NATIONAL CERTIFICATE: HORTICULTURE

66589

Learner Guide and Workbook

Module Five

HLUMELELISA

A NEW SPIRIT

SKILLS PROGRAM 5 - IRRIGATE, PROVIDE CARE/NUTRITION FOR PLANTS AND OHS

Skills Program Structure

Skills Program 1 - Mathematical Literacy

Skills Program 2 - Communication

Skills Program 3 - Plants, Soil Types and Pest control practices

Skills Program 4 - Plant, propagate, treat and clean plants

Skills Program 5 - Irrigate, provide care/nutrition for plants and OHS

Training Provider Accreditation Number: AGRI/c prov/0282/10

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UTILISE HEALTH AND SAFETY PRINCIPLES IN HORTICULTURE

264058

A person credited with this unit standard will be able to:

- Describe the implications that the health and safety legislation has on horticultural practices
- Recognise and be aware of potential hazards in the workplace
- Indicate the standard operating procedures that aim to minimise safety incidents
- Use chemical control substances safely
- Apply the principles and practices of good housekeeping

SAFETY: THE IMPORTANCE THEREOF

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

Why is workplace safety important?

Understanding and following health and safety rules in the workplace:

- Keeps you from injuring yourselves or other people when you are working with lawnmowers, pruning tools and other machinery.
- Keeps you safe when you are working with insecticides, pesticides, weed killers and other chemicals which can be dangerous.
- Helps you to protect public and private property.
- Helps you to take care of the environment.

So what health and safety rules should you follow in your workplace?

The **O**CCUPATIONAL **H**EALTH AND **S**AFETY ACT or OHS for short, is a government regulated law that sets out all the health and safety rules that you and your employer need to follow. This act states that it is your employer's responsibility and duty to provide a safe working environment for all its workers.

The act states that to create this safe working environment employers must:

- Appoint and train a safety representative in workplace safety and first aid.
- Create a safety committee where there are more than 50 workers employed in a section.
- Train all workers properly in their jobs.
- Check that all drivers have valid drivers' licenses.
- Tell all workers about the company's safety rules, regulations and procedures that need to be followed.
- Have safely constructed buildings and stores.
- Put up safety signs in the workplace.
- Issue all workers with suitable protective clothing for their specific kind of work.
- Properly and safely maintain all machinery and equipment that is used.
- Safely store all dangerous chemicals and substances that are used.

The act states that to create this safe working environment you, the employee, must:

- Take care for the health and safety of yourself and other people.
- Co-operate and obey any safety instruction you get from your employer, safety representative or other government health official.
- Report to your management or safety representative any unsafe or unhealthy situation that you may come across.
- Report immediately or no later than the end of your shift/day any accident which has happened to you, to your management, safety representative or any other person authorized to deal with safety issues.

So can you see that the OHS makes sure that:

- You, the employee, are protected against dangerous working conditions.
- Your employer and the public are protected against loss of income and/or damage to property.

If you don't obey this law:

- You could seriously injury yourself and end up in hospital.
- You could lose your life and your family would not be able to get any money in the future.
- You could lose a limb, leaving you disabled and unable to work for the rest of your life and you would not be able to get any money.
- You could get sick or poisoned and not be able to work for some time and as so lose your income.
- You could become hearing or sight impaired that could leave you without a job or income.
- You could seriously injure someone else and they could end up in hospital.
- The environment could become polluted and other people, plants and animals could become sick or die.
- You could cause damage to someone else's property.
- You could face a criminal investigation and end up with a criminal record.
- Your employer could face a criminal investigation and end up with a criminal record.

Workplace hazards

Workplace injury is a major cause of concern for all involved in occupational health and safety. The factors which cause workplace accidents and occupational illnesses are called hazards. The need for systematic management of OHS hazards and their attendant risks applies to all organisations and all activities and functions within an organisation.

It is important to distinguish between hazard, risk and exposure when undertaking risk management. Hazard is the potential for harm, or adverse effect on an employee's health. Anything which may cause injury or ill health to anyone at or near a workplace is a hazard.

Risk is the likelihood that a hazard will cause injury or ill health to anyone at or near a workplace. The level of risk increases with the severity of the hazard and the duration and frequency of exposure. Exposure occurs when a person comes into contact with a hazard. Risk management is a four step process

- Identify the hazard
- Assess the risk associated with the hazard
- Control the risk
- Review the process

The first and most important step in reducing the likelihood of an accident is hazard identification. This means identifying all workplace situations or events that could cause injury or illness. The second step is an assessment of the level of risk of the hazards you have identified.

This step involves collecting information and making decisions. It is important you consider the extent of the harm or consequence from a hazard and the likelihood of harm occurring. If your assessment is that an unacceptable risk to health and safety exists, you must introduce controls to reduce the risk to an acceptable level. There are three categories of control measures you might take.

You can

- Eliminate the hazard
- Minimise the risk
- Introduce 'back-up' controls (when all other options in the previous categories have been exhausted).

The third step in effective risk management is to establish and maintain systems which give opportunity for regular evaluation and review procedures. Evaluation means examining control measures to ensure risks are eliminated or reduced and have not caused new hazards presenting unacceptable risk.

The review system applies to the overall risk management process and checks the process is working effectively to identify hazards and manage risks.

Risk management is an organisational issue and a successful program requires the commitment and cooperation of all. All program managers and their staff need to recognise the fundamental importance of occupational health and safety risk management for it to work.

Best practice is embedding occupational health and safety risk management into daily usage at all levels of an organisation. Achieving best practice is how you can integrate risk management principles and practices into everyday business practice.

Identify the hazards

Hazard identification

The first step in reducing the likelihood of an accident is hazard identification. Hazard identification is identifying all situations or events that could cause injury or illness. Eliminating or minimising workplace hazards needs a systematic approach. It is essential to try and anticipate all possible hazards at the workplace - known as the 'what if?' approach.

Hazards defined

A hazard is a source or potential source of human injury, ill health or disease. Anything which might cause injury or ill health to anyone at or near a workplace is a hazard. While some hazards are fairly obvious and easy to identify, others are not - for example exposure to noise, chemicals or radiation.

Classes of hazard

Hazards are classified into five different types. They are:

- Physical - includes floors, stairs, work platforms, steps, ladders, fire, falling objects, slippery surfaces, manual handling (lifting, pushing, pulling), excessively loud and prolonged noise, vibration, heat and cold, radiation, poor lighting, ventilation, air quality
- Mechanical and/or electrical - includes electricity, machinery, equipment, pressure vessels, dangerous goods, fork lifts, cranes, hoists
- Chemical - includes chemical substances such as acids or poisons and those that could lead to fire or explosion, cleaning agents, dusts and fumes from various processes such as welding
- Biological - includes bacteria, viruses, mould, mildew, insects, vermin, animals
- Psychosocial environment - includes workplace stressors arising from a variety of sources

Methods for identifying hazards

The first step in control of a hazard is to identify and list them. There are many methods which are useful for identifying hazards, including:

- Injury and illness records - review your workers' compensation data and check the incidence, mechanism and agency of injury, and the cost to the organisation. These statistics can be analysed to alert the organisation to the presence of hazards
- Staying informed on trends and developments in workplace health and safety, for example via the internet or OHS publications
- Reviewing the potential impact of new work practices or equipment introduced into the workplace in line with legislative requirements
- Doing walk-through surveys, inspections or safety audits in the workplace to evaluate the organisation's health and safety system
- Considering OHS implications when analysing work processes
- Investigating workplace incidents and 'near hits' reports - in some cases there may be more than one hazard contributing to an incident
- Getting feedback from employees can often provide valuable information about hazards, because they have hands-on experience in their work area
- Consulting with employees, health and safety representatives and OHS Committee members
- Benchmarking against or liaising with similar workplaces

Summary of key points

- Conduct regular, systematic inspections of the workplace.
- Observe what hazards exist in the workplace and ask, 'what if?'
- Listen to feedback from the people performing work tasks.
- Maintain records of the processes used to identify hazards.

Let's take a look at some examples:

Workplace Hazards in automotive repair and service which facilitates training

Students must be given instruction, and must be supervised at all times. Consideration must always be given to hazards when allocating tasks. If any risk exists, students must NOT undertake the activity.

Hazard	**Possible Harmful Effects**	**Possible Employer Action to Prevent Injury / Illness**	**Preventative Action Students Can Take**
Fixed plant including automotive hoist	Laceration Operator being pinned down/crushed	♦ Undertake risk assessment of all plant, equipment and tools ♦ Put in place appropriate controls, e.g. machine guarding ♦ Provide training on safe use ♦ Develop and implement maintenance regime. ♦ Provide appropriate personal protective equipment (PPE) ***NOTE: Students must NOT operate automotive hoists***	♦ Observe risk controls, e.g. machine guarding ♦ Use plant strictly according to your training ♦ Use PPE provided NOTE: Students must NOT operate automotive hoists
Powered mobile plant including cars	Operator being rolled on or pinned underneath. Other workers being struck, crushed or pinned below	Students must NOT operate or ride on mobile plant	Students must NOT operate or ride on mobile plant
Powered and other hand-tools	Laceration and amputation. Manual handling injuries.	***Students must NOT operate powered tools*** ♦ Provide instruction in the safe use of hand tools	***Students must NOT operate powered tools*** ♦ Use hand tools carefully, according to instructions
Noise and vibration	Hearing loss	♦ Maintain plant and equipment to reduce noise and to limit vibration ♦ Provide hearing protection	♦ Follow safe work procedures ♦ Wear PPE (hearing protection) provided
Petrol, solvents, degreasers, paints Cleaning products	Skin contact may cause irritation or dermatitis. Vapours may cause headaches or other respiratory problems. Long-term exposure may cause chronic effect	♦ Use least hazardous product for the task ♦ Provide Material Safety Data Sheets (MSDS) ♦ Observe safe storage and handling practices Provide adequate ventilation ♦ Provide training in use of fire protection equipment ♦ Document and practise emergency procedures ♦ Provide appropriate PPE	♦ Read MSDS and follow safe working instructions ♦ Use PPE provided to protect you against hazardous substances
Manual handling (bending, reaching, pulling, lifting, repetitive motions, awkward working posture)	Musculoskeletal injuries	♦ Use mechanical aids where practicable ♦ Adopt safe system of work ♦ Use team lifting	♦ Use mechanical aids provided ♦ Seek help when you think a team lift is required ♦ Exercise: warm up/stretch before starting work, and cool down/stretch at end of the shift or working day
Hot working conditions	Heat stress, dehydration	♦ Provide regular rest breaks	♦ Dress appropriately for your working conditions ♦ Take scheduled breaks
Working at heights	Falls from heights – potential for fatality or serious injury Musculoskeletal injuries, including sprains and strains	Students must NOT work at heights where there is any risk of a fall	***Students must NOT work at heights where there is any risk of a fall***
Sexual harassment, work place bullying	Emotional stress, fear and anxiety, physical illness	♦ Establish work place policy ♦ Provide staff briefings or training	♦ Report any concerns immediately

Workplace Hazards in the hospitality industry which facilitates training

Students must be given instruction, and must be supervised at all times. Consideration must always be given to hazards when allocating tasks. If any risk exists, students must NOT undertake the activity.

Hazard	Possible Harmful Effects	Possible Employer Action to Prevent Injury / Illness	Preventative Action Students Can Take
Cooking equipment – oven, deep fryers, hot plates, grills	Burns or electric shock	Students must not be allowed to cook without close supervision ♦ Fit guards around hot surfaces ♦ Maintain equipment, including electrical testing and tagging ♦ Provide training on safe use ♦ Provide personal protective equipment (PPE)	Students must not be allowed to cook without close supervision ♦ Follow safe work procedures ♦ Use PPE provided
Knives and deli slicers, powered cutting equipment	Cuts	Students must NOT use powered cutting equipment	***Students must NOT use powered cutting equipment***
Hot oil / grease	Burns	♦ Fit splash guards ♦ Fit and use lids or covers ♦ Use oil pans that dump automatically ♦ Provide appropriate personal protective equipment (PPE)	♦ Use splash guards, lids and covers provided ♦ Use PPE provided
Slippery floors	Slips or falls	♦ Provide floor mats ♦ Require non-slip shoes	♦ Wear non-slip shoes ♦ Clean up spills quickly
Dishwashing products, sanitisers Cleaning products	Skin contact may cause irritation or dermatitis Vapours/fumes may cause headaches or other respiratory problems Long-term exposure may cause chronic (on-going) effects	♦ Use the least hazardous product for each job ♦ Read labels and Material Safety Data Sheet (MSDS) ♦ Provide appropriate PPE	♦ Use personal protective equipment (PPE) when provided – this could include rubber gloves, eye protection ♦ Read safety information on MSDS
Contact with public	Abuse, assault, robbery	♦ Provide adequate security ♦ Provide barriers where money is handled ♦ Provide adequate outside lighting ♦ Schedule at least two people per shift ♦ Arrange customer service and emergency response training	♦ Follow procedures regarding security and contact with the public ♦ Report any concerns immediately
Manual handling (bending, reaching, stretching, pulling, lifting, repetitive motions)	Musculoskeletal disorders including sprains and strains	♦ Use mechanical aids where practicable ♦ Keep heavy items on lower shelves ♦ Encourage team lifting where appropriate	♦ Follow instructions and training ♦ Use mechanical aids, stepladders where provided ♦ Seek help when you think a team lift is required
Exposure to blood or body fluids, needle sticks when cleaning	Blood-borne diseases	Students must NOT be exposed to contaminated fluids	Students must NOT be exposed to contaminated fluids
Sexual harassment,	Emotional stress, fear and anxiety,	♦ Establish work place policy	♦ Report any concerns

work place bullying	physical illness	♦ Provide staff briefings or training	immediately

Workplace Hazards in the office environment which facilitates training

Students must be given instruction, and must be supervised at all times. Consideration must always be given to hazards when allocating tasks. If any risk exists, students must NOT undertake the activity.

Hazard	**Possible Harmful Effects**	**Possible Employer Action to Prevent Injury / Illness**	**Preventative Action Students Can Take**
Electrical equipment	Electric shock and burn injuries Electrocution Unsafe equipment could develop electrical shorts, creating fire and/or shock hazards	♦ Test, tag and inspect electrical equipment and appliances regularly ♦ Ensure cords are not frayed/defective and do not pose tripping hazards ♦ Provide training on use of fire protection equipment ♦ Document and rehearse emergency procedures	♦ Report any faulty item immediately
Incorrectly-designed workstations	Musculoskeletal disorders, including Occupational Overuse Syndrome (OOS) – chronic soft tissue injury	♦ Assess workstation layout to minimise soft tissue injuries – redesign may be required ♦ Adjust workstation to fit operator	♦ Adjust your workstation to suit your individual characteristics – seek assistance if necessary
Storage of items (shelves	Falls from heights when storing / accessing materials	♦ Provide training in safe storage of items	♦ Store material according to your training
Poor lighting Glare	Eye strain and irritation, fatigue, watering eyes	♦ Re-design poorly-lit workstations ♦ Provide shades and task lamps where practicable	♦ Report any concern about your workstation lighting
Hazardous substances and dangerous goods, including cleaning chemicals,	Contact with hazardous substances could cause dermatitis, skin and eye irritation Fumes or vapours could cause respiratory problem	♦ Provide Material Safety Data Sheet (MSDS) for substances used in the workplace ♦ Ensure First Aid arrangements are in place	♦ Read MSDS and follow safe working instructions ♦ Use PPE provided to protect you against hazardous substances
Indoor air pollutants	Respiratory ailments	♦ Locate photocopiers in well ventilated areas and provide appropriate local exhaust ventilation ♦ Provide appropriate air conditioning system	♦ Report any concerns immediately
Manual handling (bending, reaching, stretching, pulling, lifting, repetitive motions, awkward posture)	Musculoskeletal disorders, including sprains and strains	♦ Schedule regular breaks ♦ Use mechanical aids where practicable ♦ Encourage team lifts where appropriate	♦ Use mechanical aids provided ♦ Seek help when you think a team lift is required
Noise (including printers, telephones, fax machines, and noise from outside, e.g. construction)	Tension, stress	♦ Select the quietest equipment if possible ♦ Replace or isolate loud equipment	♦ Report any concerns immediately

Workplace Hazards in a manufacturing industry which facilitates training

Students must be given instruction, and must be supervised at all times. Consideration must always be given to hazards when allocating tasks. If any risk exists, students must NOT undertake the activity.

Hazard	**Possible Harmful Effects**	**Possible Employer Action to Prevent Injury / Illness**	**Preventative Action Students Can Take**
Fixed plant	Amputation and laceration Manual handling injuries	♦ Undertake risk assessment of all plant and machines ♦ Put in place appropriate risk controls ♦ Provide relevant training on safe use ♦ Develop and implement maintenance regime. Ensure records are kept ♦ Provide appropriate personal protective equipment (PPE)	♦ Work strictly according to training and instructions ♦ Do not operate any plant in which you have not been fully trained ♦ If you have any safety concerns, notify your supervisor immediately!
Powered mobile plant including forklift	Being struck, rolled or pinned underneath – potential for fatality or serious injury	***Students must NOT operate mobile plant***	***Students must NOT operate mobile plant***
Powered and other hand-tools	Laceration and amputation Manual handling injuries	***Students must NOT operate powered tools*** ♦ Provide instruction in the safe use of tools	***Students must NOT operate powered tools*** ♦ Use hand tools carefully, according to instructions
Noise and vibration	Hearing loss Musculoskeletal disorder	♦ Maintain powered tools and mobile plant to reduce noise and to avoid excessive vibration ♦ Provide PPE (hearing protection)	♦ Follow safe work procedures ♦ Wear PPE (hearing protection) provided
Industrial chemicals (hazardous substances) Cleaning products	Skin contact may cause irritation or dermatitis Vapours/fumes may cause headaches or other respiratory problems. Long-term exposure may cause chronic effect	♦ Use least hazardous products Provide Material Safety Data Sheets (MSDS) ♦ Observe appropriate storage and handling practices of dangerous goods ♦ Provide adequate ventilation ♦ Document and rehearse emergency procedures ♦ Provide appropriate PPE	♦ Read MSDS and follow safe working instructions ♦ Use PPE provided to protect you against hazardous substances
Manual handling (bending, reaching, stretching, pulling, lifting, repetitive motions, awkward posture)	Musculoskeletal disorders including sprains and strains	♦ Document safe work procedures ♦ Provide mechanical aids ♦ Provide training in safe manual handling techniques ♦ Encourage team lifts where appropriate	♦ Use mechanical aids provided ♦ Seek help when you think a team lift is required ♦ Exercise: warm up/stretch before starting work, and cool down/stretch at end of the shift or working day
Working in heat and cold	Heat rashes, heat stress, dehydration Hypothermia (in cold rooms)	♦ Schedule rest breaks, rotate jobs ♦ Provide appropriate clothing/PPE	♦ Observe rest breaks ♦ Wear appropriate clothing
Working at heights	Falls from heights – potential for fatality or serious injury Musculoskeletal injuries such as sprains and strains	Students must NOT work at heights or where there is any risk of a fall	Students must NOT work at heights or where there is any risk of a fall

Activity – In Your Groups (120 minutes)

Part 1- As with any other workplace, your workplace may contain potential hazards. In your quest to rid your workplace of such hazards, the workplace of a bad reputation and the staff to injury, you need to identify the hazards which are found in your workplace. So far you have learned how to identify hazards regarding the classes of the hazards. Some hazards can be eradicated by a simple action of the removal thereof (loose wiring hanging from the wall), whereas others may require formal identification thereof and a change in the company procedures to remove the hazard (dangerous use of equipment). In the following table you are required to identify 5 hazards, explain how it can be removed or reduced and then, lastly, explain the procedure for removing a hazard requiring additional actions. Use your workplace as a standard and complete the following table:

HAZARD IDENTIFIED	TYPE OF HAZARD	HOW IT CAN BE REMOVED	HOW IT CAN BE REDUCED	HOW IT SHOULD BE REPORTED	IMPLICATIONS FOR NON-COMPLIANCE
Improper use of equipment by untrained staff	Mechanical	Only allow trained staff to use the equipment	Training of staff to use the equipment correctly	Formal report should be written to management to understand the hazard risks.	Untrained staff can injure themselves or cause damage to equipment

Part 2 – Answer the following questions:

Describe how the requirements of the OHS affect the horticulture industry

Why it is important to follow safety procedures?

Assess the risks

Although Risk assessment may be seen as an entirely different concept, it forms an integral part of the OHS process within a company. Assessing the risk correctly assists in the eradication of danger in workplaces, according to its level of intensity. Some risks may not be as dangerous as others, although they are all important!

Assessment of risks

When you identify a hazard, do a risk assessment. A risk assessment process means you:

- Gather information about each identified hazard
- Consider the number of people exposed to each hazard and the duration of the exposure
- Use the information to assess the likelihood and consequence of each hazard
- Use a risk assessment table to work out the risk associated with each hazard.

Factors for consideration

You should consider the following factors during the risk assessment process:

- The nature of the hazard posing the risk
- Combinations of hazards
- Types of injuries or illnesses foreseeable from exposure
- The consequences of duration and exposure to the hazard
- Workplace and workstation layout
- Working posture and position
- Work organisation
- The introduction of new work processes
- Skill and experience level of employees
- Personal characteristics of employees exposed to the risk (colour blindness or hearing impairment)
- Existing control measures in place such as the use of clothing and personal protective equipment.

Risk assessment table

One method of assessing risks is to use a risk assessment table. Record the risk rating for each hazard you have identified. To construct an assessment matrix, you can:

- Establish a specialist risk assessment team
- Get expert or specialist advice
- Brainstorm within the workplace, particularly with employees, health and safety representatives and OHS committee members - they are often a valuable source of information and experience.

Before introducing new or changed work practices, substances or plant - review your original assessment. It is good management to do regular reviews.

	Likelihood				
		Very likely	**Likely**	**Unlikely**	**Highly unlikely**
Consequences	**Fatality**	**High Risk**	**High Risk**	**High Risk**	**Medium Risk**
	Major injuries	**High Risk**	**High Risk**	**Medium Risk**	**Medium Risk**
	Minor injuries	**High Risk**	**Medium Risk**	**Medium Risk**	**Medium Risk**
	Negligible injuries	**Medium Risk**	**Medium Risk**	**Low Risk**	**Medium Risk**

Using a risk assessment table

Assessments of likelihood and consequence can be translated into levels of risk using a risk assessment table. Areas of high risk can be given first priority for elimination or control in the workplace. Consequence, or extent of the injury or ill health were it to occur, can be rated in the following way

- Fatality
- Major or serious injury (serious damage to health which may be irreversible, requiring medical attention and on-going treatment). Such an injury is likely to involve significant time off work.
- Minor injury (reversible health damage which may require medical attention but limited on-going treatment). This is less likely to involve significant time off work.
- Negligible injuries (first aid only with little or no lost time). Unlikely to involve more than 1 day off work

Likelihood, or the chance of each of the situations or events actually occurring, can be rated in the following way.

- Very likely (exposed to hazard continuously)
- Likely (exposed to hazard occasionally)
- Unlikely (could happen but only rarely)
- Highly unlikely (could happen, but probably never will)
- This classification would be used very rarely.

Activity – In Groups

You have conducted a risk assessment in your workplace, now you need to assess the risks which you have identified. Using the same table as you did, assess the risks which you have identified, by making use of the risk assessment table on the previous page.

Hazard Identified	Type of Hazard	Risk Level		
Improper use of equipment by untrained staff	Mechanical	High	Medium	Low

Find these words in the grid below:

acid	current	ear	glue	loud	RCD	strain
bending	deaf	earplug	heavy	noisy	scaffold	switch
carry	decibel	frayed	hoist	poison	shock	tag
chemical	depth	fuel	ladder	power	slip	trip
climb	electrocution	gas	lift	roof	solvents	trolley

C	Y	R	R	A	C	E	A	R	P	L	U	G
H	E	A	V	Y	E	T	F	K	O	D	F	L
E	D	I	C	A	L	B	R	R	C	O	T	O
M	C	U	R	R	E	N	T	O	A	O	F	U
I	G	W	D	E	C	I	B	E	L	Y	H	D
C	H	O	I	S	T	R	A	I	N	L	E	S
A	D	H	E	F	R	C	D	B	F	A	E	D
L	L	P	I	S	O	L	V	E	N	T	S	Y
H	O	L	I	V	C	P	A	N	G	L	U	E
C	F	X	Q	R	U	M	O	D	E	P	T	H
T	F	U	E	L	T	U	K	I	D	J	B	N
I	A	Z	C	L	I	M	B	N	S	E	F	S
W	C	R	E	W	O	P	O	G	N	O	R	A
S	S	L	I	P	N	O	I	S	Y	T	N	G

Now answer the following questions

If you spot something hazardous, what should you do?

Simple hazard (e.g. boxes on the floor in the way)

More complex hazard (e.g. frayed cords, damaged equipment)

Assess the risk

What two main things should the person in charge or responsible for safety consider when assessing the risk?

Make the changes

What sort of risk control measures (hierarchy of control) should they consider?

Pair the sentence fragments:

You could put other people at risk by …	... looking after their own health and safety and taking care not to put other people at risk.
Employers have the primary responsibility for ...	... ask for clarification, help or instructions.
Legal responsibilities for workplace health and safety are set out in ...	... reducing the risks as effectively as they can.
If you're not sure about how to perform a task safely, you should ...	... someone else getting hurt.
Where workplace risks can't be eliminated, employers are responsible for ...	... making sure that the workplace is safe.
Employees are responsible for ...	... listen carefully to safety information provided by the employer.
To help them work safely, employees must ...	... the Occupational Health and Safety Act 2004.
Failing to report an unsafe situation at work could result in ...	... not following agreed safe work practices.

Control measures

The correct course of action once a hazard is identified is to use control measures. These generally fall into three categories. You can:

- Eliminate the hazard
- Minimise the risk
- Use 'back-up' controls when all other options in the previous categories have been exhausted.

The best way to control a hazard is to eliminate it. The elimination of a hazard is the first choice in a system called the 'hierarchy of controls'.

Hierarchy of controls

There is an order of priority in hazard control:

- Eliminate the hazard from the workplace entirely. This is the best way to control a hazard. An example of elimination is to remove a noisy machine from a quiet area.
- Substitute or modify the hazard by replacing it with something less dangerous, for example, by using a paint which does not contain asthma- encouraging agents.
- Isolate the hazard by physically removing it from the workplace or by cordoning off the area in which a machine is used.
- Use engineering methods to control the hazard at its source. Tools and equipment can be redesigned, or enclosures, guards or local exhaust ventilation systems can be used to close off the source of a hazard.
- Use administrative controls. These are management strategies which can be introduced to ensure the health and safety of employees. Administrative procedures can reduce exposure to hazardous equipment and processes by limiting the time of exposure for example by job rotation or varying the time when a particular process is carried out.
- Introduce personal protective equipment (PPE) as an interim measure, to reduce exposure to a hazard.

Elimination

Where no hazard exists, no risk of injury or illness exists. For example:

- Remove trip hazards in a cluttered corridor
- Dispose of unwanted chemicals
- Eliminate hazardous plant or processes
- Repair damaged equipment promptly
- Increase use of email to reduce excessive photocopying and collation
- Ensure new equipment meets the ergonomic needs of users

Minimising the risk

This may entail;

Substitution

If it is not possible to eliminate the hazard, substitute it with something - preferably of a lesser risk - which will still perform the same task in a satisfactory manner. For example

- Substitute a hazardous chemical with a less dangerous one
- Telephone handsets with headsets where there is frequent use of telephone
- Substitute a less hazardous material to control a vapour hazard
- Substitute a smaller package or container to reduce the risk of manual handling injuries such as back strain.

Modification

Change the plant or system of work to reduce hazards. For example

- Redesign plant to reduce noise levels
- Use a scissors-lift trolley to reducing bending while lifting
- Install forced ventilation in photography darkrooms to remove vapours.

Isolation

Isolate the problem from staff. This is often done by using separate, purpose-built rooms, barricades, or sound barriers. This moves the hazardous process away from the main work area to a site where emissions can be controlled. For example:

- Isolate and store chemicals properly by using a fume cupboard
- Isolate copying equipment and other machinery in soundproof rooms to reduce fumes and noise
- Use security measures to protect staff.

Engineering controls

If you cannot eliminate a hazard of make a substitution to eliminate it, then reduce the chance of hazardous contact. Redesign equipment, work processes or tools to reduce or eliminate the risk. For example

- Ensure proper machine guarding is in place
- Use anti-glare screens on computer VDUs
- Use mechanical aids to minimise manual handling injuries
- Use ventilation to remove chemical fumes and dusts and using wetting down techniques to minimise dust levels
- Change bench heights to reduce bending
- Ensure ergonomic factors are taken into account

'Back-up' controls

These controls are a 'back-up' to the other categories. They should not be relied upon as the primary method to control risk - until all options to eliminate the hazard or minimise the risk have been exhausted. Sometimes 'back-up' controls should be used as the initial control phase while elimination or minimisation is being evaluated and applied. Some examples of 'back-up' controls are listed below.

Administrative controls

Training, job rotation, maintenance of plant and equipment, limitation of exposure time, provision of written work procedures can be used. For example:

- regularly maintain plant and equipment
- re-design jobs and use team lifting
- limit exposure time to a hazard through staff rotation
- train and educate staff to
    - identify and assess risks and use methods of control
    - apply legislative requirements
    - implement safe manual handling techniques
    - safely use mechanical aids and equipment

WORKPLACE SAFETY AND EMPLOYEE

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

What is a safe working environment?

A safe working environment is a workplace that:

Displays safety signs:	Safety signs are displayed to tell all workers what safety measures need to be obeyed, followed and what to do and what not to do.
Keeps its tools and equipment in good working condition:	Tools and equipment are regularly checked, serviced and kept in good working condition.
Maintains vehicles in good working condition:	Vehicles are regularly checked, serviced and maintained in good working condition.
Takes steps to prevent accidents and problems:	• Holds safety meetings at least every 3 months to discuss safety issues with the workers, management and the safety officer/representative • Regularly conducts health and safety inspections in the work place.
Reduces dangers and hazards:	• Fixes any reported problems as soon as possible. • Investigates reported accidents so that the workman's compensation fund can pay for medical treatment.
Appoints and trains safety representatives and safety committees:	Safety representatives and safety committees are appointed and trained by the employer in the rules and regulations of the OHS act.
Trains workers:	The company trains workers on: • The safety rules of the company. • What personal protective clothing to wear at all times whilst doing their jobs. • How to look after and maintain the tools and equipment. • How to report problems and accidents. • How to do their jobs. Checks that all drivers have **valid licenses**.

What kinds of safety signs are there in the workplace?

Let's take a look at the four different types of signs that you will come across in your workplace, these are:

Information signs/symbols.

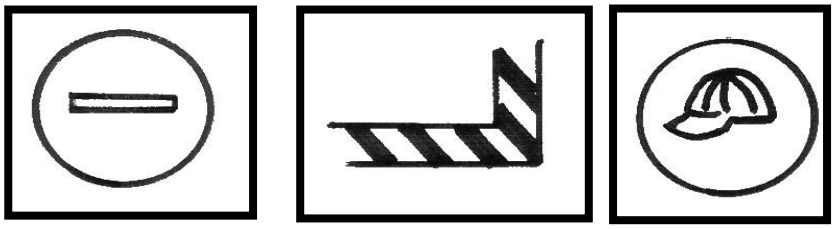
These signs can either be written or use symbols to tell you where you can go to find important places like the first aid centre, emergency collection points or fire extinguishers, etc.

Some examples of these signs are:

Instructional signs/symbols.

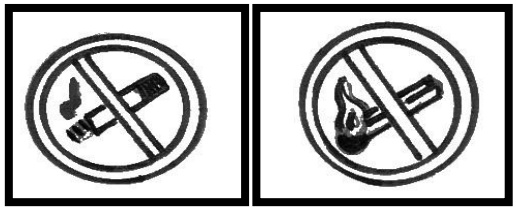
These signs can either be written or use symbols to give you direction about what you should or shouldn't be doing, for example these signs tell you where you are not allowed to go, what you are not allowed to be doing in this area or what you should be using in this area.

Some examples of these signs are:



Fire prevention signs/symbols.

