HAND PRINT™
action towards sustainability

Worming Waste

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.

The school story in this particular resource book is based on the excellent work of a teacher at Kuyasa Primary School, who has started a wormery project as part of their Eco-School programme. Thanks also to Nikky Kohly for her material on how to build a wormery, developed herself, and to Lausanne Olvitt for general guidance and advice.

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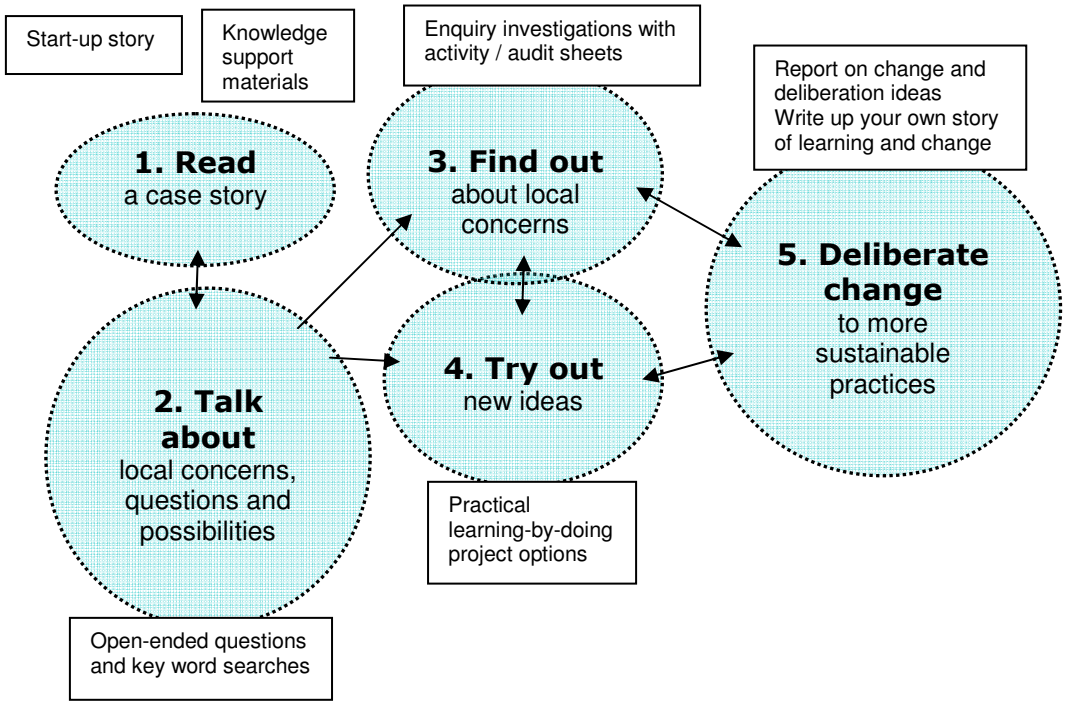
RESOURCE BOOKS

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.

