used in classrooms should always be plugged into an approved RCD. Ensure that appliances are assembled according to the manufacturer's instructions, that all appropriate safety precautions are followed, and that these appliances are regularly checked and serviced. If electrical appliances are donated to the school, they should be checked by an approved authority to ensure that they meet current electrical standards before they are used by students. See page 22 of *Safety and Science: A Guidance Manual for New Zealand Schools* for information on the frequency and scope of electrical equipment inspections.

If consumable food products are the outcome of an activity, equipment should be designated specifically for food preparation and cooking. Kits of equipment for food technology should be well labelled, and none of this equipment used for other purposes. Plastics used for moulding foodstuffs, such as chocolates and jellies, must also be food safe. All equipment used for preparing and cooking food should be regularly maintained, checked for damage, and repaired or disposed of when necessary.

Food Production

Before students prepare consumable food products, teachers must check the quality of each food item. Teachers can assess the quality of food by:

- ensuring that the “use-by” date or “best before” date on perishable foods has not expired;
- checking for damage to food packaging, such as bulging tin cans, broken seals, or the swelling sides of plastic bottles;
- observing any abnormal changes to the colour, smell, or texture of food;
- ensuring that food is kept at the correct temperature until use. That is, frozen foods are still frozen, and perishable foods, such as meat, dairy products, and fish, are chilled to 4°C.

Storing food

Food must be stored at temperatures that inhibit the growth of pathogenic micro-organisms that may cause food poisoning. Always refrigerate fresh, perishable, or high-risk foods at 4°C before using in food preparation and if storing them before consumption. In the refrigerator:

- cover cooked foods and store them above raw foods;
- keep all cooked and raw foods apart to prevent cross-contamination;
- remove left-over canned food from the can and place it in an airtight container before storing it in the fridge;
- keep frozen foods in the freezer at -18°C.

Store non-perishable food in an area that is dry, cool, well ventilated, and free of pests, such as insects and vermin. Do not store food on the floor if at all possible.

Before being used to store consumable food products, all containers should be sterilised. Containers that no longer store their original product should be clearly relabelled and dated for the new contents. Do not use paper containers to store consumable food products because they cannot be adequately sterilised.

Preparing food

Before handling food, students and teachers should observe the following hygienic practices.

- Tie long hair back from the face or wear a cap or hat, such as a disposable paper hat.
- Wash hands and scrub fingernails with warm soapy water.
- Dry hands with a disposable paper towel, a roller towel, or a hot-air hand drier.
- Remove all jewellery from hands and arms (excluding watches).
- Cover all cuts, scratches, and open wounds with plaster and/or a waterproof disposable glove.
- Wear an apron.

During food preparation, observe the following principles of food hygiene.

- Clean work and preparation surfaces with hot water and detergent before, during, and after food preparation. If the surfaces cannot be adequately cleaned, do not place food directly on these surfaces; instead, cover the surface with a clean, wipeable covering.
- Do not sit on surfaces used for food preparation.
- Wash hands between handling raw foods and cooked foods. Also wash them after handling rubbish, using cleaning chemicals, visiting the toilet, blowing the nose, coughing, and scratching the hair, nose, or face.
- Thaw frozen foods either overnight in the fridge or by using the defrost function of a microwave.

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- Use separate knives and chopping boards for raw products and for cooked products.
 - Use separate chopping boards for meat and for fruit and vegetables.
 - Cook meat to an internal temperature of at least 75°C.
 - Reheat cooked products to an internal temperature of at least 83°C.
 - Reheat food only once.
 - Do not refreeze frozen foods if they have not been cooked since thawing.
 - Cool cooked food quickly by placing it in shallow containers or dividing it into small portions before placing it in the fridge for storage. Cooked foods needing refrigeration must be placed in the fridge within 30 minutes of being cooked.
 - Taste food with a clean spoon or appropriate utensil rather than the fingers.
- Any food additives, for example, dyes and paints used when making coloured popcorn or other consumable food products, must be safe to eat.

Eating food

Students must not share eating utensils. All equipment used in serving and eating food must be clean and manufactured from food-safe materials. Food products that are to be eaten at a later date should be transported from the food technology area in food-safe containers covered with a lid or with plastic or foil wrap.

Fish should not be bottled in schools because of the risk of food poisoning caused by contamination from *Clostridium botulinum*.

Cleaning up

Appropriate cleaning procedures are important in food technology to prevent cross-contamination and the spread of foodborne illnesses. Good, clean practices that prevent cross-contamination are to:

- rinse dishes before washing;
- wash dishes in either hot soapy water, replacing dishwashing water frequently, or in a dishwasher;
- use clean tea towels to dry dishes, washing them after each use;
- wash stainless steel surfaces and benches with hot water and detergent and wipe them with a clean, wet cloth before use;
- clean walls, ceilings, and shelves regularly with detergent followed by a sanitising agent;
- mop floors regularly with hot water and detergent or a detergent-sanitiser;
- clean chopping boards and wooden surfaces with hot water and strong detergent or, preferably, soak them overnight in a chlorine sanitiser.

All chemicals for cleaning food preparation areas should be stored in a lockable cupboard with, if necessary, an appropriate hazard warning.

Food scraps and other rubbish should be carefully disposed of to prevent the spread of foodborne illness. Regular and safe disposal of rubbish is extremely important. Guidelines to follow are to:

- store rubbish receptacles above ground away from food storage and preparation areas and from sunlight;
- ensure that rubbish bins have tight-fitting lids;
- securely tie paper or plastic rubbish bags at the top when full;
- dispose of rubbish daily;
- clean rubbish bins and the surrounding storage area daily;
- where appropriate, designate separate rubbish containers for food scraps, plastics, glass, and paper and cardboard;
- dispose of chemical waste regularly, seeking advice on its disposal from the manufacturer, the supplier, or the nearest local authority.

Non-food Related Activities

Dyes and paints used for purposes other than in or on consumable food products should not be used in the area designated for food preparation and cooking.

Any food technology that involves routine scientific chemical analysis should be carried

out in a separate space designed for chemical usage, such as a science laboratory. See Section 4 of *Safety and Science: A Guidance Manual for New Zealand Schools*, for further information.

5.2 Safety in Specialist Areas

The Classroom Environment

If possible, the teaching space used for the preparation, cooking, and sensory evaluation of consumable food products should be a specialist area designated specifically for food technology. In addition to the required facilities for general classrooms, this teaching space should also contain:

- laundry facilities;
- cooking equipment, such as microwave ovens, stoves, and gas or electric hobs;
- appropriate storage facilities for food products, chemicals, and equipment used in preparing, cooking, and evaluating food;
- a first-aid kit;
- fire-extinguishing equipment;
- a telephone for use in emergencies;
- adequate seating for students.

A registered electrician or gas fitter must install electric or gas stoves and a certificate of compliance obtained from that tradesperson on completion. In the case of gas stoves, a mains gas-supply switch must also be installed to turn off the gas supply to the classroom. This gas switch must be easily accessible to staff and be regularly checked.

Food Testing

Food presented for sensory evaluation must be held at the correct serving temperatures (chilled foods at 4°C, hot foods at 75°C, and reheated foods at 83°C). Food must be served in or on food-safe containers (preferably disposable).

If food-testing panellists are known by code rather than by name, their anonymity will be preserved. Evaluation booths or compartments should be properly lighted, painted a neutral colour, temperature controlled, well ventilated, free from foreign odours, and constructed in such a fashion that students can be easily seen at all times by the teacher.

Mass Production

Where large quantities of food are produced, all members of the production team must observe personal-hygiene, safe food-handling, and safe food-selection practices, and correct cooking temperatures, cooling techniques, and storage temperatures must be used at each stage of the production process.

When using industrial equipment, ensure that all safety procedures for using particular pieces of equipment are observed. These include:

- using safety guards on commercial mixers, mincers, and other relevant equipment;
- keeping electrical cords off the floor and away from water supplies in order to prevent electrocution;
- wearing safety glasses and earmuffs when appropriate.