These signs can either be written or use symbols and tell you what you should not do if you don't want to start a fire or what to use if you want to put out a fire.

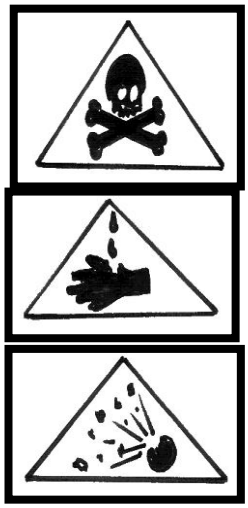


Some examples of these signs are:

- Warning signs/symbols

These signs can either be written or use symbols to warn you when certain materials or chemicals you are going to use are dangerous or poisonous.

Some examples of these signs are:



Personal Protective Equipment

PPE is defined in the Personal Protective Equipment at Work Regulations as: 'All equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work which protects them against one or more risks to their health and safety'.

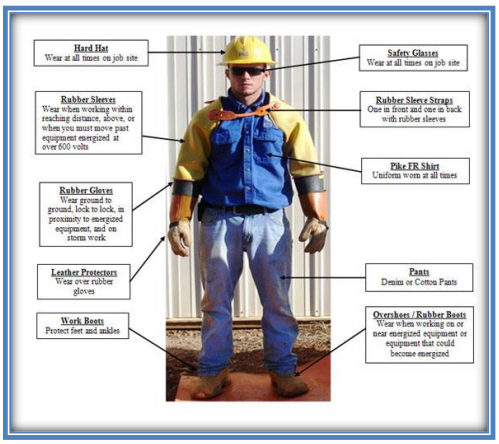
PPE includes equipment such as safety footwear, hard hats, high visibility waistcoats, goggles, life jackets, respirators and safety harnesses. Waterproof, weather-proof, or insulated clothing is subject to the Regulations only if its use is necessary to protect employees against adverse climatic conditions that could otherwise affect their health and safety.

If items of Personal Protective Equipment are required they must be provided free of charge by the employer. Here you will get advice on the selection, use, associated training, storage and maintenance of safety equipment designed to protect the health of the wearer in the workplace.

When to use PPE

PPE must always be regarded as a 'last resort' to protect against risks to safety and health. Engineering controls and safe systems of work must always be considered first. For example, it may be possible to do the job using methods that will not require the use of PPE.

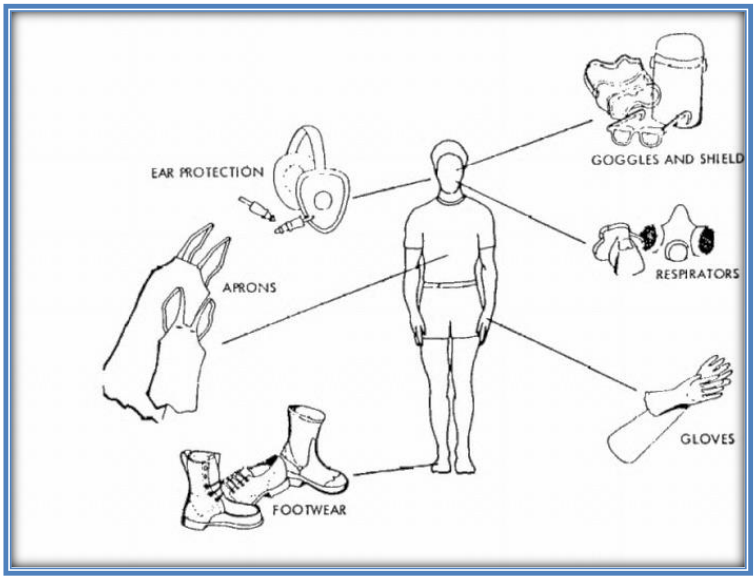
If this is not possible, more effective safeguards should be put in place. For example, fixed screens could be provided rather than individual eye protection. There are a number of reasons why PPE must be considered as a 'last resort':



- PPE only protects the person wearing it, whereas measures controlling the risk at source protect everyone in the workplace
- Theoretical maximum levels of protection are difficult to achieve and the actual level of protection is difficult to assess. Effective protection is only achieved by selecting suitable PPE and if it is correctly fitted, maintained and used
- PPE may restrict the wearer to some extent by limiting mobility or visibility, or by requiring additional weight to be carried; thus creating additional hazards.

Assessing and choosing different types of PPE

For example, a risk assessment may show that gloves are required when using the substance being assessed. As with all risk assessments, those carrying them out must be competent to do so. In addition to identifying the need for PPE, it is essential that the right type and grade of PPE is specified and provided.



Types of PPE

Hearing protection

There are three main types of hearing protection:

- Earmuffs/defenders, which completely cover the ear
- Earplugs, which are inserted into the ear canal
- Semi-inserts (also called canal-caps), which cover the entrance to the ear canal.
- Hearing protection must be worn by anyone who is likely to be exposed to noise at or above the regulatory noise levels.

Head protection

There are three widely used types of head protection:

- Industrial safety helmets (hard hats), which are designed to protect against materials falling from height and swinging objects
- Industrial scalp protectors (bump caps), which are designed to protect from knocking against stationary objects
- Caps/hair nets, which protect against entanglement

Tasks where head protection may be required include:

- Construction
- Building repair
- Work in excavations and tunnels
- Work with bolt driving tools
- Driving motorcycles and all-terrain vehicles, etc.

Eye protection

There are several types of eye protection:

- Safety spectacles: these are similar to regular glasses but have a tougher lens. They can include side shields for additional protection.
- Eye shields: a frame-less one piece moulded lens, often worn over normal prescription glasses
- Safety goggles: these are made with flexible plastic frames and an elastic headband
- Face shields: heavier and bulkier than other type of eye protector, face shields protect the face, but do not fully enclose the eyes so do not protect against dusts, mists or gases.

Tasks where eye protection may be required include:

- Handling hazardous substances where there is a risk of splashing
- Work with power driven tools where materials are likely to be propelled
- Welding operations
- Work with lasers
- Using any gas or vapour under pressure.

Foot protection

There are a number of types of safety footwear:

- Safety boots or shoes. Normally have steel toe-caps but can have other safety features (e.g. steel mid-soles, slip resistant soles, insulation against heat and cold)
- Wellington boots, which can be supplied with steel toe-caps
- Anti-static and conductive footwear. These protect against the build-up of static electricity.
- Tasks where foot protection may be required include: construction, demolition, building repair, manual handling where there is a risk of heavy objects falling on the feet, work in extremely hot or cold environments, and work with chemicals and forestry.

Where there is a risk of slipping that cannot be avoided or controlled by other measures, attention must be given to the slip resistance of soles and replacement before the tread pattern is overly worn.

Suitability of the PPE

To be able to choose the right type of PPE, the hazards involved in the task or work environment must be considered carefully. PPE must also meet the needs of the individual. The following factors should be considered when assessing the suitability of PPE:

- Is the PPE appropriate for the risk involved and conditions at the place where exposure may occur? e.g. goggles are not suitable when full-face protection is required
- Does the PPE prevent or adequately control the risks involved without increasing the overall risk? e.g. gloves should not be worn when using a pillar drill, due to the increased risk of entanglement
- Can the PPE be adjusted to fit the wearer correctly? e.g. if a person wears glasses, ear defenders may not provide a proper seal to protect against noise hazards
- Has the state of health of those using it been taken into account?
- What are the needs of the job and the demands it places on the wearer? How long will the PPE need to be worn? What are the requirements for visibility and communication?
- If more than one item of PPE is being worn, are they compatible? For example, does a particular type of respirator make it difficult for eye protection to fit properly?

Fit-testing of Respiratory Protective Equipment (RPE) face pieces

To ensure the wearer has the correct device, the initial selection of RPE should include fit-testing. RPE should have a tight-fitting face piece (filtering face pieces are usually known as disposable masks, half and full-face masks).

Repeat fit-testing will be needed if anything changes. For example, if the model or size of face piece is changed or there are significant changes to the individual wearer's facial characteristics due to weight gain/loss or dentistry.

There are two forms of fit-testing – qualitative and quantitative. ***Qualitative fit***-testing is usually adequate for disposable filter face pieces and half-masks. This can be done as a simple pass/fail based on the wearer's subjective assessment of the fit and leakage. This method is not suitable for full-face masks.

Quantitative fit-testing provides a numerical measure of the fit known as a 'fit factor'. These tests give an objective measure of face fit. They require specialised equipment and are more complicated to carry out. These methods are recommended for full-face masks. RPE suppliers can advise on the type of testing required. A number of suppliers can carry out testing for customers.

Information, instruction and training on PPE use

Where PPE is provided, employees must be provided with adequate information, instruction and/or training on its use. The extent of information, instruction and/or training will vary with the complexity and performance of the kit. For example, a full Breathing Apparatus kit will require more training to use properly than a disposable face mask. Information and instruction should cover:

- The risk(s) present and why the PPE is needed
- The operation (including demonstration), performance and limitations of the equipment
- Use and storage (including how to put it on, how to adjust and remove it)
- Any testing requirements before use
- Any user maintenance that can be carried out (e.g. hygiene/cleaning procedures)
- Factors that can affect the performance of the equipment (e.g. working conditions, personal factors, defects and damage)
- How to recognise defects in PPE, and arrangements for reporting them
- Where to obtain replacement PPE

In addition to initial training, refresher training may be required from time to time. Supervisor checks on the use of PPE may help determine when refresher training is required.

Maintaining PPE

An effective system of maintenance of PPE is essential to make sure the equipment continues to provide the degree of protection for which it is designed. Therefore, the manufacturer's maintenance schedule (including recommended replacement periods and shelf lives) must always be followed. Maintenance may include; cleaning, examination, replacement, repair and testing. The wearer may be able carry out simple maintenance (e.g. cleaning), but more intricate repairs must only be carried out by competent personnel. The costs associated with the maintenance of PPE are the responsibility of the employer.

Storage for PPE

Where PPE is provided, adequate storage facilities for PPE must be provided for when it is not in use, unless the employee may take PPE away from the workplace (e.g. footwear or clothing). Accommodation may be simple (e.g. pegs for waterproof clothing or safety helmets) and it need not be fixed (e.g. a case for safety glasses or a container in a vehicle). Storage should be adequate to protect the PPE from contamination, loss, damage, damp or sunlight. Where PPE may become contaminated during use, storage should be separate from any storage provided for ordinary clothing.

Activity – On Your Own (20 minutes)

Previously you conducted workplace hazard identification, making use of the table below; identify which personal protective equipment must be used for the people working in the areas where you have identified the risks as well as the reasons why these items are suitable for this employee. Use the table below to complete your answer:

HAZARD IDENTIFIED	TYPE OF HAZARD	TYPE OF PPE REQUIRED	HOW IT WILL SAFEGUARD THE USER	IMPLICATIONS FOR NON-COMPLIANCE
Improper use of equipment by untrained staff	**Mechanical**	**Gloves, protective eye-wear, apron**	**Flying debris will not go into the eyes** **Hot metals will not burn the clothes** **Fingers and hands are safe**	**Blindness** **Injury (burns) to the user** **Loss of fingers/hands, burn wounds**

The health and safety plan

A Health and Safety Plan is a document that is part of the Health and Safety File and can be considered as an executive summary of a “business plan” for Health and Safety management on a site. A Health Safety Plan is developed according to the Health and Safety specifications provided by the client. Also it is documentary proof of compliance with the relevant regulations which forms part of the Occupational Health and Safety Act of South Africa.

The Occupational Health and Safety Act (1993) of South Africa, requires the employer to bring about and maintain, as far as reasonably practicable, a work environment that is safe and without risk to the Health and Safety of the workers. This means that the employer must ensure that the workplace is free of hazardous substances, such as benzene, chlorine and micro-organisms, articles, equipment, and processes that may cause occupational injury, damage, disease or ill health.

Where this is not possible, the employer must inform workers of the hazards and risks present in the workplace. The employer must also educate employees on how they may be prevented, and how to work safely. Protective measures for a safe workplace must also be provided. The Occupational Health Safety Act does not expect of the employer to take sole responsibility for Health and Safety.

The Act is based on the principle that hazards and risks in the workplace must be addressed by communication and cooperation between the employer and the employees. The employer and employees must share the responsibility for Health and Safety in the workplace and work together to mitigate all hazards and risks. Both parties must pro-actively participate to identify dangers and develop control measures to make the workplace safe.

The employer and the workers are required by the Occupational Health and Safety act to be involved in a system where Health and Safety representatives may inspect the workplace regularly and then report to a Health and Safety committee.

The Health and Safety committee must in turn make recommendations to the employer about the improvement of Health and Safety in the workplace. To ensure that this system works, every worker must know his or her rights and duties as contained in the Act.

Health Safety Act & Regulations

The Act, known as the Occupational Health and Safety Act of 1993 (Act 85 of 1993) consists of 50 sections promulgated by Parliament. The purpose of the Act is to provide for the Health and Safety of persons at work or in connection with the use of plant and machinery. It further provides for the protection of persons other than persons at work from hazards arising out of or in connection with the activities of persons at work.

Below there is an example of a Health and Safety checklist of an organisation.

Company Name: _____

Health & Safety Representative's Checklist for Administration

Date _____ **Health and Safety Rep** _____

Instructions: Select the answer and add remarks where necessary

				Remarks	For Attention
Floors	**Clear?**	**Demarcated?**	**Damaged?**		
	Yes / No	Yes / No	Yes / No		
				Remarks	
Lights	**Adequate?**	**No Fused?**	**Other?**		
	Yes / No	Yes / No	Yes / No		
				Remarks	
Housekeeping	**Suff. Bins?**	**Floors clear?**	**Windows OK?**		
	Yes / No	Yes / No	Yes / No		
				Remarks	
Filing & Storage	**Shelves stable?**	**Cupboards neat & tidy?**	**Desks kept clear & tidy?**		
	Yes / No	Yes / No	Yes / No		
				Remarks	
Computer Suite	**Secure at all times?**	**Housekeeping in order?**	**Any fire hazards?**		
	Yes / No	Yes / No	Yes / No		
				Remarks	
Fire Equipment	**Location known?**	**Easily accessible?**	**Other?**		
	Yes / No	Yes / No			
				Remarks	
Emercency Procedures	**In place?**	**Fire teams?**	**Alarm known?**	**Signage?**	
	Yes / No	Yes / No	Yes / No		

Attitudes Towards Safety at				
	Positive	**Negative**	**Indifferent**	**Remarks**
Employees				
Co-ordinators				
Management				

		Suggested Action	**Resp. Person**
Noted by :			
H & S Committee	_____ Chairman		
		Suggested Action	**Resp. Person**
Employer	..... Section 16(2)		

Please turn over if more space is required

Remarks Continued :

Health and Safety Representative Checklist

From time to time the Department of Labour inspectors will visit organisations and check whether their Health and Safety Representatives are appointed and whether Health and Safety Committees are functioning correctly, in terms of the OHS Act. If your organisation employs more than 20 workers and the business has been in operation for more than four months, then you should answer 'yes' to all of these questions.

Question	Yes	No
1. Did the employers and workers consult one another with regard to the nomination or election, the period of office, the functions and appointments of Health and Safety Representatives?		
2. For workplaces such as shops and offices: was at least one Health and Safety Representative appointed for every 100 workers or part thereof?		
3. For other workplaces, such as factories: was at least one Health and Safety Representative appointed for every 50 workers or part thereof?		
4. Are the appointed Health and Safety Representatives full-time workers and do they know the circumstances and conditions of the workplace for which they have been appointed?		
5. Are all activities regarding the appointment, functions and training of Health and Safety Representatives performed during normal working hours?		
6. Were all Health and Safety Representatives appointed in writing?		
7. Are all appointed Health and Safety Representatives empowered to: • Conduct health and safety audits? • Identify potential dangers? • Investigate incidents? • Make recommendations regarding health and safety? • Conduct inspections? • Attend Health and Safety Committee meetings?		
8. Has at least one Health and Safety Committee been functioning for each workplace where the employer had to appoint two or more Health and Safety Representatives?		
9. Do all Health and Safety Committees function as follows: • Hold meetings as often as necessary but at least once every three months? • Make recommendations to the employer regarding health and safety matters? • Discuss incidents? • Keep records of all recommendations made? • Each Health and Safety Representative is a member of at least one committee? • The number of people nominated by the employer to serve on a committee does not exceed the number of Health and Safety Representatives serving on the same committee? • The committee determines the proceedings, time and place of the meetings? • The chairperson was elected by the committee?		

Checklist: Everything organisations must include in their first aid boxes

First aid boxes are usually the first measure which can be taken in the event of an accident. By ensuring that the first aid boxes are always kept well stocked and ready for use, the workplace can ensure that injuries can be treated while medical care is en route. Use this handy checklist for organisations to make sure everything is included in their first aid boxes.

These boxes must be kept in very visible areas and signs must be posted, giving an indication of where they can be found. All Health and Safety representatives must have access to these boxes and must, at all times know where the closest first aid box is situated. If the boxes are kept locked, all Safety representatives who are on shift must have keys to these boxes as well as the supervisors/managers.

CONTENTS OF FIRST AID BOX			
Name of First Aider:		**Date:**	
Unit	**In Place**		**To Replace (Quantity)**
Wound cleaner/Antiseptic (100ml)			
Swabs for cleaning wounds			
Cotton wool for padding (100g)			
Sterile gauze (minimum quantity = 10)			
1 pair forceps (for splinters)			
1 pair scissors (100mm)			
1 set of safety pins			
4 triangular bandages			
4 roller bandages (75mm x 5m)			
4 roller bandages (100mm x 5m)			
1 roll elastic adhesive (25mm x 3m)			
1 non-allergic adhesive strip (25mm x 3m)			
1 packet adhesive dressing strips (minimum 10 ass. sizes)			
4 first aid dressings (75mm x 100mm)			
4 first aid dressings (150mm x 200mm)			
2 straight splints			
2 pairs large & 2 pairs medium disposable latex gloves			
2 CPR mouthpieces or similar devices			

Activity – in Your Groups (90 minutes)

Part 1 - You have been given the necessary knowledge to complete a Health and Safety plan for your company. Your facilitator will give you a hand-out of a sample Health and Safety plan which you may use for guidance purposes.

You need to draw up a Health and Safety plan for your organisation, taking into account the knowledge which you have regarding your organisation, as well as the knowledge which you have gained so far. Once you have completed your plan, print it and attach it to this unit as a sample.

Activity – On your own (90 minutes)

Part 2 – Answer the following questions:

What are the requirements for a safe working environment?

What do you need to do to maintain a safe working environment?

In your workplace you must find the following signs, draw each of them and explain where they are as well as what their meaning is: Walk around your workplace and find 3 examples each of:

- Information signs/symbols
- Instructional signs/symbols
- Fire prevention signs/symbols
- Warning signs/symbols

Sign	Drawing	Explanation

Limiting Injuries

Hazards in the workplace

There are many things that can cause injury in the workplace. It is important that you can identify these hazards and know what you need to do in order to keep your workplace healthy and safe. Let's take a look at some of the more common hazards that can occur in the workplace:

- PPE not being worn.
- Damaged lawnmowers, brush cutters, chain saws.
- Damaged tools such as broken pick handles, loose pick heads and spades and forks without handles.
- Machinery that doesn't have proper stone guards or a safety cut-off switch.
- Broken electrical connections on equipment.
- Unsafe or badly built buildings and stores.
- Open holes in the ground with no danger tape or other warning around it.
- Leaking chemicals or fuels.
- Tools not being stored properly in their designated storage area.
- Materials stored under or around fire fighting equipment so that in the event of a fire no one can reach the fire extinguisher.
- Tools and materials stored too high on shelves so that they cannot be easily reached.
- Chemicals that is not stored in a specially built chemical store with proper ventilation and a lowered floor to prevent spilled chemicals from poisoning the environment and people.
- Fires being made too close to fuel storage areas or chemical stores.
- Tools, equipment and materials laying around not properly stored away.

Let's take a look at what you can do to prevent or minimize these hazards in your workplace.

Wear Personal Protective Equipment (PPE)

You need to wear all PPE issued to you by the company. Let's take a look at what Personal Protective Equipment (PPE) could be issued to you?

PPE	Description
Overalls	General workers should be issued with a coloured overall. Overalls must be clean and fit properly. Loose or broken overalls can get caught in machinery and could cause injury to you. Pesticide operators should be issued with white overalls because this will clearly show any marks or stains. These overalls should be washed daily to make sure that any chemicals don't soak into the overalls and then onto your skin.
Hardhat	Your hardhat should have a visor and ear muffs and is used to protect your head on construction sites. The ear muffs will protect your ears when working with loud machinery such as lawnmowers and brush cutters. The visor (or safety glasses) protects your eyes from flying debris especially when working on machines in a workshop or operating brush cutters, lawnmowers and chain saws. Ear muffs and

PPE	Description
	visor must fit properly and must not be broken- if they are you could lose your hearing or eye sight.
Gloves	Protect your hands against chemical contamination or injury.
Steel capped boots	Protects your feet from heavy objects falling on them or from injuring yourself with tools such as digging forks, spades and lawnmowers. Boots must be laced up and must not be broken.
Reflective vests	Especially important in making you easier to see by motorists when working in public places.
Dust or gas mask	This will stop you from breathing in dust or chemical fumes and gasses when working in work shops or with poisonous chemicals. Dust and gas mask filters need to be replaced regularly for them to work properly.
Safety harnesses	This is important to workers who have to work off the ground such as pruning up trees and tree felling.

Use tools and equipment in a safe way.

Make sure that you use your workplace tools and equipment in a safe way by:

Checking that you are wearing the right PPE for the job, if you are not sure ask your supervisor or safety representative. Check tools and equipment you will be using are in good working condition:	
Equipment	Check
Lawnmowers	Check for the following: ❑ The throttle- this will set the engine speed. ❑ The choke – this is used only for starting the engine when it is cold ❑ The emergency stop switch- all mowers have these, even electric ones. ❑ The fuel tap- usually just under the tank on the fuel line leading to the carburettor. ❑ The height adjustment leaver(s). ❑ If the mower is a self-propelled machine, check the positioning of the clutch lever and hand brake. ❑ On most petrol and electric cylinder mowers there is an additional lever for engaging the blades separately from the clutch. If you are using an electrical lawn mower, you will also need to check that the: • On/off switch is in working order. • Cable is not broken or frayed. • Plug connections are tight and secure and that there are no exposed electrical wires.
All other tools and equipment	Check that your tools and equipment are: • Are sharp enough to do the job. • Have no chipped blades, broken parts or loose heads and handles because these tools can be dangerous and lead to injuries. If your tools are broken, hand them to your supervisor for fixing, don't pack them away. Report any broken equipment to your safety representative and do not try to fix it if you are not authorized to do so.
Check that you know how to operate the equipment – don't try operating equipment that you know nothing about, if you're not sure ask your supervisor. Only use the tools and equipment for the purpose they are meant to do. Obey the safety rules that come with the operational manual for the equipment. Obey all the safety signs in the area.	

Looking after your PPE, tools and equipment

After using your PPE, tools and equipment and before you pack them away for the day, you need to make sure that they are:

- Clean and sterilized:

All tools should be carefully washed down after use, especially where they may have soil on them, for example when you have done some root pruning. If you have been pruning diseased plants, make sure that you clean and sterilise your pruning tools before you prune other plants, so that you do not spread the disease to your other plants. Tools should be dried and then sterilized with either alcohol or methylated spirits. Make sure that your PPE is clean. Pesticide operators should use white overalls which must be washed daily- this makes sure that chemicals don't soak into the overalls and then into your skin.

- Sharp:

Keep your tools sharp at all times and always check that your blades are sharp enough to do the next job. There are many different ways to sharpen pruning tools and how you go about sharpening them will depend on what type of pruning tool you are using, so always check with your supervisor. Remember that tools that are not sharp can bruise and damage the plants being pruned and this will allow insects and diseases to attack your plants.

- Rust free:

Where necessary rub oil into the blades and other metal pieces to prevent your tools from rusting, especially when you are using them in rainy weather.

- Safe for future use:

Check that your tools have no chipped blades or broken parts and that your laces, ear muffs and visors have no broken parts because damaged or broken PPE and tools can be dangerous and lead to injuries. If your tools or PPE are broken, hand them to your supervisor for fixing, don't pack them away.

- Stored away safely

After you have checked your tools, store your tools under lock and key, in a cool, dry place. Don't leave your tools lying out in the rain because they will rust and this will cause your tools to break, become blunt and can cause injury to yourself or others.

Make sure that you store the tools away in their designated storage area and according to your workplace safety procedures. Check that you haven't stored any equipment:

- Under or around fire fighting equipment.
- Too high on shelves so that they cannot be easily reached.

. Blades that do not have protective covers must face into the shelf because they can cut or hurt anyone entering into the area. Make sure that anyone else using the area will not cut their hand when reaching out for the tool to remove it from the shelf.

Make sure that chemicals are stored in a specially built chemical store with proper ventilation and a lowered floor to prevent spilled chemicals from poisoning the environment and people.

Keep your workplace clean

- If there is water on the floor where you are working on electrical equipment you could get electrocuted.
- If the floors are dirty and dusty you could slip and hurt yourself
- Steel rakes laying upside down (with the teeth pointing up) break noses if stood on!
- Spilled oils that are not wiped up are slippery and you could fall and injure yourself.
- Old tools and rubbish laying around can cause you to trip or may hurt you if you walk into them by accident.
- Spilled chemicals that are not washed up cause fumes in the air that can make you sick. If anyone touches these chemicals they can also get sick. Many pesticides and chemicals are flammable and cause a fire. Some chemicals when mixing with other chemicals can cause a fire or explosion.
- Tools and equipment that are not packed away may also cause a vehicle accident.
- All fire fighting equipment must be easily and quickly accessible in case of an emergency.

Reporting Procedures

From time to time things can and will go wrong and you need to report to your supervisor or manager or safety representative:

- Any unsafe situation.
- Any defective or unsafe equipment.

The OHS act says:

- In the event of an accident you must **report the accident and details of the accident IMMEDIATELY to your supervisor or safety representative**. If it is not too serious you must report it before the end of your shift.
- You **must seek medical advice immediately**. (this is very important for Workman's Compensation to pay the medical bills for you)
- For persons working with noisy machinery and/or chemicals a **monthly check-up with a medical doctor** is necessary to prevent any long term hearing loss or poisoning.
- The **safety representative must report any safety issues** to the management or safety committee.
- Regular, **monthly safety checks must be done by the safety representative** or other person authorized to do so. These checks must be reported to the management or safety committee who will then address the issues.

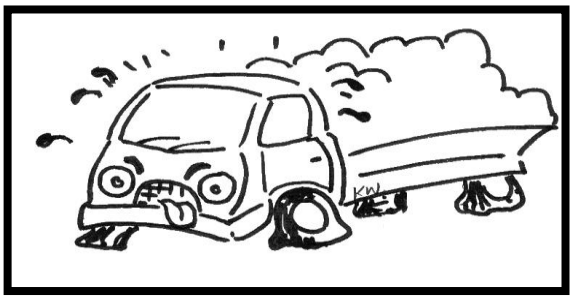
Transporting Safely

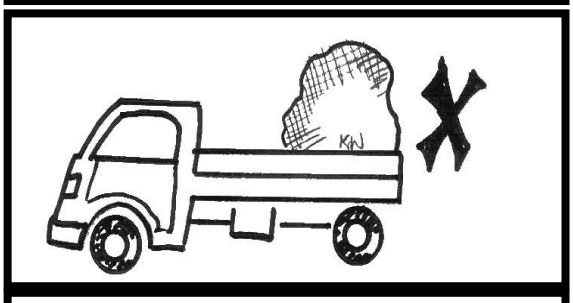
Vehicle safety:

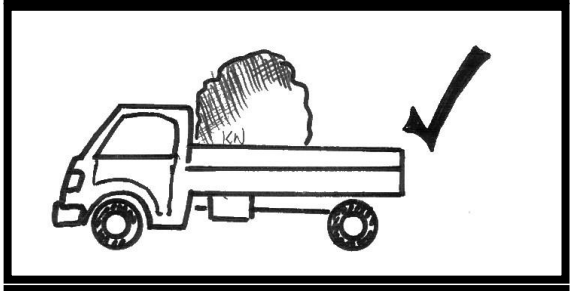
All vehicles must be in a safe and roadworthy condition.

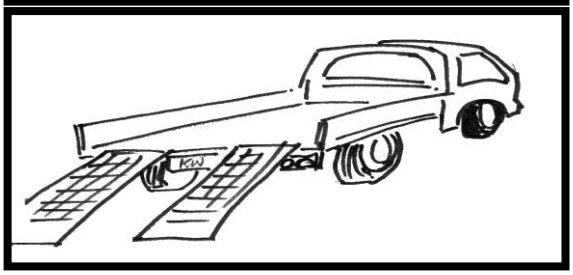
Vehicles must have:	
Good brakes and handbrake	To be able to stop properly. To avoid an accident or to be able to park on a slope without moving.
Lights that are working	To be properly visible to other cars and to be able to see properly at night.
Good shock absorbers	To allow the brakes to work properly and to keep the vehicle safely on the road.
Windscreen wipers that are in good condition	To allow the driver to see properly in rainy conditions.
Seating	In the back of trucks that are going to transport people.
Steps up the side of trucks	That are going to transport people so that they can climb on and off safely.
A canopy	Over open trucks and vehicles used to transport people to protect them from rain.
Not have smooth tyres	To prevent the vehicle from skidding out of control.

Transport and loading goods safely









- DO NOT overload!
    - Overloading causes the vehicle's front wheels to lift so that they do not stay properly on the road surface.
- Pack heavier goods to the front of the vehicle so that the weight is spread more evenly across all the wheels.
- Pack large goods so that they do not obstruct the driver in any way.
- Pack loose goods so that they cannot fall off on the road and cause an accident
- Heavy goods should be securely tied down so that they do not move around when the vehicle takes corners, breaks or accelerates.
- When loading heavy goods onto a vehicle the following should be done:
    - Heavy machinery that can drive – park the truck against a ramp and drive the machinery onto the truck. Be sure to tie the machine down, chock the wheels and pull up the handbrake before proceeding.
    - Heavy machinery that cannot drive – Make use of a fork lift or crane to lift the goods on.
    - Heavy goods that can be loaded by workers – use a ramp up to the truck and slide the goods up. Do not try to pick these goods up as you can seriously injure your back!
    - Lighter goods that can be loaded by workers. Pass the goods up to another worker on the truck to pack them. Do not throw smaller goods like plants up to the packer as any soil that comes loose could cause injury to his eye.(and damage the plants)
    - Always pack the smaller goods to the front of the vehicle so that the weight can be evenly spread across all the wheels
- It is a good idea to load large equipment onto a separate vehicle.
- Make sure that staff are seated before moving the vehicle.
- Drive at a speed relative to the road surface and avoid hazards in the road like stones, tree stumps and holes.

LIMITING INJURIES

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

Identifying emergencies

Read through the following:

One of your employees trips on the stairs and falls. One arm is broken and there may be a back injury. The employee is unconscious.

Your forklift operator is moving a 200/ drum of volatile acid into the workplace. In the process the drum is ruptured and 150l spill onto the floor.

An employee operating a degreaser accidentally drops in some metal pieces that are hot from machining. The degreasing agent splashes, erupting into flames and spreading fire in one corner of the building.

Imagine right now one of these incidents occurs. Look at your watch and count down three minutes.

What happens in the next three minutes will be critical in determining the outcome of the emergency. Do your employees have enough training in medical procedures to care for an injured employee without inflicting additional damage? How your employees respond to medical emergencies may permanently affect someone's life.

In your countdown one minute has gone by. Have you or any other managers been notified of a problem yet? What are your employees doing to shut down equipment, stop the spread of fire on chemicals in the plant, or protect themselves from further exposure to a hazardous situation? Now two minutes have gone by. Is there a need for outside assistance such as an ambulance or the fire department? If so, have they been notified and are employees taking proper steps in the interim to contain the situation or protect themselves?

Now three minutes have elapsed. How is the unconscious employee with the broken arm and possible back injury? Have untrained employees moving the individual made the injury worse? When the acid spilled, did employees know to put on proper respiratory protection before attempting to clean up the spill?