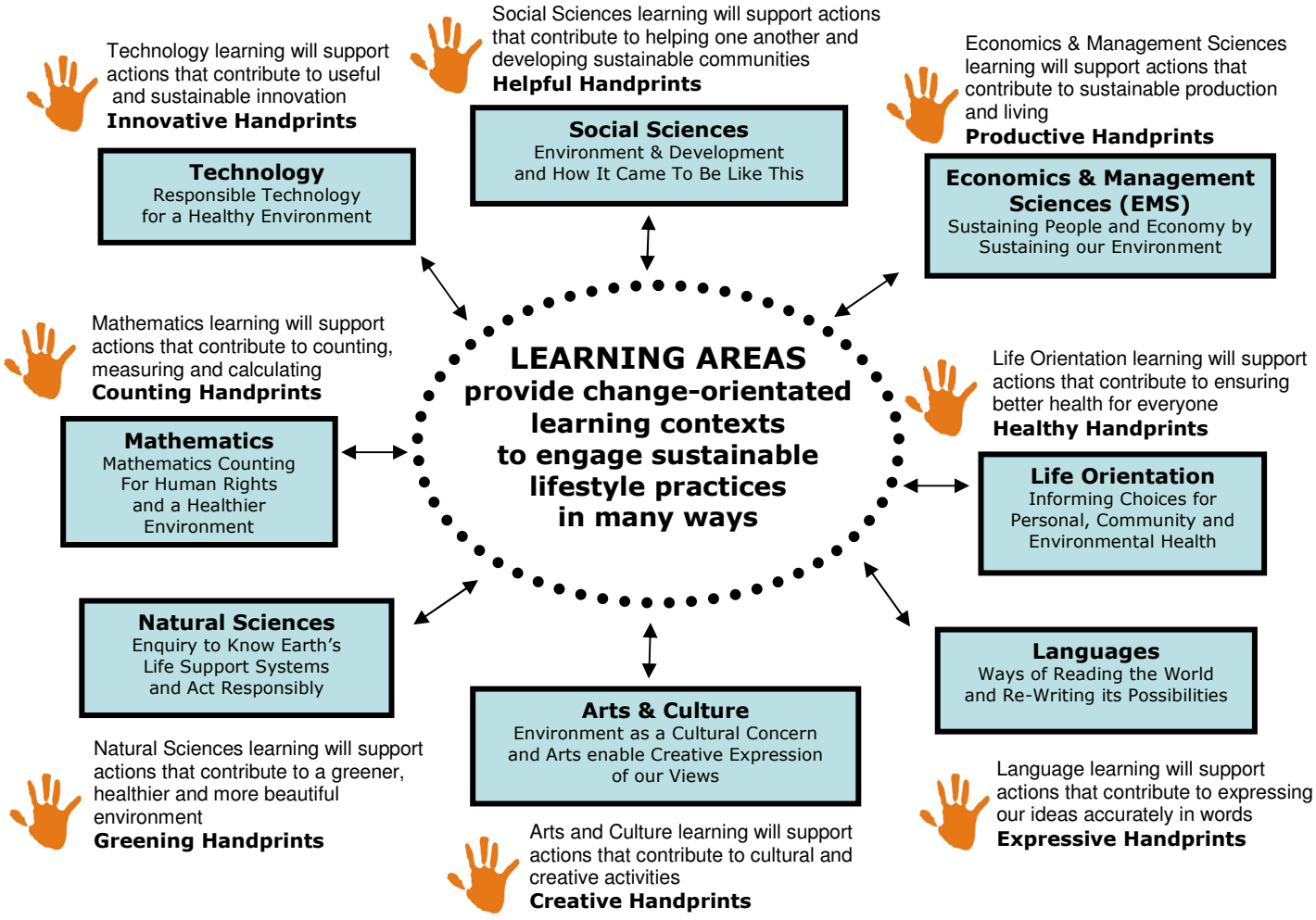
The **Handprint Resource Books** are an attempt to work from authentic cases of environmental learning and change. They combine some of the best teaching and learning tools that are being used to support change-orientated learning in the everyday realities of our South African schools. The resource books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



1-2 Start-up story to situate	2-4 Local learning engagement	5. Reporting and reflection

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.

CONTENTS

Starting points

Ideas and Tools for Local Learning

Knowledge & Activity Support Materials (SM)

School story

Worming Waste at Kuyasa Primary School

Key words			
Citrus	Microbes	Nutritious	Worm castings

Our school joined the Eco-School programme this year. I am passionate about nature, so the principal asked me to be the teacher responsible for this. I was not sure what project we should focus on. I did have dreams of extending the vegetable garden to make it more productive so we could start feeding the learners freshly grown, nutritious vegetables. The problem was that our soil was in a poor condition. The co-ordinator of the Eco-School programme visited our school and helped us decide what to do. She had heard about the effectiveness of wormeries in recycling organic kitchen waste and suggested we build a wormery. This would create very nutritious compost that we could feed to our soil and our vegetable garden would benefit significantly. She gave me a resource she had found on the Internet to inspire me. It described some of the amazing benefits of the worm castings and 'worm tea' that is produced from a wormery **(SM 1)**. After reading this my mind was made up. Our class was going to establish a wormery and we were going to feed our vegetables the highly nutritious worm castings and worm tea that it would produce.

I started doing my own research, using the Internet and library, to find out more about the fascinating animals that make this worm tea. I also wanted to learn how to build a wormery. I came across a very useful resource called 'Learn with the worm' **(SM 2)**. It described in detail how to set up a wormery. During my research I also found a two-page description of the biology of earthworms **(SM 3)** and learnt that the worm used in wormeries is called *Eisenia foetida* or the red wriggler. I adapted this information and prepared a lesson for the learners.

Many Internet sites gave options of different wormeries one could buy. I decided early on, however, that our class was going to make our own wormery out of recyclable or cheap and easy to find materials. I wanted this to become an entrepreneurial project where children could easily build wormeries at home and sell the

1. Kirkwood Wormery

2. Rhodes Wormery

3. Wizard Wormery

worms to fishermen. This proved viable: a few months later a friend was already asking to buy worms from me.

