



HAND PRINT™
action towards
sustainability

Creative Garden Design



A Share-Net Resource Book

Reading-to-learn curriculum materials to support
Technology, Natural Sciences and Language learning areas



Acknowledgments

The Handprint resource books have been compiled by Rob O'Donoghue and Helen Fox of the Rhodes University Environmental Education and Sustainability Unit. Lawrence Sisitka was responsible for coordination and review, and Kim Ward for editorial review and production for curriculum and Eco-School use. Development funding was provided by CAPE. Cover illustrations are by Tammy Griffin.

Knowledge and activity support materials have been adapted from various sources including the Internet, and web addresses have been provided for readers to access any copyright materials directly.

For this particular resource book, thank you to Laura Condi, from WESSA, East London for the idea of this school story, after seeing a number of schools successfully building tower gardens. Thanks also to Tim Wigely, a successful practitioner in making tower gardens, who willingly shared useful information on making tower gardens. A number of publications were used to compile this resource book. In particular, we found most useful Crosby's article in the *Water Wheel*, titled "Food from Used Water: Making the Previously Impossible Happen".



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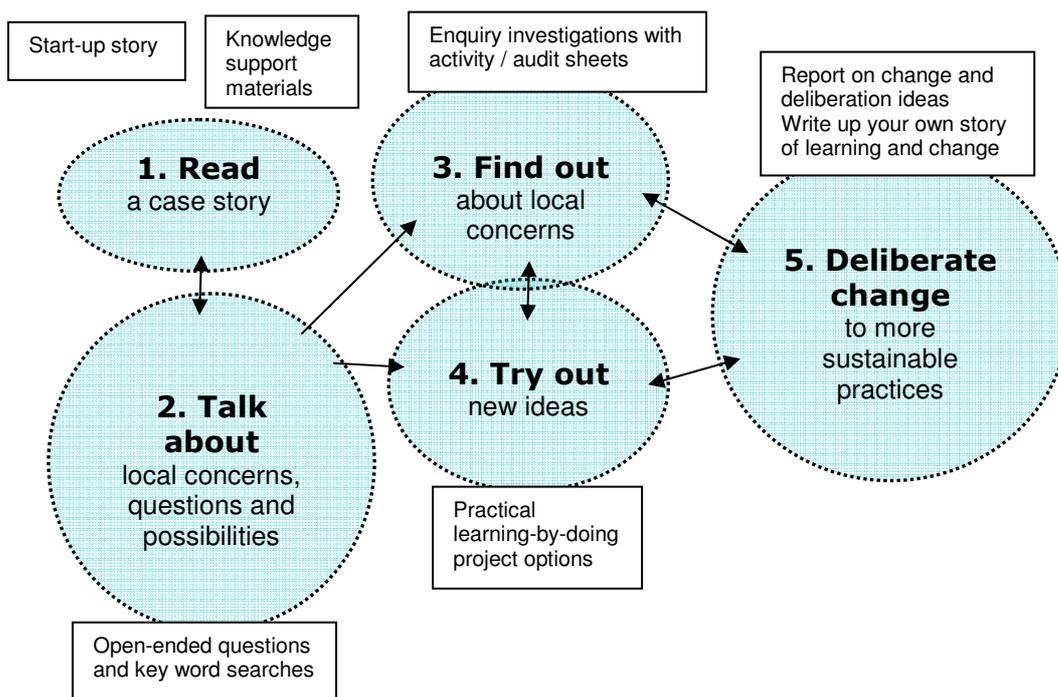


The **Handprint Resource Books** have been designed for creative educators who are looking for practical ideas to work with in the learning areas of the National Curriculum. The focus is on **sustainability practices** that can be taken up **within the perspective that each learning area** brings to environment and sustainability concerns.

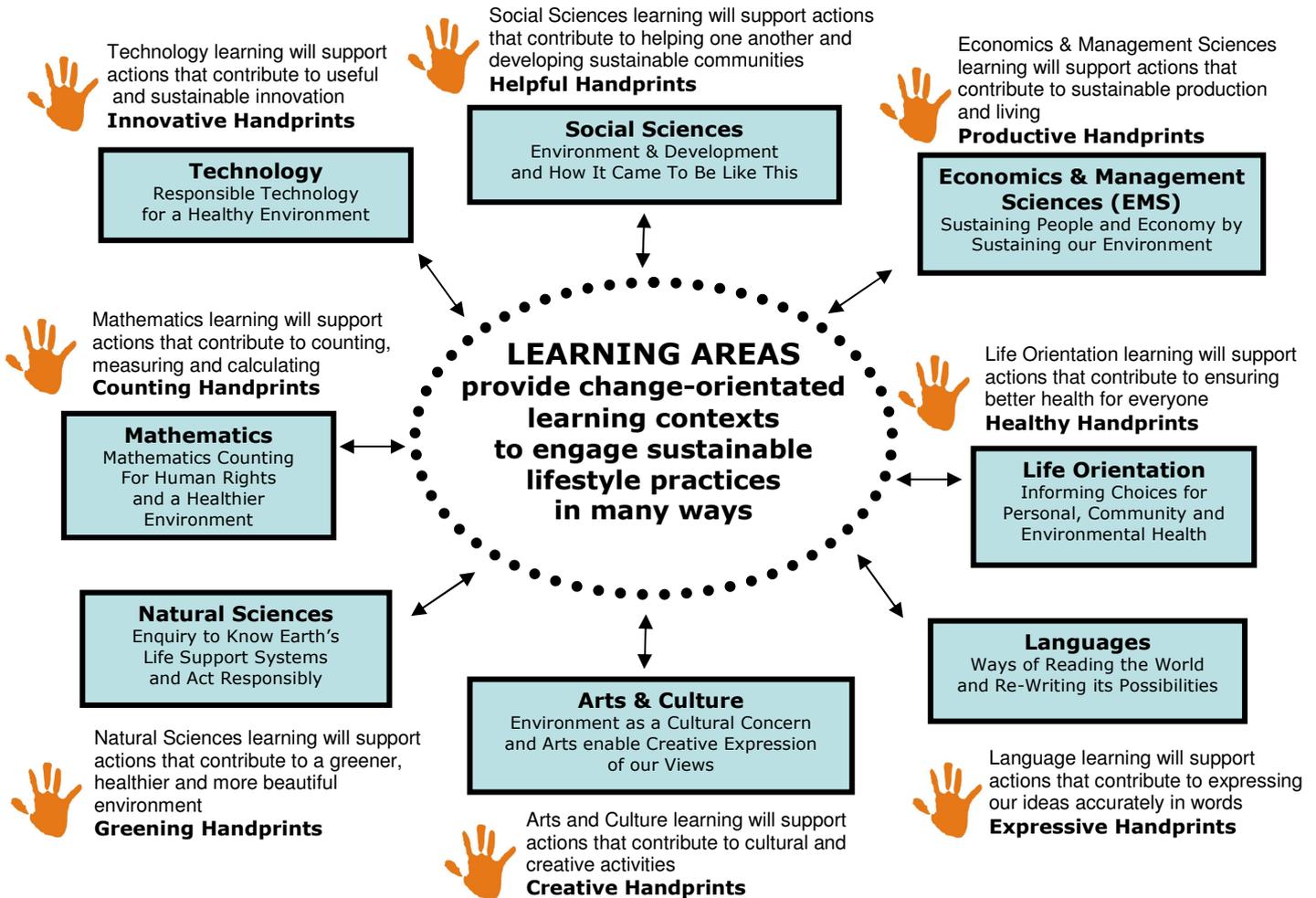
The resource books are intended to provide teachers with authentic start-up materials for change-orientated learning. The aim is to work towards re-imagining more sustainable livelihood practices in a warming world. Each start-up story was developed as a **reading-to-learn** account of environmental learning and change. Included are copies of the knowledge resources that informed those involved in the actual learning experiences described here. Working with local cases of learning and change has allowed us to develop the resource books around **locally relevant knowledge resources** and **practical learning activities** that relate to our African context. We are grateful to teachers and Eco-School support groups who have willingly shared their learning experiences and activities.