Or do you now have four employees with severe respiratory distress due to an overexposure to acid gases? What about the fire? Has it been put out, or has it spread to the rest of the building? Are any employees trapped? Is the fire department on its way?

Without your direct involvement during an emergency, what happens? Can production resume with minimal overall interruption? Are you out of business or facing a situation of catastrophic proportions? The answer to these questions depends on how well you anticipate the types of emergencies that can arise in your workplace; how well you plan proper steps to handle the emergency; and how well you train your employees in the steps to be taken.

Keys to Success

Anticipating Emergencies

The first step in handling emergencies is to anticipate what types of emergencies could arise at your workplace. The potential emergencies and their chances of occurring depend on your work environment and the operations and processes at your facility. A safety and health survey will help you identify the hazards specific to your workplace. Once the hazards have been identified, plans and procedures can be developed and implemented to eliminate or control these hazards.

However, even with these preventative measures, you are gambling to assume that an emergency situation will never arise in your facility. Identify emergencies that could conceivably happen, and then begin to make plans for the swiftest possible control of each.

Planning for Emergencies

There are five major issues to consider when planning responses to emergencies. These issues should be considered in relation to each other, particularly when deciding whether to address them in a sequential order, whether they require simultaneous attention, or if some issues need not be addressed at all.

Remember, as you address each issue to keep in mind the specific factors involved in your workplace and tailor your plan accordingly.

Notification (Emergency Alert)

You need to design a system so that any employee who notices an emergency situation can notify you or other management personnel. Even though your staff may be involved in containing a hazard or removing employees from exposure, you need to be made aware of potential problems as early as possible.

Based on the possible emergencies identified in the hazard assessment of your facility, you will need to determine where visible and audible alarms should be placed and at what point you should be called. Obviously you would not want to have employees alerting management every time a minor problem arises, but you should be made aware of a potential emergency immediately.

The employer should explain to each employee the preferred means of reporting emergencies, such as manual pull box alarms, public address systems, radios, or telephones. The employer should post emergency telephone numbers near telephones, on bulletin boards, and at other appropriate locations. When a communication system also serves as the employee alarm system, all emergency messages should have priority over all non-emergency messages.

Limit Employee Exposure

Depending on the type of emergency, you may need to limit both the number of employees exposed and the extent of exposure. Is partial or total evacuation of the building or the use of appropriate personal protective equipment necessary?

You must focus your emergency response efforts on limiting employee exposure to the hazard. This includes protecting employees who may be exposed to a hazard while trying to assist in the emergency (i.e., putting out a fire, rescuing a worker, cleaning up a chemical spill, etc.).

Hazard Control, and Equipment and/or Process Shutdown

In planning for hazard control, first consider any regulations that specify required actions for fire control, lockout/tag-out, evacuation, etc. Depending on the type of emergency or hazard, you may determine that your employees can take action to control the hazard without endangering themselves. For example, employees who have received fire extinguisher training may be able to extinguish a fire in the early stages, thereby removing the hazard.

In some instances, you would need outside assistance. In some emergencies, employees may only be able to contain the hazard until outside help arrives or until subsequent actions can be taken to control or remove the hazard.

In the case of chemical exposure emergencies, specific actions are necessary to contain spills and prevent employee exposure. Chemical exposure emergencies specific actions are necessary to contain spills and prevent employee exposure.

You may need to provide a procedure for shutting off equipment or shutting down work processes, either at their locations or by remote control. The reason for such a shutdown might be to make it easier or safer for hazard control (such as in fire fighting efforts) or to prevent other hazards from appearing (such as problems that might occur when machines are still running during a gas leak).

Medical Treatment

Occasionally an accident will happen which requires emergency medical treatment. The extent of medical care that can be provided onsite will depend on the training of your staff. It may be a good idea to provide them with general first aid or CPR training, or prepare them to respond to injuries or illnesses that could occur from the specific conditions in your facility.

Even with comprehensive treatment available offsite in an industrial clinic or hospital, your staff could still be trained to give initial treatment to stabilize victims and prepare them for transport. It is important to identify the nearest emergency resource and the actual response time to your facility as well as the response time for backup providers.

Clean-up and Start-up Operations

Occasionally a need for workplace clean-up operations develops after a hazard is brought under control and before normal operations can resume. In the event of a chemical spill, for example, the chemical needs to be cleaned up and disposed of properly.

A little thought before these clean-up operations begin can prevent additional employee exposure to the same or different hazards. Try to anticipate these needs and design protective measures for employees in advance.

The same reasoning applies to start-up operations. The process of starting up equipment or production can create hazards in addition to the problem that led to the shutdown. You need to carefully think through the start-up procedures to make sure that no problems will arise that will make the operations unsafe for your employees.

Training Employees

All of your work to anticipate emergencies and plan appropriate responses won’t help unless you train your supervisors and employees to carry out your plans. This is the essence of training: to let people know what they need to accomplish and what you expect from each of them.

You may need to do initial training on the hazards you anticipate and the response procedures you have planned.

A second phase may be needed to develop the specific skills and capabilities your employees may need to carry out those procedures and then your emergency procedures will be more effective if you delegate certain tasks or responsibilities to individual employees and train them in these areas.

For example, you designate one or more persons in each department or section to be responsible for notifying management of potential emergencies or for telephoning the fire department. Your decision on this assignment of responsibilities will depend on the organization of your company and the capabilities of your employees.

Summary

Being prepared for workplace emergencies involves three key steps:

- Anticipate what might happen
- Plan what you will do in response to an emergency
- Train your employees so they know what to do

Thorough preparation for emergencies includes developing a plan for each type of emergency that could arise in your workplace. These emergencies might be a fire emergency, a medical emergency, or one that could result from the materials or equipment used in your business. Remember, that once an emergency occurs, it's too late to stop and plan. Thorough and careful advance planning is the key to managing emergencies.

Worksheet

The following worksheet is a series of questions that will help you anticipate fire, medical, or other emergencies. Once these emergencies have been identified you can plan appropriate responses. The worksheet is meant to be a general guideline for any type of workplace, and should be tailored to your own needs

Fire

Every facility should be prepared for the possibility of a fire. Although fires can start from many causes, you can determine the most probable causes of fire and where fires are most likely to start in your workplace by answering the following questions:

1. What kinds of flammable or explosive materials are in your workplace? Make a list of these materials. Remember to include items such as flammable liquids and major electrical components as well as those items normally thought of, such as paper or wood.

2. Where, and in what quantities, are these materials located On the list of flammable or explosive materials identify areas of the workplace that contain concentrations of these materials. It may be helpful to mark these areas and materials on a floor plan, or make a second list that describes each area of the workplace and the materials it contains.

3. What major sources of ignition are in your workplace? How far are they from where the flammable or explosive materials are located? Have you taken action to control these under normal circumstances?

4. Do you have any chemicals or hazardous materials that would pose special problems during a fire? For example, will any materials tend to explode if ignited or heated, or will they release toxic gases, vapours or particles that require personal protective equipment? Do you have any radioactive material? List these materials separately, along with specific information on the type of hazard involved and conditions under which a problem would occur. For example, at what temperature will the materials become explosive?

Medical and First Aid

As with fire emergencies, you need to anticipate and prepare for general first aid and medical needs. Some workplaces can also have special needs for medical care. Answers to the following questions can help you determine what you need:

1. Do you employ anyone who has an existing medical problem that may require special care; for example, someone with epilepsy, haemophilia, or heart disease? Although as an employer you may not be aware of existing conditions such as these, and discrimination against such workers is prohibited, you can explain to workers why you desire such medical information, and then ask them to let you know of any relevant medical problems.

2. Do you have any chemicals or hazardous materials or processes in your facility that would create medical problems? Make a list of chemicals and materials used and the accompanying health effects which could result from exposure. Information from chemical manufacturers or Material Safety Data Sheets (MSDSs) that describe various substances and how to use them safely will help you.

3. Collaborate with your emergency resources in identifying potential problems and exposures at your workplace.

Specific Emergencies in Your Workplace

In addition to fire and medical emergencies, you may have processes or materials in your facility that can present very specific hazards. The flowing questions are designed to identify those hazards:

1. What type of accident or emergency could result if employees failed to follow established site-specific safe work procedures or rules? Look at each rule, guideline, and practice that you have implemented. If any or all employees failed to follow directions, list the possible outcomes. Are any special outcomes identified beyond a fire or accident requiring first aid? If so, list those.

2. Do you have any chemicals, materials, or processes in your workplace that could lead to other types of emergency situations? For example, do you have any radioactive materials, or chemicals, that are hazardous if accidentally mixed together, such as acid and cyanide? Or do you have any processes that could cause explosions, release of chemicals, etc.? To identify these hazards you should look at manufacturers' directions, specifications, and information on Material Safety Data Sheets.

By answering all of the above questions as completely and thoroughly as possible, you should now have a list of hazards specific to your workplace that could cause an emergency. You can now use it as a basis for planning your response to each kind of emergency you have identified and to train your employees to respond properly. This information should also be provided to emergency assistance personnel such as fire fighters and/or hospital staff.

Employee hazard reports can be done in many ways. Below you will find one such example of a report.

Employee Report of Hazardous Conditions

Employee

_____

Department

_____

Date_____Time_____

Hazard_____

Suggestion_____

_____

_____

Employee complete and give to supervisor

Supervisor_____

Department _____

Date_____

Action taken_____

Supervisor complete and give to manager

Date_____

Manager _____

Review/Comments

_____

_____

_____

_____

_____

Signature of Manager

Follow-up Documentation

Hazard_____

_____

_____

Exposure_____

_____

Frequency_____

_____

Duration_____

_____

Interim protection provided_____

_____

_____

Corrective action

taken_____

_____

_____

Required time for corrective action

_____

Cost of hazard elimination

_____

Retraining rovided_____

Follow-up date_____

Additional action taken_____

_____

_____

_____

Signature of Manager/Supervisor

_____

Date

_____

Fire hoses, -extinguishers and alarms

Fire extinguishers are divided into four categories, based on different types of fires. Each fire extinguisher also has a numerical rating that serves as a guide for the amount of fire the extinguisher can handle. The higher the number, the more fire-fighting power it has. The following is a quick guide to help choose the right type of extinguisher.

Class A extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish.

Class B fires involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish.

Class C fires involve electrical equipment, such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive.

Class D fire extinguishers are commonly found in a chemical laboratory. They are for fires that involve combustible metals, such as magnesium, titanium, potassium and sodium. These types of extinguishers also have no numerical rating, nor are they given a multi-purpose rating - they are designed for class D fires only.

Here are the most common types of fire extinguishers:
Water extinguishers or APW extinguishers (air-pressurized water) are suitable for class A fires only. Never use a water extinguisher on grease fires, electrical fires or class D fires - the flames will spread and make the fire bigger! Water extinguishers are filled with water and are typically pressurized with air. Again - water extinguishers can be very dangerous in the wrong type of situation. Only fight the fire if you're certain it contains ordinary combustible materials only.

Dry chemical extinguishers come in a variety of types and are suitable for a combination of class A, B and C fires. These are filled with foam or powder and pressurized with nitrogen.

BC - This is the regular type of dry chemical extinguisher. It is filled with sodium bicarbonate or potassium bicarbonate. The BC variety leaves a mildly corrosive residue which must be cleaned immediately to prevent any damage to materials.

ABC - This is the multipurpose dry chemical extinguisher. The ABC type is filled with mono-ammonium phosphate, a yellow powder that leaves a sticky residue that may be damaging to electrical appliances such as a computer

Dry chemical extinguishers have an advantage over CO2 extinguishers since they leave a non-flammable substance on the extinguished material, reducing the likelihood of re-ignition. Carbon Dioxide (CO2) extinguishers are used for class B and C fires. CO2 extinguishers contain carbon dioxide, a non-flammable gas, and are highly pressurized.

The pressure is so great that it is not uncommon for bits of dry ice to shoot out the nozzle. They don't work very well on class A fires because they may not be able to displace enough oxygen to put the fire out, causing it to re-ignite. CO2 extinguishers have an advantage over dry chemical extinguishers since they don't leave a harmful residue - a good choice for an electrical fire on a computer or other favourite electronic device such as a stereo or TV. It is vital to know what type of extinguisher you are using. Using the wrong type of extinguisher for the wrong type of fire can be life-threatening.

How does a fire-extinguisher work?

Fire needs fuel, oxygen and heat in order to burn. In simple terms, fire extinguishers remove one of these elements by applying an agent that either cools the burning fuel, or removes or displaces the surrounding oxygen.

Fire extinguishers are filled with water or a smothering material, such as CO2. By pulling out the safety pin and depressing the lever at the top of the cylinder (the body of the extinguisher), this material is released by high amounts of pressure.

How it Works

At the top of the cylinder, there is a smaller cylinder filled with compressed gas. A release valve acts as a locking mechanism and prevents this gas from escaping. When you pull the safety pin and squeeze the lever, the lever pushes on an actuating rod which presses the valve down to open a passage to the nozzle.

The compressed gas is released, applying a downward pressure on the fire-extinguishing material. This pushes the material out the nozzle with high amounts of pressure. Although the temptation is to aim the extinguisher at the flames, the proper way to use the extinguisher is to aim it directly at the fuel.

Water Extinguishers

Water extinguishers are filled with regular tap water and are typically pressurized with air. The best way to remove heat is to dump water on the fire but, depending on the type of fire, this is not always the best option.

Dry Chemical Extinguishers

Dry chemical extinguishers are filled with either foam or powder, usually sodium bicarbonate (baking soda) or potassium bicarbonate, and pressurized with nitrogen. Baking soda is effective because it decomposes at 70 degrees Celsius and releases carbon dioxide (which smothers oxygen) once it decomposes.

Dry chemical extinguishers interrupt the chemical reaction of the fire by coating the fuel with a thin layer of powder or foam, separating the fuel from the surrounding oxygen.

Carbon Dioxide (CO2) extinguishers

CO2 extinguishers contain carbon dioxide, a non-flammable gas, and are highly pressurized. The pressure is so great that it is not uncommon for bits of dry ice to shoot out. CO2 is heavier than oxygen so these extinguishers work by displacing or taking away oxygen from the surrounding area. CO2 is also very cold so it also works by cooling the fuel.

Using a fire-extinguisher

Before using your fire extinguisher, be sure to read the instructions before it's too late. Although there are many different types of fire extinguishers, all of them operate in a similar manner. A typical fire extinguisher contains 10 seconds of extinguishing power.

This could be less if it has already been partially discharged. Always read the instructions that come with the fire extinguisher beforehand and become familiarized with its parts.

It is highly recommended by fire prevention experts that you get hands-on training before operating a fire extinguisher. Most local fire departments offer this service. Once the fire is out, don't walk away! Watch the area for a few minutes in case it re-ignites.

Recharge the extinguisher immediately after use. Use this acronym as a quick reference (it is a good idea to print this reference and pin it next to your fire extinguisher):

Pull the Pin at the top of the extinguisher. The pin releases a locking mechanism and will allow you to discharge the extinguisher.

Aim at the base of the fire, not the flames. This is important - in order to put out the fire, you must extinguish the fuel.

Squeeze the lever slowly. This will release the extinguishing agent in the extinguisher. If the handle is released, the discharge will stop.

Sweep from side to side. Using a sweeping motion, move the fire extinguisher back and forth until the fire is completely out. Operate the extinguisher from a safe distance, several feet away, and then move towards the fire once it starts to diminish. Be sure to read the instructions on your fire extinguisher - different fire extinguishers recommend operating them from different distances.

<u>Remember: Aim at the base of the fire, not at the flames!!!!</u>

Fire-extinguisher maintenance

Inspect fire extinguishers at least once a month (more often in severe environments). Fire extinguisher maintenance is important for everyone's safety.

You must ensure that:

- The extinguisher is not blocked by equipment, coats or other objects that could interfere with access in an emergency.
- The pressure is at the recommended level. On extinguishers equipped with a gauge (such as that shown on the right), the needle should be in the green zone - not too high and not too low.
- The nozzle or other parts are not hindered in any way.
- The pin and tamper seal (if it has one) are intact.
- There are no dents, leaks, rust, chemical deposits and/or other signs of abuse/wear. Wipe off any corrosive chemicals, oil, gunk etc. that may have deposited on the extinguisher.
- Some manufacturers recommend shaking your dry chemical extinguishers once a month to prevent the powder from settling/packing.

Fire extinguishers should be pressure tested (a process called hydrostatic testing) after a number of years to ensure that the cylinder is safe to use. Consult your owner's manual, extinguisher label or the manufacturer to see when yours may need such testing. If the extinguisher is damaged or needs recharging, replace it immediately!

IMPORTANT: Recharge all extinguishers immediately after use regardless of how much they were used.

What is the difference between a fire extinguisher inspection and fire extinguisher maintenance?

INSPECTION - An inspection is a "quick check" to give reasonable assurance that a fire extinguisher is available, fully charged and operable. The value of an inspection lies in the frequency, regularity, and thoroughness with which it is conducted. The frequency will vary from hourly to monthly, based on the needs of the situation. Inspections should always be conducted when extinguishers are initially placed in service and thereafter at approximately 30-day intervals.

MAINTENANCE - Fire extinguishers should be maintained at regular intervals (at least once a year), or when specifically indicated by an inspection. Maintenance is a "thorough check" of the extinguisher. It is intended to give maximum assurance that an extinguisher will operate effectively and safely. It includes a thorough examination and any necessary repair, recharging or replacement. It will normally reveal the need for hydrostatic testing of an extinguisher.

Fire fighting tips

Use a mental checklist to make a Fight-or-Flight Decision. Attempt to use an extinguisher only if ALL of the following apply:

- The building is being evacuated (fire alarm is pulled)
- The fire department is being called (dial 911/10111).
- The fire is small, contained and not spreading beyond its starting point.
- The exit is clear, there is no imminent peril and you can fight the fire with your back to the exit.
- You can stay low and avoid smoke.
- The proper extinguisher is immediately at hand.
- You have read the instructions and know how to use the extinguisher.

Whenever possible, use the "Buddy System" to have someone back you up when using a fire extinguisher. If you have any doubt about your personal safety, or if you cannot extinguish a fire, leave immediately and close off the area (close the doors, but DO NOT lock them). Leave the building but contact a fire-fighter to relay whatever information you have about the fire.

All fires can be very dangerous and life-threatening. Your safety should always be your primary concern when attempting to fight a fire.

Before deciding to fight a fire, you must be certain that:

- The fire is small and not spreading. A fire can double in size within two or three minutes.
- You have the proper fire extinguisher for what is burning.
- The fire won't block your exit if you can't control it. A good way to ensure this is to keep the exit at your back.
- You know your fire extinguisher works. Inspect extinguishers once a month for dents, leaks or other signs of damage. Assure the pressure is at the recommended level. On extinguishers equipped with a gauge, the needle should be in the green zone - not too high and not too low.
- You know how to use your fire extinguisher. There's not enough time to read instructions when a fire occurs.

How to Fight a Fire Safely:

- Always stand with an exit at your back.
- Stand several metres away from the fire, moving closer once the fire starts to diminish.
- Use a sweeping motion and aim at the base of the fire.
- If possible, use a "buddy system"; have someone back you up or call for help if something goes wrong.
- Be sure to watch the area for a while to ensure it doesn't re-ignite.

Never Fight A Fire If:

- The fire is spreading rapidly. Only use a fire extinguisher when the fire is in its early stages. If the fire is already spreading quickly, evacuate and call the fire department.
- You don't know what is burning. Unless you know what is burning, you won't know what type of fire extinguisher to use. Even if you have an ABC extinguisher, there could be something that will explode or produce highly toxic smoke.
- You don't have the proper fire extinguisher. The wrong type of extinguisher can be dangerous or life-threatening.
- There is too much smoke or you are at risk of inhaling smoke. Seven out of ten fire-related deaths occur from breathing poisonous gases produced by the fire.
- Any sort of fire will produce some amount of carbon monoxide, the most deadly gas produced by a fire. Materials such as wool, silk, nylon and some plastics can produce other highly toxic gases such as carbon dioxide, hydrogen cyanide, or hydrogen chloride. Beware - all of these can be fatal.

On Your Own – Circle the correct answer

1. Use a portable fire extinguisher to fight a fire only if:

a. The building alarm has been activated, the building is in the process of being evacuated, the fire department and security have been called, the fire is small and contained and there is no imminent peril.

b. You have help to fight the fire, can fight the fire with your with your back to an unobstructed exit, can stay low to avoid smoke, have proper extinguisher at hand, and you have been trained how to use it.

c. You are the only one available to fight the fire.

d. A and B.

2. Do not attempt to fight a fire if:

a. You don't know what material is burning.

b. Others in the building haven't been warned about the fire and are not yet evacuating.

c. You don't have a clear exit to be able to leave immediately if anything unexpected happens.

d. All of the above.

3. Class A fire extinguishers are suitable for:

a. Fire in energized circuits or electrical equipment, computers.

b. Flammable liquid fires, such as oil, gasoline, solvents.

c. Ordinary combustibles, paper, wood, most rubber or plastics and textiles.

d. Flammable metal fires, machining chips, and reactive metals such as titanium.

4. Class B fire extinguishers are suitable for:

a. Fire in energized circuits or electrical equipment, computers.

b. Flammable liquid fires, such as oil, gasoline, solvents.

c. Ordinary combustibles, paper, wood, most rubber, plastics, textiles.

d. Flammable metal fires, machining chips, reactive metals such as titanium.

5. Class C fire extinguishers are suitable for:

a. Fire in energized circuits or electrical equipment, computers.

b. Flammable liquid fires, such as oil, gasoline, solvents.

c. Ordinary combustibles, paper, wood, most rubber, plastics, textiles.

d. Flammable metal fires, machining chips, reactive metals such as titanium.

6. Water, when used as an extinguishing agent:

a. May intensify the fire if used on burning liquids.

b. Poses risk of electric shock if used on energized equipment.

c. Is commonly propelled by a soda-acid chemical reaction.

d. A and B.

7. Dry chemical when used as an extinguishing agent:

a. Is multi-purpose rated B-C or ABC, depending upon the specific agent used.

b. Is nonconductive, works by blanketing the fuel to interrupt the chemical reaction at the fuel surface, and displacing oxygen to smother the fire.

c. Should be tested only upon your approach to the fire.

d. All of the above.

8. The recommended method for using a fire extinguisher is to:

a. Discharge the extinguisher in one continuous stream pointing at the center of the fire, until it is out.

b. Start at the top of the fire, sweep from side to side and work down to its base,

c. Start at the base of the fire and sweep slowly upward in one long continuous stream.

d. Pull the pin, aim low at the base of fire, squeeze the lever and sweep from side to side in short spurts.

9. What should you do once the fire is out?

a. Contact the fire department to cancel the call.

b. Watch the fire area, while being alert for re-ignition, if you cannot confine the fire, leave immediately.

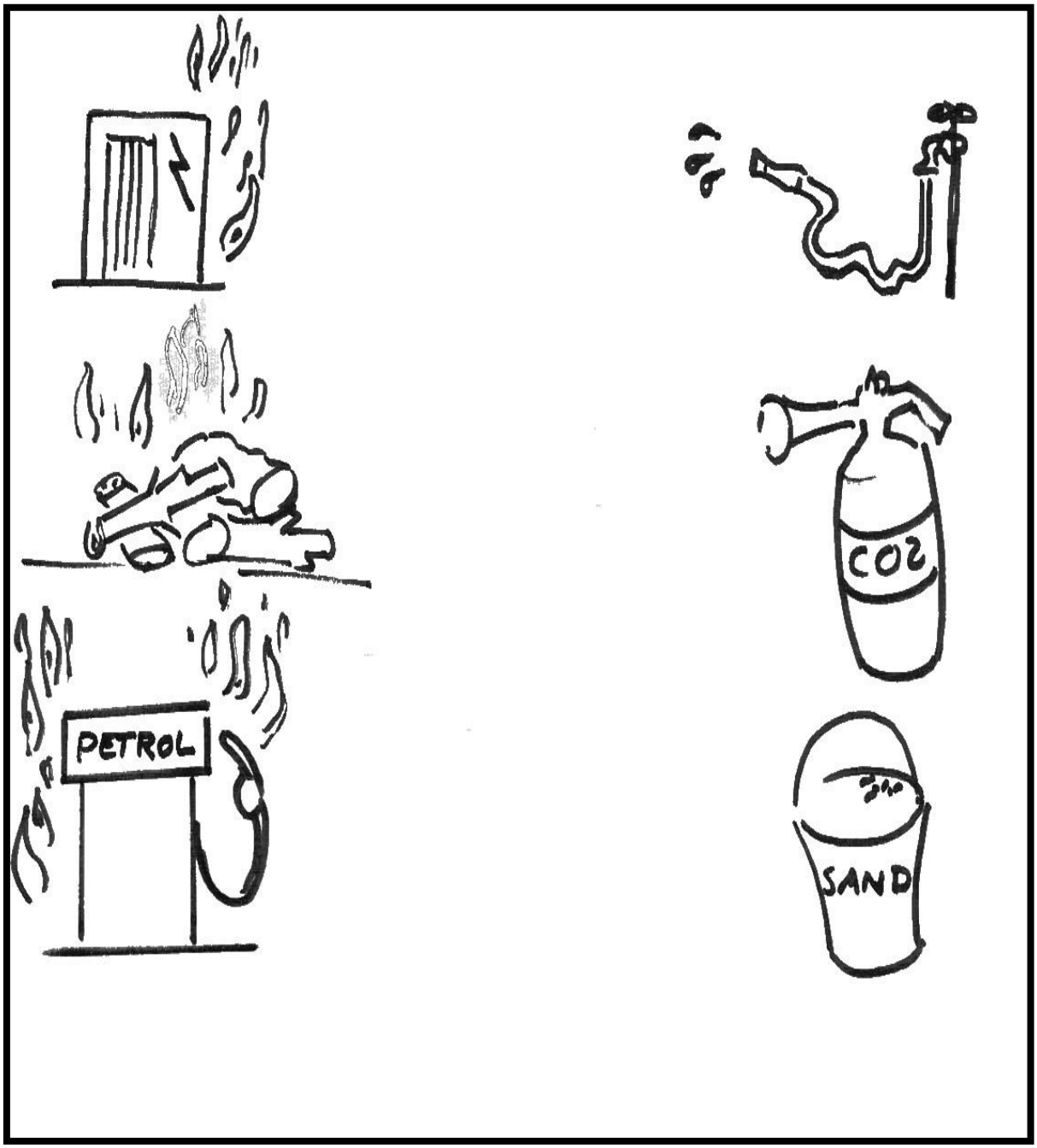
c. Ensure that the fire department inspects the scene and also recharge or replace the used extinguisher.

d. Both B and C.

Activity – On your own

Part 1 - Identify three types of situations in your workplace where a fire can erupt and explain the use of fire fighting equipment to be used in the relevant emergency situation.

Part 2 - In the picture below draw an arrow that shows where you must point the fire fighting equipment when trying to control a fire. Also identify areas or items in your organisation where these items are a danger and a fire can start from



You are now ready to go through a check list. Be honest with yourself.

Tick the box with either a √ or an X to indicate your response.

- ❑ I am able to describe the implications that the health and safety legislation has on horticultural practices
- ❑ I am able to recognise and be aware of potential hazards in the workplace
- ❑ I am able to indicate the standard operating procedures that aim to minimise safety incidents
- ❑ I am able to use chemical control substances safely
- ❑ I am able to apply the principles and practices of good housekeeping

You must think about any point you could not tick. Write this down as a goal.

Decide on a plan of action to achieve these goals. Regularly review these goals.

My Goals and Planning:

_____
_____
_____
_____
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PRUNE AND SHAPE SHRUBS

264176

A person credited with this unit standard will be able to:

- Use pruning techniques to achieve optimum growth and flowering of shrubs and herbaceous perennials
- Rejuvenate shrubs and trees by applying the appropriate pruning techniques
- Conduct formative pruning to create the desired shape
- Apply post pruning care to plants

PRUNING

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

What is Pruning?

There are two kinds of pruning that you can do:

- Corrective pruning which is the cutting away or trimming of dead, diseased and unwanted stems, shoots or flowers.
- Decorative pruning which is the cutting away or trimming of plants stems, twigs, shoots and leaves to help the plant grow into beautiful shapes.

Nature gets rid of everything that is no longer useful and in the garden you can help nature by removing all the dead wood, diseased or broken growth on your plants. Careful thinning of over-crowded growth of your plants, allows more light and air to reach your plant by removing any weak or crowded stems and shoots found on your plants.

As you can see plants can be pruned deliberately by you or plants can sometimes be pruned by:

- Animals eating the leaves, stems or twigs of plants.
- Elephants walking past or breaking off branches to get to the fruit of a tree.
- Storm damage where lighting or wind breaks off a branch or stem.
- People or children breaking the plant by mistake.
- Vehicles crashing into plants and breaking them.

Pruning of your plants, helps your plants to thrive and flourish, so let's take a look at why you should prune your plants.

Why should you prune your plants?	
Pruning encourages your plants to produce new leaves and stems.	By thinning out the stems of your plants, more light can get into your plant and this encourages strong growth in the stems that remain on your plants. Pruning also encourages plenty of bushy new growth, because each stem pruned will produce several new stems in place of the one that was removed.
Pruning encourages your plants to produce more flowers and fruit.	Since more stems are produced from pruning, more flowers will be formed as there are more shoots for flowers to grow on and on more flowers on fruit trees means that your fruit tree will bear more fruit.
Pruning encourages healthy new root development.	Pruning of your plant's roots helps to make up for the loss of foliage when you are transplanting your plants and encourages your plants to make new roots.

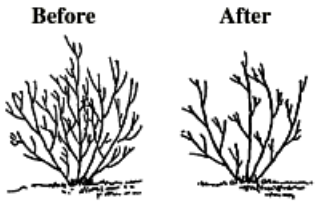
Now that you understand the benefits of pruning your plants, let's take a look at when you would need to prune your plants.

When do you need to prune your plants?	
You need to prune any dead parts of your plants.	Prune to remove any dead parts of your plants because this helps your plant to get rid of branches or stems broken by wind, hail, rain or pests and encourages your plant to produce new, strong healthy growth. After your flowers have finished flowering, the flower heads also need to be pruned and this will encourage your plants to produce new flowers.
You need to prune any diseased parts of your plant.	Prune to get rid of any diseased parts of your plants and to stop the disease from spreading to other parts of your plant or to other plants growing in the area. You can also prune your plants to allow your spray mixture to reach all parts of your plants, especially the inside stems and leaves. Getting rid of the diseased parts of your plants will open up your plant and this opening up will give your plant good air circulation and more light which will help your plant to recover from the disease.
Prune to shape your plants.	Most plants will need regular pruning as they are growing, to achieve a well balanced shape and look good. Sometimes one section of a plant grows more quickly than the other sections of the plant, when this happens lightly prune the strong shoots that are growing quickly and hard prune the weaker shoots that are growing more slowly because hard pruning will encourage strong growth. Removing parts of a plant, ("thinning" the plant), will allow for a better balance to be created in the plant
To control the size of your plants.	As some plants grow in the landscaped area, they grow to block a view or a pathway or even grow into other plants. Pruning of your plants helps to limit their size.
Before you transplant any of your plants.	Prune back your plant's foliage to help make up for the loss of roots when you are transplanting your plants. This helps your plants to be successfully transplanted.
To stop rootstock from shooting on grafted and budded plants such as roses and fruit trees.	Rootstock shoots/suckers are often more vigorous than grafted or budded stock and will take over if it is not removed. Prune these stems back flush with the stem or stems from which they are growing.
To stop variegated leaves from going back to their original green colour.	Certain variegated plants keep trying to go back to their original green foliage. Prune these stems back flush with the stem or stems from which they are growing.
To create beautiful looking shapes in your landscaped area.	You can create art forms out of your plants by pruning your plants into a ball or even animal shapes, this is called topiary. You can also prune plants to create hedges. Training of young shrubs into standards will require pruning in its initial stages to create a leader shoot.