We have set up three different wormeries and are experimenting to see which ones work best. Kitchen scraps, cut into small pieces, are fed to each of them twice a week. At first I fed them a lot of citrus and potato peels until I'd read that these were not good for the worms. The citrus is too acidic. I'm not sure what is wrong with potato peels. The first wormery is called the Kirkwood wormery. It consists of a tyre, placed on a stand. Wire mesh is placed underneath the tyre, covered with newspaper, to hold the compost in place. A hessian sack acts as a cover for the top. The bedding consists of torn-up newspaper. The problem I find with this particular wormery is that we can't control the moisture and the compost gets dry very quickly. During winter we would water it once a week, but now that it's getting hotter I'm finding we need to water it more often. On humid days, or a day after it has rained, you can actually watch the earthworms trying to escape. I think the problem is in the materials we used as a lot of evaporation takes place through the wire mesh at the bottom. However, we started with nine earthworms and after three months there are now 30 so it is working, but could be doing better.

The second wormery is called 'Rhodes Wormery', because Rob from the Environmental Education and Sustainability Unit, at Rhodes University, helped us build it. It consists of a plastic basin, covered with small stones and a layer of newspaper. A hessian sack covers the whole wormery and we drilled one hole at the bottom of the basin to catch the 'worm tea' as it is made. The compost in this wormery is much more moist and looks a lot healthier because water doesn't evaporate as quickly. However, our most successful wormery is called the 'Wizard Wormery'. It consists of a plastic basin bottom and a plastic basin to cover the top. PVC piping (6, 2cm high pieces) is placed on the bottom of the plastic basin, to hold up the wire mesh, which is covered with a layer of newspaper. The plastic bottom has holes drilled in the bottom to collect the 'worm tea'. The whole wormery is placed on a stand. I add a couple of handfuls of straw every couple of months for bedding. This gives the soil its different layers and helps the air circulate which improves oxygen levels. We bought 1000 worms to help start this wormery. I think this, with the straw being used as bedding and the better moisture levels, have all helped to produce excellent soil. It is rich, dark, crumbly, moist and looks very healthy. My learners wanted to know how this worked, so I did some more research and put together some interesting facts to share with them **(SM 4)**. I was fascinated to find out that earthworms don't have teeth and so they rely on microbes to soften their food.

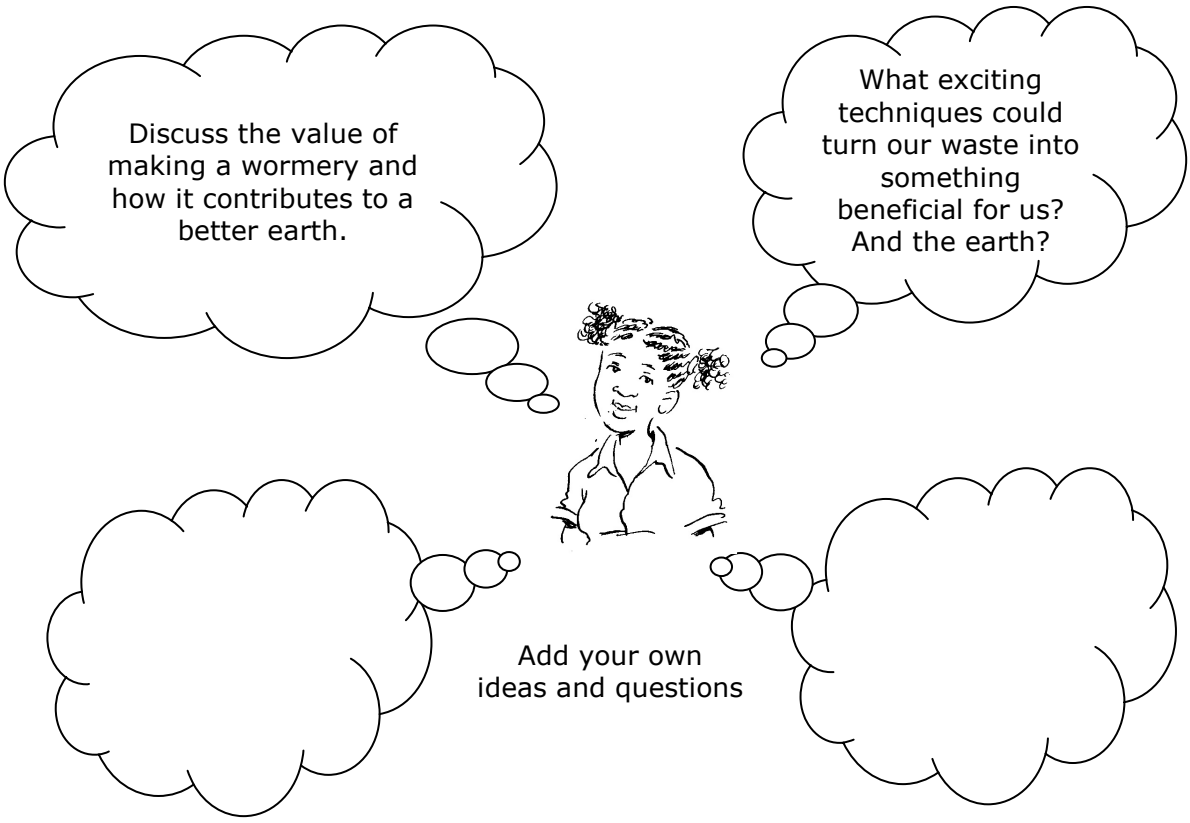
My learners started getting increasingly excited. They would count the worms each month to see how many more there were and were always amazed at the number. They also love to find the little white cocoons that hold between 2-6 little red wrigglers. I've already used some of the rich earthworm castings for a tree we planted in our school and will soon add them to our vegetable garden.