The **Handprint Resource Books** are an attempt to work from authentic cases of environmental learning and change. They combine some of the best teaching and learning tools that are being used to support change-orientated learning in the everyday realities of our South African schools. The resource books include:

1. **Start-up stories** with **knowledge support materials** (*Reading for information to build up a picture*)
2. Questions to **talk** about (*Talking to clarify issues and to plan local enquiry*)
3. Tools to **find out** about local concerns (*Writing about and reporting on local issues*)
4. Things to **try out** (*Writing up and reporting on what has been tried out*)
5. Ideas to **deliberate** (*Discussing, weighing up and recording decisions that will allow us to 're-imagine and re-write' our sustainability practices in a warming world*).



Change-orientated learning & the curriculum



The activities in this book can be used to support learning in the **Natural Sciences, Technology** and **Language** learning areas, and can contribute to the development of **Greening, Innovative** and **Expressive Handprints**.

Teachers should consult the learning outcomes and assessment standards and should adapt the activities to suit their grade requirements.

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Ideas and tools for local learning

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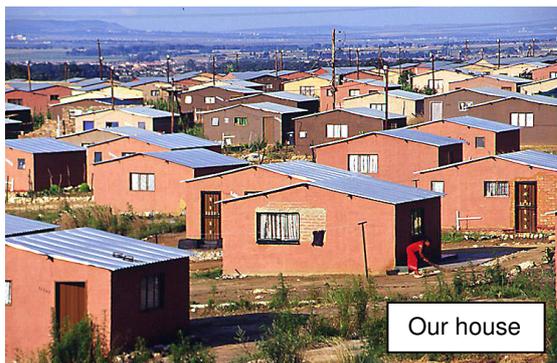
Wavecrest Primary School makes a Tower Garden

Key words

Biological control Companion planting Grey water Monoculture Pesticides



The story I would like to tell began when I heard my mother and father talking about the cost of food. Last year a cabbage was R5.00; it now costs R7.00. I got more worried when they said we could no longer afford some of the vegetables we have always enjoyed. My grandmother said vegetables had tasted good in the olden days, when her family had a garden. But the RDP houses are so close together that there is little garden space for growing vegetables. Another problem is that my sisters and I have to collect water from the river or stand in long queues at the only street tap. I was worried because if my grandmother started a garden, we would have to collect more water.



In agricultural class a few weeks later we learnt how vegetables are grown. Most of them are grown as a monoculture and pesticides are used to kill the insects that eat the crops. It sounded impressive, but I didn't know what was meant by 'monoculture' or 'pesticides'. That afternoon I used the school computer that had Internet and did a

definition search. I learnt that *monoculture is the practice of producing or growing one single crop over a wide area.* Vegetables are grown like this as it is an easy way to grow plenty of cheap food. I did a Google image search and found many photographs of what this looks like.



I also learnt that because the same plants are all growing in one area it becomes a delicious feasting ground for cabbage worms who love to eat cabbages, or cucumber beetles who eat cucumbers. This is why pesticides are used to kill these cabbage and cucumber eating bugs. *Pesticides are chemical compounds used to control undesirable plants and animals. They are toxic to some degree and can kill beneficial earthworms and organisms. They can be a threat to people if overused or carelessly applied.* I began to wonder whether it is a good thing to be having cheap abundant food if it means pesticides have to be used that could be harmful to human health.

A couple of days later our teacher announced that an expert in gardening

was going to take our agricultural class. What I remember most was his passion and how excited he became when he started talking about the benefits of a gardening technique he had begun using and teaching in many primary schools similar to Wavecrest. This gardening technique he called 'tower gardens' which he said works very well in areas where space, water and heat are limiting factors to gardening. I started listening closely. These are the very conditions that have been preventing my family from gardening. He explained that tower gardening is one of the most innovative and user-friendly ways to use grey water which he explained is any water that was not used in the toilet but that is normally thrown away. It includes water from the sink, bath, laundry tub and kitchen sink **(SM 1)**.

On the chalkboard he drew up the steps to make the tower garden the materials that we would need. I copied them to show to my grandmother **(SM 2)**. He also handed out an article that described the benefits of tower gardens, with details on how to make them **(SM 3)**.