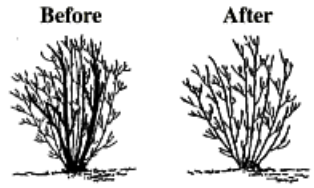
Deciduous Shrubs

The pruning recommended for most deciduous shrubs consists of **thinning out**, gradual renewal, and rejuvenation pruning. In thinning out, a branch or twig is cut off either at its point of origin from the parent stem, to a lateral side branch, to be "Y" of a branch junction, or at ground level. Thin out the oldest and tallest stems first, to allow for growth of vigorous side branches. This method of pruning results in a more open plant and does not stimulate excessive new top growth. Considerable growth can be cut out without changing the plant's natural appearance or habit of growth. Plants can be maintained at a given height and width for years by thinning out. This method of pruning is best done with pruning shears, loppers, or a saw (not hedge shears).

Thinning



Gradual Renewal



In **gradual renewal** pruning, a few of the oldest and tallest branches are removed at or slightly above ground level on an annual basis. Some thinning may be necessary to shorten long branches or maintain a symmetrical shape.

To **rejuvenate** an old, overgrown shrub, 1/3 of the oldest, tallest branches can be removed at or slightly above ground level before new growth starts.

When the shrub to be pruned is grown for its flowers, the pruning must be timed to minimize disruption of the blooming. Spring flowering shrubs bloom on last season's growth and should be pruned soon after they bloom. This allows for vigorous growth during the summer, to provide flower buds for the following year.

Pruning is a horticultural practice that alters the form and growth of a plant. Based on aesthetics and science, pruning can also be considered preventive maintenance. Many problems may be prevented by pruning correctly during formative years for a tree or shrub.

Reasons for pruning

Prune to promote plant health

Remove dead or dying branches injured by disease, severe insect infestation, animals, storms, or other adverse mechanical damage.

Remove branches and branch stubs that rub together.

Avoid topping trees. Removing large branches leaves stubs that can cause several health problems. It also destroys the plant's natural shape and promotes suckering and development of weak branch structure.

Prune to maintain plants; intended purposes in a landscape, such as:

encouraging flower and fruit development,

maintaining a dense hedge, or

maintaining a desired tree form or special garden forms.

Prune to improve plant appearance

Appearance in the landscape is essential to a plant's usefulness. For most landscapes, a plant's natural form is best. Avoid shearing shrubs into tight geometrical forms that can adversely affect flowering. Alter a plant's natural form only if it needs to be confined or trained for a specific purpose. When plants are pruned well, it is difficult to see that they have been pruned! Prune to:

control plant size,

keep evergreens well-proportioned, or

remove unwanted branches, waterspouts, suckers, and undesirable fruiting structures that detract from plant appearance.

Prune to protect people and property

Remove dead branches.

Have hazardous trees taken down

Prune out weak or narrow-angled tree branches that overhang homes, parking areas, and sidewalks — anyplace falling limbs could injure people or damage property.

Eliminate branches Eliminate branches that interfere with street lights, traffic signals, and overhead wires. REMEMBER, DO NOT attempt to prune near electrical and utility wires. Contact utility companies or city maintenance workers to handle it.

Prune branches that obscure vision at intersections.

For security purposes, prune shrubs or tree branches that obscure the entry to your home.

Pruning begins at planting time

Pruning is really the best preventive maintenance a young plant can receive. It is critical for young trees to be trained to encourage them to develop a strong structure. Too many young trees are pruned improperly or not pruned at all for several years. By then it may become a major operation to remove bigger branches, and trees may become deformed. At planting, remove only diseased, dead, or broken branches.

Begin training a plant during the dormant season following planting.

Prune to shape young trees, but don't cut back the leader.

Remove crossing branches and branches that grow back towards the center of the tree.

As young trees grow, remove lower branches gradually to raise the crown, and remove branches that are too closely spaced on the trunk.

Remove multiple leaders on evergreens and other trees where a single leader is desirable

Pruning young shrubs is not as critical as pruning young trees, but take care to use the same principles to encourage good branch structure.

When planting bare root deciduous shrubs, thin out branches for good spacing and prune out any broken, diseased, or crossing/circling roots.

When planting bare root deciduous shrubs for hedges, prune each plant to within 6 inches of the ground.

Newly planted shrubs require little pruning if they were container-grown or were dug with a soil ball.

Pruning hedges

After the initial pruning at planting, hedges need to be pruned often. Once the hedge reaches the desired height, prune new growth back whenever it grows another 15-20cm. Prune to within 5cm of the last pruning. Hedges may be pruned twice a year, in spring and again in mid-summer, to keep them dense and attractive. Prune hedges so they're wider at the base than at the top, to allow all parts to receive sunlight and prevent legginess.

Renewal pruning for older or overgrown shrubs:

Every year remove up to one-third of the oldest, thickest stems or trunks, taking them right down to the ground. This will encourage the growth of new stems from the roots. Once there are no longer any thick, overgrown trunks left, switch to standard pruning as needed.

Pruning evergreens:

With few exceptions, evergreens (conifers) require little pruning. Different types of evergreens should be pruned according to their varied growth habits.

Spruces, firs and douglas-firs don't grow continuously, but can be pruned any time because they have lateral (side) buds that will sprout if the terminal (tip) buds are removed. It's probably best to prune them in late winter, before growth begins. Some spring pruning, however, is not harmful.

Pines only put on a single flush of tip growth each spring and then stop growing. Prune before these "candles" of new needles become mature. Pines do not have lateral buds, so removing terminal buds will take away new growing points for that branch. Eventually, this will leave dead stubs.

Pines seldom need pruning, but if you want to promote more dense growth, remove up to two-thirds of the length of newly expanded candles. Don't prune further back than the current year's growth.

Arborvitae, junipers, yews, and hemlocks grow continuously throughout the growing season. They can be pruned any time through the middle of summer. Even though these plants will tolerate heavy shearing, their natural form is usually most desirable, so prune only to correct growth defects.

Activity – On your own

Walk around outside and see if you can find any plants that need pruning and then give reasons why you think these plants should be pruned

When would you need to prune a plant?

List the reasons why you should prune your plants

Explain how pruning encourages new growth and flowers

USING THE CORRECT TOOLS FOR PRUNING

TIME: 60 MINUTES **ACTIVITY: SELF & GROUP**

The right tools make pruning easier and help you do a good job. Keeping tools well-maintained and sharp will improve their performance. There are many tools for pruning, but the following will probably suffice for most applications:

A good pair of **pruning shears** is probably one of the most important tools. Cuts up to 2cm in diameter may be made with them.

Pruning Shears

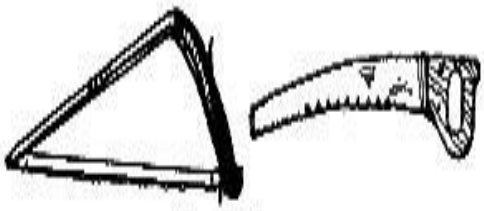
Lopping shears are similar to pruning shears, but their long handles provide greater leverage needed to cut branches up to 11/2 inches in diameter.

Lopping Shears

Hedge shears are meant only for pruning hedges, nothing else. They usually cut succulent or small stems best.

Hedge Shears

Hand saws are very important for cutting branches over 1 inch in diameter. Many types of hand saws are available. Special tri-cut or razor tooth pruning saws cut through larger branches — up to 4 inches in diameter — with ease. **Pole saws** allow for extended reach with a long handle, but they must be used carefully as it's difficult to achieve clean cuts with them.



Hand Saws

Small **chain saws** are available for use on larger branches. Operators must wear protective clothing and exercise caution when using them. Never use chain saws to reach above your shoulders, or when you are on a ladder.

Although pruning is the cutting away of any unwanted part of the plant, you need to use special tools for the job because some tools can cause bruising and ragged cuts on the plant stem and it through these ragged cuts that diseases and pests can enter and cause damage and even death to your plants. Let's take a look at the different types of pruning tools that you can use.

Pruning Tools

Tool	Use	Description
Secateurs or Pruning Shears	To prune a wide range of small plants stems like those of rose bushes which are up to 15 mm in thickness depending on the hardness of the plant's stem, for example if the stem of your plant is very hard, you will need to use a lopper or if the stem of your plant is very soft you may be able to cut thicker stems. To deadhead flowers that have finished flowering.	Secateurs are quick and easy to use. They come in different sizes, shapes and colour, for example some secateurs: • Have plastic coated, contoured hand grips and spring loaded handles for easy grip and use. • Are made for right handed people, others are made for left handed people. Their blades are usually high quality steel and attached to a swivel section. **Bypass secateurs -** This type of secateur has two curved blades that cut in a scissor-action where one blade passes the other. **Anvil secateurs -** This type of secateur has one blade that cuts down against a bar of softer metal.
Pruning knife	To prune a wide range of small plant stems, like rose bushes which are up to 15 mm in thickness, depending on the hardness of the plant's stem, for example if the stem of your plant is very hard, you will need to use a lopper or if the stem of your plant is very soft you may be able to cut thicker stems. To dead head spent flower heads.	Pruning knives rely on the sharpness of the blade to make a very clean cut, with the stem of the plant being hooked by the knife while the cut is made. Pruning knives are mostly used by experienced pruners and are not often used by home gardeners. The pruning knife blade can be either straight or curved and they come in many different sizes, with some pruning knives having blades that fold back into the handle.
Loppers	Depending on the size of the lopper, they can be used to prune plant stems ranging from 25 mm up to 40 mm thick without having to use a saw. Again this will depend on the hardness of the plant's stem, for example if the stem of your plant is very hard, you will need to use a saw or if the stem of your plant is very soft you may be able to cut	Loppers are just oversized secateurs with longer handles and they come in many different sizes. Their long handles allow for good leverage and they easily and cleanly cut the stems of plants. Loppers are also available in **bypass** or **anvil** types. **Tree loppers** are also available. These are often attached to a long pole and have rope pulleys that you pull on to create the cutting action.

Tool	Use	Description
	thicker stems.	
Hedge shears	Hedge shears are good for trimming hedges and other plants that have plant stems thinner than the thickness of a pencil. Some hedge shears have a notch at the base of the blade that allows for the cutting of slightly thicker stems. If the stems of your hedge are very hard you might need to use a powered hedge shears.	Hedge shears have high-quality steel blades which work in a scissor action and come in many different styles. Try and choose a tool that is light and comfortable to work with. The hand grips on the handles of the hedge shears are often covered with rubber which helps to ease the jolting action on the wrists that results from the repeated cutting action when opening and closing the blade (i.e. when using them). **Powered hedge clippers -** Powered hedge clippers are either battery rechargeable or electric powered and often have blades on both sides.
Pruning Saws and Bows	Pruning saws are used to prune large plants stems up to 50 mm thick. depending on the hardness of the plant's stem, for example if the stem of your plant is very hard, you will need to use a bow saw or if the stem of your plant is very soft you may be able to cut thicker stems. Bow saws can prune plant stems larger than 75 mm, depending on the hardness of the plant's stem, for example if the stem of your plant is very hard, you will need to use a motorized saw or if the stem of your plant is very soft you may be able to cut thicker stems.	Pruning saws are available in different sizes and styles. Some saws can be used in the narrow spaces and angles between plant stems. **Folding saw -** These saws when they are unfolded are usually about 40 cm or longer. They are easy to carry and the teeth of the blade cut on both the push and pull strokes. **Saws with curved blades -** These saws cut on the pull stroke and their tapered and pointed blade allows them to cut in narrow spaces. These are widely used and often called Grecian saws. **Saws with straight blades -** Depending on the size of the saw, these saws can easily cut stems bigger than 75 mm. The blades often have teeth on both sides of the saw and so you need to be careful not to cut other stems on your plants with the teeth on the opposite side of the saw. **Bow saws -** These saws have blades that are tensioned and can vary in length from 30 to 90 cm.
Gloves	All types of pruning.	When pruning it is always a good idea to wear gloves, especially when pruning thorny shrubs. Some gloves have long cuffs that will also protect your arms.

Choosing your tools

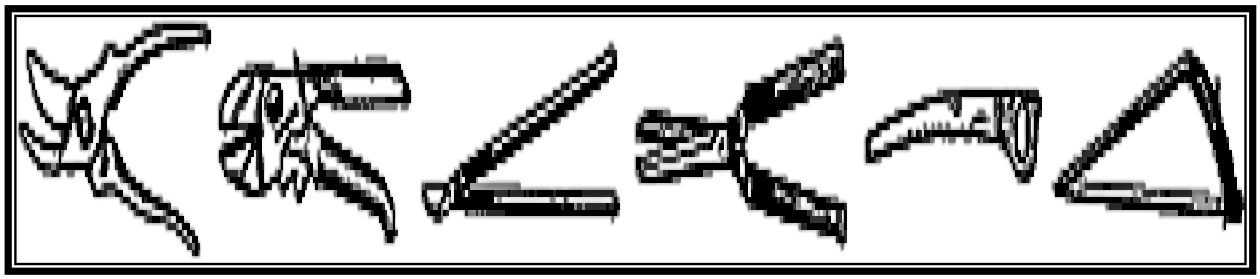
Always choose a pruning tool that is sharp and can easily cut through the size and the thickness of the stems, shoots, flowers or leaves that you want to prune. Don't try to cut through stems that are too thick or hard for the tool because this will strain your pruning tools and cause bruising and raged cuts on you plants, especially when the tool is being twisted and forced to cut. Remember it is through these ragged cuts that pests and diseases can enter your plants and cause damage.

Always check that the pruning tools you are using:

- Are clean and have been sterilized with alcohol or spirits because diseases can be spread from one plant to another plant during pruning.
- Are rust free because rust can damage the blades of your tools and damaged tools can cause injury to yourself or others.
- Have no broken parts and that fittings and protective covers are tightly attached, so that you do not cause an injury to yourself or others.
- Have no chipped blades which can cause an injury to yourself or others.
- Have no unsafe mechanisms on the tools which can cause an injury to yourself or others.

Activity – On your own

In the picture below there are 6 pruning tools. Start by identifying each of them and then explaining what they are used for, and lastly explaining the various safety measures which must be taken when using each of them:



Tool	Uses	Safety measures

USING THE CORRECT PRUNING TECHNIQUE

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

Well pruned shrubs and trees are a hallmark of a carefully tended yard or garden. Foundation plantings are lush and full, and blooming shrubs display their blossoms on shapely branches that accentuate each plant's unique style.

In addition to proper planting, watering, and fertilizing; pruning is an important practice for promoting plant health and enhancing the natural size and shape of landscape plants. Pruning is easy—a basic understanding of plant growth, and a few simple techniques, and you'll be ready to go.

Tools

Most pruning tools have an arc-shaped blade, which makes short work of slicing through small branches. "Scissor action" pruners involve two sharp blades sliding past each other "Anvil cut" pruners have one blade slicing against a wide, flat surface. While scissor action pruners are more expensive, they usually make the cleanest, closest cuts.

Hedge clippers have long, straight blades. They are used for cutting small, green branches and tips and are best reserved for shearing formal hedges. Pruning saws come in a variety of shapes and sizes, with blades designed for larger branches and small trunks. Make sure blades are kept sharp and oil them periodically. To prevent the spread of plant diseases, clean and disinfect pruning tools after use.

Proper Timing

Spring-flowering shrubs, such as these, should be pruned immediately after blooming:

- Andromeda
- Azalea
- Chinese Redbud
- Fringe Tree
- Kerria
- Mock Orange
- Philadelphus
- Pieris
- Roses
- Spiraea (early varieties)
- Mountain Laurel
- Viburnum
- Syringa (Lilac)
- Japanese Quince
- Pearlbush
- Star magnolia
- Weigela
- Rhododendron
- Deutzia
- Forsythia
- Lonicera

Shrubs that bloom in summer and autumn, and shrubs grown primarily for their foliage, can be pruned in early spring, before growth starts:

- Abelia
- Callicarpa (Beauty Berry)
- Hydrangea
- Spirea (late varieties)
- Summersweet
- Crape Myrtle
- Snowberry
- Barberry
- Lagerstroemia
- Boxwood
- Buddleia (Butterfly Bush)
- Clethra
- Hypericum
- Bluebeard
- Shrub Althea
- Coralberry
- Chaste Tree
- Hibiscus
- Privet
- Ilex (Holly)

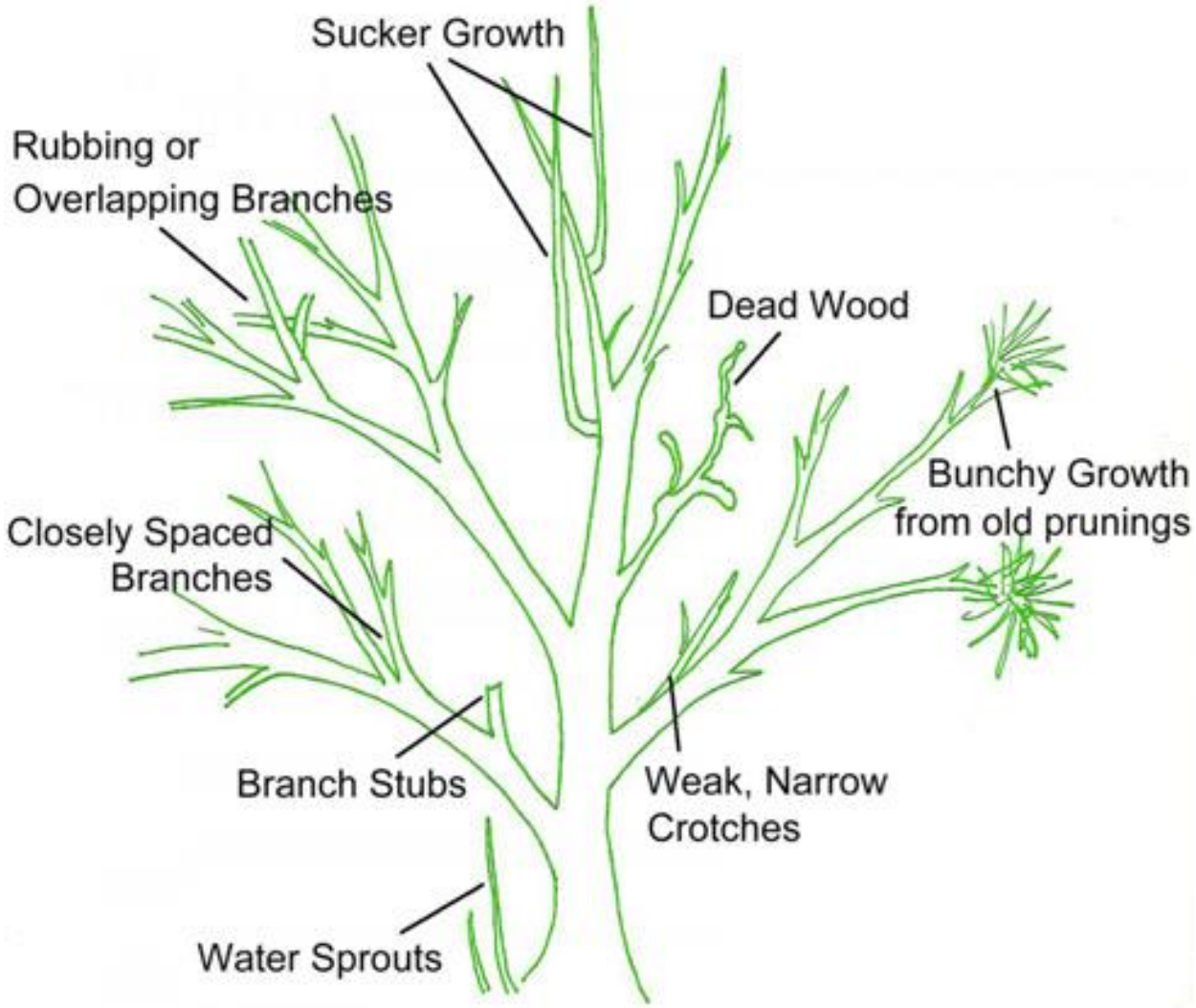
The soft, green growing tip of a branch is called the “terminal bud.” This bud produces a hormone that affects the growth of side branches. The biology of basic pruning is simple: if you remove the terminal bud, the lateral buds below your cut will be stimulated to grow into more branches. If you leave the terminal bud, the branch will grow longer instead of thicker.

Choosing the Branches

Start by removing any of the branches illustrated below that don't belong. Next, look at your shrub with a critical eye while considering the following questions:

- What is this shrub's natural size and shape (rounded, arching, tree-like)?
- What is the design purpose of this shrub (hedge, foundation planting, specimen plant)?
- Does the plant growth need to be influenced to achieve that purpose?
- Is the shrub healthy and growing evenly?

A well-pruned shrub looks natural, and in most cases doesn't look like it has been pruned at all. If a shrub's natural shape does not suit your taste or needs, consider moving it and planting one that is better suited for that location.



Making the Cuts

There are five basic techniques for pruning shrubs. Most pruning jobs will involve a combination of techniques.

1. **Pinching back:** Simply use your fingers to pinch off the terminal bud of the branch. This will encourage lateral branches to form and can be a great way to prevent more pruning later on.
2. **Heading back:** This method removes the terminal bud, resulting in more branches. Cut the branch at an angle, about ¼" above a branch bud and sloping down and away from the bud. The branches about 6" to 8" below your cut will be stimulated the most, so keep that in mind when choosing where to cut. The bud nearest the cut determines the direction the branch grows, with the outward facing bud usually resulting in the best shape. If a heading cut is made in the middle of a branch with no bud, the result will be a flush of growth at the site of the cut.
3. **Thinning:** Thinning involves removing branches while leaving the terminal bud. Make the cut just outside the branch collar, which is the bulge where the branch meets the stem, but don't leave a stub. Thinning can produce a more open, shapely plant, without altering its overall size, shape, or growth habit.
4. **Renewal or rejuvenation pruning:** Renewal pruning involves removing the oldest stems and branches at the base, then thinning or heading back the younger stems to promote regrowth. With rejuvenation pruning, the entire shrub is cut to stubs less than 12". This drastic measure is usually done if a shrub has become an overgrown, tangled mass that is not blooming well.
5. **Shearing:** Shearing involves trimming off the tips of branches and is best used only for formal hedges. Shearing alters the shrub's natural shape and promotes thick growth only on the exterior of the plant, which results in dead foliage and lack of growth on the interior branches.

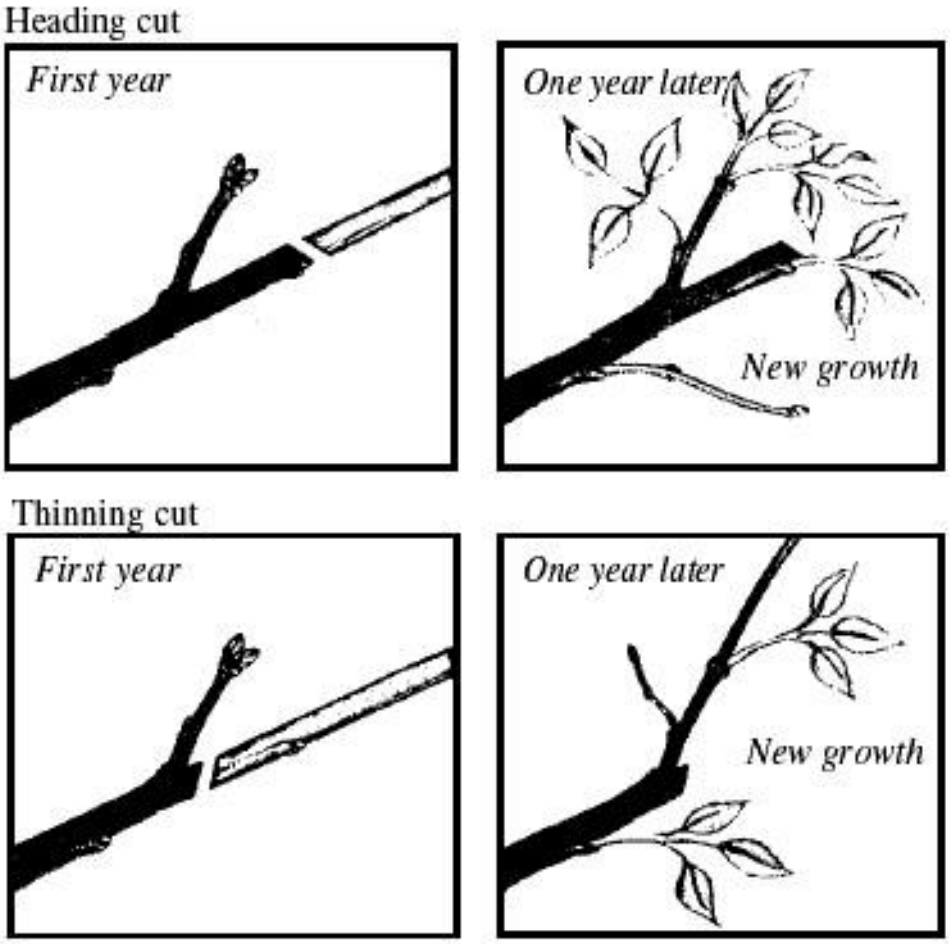
For most shrubs, pruning is a forgiving task – once you learn how each plant grows, you can correct previous pruning mistakes as you go. With a little practice, pruning becomes intuitive and is a quick way to revitalize your yard or garden.

Shrubs, like most plants, come in all many of shapes and sizes. Depending on a shrub's individual growth habit, and the tastes of the individual gardener pruning will be approached in a varied manner.

Growth Habit

Understanding the natural "habit" or shape of shrubs will help you determine how to prune them. All shoots grow outward from their tips. Whenever tips are removed, lower buds are stimulated to grow. Buds are located at nodes, where leaves are attached to twigs and branches. Each node produces from one to three buds, depending on shrub species.

Shrubs have mounding, cane, or tree-like growth habits. Those with mounding habits, such as evergreen azalea and spirea, generally have soft, flexible stems, small leaves, and are often used in mass plantings. Shrubs with cane habits include forsythia and nandina. These shrubs spread by sending up erect new branches, called canes, from their base. Tree-like shrubs have woodier, finely divided branches. Witch hazel and rhododendron are examples of shrubs with tree-like habits.



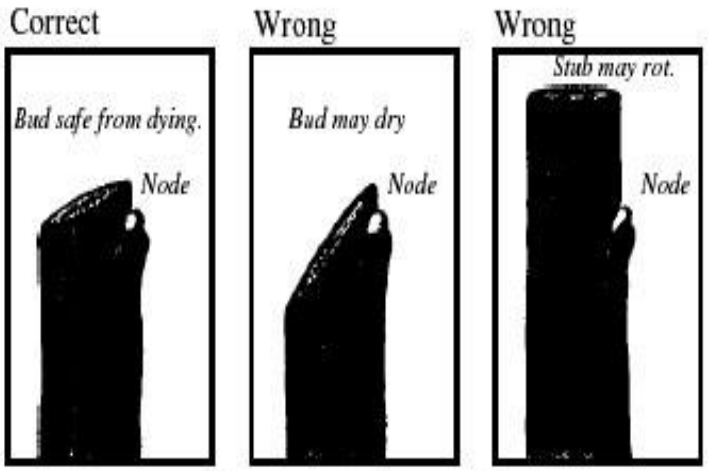
Heading and thinning cuts

Heading and thinning cuts have different effects on subsequent growth.

How to Prune

There are two basic types of pruning cuts: heading cuts, and thinning cuts. Heading cuts stimulate growth of buds closest to the wound. The direction in which the top remaining bud is pointing will determine the direction of new growth. Make heading cuts selectively to reduce shrub height and retain natural form. Non-selective heading cuts made indiscriminately will stimulate rapid regrowth from buds below the cut. These vigorous shoots are unattractive and make shrubs bushier, but not smaller. Non- selective heading cuts are only justifiable when using hedge clippers on a hedge or topiaried shrub.

Thinning cuts remove branches at their points of origin or attachment. Used in moderation, thinning cuts reduce shrub density without stimulating regrowth.



Proper pruning angle

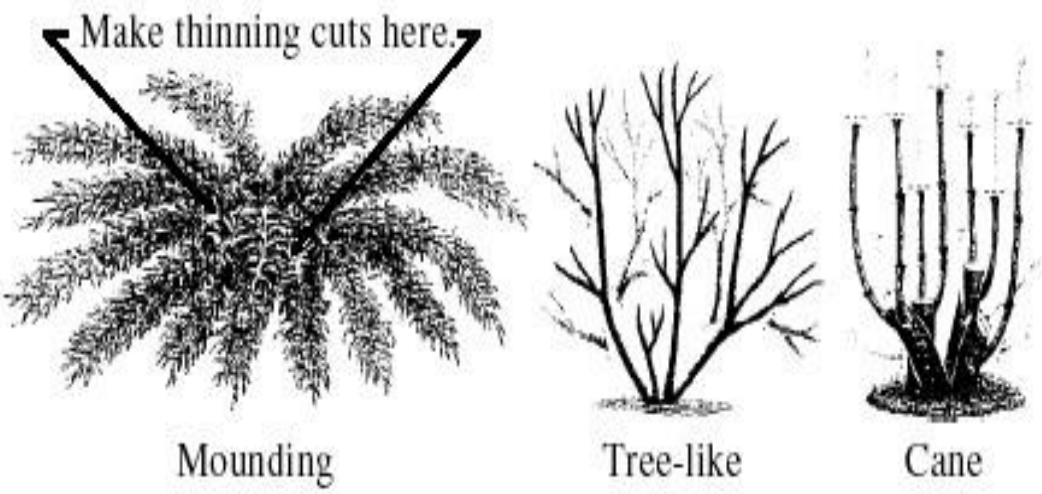
Make pruning cuts correctly. For heading cuts, prune 1/4 inch above the bud, sloping down and away from it. Avoid cutting too close, or steep, or the bud may die. When pruning above a node with two or more buds, remove the inward-facing ones. Make thinning cuts just above parent or side branches and roughly parallel to them. Don't coat pruning cuts on shrubs with paint or wound dressing. These materials won't prevent decay or promote wound closure.

Maintenance Pruning

Deciduous shrubs require maintenance pruning to keep them healthy and in scale with their surroundings. Maintenance pruning practices should begin at the time of planting, or after rejuvenation of older shrubs. Always remove dead, diseased, or broken branches promptly. When pruning dead or diseased branches, make thinning cuts into healthy wood, well below the affected area. Disinfect tools between each cut with products such as "Lysol," "Listerine," or rubbing alcohol. Tests have shown that "Pine-Sol" and household bleach are highly corrosive to metal tools.

To reduce the height of shrubs with a cane habit, first remove the tallest canes by cutting or sawing them out near ground level. Then, thin out any canes crowding the center, as well as those growing in an unwanted or unruly direction.

For height maintenance of mounding-type shrubs, prune only the longest branches. Make thinning cuts well inside the shrub mass where they won't be visible. This method reduces mounding shrubs by up to one-third their size without sacrificing their shape.



Shrubs with a tree-like habit are the most difficult to shorten. After removing any rubbing branches, prune to open up the center of the shrub. Keep the crown open and maximize light penetration by careful use of thinning cuts. Prune branches that touch the ground and suckers originating from the roots. Wait until the very end of the job to make any heading cuts. Tree-like shrubs can usually tolerate removal of one-eighth to one-fourth of their branches.

Rejuvenation Pruning

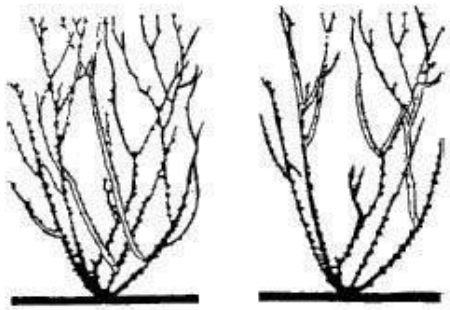
Older shrubs often grow out of proportion with their surroundings, and may have large amounts of unproductive wood. Two techniques are used to restore old shrubs, provided they still have sufficient vigour and are growing in a favourable location. Keep the following in mind with rejuvenation pruning:

1) Select an appropriate species. Not all shrubs respond well to drastic pruning.
2) Observe proper timing. The preferred time for renovative pruning is just before bud break in early spring.
3) Give extra care to heavily pruned shrubs. Fertilization, watering, and pest control will be critical factors.
4) Consider the shrub's new appearance. What will be the immediate impact on the landscape?

The first technique involves complete removal of the entire plant 18-25cm inches above the ground. Use heavy lopping shears and a pruning saw. Remove half of the new canes that develop by mid- summer, and head back some of the remaining canes. When using a heading cut, be sure to prune to outward-pointing buds so that the inner portion does not become too dense. Shrubs that tolerate extensive rejuvenation are: abelia, dogwood, honeysuckle, hydrangea, lilac, mallow, rose-of-Sharon, spirea, and St. John's wort (hypericum).

