Lesson 5

The universal law of

MOVEMENT

Lesson summary

In this lesson you will:
•Identify processes and agents of movement in the soil and around the garden

• Learn how to get rid of snails and slugs

•Learn how to propagate your own seedlings

• Have a strategy for maintaining long-term soil fertility and at the same time maximise production.

• Start work developing a planting schedule so that you have a constant supply of nutritious food.

• Know which vegetables to plant from seed and which to transplant as seedlings.

Review of Lesson 4

In Lesson 4 we looked at some of the trace elements that are essential to healthy plants and the problem of sourcing a reliable supply of organic matter than contains a full range of trace elements. Some problems arising from the use of poisons to stop damage by pests and disease were outlined. Your practical task was to start building and maintaining soil fertility and to start propagating your own seedlings. A discussion of the importance of providing an environment that supports the "good guys" highlighted the contribution made by birds and bees to your garden.

Task 1
It is not important for you to know lots of details about trace elements, but it is important for you to understand just how important they are and how they interact with one another. To help you review the information on trace elements, complete the following multiple-choice exercise. Circle the correct answer.

1. The best source of trace elements will be:
(a) Compost incorporating organic matter from your garden.
(b) Compost from your garden to which crushed basalt and seaweed have been added.
(c) Blood and bone from grain fed beef.
(d) Compost from your garden plus chicken manure.

2. Catalysts:
(a) Control chemical processes in plants.
(b) Are substances that promote chemical reactions but don't end up being part of the end product.
(c) Allow plants to generate the energy used in a variety of processes.
(d) All the above.

3. Carbonic anhydrase:
(a) Is a catalyst.
(b) Is a trace element.
(c) Requires zinc to be present before it can be formed.
(d) Converts carbonic acid to carbon dioxide.

4. Phosphorous is taken up by plants in the presence of:
(a) Zinc
(b) Iodine
(c) Cobalt
(d) Molybdenum

5. The difference between trace elements and elements such as calcium, phosphorous and magnesium is:
a) Trace elements become part of the structure of plants.
b) Trace elements are not as important as elements such as calcium and phosphorous.
c) Elements like calcium, phosphorous and magnesium cannot function fully without the catalytic role of trace elements.
d) Trace elements are constituents of proteins.

6. Copper:
(a) Is critical for the uptake of moisture
(b) regulates cell division
(c) Is necessary for the formation of the nitrogenase enzyme.
(d) Is essential for the production of chlorophyll.

7. Iron:
(a) Fixes boron to the chloroplast.
(b) Requires sulphur before it moves in plants.
(c) Is required for the assimilation of nitrogen.
(d) Helps to fix atmospheric nitrogen.

8. Atmospheric nitrogen:
(a) Can be used by plants only in the presence of cobalt.
(b) Requires molybdenum for the formation of the nitrogenase enzyme that is vital in nitrogen fixation.
(c) Cannot be used by plants in its gaseous form.
(d) All the above.

9. Boron:
(a) Is toxic in soils in which phosphorous is deficient.
(b) Releases anions from the soil.
(c) Regulates cell division especially in the tips of roots and in leaves.
(d) Is rare in Australian soils because it leaches easily.

10. Selenium:
(a) Is rare in Australian soils
(b) Is involved in the formation of many enzymes.
(c) Affects the working of oxygen, carbon and nitrogen.
(d) All the above.

Task 2

Complete the following exercise. This will help you remember some of the important jobs that trace elements perform. Add the appropriate trace element to make the sentence correct.

Remember, these exercises are not intended as tests. The intention is that you review the data you have been given and become familiar with it.

1. _____ is necessary for the formation of nitrogenase.
2. _____ is needed to produce energy molecules.
3. _____is required for the assimilation of nitrogen and carbon dioxide.
4. _____ reduces availability of phosphorous and sulphur.

5. _____ is essential for production of chlorophyll.
6. _____ increases the uptake of ammonium nitrogen.
7. _____ is necessary to convert nitrogen to nitrate.
8. _____ regulates potassium
9. _____ is the carrier for ten other minerals.
10. _____ works with copper and potassium to build stalks.
11. _____ is essential for the germination of seeds.
12. _____ regulates cell division.
13. _____ is rare in Australian soils.
14. _____ is critical for the uptake of moisture.
15. _____ increases stalk strength and elasticity.
16. _____ stimulates beneficial bacteria in soils.
17. _____ releases cations from the soil.
18. _____ aids in the synthesis of chlorophyll.
19. _____ is required for the uptake of iron.
20. _____affects the working of oxygen, carbon and nitrogen.

Task 3
Select one piece of information from this lesson that you believe is significant in terms of how you think about your garden.

Explain why you believe it is significant.