Safety and Information and Communication Technology

6.1 Information for All Teachers

The curriculum statement *Technology in the New Zealand Curriculum* defines information and communication technology as including

... systems that enable the collection, structuring, manipulation, retrieval, and communication of information in various forms. This includes audio and graphical communications, the use of electronic networks, and interactive multimedia.

Technology in the New Zealand Curriculum, page 12

Teachers planning for safety in information and communication technology should have thorough knowledge and experience in this area. If this is not the case, teachers should seek advice from a specialist in this technological area.

Information and communication technology involves students in gathering, storing, processing, retrieving, and sharing information. The ways in which this may be done, and the information technologies that students may use, are varied, and so it is difficult to predict all the hazards that students might be exposed to while participating in this area of technology.

Computers and their associated peripherals of printers and scanners; digital cameras; data projectors; telephones; facsimile machines; and access to video and audio equipment (with some schools having their own production studios) extend the range of possible techniques available to students and teachers. In some schools, specialist rooms house computer suites, radio stations, television studios, and photographic darkrooms. This equipment and these environments can present teachers and their students with hazards that need careful consideration.

Students need to be kept both physically safe and emotionally safe and to be encouraged to develop safe practices both for their current and their future use of information and communication technologies. Physical danger can arise from accidents, such as tripping over a wire, or from injury developed over a period of time from exposure to such hazards as poor sitting positions or noise. Emotional danger may arise from exposure to material unsuitable for the age group or from access to undesirable people.

Locating Equipment

The first issue that schools face when obtaining information and communication technologies is where to locate the equipment; this depends on how each school plans to use this technology. A good place to start is in developing an information and communication technologies plan that is linked to curriculum goals. Specific technologies can then be identified and issues of staff and student access addressed. This, in turn, will determine where the equipment should be located, whether in classrooms, in a laboratory, in the library, or in an office. Specific issues relating to the location of equipment in each of these environment need to be discussed.

Classroom Layout

When setting up equipment areas in the classroom, careful planning is needed to ensure that enough safe power points are located close to where they are required. When planning, it is better to install more power points than are needed.

Ensure that cables to computers and peripherals are:

- safe in terms of electrical supply;
- in excellent repair, with no case damage and with the plugs correctly attached;
- not tripping hazards for students moving about the classroom. To reduce this hazard, install new power points in suitable areas or fix trunk-cabling facilities to the wall to carry power cables and networking cables. Where networks are used, the network outlets also need to be close to the equipment.

Regular checks should be made on all electrical 240-volt (V) cabling to check for fraying and other mechanical damage.

Do not overload power circuits that may not be designed for heavy usage. Instead of adding multi-boxes, it is preferable to get advice from a qualified electrician and upgrade the supply.

Lighting

Although general lighting conditions need to be considered wherever students are working, specific lighting considerations apply when students are using a visual display unit (VDU). Reflections on a VDU can be prevented by:

- using downlights rather than fluorescent lights;
- ensuring that lights are not placed above ceiling fans to create a flickering effect;
- ensuring that there is enough light for students to see any written work that they are using as source material;

- not placing a VDU where light from windows and other sources reflect on the screen;
- ensuring that there is no direct glare from bright lighting behind the VDU (including natural lighting from windows). Place the VDU at right angles to a window. Careful positioning of VDUs in classrooms can avoid the need for curtains.

If data shows (liquid crystal displays) are to be used in the classroom, consider how lighting levels can be easily controlled.

Working in Unobservable Areas

Teachers and their students should not work in spaces where they cannot be observed. Develop a policy for making spaces observable so that students are not vulnerable to physical, verbal, or sexual abuse from their peers, and so that teachers are not vulnerable to accusations from students. Video surveillance may be considered in some situations.

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Audio Production

The hazards associated with audio production depend on the situation and the equipment used.

Headphones

Prolonged use of headphones should be monitored, and guidance in appropriate volume control given to students. Headphones are a potential health issue when used by different students. One solution is to treat headphones as personal items and have students supply their own.

Computers

Unlike people working in office situations, students are usually not exposed to the dangers of computer-generated health problems because they do not generally spend long periods at the keyboard. However, as access to computers at school increases, this may be a consideration. If so, students will need to develop awareness of the associated hazards and acquire good posture and work habits.

Laptop computers

The prolonged use of laptop computers by students in classrooms exposes them to greater risks than the intermittent use of desktop machines. If students are expected to use a laptop with a small keyboard and trackball, touchpad, or other pointing device, they are more likely to develop overuse symptoms (OOS). In this situation, it becomes even more important to address the associated ergonomics issues, such as seating position, desk height, screen angle and brightness, lighting, and exercise. Students should not use laptops in poor seating positions for extended periods of time, and they should be encouraged to adjust lighting to avoid reflection and glare.

When students are using laptop computers connected to a power adaptor, do not create tripping hazards with the cables. Some models have wireless network connections that reduce the need for cabling. If students use laptops in classrooms as stand-alone units, not plugged into the mains power supply, consider how the internal batteries of the machines can be safely recharged between work sessions.

Printers

Take care when changing printer cartridges because spilled ink can damage clothing. Students should be shown how to dispose of used cartridges.

6.2 Safety in Specialist Areas

Computer Laboratory Layout

Special attention needs to be given to the layout of computers in computer suites or laboratories. It is worth getting guidance when setting up a room specifically for information and communications technology, because mistakes may be expensive to fix. From a safety point of view, computers should be grouped in clusters, for example, in a hexagon with all cabling in the centre, or around the walls of a classroom with all wiring against the wall. However, many classrooms may not be large enough for these layouts, or teachers may prefer a standard row-by-row format. In this case, special care must be taken to prevent students snagging the cables on the computers behind them as they move about. See Classroom Layout on page 36 for hazards associated with cabling.

Take care not to overload power circuits. Typical classrooms have not been wired for full computer suites involving 20 to 30 machines, and the use of multi-outlet power boxes can easily overload the building's power circuits. Before a school sets up a computer suite, a qualified electrician should confirm the power loading.

Ventilation

Computers generate a lot of heat, and rooms containing several computers and peripherals, such as printers, can become very warm, especially when a number of devices are running at the same time. Extra room ventilation should be considered in situations where many computers are used, and specialist rooms may also need cooling equipment.

Curtains installed to reduce backlighting and reflections on screens may restrict the air flow that normally comes from windows. When windows are open, the curtains may be blown open, which defeats their purpose. Where a room has many windows facing north, options for reducing heat from direct sunlight could include using sunfilter screens that tape directly to window glass or using external shades over the windows.

Workstations

Enough space should be provided for students to consult resource material while they are working at a computer. Stands to hold this material are useful. The keyboard and the mouse should be on the same level in order to prevent strain when the user's hand moves between them. The monitor should be directly in front of the user and at such a height that the user looks slightly down at it. The surface holding the keyboard and mouse should be at such a height that the user's forearms are parallel with the floor.

Electromagnetic fields

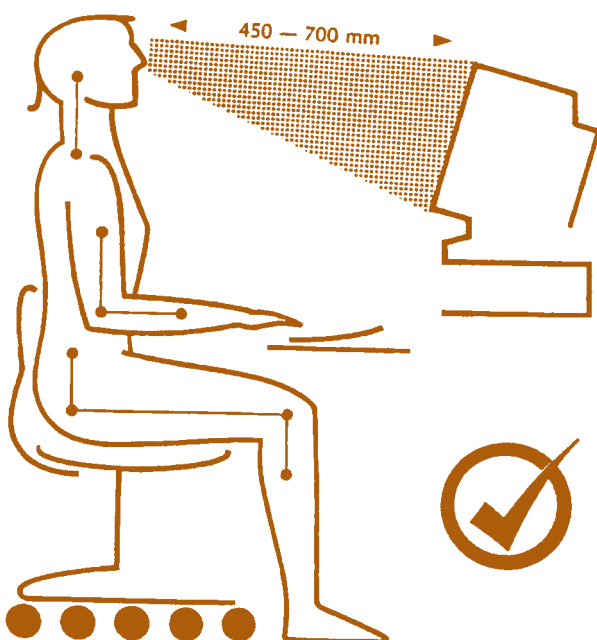
Visual display units are not considered to put users in danger from magnetic fields, radiation, X-rays, or microwaves. However, it is recommended that users sit at least 700 millimetres (mm) away from a VDU. This is approximately an arm's length, which is the distance most users would normally sit anyway. There is no evidence that miscarriages, birth defects, or skin complaints are associated with using VDUs.