Extensive rejuvenation

The second technique for shrub rejuvenation removes growth more gradually. The first year, remove one-third of the oldest, unproductive branches. The next year, take one-half of the old, lingering stems. Finally, in the third year, prune out the remainder of the old branches. New, productive stems should quickly replace the old wood. This method takes longer to complete, but the shrub stays more attractive throughout the rejuvenation period.



Unpruned shrub Gradual rejuvenation

When to Prune

Pruning at different seasons triggers different responses. Late winter or early spring, before bud break, is usually the best time to prune many species because new tissue forms rapidly. However, pruning should be delayed for most spring-blooming shrubs until immediately after flowering to avoid reducing the floral display. Summer pruning tends to suppress growth of both suckers and foliage. Summer-blooming shrubs should be pruned in early spring prior to bud set, or in summer immediately following flowering.

Late summer or early fall pruning causes vigorous regrowth, which in some cases may not harden off by winter, leading to possible cold damage. Whenever unexpected damage from vandalism or bad weather occurs, prune at once.

Pruning Cuts

Although pruning is the cutting away of any unwanted part of the plant, you can't just cut anywhere on the plant as this can cause your plants to die back. To know how to prune so that your plants will thrive and flourish, you need to understand how your plants grow.

How plants grow

Plants have terminal/apical buds at the tip of their stems and when you prune these away, the lateral (side) buds along the stems, below the cut, will begin to grow and the plant will lose its apical dominance. Apical dominance means that the bud at the end of the stem gets most of the plant's food supplies to encourage its strong growth but once you have pruned this bud, the plant's food supply is then sent to the lateral buds which now start to grow.

You can decide which way you want the new shoot to grow by looking at the direction in which the bud is growing/pointing. Prune the bud which is pointing in the direction that you want the new stem to grow, because the new stem will grow in the direction that the bud is pointing.

If you cut away a big piece of your plant's growth, your plants will make up for this loss by producing lots of new growth. If you only trim back a small part of your plant, your plants will produce a little new grow to make up for this loss.

But, different plants will respond to pruning in different ways, many plants, like roses can suffer dieback after pruning if the cut is not carried out sharply and correctly and so you need to know a little about the plant you are pruning to make sure that you are pruning it properly.

When is the right time to prune?

The correct season to prune is from late winter to early spring through to summer depending on the type of plant being pruned. **Deciduous plants** are best pruned during the late autumn and winter – just before the growing season. **Evergreen plants** are best pruned just before spring growth starts. It is better to prune before or at the beginning of the growing season of the plant because when the plant becomes dormant, it will not produce new growth.

For example, summer flowering shrubs should not be pruned close to the winter months when the plant will become dormant because any new shoots that do grow will be damaged by cold weather.

Light pruning can also be done during the growing season especially if you are dead heading, doing corrective pruning or decorative pruning and clipping. Corrective pruning of any kind is best done during the plant's growing season. Palms can be pruned at any time of the year because only the dead, diseased or damaged leaves are removed. If you cut off the top of the stem of a palm at any height the plant will not continue to grow.

Types of Pruning Cuts

The straight cut

There are two main ways to use the straight cut:

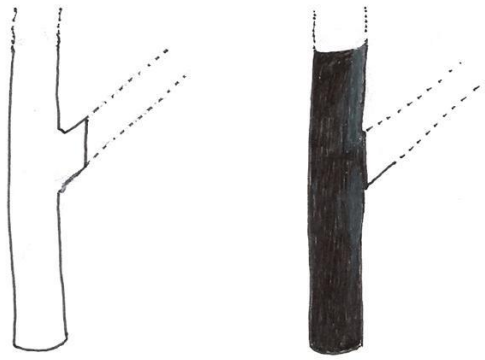
- To remove an entire branch or
- To cut above a pair of buds on a plant that has opposite buds.

Let's take a look at both these ways in more detail.

Removing an entire branch

If you are pruning a stem at the point it joins a larger stem, you need to make a clean cut by cutting the stem off as flush as possible so that no stump remains. If you are cutting the stem with secateurs remember to hold the flat side of the secateurs against the stem and not the rounded side. Try to cut the stem off just outside the stem collar, which is the slightly swollen area at the base of the stem where the stem joins the main stem because this collar serves as the plants natural defense against infection. The plant wound will also be smaller beyond the collar.

The basic rule of pruning is not to leave stubs (often referred to as "coat hangers"), on the plant because this allows diseases and insects to invade your plant.



Straight cut for removing entire stems

Picture A. Incorrect method of leaving a "coat hanger"

Picture B. Correct cut just beyond the collar and almost flush with the stem

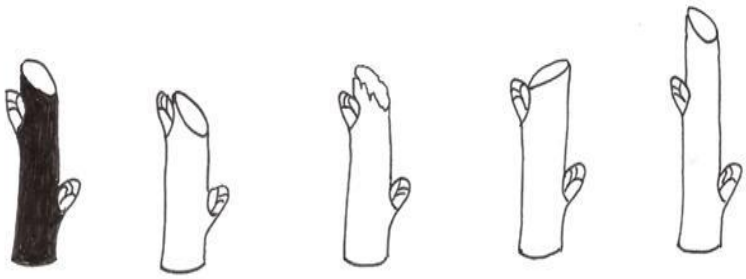
Pruning above opposite buds

The other use of the straight cut is to prune plants that have opposite buds. Choose healthy, strong buds and cut back above a pair of buds.

Straight cut for pruning opposite buds

The slanted cut

As you have seen, when you prune you need to cut back to a bud. Select a healthy, strong outward facing bud or a bud that faces in the direction that you want the shoot to grow in. Cut about 8 mm above the bud at a slant of 45 degrees. The cut should not slope towards the bud, but away from the bud, especially where the stem is upright and the cut should be clean.



Slanted cut used in pruning plants with alternate buds

- Picture A. The correct cut, where the bottom of the cut is in line with the bud
- Picture B. Incorrect cut – cut too close to the bud – it may damage the bud
- Picture C. Incorrect cut – cut ragged i.e. not a clean cut
- Picture D. Incorrect cut – the slant is angled in the wrong direction i.e. because the water will run off the cut and onto the bud
- Picture E. Incorrect cut – cut is too far from the bud, the stub will die back and encourage disease to enter

Position to prune plants with alternate buds

Where the buds on the stems are alternate sides, select a bud (normally an outward facing bud) and slant the cut above the bud using the slanted cut. The 45 degree slope of the cut will allow water to run off the cut and stop water from collecting on the cut which could help disease to enter your plant. Remember, the slope of the cut will also face away from the bud and be almost level to 3.5 mm above the bud at the base of the cut and about 8 mm above the bud at the top of the cut.

Pruning Hedges

There are two styles of hedges; formal and informal.

- **Formal hedges** need regular trimming or clipping to keep them in shape.
- **Informal hedges** are far looser and only need to be pruned now and again to stop them from becoming overgrown with long straggly shoots. Informal hedges are not as neat as formal hedges but can look very attractive especially when they are flowering or bearing fruit, like berries.

The style of hedge you choose will depend on their purpose.

- Small formal hedges are often used decoratively to accentuate and frame an area.
- Larger formal hedges are often used as boundaries for screening and even protection (especially where plants with thorns are used).
- Informal hedges are also used as a divisions or screening ability in a garden but are used in a more natural landscaped setting and are often selected for the beauty of their flowers or fruit.

The width of the hedge is normally kept as narrow as the particular plant's growth will allow without wasting space in the garden. Effective hedging that has well knitted, dense growth relies on a sufficient framework of stems to make it look full, so as with height the type of plant and its branching habits will determine how narrow or wide you will be able to make the hedge (normally this is between half to just over three quarters the natural mature width of the plant).

Clipped or formal hedge plants

Hedges can be made from both evergreen and deciduous plants, but whatever plant you choose to grow and prune into a hedge, make sure that the plants:

- Have a long lifespan.
- Are hardy and can survive in the coldest temperatures for the region. If plants are damaged by cold temperatures, it will be difficult to keep the hedge at a uniform shape and size.
- Respond well to pruning, by shooting in great amounts from below the cut stems and twigs to form bushy growth.
- You choose can grow as high as you want them to grow. Formal hedges can vary in size, the smallest being as small as about 10 cm high to large hedges of 3 metres or more, depending on their purpose. The type of plant and its mature height will determine the range of heights that the hedge can be pruned to with good effect i.e. not so tall that the hedge looks sparse and not too short, where the hedge is very woody (mainly consisting of large thick stems). Each type of plant will have a range of

heights that will best suit their growth habit and this is normally from about half of their mature height upwards to almost the full mature height, depending on their branching habit.

Some examples of formal hedge plants

Plant	Deciduous or Evergreen	Size of hedge: Small = up to 1m Medium = 1m to 2m Tall = taller than 2m
Lavandula	Evergreen	Small
Escallonia	Evergreen	Small to medium
Myrtus communis	Evergreen	Small to medium
Buxus	Evergreen	Small to medium
Duranta	Evergreen	Small to medium
Abelia grandiflora	Evergreen	medium
Prunus laurocerasus	Evergreen	medium
Eleagnus	Evergreen	medium
Dodonaea viscosa	Evergreen	Tall
Photinea glabra	Evergreen	Tall
Syzigium paniculata	Evergreen	Tall
Camellia japonica	Evergreen	Tall
Camellia sasanqua	Evergreen	Tall
Cupressocyparis leylandii	Evergreen	Tall
Berberis	Deciduous	Small
Spirea floribunda	Deciduous	Small to medium
Ligustrum	Deciduous	Medium to tall

Pruning tools for hedges

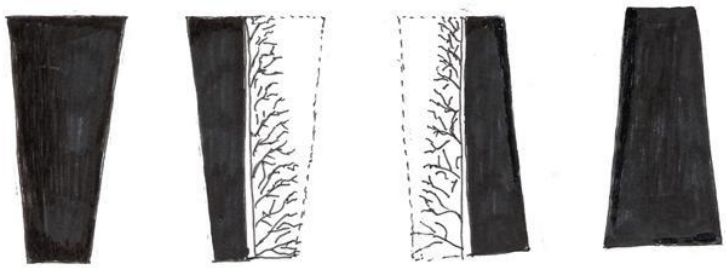
The most commonly used pruning tools for pruning formal hedges are hedge shears, electric hedge shears and secateurs. Although pruning a formal hedge with a secateur takes a long time, secateurs are the best pruning tool to use if you are pruning a hedge with large leaves like the Prunus laurocerasus, because the cut leaves will spoil the overall effect of the hedge while the secateur trims the stems/twigs and does not cut the leaves.

Pruning Hedges

Most hedges have a squared-off shape and are cut to have vertical sides and a flat top. To get the best from your hedge you should cut it in the shape of a wedge, with the bottom of your hedged being wider than the top of your hedge and with the sides of your hedge gently tapering towards the top. This shape will allow for maximum light to reach all parts of your hedge.

Often hedges become top-heavy in their wedge shape starts at the top, with the bottom of the hedge being narrower. If you have a hedge this shape you will need to correct the shape of the hedge to allow enough light into the base area of the hedge which over time will become sparsely branched or even bare. By correcting the shape of your hedge you will also prevent your hedge from being damaged by wind and storms.

Tilt the blade of your shears towards the hedge so that it is easy to keep the hedge shape tapered. Start pruning from the bottom of the hedge and prune the hedge to the width you want. Prune upwards, making sure as you go along that you are forming a wedge shape.



Picture A. This is the wrong shape for a hedge. Light and air movement are restricted and the bottom of the hedge will become bare

Picture B. Start to rejuvenate the hedge by pruning one side only, to the correct shape

Picture C. Prune the other side once the other side has recovered (normally a season later).

Picture D. the correct shape of a hedge

To rejuvenate or correct the shape of your hedge cut back one side of your hedge to the correct shape, wait for it to recover for one or sometimes even two seasons and then prune the other side in the same way.

Pruning Shrubs

Pruning of deciduous shrubs that flower from late winter to early spring:

Some shrubs as they mature start to produce fewer flowers and become very dense. If the shrub produces its flowers on previous season's wood/growth i.e. not the new spring growth as most shrubs do, then the shrub should be pruned and rejuvenated directly after flowering. The shrub will respond with new growth that will flower next year.

Example of shrubs that flower on last year's wood are:

- Deutzia
- Philadelphus
- Spirea
- Weigelia.

To prune these shrubs remove:

- Any diseased, dead, crossing, damaged stems or suckers (shoots coming up from the root stock)
- Remove any weak growth

And then stand back and by looking at the plant decide which stems should be removed or shortened in order to encourage a well-balanced framework for the plant.

- Cut or shorten some of the oldest stems by about one third and shorten shoots that have flowered to 2 to 3 buds from a side stem.
  - If the shrub is still too dense, thin out the weakest of the new shoots and only leave stems that are at least a pencil thick.

Always cut just above a vigorous side stem or strong, healthy bud facing in the correct direction, or healthy pair of buds. Don't forget to make accurate, clean cuts with sharp equipment and seal the wounds with a wound sealant.

Pruning deciduous shrubs that flower from the middle of spring to autumn

The rose is a good example of deciduous shrubs that flower from the middle of spring to autumn, however not all shrubs that flower on new wood need to be pruned every year. Some will only require rejuvenation every three to four years. Therefore, remember that pruning must have a purpose.

When pruning these shrubs:

- Remove any diseased, dead, crossing or damaged stems.
- Remove any weak growth.

Stand back and looking at your plant, decide which stems should be removed or shortened in order to encourage a well-balanced framework for the plant. In this case you want to produce a low framework of main stems, from which shoots will grow and produce flowers.

- Cut back the strong previous seasons stems left on the plant to about a third of their size. Cut back to a strong bud (– often about 3 buds from the base).
- In the case of rose pruning, in order to allow light into the middle of the plant try to create a vase shape as a guideline to shaping the framework stems i.e. don't encourage new shoots to face inwards.

Always cut just above a vigorous side stem or strong, healthy bud facing in the correct direction, or healthy pair of buds. Don't forget to make accurate, clean cuts with sharp equipment and seal the wounds with a wound sealant.

Pruning evergreen shrubs

Most evergreen shrubs are naturally quite bushy and do not need much more than minor pruning. Pruning should take place in the growing season and again you need to:

- Remove dead, diseased or weak growth at any time of the year.
- Remove spent flowers after flowering.
- Only remove any growth damaged by cold weather (frost or winds) once the signs of the last frosts are passed, don't cut back too early in late winter and spring as this will encourage new growth that may become damaged by late cold spells in early spring. In the same way, pruning too close to winter will produce soft new growth that will damaged by cold winters.
- Some evergreen plants like Santolina will take to pruning the plant back heavily but most evergreens will not.
- Lanky shoots that affect the shape of the plants are best removed or cut back.

Pruning variegated shrubs

The general pruning of variegated shrubs is not different to pruning any other deciduous or evergreen shrub if the leaves of your shrubs are all uniformly variegated but sometimes the leaves on stems of variegated shrubs can revert back to the original green leafed species. When this happens, remove the entire non-variegated stem at its base where it joins a larger stem or the main stem (normally it is an entire stem that has reverted). If you don't remove these stems eventually the shrub will become almost entirely green. Use the straight cut to remove these stems.

Activity – On your own

Explain the differences between pruning:

- Deciduous shrubs that flower from late winter to early spring.
- Deciduous shrubs that flower from middle spring to autumn.
- Evergreen shrubs.
- Variegated shrubs

Activity – On your own

Part 1 - Identify the correct methods for pruning an evergreen shrub

Part 2 - Explain the differences between pruning:

- Deciduous shrubs that flower from late winter to early spring.
- Deciduous shrubs that flower from middle spring to autumn.
- Evergreen shrubs

Activity – On your own

Part 1 - Identify the correct methods for prune deciduous shrubs as well as the reasons why the particular shrub should be pruned.

Part 2 - Explain the differences between pruning:

- Deciduous shrubs that flower from late winter to early spring.
- Deciduous shrubs that flower from middle spring to autumn

Maintenance of Tools

After using your tools and before you pack them away for the day, you need to make sure that they are:

- ***Clean and sterilized*:**

  All tools should be carefully washed down after use, especially where they may have soil on them, for example when you have done some root pruning. If you have been pruning diseased plants, make sure that you clean and sterilise your pruning tools before you prune other plants, so that you do not spread the disease to your other plants. Tools should be dried and then sterilized with either alcohol or methylated spirits.

- ***Sharp*:**

  Keep your pruning tools sharp at all times and always check that your blades are sharp enough to do the next job. There are many different ways to sharpen pruning tools and how you go about sharpening them will depend on what type of pruning tool you are using, so always check with your supervisor. Remember that tools that are not sharp can bruise and damage the plants being pruned and this will allow insects and diseases to attack your plants.

- ***Rust free:***

  Where necessary rub oil into the blades and other metal pieces to prevent your tools from rusting, especially when you are using them in rainy weather.

- ***Safe for future use:***

  Check that your tools have no chipped blades or broken parts because these tools can be dangerous and lead to injuries. If your tools are broken, hand them to your supervisor for fixing, don't pack them away.

Storage and protection of tools

All pruning tools should be packed away after use, making sure that the blade faces into the shelf. Blades that do not have protective covers must face into the shelf because they can cut or hurt anyone entering into the area. Make sure that anyone else using the area will not cut their hand when reaching out for the tool to remove it from the shelf. To protect your tools, always oil your tools after use by applying 3 in 1 oil to the swivel section of secateurs and loppers for smooth operating ability.

Where necessary rub oil into the blades and other metal components that require this for the prevention of rust and then cover them with their protective covers. Store your tools under lock and key, in a cool, dry place. Don't leave your tools lying out in the rain because they will rust and this will cause your tools to break, become blunt and can cause injury to yourself or others.

Activity – On your own answer the following questions

Describe the condition that tools should be restored to after pruning

Explain the reasons why tools must be kept in these conditions and how it can affect the tools' performance if they are not kept in this condition

Explain the ways in which tools which are not kept in optimal condition can cause injury to the people using them

You are now ready to go through a check list. Be honest with yourself.

Tick the box with either a √ or an X to indicate your response.

- ☐ **I am able to use pruning techniques to achieve optimum growth and flowering of shrubs and herbaceous perennials**
- ☐ **I am able to rejuvenate shrubs and trees by applying the appropriate pruning techniques**
- ☐ **I am able to conduct formative pruning to create the desired shape**
- ☐ **I am able to apply post pruning care to plants**

You must think about any point you could not tick. Write this down as a goal.

Decide on a plan of action to achieve these goals. Regularly review these goals.

My Goals and Planning:

_____
_____
_____
_____
_____
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_____

UTILIZE IRRIGATION EQUIPMENT AND OPERATE MANUAL SPRINKLER SYSTEMS

264017

A person credited with this unit standard will be able to:

- Select the most suitable equipment for watering plants and landscapes.
- Operate a manual irrigation system effectively.
- Control the length of a cycle to ensure that the correct amount of water is applied to the planted areas.
- Perform basic maintenance on sprinklers and irrigation piping.

Training Provider Accreditation Number: AGRI/c prov/0282/10

NPO Registration Number: 030-972

WATERING EQUIPMENT

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

Watering equipment

Choosing the correct watering equipment for the purpose is very important to ensure that the watering process occurs naturally and that there is as little possible loss or waste of water in the watering effort. Equipment for delivery of landscape irrigation water ranges from automated in-ground sprinkler systems and drip irrigation systems to hose-end watering. A basic outline of each with their strengths and limitations follows.

In-Ground Sprinklers

Different types of irrigation equipment are most effective to water various types of planting in the home landscape. For lawns, sprinkler irrigation with pop-up spray heads and rotor heads are generally used. Because each type of sprinkler delivers water at a different rate, do not mix sprinkler types in a zone. All sprinkler systems must comply with local building codes, requiring building permits and inspection. In-ground sprinkler systems have the following basic components.

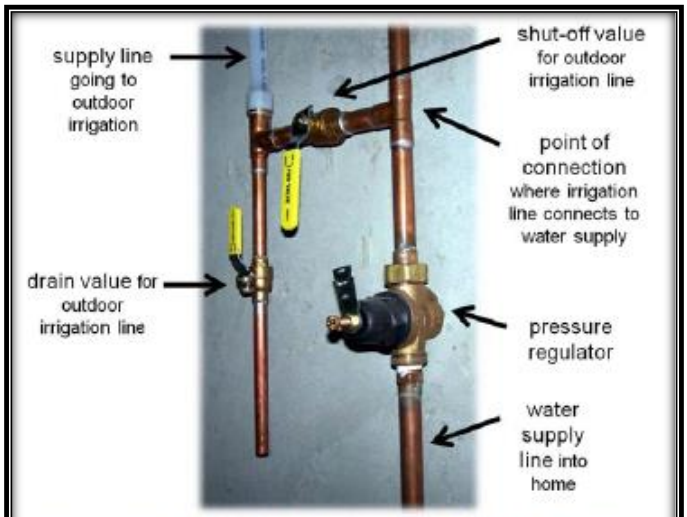


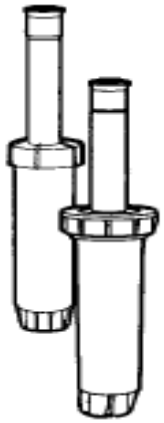
Figure 1. Point of connection with pressure regulator, shut-off value for outdoor line and drain valve that drains the outdoor line to the backflow prevention device (located just outside the house).

Point of Connection – The system starts at the point of connection where the supply line connects to the water supply. This is in the basement of the typical house. The size of the pipe and water pressure determines water flow and thus influence design of the system (how many heads can run at one time). A pressure regulator provides uniform, lower water pressure for uniform water delivery. This is typically found just before the point of connection. It should be set at 30 to 40 psi for the landscape irrigation system and household water use.

Sprinkler systems have maintenance problems and values may fail to shut off when the pressure is above 80 psi. Pressure regulators are typically not found in older homes. Due to increased uniformity of water delivery, adding a pressure regulator may result in significant water savings in landscape irrigation.

Pop-Up Spray Heads

This is a generic name for sprinklers that automatically “pop-up” with a fan-shaped spray pattern and do not rotate when running. The heads retracts by spring action when the water is turned off.



Delivery pattern - Pop-up spray heads are best suited for small to moderate sized lawns and bedding areas as well as irregular or curvilinear areas in gardens. They are most common with 5, 4, 3 and 2 meter radii. Usually the radius can be adjusted down about 30% of the amount indicated on the nozzle, using the screw on the nozzle. Therefore a commonly available 3 meter spray nozzle can be reasonably adjusted to 2 meters. Any greater adjustment would significantly distort the pattern resulting in poor application efficiency.

The spray pattern of a pop-up spray head depends on choosing nozzles, to water quarter circles, half circles or full circles. Some manufacturers offer adjustable arch nozzles that can be set at any angle. However, do not use adjustable nozzles where a fixed nozzle could work, as the uniformity of water delivery is not as high. Some speciality patterns to handle narrow, rectangular turf areas are available. However, nozzle performance is not as uniform compared to quarter circle, half-circle or full circle nozzles.

With any given brand, spray nozzles have match precipitation rates. That is, a half circle head uses half the amount of water per hour as the full circle head. With match precipitation rates, full, half and quarter circles may be used in the same zone. It is also acceptable to mix a combination of nozzle radii in a zone.

Pop-up height – For uniform water distribution, the sprinkler heads should rise above the grass height, this makes the 12cm heads the most popular. The 30cm rising heads are more popular for areas which have ground cover and lower flower beds.

Pressure – pop-up spray heads works the best when the water pressure is around the 30-40 psi mark. The water pressure at some homes may be significantly higher, and an in-line pressure regulator will be needed in

these cases. A sprinkler producing a mist-cloud is a common symptom of excessive water pressure. This gives a distorted distribution pattern and leads to increased maintenance problems.

Small areas – small areas that are less than 3-5 meters wide are difficult to sprinkle irrigate efficiently with pop-up spray heads. Consider landscape alternative; for example, the small area between houses may be an excellent site for low maintenance, non-planted, non-irrigated mulch areas. Alternatively, the small area could be a shrub/flower bed watered with drip irrigation. A narrow water strip may be efficiently with the new sub-surface drip for lawns.

Rotor-heads

Some specialty patterns to handle narrow, rectangular turf areas are available (often called “end-strip,” “center-strip” or “side-strip” nozzles). However, nozzle performance is not ass uniform compared to quarter-circle, half-circle, or full-circle nozzles.

Rotor heads mechanically rotate to distribute the spray of water. Impact and gear-driven heads are two common types in the home garden trade. Rotor heads in the home garden trade are best suited for larger lawn areas, generally 6 to 10 meter radius and greater. Some rotor-type heads in the commercial line have a radius of 20 to 50 meters.

Impact or impulse heads rotate as the water stream coming from the nozzle hits a spring-loaded arm. Impact heads tend to experience fewer problems with marginal (dirty) water quality. Gear-driven heads use the flowing water to turn a series of gears that rotate the head.

Gear-driven heads are quieter to operate than impact heads. The spray pattern depends on the head. Most can be set at any angle from 15º up to a full circle. Some are adjusted at 15º increments. Others are designed for a quarter-circle, half-circle or full-circle spray pattern.

In rotor head design, you must not mix quarter, half and full circle patterns in the same zone. The water flow is the same for each head, but the area covered will be different. For example, a full circle (covering twice the

area of a half circle) will have half the precipitation rate of a half circle. The full circle will need to run twice as long to apply the same amount of water as the half circle.

Pressure

Rotor heads typically operate at 30 to 90 psi, 30 to 40 psi being most common for heads in the home garden trade. Better quality heads have built-in pressure regulators.

Precipitation rate

Rotors are more uniform in water distribution than pop-up spray heads and take much longer to water. As a rule of thumb, rotor heads deliver water at a rate of 2cm per hour. At the typical precipitation rate of 2cm per hour, it would take 60 minutes to apply 1cm of water. The slower precipitation rate can be an advantage on clayey or compacted soils where water infiltration rates are slow.

Strengths and Weaknesses of In-Ground Sprinklers

Strengths of in-ground sprinklers include the following:

- Convenience
- Time savings
- Usefulness for irrigating small areas
- Very efficient if well-designed, maintained and managed according to plant water needs

Weaknesses of in-ground sprinklers are that they can be very inefficient if poorly designed, maintained, or managed. Being “too” convenient, many gardeners give them little attention, significantly wasting water.

Bubblers

Small groupings of flowers and other small plants can be efficiently watered with bubblers, which flood an area and rely on the natural wicking action of the soil to spread the water. They are ideal for level shrub and ground cover areas. Heads are typically placed at 1-3 meter intervals or placed by individual plants for spot watering.

Stream bubblers are directional and come in a variety of spray patterns. Bubblers deliver water faster than drip emitters and are used to water trees and shrubs. Refer to manufacturers’ literature for design and management criteria related to various models.

Drip Systems

For flower and shrub beds, small fruits and vegetable gardens, drip emitters, drip lines, micro-sprayers, and soaker hoses are popular. Water use rates, weed seed germination, and foliar disease problems are reduced in drip systems that do not spray water into the air and over the plants and the soil surface. As a rule of thumb, a drip system coupled with mulch can reduce water needs by 50%.

Drip emitters, micro-sprayers, and drip lines require clean water, which is relatively free of soil particles, algae, and salts. In-line filters are part of the system. Water quality is generally not a problem when using potable water sources.

However, with non-potable water sources, the filtering system required may be expensive and high-maintenance, making drip impractical. However, with non-potable water sources, the filtering system required may be expensive and high-maintenance, making drip impractical. Drip systems work with lower pressures (typically around 20 psi), generally using in-line pressure regulators. The system snaps together with small fittings. No gluing or bands are required. It is much easier to work with if the tubing has been warmed by the sun for an hour.

The system is put together with half-inch and quarter-inch poly tubing, fittings and emitters. For the main line and branch lines, half-inch poly tubing is used. The quarter-inch micro-tubing serves as feeder line to individual drippers or micro-sprinklers. Ideally, the tubing is on the soil surface under thee mulch.

Drip emitters deliver water at a slow, consistent rate, such as 2, 4 or 8 liters per hour. Emitters can connect to the branch line or extend on micro-tubing out to individual plants or pots. Small annuals and perennials typically have one emitter per plan. Several would be used spaced around larger perennials, shrubs and small trees.

As a point of clarification, some gardeners mistakenly think that using 2, 4 or 8 liters per hour drippers is an effective method to manage differing water needs. Although this works to a small degree, the concept is basically flawed. The 8 liter per hour drippers will have significantly larger wetting zones than the 2 liter per hour dripper.

However, plants with the higher water needs do not necessarily have a larger root spread. Likewise, plants with lower water needs will not necessarily have a smaller root spread (in fact, a large root spread is what makes some plants more xeric). The factor missing here is irrigation frequency to match the water needs.

In-line drip tubing is a quarter-inch micro-tubing with built-in emitters spaced at 12, 24 or 36 centimetre intervals. The 36 centimetre spacing is readily available in the home garden trade. These are great for snaking through a bed area. For sandy soils, spacing of the tubing should be at 36 centimeters. For clayey soils, spacing may be at 50-100 centimeters for perennial beds.

Micro-sprayers, often held up on a spike, cover a radius of 0.5 - 6 meters. Delivery rates vary from 2mm to 30cm per hour, depending on the head selected. Because water is sprayed in the air, drift and water waste in wind resembles sprinklers more than ground-applied drip.

Micro-sprayers work with a very small droplet size that readily evaporates. For this reason, their efficiency in low humidity is questionable. Specifications on design and management vary among manufacturers and types selected. Refer to the manufacturer's literature for details. Typical run times are 60 to 90 minutes.

Drip systems are easy to automate by connecting the zones to valves and a controller (like an in-ground system for a lawn). For ease of programming to the specific watering needs of the drip system, use a dedicated controller for multiple drip zones. In small yards, a single zone or two could be added to the controller used for the lawn, but they would run on a different program than the lawn to match the different watering needs.

When connected to the garden hose, the zone can be automated with single-zone controllers that connect with hose-end fittings at the tap. Some simple models turn the water off after a set number of minutes or gallons. More elaborate battery-operated models turn the water on and off at the day and time interval set by the gardener. Like any irrigation system, drip systems require routine maintenance. They are not an install-and-forget type of system.

Soaker Hose and Soaker Tubing

The soaker hose is a different type of drip system that allows water to seep out the entire length of a porous hose. They are great for raised bed gardens and flower beds. In sandy soils, space runs at 36 centimeters. For flower and shrubs beds on clayey soil, space runs at 36-100 centimetres. In a raised bed vegetable garden (where uniform delivery to small vegetables is important), make three to four runs up and down a 1 meter wide bed. Typical run time is 10 to 20 minutes.

Quarter-inch Soaker Tubing – Quarter-inch soaker tubing is available in the drip irrigation section at garden stores. Cut the soaker tubing to desired length and connect with drip system components. An in-line pressure regulator is required; otherwise, the fitting may pop or leak. Half-Inch Soaker Hose: Some brands are a ½-inch hose that connect with a standard hose fitting. These are found in the garden hose section. It can be cut to any length and connected with garden hose fittings.

A small plastic disc fits inside the female hose connection as a flow regulator. Too adequately water the garden with the reduced water flow; it may need to run for around an hour. For better performance, use the pressure regulators with hose-end fittings found with the drip irrigation supplies. To adequately water the garden with this type of regulator, the drip line runs 10 to 20 minutes. Without a pressure regulator of some type, the soaker hose tends to rupture, sending out steams of water at spots rather than dripping along the line.

This half-inch hose style is more tolerant of small amounts of dirt, algae, or salts in the water than other types off drip systems and may be successful on some non-potable water sources. Periodically, open up the end of the hose and flush out soil deposits. Because the soaker tubing has a higher delivery rate, it cannot be on the same zone as other in-line drip tubing, button emitters, or bubblers.