Glossary
Citrus: a fruit from the citrus family, e.g. oranges, naartjies, grapefruit.
Microbes: microscopic living organisms such as bacteria and viruses.
Nutritious: high in useful nutrients and therefore healthy.
Worm castings: the soil-like material produced from digestive tracts of earthworms.

Comprehension Questions

1. Why did the teacher decide not to buy wormeries, but rather to make some out of recyclable, easy find or cheap to buy materials?
2. Describe the characteristics of the three wormeries.
3. What are two of the benefits of adding straw as bedding?
4. Why do earthworms rely on microbes?
5. What are two of the things the teacher could use the earthworm castings for?
6. What did you find out about the benefits of worm tea and earthworm castings after reading **Support Material 1**?
7. What are some of the things you need to remember when setting up your own wormery? **(SM 2)**
8. After reading **SM 3**, what did you find most interesting about the biology of earthworms?
9. Give one interesting fact on how worms change food scraps into nutritious compost **(SM 4)**.

Discussion Points



FINDING OUT ACTIVITIES

Activity 1: the aim of this activity is to investigate earthworm feeding patterns:

- How long does it take for earthworms to eat their food?
- What are earthworms' favourite types of food?

To conduct this investigation you will need to feed your earthworms in one particular spot, about 10cm square. Observe how many days pass until the earthworms find their new food. How long did it take them to completely eat all of their food in this location? Over a couple of feeding schemes, vary what you feed them to find out which food scraps are their favourite.

Activity 2: After your first month count how many earthworms you have. Work out how quickly they have reproduced. Find out how much earthworms could be sold for. If earthworms continued to reproduce at this rate, how much money could be made in a year if they were sold.

Some useful information:

- Red wrigglers live between two to five years.
- They make two to five cocoons per week
- Two to three worms hatch (the hatchlings) from each cocoon.
- There is a 45-day hatch time.
- It takes six weeks before the hatchlings are reproducing.

(Ref: Studer, K. 2007. What a Can of Worms!)

Activity 3: Find out the weight of food scraps required to make one kg of worm castings. Roughly work out how quickly it will take if you have 1000 worms?

Here is the information required to work this out:

- One kilogram of food scraps will lose 80% of its volume as the water evaporates. This leaves you with 0.2 kg.
- Of this 0.2kg or 200g, four fifths is converted into energy for the worm. Only one fifth is turned into compost. This leaves you with 40g.
- 20 000-50 000 earthworms process 2kg of food per day.

(Ref: Thomson, R. Worms get rid of waste! www.saasta.ac.za)

Activity 4: Mix different portions of the harvested castings into potting soil and observe the difference in growth, size and production of plants.

TRYING OUT ACTIVITY

Build and look after your own school wormery. Use **SM 1** and **SM 5** to help you.

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.

Given what you now know about the value of earthworm castings and worm tea, and how much you can realistically produce in a year, consider the best use of your valuable wormery. This is a deliberation exercise where you weigh up with your learners the best use of the earthworm castings for your school context. You might consider whether you have a vegetable garden, want to plant a tree, or make healthy potting soil as you deliberate options.

BENEFITS OF WORM CASTINGS & WORM TEA

These benefits are due largely to the many microbes that exist in worm castings and tea.

The benefits of worm tea include:

- The microbes in worm tea produce hormones, vitamins, nutrients, enzymes, amino acids and minerals that are needed by seedling cuttings and young plants. Plants that are fed worm tea are therefore healthier as they are getting more nutritious food. They are in fact healthier than plants that have had chemical fertilizer put in the soil.
- Worm tea can be used as an inoculant for potting soil as it helps plants resist disease. This is because the microbes in the tea stop airborne pathogenic fungi from infecting the soil.
- Another factor that improves the health of your plants is that feeding your plant worm tea allows for a symbiotic relationship to develop between the plant and microbes that were in the worm tea and are now in the root zone. Plants feed the microbes and the microbes produce or make available all of the food and medicine the plants need to thrive.
- Worm tea can improve soil that has been damaged by agricultural chemicals. What happens is that when worm tea is fed to the soil enough times the microbes adapt to the soil and change organic and inorganic chemicals into something that no longer has negative effects on the ecosystem. They will also remove heavy metals that the plant is not able to use.
- Worm tea also improves the water retention in soil. This is because many of the microbes present make a protective mucus. This mucus is like a glue that holds soil particles together. This creates passageways in the soil for water to move through.
- The microbes in worm tea also turn organic matter into humus. Humus greatly improves soil fertility.