Our school had recently joined the Eco-Schools programme. Our teacher, Mrs Jadi, asked us if we would like to make our own tower garden as our project. It seemed that everyone was as excited about tower gardens as me because we all said "YES PLEASE!" So that's exactly what we did.



The start of our tower garden

The next day we used our lesson to plan how we were going to make the tower garden, where we could collect everything we needed, and what vegetables we should grow together. Our teacher introduced us to a gardening technique called 'companion planting'. She gave us a sheet of information on useful plants to grow and which ones grow together well **(SM 4)**. After reading this we decided to grow onions and garlic as they biologically control diseases and pests. Our teacher also gave us a sheet on the value of composting and how to make a compost heap **(SM 5)**. We decided to start our own compost heap to improve the quality of our soil.

It took us almost a week before we had made a tower garden that worked. There were a number of challenges and I realised that it does need some experience and skill to make one properly. But the results were worth all our effort. In only 10 days we saw tiny spinach, tomatoes and a variety of herbs beginning to grow. After five weeks we enjoyed eating our first harvest of delicious school-grown spinach. We had learnt how healthy vegetables can be grown with a little effort and not much cost. What I also liked was how we were reusing our water to grow things to eat.

Note: In continuing work with tower gardens, where very soapy water is used it is best to use a water filter (see Resource Book on filtering grey water for garden use).



Our first school-grown vegetables

Glossary

Biological control is the control of pests and parasites using other organisms, often natural predators.

Companion planting is about growing two or more plants together in a given area to improve each other's quality, repel pests or to maximize the use of garden space with plants that take different amounts of time to mature.

Grey water is the waste water from baths, basins, sinks, washing machines, dishwashers etc., which has been used to clean things and which is considered to be only mildly dirty.

Comprehension Questions

- What are the dangers of using pesticides?
- What planting technique could you use instead of pesticides?
- What are the benefits of using grey water?
- What must you be careful to do if your plants have been grown using grey water? **(SM 1)**
- If you wanted to make a tower garden what would you need? **(SM 2)**
- What are the benefits of using the tower garden technique? **(SM 3)**
- What plant combinations could you plant? **(SM 4)**
- What is the value of making compost? **(SM 5)**

Discussion Points



FINDING OUT ACTIVITY

Find out who has vegetable gardens in your neighbourhood. Conduct interviews among local residents to find out what factors encourage and discourage people from growing their own food.

TRYING OUT ACTIVITY

Start your own vegetable garden at school. A very useful resource to look at is called "Setting up and running a school garden" and can be found on the web at the following address: <http://www.fao.org/docrep/009/a0218e/a0218e00.htm>

DELIBERATION IDEAS



To deliberate is to think carefully about, to consider, to discuss in a focused way, to weigh up and debate. Here are some ideas to support this process in your learners.

- Before starting your own vegetable garden let all learners participate in a deliberation exercise to decide which gardening technique (tower garden, trench garden or tyre garden) they want to use. **(SM 3, SM 6, SM 7)**
- Deliberate the strengths and weaknesses of monocultures **(SM 8)**, crop rotation **(SM 9)**, and intercropping **(SM 10)** – see glossary below.

Glossary

Crop rotation is the practice of growing several different crops on the same land in successive years or seasons. It is usually practised to replenish soil, and curb pests and diseases.

Intercropping is the growing of two or more crops simultaneously on the same piece of land. There are benefits because crops need different soil, water, light, and other resources, or mutually interact with one another, to increase yields or control pests and weeds.

Monoculture is the practice of producing or growing one single crop over a wide area.



GREY WATER

Domestic grey water is defined as household wastewater which does not contain faeces (human poo) and urine in large quantities. Grey water has been used for yard irrigation including crop production for a number of years in various overseas countries and to some extent in South Africa. In this country, grey water is used for such purposes by people with small and large incomes. Very few negative effects as a result of grey water irrigation have been reported in South Africa. High and middle income householders are motivated primarily by the need to save money, and also by wanting to conserve a precious resource in a semi-arid land. Low income householders with water systems in the form of street standpipes (limited data available) are also motivated by a desire to save money. Residents in remote areas may have to carry water long distances to the household. The benefits of using grey water for gardening in such circumstances are clearly evident. The use of domestic grey water as a valuable additional supply/plant nutrition resource for low income households has been supported by a number of small intervention programmes which have been undertaken mainly in the drier western half of South Africa. These programmes concentrate on both agricultural and non-agricultural aspects where a broad health, family well-being and environmental theme is stressed.

The use of household grey water for irrigating vegetables and fruit trees involves some degree of risk in terms of potential chemical damage to plants and the soil. A major concern is the possible spread of human pathogens in the grey water. Measures which will considerably reduce or eliminate difficulties include (a) regular leaching of the soil by using fresh water or stored rainwater, (b) carefully applying diluted grey water (preferably bath water) to vegetables in particular, (c) regularly inspecting the garden to detect any early signs of crop damage - which if sustained also suggests declining soil properties, and (d) avoiding the use of grey water contaminated with faecal matter. A further factor of safety involves the use of stakes or a trellis network to raise certain vegetables above the ground. It is essential to thoroughly wash produce irrigated by means of grey water, and to place the produce in the sun for at least an hour. Crops eaten raw should be washed again before being eaten. Crops which can be eaten raw or cooked should rather be cooked. It is also necessary for households to maintain acceptable standards of hygiene to prevent any ponding of grey water, odour and the possible breeding of flies and mosquitoes. Grey water generated in the small volumes typical of low income households is unlikely to constitute a major environmental hazard.

It is concluded that grey water can be used for yard vegetable and fruit tree cultivation provided that several precautions are strictly observed.