_____
_____
_____
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The Universal Law of Movement

If you stand and look at a garden, you may not realise that there is movement everywhere. Again, we do not feel it, but Earth itself is in a state of constant movement. It moves on its axis and it moves in its orbit. On Earth, air and water are constantly circulating.

If there is a breeze blowing you will see leaves moving, but this is nothing compared with the movement that is going on everywhere: within the soil, in the plants, between the plants and the soil, between the air and the soil, and between the air and the plants.

Airborne elements including oxygen and nitrogen move into soil and into plants. Others, including carbon, move from the soil and the leaves into the air. Within each plant there is constant movement of elements upwards and downwards through the processes of capillarity and osmosis. Even within and between cells there is movement of minerals. Within soils, minerals and organic matter are moved around as a result of the activities of earthworms, caterpillars and arthropods and as a result of the processes of leaching, infiltration and evaporation.

As a gardener you will find that your major job involves moving things from one place to another. Digging involves moving the soil from where it is to where you want it. Weeding involves moving various types of plants from where they are growing and putting them somewhere else. Composting involves moving what remains of the crops that have been harvested and placing them, with a variety of other materials that you have assembled from other places. Mowing, harvesting and edging are tasks that require constant movement. You're likely to find, as I do, that

the cart that is attached to your ride-on mower or your wheelbarrow is in constant use.

Movement takes energy and sunlight is the source of the energy being used, which is turned into food: the source of our energy.

Man would be wise to take his lead from Earth and the natural systems of Earth. As a people, we have become too sedentary, relying on the energy of Earth to act as a substitute for our own energy. The consequence of stopping physical movement is seen in fat accumulation and poor blood circulation making movement more and more difficult. Oxygen is not available to provide the energy that movement requires.

What you may not realise as a gardener, is that movement actually activates cellular memory which contains the records of all that we know, and have ever known, both consciously and unconsciously. With movement we are able to tap into information, which exists within the same vibrational frequency that we operate at. When our frequency is at a high level, we tap into knowledge of how Universe operates. In your garden you will start to tap into information about how the natural world operates and start to realise that you have allowed yourself to be manipulated by organizations whose function is to control.

Once there is an awareness that the soul does not have to bow to such control, ways will be found to create communities which no longer need to comply with the standards and rules of the world as we know it: rules and standards that have been dictated by those organizations that are in control in order for them to remain in power.

There is no way that communities that do not have to rely on organizational structures provided by those in power can be controlled. By demonstrating the possibility of self reliance, even in something as simple as taking responsibility for growing your own food, people like yourself act as a beacon to which people will be drawn so that they too can learn and understand and then apply what you have learnt, in their own lives.

Organizations, which control the type and quality of food we eat are among the largest and wealthiest in existence, second only to the oil and agrochemical multinationals. We are seeing signs that these organizations are starting to collapse under the weight of the reliance they have created. They no longer have the means to supply the needs of those who have become reliant. Nor do they have the answers any more. Those who seek the continuance of such structures know, deep down, that it is only a matter of time before they will collapse.

Food supplies are no longer guaranteed and we are already sleepwalking into crisis. Food prices are escalating and this trend is unlikely to change any time soon. Fortunately, there is an alternative to food provided by others. We can grow our own. Food we grow ourselves is fresher, chemical free and nutritionally better than food we buy,

Increased oil prices affect every aspect of commercial farming, which uses very high levels of oil-based energy. Drought in Australia has had a big impact on food production. Uncertain weather is causing dislocation in food supplies. In March, 2008, organically grown tomatoes were just not available in Queensland. This problem of shortage is not restricted to Queensland. It is a worldwide issue, and one, which many are looking at with concern.

In early 2008, global wheat stockpiles had fallen to a 30-year low and prices had risen 50% over the previous twelve months. By mid 2008, Japan, South Korea, Iraq, Egypt, Taiwan, Mexico,

Nigeria and Venezuela were looking to import huge quantities of wheat at a time of steadily decreasing supply. In some countries riots broke out in the face of rising wheat and rice prices.

Disaster, whether man made or of natural origin, creates massive movement. Famine, and the prospect of famine, creates worldwide movement of people. Seeing this, we are starting to realise that unless something is done to change the rules that have been set by those in power, we can anticipate a scenario of greater and greater chaos and disruption. Wealthy countries, which are being "invaded" by the poor and dispossessed of this world, are having difficulty coping with the influx of people. Perhaps this will provide the motivation to help those who have been massively disadvantaged by a grotesque system that allows 800 million people go hungry.

Disasters also provide motivation to change the status quo. On a world scale we are seeing countries achieving independence and self-determination. In the past they have served the more powerful nations by providing resources, land or labour and have subjugated their own unique customs, religions, and cultural practices in return for promises of "security". The Chiqitanos of Bolivia are an example of such people. They lost their land when Bolivia was colonized and were forced to work on rubber plantations to survive. In July, 2007, through an extraordinary process of self-organization, the Chiquitanos won back their land.

