

# Curriculum Integration



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## Linking composting to the New Zealand curriculum

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Introducing composting systems (traditional composting, worm farming and Bokashi) into your school can integrate across many areas of the New Zealand curriculum. This resource for teachers is divided into sections for years 1-8 and years 9-13. It is designed to be relevant to primary and secondary school teachers.

Guidelines for Environmental Education in New Zealand Schools (MoE 1999) provides more information on opportunities for teachers to educate students in, about and for the environment.

The Ministry of Education website (<http://efs.tki.org.nz/>) provides useful links to curriculum resources and activities specifically related to education for sustainability, including waste minimisation.

## Principles

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Some ways in which the introduction of school composting systems (traditional composting, worm farming and bokashi) can reflect key curriculum principles by incorporating:

### Future Focus

- School composting systems can assist schools to reduce their waste, which in turn reduces their ecological footprint. This helps to focus students and the whole school on the impacts of today's actions on our future sustainability.

### Community Engagement

- There are a number of ways in which a school can use the introduction of a school composting system to engage their local community. Families, whanau and communities can get involved in providing expertise, design ideas and building the compost system. Workshops on composting can be run by students to teach the community to compost. Students can use their new knowledge to develop composting systems at home.

## Values

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By creating and maintaining school composting systems, schools encourage, model and support students to explore the following values:

### Ecological Sustainability

- By composting, students and the school are reducing waste, adding nutrients to soil and creating thriving gardens. These are all ways of caring for the environment.

### Community and Participation

- Separating organic and inorganic waste may not directly benefit a student. However, by using school composting systems and taking part in the development and maintenance of the systems, students are participating in an activity that benefits the whole school community (by reducing waste, saving money, and creating good soil).

### Innovation, Inquiry and Curiosity

- Students can develop school composting systems as a form of inquiry learning. They will learn to think creatively, critically and reflectively as part of the process of developing an effective system.

## Key Competencies

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Introducing school composting systems (traditional composting, worm farming and Bokashi) will help develop student capabilities in the following key competency areas:

### Thinking

- By reflecting on how their choices affect and impact on the environment (at a local, national and global level) and by making plans to lessen these.
- By developing a 'compost care code' to support organic recycling actions at school.
- By learning from other cultures that practice sustainable organic recycling and by applying these to a New Zealand setting.
- By problem solving to find solutions to reduce organic waste at school.

### Using language, symbols and text

- By carrying out a waste audit.
- By using symbols and technology to encourage the school community to participate in reducing organic waste.
- By communicating to the local community the benefits of setting up a composting system at home.

### Managing self

- By creating an action plan to introduce a composting system into their school.
- By changing personal attitudes and behaviours towards waste, through recycling organic waste, to become more sustainable.
- By identifying possible safety risks before completing a waste audit; by making a plan to keep themselves and others safe; and by following safety procedures.
- By running a 'compost club' meeting or assembly to inspire the school community to take part in its new composting system.

### Participating and contributing

- By raising awareness of the importance of organic recycling at school and by developing sustainable systems to divert waste from landfill.
- By running a school awareness event to promote the use of the school's composting system.
- By working together to initiate and follow through on actions that benefit both the environment and the school community.

### Relating to others

- By working together to achieve common goals (e.g. composting, creating worm farms, creating bokashi, organic gardening, organising an organic recycling campaign to educate others).
- By practicing communication and listening skills when sharing ideas.
- By allocating roles within an action plan to achieve tasks.
- By inviting experts in to share their knowledge on compost, worm farms and bokashi.

# Curriculum Integration Years 1-8, Level 1-4



There is significant scope for working through the different subjects within the primary and intermediate school curriculum in order to achieve waste minimisation, successful organic waste recycling and sustainable outcomes. This section provides links to the 2007 New Zealand curriculum with examples of activities to assist teachers to use organic waste recycling as a context for authentic learning. These suggested learning activities can be adapted to the required levels by primary and intermediate school teachers.

Additional information for teachers with suggested learning activities for each type of composting system (traditional composting, worm farming and Bokashi) is found in the composting information and facts for teachers sections of this resource. Selected learning activities are also available for download from [www.createyourownden.org.nz](http://www.createyourownden.org.nz).