Reference

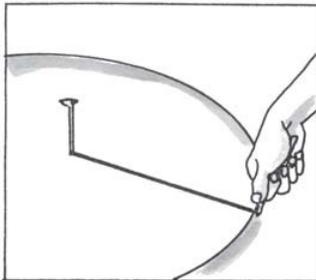
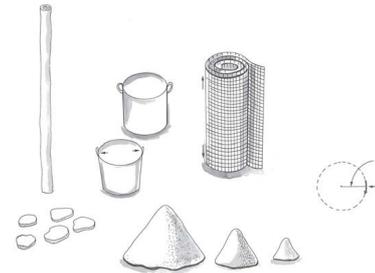
Adapted from Alcock, P.G. 2002. *Executive summary: The possible use of grey water at low income households for agricultural and non agricultural purposes: a South African overview*. For the full report email: suwtie@nu.ac.za

STEPS TO MAKE A TOWER GARDEN

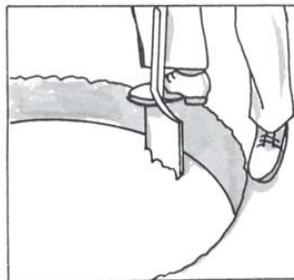


Materials needed

- Shade cloth 2.5m long and 1.2m wide
- 5 wooden stakes (at least 2m long)
- Bucket with no bottom
- Flat stones to fill the bucket
- Soil that is 3 parts soil, 2 parts manure and 1 part ash



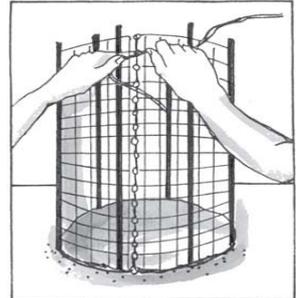
1. Mark out a circle – 40cm diameter for 2,5m wide shade cloth.



2. Dig out the bottom layer of the tower.



3. Plant the side poles or droppers firmly into the ground.



4. Wrap the shade cloth around the poles and tie the ends together to make a cylinder.



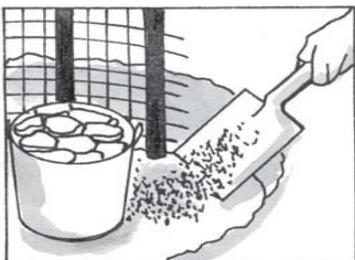
5. Roll the sides of the shade cloth cylinder down out of the way before filling.



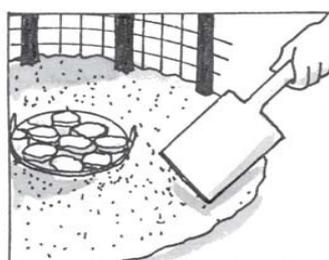
6. Place a bucket (bottom removed) on the ground in the middle of the tower.



7. Pack stones carefully in the bucket to make sure that the water does not run through too fast.



8. Backfill around the bucket with the soil mixture.



9. Dampen and smooth soil but do not compact.



10. Pull the bucket partially out, leaving the stones in position. Fill the bucket again with stones and backfill with soil. Repeat for each layer.

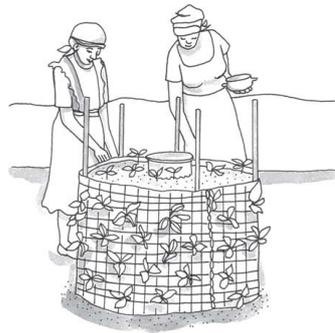
Reference

Crosby, C. 2005. *Food from Used Water: Making the Previously Impossible Happen*. The Water Wheel. January/February.
<http://www.dwaf.gov.za/Events/WaterWeek/2005/Documents/WaterWheelJan05d.pdf>



BENEFITS OF TOWER GARDENS

One of the most innovative and user-friendly ways of using water is the "tower garden". It is not a new idea and South African developments are derived from what was seen in Kenya by a small group of people on a visit to assess treadle pumps. Vegetables are grown in a column of soil that fills a bag. Each day the available grey water is poured into the bag and the vegetables are planted in holes cut in the sides of the bag itself. The results speak for themselves but like all irrigation the user must master the tricks of the trade; nothing is as simple as it appears at first sight! Initially the housewives were sceptical, they didn't believe you could grow good vegetables successfully with soapy water! The answer to this problem is to clear the system out by pouring two buckets of clean water into the column each Saturday.



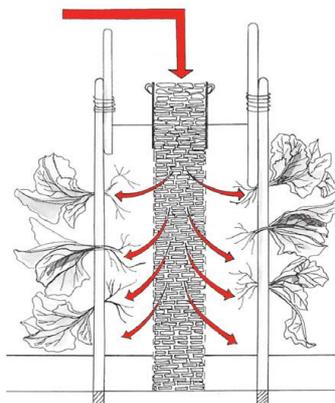
What vegetables can be grown?

The towers are ideal for leafy crops typically the various varieties of spinach that are planted through the holes in the side of the shade net cylinder. Ideally the holes should not be one above the other but should be

staggered diagonally providing more space for root development. Tomatoes and onions can be planted in the top layer and if crops require trellising this can be provided by extending the vertical uprights and joining them with wire or string. Where possible, companion crops should be grown to facilitate biological control of diseases and pests. Garlic and onions are useful in this regard.

An unexpected benefit is the way in which the vegetables have thrived in severe heat wave conditions that have proved too much for conventionally planted gardens. The reason for this is not quite clear. It may be the free air circulation, lower soil temperature or the better moisture status of the soil. It is not claimed that towers will be able to provide all the food a family needs but the contribution made to nutrition and eating pleasure is very considerable. It is difficult to predict how much water will be required, only time can tell. If water forms a puddle around the bottom of the tower it is an

indication that too much water is being applied and the obvious answer is to make a second tower! One of the main attractions of the method is that little labour or attention is required and this appeals to all busy housewives.



Making up the tower

The way in which the tower works is simple. The soil is contained by the shade cloth "skin" and surrounds a central stone packed drain. The purpose of the stones is to control the flow of water so that the soil in the tower is kept at the right water content for growth. The soil mix provides fertility.

The upright poles are not critical. Branch trimmings or fencing standards are suitable and where crops such as tomatoes are planted in the top layer of soil, extensions can be wired on to provide trellising. The selection of the cloth that forms the sides of the tower is, however, critical. All sorts of materials were tried initially in South Africa. In Kenya nylon gunny bags were used but were found to only last about two years. In South Africa sacking, as shown in some of the photographs, did not last the season. Black plastic sheets deteriorated rapidly in the sunlight. Shade netting proved to be far more durable but it was important to use nylon string or fishing line to join up the ends of the shade netting to form a cylinder as shown in the diagram.