Strengths and Weaknesses of drip Irrigation

Strengths of drip irrigation include the following:

- Convenience
- Water saving
- Operates with low water pressure
- Easy to change when the plantings change

- Does not require trenches for installation
- Readily automated on a multi-zone controller or single-zone controllers that connect to the faucet

Weaknesses of drip irrigation include the following:

- Require good-quality water and filtration
- Maintenance difficulty in seeing if systems are operating and need to check water delivery to individual plants
- Cost: for large areas, the cost will be significantly higher than a sprinkler system
- Unsuitable for watering large trees

Subsurface Drip

Subsurface drip is a relatively new way to water lawns and flowerbeds. Tubes are permanently buried below ground. Water soaks upward and laterally so subsurface drip works in clay-containing soils, but not well in sands.

Generally installed by a trained and experienced professional, subsurface drip requires very exact installation depth and spacing. Without proper attention to installation, the lawn becomes striped with green and dry strips. Studies being conducted find that water use is similar to a well-designed sprinkler system.

Strengths of subsurface drip include:

- Convenience
- Operation at low pressure
- Equipment located out of sight, where it is less prone to damage
- Easy to water anytime day or night, even when the lawn is being used
- Application of water directly to the root zone
- Easy to automate with soil moisture sensors
- Potential to inject fertilizers with the irrigation water

Weaknesses of subsurface drip include:

- Requires high-quality water
- Inability to see if it is operating correctly and need to dig it up if it is not
- Prohibition of inserting stakes in the ground
- Requires professional installation
- Relatively high cost

Hose-End and Hand Watering

Hose-end watering devices include various types of spray heads, water wands and water breakers, soaker hoses, and soil needles. Such devices are commonly used for temporary situations and where permanent installations are impractical or not desired.

Hose-end watering is very inefficient in uniformity of water delivery, resulting in high water use. However, significant water savings may occur because gardeners generally do not water until the lawn/garden show signs of being dry.

A common problem with hand-held water wands is that folks tend to only water the surface, rather than deep watering of the root system. Avoid soil needles because they apply the water below the primary root system of trees, shrubs, and flowers.

A hand-moved sprinkler can be automated with single-zone controllers that connect with hose-end fittings at the tap. Some simple models turn the water off after a set number of minutes or gallons. More elaborate battery-operated models turn the water on and off at the day and time interval set by the gardener.

Strengths and Weaknesses of Hose-End Watering

Strengths of hose-end and hand watering include the following:

- Relative low cost of equipment
- Ability to water plants differently and usefulness for spot watering.
- Allows for close observation that may result in more timely care of plants.
- Being outside in the yard encourages neighbourhood relationships.

Weaknesses of hose-end hand watering include the following:

- Time-consuming
- Poor uniformity of water distribution with hand-placed sprinklers, leading to high water use
- Hand-held watering often leads to surface watering rather than effectively watering the root zone
- Wasting water by allowing it to run too long

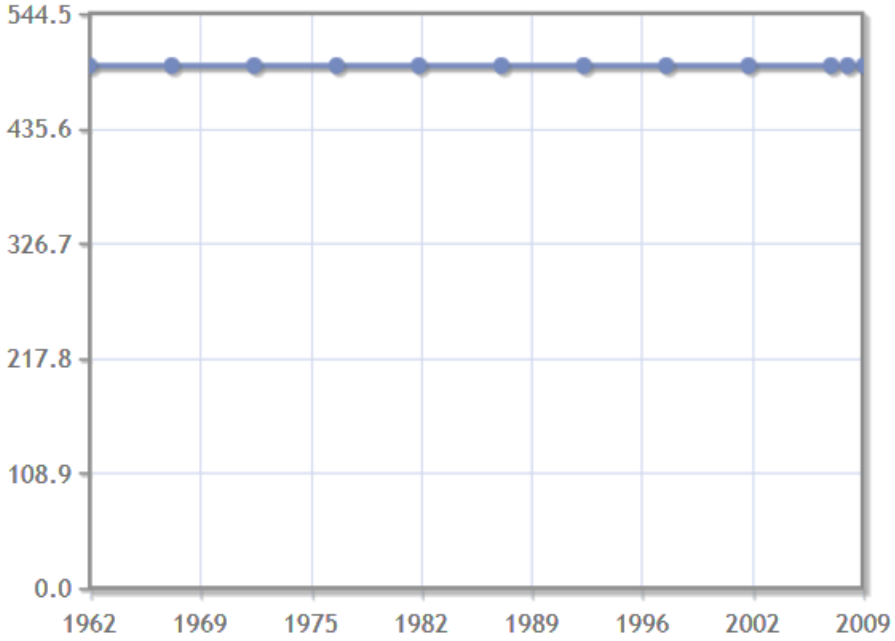
Any type of irrigation system (in-ground sprinklers, drip, or hand watering) can be very efficient with attention to detail. Likewise, any type off irrigation can be inefficient, wasting water. What makes a system efficient or inefficient is not the equipment, but rather the attention given by thee gardener.

USING THE IRRIGATION SYSTEM

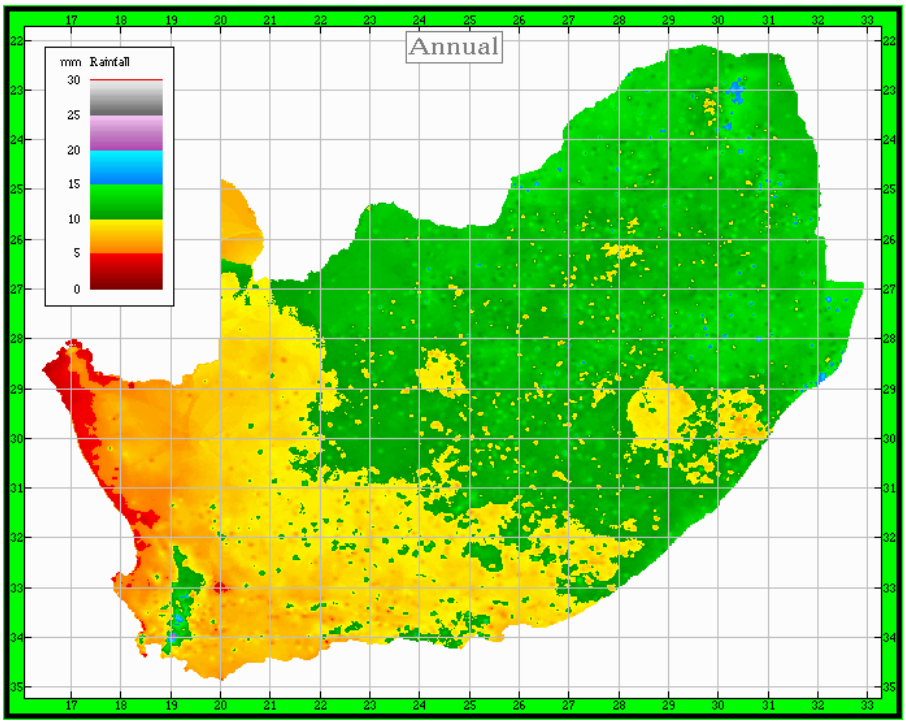
TIME: 120 MINUTES **ACTIVITY: SELF & GROUP**

Precipitation

The definition of precipitation is any form of water - liquid or solid - falling from the sky. It includes rain, sleet, snow, hail and drizzle plus a few less common occurrences such as ice pellets, diamond dust and freezing rain.



The value for Average precipitation in depth (mm per year) in South Africa was 495.00 as of 2009. As the graph below shows, over the past 47 years this indicator reached a maximum value of 495.00 in 2009 and a minimum value of 495.00 in 1962. Definition: Average precipitation is the long-term average in depth (over space and time) of annual precipitation in the country. Precipitation is defined as any kind of water that falls from clouds as a liquid or a solid.

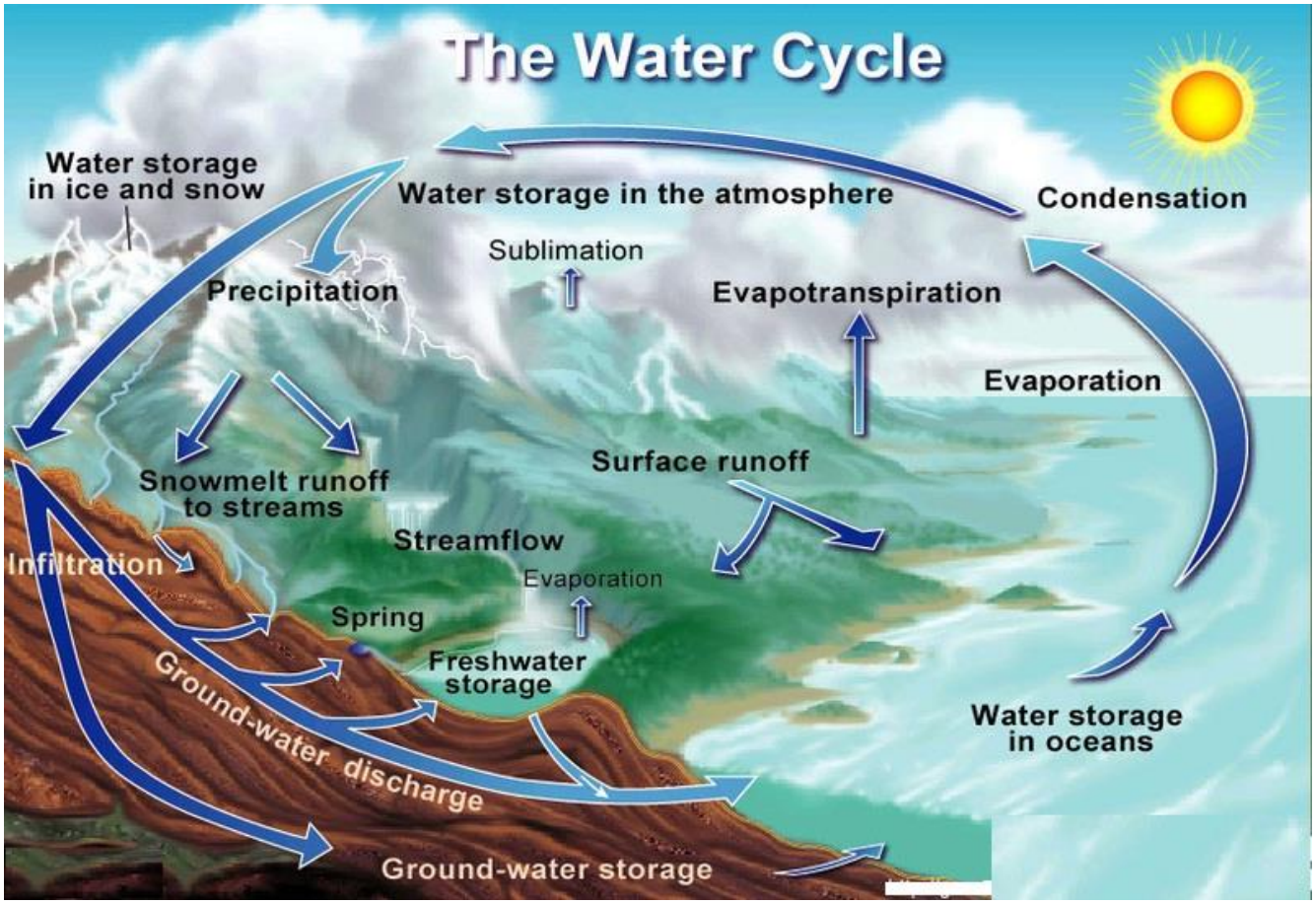


The image below shows the annual rainfall in South Africa, with the amounts shown depicting monthly averages in millimetres.

What role does in play?

Precipitation, especially rain, has a dramatic effect on agriculture; all plants need at least some water to survive, therefore rain (being the most effective means of watering) is important to agriculture. While a regular rain pattern is usually vital to healthy plants; too much or too little rainfall can be harmful, even devastating to crops. Drought can kill crops and increase erosion, while overly wet weather can cause harmful fungus growth. Plants need varying amounts of rainfall to survive. For example, certain cacti require small amounts of water, while tropical plants may need up to hundreds of inches of rain per year to survive.

In areas with wet and dry seasons, soil nutrients diminish and erosion increases during the wet season. Animals have adaptation and survival strategies for the wetter regime. The previous dry season leads to food shortages into the wet season, as the crops have yet to mature. Developing countries have noted that their populations show seasonal weight fluctuations due to food shortages seen before the first harvest, which occurs late in the wet season.



How much water to give

As seen on the map on page 153, South Africa has parts where there is quite sufficient rainfall per year; however some parts do not receive sufficient for plants and other vegetation to grow. Some parts of the country are in the winter rainfall areas and some in the summer rainfall areas.

This means that in those seasons where there is minimal rain, watering of the vegetation must be supplemented by watering of the areas. However, during the growing season, there can be periods of little to no rain, causing plants to suffer from drought stress and many of us to reach for the sprinkler. How do we know we are applying the right amount of water? We need to measure how much water the vegetation has received, and doing this, we need to use a rain meter.

A rain gauge is one of the most important tools in your home landscape. With it, you can properly manage lawn and garden watering. Summer showers are often spotty and unpredictable. The only way to know how much rain we're getting is to measure it using a rain gauge.

While drought stress can impact plants, over-watering creates many concerns such as:

- Increases risk of pollution from yard and garden care products.
- Wastes valuable water and impacts water supplies.
- Encourages shallow root zones and increases plant susceptibility to disease.
- Wastes time and money – it costs money to irrigate.

A rain gauge measures rainfall and other precipitation events, such as heavy dew and mist. Most lawns and gardens need about one inch of water each week. By measuring and recording rainfall, you will have an accurate account of what nature has already supplied. Irrigation should only be used to make up the difference, and it should not be set to an automatic schedule.

Rain gauges should be placed in an open area away from trees, buildings, and other structures, as this may cause an inaccurate reading. A general guideline to follow is placing the rain gauge twice as far away from the height of an object such as a tree.

Depending on the type, it may be made for mounting on a post with a screw, stuck into the ground with a plastic or metal spike, or stand on the ground with a special holder. Some holders are specially designed to add decoration to the garden.

Measuring Sprinkler Output:

The 1cm watering gauge can be used to collect water from your sprinklers so you know how much water is being applied. You can also use a bake pan or shallow can such as a tuna can if you do not have an extra rain gauge or special watering gauge.

Place your watering gauge or can within the wetted path or radius of the sprinkler just prior to watering. Avoid placing at the extreme outer edge of your sprinkler's wetted path.

When watering is complete, read and record the water collected in the gauge. If using a pan or shallow can, take it to a flat surface and measure the depth of water with a measuring stick.

Here is an easy way to calculate sprinkler output:

- Run the sprinkler system for 30 minutes.
- Measure the amount of water collected in your watering gauge, pan or shallow can.
- Multiply that depth by 2 to get the amount of water that your sprinkler applies over a one hour period.

Adjust the flow rate and running time of the sprinkler to apply the amount of water intended without causing runoff.

For example, your sprinklers ran for 30 minutes and you collected 2cm of water. Multiplying 2cm by 2 equals 4 cm over a one hour period.

Next time you irrigate, you can reduce the flow rate (gallons per minute) as needed to result in ½" over 30 minutes or 2cm over a one-hour period. You can figure this out through trial and error. If the flow rate is set and not contributing to runoff problems, then simply reduce the running time. For example, you could reduce the watering time to 20 minutes and then measure again to see if you are now at 1cm.

MAINTAINING THE IRRIGATION SYSTEM

TIME: 120 MINUTES **ACTIVITY: SELF & GROUP**

Underground, automatic sprinkler systems can be expensive. They are costly to install, maintain, repair, and to run.

Water costs a fortune, sprinkler parts are never a fun expense, and irrigation contractors always seem to charge way too much.

If you have one, you know the benefits of an underground irrigation system come with a price.

And like all nice things, if you want them to last a long time, it is important that you take care of them and learn how to properly maintain them. Here are a few tips on how to make your underground sprinkler system function properly and last through the years.

Check Sprinkler Valves

Sprinkler Valves are the bread and butter to a smooth working sprinkler system. At the beginning of spring and the end of every fall, check to make sure your solenoid valves and solenoids are working properly. This will also include checking all electrical connections and ensuring that they are secure.

This can be done by getting hands on with the sprinkler valves found in the sprinkler valve box. Using a plumber's wrench, loosen each valve free and examine their intricate parts for flaws, debris, and broken or missing areas. If you do come across a faulty valve, or need further instruction on how to identify and repair a bad valve.

Clogged Sprinklers

Sprinklers become clogged over time by dirt and debris that is trapped in the filter or nozzle of the sprinkler. When a sprinkler is clogged, little or no water will be able to exit the nozzle while the system is running. Two of the main types of sprinklers are sprays and rotors.

The components in a spray type sprinkler. The assembled spray is shown (A) along with the unassembled spray (B through F). The unassembled parts include the body (B), the spring and pop-up portion (C), the nozzle (E) and the filter (F).

Irrigation Flush

A good flush from time to time will also help your sprinkler system last for many years. An irrigation flush is the process of flushing out all the pipes in effort to eliminate any debris or grit that infiltrates your irrigation system.

Clogged pipes, sprinkler heads, and nozzles can lead to cracked pipes, flooding, zero watering, and a ruined sprinkler system. Flushing the pipes 4-5 times each year will remove all the dirt and mud that is sure to get into the system at some point, one way or another. It is common to assume that screens and/or filters keep all dirt and debris from getting into your watering system, but this is not so.

Replace Filters and Screens

In addition to a frequent irrigation flush, replacing those sprinkler filters and screens mentioned previously is something that should be done annually. Check the filters regularly for build-up, clots, or clogs. It is good to have a filter, but a clogged filter is not any good at all.

Rotors

- The internals of the rotor need to be removed because the small basket-shaped filter is at the bottom of the rotor body. This can usually be performed by unscrewing the top portion of the rotor from the body using counter clockwise turns.
- Remove the filter.
- Rinse filter thoroughly.
- While the rotor is dismantled, the irrigation line should be flushed to ensure no other debris is in the system. Use care that dirty water and trash doesn't drain back into the open rotor body.
- Replace filter and nozzle.
- Turn on the irrigation and adjust the rotor's coverage pattern if necessary

Sprinkler and Valve Leaks

Leaks can occur in sprinklers when seals become worn over time (Figure 3 and Figure 4). Often, leaking sprinklers are a result of damage that occurred during mowing or other lawn maintenance. Automobiles that accidentally drive over sprinkler heads can also cause large leaks. Leaks in the irrigation system can lead to significant loss of pressure, which causes dry areas in the landscape. Unchecked water loss results in high water bills and overly wet areas in the landscape near the leak, which can lead to disease and the presence of weeds.

The location of a leak determines how to repair it:

- Some types of rotors allow for replacement of the seal inside the sprinkler. In general, once the sprinkler body (both sprays and rotors) has a large leak the entire sprinkler should be replaced.
- Many models of sprinklers are available at your local hardware store. Care should be taken to ensure that replacement sprinklers have the same operating characteristics (pressure, throw diameter, arc, etc.) as the damaged sprinkler. Sprinklers can be replaced easily by unscrewing the old sprinkler and replacing it with a new one.
- If the sprinkler body is located below ground level, the area around it should be dug out so as to free the body of the sprinkler from the soil. Clean the area where the new sprinkler will screw on so that soil will not be introduced into the system when the sprinklers are changed. Leaks often develop from broken pipe connections at the base of sprinklers, especially near streets and driveways. Flexible connection kits are available to reduce the occurrence of this breakage. Use a hand shovel when digging around the sprinkler to prevent cutting the irrigation line running to the sprinkler. Note: When digging, look out for buried irrigation control cable which is sometimes installed in the same ditch alongside the piping. It can be easily cut with a shovel making an additional repair necessary.

Leaks can develop in irrigation valves, whether from high pressure in the system or from general wear and tear. For electric valves, wire connections should be made using waterproof wire connectors (also called grease caps) to prevent the loss of signal between the irrigation timer and the valve due to water damage (especially since the valves are typically buried underground).

There are several types of irrigation valves, each having different problems and maintenance requirements. The problems that can cause leaks in valves depend on the type of valve. In general, if the valve has an external crack it will need to be replaced. Many irrigation equipment suppliers stock solenoids, gaskets and O-rings to repair valves. For leaking valves, a local irrigation contractor can assist with the repair.

The pictures on the right depict the following problems (from top to bottom):

- Leak in a rotor due to a worn seal indicated by the arrow. Note that the rotor body is crooked and should be buried to maintain vertical alignment and prevent damage from mowing
- Leak in a spray due to a worn seal
- Leaking solenoid valve (indicated by arrow) covered in water after irrigation
- Leak in an indexing valve during irrigation due to high pressure in the system

Inspect Watering Timer

The sprinkler timer is the brain of every underground automatic sprinkler system. If the sprinkler timer is not working properly, your entire irrigation system will not perform. A good timer will last around 10 years, while other, less expensive models need replacing every 2-3 years.

Run your system manually using your sprinkler timer and make sure it is signalling each and every station properly. Forgetting to set the clock on the sprinkler timer is a common mistake made by many homeowners. Programming your sprinklers to go off at 7am every morning is only part of the process. If the clock is not set to the correct time, your automatic sprinklers will turn on at 2 in the afternoon, thinking it is 7 in the morning.

Sprinkler timers function by means of many wires and transformers. It is advised to have professional inspect your sprinkler timer annually for any electrical or technical glitches. However, if you can run each station manually and everything works as it should, you probably don't have any technical issues.

Check Sprinkler Heads

Some of the more obvious ways to maintain a sprinkler system are to inspect sprinkler heads and replace any broken or malfunctioning ones immediately. Also, sprinkler nozzles can become clogged with hard water and mineral build-up. As you inspect each sprinkler head, watch for mineral build-up and clean out the nozzles accordingly.

A smooth running sprinkler system can be extremely convenient and worthwhile. But if they are not properly maintained, they can be an expensive headache. Do your part to make sure the quality and proper functionality of your sprinkler system is maintained.

Obstructed Sprinklers

It is easy to forget the location of pop-up sprinklers in the landscape depending on the type of plants surrounding them. Make sure that objects, such as trash cans and plants are not placed in a location where they obstruct a sprinkler (especially when deciding where new plantings will be located). If something is located in front of the sprinkler, the irrigation will not reach its designated path and a dry spot will form in the landscape.

It is also important to maintain the area surrounding a sprinkler to prevent obstruction of the spray. Turf grass can grow over pop-up sprinklers making it impossible for the sprinklers to pop-up. Shrubs and overhanging tree branches may also need to be pruned back far enough to keep the sprinkler from being obstructed. Over time, sprinklers can be pushed further into the ground causing the spray of the sprinkler to not reach surrounding areas. This can happen from vehicles, including lawn mowers, being driven over the sprinkler

As can be seen in the picture on the previous page: Spray head that no longer pops-up causing irrigation to only reach turf grass within a couple of inches of the spray.

Missing Nozzles

Nozzles from spray type irrigation systems can become detached from the sprinkler body over time or cut off by mowers. When a nozzle is missing, the pressure to the rest of the system will be decreased, causing poor coverage and possibly dry areas.

The area directly around the sprinkler will be wetter than usual, possibly leading to weed growth and or fungus (figure on the right). Replacement nozzles for many types of spray heads are available at local hardware stores or can be ordered through a local irrigation supply company.

Design Problems

Landscaped areas can change over time and it is important to take into account the irrigation system design when modifying the landscape. For example, in the top figure on the right, the rotor is located behind a large shrub causing water to pool right next to the sprinkler. This system could be modified to have a spray type sprinkler on a riser in order to irrigate the entire area or more preferably micro irrigation could be used to irrigate the shrub areas (bottom figure). For major design changes to your sprinkler system, contact an irrigation contractor

The top figure shows that the irrigation system was designed before plants were installed. Modify system to meet plant needs. For established shrubs this sprinkler may not even be necessary.

The bottom figure shows the riser added below rotor to give additional height so irrigation covers entire area

You are now ready to go through a check list. Be honest with yourself.

Tick the box with either a √ or an X to indicate your response.

- ☐ **I am able to select the most suitable equipment for watering plants and landscapes.**
- ☐ **I am able to operate a manual irrigation system effectively.**
- ☐ **I am able to control the length of a cycle to ensure that the correct amount of water is applied to the planted areas.**
- ☐ **I am able to perform basic maintenance on sprinklers and irrigation piping.**

You must think about any point you could not tick. Write this down as a goal.

Decide on a plan of action to achieve these goals. Regularly review these goals.

My Goals and Planning:

_____
_____
_____
_____
_____
_____
_____
_____

PROVIDE NUTRITION TO PLANTS AND LANDSCAPES

264180

A person credited with this unit standard will be able to:

- Describe the benefits of applying the appropriate nutrition to ornamental plants and landscapes.
- Recognise the various types of fertilisers and their composition.
- Demonstrate soil sampling techniques.
- Utilise knowledge of nutrition to successfully propagate and maintain ornamental plants.

NUTRIENTS REQUIRED BY PLANTS AND METHODS OF APPLICATION

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

If plants fail to thrive, despite adequate soil preparation, watering and mulching, it may be a sign of a nutrient deficiency. Fruit and vegetables are particularly vulnerable, as are containerised plants and those growing in very acid or alkaline soils. Yellow or reddish coloured leaves, stunted growth and poor flowering are all common symptoms of nitrogen, magnesium or potassium deficiency.

What are nutrient deficiencies?

Some garden soils and potting composts suffer from a lack of nutrient content, leading to deficiency symptoms in the plants growing in them. Plants can also suffer deficiencies where the growing conditions are poor and the plants are unable to take up nutrients present in the soil. Very acid or alkaline conditions, dryness and waterlogging can all make it difficult for plants to take up soil nutrients. Nutrient deficiencies cause symptoms such as leaf yellowing or browning, sometimes in distinctive patterns. This may be accompanied by stunted growth and poor flowering or fruiting.

Symptoms, cause and remedy

Nitrogen deficiency

Symptoms:

Spindly yellow plants or yellow leaves, sometimes with pink tints

Cause:

Nitrogen promotes green, leafy growth and deficiency results in yellowing and stunted growth. Nitrogen is very soluble, so is easily washed out of the soil in winter rains, leaving the soil deficient in spring, just when plants are putting on new growth. Nitrogen deficiency is a common cause of yellow leaves in spring.

Remedy:

In the long term, mulching with organic matter (such as well rotted garden compost or manure) provides a steady trickle of nitrogen to stabilise levels. In the short term, applying high nitrogen fertilisers such as sulphate of ammonia or poultry manure pellets will remedy the problem.

Potassium deficiency

Symptoms:

Yellow or purple leaf-tints with browning at the leaf edge and poor flowering or fruiting.

Cause:

Potassium is needed for controlling both water uptake and the process allowing plants to harness energy from the sun (photosynthesis). Potassium promotes flowering, fruiting and general hardiness. Shortages are more likely on light, sandy or chalky soils where potassium is easily washed away. Clay soils, by contrast, hold potassium within their structure.

Remedy:

Apply high potassium fertilisers such as sulphate of potash, tomato feed or certain organic potassium sources derived from sugar beet processing.

Phosphorus deficiency

Symptoms:

Slow growth and dull yellow foliage.

Cause:

Phosphorus is needed for healthy roots and shoot growth. Soil shortages of phosphorus are rare, but may occur in areas with high rainfall and heavy clay soil.

Remedy:

Apply fertilisers such as superphosphate or bone meal.

Magnesium deficiency

Symptoms:

Yellowing between the leaf veins, sometimes with reddish brown tints and early leaf fall. Magnesium deficiency is common in tomatoes, apples, grape vines, raspberries, roses and rhododendrons.

Cause:

Magnesium is needed for healthy leaves and for plants to harness energy from the sun (photosynthesis). Soil shortages of magnesium are more common on light, sandy soils. Over-use of high-potassium fertilisers (such as tomato feed) can cause magnesium deficiency, as plants take up potassium in preference to magnesium.

Remedy:

In the short term, apply Epsom salts as a foliar feed in summer. Dilute the salts at a rate of 20g of Epsom salts per litre of water plus a few drops of liquid detergent. Apply two or three times at fortnightly intervals, spraying in dull weather to avoid leaf scorch. In the long term apply to the soil around the roots either Dolomite limestone (calcium-magnesium carbonate) at 100g per sq m or Epsom salts (magnesium sulphate) at 30g per sq m. Dolomite limestone will make the soil more alkaline, so should not be used around ericaceous (acid-loving) plants such as rhododendrons or camellias, or where the soil is already alkaline.

Manganese and iron deficiencies

Symptoms:

Yellowing between the leaf veins with browning of leaf edges on acid-loving plants

Cause:

Manganese and iron are important for allowing plants to harness the energy of the sun (photosynthesis). Soil shortages are rare, but manganese and iron can be unavailable to plant roots in alkaline conditions. Ericaceous (acid-loving) plants are particularly vulnerable when growing in alkaline soils or potting composts.

Remedy:

Apply chelated iron and manganese treatments, such as Sequestrene, to the soil around the plant roots.

Molybdenum deficiency

Symptoms:

Elongated twisted leaves on cauliflowers or other brassicas growing in alkaline soil. Molybdenum deficiency is normally seen in cauliflowers and brassicas, particularly when growing in insufficiently alkaline soil.

Cause:

Molybdenum is required for a variety of plant growth processes, but is needed only in tiny quantities. Soil shortages of molybdenum are rare, but it can be less available to plant roots in acid conditions.

Remedy:

Treat with fritted trace elements (see our advice on fertilisers). Liming the soil will help in the long term, as making the soil more alkaline will help to make the molybdenum more available. See our advice on lime and liming for further detail.

Boron deficiency

Symptoms:

Stunted growth and tip dieback on lettuce, brown cracks in celery; rotten swedes, turnips and celeriac; dimples in pears with brown patches underneat

Cause:

Boron is required for healthy plant cell formation. Soil shortages are rare, but this nutrient can be less available to plant roots in alkaline conditions.

Remedy:

Treat with fritted trace elements (see our advice on fertilisers) or by applying borax (disodium tetraborate) to the soil before sowing vegetables or as a foliar spray feed applied to pear trees. Soil application rates for borax are: 35g per 20 sq m.

Mix well with a large quantity of light sand before spreading so that the chemical is evenly distributed. Foliar spray application rates for borax are: 70g borax in 22-litres water, plus a few drops of detergent to act as a wetting agent, sprayed at petal fall.

The Macro-elements in soil

The increase in cultivation intensity with the increasing demand for higher yields with better quality has resulted in increasing demand for micro-elements. Plant productivity has increased along the years due to genetic development and selection of high yielding cultivars. These cultivars with intensive cultivation methods were found to remove higher quantities of micro-elements from the soil, leading to deficiencies occurring in many soils.

In this section we will review micro-elements, their importance, the problems affecting their supply, and ways to overcome these availability problems. Plants require water, air, light, suitable temperature, and 16 nutrients to grow. Plants absorb carbon, hydrogen and oxygen from air and water. The other 14 nutrients come from the growing medium/soil.

Soil nutrients are divided into two groups according to their demanded quantity by the plants. The macronutrients are those that are demanded in relatively high levels. In the group of macro-elements we can distinguish between two sub groups, major ones and secondary ones. The nutrients nitrogen (N), phosphorus (P) and potassium (K) are referred as the major macro-elements, and calcium (Ca), magnesium (Mg), and sulfur (S) are the secondary ones.

The micronutrients, which are needed only in trace amounts, are iron (Fe), manganese (Mn), boron (B), zinc (Zn), copper (Cu), molybdenum (Mo), chloride (Cl), sodium (Na), nickel (Ni), silicon (Si), cobalt (Co) and selenium (Se). Within this group of nutrients two definitions exist.

The 'essential mineral elements' (or mineral nutrients); this term was proposed by Arnon and Stout (1939). They concluded three criteria must be met for an element to be considered essential. These criteria are:

1. A plant must be unable to complete its life cycle in the absence of the mineral element.
2. The function of the element must not be replaceable by another mineral element.
3. The element must be directly involved in plant metabolism.

These criteria are important guidelines for plant nutrition but exclude beneficial mineral elements. The 'beneficial elements' are those that can compensate for toxic effects of other elements, or may replace mineral nutrients in some other less specific functions such as the maintenance of osmotic pressure. The omission of beneficial nutrients in commercial production could mean that plants are not being grown to their optimum genetic potential but are merely produced at a subsistence level.