Seating position

To use a keyboard, students need to be seated in a comfortable position. Because students vary in height and size, ideal working positions for them will also vary. Furniture needs to be adjustable to allow for these differences. Properly constructed seats allow each user to adjust the height and angle positions to suit their needs. Students need to be able to:

- adjust the keyboard height so that their wrists are straight (constant bending of the wrists creates muscle tension);
- see the VDU without twisting their heads;
- sit with their knees and ankles at an angle of 90° or greater to the floor;
- sit with their feet flat on the floor. Students whose feet do not reach the floor when sitting should be provided with footrests.

Purpose-built furniture is more likely to encourage good sitting positions. Ideally both the seat and desktop should be adjustable and the monitor able to be pivoted so that the angle can be modified both vertically and horizontally. When buying computers, the cost of purchasing proper furniture for it also needs to be taken into account.



Exercises

Encourage students to do regular relaxation exercises when using a computer to help promote blood flow and counter the effects of muscle tension.

Using Communication Technologies

Students often use information technology that gives them access to people and information beyond the school. Whether such technology is the Internet, the fax, or the telephone, students need to be kept safe from contact with undesirable information and people. Information available via electronic media, especially the Internet, is vast and constantly changing, and it is impossible to preview all the information students might be exposed to. Schools need to develop a policy that reduces risk to students without depriving them of the benefits of these technologies.

Censorship

Agreeing on what is undesirable is not a simple task because people's views are influenced by their cultural, religious, political, and moral perspectives. Schools will need to decide for themselves whether they are going to censor material and, if so, on what basis.

If students are determined, they will always find ways of getting and sharing dubious information. Teachers need to be aware that a classroom computer or a video player operated by unsupervised students may be used to view unacceptable material.

Chat services on the Internet are set up to give computer users opportunities to discuss interests and issues on-line and to make new friends. They give students access to people throughout the world. However, some of these contacts have led to students getting into dangerous situations without the knowledge of their parents or teacher. Schools need to consider these matters carefully and develop an "acceptable use" policy for such electronic media.

Acceptable use policies

The purpose of an acceptable use policy is not to set limitations or restrictions but rather to facilitate, and set guidelines for, exploring and using communication technologies, particularly the Internet, as a tool for learning. The policy could provide guidelines for teachers on what is and is not acceptable and describe ways that teachers can regulate and monitor student access.

As well as safety issues, an acceptable use policy could incorporate a policy for students' use. This would be an agreement between the school and the students to adhere to set guidelines when they use communication technologies.

Teachers, in consultation with parents, need to reflect on their own beliefs and then develop an acceptable use policy that will help students develop the skills of:

- discriminating between information sources;
- identifying information that is appropriate to their age and developmental level;
- evaluating and using information to meet their educational needs.

The policy should set up procedures that minimise risk to students by providing guidelines to deal with behaviours, such as:

- violation of privacy;
- harassment (such as sending or receiving unsolicited messages);
- flaming (making or receiving emotional verbal attacks);
- addiction (excessive use of the Internet);
- sending or receiving objectionable material;
- engaging in destructive or illegal behaviours;
- making or coming into contact with undesirable people;
- failing to respect property rights (copyright).

Consideration needs to be given to:

- the imposition of a specific code of morality or standards of behaviour on others;

- the issue of intellectual freedom;
- the freedom of the individual to make choices;
- the rights of students to make informed choices;
- the purpose of such facilities at school (which may well be different from that at home).

In developing this policy, schools need to determine their roles and responsibilities and those of parents.

- What is the role of the teacher with regard to censorship and guidance?
- Should the school have a role in consulting and advising parents?
- What is the role of the school in developing responsibility among its students?

Positive management

Positive management of such technologies within the school includes developing appropriate skills with students.

- **Search skills.** Students should always be searching with a clear purpose in mind. If students state this purpose in writing before gaining access to the Internet, the fax machine, or the telephone, staff can check that the student is on task. This statement also acts as a self-check for the student.
- **Etiquette.** Students can be given lessons on appropriate ways to request and thank people for information, including “netiquette” (how to behave on the Internet).
- **Discriminatory skills.** These help students to decide what is or is not appropriate. Search results on the World Wide Web that give a brief summary of accessible material can help students decide what is or is not suitable for their purpose. The ability to discriminate can also save a great deal of research time.
- **Coping with inappropriate material.** Guide students in ways to deal with inappropriate material. Even with careful planning, students could find objectionable material, and teachers need to know how to deal with this situation.

Monitoring access to the Internet

It may be necessary to monitor student access to the Internet. Some of the ways this can be done are listed below. Schools need to work out a system that functions best for them.

- **Password restrictions.** Passwords can be used to give staff or other designated people control over who has access to the Internet and when. The password may restrict access to the hardware or software, but remember that students delight in bypassing such devices!
- **Supervised use.** If students and the VDU are clearly visible to others, this will encourage students to self-monitor the material they are using. However, it does not take a student long to save to disk material that can be accessed at a later date.
- **Restrictive programmes.** It is possible to install screening software that will remove access to most identified undesirable material. This software is available through software retailers.
- **Self-imposed restrictions.** Students agree to follow guidelines for accessing material and for dealing with material that is not acceptable to the school. This is most effective when the guidelines have been developed with the students themselves.
- **Intranet.** An Intranet relies on the school having someone who is able to download material onto the school network. While students feel as though they have access to the Internet, they actually have access to only a limited selection of material. Student safety is increased because teachers select and monitor the material that students have access to. Because search time is reduced, access to material is also sped up, and costs are reduced because relevant material is downloaded only once. However, the safety issue needs to be weighed against the time needed to download material in anticipation of student needs and also against the restrictive nature of such a system.

Photography

If students can develop their own photographs, the school needs to ensure that they are doing so in a safe environment. There is also an issue of students and teachers working together in spaces where they cannot be observed. Teachers should not put themselves or their students in vulnerable situations.

The workspace needs to be well ventilated, and students should be properly instructed in the correct use of the chemicals involved. Teachers of photography should be aware of the recommendations in *Safety and Science: A Guidance Manual For New Zealand Schools*, Section 4, with regard to the storage and safe use of chemicals.

Video Production

The hazards associated with video production depend on the situation and equipment used by the students. Issues identified with viewing and concentrating on VDUs for prolonged periods, as on page 38, are also appropriate here.

7.1 Information for All Teachers

The curriculum statement *Technology in the New Zealand Curriculum* defines materials technology as including

... the investigation, use, and development of materials to achieve a desired result. It involves knowledge of the qualities and suitability of different types of materials, including wood, textiles, composites, metals, plastics, and synthetics, and fuels, as well as the processing, preservation, and recycling of materials. Materials technology contributes to many other areas, especially Structures and Mechanisms.

Technology in the New Zealand Curriculum, page 12

Teachers planning for safety in materials technology should have thorough knowledge and experience in this area. If this is not the case, teachers should seek advice from a specialist in this technological area.

Most general materials in materials technology can be safely handled and worked, but they all have their own particular properties. Issues of safety, particularly those concerned with working, shaping, and joining of materials, are covered in Section 9: Safety and Structures and Mechanisms.

The following materials are the ones most likely to be found in schools. For fully comprehensive details about their use and safety, teachers will need to do their own research on the correct way to work with and handle them before making a decision as to whether or not they are appropriate to use in particular classrooms.