Filling the tower with the soil is an art. The soil should be dampened to provide cohesion but not compacted. The water must be distributed evenly throughout the soil mass and will not penetrate the compacted areas. Similarly the stone filling is critical. When the first attempts were made in South Africa round stones were used and the water simply ran down the centre of the tower and did not filter through evenly into the soil mass. Packing flat stones or building rubble carefully, solved the problem. It is possible to use smallish round stones provided they are arranged in a way that water is well distributed. The soil must be fertile and retain moisture and it has been found that a mixture of six parts of soil, four parts of manure and two parts of wood ash is satisfactory. It is likely that people will be able to develop appropriate soil mixtures using locally available material but experimentation will be required.

Tower gardens are still new in South Africa but have the potential to make a real difference in areas where extreme climate and adverse circumstances have led to household vegetable gardening being considered out of the question. The initial examples are in the Ndonga area near Queenstown in the Eastern Cape and there are two areas in Limpopo Province, both with hot arid conditions. One is the Nzhelele valley north of the Soutspansberg and the other Makuleke in the north east of the province.

Further information can be obtained from Johann Adendorff at (014) 717 3336, cell 082 8594896 and Chris Stimie at (012) 842 4103, cell 082 4694535.

The assistance given by Johann and Marie Adendorff, Chris Stimie and Gerhard Nel in providing information and pictures is gratefully acknowledged.

Reference

(Adapted from) Crosby, C. 2005. *Food from Used Water: Making the Previously Impossible Happen*. The Water Wheel. January/February.
<http://www.dwaf.gov.za/Events/WaterWeek/2005/Documents/WaterWheelJan05d.pdf>



Facts of companion planting

- Plants with strong odours confuse, deter, and often stop certain pests.
- Certain plants hide other plants we may not want to be detected.
- Certain plants, and especially herbs, are considered nursery plants for the good insects providing shelter, nectar, pollen, and even dark, cool moist spots for lacewings, lady beetles, parasitic flies, and wasps.
- Certain plants serve as a “trap” crop, which pushes insects away from other essential plants (rue’s bad odour and disagreeable taste will keep even the most persistent of pests away).
- Certain plants create habitats which attract more beneficial insects (such as lady beetles, praying mantis, and ambush bugs).

Planting particular plants together can attract good insects and drive away pests. In general, mixed crops and strong smells repel garden enemies, while flowers attract beneficial insects. ‘Companion planting’ is a natural way to protect plants.

Flowers which attract beneficial insects are camomile, carrot, celery, clover, coriander, daisy, dill, canna, carrot, citrus, mint, nasturtiums, parsley, parsnip, rosemary, rue, thyme and yarrow. Let some of your vegetables flower.

Strong-smelling plants which deter pests by “putting them off the scent” are aloe vera, artemisia, basil, calendula, camomile, catnip, chilli, chives, citronella, garlic, ginger, horehound, lantana, lavender, leeks, lemon grass, marigold, mint, onions, tansy, thyme and tobacco.

Plants which repel soil pests

- Garlic plants kill off some fungi in the soil.
- Some marigolds kill nematodes in the soil. Get the right kind.
- Cabbage smell repels soil pests.

Special combinations

Some say these combinations work well. Try them and see!

- Basil repels tomato hornworms.
- Nasturtiums get rid of squash bugs.
- Marigolds, mint, thyme and camomile drive away cabbage moths.
- Radishes trap beetles that attack cucumber and squash.
- Thyme and lavender deter slugs.
- Tansy and pennyroyal get rid of ants.
- Tomatoes repel asparagus beetles.
- Beans and brassicas planted together confuse each other’s pests.

Reference

(Adapted from) Mettot, B. 2007. *Companion Planting*. In Backwoods home magazine. May/June: 11, <http://www.backwoodshome.com/articles2/mettot81.html>



COMPOSTING

Definition: the aerobic decomposition of biodegradable organic matter, to produce compost.

How a compost pile works

Composting uses nature's own recycling system. When leaves drop from a tree, they decay into soft black humus over time, without any help from people. Anything that once lived will eventually decompose. Composting is based on this natural process and begins with the thousands of micro-organisms which live naturally in soil. They feed on a moist heap of organic waste materials, generating considerable heat in the process. Other groups of "decomposer" organisms go to work as the temperature rises, an ever-changing workforce of bacteria, fungi, and insects. When the temperature drops, turning or stirring the pile gives the decomposers more oxygen and the heat builds again, helping to kill harmful bacteria. When all the easily decomposed material has been consumed, the temperature drops for the last time and earthworms and ants may move in, signalling that the compost is ready to feed new plants with its "recycled" nutrients. Finished compost has the distinctive fresh smell of newly-turned soil and won't heat up again no matter how often you turn air into the pile. The ideal result of the composting process is crumbly, dark, soil-like humus.

Many different materials are suitable for composting organisms. Some materials contain high amounts of carbon in the form of cellulose which the bacteria need for their energy (brown materials). Other materials contain nitrogen in the form of protein, which provide nutrients for the energy exchanges (green materials). Suitable brown materials with relatively high carbon content include:

- Dry, straw-type material, such as cereal straws
- Autumn leaves
- Sawdust and wood chips
- Paper and cardboard (such as corrugated cardboard or newsprint with soy-based inks).

Green materials with relatively high nitrogen content include:

- Green plant material (fresh or wilted) such as crop residues, hay, grass clippings, weeds
- Manure of poultry and herbivorous animals such as horses, cows and llamas
- Fruit and vegetable trimmings.

Making compost

Start with a layer of sticks for drainage, followed with layers of grass, leaves, manure, and soil, alternating brown and green materials. Chop up big leaves. Add a final layer of soil, make a hole in the middle to let air in, water the heap and cover with grass or with a cloth to keep it damp. After about five days the heap will heat up as bacteria work to break it down. Keep the compost damp. After about six weeks, turn the compost, and then every few weeks. After three months, test it. If it is dark, crumbly, light and moist, it is ready to use.