Earthworm castings have many benefits too:

- They have been shown to be much richer in plant nutrients than the soil, with three times more calcium, five times more nitrogen, seven times more phosphates and eleven times more potassium (www.wikipedia.org. Jan 2006).
- Related to this, the nutrients that are in organic matter are broken down into a form plants can use. For example, nitrogen is broken down into ammonia and nitrates.
- Professor Clive Edwards states that "Vermicompost outperforms any commercial fertilizer I know of… I think the key factor is microbial activity, research that I and others have done show that microbial activity in worm castings is 10-20 times higher than in the soil and organic matter that the worm ingests." (Ref: Lodson, G. 1994. Vermicomposting. In BioCycle: 63).
- Earthworm castings contain a high percentage of humus. This improves the structure of the soil because humus forms clusters from the soil particles. This creates channels for air to move through and improves the soil's ability to hold water. Humus is also believed to help protect plants from harmful pathogens, fungi, nematodes and bacteria.
- Earthworm castings are rich in humic acids (www.wikipedia.org. Jan 2006). Humic acid binds plant nutrients so that they don't get washed away, but also releases the nutrients when the plant needs them.

Worms in the Classroom

Worm composting or vermicomposting is a perfect illustration of "natural" recycling. Worms eat food scraps, leaving behind dark castings (i.e. worm manure) called vermicompost. Vermicompost is a nitrogen-rich natural fertilizer that commercial worm farms have found to be very profitable. Steps to successful classroom vermicomposting include Set Up, Worm Adoption, and Maintenance.

SET UP

Like all living creatures, worms need food, water, air and shelter. Set up is simply creation of the worm ecosystem which includes: 1) a bin, 2) bedding, and 3) food.

Bin

You can purchase commercially made bins or construct a bin from wood or plastic. A bin needs to be 30-45 cm deep, have a snug fitting lid and small holes in the bottom or sides for ventilation. The ideal bin for classroom use and first time vermicomposters is a 70 litre plastic drum with a tight fitting lid (30 to 34 cm tall, 30 x 60 cm base). Drill air holes (no bigger than 1/4 inch, or about 0.5cm diameter) about halfway up on the sides of the bin. Drill one or two holes at the bottom to collect the worm tea that will come out. Make sure to put something underneath to collect this highly nutritious tea to feed to your plants. Also ensure that the legs of your wormery are in lubrication oil or soapy water as this prevents ants from coming in. Worms prefer temperatures of 18-30 degrees Celsius. At this temperature the worms, and bacteria, necessary for softening the food are all happy. Keep your worm bin indoors, out of the sun, in a quiet place, but not so isolated you or your class forget about them!

Bedding

Worms need to live in moist bedding. Bedding keeps the worms damp and also provides a high carbon material that the worms will break down. Shredded leaves, chopped up straw, sawdust, compost, aged manure, paper torn into strips, cardboard or straw are all good bedding materials. Moisten your bedding so that it is as damp as a wrung-out sponge. It is good to vary your bedding as this will provide more nutrients for your worms and thus a richer compost. Fill your bin three quarters full with this moist bedding. Sprinkle bedding with a few handfuls of soil as this will help the worms digest their food. Gently lifting the bedding will create air spaces. This will help control bad smells developing and give the earthworms free movement in their bedding. A good idea is to mix compost in a new bin as this will help decompose the food waste quicker.

Food

Worms eat about half their body weight a day! Feed ½ a kilogram of worms (about 1000 worms) about a cup of chopped up food scraps per day. Store the food scraps in a bucket for 2-3 days, and add a little water so that they ferment easily.

Food scraps include:

- Fruit and vegetable peelings, cores, seeds
- Breads, cereals, pasta
- Eggshells (good for calcium).

Do not feed your worms

- Oil or oily food and not too much sugar or salt

- Soaps or chemicals
- Bones, meat or dairy
- Citrus, other acidic fruits and potato peels.

Always bury food at least 10cm down under the bedding. If the bin starts to smell or food isn't breaking down quickly, give your worms a break and feed them less food. Worms reproduce quickly, so they should be able to eat all your food if there's enough space and you increase the amount of food gradually. Hint: wrap food scraps in moistened newspaper. It reduces chances of developing fruit fly problems. Add fresh bedding at each feeding. Stirring up the contents allows for a good air flow. As you feed the worms, take a look at the bin. Is the bedding drying out? Is the bedding too wet? Where are most of the worms hanging out?