Secure and safe storage is required for all materials used in classrooms, especially in specialist rooms. All students' project work should be stored in lockable cupboards. Do not store work above head height because objects can become projectiles during an earthquake.

For safe storage of specific chemicals and other materials, consult the relevant information in *Safety and Science: A Guidance Manual For New Zealand Schools*.

Materials That Can Be Used in Classrooms

Adhesives (glues)

Always follow the manufacturer's recommendations for adhesives. Restrict access to glues that have the potential for solvent abuse. At all times when handling resins, solvents, and a number of adhesives, wear safety glasses, aprons, rubber gloves, and face masks for protection. Treat resins with respect because many adhesives are chemically active or are activated when a catalyst is added to them. After working with resins and adhesives, always wash hands to avoid the risk of dermatitis. Store adhesives in lockable cupboards in clearly labelled containers.

Aluminium

In sheet form, aluminium has sharp edges. It is one of only two metals that may be cast in school workshops.

Bone

When bone is worked, it gives off fine dust. Adequate ventilation is required, and each student should wear a dust mask that covers the nose and mouth for protection.

Brass

Refer to the notes about steel on page 45.

Cleaning agents

Store all cleaning agents, including turpentine and methylated spirits, close to the floor in a lockable cupboard labelled with a hazard warning. If the school stores more than 15 litres (L) of flammable materials in one place, keep them in a dangerous-goods store. See *Safety and Science: A Guidance Manual For New Zealand Schools*, page 16, for details about storing these materials.

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Copper

Copper has sharp edges in sheet form, and it hardens when worked. It occasionally requires annealing to soften it.

Fibre board

Fibreboard, such as medium density fibreboard (MDF), has sharp edges. Take care when manoeuvring large sheets. Dust from fibreboard can be a fire danger when it is held in a waste-extraction system because heat can build up, with explosive results.

Finishing materials

Finishing materials, such as enamel paints, varnishes, thinners, and solvents, are highly flammable. Store these products securely, away from heat. Refer to Cleaning Agents, above, for information on storing large amounts of flammable materials.

Fluxes

Fluxes are used in conjunction with solder and give off poisonous fumes. Use them only in a well-ventilated space and when wearing protective clothing. If spattering occurs, wash the flux off immediately.

Glass

Where glass cutting has taken place, take special care with the cleaning-up process, especially the surfaces of workbenches, to protect students from being cut. Glass is a hazardous waste and should be placed in a separate waste bin.

Glass-reinforced plastics (GRP)

Conditions for working with GRP are similar to those for plastics. Use safety glasses, aprons, gloves, and face masks. Because resins and catalysts require careful handling, follow the manufacturer's instructions at all times. Although glass fibre is non-combustible, most other materials used in GRP are combustible. Store GRP in a lockable cupboard.

Lead

Lead is heavy in large quantities. Do not breathe lead dust because the effects are cumulative and may have serious chronic consequences. Lead is one of only two metals that may be cast in school workshops.

Oils

Clean up any oil spillage immediately.

Plastic

The term “plastic” can describe a wide range of synthetic, composite, and natural resin materials used in school specialist rooms. Many of these materials are worked by moulding, by heating, or by chemical treatment. They can also be worked with most hand tools but sanding by hand is preferable. When working plastic and/or heat bending it, handle it with cotton or leather (not rubber) gloves to prevent cuts from the sharp edges.

Because solvents, cements, resins, and catalysts used with plastics can give off toxic and dangerous fumes, students should use as little as possible to achieve the desired results. Provide adequate ventilation and always follow the manufacturer’s instructions.

Polystyrene

When polystyrene is cut with a hot wire, dangerous fumes are given off. This activity should be carried out in a well-ventilated space

Hot-wire cutters used to cut polystyrene must be operated from a battery source or through a transformer.

Recycled materials

A variety of reused or recycled materials can be useful in technology education. All recycled material that students work with should be clean and hygienic. When using aluminium or tin cans, ensure that they have no sharp edges.

Solder

Because solder contains lead, ventilation is required.

Solvents

Keep solvents away from heat and store them in cool conditions. Label containers of solvents clearly. Do not mix unknown materials. When wiping up spills, take care to use clean rags so that materials are not accidentally mixed during the cleaning process.

Steel

Steel is heavy to handle in large quantities. Because it can be dirty, has sharp edges, and has burrs on the cut ends, handle it with gloves.

Timber

Timber should be racked in secure storage away from work areas, with heavy timbers stored close to the floor. Take care when manoeuvring long lengths of timber. Watch for handling defects, such as splinters and sharp edges, and cut out loose knots, which are a danger when passing timber through a thicknesser.

Tanalised timber

Where students are designing and manufacturing products to be used by children, they should not use tanalised timber because it contains poisonous chemicals from the treatment process.

Materials That Are Forbidden in Classrooms

Section 5 of *Safety and Science: A Guidance Manual For New Zealand Schools* lists substances forbidden in New Zealand schools.

7.2 Safety in Specialist Areas

In specialist areas, a major safety concern is the storage of large amounts of bulky materials. An adequate rack system needs to be in place to store sheet materials – wood, metal, plastics, and long lengths of timber and steel. Store bulky and dense materials in such a way that people cannot be hurt if the materials fall.

Store all steel in a separate area away from work areas. Upstands on the face of racks should be high enough to prevent steel from rolling, sliding, or falling. Do not store steel in the roof trusses of a building because it can become a projectile during an earthquake.

When large quantities of materials are being shaped or joined, dust or fumes can build up. Adequate ventilation as well as dust extraction is important, and classroom spaces must be set up to accommodate this.

Chemicals should be stored in accordance with the hazardous substances requirements (see *Safety and Science: A Guidance Manual For New Zealand Schools*, Section 4.2).

SECTION 8

Safety and Production and Process Technology

The curriculum statement *Technology in the New Zealand Curriculum* defines production and process technology as including

... both the manufacture and assembly of products from individual components in, for instance, *a furniture or appliance factory or a motor vehicle assembly line*; and the processing of fluid-bulk raw materials—gases, fluids, and fluidised solids—into products such as *paints, fertilisers, and petrochemicals through a continuous process*. This area also includes large-scale primary production of agricultural and forest products.

Technology in the New Zealand Curriculum, page 12

Teachers planning for safety in production and process technology should have thorough knowledge and experience in this area. If this is not the case, the teacher should seek advice from a specialist in this technological area.

Production and process technology is about producing outcomes in the form of artefacts, systems, or environments. It incorporates both the specific outcome to be produced and the process of achieving that outcome. This can be as basic as developing rough concept designs or as detailed as setting up an actual process to produce a planned outcome. Production and process technology, therefore, applies to all the other technological areas. It can be carried out in a general classroom, in a specialist room, in the school grounds, or off the school site.

Safety in production and process technology depends both on the nature of the outcome and on the production process used to achieve it. Before commencing work with students, teachers need to undertake an initial risk analysis of the production process to identify hazards in relation to:

- the people involved, such as students, resource personnel, and the intended end-users (including cultural and ethical considerations);
- the materials and equipment used, including energy sources and wastes associated with the process;
- the environment, in both the production process and in the final outcome.

When hazards are identified, risks can often be minimised by incorporating appropriate control technology into the process. In good technological practice, students should also be made aware of the importance of risk analysis. This process can become an integral part of classroom practice from an early age.

An activity centred on production and process technology often involves groups of students working outside the classroom and may incorporate visits to sites using specific technological practices. Such visits must comply with existing school policy. Teachers should take particular care to visit the site beforehand to:

- confirm the rationale for the visit and the expected outcomes;
- find out whether any specific clothing and equipment is required;
- find out how much time is required for travelling and to completing the required tasks;
- identify potential risks and establish management procedures to minimise them;
- determine the amount and nature of the adult supervision required;
- establish the level of prior knowledge needed by the students.