Different divisions exist and in certain references some nutrients might be considered essential, although they only serve as such for certain plant species. As the science of chemistry progresses and the analytical techniques improve, Table 1 might extend to include mineral elements that are essential in very low concentrations (ppb).

Essential of mineral elements for higher and lower plants			
Classification	Element	Higher plants	Lower plants
Macronutrients – major	N, P, K	+	+
Macronutrients - secondary	Ca, Mg, S	+	+ (exception Ca for fungi)
Micronutrients - essential	Fe, Mn, Zn, Cu, B, Mo, Cl, Ni	+	+ (exception B for fungi)
Micronutrients - beneficial	Na, Si, Co, Se	+/-	+/-

The importance of micro-elements

The importance of micro-elements in plant nutrition is high and they should not be neglected although they are needed in minor quantities. This understanding was developed in 1840 by the German chemist, Freiherr Justus von Liebig, who made a major contribution to the science of agriculture and biological chemistry.

He determined the 'Law of the Minimum', which describes the effect of individual nutrients on crops. Liebig's Law of the Minimum, often simply called Liebig's Law, is a principle developed in agriculture that states that if one of the nutritive elements is deficient or lacking, plant growth will be restricted and not in its full potential even when all the other elements are abundant.

Any deficiency of a nutrient, no matter how small the amount needed, it will hold back plant development. If the deficient element is supplied, growth will be increased up to the point where the supply of that element is no longer the limiting factor. Increasing the supply beyond this point will not be helpful, as some other elements would then be in minimum supply and become the limiting factor. Liebig used the image of a barrel to explain his law. The capacity of a barrel with staves of unequal length is limited by the shortest stave, so a plant's growth is limited by the nutrient in shortest supply.

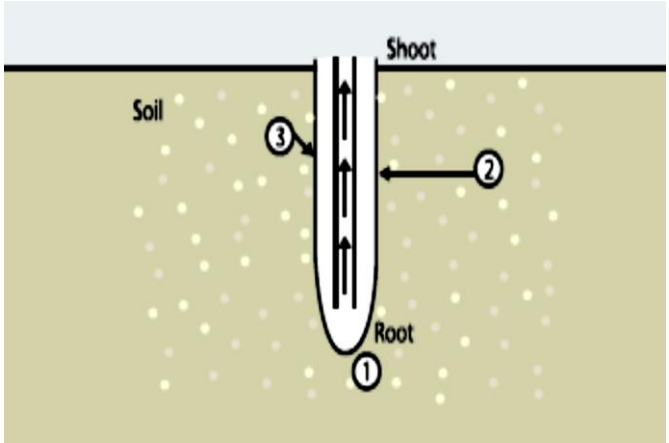
Plant nutrient uptake

Plants absorb nutrients only from the liquid solution phase of the soil. The problem with micro-elements is their limited solubility and therefore their limited presence in the solution. The uptake from the soil solution is done in three major ways: root interception, mass flow and diffusion.

Root interception - as roots proliferate through the soil they also move into spaces previously occupied by soil containing available nutrients, for example, absorbed by clay particles. Root surfaces may thus intercept nutrients during this displacement process (Barber, 1984).

Mass flow - is movement of water and dissolved nutrients, which is driven by the transpiration gradient.

Diffusion - is movement of nutrients according to the gradient from high concentration to low concentration. In diffusion, the soil moisture content has a major effect as well as the presence of other ions - both factors may increase the diffusion coefficient (De) of the micro-elements and may increase their uptake. Diffusion is considered the major uptake route for micro-elements, especially when their concentration is limited in the soil solution.



Schematic presentation of mineral element movement to root surface:

(1) Root interception

(2) Mass flow

(3) Diffusion

(o) Available nutrients

The contribution made by mass flow to total supply differs between mineral nutrients and between plant species due to differences in transpiration rate or uptake rate of a particular mineral nutrient, or both these factors.

In soil, a gradient is created when the uptake rate of ions exceed the supply by mass flow. The depletion profile develops with time and depends mainly on the balance between uptake by roots, replenishment from soil and mobility of ions by diffusion. Ion mobility is defined by diffusion coefficient, which is fairly uniform for different ions on homegenous medium such as water, and differ in non-homegeneous soils such as aerated soil.

Low soil organic content effects

Plants grown on soils with low organic content have a higher tendency to develop different micro-element deficiencies. Organic matter in the soil has the ability to form stable complexes with metal ions; accordingly, when organic matter in the soil is low, plants may suffer from it by showing different deficiencies. Two groups can be defined in the organic complexes formed in the soil:

1. Complexes formed due to micro-organism activity – organic acids, polyphenols, amino acids, peptides, proteins and polysaccharides.
2. Complexes formed in secondary synthesis reactions – humic acid and fulvic acids.

SOIL SAMPLING

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

Why do we sample soil?

The Benefits:

Soil testing is the single most important guide to the profitable use of fertilizer and lime. It is in the best interest of farmers, lawn care professionals, landscapers, gardeners, fertilizer suppliers, and consultants to promote the use of soil testing for several reasons.

- Grow higher crop yields
- Produce higher quality crops and ornamentals
- Use fertilizer spent more efficiently

The Goal:

The purpose of soil testing is to identify the soil fertility that the plants or crop, in a given area will experience. The soil area and volume could be a large field, a small garden, or simply the root zone of a single tree or shrub.

The most difficult step in soil testing is accurately representing the desired area of soil. A laboratory cannot improve the accuracy of a sample that does not represent the area.

In most soils, it takes more than one year to make significant changes to the soil test levels. As the soil improves with better fertility programs, subsequent crops or plant growth should show increasing rates of improvement. Soils are formed over thousands of years, and are not easily changed in a short time.

The Method:

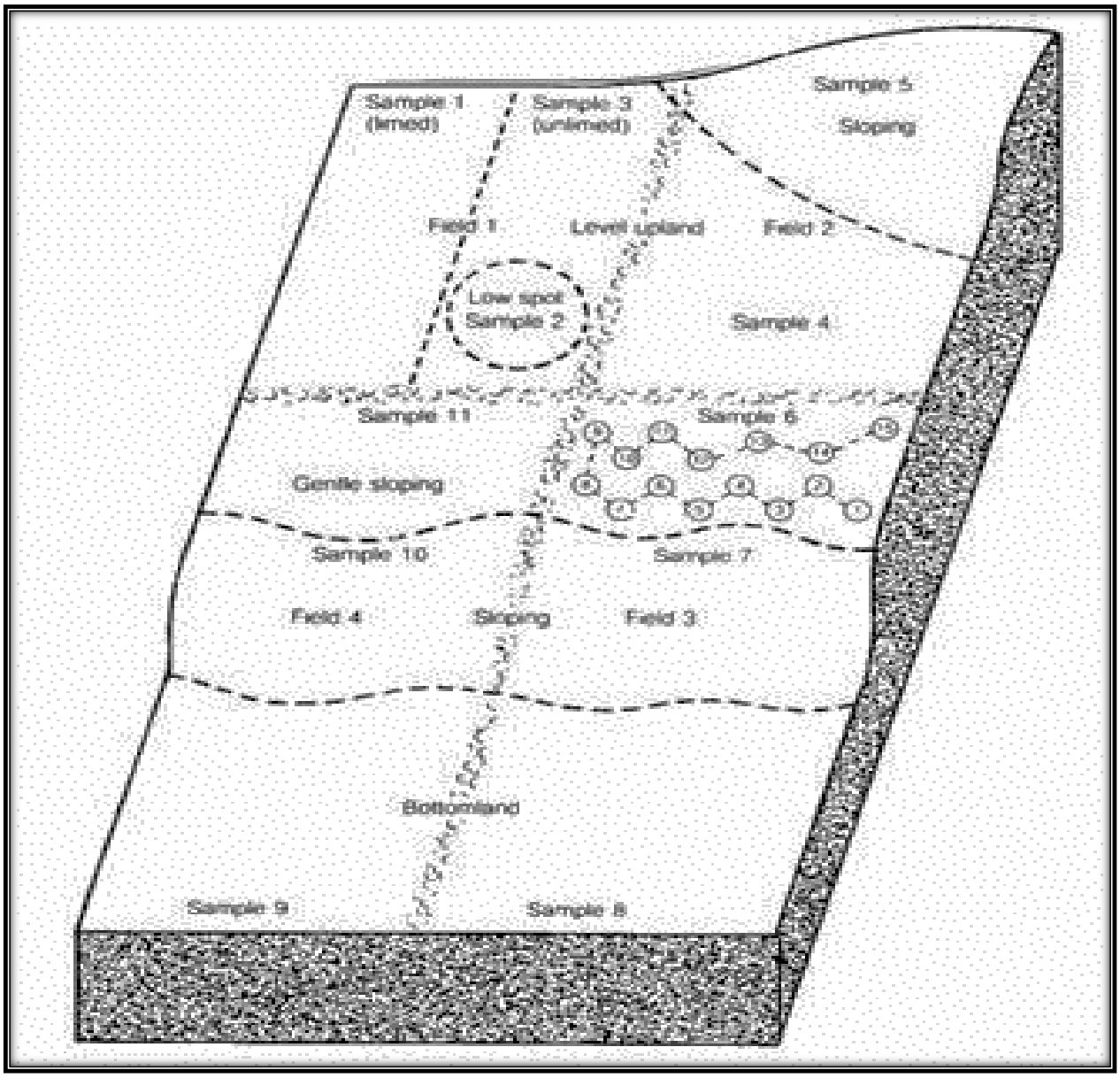
You should plan how the field is to be sampled before you begin. You should plan how you will divide the field into sampling areas, then always use the same areas in the future.

A soil map, available at the county Soil Conservation Service office will often be helpful.

Some factors that might cause you to sub-divide the field into separate sampling areas are...

- The size of the field
- Different soil types
- Different topography
- Different past usage (previous crops, livestock confinement, fertility practices, etc.)
- Fertilizer application capabilities
- Different past crop performance

Soil test levels in any soil area will vary both laterally and vertically. This, plus the intended use of the field, dictates how the field or area of land should be sampled (see example in the figure below).



A few universal basics

1. Soil samples can be taken with a professional soil probe, or simply using a shovel, spades, or garden trowel (see figure below).

2. Each sample should be composed of from 10 to 15 cores.

3. As you take cores of soil, put them into the plastic bucket. Mix the soil thoroughly in the bucket (galvanized buckets will contaminate the sample with zinc), breaking up all cores. Then, fill the soil bag to the green line (about 1 cup of soil). Discard any extra soil.

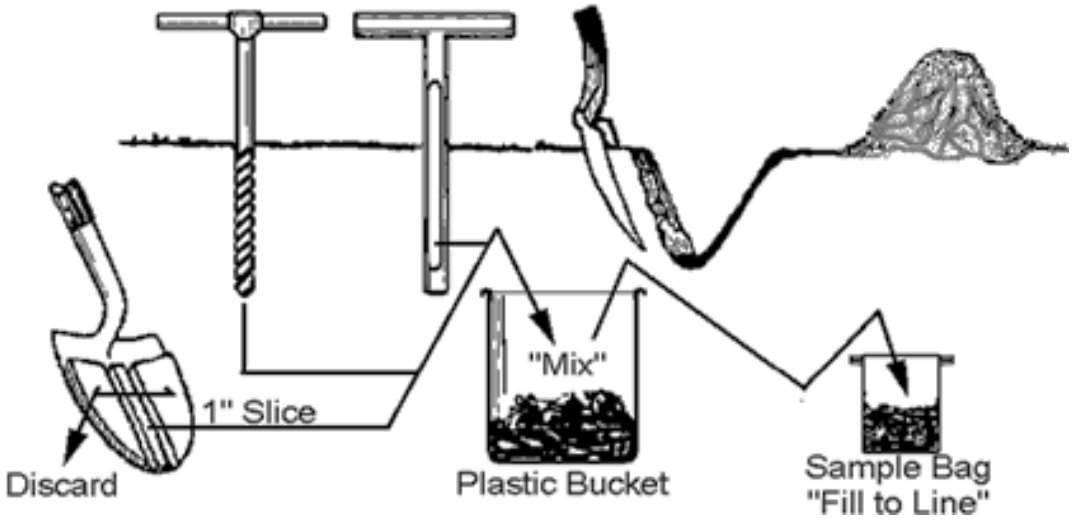
4. The cores should be taken in a random pattern that is uniform across the area being sampled (grid sampling may require a specific pattern).

5. Each sample should represent 10 acres, or less, per sample(grid samples will represent from 2.5 to 5 acres per sample).

6. Normally for most agronomic crops and conditions, each sample core should be taken to a depth of 21cm in tilled fields. Special conditions such as no-till, orchards, turf, and others are discussed in the following sections. Tip: Permanently mark your soil probe at the depths that you expect to pull samples. This will help you maintain constant depth. A probe with a welded foot pedal at the correct depth is also helpful.

7. Complete the information on the soil bag while you are in the field! Assign each sample bag an ID consisting of up to 12 letters and/or numbers that will let you identify it later. Record the sample ID on a field map (hand drawn if necessary), as well as the pattern and locations in the field that the samples were taken. This will enable you, or others to take the next samples in the same locations.

8. Enter all necessary information on the soil sample information form, and check to see that it agrees with the soil bags it accompanies.



Tree Crops - Orchards, Christmas Trees, Nurseries

Tree crops must be sampled much differently than row crops or forages. Also, with tree crops, plant analysis is more important that soil testing, and should be done every year! There are several opinions on the best way to sample tree crops, and they are somewhat dependent on the planting pattern of the trees. We prefer the following; however it requires additional care on your part...

Organization - Divide the field into blocks of trees of the same species, the same general age, and the same general soil conditions. Within each block, select 5 trees that are typical of the general condition of that block. These trees will be used as indicator trees for the rest of the block. They will be intensively sampled (soil and foliage) and monitored as a guide to the treatment of the entire block. These indicator trees should be permanently marked or tagged so that you can come back to them each year for re-sampling.

Soil Sampling - From each indicator tree in a block, pull 3 to 4 cores from the drip-line of the tree (the outside perimeter of the maximum foliage diameter). The resulting 15 to 20 cores will make up a single soil sample. Mix the cores well and take about a cup of this soil for the sample and send that to the lab. Fertilize the entire block according to this sample.

Plant Sampling - With tree crops of any type, it is important to use annual plant analysis in addition to periodic soil samples to determine your fertility programs. This is due to several reasons, such as a trees' extensive root system, nutrient storage by some woody plants, and slow internal nutrient transport by large trees. It sometimes requires more than one year for woody perennial plants give the maximum response to a change in fertilizer programs. Take this year's leaves/needle along with a less frequent soil sample to develop and refine the fertility program for the next season. You can also use leaf/needle analysis to determine the need for foliar sprays. The proper tissue to sample is: Fruit trees: youngest fully matured leaves on current years twig growth, 30+ leaves...Conifers: the entire current years growing tip after it has hardened, 20 to 30 tips

Lawns and Turf

Sample depth should be 4 inches, and should not include accumulated surface organic materials such as thatch, or the blades of grass. It would be desirable to not include the grass roots either, but this may be nearly impossible to avoid. Sample handling procedures at Spectrum Analytic will remove most of the roots and larger pieces of non-soil material. The pattern of taking the cores is similar to that used in sampling crop fields (random and scattered), and avoiding unusual areas, unless the unusual areas are of interest.

Identifying your soil type

The best way to tell what type of soil you have is by touching it and rolling it in your hands.

Sandy soil has a gritty element – you can feel sand grains within it, and it falls through your fingers. It cannot be rolled to make a sausage shape. If it is not a coarse sand and perhaps a sandy loam it may stick together better

Clay soil has a smearing quality, and is sticky when wet. It is easily rolled into a long thin sausage and can be smoothed to a shiny finish by rubbing with a finger. If is it not a heavy clay it won't get quite as shiny and be as easy to make a sausage

Pure silt soils are rare, especially in gardens. They have a slightly soapy, slippery texture, and do not clump easily

If soil froths when placed in a jar of vinegar, then it contains free calcium carbonate (chalk) or limestone and is lime rich. Another important aspect of soil type is the pH (acidity or alkalinity). This will also affect the type of plants you can grow and how you manage your soil.

Working with your soil

Now you know what type of soil you have, you can start to work with it and improve it.

Clay soils

Clay soils are rich in nutrients and very fertile if their cloddiness can be broken up by the addition of organic matter. This breaks down the clay into separate crumbs, making the water and nutrients held within the clay more easily available to plant roots. Breaking up the clay into crumbs also makes the soil warmer, more easily workable and less prone to compaction.

Sandy soils

These light soils are usually low in nutrients, and lose water very quickly being particularly free-draining. You can boost the water and nutrient holding capacity of your soil by adding plenty of organic matter to bind the loose sand into more fertile crumbs. Fertilisers may also be necessary to give plants grown in sandy soils an extra boost.

Silt soils

These soils are made up of fine particles that can be easily compacted by treading and use of garden machinery. They are prone to washing away and wind erosion if left exposed to the elements without plant cover. However, they contain more nutrients than sandy soils and hold more water, so tend to be quite fertile. You can bind the silt particles into more stable crumbs by the addition of organic matter.

Loams

These soils are the gardener's best friend, being a 'perfect' balance of all soil particle types. But even though they are very good soils, it is important to regularly add organic matter, especially if you are digging or cultivating these soils every year.

Chalky soils

Chalky soils are alkaline, so will not support ericaceous plants that need acid soil conditions. Very chalky soils may contain lumps of visible chalky white stone. Such soils cannot be acidified, and it is better to choose plants that will thrive in alkaline conditions. Many chalky soils are shallow, free-draining and low in fertility, but variations exist, and where there is clay present, nutrient levels may be higher and the water holding capacity greater.

Soil: understanding pH and testing soil

When designing and planting your garden, you need to know whether the soil is acid or alkaline, as different plants thrive in different soils. The soil pH is a number that describes how acid or alkaline your soil is. A pH of 7.0 is considered neutral. An acid soil has a pH value below 7.0 and above 7.0 the soil is alkaline.

When to test soil pH

It is especially worth checking soil pH before designing or planting a new garden, making vegetable plots, planting fruit, when growth is disappointing, or where yellowing of foliage occurs. Lime is added to increase soil pH (make it more alkaline) and acidifying materials are added to decrease soil pH. Testing can be done at any time, but if carried out within three months of adding lime, fertiliser or organic matter, the test may give misleading results.

How to test soil pH

You can test your soil pH yourself using a DIY kit widely available at garden centres. These kits are relatively cheap and easy to use and give a good indication of soil pH. But for the best results, send a soil sample to a laboratory for detailed analysis.

Always follow the sampling directions given by the test kit or laboratory to get a representative sample for the area in question. Laboratory tests also detect free calcium carbonate (chalk or limestone). This may not be

measured by DIY kits. A quick home test to check for free calcium carbonate is to add vinegar to a soil sample. If 'fizzing' is seen, free calcium carbonate is present.

Interpreting the results of a soil pH test

A pH test measures soil acidity or alkalinity. A pH 7.0 is considered neutral. An acid soil has a pH value below 7.0. Above pH 7.0 the soil is alkaline.

PH 3.0 - 5.0 - Very acid soil

- ☐ Most plant nutrients, particularly calcium, potassium, magnesium and copper, become more soluble under very acid conditions and are easily washed away
- ☐ Most phosphates are locked up and unavailable to plants below pH 5.1, although some acid tolerant plants can utilise aluminium phosphate
- ☐ Acid sandy soils are often deficient in trace elements
- ☐ Bacteria cannot rot organic matter below pH 4.7 resulting in fewer nutrients being available to plants
- ☐ Action: Add lime to raise the pH to above 5.0. The addition of lime can help break up acid clay soils

PH 5.1 - 6.0 - Acid soil

- ☐ Ideal for ericaceous (lime-hating) plants such as rhododendrons, camellias and heathers
- ☐ Action: Add lime if other plants are grown

PH 6.1 - 7.0 - Moderately acid soil

- ☐ A pH 6.5 is the best general purpose pH for gardens, allowing a wide range of plants to grow, except lime-hating plants
- ☐ The availability of major nutrients is at its highest and bacterial and earthworm activity is optimum at this pH
- ☐ Action: It is not usually necessary to add anything to improve soil pH at this level

PH 7.1 - 8.0 - Alkaline soil

- ☐ Phosphorus availability decreases
- ☐ Iron and manganese become less available leading to lime-induced chlorosis
- ☐ But an advantage of this pH level is that clubroot disease of cabbage family crops (brassicas) is reduced
- ☐ Action: Sulphur, iron sulphate and other acidifying agents can sometimes be added to reduce pH. Clay soils often require very large amounts of acidifying material and soils with free chalk or lime are not usually treatable

TYPES OF ORGANIC MATERIAL

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

What is soil?

Soil includes mineral and organic components, water, and air. All of these are essential to plant growth. Soil formation is the result of physical, chemical and biological processes. The process of soil formation begins when wind, rain and fluctuating temperatures break rock into smaller and smaller fragments. The rock fragments that compose most soils, in order of decreasing particle size, are sand, silt and clay.

Soil textures refer to the coarseness of the soil, which depends on the combinations of these three types of particles. Soils high in sand tend to be fast-draining and subject to drought, while soils high in clay can store a lot of water but are “heavy” and not as permeable to air and water. Loam soils feel as if they have a balance of sand, silt and clay.

The soil is also host to a large number of living organisms. Without soil organisms, very little soil formation will take place. Some of these organisms such as bacteria, fungi and certain insects and mites are microscopic. Others such as ants and earthworms are larger. Soil formation results in layers of soil much like the layers of a cake. The topsoil is where most of the organic matter is and where most biological activity occurs. The subsoil layers tend to be lighter in colour and finer textured than the topsoil. Subsoil tends to be low in organic matter and is usually less suitable for plant growth.

Of all the components of soil, organic matter is probably the most important and most misunderstood. Organic matter serves as a reservoir of nutrients and water in the soil, aids in reducing compaction and surface crusting, and increases water infiltration into the soil. Yet it's often ignored and neglected. Let's examine the contributions of soil organic matter and talk about how to maintain or increase it.

What is Organic Matter?

Many times we think of organic matter as the plant and animal residues we incorporate into the soil. We see a

pile of leaves, manure, or plant parts and think, "Wow! I'm adding a lot of organic matter to the soil." This stuff is actually organic material, not organic matter.

What's the difference between organic material and organic matter? Organic material is anything that was alive and is now in or on the soil. For it to become organic matter, it must be decomposed into humus. Humus is organic material that has been converted by microorganisms to a resistant state of decomposition.

Organic material is unstable in the soil, changing form and mass readily as it decomposes. As much as 90 percent of it disappears quickly because of decomposition.

Organic matter is stable in the soil. It has been decomposed until it is resistant to further decomposition. Usually, only about 5 percent of it mineralizes yearly. That rate increases if temperature, oxygen, and moisture conditions become favourable for decomposition, which often occurs with excessive tillage. It is the stable organic matter that is analysed in the soil test.

How Much Organic Matter Is in the Soil?

An acre of soil measured to a depth of 6 inches weighs approximately 2,000,000 pounds, which means that 1 percent organic matter in the soil would weigh about 20,000 pounds per acre. Remember that it takes at least 10 pounds (4.5kg) of organic material to decompose to 1 pound (0.5kg) of organic matter, so it takes at least 200,000 pounds (100 tons) of organic material applied or returned to the soil to add 1 percent stable organic matter under favourable conditions.

In soils that formed under prairie vegetation, organic-matter levels are generally comparatively high because organic material was supplied from both the top growth and the roots. We don't usually think of roots as supplying organic material, but a study showed that a mixed prairie had an above-ground (shoot) yield of 1.4 tons of organic material per acre, while the root yield was about 4 tons per acre. The plants were producing roots that were more than twice the weight of the shoots.

Soils that have developed under forest vegetation usually have comparably low organic-matter levels. There are at least two reasons for these levels:

1. trees produce a much smaller root mass per acre than grass plants, and
2. trees do not die back and decompose every year. Instead, much of the organic material in a forest is tied up in the tree instead of being returned to the soil.

Soils that formed under prairie vegetation usually have native organic matter levels at least twice as high as those formed under forest vegetation.

What Are the Benefits of Organic Matter?

One of the most important reasons for adding organic matter to soil is to improve the ability of the soil to accept and store water. Amending your soil means that you can reduce the amount of water a newly planted garden requires. This effect can be enhanced by the use of organic mulch on the soil surface, which will reduce evaporation as compared to bare soil.

Adding organic matter also increases the activity and number of soil organisms; over time a well amended soil will supply more of the nutrients your plants require, which will reduce fertiliser requirements. Although you might not expect it, adding organic matter to soil also helps to protect water quality and the environment. Soils amended with organic matter are a better sponge for water. More water goes into the soil, and less water runs off the surface.

Because surface run-off is reduced, pesticides and fertilisers are retained in the soil instead of washing into nearby rivers and lakes.

- Nutrient Supply

  Organic matter is a reservoir of nutrients that can be released to the soil. Each percent of organic matter in the soil releases 20 to 30 pounds of nitrogen, 4.5 to 6.6 pounds of P_2O_5, and 2 to 3 pounds of sulfur per year. The nutrient release occurs predominantly in the spring and summer, so summer crops benefit more from organic-matter mineralization than winter crops.

- Water-Holding Capacity

  Organic matter behaves somewhat like a sponge, with the ability to absorb and hold up to 90 percent of its weight in water. A great advantage of the water-holding capacity of organic matter is that the matter will release most of the water that it absorbs to plants. In contrast, clay holds great quantities of water, but much of it is unavailable to plants.

- Soil Structure Aggregation

  Organic matter causes soil to clump and form soil aggregates, which improves soil structure. With better soil structure, permeability (infiltration of water through the soil) improves, in turn improving the soil's ability to take up and hold water.

- Erosion Prevention

  This property of organic matter is not widely known. Data used in the universal soil loss equation indicate that increasing soil organic matter from 1 to 3 percent can reduce erosion 20 to 33 percent because of increased water infiltration and stable soil aggregate formation caused by organic matter.

How Can I Maintain or Improve Soil Organic Matter Levels?

Building soil organic matter is a long-term process but can be beneficial. Here are a few ways to do it.

- Reduce or Eliminate Tillage

  Tillage improves the aeration of the soil and causes a flush of microbial action that speeds up the decomposition of organic matter. Tillage also often increases erosion. No-till practices can help build organic matter.
- Reduce Erosion

  Most soil organic matter is in the topsoil. When soil erodes, organic matter goes with it. Saving soil and soil organic matter go hand in hand.
- Soil-Test and Fertilize Properly

  You may not have considered this one. Proper fertilization encourages growth of plants, which increases root growth. Increased root growth can help build or maintain soil organic matter, even if you are removing much of the top growth.
- Cover Crops

  Growing cover crops can help build or maintain soil organic matter. However, best results are achieved if growing cover crops is combined with tillage reduction and erosion control measures.

A good supply of soil organic matter is beneficial in crop or forage production. Consider the benefits of this valuable resource and how you can manage your operation to build, or at least maintain, the organic matter in your soil.

Checking the soil organic matter in the garden

Here are some simple ways to assess the organic matter content of your soil:

- Use your eyes – soils with adequate organic matter content are dark in colour both because they have more humus, which is dark, and because they hold more water.
- Look for puddling and standing water – soils rich in organic matter content and with good tilt allow water to percolate below the surface
- Use your fingers – look for aggregated soils. If you rub the soil between your fingers, the soil will seem to contain “crumbs” made up of mineral and organic particles. The crumbs are examples of

aggregation and are the result of sticky substances released by soil bacteria after feeding on organic matter. Aggregation generates soil structure.

- Use your nose – soils with adequate organic matter content have the rich smell of earth. Soils that have poor air circulation, a result of reduced organic matter content, may smell sour.

Fresh vs. composted materials

Both fresh and composted materials are useful for amending soils. Fresh organic material is rapidly decomposed by micro-organisms in a compost pile or in the soil. The microorganisms use the organic material as a food source and release carbon dioxide to the atmosphere. As decomposition proceeds, the remaining organic compounds are more resistant to decomposition; they have less food value to microorganisms.

Decomposition is usually very rapid for the first 30 days after application of fresh leaves, fruits or other vegetative material to soil. When decomposition of fresh organic materials take place in soil, the sticky exudates produced by soil organisms help glue soil particles together, improving the soil structure. The volume of material will be reduced rapidly as decomposition takes place.

Soil microorganisms require nitrogen for their growth, so the process of degrading fresh organic matter in the soil sometimes causes a nitrogen deficiency for plants. If you use fresh plant material, allow it to decompose in the soil for several weeks before planting into it. Also keep in mind that very woody materials such as saw-dust or sawdust-bedded manures, may cause nitrogen deficiency in soils for a long time, even after composting.

When organic materials are composted before use, the rapid decomposition phase takes place in the compost pile instead of in the soil. Organic matter supplied by compost lasts longer in soil than fresh organic matter because much of the decomposition has already occurred. However, composted organic matter is a poorer food source for soil organisms compared to fresh organic matter, so less of the sticky exudates that build solid structure are produced in the soil after compost application.

On the other hand, composted materials have fewer weed seeds and are less likely to carry plant disease organisms. Composted manures are preferred over fresh manures when contamination of food crops with human pathogens such as *E. coli* is a concern. In a garden situation, fresh or composted materials may be used. If you are establishing a raised-bed garden, compost is preferred because it will lose volume less rapidly and because it has less potential to compete with plants for nitrogen.

TYPES OF SYNTHETIC FERTILISERS

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

Should I use a general purpose or single nutrient fertilizer?

General purpose fertilizers supply plant nutrients i.e. nitrogen, phosphorus and potassium in the largest amounts and may contain other essential minerals such as iron or calcium. These types of fertilizers were developed for ease of use. However, single nutrient fertilizers are widely available and are equally easy to use.

Inorganic and Organic Fertilizers

Any substance that contains one or more essential plant nutrient elements has the potential to be used as a fertilizer. Fertilizers are broadly classified as either organic or inorganic, although the distinction between the two types is not always clear-cut. Urea, for example, is a naturally occurring organic compound, but chemically synthesized urea is generally grouped with inorganic fertilizers.

According to the Department of Agriculture, a natural organic fertilizer has to be derived from either plant or animal materials containing one or more elements (other than carbon, hydrogen, and oxygen) that are essential for plant growth.

Organic food production, however, allows for a broader definition that includes naturally occurring inorganic substances such as rock phosphate, elemental sulphur, and gypsum that are not chemically modified.

Plant roots absorb the majority of their nutrients from the soil solution as simple, inorganic ions (charged atoms or molecules). Larger molecules can also be absorbed, but their rate of absorption is slow. Most inorganic fertilizers dissolve readily in water and are immediately available to plants for uptake. When used according to recommendations, these types of fertilizers efficiently supply the required nutrients for plant growth and are safe for the environment.

However, excessive rates can injure plant roots and potentially lead to environmental degradation. Organic fertilizers are more complex chemical substances that take time to be broken down into forms usable by plants.

They are slow-release type fertilizers, compared to the quick-release characteristics of most inorganic fertilizers. It is important to apply these organic fertilizers well before periods of rapid plant growth.

Organic fertilizers usually have a low salt index, so larger amounts can be applied at one time without causing injury to plant roots. With organic nitrogen sources (except urea), one application can be made without having to be concerned about losing most of the nitrogen to leaching. However, even organic fertilizers applied at excessive rates can cause environmental degradation due to nitrate leaching or runoff of soluble organic compounds.

The cost of organic fertilizers at garden centres on a per kilogram of nutrient basis is usually higher than quick-release inorganic fertilizers. Manure, compost, and many other materials used as organic fertilizers add considerable quantities of organic matter to the soil.

Organic matter can increase soil drainage, aeration, water holding capacity, and the ability of the soil to hold nutrients. The beneficial effects of organic matter on soil structure can have a greater effect on plant growth than the fertilizer value of some of these organic materials.

Slow-Release Fertilizers

Slow-release fertilizers are inorganic fertilizers made up of either larger molecules that require microbial action for degradation or regular fertilizer such as urea that is coated in some way to reduce solubility. Like organic fertilizers they have a low burn potential. They also release fertilizer over a longer period of time. Many formulations are now available that have release rates of 50 days to over one year.

They are particularly useful on sandy soils where leaching of nitrogen is a concern. Higher rates of fertilizer can be applied without the fear of losing nitrate with excessive rainfall. The main disadvantages of slow release fertilizer are the high cost relative to quick-release fertilizer and the release rate is too slow for fast growing crops.