WORM ADOPTION

For vermicomposting, the red wiggler or *Eisenia fetida* is the preferred species. These worms are "composter" worms, capable of processing large amounts of organic material. They thrive in the fluffy layer of leaves on the forest floor and in manure piles. Soil dwellers, earthworms or night crawlers, thrive in earth tunnels and won't be happy in the confined space of a vermicompost bin with the constant interruption of waste additions and observation by students.

Red wigglers can be purchased at local bait shops or via the Internet. You will get quick results if you start your bin with a 1000 or more earthworms. You could also search for your own worms in manure piles or on the surface of forest soil. Even if you start with four that is okay – they will soon start multiplying. When the worms arrive, place them on top of the bedding. Leave the bin exposed to light as the worms work their way down in to the bedding. If worms disappear it means that they like their new home. If they stay on top something is wrong with either the bedding, moisture levels, or the food. Once all the worms have left the surface, bury their first meal, cover with the lid and leave them alone for a week or so to allow them to get used to their new home. Then begin their regular feeding schedule.

MAINTENANCE

A healthy worm bin is a productive worm bin! Keep your worms healthy and happy by:

- Adding fresh bedding every 2-3 weeks, keeping a 10 to 15cm layer of fresh bedding over the worms and food in your bin.
- Keep bedding moist, like a wrung-out sponge. Add dry bedding to absorb excess moisture.
- Harvest worm castings periodically every 3 - 6 months.

After about 6 weeks, there will be noticeable changes in the bedding. It will be darker, and you will see more castings than bedding. It is time to harvest the vermicompost.

THE HARVEST

The simplest way to harvest the worm castings is to move the contents of your bin to one side. Fill the empty side with fresh damp bedding and a small handful of soil. Feed only on the new side and the worms will eventually migrate to the fresh side. Add the castings to your garden or make potting soil.

Reference

(adapted from) Learn with the worm. The resourceful schools project. Downloaded on the 7th November 2008. http://www.resourcefulschools.org/2004/learnwithworm.htm

EARTHWORM BIOLOGY

Introduction

"---the intestines of the soil" – Aristotle (about 330 B.C.)

"It is a marvellous reflection that the whole expanse has passed, and will again pass, every few years through the bodies of worms. The plough is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed, by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures." - Charles Darwin (1881)

The Position of Earthworms in the Animal Kingdom

The animal kingdom has some major subdivisions called phyla. Humans, frogs, birds and fish belong to the phylum Chordata while earthworms belong to the phylum Annelida. A phylum can therefore include many animals that are different. The phylum Annelida is further divided into the Polychaeta (aquatic and marine worms) and the Oligochaeta (the earthworms).

The Structure of Earthworms

Earthworms do not have a skeleton but have external segments that match up with internal segments. The way they have been designed has been described as a "tube within a tube". The inner and outer tube is mostly made up of strong sets of muscles. The digestive tract runs the whole length of their body and their organs of reproduction, water balance control and nervous system occur between the two tubes. A blood-like fluid fills the rest of the space between the two tubes.

The Physiology of Earthworms

There are many different species of earthworm and these have adapted to different climates (temperature and moisture levels) and different soil types. For example, some occur in very high carbon organic content soils while others live in very low carbon soils. Because of these adaptations the different species of earthworm can look very different.

There are, however, some general characteristics that can be described:

1. Earthworms breathe through their skin. The whole surface of their skin breathes in oxygen which enters the blood through highly branched capillary blood vessels. A mucous layer, on their skin dissolves this oxygen so that it can be absorbed. This is why earthworms need moisture to survive. Carbon dioxide leaves the earthworm, also through the skin.
2. Earthworms may survive for considerable lengths of time in water if the dissolved oxygen level is high enough. Some people have put earthworms at the bottom of their fish tank and they have survived.
3. One of the differences between earthworms and mammals such as human beings is that they cannot keep their body at a particular temperature. For example, we are able to keep our body at a temperature around 38 degrees Celsius. What this means for earthworms is that the amount they have to breathe increases as the temperature rises.

The more they breathe the more energy they need. Worms therefore eat more food when the temperature is warmer and less food when it is colder.
4. Earthworms get their food from many different kinds of organic matter. This includes plant matter that is fresh or decayed, protozoans, rotifers, nematodes, bacteria, fungi and decomposing remains of other animals.
5. For the red wriggler, that is used for wormeries, it seems that protozoans is the main thing that they eat. This means that the higher the protozoan population is, the healthier your worms will be.
8. Earthworms have light sensitive structures and are able to sense differences in acidity, relative humidity, touch, and different kinds of foods.