9.1 Information for All Teachers

The curriculum statement *Technology in the New Zealand Curriculum* defines structures and mechanisms as including

... a wide variety of technologies, from simple structures, such as a *monument*, or mechanical devices, such as a *mousetrap*, to large, complex structures such as a *high-rise office block*, or mechanical devices such as a *motor car*.

Technology in the New Zealand Curriculum, page 12

Teachers planning for safety in structures and mechanisms should have thorough knowledge and experience in this area. If this is not the case, teachers should seek advice from a specialist in this technological area.

In the area of structures and mechanisms, the teacher's role in implementing safe practices and anticipating dangers is vital. Teachers should give careful instructions that are understood by all students and supported by clear, practical demonstrations. Students' behaviour with machines must be constantly monitored. In order to do this, teachers need to be fully aware of the dangers associated with each piece of machinery, know and use safe practices, and be able to plan ahead for the safety of students.

Full safety instructions must be given before any student uses any machine. This should include demonstrating any safety equipment to be either used or worn, and modelling safe working practices.

Only one person at a time should use a machine, including starting and stopping it. The only exception to this is when another person is needed to help with heavy objects. Other students must stay a minimum of 1 metre (m) away from a machine when it is operating.

Students need to be taught how to prepare for work by:

- working out the correct order of operations before they begin;
- deciding on the correct machine to do the task;
- stacking or storing the required material in a convenient, safe place;
- checking materials for any potential handling hazards.

Using Machines Safely

The main rules for using machines safely are as follows.

- Never wear loose clothing, including loose sleeves, ties, or scarves, when working with machinery.
- Tie back and cover long hair.
- Wear solid footwear, not sandals, jandals, or open-toed shoes.
- Remove rings and other jewellery.
- Where processes have a particular hazard, use protective clothing, safety glasses, or noise protection as required.
- Plan and prepare correctly before operating a machine. This includes having a full knowledge of the machine, its hazards, and safe procedures for operating it. Never use any machine until you have been properly trained for using it.

- Use machinery only for the purpose that it was designed for.
- Check that all guards are in place.
- Check constantly for any defects. If you find any, isolate the machine and notify the person responsible for maintaining it.
- Obtain and use correct safety equipment.

Note: All metals, when drilled mechanically or turned, leave a waste called swarf. This is dangerous to handle because it has sharp edges. Clean up swarf with a brush and shovel.

Hand Tools

Always store tools in a safe position. When they are in use, place tools in the well of the bench or store them in racks with their sharp edges facing downwards so that the user will not cut themselves when handling them. Do not leave a tool on the floor or in a position where it can roll off a bench. Careful instruction must be given in the safe use of hand tools, and each tool should be used only for its correct purpose. Safety glasses must be worn when cutting or chipping some materials.

Tools to be used in wood- or metal-based tasks are safer to use when they are sharp. Students should know how to recognise when a hand tool needs to be sharpened and understand the need to draw the teacher's attention to this. Before year 10, students are not expected to learn how to sharpen tools. However, students who are year 10 and over should be taught how to carry out minor maintenance and how to sharpen some tools. Metalworking tools are often subjected to hard, heavy use and need more frequent attention.

All files, with the exception of needle files, should have handles fitted.

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Chisels

Always use chisels with both hands behind the cutting edge.

Craft knives

These should be issued by the teacher and used under supervision. Students should be discouraged from using their own craft chisels in class. Place a board under the object to be cut in order to prevent it from slipping and the knife damaging both students and the work surface. If cutting a straight edge, students should use a safety ruler, never an ordinary ruler. Before students use craft knives independently, they must be taught how to use them correctly and safely.

Guillotine (paper type)

Because these pieces of equipment cannot be fully guarded, students need to be fully instructed in their use. If there is any doubt about a student's ability to use this device safely, an older student, parent helper, or teacher should do the cutting.

Handsaws

Students should use a vice with all types of handsaws, such as a coping saw, a hacksaw, or a woodsaw. This holds the work piece firmly and keeps the student's hands away from the blade.

Hot-glue gun

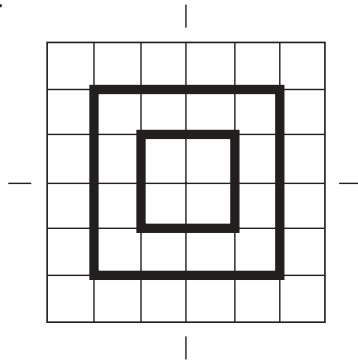
Use these with care. Teachers who are concerned about their students' ability to control a hot-glue gun should encourage students to wear a glove on the hand that holds the work to be glued, or ensure that they have an adult or senior student to help them.

Scissors

Carry scissors by the blades, with the blades shut, and pass them to another person handle first.

Portable Electrically-powered Tools

Electrically-powered hand tools should be of an industrial type, of robust construction, and double insulated, as indicated by the symbol.



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When working with power tools, observe the following safety rules.

- Use an isolating transformer or RCD at all times.
- Ensure that the electric lead between the transformer and the power source is as short as possible.
- Use only one tool for each transformer or RCD.
- Do not use power tools in wet conditions.
- Ensure that tools and leads are regularly maintained.
- When tools are not in use, turn them off and remove the plug from the socket.
- Do not put any power tool down until it has completely stopped.
- Make sure there are no trailing leads.
- Use safety glasses at all times and, in most cases, earmuffs for noise protection.

9.2 Safety in Specialist Areas

The tools, machinery, and processes used in schools' workshop facilities are similar to those found in industry. If used correctly, this equipment is safe, but there is the potential for this equipment to be hazardous. Specialist teachers employed in this area must be fully trained in the use of this machinery and equipment; this includes having an understanding of

aspects of the maintenance of these machines. Users of these machines must wear protective clothing, safety glasses, and earmuffs. They should also use correctly designed pushsticks where necessary.

When operating these machines, follow all the safety guidelines mentioned in 9.1 above about instructing and supervising students, using correct operating procedures, and carrying out safety requirements.

No machine in a workshop, with the exception of a power hacksaw, should be left unattended.

The Health and Safety in Employment Act 1992 does not set qualifying ages for the use of machinery and equipment. The Act states that, providing the person has had adequate training, they may use a particular or portable machine. However, in the interests of student safety, it is advisable that teachers restrict students' access to some machines and equipment until they are old enough to fully understand instructions in their use and the need to adhere to safety procedures, and to be physically capable of working with the equipment and machines. See Appendix Four on page 68 for a list of recommended minimum year levels for using machinery.

Classroom Requirements

The school's materials technology room should be large enough to ensure that there is no overcrowding of people or equipment. Bench layout should be designed to enable the easy flow of students around the room with aisles, entries, and exits kept free of obstructions and with all benches anchored to the floor. Machine-bay areas need to be designed to provide space so that bulk materials from storage can be broken down for student use.

Because students using specialist rooms and workshops vary in height, it is difficult to ensure that benches and machines will be at a suitable working height for all users. Some ergonomic consideration needs to be given to varying the heights of benches and machines so that they can be operated safely. Students must not stand on boxes to operate machines.

The risk of accidents increases in a materials technology workshop that has poorly controlled heating and ventilation. Students should be able to work in a comfortable temperature without having to wear coats. Ventilation must distribute fresh air without creating draughts, but it may not be enough to remove dust and fumes. Exhaust equipment should be positioned to remove polluted air at its source from hot-metal bay areas, finishing rooms, and spray booths.

Floors should have non-slip surfaces, be maintained in good condition, and be free of tripping hazards.

Electrical Requirements

Black-heat appliances, soldering irons, and electric irons should have a red pilot light at the electrical outlet to indicate when they are switched on. All machine switches should comply with electrical regulations. Emergency machine-stop systems must be maintained in good working order; the use of foot or knee-stop buttons on machinery are an important safety device.