## Social Sciences

### Place and Environment

- Begin an environmental campaign at your school to promote your composting systems to students and staff.
- Survey the class or school to find out their thoughts and ideas on composting, worm farming and bokashi. Analyse the results to find out people's perceptions.

### Identity, Culture and Organisation

- Research how decisions about organic waste recycling are made and how these decisions can influence people.

### Economic World

- Investigate the problem of organic waste and the impact it has environmentally, socially, politically and economically.

## Science

### Living World

- Explore how traditional composting, worm farming and Bokashi systems work, how the circular processes involved in turning food waste into compost work and how composting helps more food to grow.
- Investigate the decomposers within a compost bin or the life cycle of a worm.
- Use a microscope to investigate the bug life found in compost bins and worm farms.

### Planet Earth and Beyond

- Discover how a landfill works, how methane gas is captured and turned into electricity and how toxic chemicals are managed.
- Talk about the fact that everything comes from a natural resource and discuss what we can do to save our limited natural resources.

## Mathematics and Statistics

### Number and Algebra

- Conduct a waste audit. This will require students to:
  - use a calculator, and
  - perform decimal operations.
- Calculate the number of composting systems needed in the school, dependent on various factors like number of students, how the systems will be used, and which types of systems best meet the particular needs of the school.

### **Statistics**

- Conduct a waste audit. This will require students to:
  - use data displays to analyse data and communicate findings,
  - calculate the percentage of organic waste that can be diverted from landfill, and
  - investigate the costs and the financial savings.

### **Geometry and Measurement**

- Conduct a waste audit. This will require students to:
  - accurately weigh, read scales and record information, and
  - convert measurement units.

## **Technology**

### **Technological Practice and Knowledge**

- Research and design a worm bin using various materials and by taking into account dimensions, location and the specific requirements of the worms like temperature, moisture and light.
- Create a worm farm based on research and design.

## **English**

### **Listening, Reading, and Viewing**

- Incorporate suggested books and journals into the GSR reading programme.
- Share suggested books with students and colleagues. Encourage students to look for these books at the school or public library.
- Ask a compost expert to visit your class or school to share information about composting, worm farming and bokashi.

### **Speaking, Writing, and Presenting**

- Present a speech or write a report about the school waste audit, about building a worm farm or about making a compost bin.
- Write letters to companies, asking them about their use of compostable packaging.
- Share and present views on what your school can do to reduce its organic waste to the school's Board of Trustees or to the community.
- Design surveys about organic recycling for the school and community as a way to find out their opinions and to improve their knowledge.
- Organise multimedia presentations on your school's audit results or on the implementation of composting systems at your school.
- Present a speech to persuade your class/school that organic recycling is important and necessary.
- Write and perform role-plays about building or using a compost bin, worm farm or Bokashi unit.

## **Health/PE**

### **Healthy Communities and Environments**

- Share ideas on how organic recycling could contribute to the wellbeing of the school community and the environment. Work with others to brainstorm ways to make improvements.
- Participate in the development of organic recycling systems in school and describe the ways in which the wellbeing of the school is enhanced as a result.