Benefits of compost

- **Reducing garbage:** Up to 30% of the garbage we throw out each week can go in the compost pile. Cutting domestic waste generation means a longer life for landfill sites and better environmental management for the entire community.
- **Helping plants grow:** Your garden and house plants can never get too much compost. It gradually releases a variety of nutrients just when they're required by the growing plants. Insects and diseases don't seem to do as much damage where the soil is enriched with plenty of decayed organic matter.
- **Building up the soil:** Plenty of compost added to the soil will act like a sponge, soaking up water when it rains and releasing it in dry spells. It improves the structure of both sand and clay soils, protecting them against drought and erosion.

Can I compost this?

Ashes	Maybe	From untreated wood or paper, yes, in small amounts; but not from barbecues, plywood, coloured or glossy paper
Banana Skins	Yes	Decompose rapidly; can help to activate a slow compost; loaded with plant nutrients
Cardboard	Yes	Shred, soak, and mix with "greens"; but try first to reuse or recycle it
Citrus Fruits	Yes	Shred rinds; bury in compost to discourage fruit flies
Coffee Grounds	Yes	Good earthworm food; use directly on many plants; compost shredded filters, too
Corn Cobs	Yes	Shred; adds both fibre and nutrients to compost; good mulch; slow to break down
Dairy Products	No	Fats seal off air from compost; odours attract pests
Dishwater	Maybe	If water doesn't contain grease or chemical cleansers, use it to wet pile
Eggshells	Yes	Dry and crush first; good earthworm food; slow to break down; help neutralize acidity; as mulch, may discourage slugs
Fabrics	Maybe	Small scraps of wool, cotton, felt and silk; not synthetic fibres or blends
Feathers	Yes	Keep somewhat wetter than usual; extremely high in nitrogen
Grass Clippings	Yes	Available and valuable; mix well to avoid clumps; leave some clippings to feed lawn
Hair	Yes	Both human and pet hair; keep quite damp
Hay / Straw	Yes	Very good fibre, nutrients usually low
Leaves	Yes	Shred and soak; add both nutrients and fibre; tend to be slightly acidic
Manure	Yes	Cow, horse, pig, rabbit, poultry -- the fresher the better -- helps any compost
Meat and Bones	No	Odours and pests are problems; but dried, ground bonemeal is fine source of nitrogen
Soil	Yes	Adds decomposer soil organisms; scatter lightly to avoid compacting
Nutshells	Maybe	Crush delicate shells like peanuts; heavier shells are better used as decorative mulch
Pet Wastes	No	Risk of pathogens and parasites; use only barnyard manure (horse, cow, sheep, etc.)
Seafood Shells	Yes	Crush or grind very finely; break down very slowly; reduce acidity; good mulch
Seaweed	Yes	Rinse off salt so it won't contaminate soil; great fertilizer
Tea Leaves	Yes	High in nitrogen; can be applied directly to some plants; compost tea bags
Toadstools	Yes	Decompose quickly; excellent source of many minerals

References

Adapted from

- Department of the Environment. New Brunswick, Canada. *Backyard Magic: The Composting Handbook*. <http://www.gnb.ca/0009/0372/0003/0001-e.asp>
- Setting up and Running a School Garden. A Manual for Teachers, Parents and Communities. Food and Agriculture Organization of the United Nations Rome. <http://www.fao.org/docrep/009/a0218e/a0218e00.htm>



TRENCH GARDENS

In 1955 this technique was developed in Kwazulu-Natal. It is the perfect way to feed and improve the quality of the soil, use organic waste material, and grow vegetables organically on a relatively small patch of ground.

1. Dig a trench, the size of a door, 50 cm deep, separating subsoil and topsoil.
2. Half fill with organic material i.e. vegetable and fruit peelings, leaves, grass, maize stalks and cobs, bones, feathers, newspapers, egg shells and manure.
3. When half-full, water well and cover with 15 cm of subsoil and then topsoil is mixed with manure above that - do not trample!
4. Cover the soil with 6cm of mulch. Mulching means putting dry organic material (grass, straw, leaves) about 6cm deep around the base of plants. The mulch keeps moisture in the soil, keeps the soil surface cool and soft, prevents weeds, and gradually decays like compost to enrich the soil. It is particularly useful where the soil is poor or there is very little water, in hot climates and hot seasons. The best mulching material is light-coloured and reflects the light. Use grass and weeds before they produce seeds, otherwise they will be provide competition.
5. Build a low fence of sticks around your bed to protect it from animals and the wind. Plant beans against this fence.
6. Plant your seedlings or seeds [according to the season].
7. Separate the mulch with a stick and plant the seedlings or seeds across the bed. Plant a good variety of vegetables in alternate rows. If you plant marigolds in some rows you will have fewer insect pests. If the sun is scorching them build a light frame of twigs and dry grass over the bed for shade. Remove the grass bit by bit as the seedlings grow stronger.
8. Water regularly and lightly with a punched tin can, keeping the soil surface damp under the mulch.
9. When the seedlings reach 5cm tuck the mulch up against the plants.
10. Start a new trench each month, for 4 months. This will ensure a regular supply of fresh vegetables all year round.
11. Such a trench garden can be planted continuously for 5 years but it is wise to plant different types of plants in rows by rotation for best results. For example: **ROOTS** (e.g. beetroot, turnips, carrot) then **LEAVES** (e.g. cabbage, lettuce, onions, spinach) then **LEGUMES** (beans, peas). This will require you to keep good records of where you planted your last crop.
12. Practice intercropping (growing different crops near to one another) as it helps to utilize and conserve the soil and protect plants. A multi-layered garden, with plants at different heights, is a form of intercropping that makes the most of garden space and sunshine. Putting plants with different needs together cuts competition. In particular, try growing **tall plants next to small ones**, e.g. maize with cabbage, **fruit trees next to vegetables**; **deep-rooted plants next to shallow-rooted plants**, e.g. maize with sorghum and pigeon pea; **climbing plants next to ground plants**, e.g. passionfruit, beans or corn with lettuce, onions, or carrots; **broad leaves next to narrow leaves**, e.g. cabbage with carrots.