The consequence of subjugation of land, people and resources has been that those who control powerful nations have grown obscenely rich. The income of the 500 hundred richest people in the world exceed that of its poorest 400 million. Much of the turmoil we are now witnessing is a consequence of weaker groups and nations demanding the opportunity to be independent and responsible for their own destinies. Such moves are creating huge changes and are being resisted. Change disturbs the status quo. In situations of change, secrets are uncovered: secrets relating to misappropriation of funds, greed and corruption of those in power, or the use of force, manipulation and lies to keep populations under control.

Through movement, change will eventually occur. Balance will be restored, just as it is in nature. We will realise that stealing other people's land and resources, is not a long-term strategy for achieving abundance.

Agents of Movement in Your Garden

Probably the greatest amount of time you spend in your garden will be involved in movement of some form or another. At times it will just be you who is moving. Sometimes you will be behind the lawn mover or pushing the wheelbarrow, or wielding a pick. Most of the time it will be you moving things from one location to another. You will move plants that have finished producing to the compost bin to decompose and create humus. You will take the humus back to the garden to re-fertilise the soil. You will take seedling from the planter boxes or from their packets to where you want to plant them in the garden. You will move branches you have pruned. You will take mulch or fertilizers from where they have been stored and put in on the garden. You will move manure to where it is needed and weeds from where they are not needed. In a garden you are constantly moving and it is that constant movement that keeps you fit.

In addition to your own activities, a whole variety of creatures and processes cause movement in your garden. You don't realise that there is constant movement until you stop and watch. Creatures that are constantly moving include birds, insects, bees, ants, snails and worms. Processes involving movement include transpiration, diffusion, osmosis and capillarity.

insects

In scientific terms, an insect is any small organism with six legs, but we commonly call any small creature that has more than four legs, an insect. Thus mites and spiders are often thought of as insects. Beetles, ants, aphids, bugs, grasshoppers are all classified as insects.

Bugs cause damage by sucking sap from the plant leaf. Bugs have a proboscis running down their undersides and they use this to pierce fruit or leaves. When sap is sucked from the plant leaf, white spots are left where the insect has removed the chlorophyll.

Bugs include aphids, mealy bugs, scale, fruit spotting bugs, plant hoppers, harlequin and lace bugs and whiteflies. Not all of them are bad. The assassin bug is a beneficial bug.

Insects, also cause damage by chewing. Beetles, crickets, sawflies, grasshoppers, millipedes and earwigs are all chewing insects. They use their mandibles to cut into plant tissue leaving holes. Some insects only eat the soft tissue and leave skeletal remains.

Caterpillars and grubs are insects that haven't yet grown up and because they are voracious eaters, are the ones that do the most damage. Grubs are immature beetles and caterpillars are immature moths and butterflies. Eggs are often laid directly onto vegetables and the hatching caterpillars or maggots eat the plant tissue or fruit.

Beneficial insects include spiders and mites, lacewings and microscopic wasps.

Birds are constantly moving around your garden looking for food. You will also find a number of other animals are there too: lizards, snakes, rats and mice.

soil dwelling organisms

The number and range of hidden life forms that live and move around our soils is quite amazing. It includes **worms, algae, bacteria, fungi, nematodes, protozoa and arthropods.** Immediately following, you will find some interesting information on worms. Details on the others will be provided in Lesson 7.

Worms

When people visit, they often want to see my "worm farm" because this is something I speak about frequently. They expect to see a specially constructed tray, full of worms. Worms living in a separate home are great when it comes to producing worm pee and worm poo, but I want my worms where they can do the most good. My worm farms are in the garden. Every furrow contains a mass of worms doing what they do best: improving the soil. They like the warm moist conditions that are created by the animal manure, compost and mulch and when I water, moisture is trapped in the furrows for long periods providing ideal conditions.

Worms are the real good guys when it comes to maintaining a healthy garden. A worm is like a vacuum cleaner. Its food consists of bacteria and fungi that grow on decaying plant and animal matter, which a worm sucks into its mouth, stores it in its crop before grinding up into small digestible pieces in its gizzard. A worm's body is covered in chemoreceptors, which are tiny sense organs, which detect chemicals in the soil. Nutrients from the food are absorbed into the worm's body in the intestine.

Worms are voracious feeders. They produce their own weight in worm castings every 24 hours.

I honestly thought I had cut through an electric cable the first time I encountered one of our Tamborine Mountain giant worms. I'm told they can be 2 metres long. I know I've seen some that are over a metre long and about 3 centimetres in diameter. These aren't the normal garden worms that we encourage in the garden. They live much deeper in the clay sub-soil. Sometimes, when it rains very heavily, they come to the surface.