Fertilizer Grades

The grade or analysis of a fertilizer represents its percent composition of the three primary plant nutrients. By convention, nitrogen is expressed on an elemental basis as percent N, whereas phosphorus and potassium are expressed on an oxide basis as percent P2O5 (phosphate) and percent K2O (potash), respectively. Law requires that any material sold as fertilizer be clearly labelled with its fertilizer grade (e.g., 10-10-10) and this analysis is guaranteed by the manufacturer.

The first number in the series is the percent N, the second number is the percent P2O5, and the third number is the percent K2O. It should be noted that N, P2O5, and K2O do not exist in fertilizer in these forms. Rather, these forms are calculated based on the elemental analysis and then simply used to allow a convenient way of comparing the nutrient value of one fertilizer with another.

For example, a 10-20-10 fertilizer has the same amount of nitrogen and potash, but twice as much phosphate as a 10-10-10 fertilizer. Also note that the percentages do not add up to 100. This is because the fertilizer is made up of other elements not included in the analysis and in some cases may also contain a filler or carrier.

Methods of Applying Fertilizers

Fertilizers can be applied in several ways. The most important point to remember is to apply them at the proper rate, as over-application can result in plant damage or death. Follow soil test recommendations or manufacturer's directions. Some of the common fertilizer application methods are as follows:

Broadcast Application

Broadcasting refers to uniformly applying the fertilizer over the entire area before planting. This is the safest and easiest method for the home gardener and best accomplished with a mechanical spreader. The fertilizer should be worked into the soil to a depth of 10-15 centimeters.

Band Placement

Banding fertilizer refers to placement of fertilizer 5-10 centimeters to each side and below the seed at planting. This technique is risky for gardeners to use as placement too close to the seed or at too high rate can cause fertilizer burn and inhibit germination.

Side-dress Application

Side-dressing refers to placing the fertilizer beside the row during the growing season. This technique is usually used to apply additional nitrogen during the growing season and is particularly useful for applying nitrogen on sandy soils.

Top-dress Application

Top-dressing is similar to side-dressing except that the fertilizer is applied around the plant. *Caution: fertilizer applied too close to the plant can cause fertilizer burn.*

Starter Solution Application

Starter solution fertilizers are soluble in water, usually high in phosphorus, and applied as a liquid around the plant roots at the time of planting. They are primarily used for vegetable transplants to hasten root development and establishment. Follow manufacturer's directions for application rates. A general recommendation for 8-16-16 or 15-30-15 is to dissolve 2 tablespoons in 5 liters of water. Then apply 1 cup of the solution around the roots of each transplant.

Foliar Applications

Foliar fertilizers are dilute solutions applied directly to the leaves. They should not be relied upon to supply the total nitrogen, phosphorus, and potassium needs of plants. They can used to supplement soil applications of these nutrients. Foliar applications of micronutrients, especially iron, may be beneficial when high soil pH conditions make the soil iron unavailable to plant roots.

Yard Waste Compost Application

Well-composted yard waste usually has nitrogen availability between 10 to 15% the first year. Application of composted yard waste for general gardening is usually made to improve soil physical properties as well as to provide nutrients. An application of 50 kilograms of moist compost per 30square meters (about 20-30 liters) is sufficient for most gardens.

Incorporate the compost to a depth of 6 to 8 inches. With this application of compost, the amount of fertilizer recommended can be cut in half. Compost that is immature or not well decomposed should be used primarily as mulch. Incorporation of immature compost into the soil may result in nitrogen deficiency and poor plant growth. Do not reduce fertilizer application if the compost is used as mulch.

Types of fertiliser

Fertilisers are available as solid, liquid or soluble formulations. They may either be quick acting or have a slow or controlled release mode of action. The differences of each type and when to use them are explained below.

Solid fertilisers are available in powder or granular form. Growmore is an example of an inorganic granular fertiliser. They release nutrients readily - but are not quick acting. Organic fertilisers such as blood and bone meal and fish and bone meal are slower acting since they need to be broken down by soil bacteria before the nutrients are available to the plant. Solid fertilisers are generally used as pre-sowing or planting fertilisers or routine top dressings. They are less useful where plants are suffering from a nutrient deficiency because of the time it takes for plants to be able to absorb and then use the nutrients.

Solid fertilisers require good soil moisture to transport the nutrients to plant roots. Thus, in dry periods, watering will be necessary. The main benefits of solid fertilisers are their familiarity, ease of application and the fact that they are usually cheaper per unit of nutrient.

Liquid or soluble fertilisers are quicker acting, especially if they can be applied as a foliar feed. This is an important consideration when treating nutrient deficiencies. They are a better option in dry weather although in wet weather, the nutrients can be more easily leached through the soil.

'Straight' Fertilisers, which contain one key nutrient (see table below) are suitable if a gardener needs a particular plant nutrient in preference to others, either because of a deficiency problem or if a crop has a particularly high demand for an individual nutrient. These fertilisers are relatively inexpensive and are often used by 'traditional' gardeners.

Houseplant fertilisers are available in different formulations to suit different types of users. Some are available as concentrated liquids or soluble powders for dilution by the user. These tend to be more cost effective. Some are available ready diluted, for speed and ease of use. Others (eg spikes or tablets) will supply nutrient for several months and are ideal if a user tends to be forgetful about feeding their plants.

Controlled release fertilisers are becoming extremely popular with gardeners - they are easy to use and effective, provide plants with nutrients for a whole season and release nutrients at times when plants have the greatest demand for them. They are particularly good for containers and hanging baskets. They are put into the containers at planting time and perform well throughout the season, without the need for supplementary feeding.

You are now ready to go through a check list. Be honest with yourself.

Tick the box with either a √ or an X to indicate your response.

- ☐ **I am able to describe the benefits of applying the appropriate nutrition to ornamental plants and landscapes.**
- ☐ **I am able to recognise the various types of fertilisers and their composition.**
- ☐ **I am able to demonstrate soil sampling techniques.**
- ☐ **I am able to utilise knowledge of nutrition to successfully propagate and maintain ornamental plants**

You must think about any point you could not tick. Write this down as a goal.

Decide on a plan of action to achieve these goals. Regularly review these goals.

My Goals and Planning:

_____

_____

_____

_____

_____

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_____

_____

PROVIDE CARE FOR ORNAMENTAL PLANTS

264192

A person credited with this unit standard will be able to:

- Utilise the principles and practices of safety when providing plant care
- Recognise the effects that environmental conditions have on common plants
- Provide care for newly-planted plants
- Conduct the necessary pruning, trimming and deadheading of plants
- Implement watering, feeding and pest control programmes

INFLUENCE OF ENVIRONMENTAL FACTORS ON PLANTS

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

Just like a person who moves into a new environment, plants go through a period of adjustment during which they need a little extra help to settle in. Understanding and providing the basic needs of new plants will increase their chances of successful establishment.

Nothing can be more frustrating for a gardener than to spend time deciding what plants to grow, travel to the garden center to select and purchase the plants, take them home and go through the work of planting them only to have the plants either fail to perform as expected or worse yet, die.

New plant care does significantly differ from established plant care and just a few extra minutes of your time can make all the difference. Plants grow in nature without all sorts of extra attention, why can't I rely on nature to take care of the plants in my landscape?

Ideally, nature would take care of this for us. Unfortunately we often want to grow plants in places they wouldn't naturally grow. We also want to grow more of them than would naturally grow in an area. And we want to plant them at what nature would consider being the "wrong" time or season.

Because of all this, we can't simply rely on nature to provide what is needed to establish our new plants. "A new plant" will vary according to the type and size of plants. Generally, our goal is to be sure any plant is getting what it needs until it has developed a new root system and foliage that is extensive enough to let it gather what it needs from its surroundings.

With fast growing plants such as annual flowers and vegetables, new plants will only need extra attention the first two or three weeks. Because they are genetically programmed to complete their life cycle within a growing season, they very quickly develop the needed roots and foliage.

Perennials are a little slower to establish and may require special attention for a month or two. Woody plants such as trees and shrubs are much slower growing and are usually larger to start with, so they will require extra attention throughout their first growing season.

If they are planted late in the season, they may need some help early the next season too. If you are planting very large plants of any type, they will need even more care because they have much more plant material to support right away.

Bulbs are the exception. Because they have their own fleshy storage system (i.e. a bulb, corm, rhizome, etc.), they are a little bit more tolerant of adverse conditions. After going through the initial period of time when you have babied them, plants will develop extra strength by going through slight periods of drought or other stress.

But you certainly don't want to push them too far. In the wild, it isn't too crucial if a few trees out of a hundred die from some stress, but losing just one tree can be very important to the home landscape.

A plant's needs can be divided into two categories: what plants need before they are planted and what they will need after planting. Before a plant is introduced, you need to determine if the site is right. Does it provide the level of light this specific plant will need to thrive? Is the soil type compatible with this plant?

Is the pH of the soil acceptable? Is there good air circulation? Once you have matched the plant to the site (or made any necessary adjustments to the site), the plant will require water and nutrition.

Of course, the most critical time is going to be right after it is planted. Again, this critical time period will vary according to the type of plant. You are moving a plant from one environment into another and it will help to take a few moments and note just how much of a change might be taking place.

The plant may be going from a sheltered area where it was kept consistently moist to an exposed spot in your yard. The more drastic the change, the more careful you will need to be. During and immediately after the move, you will need to watch for signs of water stress. Newly planted plants may also develop signs of sunburn or windburn.

If you have time, introduce the plant to its new environment gradually. If the plant is coming straight out of a warm greenhouse, let it spend a few days in a cooler area before planting. And if it is going from shade to sun, let it spend a few days where it will get lots of sun, but be shaded from the more intense direct afternoon sun. Letting the plant acclimate to its new surroundings gradually will make your job easier in the long run.

There is a single element that is the most crucial it's water. All plants need water. Plants gather water principally by absorbing it with their roots from the soil. While a new plant has limited roots reaching into the surrounding soil, it is important to keep that area consistently moist, but not wet.

How much water you will need to provide depends on the soil type, ground temperature, air temperature, how windy it is and the type of plant. Because so many factors can influence the amount or frequency of watering, there is no magic formula. You will have to judge your own situation. The most common and obvious sign of trouble with a plant is wilting.

The confusing part is that while plants most often wilt from lack of water, they can also wilt from too much water. Check the soil by digging down a few inches and feeling it before adding water. If it is still moist, lack of water is not the problem. Watering when plants have wilted from lack of water is easy. Drying out a plant that is too wet is difficult, especially since we don't have control of the rain.

To give your plants a jump-start try Bonides Start-Up Plant Starter. This is a very gentle starter solution. They are nutritionally very dilute and often contain a rooting hormone such as IBA (indole butyric acid) and might also contain some vitamins.

Plants should be allowed to rely on the nutrients already in the soil when they are first planted. The general rule is related to the guideline you use for providing extra care. Annual flowers and vegetables can be fertilized after the first two or three weeks. Perennials can be fed after the first month or two. And woodies can be fertilized after their first season. When fertilizing the basic rules for fertilizing and what formulas to use should be followed.

Transplant shock is fairly common in newly transplanted trees. Arboretum researchers have found that a tree can lose as much as 90% of its root system when it is removed from the nursery. This causes a great deal of stress on the plant as it is tries to re-establish itself.

Research has shown that approximately one year of recovery is needed for every inch of tree diameter. Starting a regular plant maintenance and inspection program to head-off problems early, and providing good after-care will help maintain the health and vigour of your newly planted trees and shrubs.

Water is probably the most important element in caring for new trees and shrubs. Since a newly transplanted tree or shrub has not extended its roots into the existing soil, adequate moisture needs to reach the root ball.

Soil type and the amount of rainfall govern the amount of watering necessary. On most well drained soil, one inch of water per week throughout summer and fall is required to establish and maintain good growth. In sandy soils, as much as 5 centimeters of water per week is needed.

Mulch is another important element in good plant health care maintenance. Apply a 7-10 centimetre layer of organic, composted mulch (wood chips, leaves, or pine bark) extending from the base of the plant out past the drip line (end of the branches). Do not let the mulch rest against the trunk of the plant.

All plants benefit from mulch, because, as the mulch breaks down, it provides an excellent growing medium for roots, and acts as a slow release fertilizer. Mulch will also help conserve moisture, moderate soil temperatures, eliminate weeds, and protect the trunk from mechanical injury, especially weed whips and lawn mowers.

Fertilization at the time of planting is generally not recommended. It is ineffective until the root system has a chance to re-establish. It is usually advisable to wait two or three years before applying fertilizer, and then it is recommended to get a soil test first.

Pruning after planting should be limited to removing dead, rubbing, or broken branches only. Wait at least a year before removing any larger limbs or shaping the structure of the tree or shrub. Remember, pruning encourages growth, so cut only where you need growth, and try to maintain the natural shape of the plant.

Occasionally trees may require support, especially in windy sites, to prevent uprooting and leaning until the roots have had a chance to grow and stabilize that tree. Avoid staking too rigidly. Some trunk flexibility allows the flare at the base of the tree to develop naturally. Inspect staking material regularly for tightness and damage, and remove after one or two years.

The effects of cold

Cold weather, particularly frost, causes the water in plant cells to freeze, damaging the cell wall. Frost-damaged plants are easy to spot, their growth becomes limp, blackened and distorted.

Evergreen plants often turn brown and the leaves of tender plants take on a translucent appearance. Frost problems are often made worse where plants face the morning sun, as this causes them to defrost quickly, rupturing their cell walls.

Hardy plants and tough evergreens can also be damaged by prolonged spells of severe cold when soil becomes frozen. Roots are unable to take up water and plants die from lack of moisture. Periods of cold, frosty weather during April and May can also kill blossom and damage fruit.

Minimising damage

Prevention is far better than cure, so try to minimise the damaging effects of cold on your plants:

- Avoid golden or variegated plant varieties that are often more tender.
- Choose plants that are reliably hardy in the area where you live.
- Avoid high-nitrogen fertilisers as they encourage plants to make lots of sappy leafy growth that is particularly susceptible to damage, especially early and late in the year.
- Make sure tender specimens are planted in a sheltered spot, under large trees and shrubs or against walls, give them some heat and protection during the winter.
- Ensure that plants with tender flower buds or shoots are not planted in east-facing sites.
- Leave the old growth of tender plants un-pruned over the winter months. This will help to protect the central crown of the plant and take the brunt of any frost damage. If plants are cut back hard in autumn new growth could be damaged by frost.
- Cold air and frost always descend to the lowest point in a garden so avoid planting tender plants in obvious frost pockets.

Damaged plants

If your plants do get frosted this doesn't necessarily mean the end for them, many plants will recover given time. However there are ways of minimising the damage:

- Protect them from the morning sun, which can damage growth if the plant defrosts too quickly. If you can't move the plants, try covering them with a layer of black plastic to block out the sun.
- Cut back frosted growth in spring to a healthy, new bud, to prevent further die back and encourage plants to produce fresh, new shoots.
- Feed damaged plants with a balanced fertiliser (one with equal amounts of Nitrogen, Phosphorus and Potassium) to encourage strong, healthy growth.
- Dig up small, tender plants and take them into the greenhouse. Many will quickly produce new growth and recover, provided they are not subjected to prolonged periods of heavy frost, wet or cold.
- Newly-planted specimens will often lift themselves proud of the soil surface if there is a hard frost straight after planting. Check them regularly and re-firm the ground around them to ensure their roots are always in contact with the soil.

Protecting plants

The ever-increasing number of tender plants on offer may not withstand sustained cold without some form of protection. How you protect your plants from the effects of cold depends on the type of plants and the situation they are growing in.

- Plants that are trained against walls or tender plants growing in the open ground can be protected with simple, fleece-covered frames. Alternatively, sandwich a layer of bracken leaves or straw between two large sections of chicken wire and use this to cover plants during frosty evenings. Tender bulbs, corms and tender, herbaceous plants (that die back) should be covered with a thick mulch of manure, straw or old leaves to prevent the soil from freezing. In the spring, new shoots can be protected with a loose layer of straw or a bell-cloche.
- Evergreen plants will benefit from a thick layer of mulch around their bases to keep the soil frost-free. This will allow them to take up moisture during periods of cold weather and stop them from becoming dehydrated.
- Tender plants should be grown in pots so that they can be moved inside during bad weather. Take cuttings of those that cannot be grown in pots and over-winter these in a warm greenhouse, ready for planting in spring.
- Protect the crowns of tree ferns and insulate their trunks by wrapping them in layers of fleece or hessian stuffed with straw. Cordylines and palms should be treated similarly, by tying their leaves into bunches, to protect their crowns.

- Protect low-growing plants from wet weather by covering them with a sheet of glass or a cloche and surrounding them with a layer of gravel or grit, to ensure swift drainage.
- Choose outdoor containers that are frost-proof to prevent them cracking. Lift pots and containers into a shed or greenhouse for protection. Those that can't be moved should be placed on 'pot feet' to prevent waterlogging. Using a light, free-draining compost with added perlite will also help with this. Insulate them with a layer of bubble wrap or hessian to prevent them freezing and cracking and ensure plant root-balls stay healthy.

Frost can affect many plants, and is particularly damaging to tender new growth and blossom in the spring. The risks of frost damage can be reduced by taking some simple steps to protect the plants in your garden.

How do plants protect themselves from frost damage?

Plants can survive frosts by several mechanisms:

- Sometimes bark can insulate the living water-conductive tissues in the same way that water pipes are lagged to prevent water freezing within cells
- Some plants accumulate materials, certain sugars and amino acids for example, that act as anti-freeze lowering the freezing point of cell contents – shortening autumn days induce this
- A more effective mechanism is the ability of some plants to allow their cell contents to 'superfreeze' where the cell contents remain liquid even though below freezing point. To do this plants have to experience several days of cold weather before the freeze and this explains why even hardy plants can be damaged by a sudden autumn frost
- In very severe climates such as within the arctic circle native trees remove water from their cells, tolerating the dehydration of the cell contents, and place the water between the cells where it can freeze without causing damage. This works where the weather provides a prolonged slow chilling

Symptoms

Sometimes frost damage is apparent almost immediately following freezing. However, this is not always the case and with some plants, particularly woody ones, the damage may take several months to appear. Look out for the following signs;

- Tender young growth may be damaged by spring frosts, causing scorching and pale brown patches to appear between the leaf veins. This tends to be on the exposed and top edges of the plant e.g. acer and carpenteria

- Hard frost in winter can cause the leaves of hardy evergreen plants to be scorched and turn brown, and may eventually lead to the death of the plant, e.g. bay and pittosporum
- The foliage of tender perennials e.g. dahlia and canna may be blackened by the first frost of autumn. Stems usually collapse
- Spring frosts can damage blossom and young fruits. This may cause a corky layer to form at the flower end of the fruit i.e. apple and damage to blossom may lead to few or no fruits forming
- As a result of late spring frosts summer bedding plants and tender vegetables, such as potatoes and tomatoes, may suffer from leaf scorch, browning and even total plant death
- Prolonged periods of frost may cause spotting on the leaves of some shrubs such as photinia and garrya
- The foliage of certain plants exhibiting early symptoms of frost damage appears water-soaked and dark-green, turning black in time

Causes of frost damage

Ground frost occurs when the temperature of the ground falls below freezing point (0ºC/32ºF) and air frost occurs when the temperature of the air falls below freezing point. Plant cells can be damaged or even destroyed by frost. Repeated freezing and thawing, or very rapid thawing can be particularly damaging to plants. Once the temperature has fallen below freezing, a strong wind can make a frost more damaging. Cold winds remove moisture from evergreen foliage more quickly than it can be replenished by the roots; this can cause leaf browning particularly at the tips and margins.

Tender plants survive the winter better when they are planted in a sheltered sunny position. This is because new wood is ripened by the sun accumulating more carbohydrates during the growing season, making it more frost resistant. Newly planted, young plants can be more susceptible to frost damage than fully established specimens.

Cold air naturally flows downwards on sloping ground, collecting at the lowest point or against a barrier, this is known as a 'frost pocket'.

Prevention of frost damage

There are a number of ways to keep your plants safe during cold weather;

- Choose plants that are reliably hardy and suited to your growing conditions.
- Select planting positions carefully to avoid 'frost pockets'
- Slightly tender plants should be grown in a warm sunny spot, e.g. against a south-facing wall, which will provide some extra warmth and winter protection

- Cover plants with a double layer of horticultural fleece or other suitable protection when frost is forecast
- Mulch the root area of evergreens, conifers, tender shrubs and tender perennials with a thick layer of organic matter to prevent the ground becoming frozen
- Move container-grown plants to a sheltered part of the garden in cold weather and provide some extra protection by wrapping the pot in bubble wrap
- Leave the previous seasons' growth on more tender plants until spring, for example penstemon, as this provides valuable frost protection during the winter
- Tender plants can be lifted or moved to a more sheltered position or greenhouse. If this is not practical then protect them by wrapping examples include bananas and tree ferns
- Lift tender perennials such as dahlias, cannas, pelargoniums and fuchsias before the first frosts
- Protect fruit and strawberries from frost by packing with bracken or straw
- Avoid applying nitrogen-rich fertilisers late in the season as they stimulate soft, sappy growth which is especially vulnerable to frost damage
- Plants exposed to early morning sun may thaw too rapidly after a frost, causing damage to flowers and young growth. Camellia and magnolia flowers in particular can be ruined by a single frost
- Plant tender bedding plants out after the danger of frost has passed; this is generally late May in the south of England and June elsewhere. Always harden off plants before planting outside
- Ensure tender plants are overwintered safely in the greenhouse by providing adequate heating

Treatment of damage

As most gardeners will testify, it is easy to be caught out by frost. And sometimes frost damage is simply unavoidable. When damaged has occurred, what should be done?

- If no more frost is expected, prune out damaged growth, cutting to an undamaged sideshoot or bud
- After pruning, apply a top dressing of a general-purpose fertiliser to encourage strong re-growth
- If a fence or hedge is causing a 'frost pocket' consider creating a gap, or remove some of the lower growth to improve cold air drainage
- Frost may lift newly-planted shrubs out of the ground, so check and re-firm the ground around them
- In gardens exposed to cold winds, consider creating more shelter by planting a shelterbelt
- Even though the foliage of dahlias and cannas has been blackened by frost the roots are alive and can still be protected or lifted and stored
- Important: Do not automatically give up on a plant that has been frost damaged. Many plants can be surprisingly resilient and may well rejuvenate from dormant buds at or below soil level. This takes time so recovery may not be seen until early summer. If the plant is of high value or it is not essential to fill

the gap, consider leaving the damaged plant in the ground until mid-summer. If no re-growth has appeared by then, replace the plant.

Watering on plants

Watering

Vegetables, bedding plants, and perennials are usually small when planted and have comparatively shallow roots. These plants may have to be watered more often to ensure a consistent water supply. Check the soil with a trowel or spade to the depth of the expected root zone.

The entire root zone should be moistened before the plants show signs of wilting. If the plants are allowed to wilt a few times, growth will be retarded and harvest yields reduced. Be careful not to overwater. Drip irrigation systems are beneficial for this purpose.

Plants in containers need special attention. Both volume of soil and total water available for plant use are limited. These plants have to be watered more often than plants growing in the ground. Watering should begin when the soil surface feels dry to the touch, but not before. Frequency and amount of water depend on media, location, amount of sun, temperature, type of plant, etc. Containers which have been allowed to completely dry out may need to be soaked in water to rewet the soil.

A plant which uses a lot of water, such as Fuschias, or one that is pot bound, may have to be watered daily or several times a day. But for most container grown plants, a thorough watering once or twice a week will be sufficient. Plants in plastic or solid containers will have to be watered less often than plants in porous containers or clay pots. Be very careful not to keep the root system constantly soaking wet. Pathological (disease) problems will occur if air is excluded from the soil.

Trees, shrubs, and landscape plants should be watered just inside and outside the drip line, or outer edge of the plant. In foundation or border plantings, it may be more convenient to water the entire area. A hose, soaker hose, or various kinds of sprinklers are commonly used. For deep-rooted trees, a root needle or fertilizer feeding needle (minus the fertilizer) may be used for deep watering. This is a tedious process but it works. Penetration is important.

A dished- or berm-enclosed area constructed around the base of a tree or shrub may be filled with water. This allows for slow percolation into the root zone. However, on heavier soils during the rainy season or in the winter, these basin rims are best removed to avoid concentrating too much water.

Shrubs and trees near house foundations, under eaves, have to be watered more frequently. They may get little water from precipitation, and reflected heat from walls leads to increased water and heat stress.

Capillary action can cause dissolved salts to be carried from moist zones into the dry soil under eaves. A salt concentration is then left behind as the water evaporates. Thorough leaching of such areas may occasionally be necessary, particularly in the drier regions of the state, to remove salt build-up.

Mounds or berms in which landscape plants have been installed have much more soil surface exposed to evaporation than the natural soil profile. Therefore, these areas will have to be checked and watered more frequently.

Recently transplanted woody plants need special attention. The soils in which balled and burlapped and containerized plants have grown are often radically different than the soils into which they are planted in the home landscape. When this occurs, interfaces are created between the original nursery soil and the soil at the new site. Because of these interfaces, water does not move readily between the different media.

Therefore, it is most important that water be applied to both the nursery soil and the surrounding soil during the critical establishment period. Roots grow only where there is moisture, and unless both media are moist the roots may never grow out of the original nursery soil. Plants in such a situation may ultimately girdle themselves and die.

Container soils, in particular, have a bad habit of drying out much faster than the surrounding or backfill soils. Both media should be adequately moistened to prevent newly installed plants from being injured or dying of drought; be careful not to overwater.

Mulching newly established shrubs and trees helps prevent moisture loss. Moisture-demanding plants, such as rhododendrons, azaleas, and ferns, have to be irrigated more often during warm, sunny weather.

Many native woody plants should not receive summer watering. Once they are established, they are drought tolerant in the summer, and some may be damaged by moisture at this time. It is especially important to keep water away from the crowns and larger roots of madronas and western dogwood in western Washington. They often succumb to root rot problems with summer watering. Avoid planting moisture demanding plants underneath them.

Other drought tolerant shrubs and trees also do not need to be watered. For lists of drought tolerant shrubs and trees, a good reference work should be consulted. Many plants in the following genera have proven themselves drought resistant: Caragana, Ceanothus, Cotoneaster, Cytisus, Eleagnus, Genista, Juniperus, Koelreuteria, Pinus, Quercus, and Robinia. There are also many more.

Lawns are best watered by overhead sprinklers. The deeper the wetting, the deeper the roots will grow. Deep-rooted grass plants are much healthier and better able to withstand drought stress. Grass should be watered when the soil begins to dry out, but before the plants actually begin to wilt, and certainly before they begin to desiccate.

Grass should be irrigated when it begins to be less resilient and springy and does not bounce back up after being walked on. The amount of water to wet the root zone is determined by soil type, amount of thatch accumulation, and several other variables. To determine when a sprinkler has put out an inch of water, or any specific quantity, simply use several coffee cans or jars spaced at intervals from the sprinkler itself to the edge of the watering pattern.

Conservation of water - Water is a scarce commodity and will continue to become scarcer in South Africa. With a little care and prior planning, water can be conserved when used for home plantings. Anything that can be done to reduce downward percolation, run-off, and evaporation from the soil surface or transpiration will conserve water.

Organic matter - Deep incorporation of some sort of organic matter will help reduce downward drainage (percolation) if done before planting. This may not be feasible for shade and ornamental trees, but can be done for vegetable gardens, flower beds, and foundation plantings. Organic matter absorbs many times its own weight in water, which is then available for plant growth.

Mulching materials placed over the soil reduce evaporation from the soil surface, may also reduce some of the water run-off, allow better water penetration into the root mass, and limit weed growth. Mulches may be organic (shredded leaves, bark, sawdust) or inorganic (gravel, etc.). Plastic mulch is especially effective in limiting evaporation from the soil surface, but also limits water absorption.

Spraying - Little can be done to stop plants from transpiring. However, newly planted plants (woody, bedding, vegetable) will benefit by occasionally spraying the foliage during the day, and by shading.

Trickle or drip irrigation systems allow slow water penetration into the root zone with minimum surface wetting. Such installations may be worthwhile, particularly if large areas are to be irrigated. A variety of kits and parts to make up such a system is readily available. Plastic tubing, emitters, filters, and pressure reducers are included in these systems. They are easily attached to an existing outdoor water supply. Drip or trickle irrigation allows a steady supply of water to be delivered slowly to the soil around the plant roots. Often a 60 percent or more savings in water usage may be realized using such a system.

CREATING A FEEDING SYSTEM FOR PLANTS

TIME: 180 MINUTES **ACTIVITY: SELF & GROUP**

About plant nutrients

Most plants need three major nutrients to thrive; nitrogen, phosphorous and potassium, which are generally known as NPK (their chemical symbols). The three main nutrients are needed by plants for different reasons.

Nitrogen promotes leaf growth, phosphorous is for the roots and potassium is needed for flower and fruits. The amount of each is written on fertiliser packets as a ratio, for instance 6:4:6. Note that the order of nutrients is always the same, ie N, P, K. If the ratios are about the same, it is a general-purpose fertiliser and will aid all round growth, but some fertilisers are higher in one or another nutirent.

For instance, tomato fertiliser is designed to promote lots of plump fruit and will be high in potassium (K) and have a ratio of 4:5:8. Similarly a fertiliser for feeding grass in the spring will be high in nitrogen.

To remain healthy, plants also need other nutrients, such as calcium (Ca), sulphur (S) and magnesium (Mg), as well as zinc (Zn), iron (Fe), copper (Cu), boron (B) and manganese (Mn). Smaller amounts of these will be contained in most general fertilisers.

What to do

When to feed

- Give beds and borders a kick start by feeding in spring with a slow release fertiliser, before plants have put on too much growth. This is known as top dressing. Fertiliser applied to the soil and worked in prior to sowing or planting is called base dressing.
- Vegetables are hungry crops and will thrive if given a slow-release fertiliser two or three times a year.
- Other 'greedy' flowering plants, such as sweet peas, clematis and roses, will benefit from a mid-summer 'top up'. Sprinkle fertiliser around plants and water in. There's no need to feed in late summer. This only encourages a flush of late, lush growth that'll get hit hard by frosts.
- During the growing season, feed flowers in hanging baskets, pots and containers once a week, using a liquid feed applied from a watering can.

Improving soil

- Apart from providing fertilisers to the soil, it's a good idea to enrich soil before planting by adding plenty of organic matter, such as leaf-mould, garden compost or well-rotted manure. Not only will this boost the nutrient content of the soil, but it will improve its structure and help it to retain moisture.
- To do this spread a thick (about 5cm (2in) will do) layer of the material over the soil and fork into the surface to a depth of about 10cm (4in). To give existing beds a boost, mulch around plants with organic matter in the spring.

Different fertilisers

There are many different types of fertiliser available, including liquid tonics that can be applied from a watering can, granular fertilisers that are mixed into compost and powdered feed that is applied to the soil.

These feeds work in three main ways:

1. Controlled release fertiliser – ideal for containers, these come as granules that are mixed into compost and release their nutrients over a long period of time, some for up to 12 months. Plugs made from granules bonded together are also available - these can simply be pushed into the surface of the compost.
2. Slow release fertiliser – good for feeding plants in the soil. Usually applied as a powder that can be scattered around perennials, trees, shrubs and vegetables.
3. Fast acting fertiliser – for plants in need of a pick-me-up. These are ideal if a plant is suffering from a deficiency and are usually applied in a liquid form that can be used by the plant quickly.

Seaweed fertilizers are a good organic option. Alternatively try diluting the liquid from a worm composter

You are now ready to go through a check list. Be honest with yourself.

Tick the box with either a √ or an X to indicate your response.

- ☐ I am able to identify the various stages in the reproductive cycle of a flowering plant.
- ☐ I am able to explain how each stage develops from the previous one.
- ☐ I am able to recognise all the major physiological components that are involved in the reproductive cycle.
- ☐ I am able to utilize knowledge of the reproductive cycle in the propagation of ornamental plants.

You must think about any point you could not tick. Write this down as a goal.

Decide on a plan of action to achieve these goals. Regularly review these goals.

My Goals and Planning:

_____
_____
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