All electrical equipment and installations must comply with local authority and electrical safety regulations. A registered electrician must carry out all wiring and electrical maintenance except for replacing a fuse or wiring an extension cord. The following defects must be investigated immediately and be corrected by a registered electrician:

- machinery or equipment that gives electric shocks, however slight;
- overheated switches or plugs;
- sparking or spluttering from cords or plugs;
- broken or frayed leads or cords;
- broken switches.

Electrical regulations require that all electrical appliances, including portable power tools, isolating transformers, and RCDs used in school workshops, be:

- inspected and tested before use;
- inspected before being used again after repair;
- inspected at intervals not exceeding 12 months;
- tagged at inspection (each piece of equipment should be tagged, and all inspections should be carried out by a registered electrician or an approved power tool agent);
- recorded in a school register of all electrical equipment.

Outsourcing

In some areas of technology education, it is difficult to predict what outcomes students will want to develop. Students should not have to limit their choice of solutions to a particular technological problem because the school does not have the facilities to allow them to develop their solutions. For one-off projects, outsourcing of the final construction may be considered. The issues of cost versus choice of alternative solutions should always be considered as well as the availability of a reputable supplier.

In some situations, the safety of the end-user of a product relies on the quality of the workmanship during its development. If teachers are not confident that students have all the skills needed to manufacture a product that is safe for the end-user, outsourcing of these skills should be encouraged. Examples of where outsourcing is encouraged are:

- in the repair or manufacture of petrol tanks and/or containers for flammable liquids;
- for any repair to bicycles, cars;
- for any other equipment where personal safety depends on the repaired part.

In this case, a reputable and qualified agent should be sought. This also applies to the modification of parts.

Machine Hazards

Examples of dangerous parts of machines are:

- revolving shafts, spindles, mandrels, bars, machine shafts, drilling-machine parts, drills, and chucks;
- revolving gears;
- belts and pulleys;
- chains and gears;
- connecting rods, links, and rotating wheels;
- reciprocating fixed parts;
- control handles and fixed parts;
- projections on revolving shafts, keys, set screws, and cottar pins;
- rotating parts and open pulleys;
- revolving cutting tools and saws;
- reciprocating knives and guillotines;
- abrasive wheels;
- endless cutting machines.

Methods of addressing some of these hazards include the following practices.

Using colour coding

Workshop equipment should be colour coded according to NZS 5807:1980 *Code of Practice for Industrial Identification by Colour, Wording, or Other Coding* to identify the dangerous aspects of machines.

<i>Colour Name</i>	<i>Colour Paint Reference Number</i>	<i>Meaning</i>
Safety Red	BS 5252 Colour Number: 04	Stop Danger To indicate fire-fighting equipment and its location
Safety Yellow	13S 5252 Colour Number: 08	Caution Warning of danger
Safety Green	BS 5252 Colour Number: 14	Safety To identify the location of safety equipment, emergency escape routes, and medical first-aid equipment
Safety Blue (auxiliary blue)	BS 5252 Colour Number: 18	Mandatory Action For example, "Wear safety goggles" Information For example, locating the telephone

Note: Blue is used only as a component of a sign and is considered a safety colour only if used in conjunction with a circle.

Using machine guards

On the construction and fitting of machine guards, NZS 5801:1974 *Specification for the Construction and Fitting of Machinery Guards* states that guards should be painted safety yellow. Fixed guards on machines, which are occasionally removed only for repairing or maintaining the machine may, however, be painted the same colour as the machine. Movable guards, such as saw guards and thicknesser guards, which must be adjusted for each particular job, should be painted safety yellow. However, the inside of all guards, whether fixed or moveable, should be painted safety yellow.

Isolating switches should be fitted to all machines so that they cannot be switched on accidentally while under maintenance or being adjusted. Because the basic principle in guarding machinery is that all moving or dangerous parts need to be covered unless touching them is necessary to operate the machine, adjustable guards should be fitted to all machines. Machines that must be fitted with guards are listed in Appendix Two on page 67.

Using Machinery

Because all machines, whether wood based or metal based, can seriously injure the operator if used incorrectly, they must be correctly installed, safely guarded, and maintained. All permanently-wired machines should be anchored to the floor, and electrical machines on a wooden floor must be correctly earthed to prevent the build-up of static electricity.

Note: In years 7 to 10 in particular, teachers must check the set-up of all machines before students switch them on.

Machines must be installed in locations where accidentally ejected material will not injure nearby students. Students should not be able to stand in line with work coming off a machine because of the danger of flying material. This applies, in particular, to circular saws, surface planers, and lathes. Students should also not look directly into the openings of a thicknesser in operation.

Regular maintenance and overhauling of machines is an essential part of safety. Unsafe equipment must be identified, and the head of department or teacher in charge must be notified about it. Unsafe equipment must be taken out of service.

Bandsaw and scroll saw

Carry out all adjustments with the machine turned off. Before students use a band or a scroll saw, the teacher must:

- fit and adjust the blades to the correct tension;
- adjust tool guides and guards to be just clear of work;
- warn students to keep their hands well clear of the cut line and to take care with sharp corners or curves so as not to jam the blade.

Drill (bench mounted and pedestal)

Before students use this machine, remind them to:

- always use safety glasses;
- choose the correct speed for the job;
- keep their hands clear of the revolving chuck or drill bit;
- ensure that only one person at a time is operating the drill;
- always remove the chuck key after tightening;
- carefully secure work. Large pieces of timber having small holes drilled in them may be safely held by hand. Hold small work in a vice or clamp it to the table.

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Drilling machine

Wear safety glasses at all times. An additional concern when using drilling machines is the production of swarf. When metals are drilled, swarf comes off as a long curl. Break it by stopping the feed momentarily. Swarf is a waste from the drilling process, and it must never be handled without gloves. Clean it up with a small brush and shovel.

Electric arc welding

Electric arc-welding equipment may be used by year 10 students and above. Students must take care in welding anything where personal safety is dependent upon the finished product because a fault in the weld may cause an accident.

Students should wear safety glasses or shields with the correct shade of filter glass, according to AS/NZS 1338.1:1992 *Filters for Eye Protectors – Filters for protection against radiation generated in welding and allied operations*; AS/NZS 1338.2:1992 *Filters for Eye Protectors – Filters for protection against ultraviolet radiation*; and AS/NZS 1338.3:1992 *Filters for Eye Protectors – Filters for protection against infrared radiation*, to protect the eyes from infrared and ultraviolet radiation and from high-intensity light. An extra shield needs to be available for the teacher to use when supervising students. All shields must be kept in good condition. Do not use oxyacetylene goggles for electric welding because they are not adequate.

Special welding curtains should be installed around welding bays to protect other students. Do not allow anyone to watch, because when the arc is struck, the associated flash can damage eyes.

Keep all equipment in good condition and use suitable safety equipment. Cover all skin because arc welding has a “sunburn” effect and gives off sparks that can burn. The work and electrodes will also be hot to touch and can cause burns.

Always use safety glasses when chipping slag.

Ensure that the area is ventilated to remove fumes.

Electric spot welding

After demonstration, this is a simple and safe operation for students, but they should always use safety glasses or a safety shield.

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Gas welding and cutting

Oxyacetylene equipment is not to be used by students before year 10. Acetylene is a highly flammable gas and, under some conditions, it will explode violently. Take particular care to prevent acetylene gas from escaping because it might create an explosion in a workshop or storage area. Oxygen leaks are as dangerous as acetylene leaks. Gas equipment can be tested for leaks by:

- immersing hoses in water and checking for bubbles;
- immersing the tip of the torch in water to test the valves.

Gas-welding hazards include the following.

- Damage to the eyes from radiant energy, spatter and chipping, or cleaning operations. See the above item on electric arc welding for the correct filters for welding goggles.
- Burns from hot metals and sparks. These can be prevented by wearing gloves and suitable clothing.
- Fumes from materials that have been galvanised or similarly treated.
- Explosions and fire from gases, and explosions caused through using gas-welding equipment in confined spaces. Ensure that there is adequate ventilation.
- The ignition of flammable materials. Remove such material before welding or cutting starts.
- Strains caused by lifting or moving heavy cylinders. Only move cylinders on their trolleys.