Because they have no lungs, they breathe through their skin by releasing internal fluids which trap dissolved oxygen. For this to happen they need a moist environment. Too much moisture displaces oxygen, and this is when worms come to the surface to breathe. The problem is that at the surface they are exposed to sunlight, which kills them. When it gets too hot or too cold, worms go into hibernation. From their bodies they generate a form of anti-heat or anti-freeze, curl up into a little ball and just exist until conditions are more to their liking.

Encouraging worms is a beneficial thing to do for your garden because the quality of your soil will depend greatly on the work done by earthworms. Their large burrows allow oxygen and rainwater easy entry into the soil. This prevents soil erosion and allows water entry to the root zone where it can be used by plants. Burrows also allow roots entry into new areas.

Worms are also important agents of soil organic matter decomposition making nutrients that were tied up in the organic matter available for use by plants.

Earthworms provide easily recognisable evidence of movement within soil and of soil being moved from one place to another. Earthworms bury plant residues as burrows are formed. As a result of the building of burrows, earthworms increase the water holding capacity of soils.

Earthworms dramatically alter soil structure, water movement, nutrient dynamics and plant growth. As organic matter passes through their intestines it is fragmented and inoculated with micro-organisms. There are more micro-organisms in earthworm castings than in the organic matter they consume. Earthworm burrows are lined with readily available nutrients making it easier for plant roots to penetrate deep into the soil. Worms help translocate minerals from the sub-soil to the root zone. Like many of the soil microbes, they excrete a slime layer that helps hold soil particles together in crumbs.

Worm castings contain five times more available nitrogen, seven times more available phosphorus and eleven times more potassium than the surrounding soil. The castings are so different from the soil that provides their raw materials that a hypothesis exists that the earthworm may actually be capable of **transmuting** elements. The earthworm's digestive system creates **colloids** from organic matter and mineral particles by the grinding action of the gizzard, digestive chemicals and powerful bacteria.

Earthworms incubate enormous quantities of beneficial micro-organisms that produce essential by-products for plant production. These microbes are especially important because they produce vitamins, enzymes and natural growth hormones. Earthworms are also responsible for the creation of organic carbon.

solutions to insect damage

The best solution to insect damage is to ensure a healthy, well-balanced soil. Other solutions include using yellow sticky traps for whitefly, aphids and thrips. You can also use commercially available pheromone baits for fruit fly. Insect zappers attract insects to fluorescent light, which kills them.

Crop rotation, intercropping and companion planting with plants such as garlic that repels insects, are other options.

An even better solution is to ensure your plants have strong immune systems. High silicon levels ensure plants are strong and leaf cells are difficult to penetrate.

Soils that have high levels of nitrate nitrogen, poor physical characteristics and poor mineral balance produce plants that are prone to damage by insects and disease.

By comparison, soils that have a high level of beneficial microbial activity will have plants that resist insect attack. When the soil is good for beneficial microbes, disease-causing organisms do not thrive. Beneficial microbes suppress bacterial pathogens by putting out antibiotic-like substances. Some microbes give plants the equivalent of a vaccination that triggers the plant into an immune response. Many plant bio-chemicals responsible for disease and pest resistance are triggered in this way and also cause increased plant growth.

slugs and snails

Slugs and snails are classified as gastropods, which means stomach foot. The only difference between a slug and a snail is that snails carry a spiral shell around. Slugs are both male and female so they don't need to find a mate to get pregnant. They can lay 100 eggs in a season and in dry times they can hibernate for years.

Slugs and snails thrive in moist conditions. They can do enormous damage because they have the ability to eat 30 to 40 times their body weight each day.

There are lots of snail poisons available which certainly work, but these poisons also kill other insects and, most importantly, they kill worms, which deter snails.

Snails have many natural predators. Many beetles prey on them. Ducks, geese, chickens, rats, birds, snakes and lizards all eat snails.

If the snail population is growing faster than the natural predators are killing them, the best way to get rid of snails is to collect them and kill them in a strong salt and water solution or in a vinegar and water solution. Snails are unable to withstand hot sunlight so during the day they shelter under leaves and come out to feed at night. Snails travel along self-created trails of mucus laid down by the leader. This is their undoing. Because they find it difficult to create a mucus roadway for themselves, they tend to follow the leader, so it is quite easy to find them if you go out with a torch a couple of hours after it

gets dark. Go out on several consecutive nights and you will reduce the snail population considerably.

Snails also like to climb, particularly when it is raining, so you can control your snail population by providing shady climbing posts. To provide shade, hammer a piece of sacking over the top of the post. If you have to purchase posts, remember that posts that have been impregnated with poison to stop rotting and termites will not be suitable.