Reference

Adapted from Opie, F. *Be Prepared for Life. Activity Kit Three: Food for Life.*
<http://www.scouting.org.za/bp4life/kit3-1.html>



TYRE GARDENS

The best thing about tyre gardens is that you can set them up and move them just about anywhere. You can garden on a cement patio, on flat rock, on a rooftop, on a steep hillside, even on the roots under a tree. All you will need to start are several old tyres, some plastic sheets, soil or growing mix, and plant seeds. A tyre garden is easy to make. You can cut off the top rim of the tyre for a wider space to garden or you can garden in the tyre without cutting it at all. To cut the rim, lay a tyre flat on the ground. The rim is the whole top section from the side to the hole in the centre. Notice that the top rim and bottom rim are exactly the same size. With a knife or machete, cut off the top rim. You can prevent the knife from sticking by pouring a small trickle of water on the rubber just behind the knife.

Next, place a piece of plastic such as a garbage bag inside the tyre over the bottom rim. The plastic should be large enough so that it covers the bottom of the tyre and 3 or 4 cm stand up along the walls. Now turn the top rim that has been cut off upside down and press it in against the bottom rim. It will fit tightly and hold the plastic in place. If you have not cut the rim, use a few stones or gravel to hold the plastic in place on the bottom of the tyre.



The plastic sheet in the bottom of the tyre helps your garden in two ways. It holds water at the bottom of your garden so your soil does not completely dry out. Any extra water can seep between the plastic and the side of the tyre, then out through the bottom. You may want to cut one

or two extra small holes in the bottom rim for extra drainage. Plastic also prevents tree roots from growing up into the tyre garden. Now fill the tyre with good soil or compost. Make sure the soil is pushed well up against the walls of the tyre. Now it is time to sow your seeds. If you are gardening on a cement patio or rooftop, you can place your tyre gardens on top of sticks, large stones, bricks, or cement blocks. This will let air blow beneath them and keep the patio or roof dry between waterings.

Most vegetables and herbs grow well in tyre gardens as long as you water them regularly. People around the world have successfully grown carrots, onions, cabbages, spinach, tomatoes, lettuce and peppers. Certain crops do not grow well in tyres. Trees are just too tall to grow properly. In the hottest, dry months, plants that need a lot of water such as sweet potatoes may not survive, even if you are watering them properly. Plants with big leaves that spread over a large area such as pumpkins probably need more soil than a tyre garden can hold, so you may want to avoid planting them. Some very tall plants, 1.5 metres or taller, may be hard to grow because they might tend to lean over and break. However, you could use sticks to support them. But there are no rules for tyre gardening. You can experiment with many types of plants.

Every six months, or after two crops have been planted, replace the soil mix in the tyre completely with fresh compost and manure. It is possible to use the soil mix longer than this, but other tyre gardeners have found that crop production goes down.

Reference

PACE: The Pan African Conservation Education Project. Growing Vegetables in the City: Action sheet 76. www.paceproject.net



MONOCULTURE

Monoculture is the practice of producing or growing one single crop over a wide area. The term is also applied in several fields.

The term is mostly used in agriculture and describes the practice of planting crops with the same patterns of growth resulting from genetic similarity. Examples include wheat fields or apple orchards or grape vineyards. These cultivars have uniform growing requirements and habits resulting in greater yields on less land because planting, maintenance (including pest control) and harvesting can be standardized. This standardization results in less waste and loss from inefficient harvesting and planting. It also is beneficial because a crop can be tailor planted for a location that has special problems - like soil salt or drought or a short growing season.

Monoculture produces great yields by utilizing plants' abilities to maximize growth under less pressure from other species and more uniform plant structure. Uniform cultivars are able to better use available light and space, but also have a greater drain on soil nutrients. In the last 40 years modern practices such as monoculture planting and the use of synthesized fertilizers have greatly reduced the amount of land needed to produce much higher yielding crops. The success of monoculture cropping has produced a worldwide surplus of food stuffs that has depressed crop prices that farms receive.

Catastrophic crop failure

The dependence on monoculture crops can lead to large scale failures when the single genetic variant or cultivar becomes susceptible to a pathogen or change in weather patterns. The Great Irish Famine (1845-1849) was caused by susceptibility of the potato to *Phytophthora infestans*. The wine industry in Europe was devastated by susceptibility to *Phylloxera* during the late 19th century. Each crop then had to be replaced by a new cultivar imported from another country that had used a different genetic variant that was not susceptible to the pathogen.

Reference

Wikipedia, the free encyclopedia. 2008. Monoculture. <http://en.wikipedia.org/wiki/Monoculture>



CROP ROTATION

Crop rotation is one of the oldest and most effective cultural control strategies. It means the planned order of specific crops planted on the same field. It also means that the succeeding crop belongs to a different family to the previous one. The planned rotation may vary from two or three years or could be a longer period.

Some insect pests and disease-causing organisms are host specific. For example, rice stem borer feeds mostly on rice. If you don't rotate rice with other crops belonging to a different family, the problem continues as food is always available to the pest. However, if you plant a legume as the next crop, then corn, then beans the insect pest will likely die due to a lack of food.

Advantages of crop rotation

1. Prevents soil depletion/maintains soil fertility and reduces soil erosion
2. Controls insect/mite pests and reduces the pests' build-up
3. Reduces reliance on synthetic chemicals
4. Prevents diseases
5. Helps control weeds

Useful tips in planning crop rotation

1. Know the family of your crop to make sure that you plant a crop that belongs to a different family the next season (see table below).
2. Make a list of the crops you want to grow and plant them in the right order.
3. Grow legumes before grains or cereals.
4. Always keep farm records.