The Ecology of Earthworms

Earthworms live in the soil, but where they live and how they move in the soil differs between species. For example, some earthworms are soil mixers while others are soil spreaders. Some worms, such as the dew worm, move vertically in the soil. Other species such as the garden worm (Aporrectodea) live in the top 5-10cm of the soil and move horizontally. The red wriggler (*Eisenia foetida*) needs soils that have a high carbon content to survive and are found in manure piles or in the top layers of a forest floor. All the earthworm species need moist environments and they cannot survive when oxygen levels are very low. Earthworms also suffer when there are toxic chemicals in the soil, such as insecticides, fungicides and herbicides.

The Reproduction of Earthworms

Earthworms are hemaphrodites. This means that a single earthworm will have both male and female organs at the same time. Some earthworm species, however, reproduce as human beings do, i.e. with another earthworm. This means they reproduce biparentally. Other species, don't need another earthworm to reproduce. This means they reproduce uniparentally (no sexual fertilization by another worm takes place). Earthworms produce a cocoon, which can have as many as 11 baby worms in it, if it is the red wriggler. Worms take between three weeks to a year to a reach the age when they can start producing babies, i.e. reproductive maturity.

Reference

(Adapted from) Tomlin, A.D. 2006. Earthworm Biology. Pest Management Research Center. Earth-WormDigest.org. Agriculture & Agri-Food Canada:
http://www.wormdigest.org/content/view/200/2/

INTERESTING FACTS ON HOW IT ALL WORKS: KITCHEN WASTE TO COMPOST

Fact 1:
Many other creatures live in the wormery apart from the red wrigglers including:

- bacteria
- fungi
- sow bugs
- microarthropods
- springtails
- protozoa
- mites
- fruit flies
- pseudoscorpions

All these creatures work hard at decomposing what you put into your worm bin (the ecosystem).

Ref: Frankel, S.Z. 2005. 'Young Person's Guide to Vermicomposting'. Earthworm digest.org http://www.wormdigest.org/content/view/15/2/

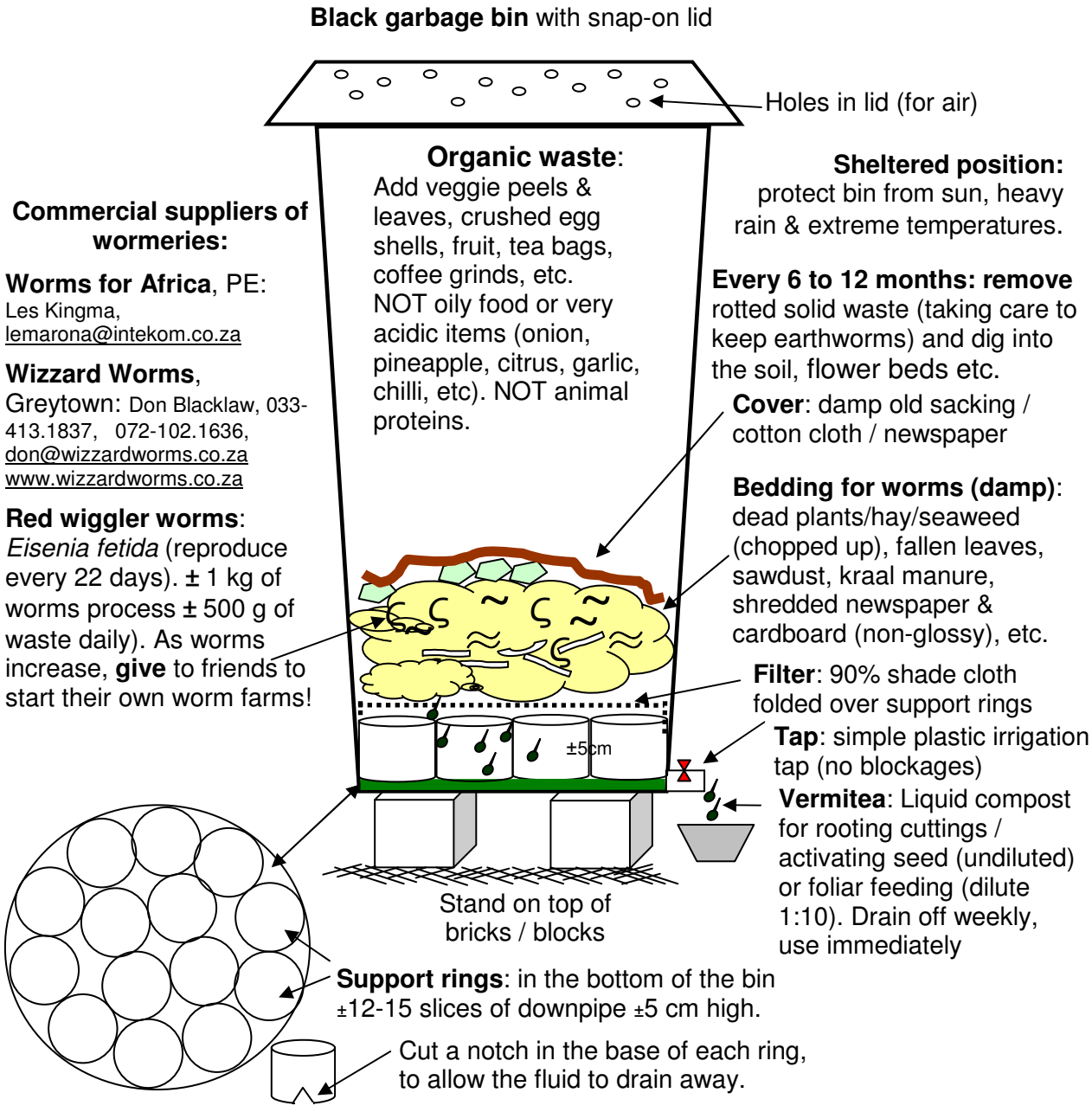
Fact 2:
Earthworms do not have teeth. They wait for bacteria and fungi to start eating the food first so that it gets soft enough to eat.