As you start your snail hunt, remember that snails and slugs also tend to attack weak, unbalanced plants so this where you'll find them hiding. When you understand that a snail's job is to remove unhealthy plants, you can use their presence as an indicator that some area of your garden may need attention. This is particularly true during times of constant rain because rain causes soil minerals to be leached away.

If you have particularly vulnerable seed trays or young plants you can set up barriers which slugs and snails cannot cross. Seaweed laid down in strips will act as a barrier and is also a valuable fertilizer. Crushed rock has the same effect. Garden centres sell snail barriers, which resemble strips of sandpaper or are made of copper, which shocks and repels snails. These strips are effective on trees, particularly citrus, which snails love.

A good piece of advice is to kill any snail you see and keep the population to manageable levels.

Processes of movement in soil

A variety of processes in your garden cause movement of nutrients. These include transpiration, evaporation, diffusion, osmosis, leaching and capillarity.

The ideal soil has peds: block-like accumulations of mineral and organic matter, which are "cemented" together by worm castings and the organic matter within the soil. Where peds form, soil has many passages along which water and air move. Soil, which is tilled frequently loses its structure, becomes an amorphous mass and loses its ability to allow free flow of water and air.

Transpiration is the engine that pulls water from the roots to supply the leaf cells with their water requirements for photosynthesis. This movement also brings minerals from the roots for biosynthesis within leaves and cools the leaf. While its stomata are open for passage of CO_2 and O_2 during the process of photosynthesis, water is released. The photosynthesising leaf loses substantial amounts of water by a combination of evaporation and transpiration. This water must be replaced.

A plant cannot continue to transpire rapidly if the water lost through evapo-transpiration is not replaced with water brought up from the soil. When the absorption rate of water through the roots fails to keep up with the rate of transpiration, the stomates close, immediately reducing the rate of photosynthesis. Visual evidence of this occurs when we see the plant wilting.

Diffusion is the process by which molecules intermingle as a result of their kinetic energy of random motion. In simple terms this means that where there is a lot of something in one area and not much of it in another, flow will occur from where there is a lot to where there isn't much, as long as there are no barriers stopping it.

Water moves through soil, going from soil particle to soil particle, from areas of high concentration to areas of relative deficiency. For this to happen soils must be firm. Over-tilled soil slows down the diffusion process, which is critical to

maintain healthy growth because soil nutrients diffuse from the soil particles into the capillary film to produce a steady supply of nutrients moving towards root hairs.

Roots use up oxygen as do many soil living creatures. This means that the oxygen level in soil is lower than in the air, causing oxygen to be drawn into soil providing the soil has passages through which air can pass.

Once fertilizer goes into solution it has the ability to diffuse. When dry fertilizers are placed in soil, they absorb water giving them the ability to diffuse outwards in all directions, but particularly towards the area where there are plant roots. This is because plant roots are taking in water, creating a slight deficiency which draws the nutrient solution towards the roots.

Capillarity is the spontaneous movement of liquids up or down narrow tubes or capillaries. Soil contains spaces between the soil matter, which allows water and nutrients to move up. During dry periods when the soil surface dries out, water will move upwards through the process of capillarity, bringing minerals to the surface. This is the process, which causes soil salting and the formation of hardpans. Where there are large deposits of salt deep within the soil, water movement carries that salt to the surface.

Leaching is the downward movement of water through the soil. Water carries soluble minerals down to the water table and then moves under gravity down slope. Eventually the water and the minerals it carries, ends up in rivers, which carry it to the sea.

Osmosis is the means by which water is transported into and out of cells. It occurs when there is a partially permeable membrane, such as a cell membrane. If there is a stronger solution on one side compared with the other, there will be a net flow from the weaker to the stronger solution to equalise the two solutions.

The importance of this process in practical terms, is that when the root cells of a newly planted seedling contain fewer soluble nutrients than are available in the soil around the roots, water in the root cells will move out through cell walls towards the stronger solution causing the plant to become dehydrated. For this reason it is not advisable to fertilize soil close to the time you plan to plant seedlings. Fertilize a few weeks before you plant and use liquid humic acid or soluble humic acid granules to buffer against root dehydration. When side dressing, it is important to place the fertilizer about 19cm away from the plants.

Practical Exercise: Planting

Whilst it may seem very obvious, I have been amazed at the number of "beginner" gardeners who have no idea that different vegetables grow at different times of the year. If you are in that category, my suggestion is that when you buy seeds, you read the instructions regarding when to plant them in your area.

The varieties of vegetables and fruit that can be grown, differs from place to place. Here on Mt Tamborine we have great difficulty growing grapes, watermelons and rockmelons. The reason is that our summers are quite wet and humid and the fruit rots before it ripens. Surprisingly, pumpkins love the climate. Winters are too warm for many stone fruit to grow well but summers are not hot enough to grow pineapples, mangoes and lychees. Every area is different, so before you plant, check what grows well in your area.