## **The Arts – Dance/Drama/Music/Visual Arts**

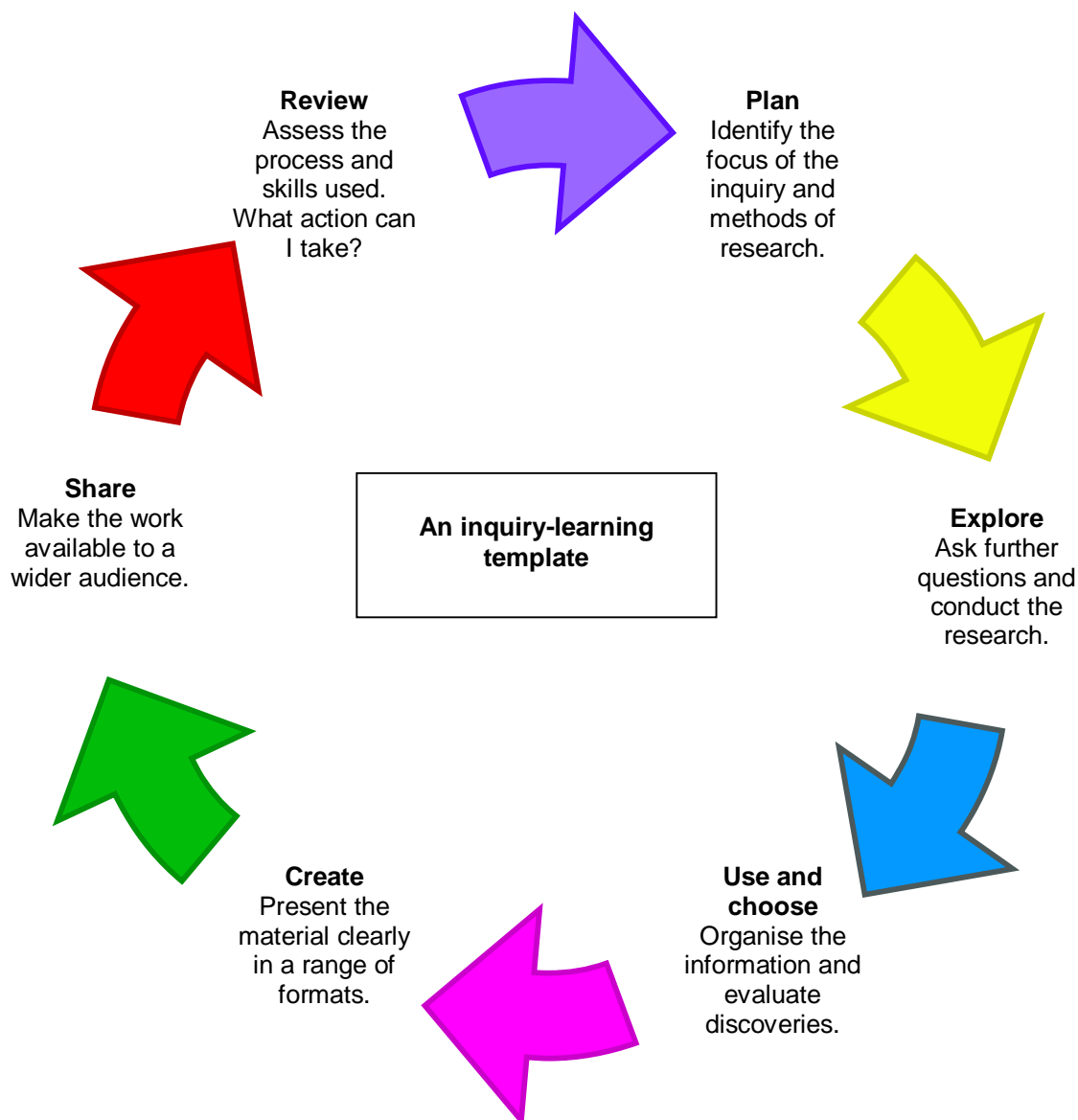
### **Communicating and interpreting**

- Visually document the processes of carrying out the waste audit and of designing and building the school's organic waste system.
- Use organic resources to create art in the form of a collage.
- Make posters to advertise the school composting system.
- Perform a play to educate the school about the composting system and how to use it.

## Inquiry-based learning

Learning to live in more sustainable ways, both now and into the future, requires action oriented, transformative teaching approaches including inquiry-based learning. Inquiry-based learning is an approach in which students gain ownership of their learning. It begins with exploration and questioning, which leads to investigation of a worthy question, issue, problem or idea. It involves asking questions, gathering and analysing information, generating solutions, making decisions, justifying conclusions and taking action.

Inquiry-based learning approaches help develop higher-order, information literacy and critical thinking skills. They encourage reflective thought and action and develop problem-solving abilities. An inquiry learning approach engages and motivates students and often results in a depth of understanding far greater than that provided by other traditional teaching approaches.



### Key action questions:

- ? How can we reduce waste at school and at home?
- ? What happens to the waste that goes into our rubbish bins at school and at home?
- ? What makes waste decompose/break down?
- ? Why should we compost?
- ? What products can be composted at school or at home?
- ? What is a cost-effective way to compost?
- ? What food do worms eat?
- ? What is the difference between what goes into a compost bin, worm farm or bokashi and what comes out?
- ? What would the differences be to my banana skin if it was composted or landfilled?
- ? What can we do with compost once it is made in a compost bin, worm farm or bokashi?
- ? How do we tell people about composts, worm farms and bokashi?