In the event of a gas fire from a cylinder or pipe outlet, teachers should leave the gas burning, set off the fire alarm, evacuate students from the premises, call the fire brigade and, if possible, hose the cylinder and surroundings to cool and restrict the fire.

Grinder

Although grinders are fitted with safety-glass shields, safety glasses should still be worn.

When using a grinder, set the work rest at a distance of 3 millimetres (mm) from the wheel to minimise the risk of the piece of work being wedged between the grinding wheel and the work rest. Do not use the side of the grinding wheel for grinding. If soft metals, such as aluminium, are ground, then loading of the wheel will take place and the wheel will need dressing.

Regularly assess the condition of the grinding wheel. Under certain conditions, flaws can cause the wheel to shatter. The user should check for cracks and ensure that the wheel is balanced. When replacing worn grinding wheels, follow the manufacturer's instructions.

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Guillotine (sheet metal)

A sheet-metal guillotine is normally fitted with a fixed guard to prevent the user from placing fingers under the blade. Check that a foot-operated guillotine cannot trap the user's foot under it. A lock pin should be fitted to the treadle. Do not feed a guillotine from the back.

Horizontal-boring machine

The safe use of the horizontal-boring machine is similar to that of bench-type drills. However, for many of these machines, the work is hand held and fed onto the drill. Keep hands well clear of the drill bit and ensure that the material being drilled is firmly secured.

Internal combustion engine

If the technological activities require students to modify, adapt, and work with functional internal combustion engines, full supervision is required at all times. Ventilation is required, and the engine must be exhausted to the open air. Because this equipment uses petrol, full consideration must be given to the availability of fire-safety equipment, including fire extinguishers. Do not fight a petrol fire with water.

Lathe (metal)

In operating this machine, students should:

- wear safety glasses;
- tie back or net long hair;
- not wear loose clothing because it can get caught in the revolving work;
- remove the chuck key after tightening;
- when the workpiece protrudes excessively from the chuck, provide support by "steadies" and/or by the tail stock;
- set the correct speed and feed before starting the lathe and not change speeds while the machine is running;
- if the work is so long that it protrudes past the end of the machine, guard the protruding work.

Students should not:

- handle the swarf without gloves;
- touch revolving work;
- apply cloth or cotton waste to rotating work.

Lathe (wood)

Constant supervision of students is required, particularly when they begin a piece of work. Always wear safety glasses or a face shield.

In operating this machine:

- keep other students 1 metre (m) away;
- use knot- and defect-free timber where possible, and ensure that any glued-up work is well fitted;
- reduce squared-off timber to an octagonal shape by planing or cutting the corners;
- select a safe cutting speed to suit the bulk of the wood to be turned and the nature of the selected timber;
- balance the wood to avoid vibration;
- make sure the work is secure by adjusting the tool rest and turning the work over by hand before starting to ensure that all adjustments are set correctly;
- if a brake is fitted, apply it steadily and cautiously;
- keep hands well away from the work;
- ensure that the handles of woodturning tools are firmly fitted;
- do not use tools made of old files;
- remove the tool rest when sanding.

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Metal plating (by electroplating and anodising)

If this equipment is installed in the school workshop, a full understanding of the Health and Safety in Employment Regulations 1995 is required. If only a few projects require metal plating, it is advisable to outsource this work with a reputable company because many plating solutions use cyanide, which is prohibited in schools.

Overlocker

Overlockers are fitted with a cutting blade, so take care when using this device. If using industrial machines with a mechanically driven cutting blade, ensure that this blade is guarded. Students need to be competent to use an industrial machine.

Plastics

When working with plastics, read and follow the supplier's instructions for all equipment and materials because these will differ between products. Ensure that any materials are safe to use for educational purposes and are the correct type for the operation being performed. Some materials can emit dangerous fumes or become flammable if incorrectly processed. Reputable suppliers will provide materials that are safe for educational use and training programmes for their products.

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Using a hotplate system

As the working surface of a hotplate system can reach very high temperatures, the main hazard is burns. The hotplate must be positioned on a heat-resistant surface at an appropriate height for the age of the students so that they have safe and easy access to it. Ensure that the electrical supply lead cannot be snagged, causing the unit to move unexpectedly.

Injection moulding machine and thermoplastics thermoforming machine

Ensure that the heaters in these machines are turned off when they are not in use, and never use these machines unless the heater guards are properly in place. Follow any other instructions supplied with the machines. Ensure that any materials are safe to use for educational purposes and that they are the correct type for the operation being performed. No teacher should use such a machine before receiving training in how to use it safely.

Never use an oven when working with plastic materials.

Polishing machine

Always wear safety glasses or a face shield when operating polishing machines. Stop the machine before adjusting it. The piece of work being polished must be securely held in both hands and gloves must be worn at all times. Do not hold the work in a cloth or apron. Always use the lower quarter of the wheel for polishing.

Power hacksaw

Clamp the work firmly, and securely support the long pieces of metal to be cut. Do not manually assist the saw. Adjust the flow of coolant for each job to maximise cooling and minimise spillage.

Sewing machine

Before students replace a needle or fit a bobbin, the sewing machine should be turned off. If students are to maintain and oil the machine, it should also be turned off first. The electrical cord needs to be checked regularly for wear, and students should be instructed

on how to unplug the machine without putting stress on the cord. If students are to use the sewing machine for an extended period of time, an ergonomically designed workstation should be provided, with the seating position and desk height adjusted appropriately for each student.

Constant supervision is required when students use pins and needles. No students should hold pins in their mouths. A pincushion or other holding device can minimise the risk of pins being dropped and causing harm. Needles should also be secured in a piece of fabric or a pincushion when not in use. If a pin or needle is dropped, it should be found immediately; a magnet is effective in clearing pins and needles from the floor.

Shaping machine (metal)

Always wear safety glasses. Firmly secure both the work and the cutting tool. Before operating this machine, set the correct speeds and hand-operate the ram for a full forward and backward stroke, making sure that the tool is clear of the work and the head slide is clear of the main housing. Operate the machine from the side to avoid cuttings that are ejected from the front of the machine. The back of the ram must be enclosed, and there should be a minimum clearance of 500 millimetres (mm) between its furthest backward position and any fixed objects behind it.

Appendices

Appendix One *Template for Safety Planning in Technology Education*

School: _____

Teacher: _____ Date: _____

Unit: _____

Year: _____ Level: _____

Technological Area(s): _____

Physical Safety

Classroom/teaching environment

In this unit, the following aspects of the teaching environment have been considered when planning for the safety of students and staff. Staff and students have been made aware of the safety aspects of this unit.

	Tick or N/A	Details
Accident register checked for accident patterns?		
Dust collection organised?		
Electrical equipment checked?		
First-aid assistance available?		
Handwashing facilities available?		
Hygiene considered?		

	Tick or N/A	Details
Lighting checked?		
Noise levels considered?		
Overcrowding considered?		
Raised objects secured?		
Students with special needs planned for?		
Telephone/ emergency contact (s) available?		
Tripping hazards minimised?		
Ventilation organised?		
Others?		

Student personal safety equipment

Needed	Availability

Assessing hazards and managing risk

The following potential hazards have been identified in this unit and safety has been planned for in the following ways.