Planting times also differ from area to area. The change over time, when we switch from planting cold season crops to planting warm season crops, is mid-September but we continue planting broccoli till November. We are fortunate that we do not have many frosts so we have a very long growing season. The difficult time is mid-summer but crops like cucumber, corn and zucchini do very well at that time of year.

Knowing what to plant and when to plant it comes from trial and error, or even better, from consulting the experienced gardeners in your area. Follow their lead and you cannot go too far wrong.

Direct Sowing

Vegetable seeds that are best planted directly into the soil include **carrots, beetroot, parsnips, turnips, onions, shallots, onions, garlic, radish, peas, beans, broad beans, zucchini, squash, pumpkin, cucumbers, and corn**.

To sow, mark two parallel rows along a prepared ridge. Use the end of a pick, a trowel or your hand to prepare a shallow channel in which you will place your seeds. Place the seeds in this channel and cover by pushing the soil from the side of the channel over the seeds. Be careful to cover tiny seeds with just a sprinkle of soil. If you bury them too deep they will not germinate.

Probably the most difficult vegetable to germinate is parsnip. Parsnip seeds need to be kept damp for about 3 weeks after sowing. The best way to do this is to cover the seeds with a thick layer of newspaper and keep it wet. You will see the parsnip plants emerge when you remove the newspaper.

Obviously, different vegetables require different amounts of space. Crowded vegetables are smaller than vegetables that have lots of room to grow. The best guide regarding seed spacing is that the bigger the seed, the further apart you plant them.

Broad beans require a large amount of room because each plant develops many tall stems, which need to be supported. Zucchinis and squash also need a lot of room because they grow along the ground and need to be planted about 20 cm apart. Beans, peas and corn are planted about 10 cm apart and in two rows that are 20 cm apart. If you plant too close, the plants do not get enough sunlight and the yield suffers.

Before planting large seeds, loosen the soil and mark a furrow. Use the handle of a trowel or a stick, or even your finger to make a hole for the seed. The hole should be about 2 cm deep. Cover and water as soon as possible.

Carrots, beetroot and spring onion seeds are best planted about ½ cm apart and this is very difficult to achieve. They are so small that you cannot handle each seed individually. When planting tiny seeds, I find it is good to mix them with sand to help spread them more easily. I find it is easiest to move quickly along the row, scattering the seeds along a line about 2 cm wide. The further above the line I work, the more the seeds scatter. If you plant in rows, it is easy to side dress with fertilizer and to weed once the seedlings emerge.

When the seeds are about 2 cm tall, it is important to thin them out. Sometimes you have to remove a lot of baby plants but this is preferable to having them all bunched up together. Seeds planted too close together will not grow well.

Planter Boxes
Seedlings usually cost quite a lot of money, so it is a really good idea to learn to grow your own. Apart from saving money, it is really simple to do and it means you have a steady supply of seedlings ready to plant, whenever you want them.

The vegetables that are best germinated in a seedling box and then transplanted include **tomato, cabbage, cauliflower, kohl rabi, broccoli, lettuce, endive, tatsoi, bok choi, rocket, silver beet, spinach, parsley, celery, capsicum, egg plant and kale.**

All you need to do this is a polystyrene box with holes in it, a newspaper or two, some good quality potting mix, a handful of soil from your garden and a couple of handfuls of compost.

Layer the newspaper on the bottom of the box. Newspaper holds moisture which means you don't have to water as often. Good quality potting mix, which is sold commercially, contains enough nutrients for the seeds to germinate, so you don't have to add anything, but if you have compost, that is a good addition to the mixture. Also add a handful of garden soil. Garden soil contains microbes and worms, which multiply in the planter box and are beneficial to the seedlings. I think of the handful of soil as my "starter" mix. When you empty your box, don't be surprised to find a number of worms living there.

Mix the potting mix, garden soil and compost in your wheelbarrow. Fill your box almost to the top. Now you are ready to plant. With your finger, make some very shallow trenches about 3 cm apart. You sprinkle the seeds in these trenches then cover them with a very thin layer of soil. Water every day until the seeds appear, then every second day unless it is hot and dry. During hot weather it is a good idea to water at least once a day.

Place the seed box in a sheltered place, ideally somewhere where there is filtered sunlight. In summer, place the boxes in full sunlight for at least three days before planting to acclimatise the seedlings.

Some of your seedlings will be ready to plant in four weeks. Fast growers include broccoli, cabbage, cauliflower, pak choi, bok choi, misuma, endive and rocket. Lettuce takes slightly longer. Parsley, celery, leeks, capsicum, eggplant and onions will grow for 6-8 week before they are big enough to transplant.