Crop groups

Family	Common names
Allium	Chive, garlic, leek, onion, shallot
Cucurbit (Gourd family)	Bitter gourd, bottle gourd, chayote, cucumber, ivy gourd, luffa gourd, melons, pumpkins, snake gourd, squash, wax gourd
Crucifer (Brassica)	Bok choy (petchay), broccoli, brussel sprouts, cabbage, Chinese cabbage, cauliflower, collard, kale, kohlrabi, mustard, radish, turnip, watercress
Legume	Common beans, black bean, broad bean (Fava), clover, cowpea, garbanzo, hyacinth bean, kidney bean, Lima bean, lintel, mungbean, peanut, pigeon pea, pinto bean, runner bean, snap pea, snow pea, soybean, string bean
Aster	Lettuce, artichoke
Solanaceous	Potato, tomato, pepper, eggplant
Grains/cereals	Corn, rice, sorghum, wheat, oat, barley, millet
Carrot family	Carrot, celery, dill, parsnip, parsley
Root crops	Cassava, sweet potato, taro, yam

Reference

PAN Germany, OISAT. Intercropping.

http://www.oisat.org/control_methods/cultural_practices/intercropping.html

INTERCROPPING



Intercropping is like companion planting, except that it has more to do with finding two crops that fit well with one another in terms of space, sun and nutrient needs than it does matching complimentary plant personality types.

Intercropping is therefore the cultivation of two or more crops simultaneously on the same field. It also means the growing of two or more crops on the same field with the planting of the second crop after the first one has completed its development. The rationale behind intercropping is that the different crops planted are unlikely to share the same insect pests and disease-causing pathogens. Intercropping also conserves the soil.



Types of intercropping practices

- Mixed or multiple cropping is the cultivation of two or more crops simultaneously on the same field without a row arrangement.
- Relay cropping is the growing of two or more crops on the same field with the planting of the second crop after the first one has completed its development.
- Row intercropping is the cultivation of two or more crops simultaneously on the same field with a row arrangement.
- Strip cropping is the cultivation of different crops in alternate strips of uniform width on the same field. There are two types: contour strip cropping and field strip cropping. Contour strip cropping involves a definite rotational sequence and the crops are planted along the exact contour of the field. Field strip cropping has strips with uniform width that follows across the general slope of the land.

Advantages

1. Reduces the insect/mite pest populations because of the diversity of the crops grown. When other crops are present in the field, the insect/mite pests are confused and they need more time to look for their favorite plants.
2. Reduces the plant diseases. The distance between plants of the same species is increased because other crops (belonging to a different family group) are planted in between.
3. Reduces hillside erosion and protects topsoil, especially the contour strip cropping.
4. Attracts more beneficial insects, especially when flowering crops are included in the cropping system.
5. Minimizes labour cost on the control of weeds. A mixture of various crops gives a better coverage of the soil leaving less space for the development of weeds.
6. Utilizes the farm area more efficiently and increases total production and farm profitability than when the same crops are grown separately.
7. Provides two or more different food crops for the farm family in one cropping season.

Reference

PAN Germany, OISAT. Intercropping.
http://www.oisat.org/control_methods/cultural_practices/intercropping.html



NOTES



Handprint resource books available from Share-Net

TITLE	LEARNING AREAS COVERED (BROADLY)
 1. Reusing Shower and Bath Water	Language Natural Sciences Technology
 2. The Buzz on Honey Bee Economics	Language Natural Sciences Social Sciences Technology Economics & Management Sciences
 3. Have you Sequestered your Carbon?	Language Natural Sciences Technology Mathematics
 4. Did you Grow your Greens?	Language Natural Sciences Social Sciences Life Orientation Arts & Culture
 5. Clearing Invasive Weeds	Language Natural Sciences Technology
 6. The Secret of a Spring	Language Natural Sciences Social Sciences Life Orientation Technology Mathematics
 7. The Secret of the Disappearing River	Language Life Orientation Social Sciences Economics & Management Sciences
 8. Creative Garden Design	Language Natural Sciences Technology
 9. Recycling, Waste Reduction and Creative Re-use	Language Social Sciences Life Orientation Arts & Culture Technology Economics & Management Sciences
 10. Worming Waste	Language Natural Sciences Technology
 11. Growing Mother-tree Seedlings	Language Natural Sciences Technology
 12. Rooibos: a Biodiversity Economy at Risk	Language Natural Sciences Economics & Management Sciences

Many more Handprint resource books are in the planning stages. These resource books and many others for teacher educators and teachers are available electronically in pdf format on www.tessafrica.net. The Handprint resource books can also be downloaded from www.handsforchange.org.

The adaptive use of these resource books for educational purposes is encouraged. Anyone wishing to develop their own resource or adapt one, can contact Share-Net sharenet@wessa.co.za for a version in Microsoft Word.



HAND PRINT™
action towards
sustainability

This handprint is of a 10-year-old girl, Srija, from a school in Hyderabad, India, who was involved in a project taking action for sustainability. Her handprint can be taken as a symbol for positive action.

Increase your handprint. Decrease your footprint.

Human impact on the Earth has tripled since 1961 and our human footprint is now 25% bigger than the planet can support. In other words we are using 25% more natural resources and services than the planet can create and provide. The 'Ecological Footprint' is one way to measure what area of land and water the whole human population requires to produce the resources it consumes and to absorb its wastes, and we now need 25% more area than is available on the whole planet. This means that the planet is simply being damaged beyond what it can repair, and this cannot continue without causing very serious threats to all life, including our own.

Education is a key way to achieve the changes we need to live in a manner that the planet can support. Environment and Sustainability Education (an environmentally focussed approach to Education for Sustainable Development – ESD) is a move away from seeing education just as a means of producing the skills to carry on doing what we are doing. It develops the abilities needed to address the big issues affecting the planet, and builds the capacity in communities to make important decisions about their future. Environment and Sustainability Education calls for action.

The Handprint is one measure of Environment and Sustainability Education action. The idea is to decrease the human footprint and to make the world more sustainable. The Handprint is a new approach or 'tool' being developed by the Centre for Environment Education (CEE), in Ahmedabad India, with many partners across the globe. The purpose of the Handprint is to help measure **positive action for change** at different levels. We all need to decide **what we can do** at the individual, community, national and global level in order to increase our Handprint, and decrease our Footprint.

“Through our actions, we add substance and vigour to the quest for sustainable living.”

The Ahmedabad Declaration 2007: A Call to Action, 4th International Conference for Environmental Education



www.handsforchange.org