Equipment

Item:
Hazard elimination/isolation/minimisation by:
Emergency Procedures:

Item:
Hazard elimination/isolation/minimisation by:
Emergency Procedures:

Item:
Hazard elimination/isolation/ minimisation by:
Emergency Procedures:

Materials

Item:
Hazard elimination/isolation/ minimisation by:
Emergency Procedures:

Item:
Hazard elimination/isolation/ minimisation by:
Emergency Procedures:

Item:
Hazard elimination/isolation/ minimisation by:
Emergency Procedures:

Environmental Safety

General waste disposal
Hazardous-waste disposal

Approvals obtained

	Tick or N/A		Tick or N/A
DNA transformations: ERMA New Zealand		Animals: Animal ethics advisory committee	

Mental and Emotional Safety

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Cultural Safety

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Enterprise and Community Visits

Health and Safety in Employment Regulations 1995, Regulation 59

Presence of young persons on a worksite

Allowance under subclause 2

a	b	c	d	e
---	---	---	---	---

Health and Safety in Employment Act 1992, Section 16 (as amended in 1998)

Duties of persons with control of places of work

Warning of significant hazards in the work place given

by: _____

to: _____

Appendix Two *Guarding of Woodworking and Abrasive Machinery*

These machines require the protective devices that are indicated regardless of whether they are used by students or adults.

Machine	Protective Device Required
Circular saw (bench)	Pushstick
Edger	Anti-kickback device
Hand-held abrasive grinding machine	A control switch that requires constant pressure by the operator
Power hand-tool circular saw	A control switch that requires constant pressure by the operator
Routing machine (router)	Jig or routing board
Thicknessing machine (thicknesser)	Anti-kickback device
Vertical spindle-moulding machine	Pushstick or jig
Any machine operated by a foot-control pedal	Cover or locking device

Appendix Three *Micro-organisms Suitable for Use in Schools*

- Vinegar-producing micro-organisms
- Baker's yeast
- Mildew and rust from plants
- Yoghurt bacteria
- Bacteria and fungi used to produce cheese
- Some fungal diseases on plants and rotting fruit
- Potato blight
- Black spot on roses
- Yeasts from grapes
- Fungi from jams and jellies
- Known non-pathogenic strains from reputable suppliers

Appendix Four Recommended Ages for Using Machinery

This table indicates the minimum year of schooling in which students may be expected to use the following machinery and equipment after being instructed how to use them safely.

<i>Fixed Machinery</i>	<i>Year</i>	<i>Portable Machinery</i>	<i>Year</i>
Drilling machine	7	Hot-glue gun	2
Portable drill in stand	7	Battery-operated drill	7
Horizontal borer	8	Electric drill	8
Scroll saw	8	Hot-air gun	8
Sanding disk on lathe	8	Spot welder	8
Power hacksaw	9	Hand-held precision grinder	8
Bench grinder	9	Disk sander	8
Lathes (wood and metal)	9	Jigsaw	9
Polishing machine	9	Orbital sander	9
Computer numerically controlled (CNC) lathe	9	Nibbler	9
Milling machine	9	Hand shears	9
Bandsaw	9	Belt sander	10
Oxyacetylene equipment	10	Router	11
Aluminium casting	10	Disk grinder	11
Shaper	10	Circular saw	never
Arc-welding equipment	10	Surface planer	never
Thicknesser	12		
Combination saw	never		
Vertical spindle-moulder	never		

Consultative Group

The Ministry of Education would like to thank the following organisations consulted during the development of these guidelines:

Aoraki Polytechnic
Association of Proprietors of Integrated Schools
Auckland College of Education
Auckland College of Education School Services
Auckland Diocesan School for Girls
Auckland Institute of Technology
Auckland University Department of Technology
Auckland University School of Engineering
Bay of Plenty Polytechnic
Central Institute of Technology
Christchurch College of Education
Christchurch College of Education Nelson Campus
Christchurch College of Education School Services
Christchurch Polytechnic
Dunedin College of Education
Dunedin College of Education School Support Services
Education Review Office
Electrotechnology Industry Training Organisation
Fairfield Intermediate
Food and Beverage Institute
Home Economics and Technology Teachers Association of New Zealand
Ilminster Intermediate
Independent Schools Council
Industrial Research Limited
Institute of Professional Engineers of New Zealand
Lincoln University Department of Technology
Manawatu Polytechnic
Manukau Institute of Technology
Massey University College of Education Teacher Support Services
Ministry for the Environment
Ministry of Agriculture and Forestry
Ministry of Health
Ministry of Science and Technology
Mountview School
Nelson Polytechnic
New Zealand Association of Science Educators
New Zealand Biotechnology Association
New Zealand Chemical Industry Council Inc.
New Zealand Educational Institute
New Zealand Fire Service
New Zealand Graphics and Technology Teachers Association
New Zealand Institute of Chemistry Inc.
New Zealand Manufacturers Federation
New Zealand Post Primary Teachers Association
New Zealand Principals Federation
New Zealand School Trustees Association
Northland Polytechnic
Occupational Safety and Health Service,
Department of Labour
Open Polytechnic of New Zealand
Order of St John
Otago Polytechnic
Royal Society of New Zealand
Secondary Principals Association of New Zealand
Southland Polytechnic
Tai Poutini Polytechnic
Tairāwhiti Polytechnic
Taranaki Polytechnic
Technology Education New Zealand
Telford Rural Polytechnic
Tongariro High School
Unitec Institute of Technology
University of Canterbury
University of Otago Department of Technology
University of Waikato Department of Technology
University of Waikato School of Education
University of Waikato School Support Services
Vardon School
Victoria University of Wellington School of Chemical and Physical Sciences
Wairariki Polytechnic
Waikato Polytechnic
Wairarapa Community Polytechnic
Wanganui Regional Community Polytechnic
Wellington College of Education
Wellington College of Education School Support Services
Wellington Polytechnic
Whitireia Community Polytechnic

Glossary

<i>Agrobacterium</i>	A natural bacterium that can be used to transfer DNA genes in broadleaf plants.
Bacteriophage	Virus growing on bacteria.
Bioremediation	The microbiological treatment of human and/or industrial wastes).
DC	Direct current: electric current that flows in one direction only.
DNA	Deoxyribonucleic acid: the substance within cells that carries the “recipe” for the organism and that offspring inherit.
Electrophoresis	A laboratory technique for determining DNA fragments by separating them in a gel placed in an electric field.
Electrophoretically	Using electrophoresis.
ELV	Extra-low voltage: voltage not exceeding 32V (AC) or 15V (DC).
Enzymes	Proteins involved in many biochemical reactions.
Flux	A substance used to clean metal to be soldered. Active fluxes remove oxide film from the metal; passive fluxes prevent oxides from forming on previously cleaned metal.
Gall	The formation of a cancerous swelling on a host plant by bacteria such as <i>Agrobacterium</i> .
Gene	The “recipe” for making protein; genes determine the expression of an organism’s physical characteristics.
Gene gun	A gun that shoots DNA into the cells of an organism.
Genetic engineering	The process of transferring DNA from one organism into another which results in a genetic modification; the production of a transgenic organism.
Hazard	Anything that is an actual or potential cause of distress or harm.

Intranet	An intranet is an internal network connected to the Internet that may screen incoming and/or outgoing messages.
Isolating transformer	A device that isolates the output circuit from the input power-supply circuit so that electrical faults cannot result in current being routed to earth through the operator.
Mutation	A change in the structure of DNA that can be caused by chemicals, ultraviolet radiation, X-rays, or natural processes.
OOS	Occupational overuse syndrome: associated with repetitive small movements.
OSH	Occupational Safety and Health Service.
PCB	Printed circuit board: circuit tracks are outlined on a copper-coated base board, and the excess copper is dissolved chemically, leaving the desired tracks.
Plasmid	A small, circular DNA molecule that is used to transfer genes from one organism to another.
RCD	Residual current device: a safety device that automatically switches off the flow of electric current if it detects an imbalance in the circuit.
SELV	Safety extra-low voltage: ELV isolated from the supply by such means as an isolating transformer.
Serious harm	A category of harm defined in the Health and Safety in Employment Act 1992. Accidents causing serious harm must be reported to OSH.
Spore	The reproductive body released from a mature fungus.
Transgenic	The term describing an organism that has been modified by genetic engineering to contain DNA from another source.
VDU	Visual display unit: computer monitor.
Vector	Any DNA structure that is used to transfer DNA into an organism. The most commonly used are plasmid DNA vectors or viruses.
Whakapapa	Genealogy.

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