Transplanting
When your seedlings are big enough to handle, you need to transplant them into the garden beds that are already prepared. To do this you first water the soil generously or transplant immediately after it has rained. This makes it easier to work the soil and ensures that the tiny seedlings are placed in soil that contains lots of moisture.

First separate the seedlings. You have to do this very gently to make sure the roots stay intact and the stems don't bend and break. Use a trowel or your fingers to dig a hole about 5 cm deep. Place the seedling into the hole and use your fingers to bring the soil back and close the hole around the plant. There is no need to press the soil down from above. This can damage the roots.

When deciding how far apart to plant, you have to consider the size the plant will be when it is fully grown. When you use the trench and mound method, the plants will grow out over the trench so it is possible to plant vegetables such as broccoli, cabbages, kohl rabi and cauliflower in two rows along the mound.

After transplanting water your soil and cover as much of the soil as possible with mulch. Do not try to mulch around the plants. They are too small and are easily smothered. The time to mulch your seedlings is when they have trebled in size. This is when you fertilize, weed and mulch.

Develop a planting schedule

Your planting schedule will depend on why you are growing your own vegetables. If you are growing them to eat, then it is a good idea to plant as many varieties as you can each month. This will ensure you have a regular supply. Your biggest problem is going to be "think small!" You don't want to have 30 cauliflowers ready to pick if you are growing for the family, unless of course you are going to use some of them to make pickles and chutneys.

Many studies have been done which suggest that moon energy plays a very big part in nature and there are calendars available which show which crops to plant when. I tend to plant in the week before full moon, which provides me with a regular schedule for preparing seed boxes, planting and preparation.

Plants that require special treatment.
Strawberries grow from runners, which are sent out by the plant at the end of its fruiting season. One strawberry plant will produce several new plants. Replant annually for best result. Throw away the woody plant from the previous year and plant the runners.

Ginger, Yacon and Jerusalem Artichokes grow from tubers saved from the previous crop. Ginger and Jerusalem Artichokes all grow from the tubers that we eat, so it is always a good idea to save some for the next season. Store in boxes full of dry potting mix until it is time to plant. One ginger root, one yacon or one Jerusalem artichoke can be cut into several pieces, each of which will produce a new plant.

Sweet potato sends shoots out in early summer. Place that part of the potato that has "eyes" in it in a planter box. Shoots will appear and grow and roots also develop. When the roots are well established, remove the shoot with the roots intact and plant.

Potatoes have eyes, which grow into new plants. You can cut a potato into several pieces. As long as the piece has an eye, it will grow into a potato plant. Potatoes start to grow when the temperatures rise. You can fool a potato into thinking it is time to grow by putting it into a refrigerator for two or three weeks.

Asparagus has both male and female plants. Asparagus needs really deep fertile soil to produce thick asparagus stalks. The female plants have the thickest, juiciest stalks. When you grow asparagus, stop picking before the plant stops sending up new growth so that it can use some of the season's late shoots for photosynthesis. Give asparagus time to produce sugars for its own growth.

Asparagus has a very large root system, which forms several plants over a period of several years. You can separate the roots to give you more asparagus plants. Alternatively, you can grow asparagus from seeds, which develop at the end of summer.

Rhubarb grows several new plants each year. If you wish to increase the number of plants you are growing, it is necessary to dig out the plant, and split it making sure each new plant has a growing bud and a piece of root attached.

Garlic is planted from last year's garlic, which can be stored in a container until it is time to plant. Separate the bulb into cloves

and plant the cloves about 4 cm apart. Place the flat end down. This is where the roots come from.

Review Exercise

In gardens things happen that shouldn't happen in an ideal world. When the weather behaves in an un-seasonal manner, or you've not had the time to maintain the garden as you would like to and the weeds take over, or when you've just misread the label and applied too much fertilizer, things go wrong. The following situations are examples of what has happened from time to time in my garden. What would you do in such situations? In Lesson 6, I'll tell you what I did, what I should have done, and talk about what had gone wrong and what I needed to do, to fix it. But first, what would you do?

1. You have a sudden influx of snails. Not just a few snails - millions of snails! You've just had a very wet season but the snail influx is unexpected because you've never had a problem with snails before. What steps will you take to eradicate them?

_____
_____
_____

2. Your cabbages are full of holes and are not growing as fast as they should. What are you going to do?

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_____
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3. Your zucchinis are covered in mould and they're only just beginning to produce flowers. What are you going to do?

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_____

4. Your beetroot looked really healthy a couple of days ago and now the leaves have suddenly turned red and are being eaten. The same instant "sickness" is happening with the beans. What are you going to do?