Fact 3:
Although earthworms consume the organic matter, the true nourishment comes from the micro-organisms to be found inside the worms, busily eating away. Strange but true, the worm casts have eight times as many organisms as their food does. These micro-organisms encourage healthy plant growth; the castings do not have any harmful disease pathogens, which have been reliably destroyed in the worm's gut.

Ref: Studer, K. 2007. What a Can of Worms! Earthworm digest.org. http://www.wormdigest.org/content/view/477/2/

HOME VERMICOMPOSTER

Composting with earthworms



Commercial suppliers of wormeries:

Worms for Africa, PE: Les Kingma, lemarona@intekom.co.za

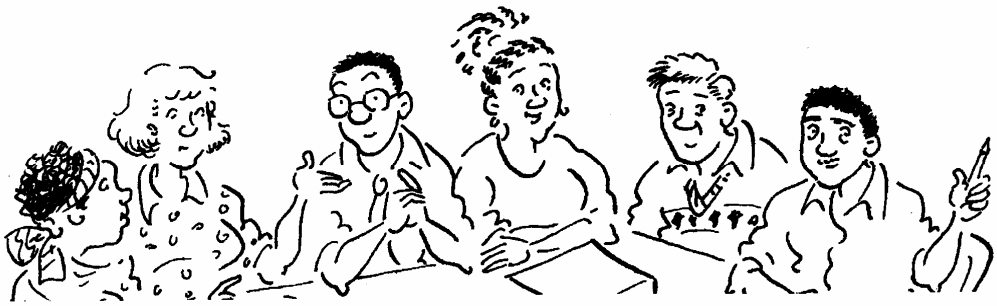
Wizzard Worms, Greytown: Don Blacklaw, 033-413.1837, 072-102.1636, don@wizzardworms.co.za www.wizzardworms.co.za

Red wiggler worms: *Eisenia fetida* (reproduce every 22 days). ± 1 kg of worms process ± 500 g of waste daily). As worms increase, **give** to friends to start their own worm farms!

Reference

Kohly, N. 2008. Home Vermicomposter: Composting with earthworms.

Please send any comments/suggestions on this page to Nikki Köhly 046-6361643 n.kohly@ru.ac.za



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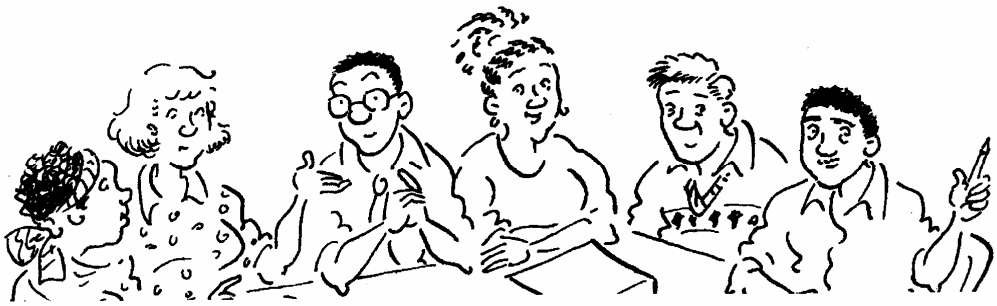

NOTES

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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 Sequestrated 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