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_____

5. The cauliflowers are rotting as the heads form. What are you going to do?

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6. The rosella bushes are flowering but the calyxes aren't forming. At the same time, the okra is looking sick and is being attacked by insects. What would you do?

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_____

7. The garden is totally overgrown with weeds that are two feet high and going to seed. It is absolutely out of control. What would you do?

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_____

8. The turnips and kale are just ready to pick and you go our and find that in several area of your turnip crop the leaves have turned white and the plants have collapsed. Sections of the kale crop have lost their colour. Closer examination shows that the underside of the kale leaves and the stems are covered in tiny clear creatures that look like miniature aphids. The turnip leaves are also covered in these creatures. What would you do?

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_____
_____

Task 2

Planning

If your garden is to supply your own family and perhaps a few friends with fresh fruit and vegetables you need to start planning what to grow and how much to grow.

Get a seed catalogue or a list of fruit and vegetables. Investigate which ones grow in your area and when they grow and make a list. Then make a second list of what fruit and vegetables your family will eat and how much they eat. Now compare the two lists. They may be quite different. There is no point planting mandarin and grapefruit trees if no one eats them. There is no point growing okra or kale if none of the children will touch it. There is no point planting apple and cherry trees if the winters are too warm and the trees won't bear fruit.

Sit down and make a plan. Decide what you will plant in January, May, September, etc. Remember, if you have the whole garden planted in January, you can't plant in February or March. Then have a look at how long each vegetable takes to grow. You will need to look at turnaround time. It takes time to remove the old crops, prepare the soil and plant your next crop even when you fertilize 6 months in advance. On average you will be looking at 2 crops per year for each bit of garden unless you have cold winters. I find that at any given time, only about two-thirds of my garden is planted.

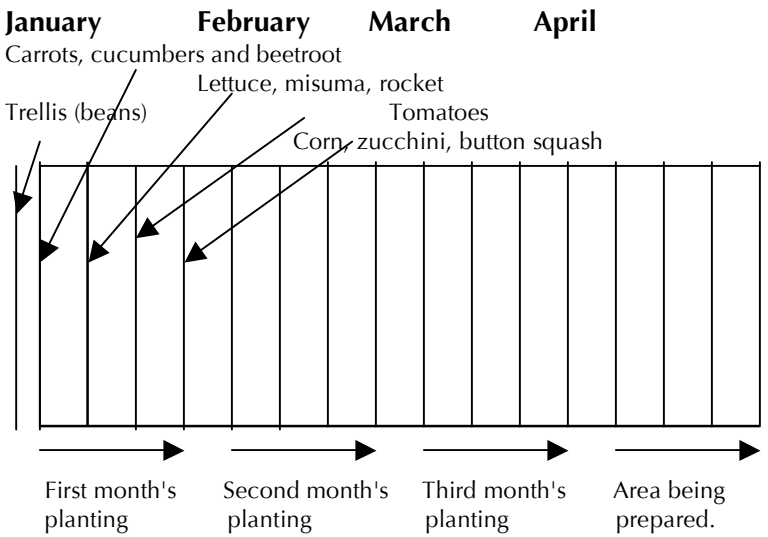
You will also need to think about crop rotation. Perhaps you could devote each row to one category of vegetable. The rule is potatoes and tubers first, followed by root vegetables, followed by leafy vegetables, which are followed by brassicas (broccoli, cauliflowers, cabbages). Whilst you may have several different vegetables in one row, if you plant vegetables of a similar variety in each row, then you can rotate them easily.

Maintaining a regular supply is a challenge. The key is to think small and often. For a family, you should attempt to plant 2 metres of each vegetable per month. Since each of your planting ridges will have 2 rows, this means you plant two rows of one metre in length along each ridge. A metre will give you 6 broccoli or 6 cauliflowers. It will give you 2 zucchini bushes, 4 eggplants, plenty of beetroot or carrots. A metre is sufficient to grow 15 lettuce or 40 cobs of corn from 20 corn plants. Tomatoes bear for a long time and should be planted as soon as it is warm enough, so you might extend your tomato area to 3 or 4 metres.

Planting at monthly intervals is sufficient to have a continuous supply. Some plants grow faster than others even when they are all of the one variety, so your harvest will spread over 3 or 4 weeks.

Remember that you have to integrate your seed box planting with your direct sowing. You plant your seed boxes in December ready for transplanting in January.

Draw a plan of your garden. Indicate the number of rows. Divide the number of rows by 4. This is the number of rows you will plant each month. Now write what you will plant the first month.



It is likely that in the second and third months you will plant the same as you did in the first month. Then the seasons will change and you will introduce crops more suited to the cooler or warmer climate.
Draw up your plan on the page provided, and remember, this is a first draft. Nothing is set in concrete - EVER.

My Planting Programme