### Flow chart

- \* Design a flow chart with pictures and captions showing:
  - the process of the different types of composting, and
  - the results of not composting.

### Interpretation

- \* *There are no food scraps for our school compost this week.*
- \* Give five possible explanations for this happening.

### Communication

- \* Your whole school including staff, board of trustees, parents and caregivers, local community, local council, other schools in your area.
- \* Use your assemblies, school newsletter, school website, school intranet, posters, parent-teacher meetings, board of trustee meetings, and display areas.

### Research ideas

- \* What are the different ways people can reduce their waste?
- \* What alternatives are there to landfills?
- \* What initiatives/ideas does the Government have to reduce waste?
- \* How do different composting systems work?

### Compare and contrast

- \* Compare and contrast key facts about compost bins, worm farms and bokashi. Show the similarities and differences amongst the three composting systems.

PMI		
Composting at our school		
Plus	Minus	Ideas

### Thinking hats

- \* Black hat: list five problems with composting.
- \* Yellow hat: list five good things about composting.
- \* Green hat: design a composting system that keeps the good points and overcomes the bad points. Label your diagram.

## How can we Create our own Eden?

*These ideas are suggestions to help develop an inquiry learning unit around composting. Be creative and add your own ideas!*

### Key words

Compost, worm farm, bokashi, landfill, reduce, reuse, recycle, rubbish, waste, decompose, soil, greenhouse gases, environment, recover, kitchen waste, garden waste, systems.

### A digital story

- \* Use your knowledge of composting to create a digital story. Take a piece of food that could be composted and follow the journey of that food's life.
  - Use a storyboard to sequence ideas.
  - Use photos, text, voice narration, and music.
  - Tell your story in the first person.
  - Share your story with your class and school.

### Prediction and comparison

- \* What does your lunchbox look like now? Compare this with how it looks at the end of the unit.
- \* What happens to a banana skin in a landfill? In a compost bin?
- \* If everyone started composting, how would packaging change? How would our environment change?

### What if?

- \* We didn't have worms?
- \* We didn't have composting systems?
- \* All of our waste went to landfill?
- \* People didn't pass on knowledge and share information about composting?

### Design your own quiz

- \* Use [www.puzzlemaker.com](http://www.puzzlemaker.com) to create a word find or cross word game using topic-related vocabulary and ideas.
- \* Use the forms toolbar (drop down fields) in MS Word to create a quiz with questions about composting and multi-choice answers.

### Action

- \* Staff and parents can attend a Create your own Eden workshop to improve their knowledge of composting systems.
- \* Create an action plan to help reduce the amount of food scraps going to landfill from your school.
- \* Educate audiences about composting.
- \* Develop composting systems that will work for your school.
- \* Develop monitoring groups to look after your composting systems and to ensure they will be sustainable at your school.

# Curriculum Integration Years 9 and 10, Level 4-5



This section addresses level 4-5 of the 2007 New Zealand curriculum. It provides ideas for activities that will assist secondary school teachers to use organic waste recycling as a context for authentic learning. Having a successful school composting system is an important part of reducing waste and can be used to broaden student understanding of sustainability issues. Most of the following links are specifically about organic waste recycling; some also connect to broader sustainability concepts. These suggested learning activities are presented by level, in order to be most relevant to secondary school teachers.

Additional information for teachers with suggested learning activities for each type of composting system (traditional composting, worm farming and Bokashi) can be found in the composting information and facts for teachers sections of this resource. Selected learning activities are also available for download from [www.createyourowneden.org.nz](http://www.createyourowneden.org.nz).

## Social Sciences

### Place and Environment, level 4 and 5

- Survey students and staff members to find out the attitudes and values of these two groups towards recycling organic waste at school and at home. Compare and contrast the attitudes and values these groups have with each other. Remember to compare and contrast their attitudes and values both to waste at school and waste at home.
- Begin an environmental campaign at your school to promote your composting systems to students and staff.

### Identity, Culture and Organisation, level 4

- Explore the roles of groups of people in the school community and the influence these roles have on decisions made about organic recycling systems at school (e.g. board of trustees, caretaker, students). What role do these groups consider they have in the organic recycling decision-making process?

### Economic World, level 4

- Investigate the business opportunities involved in worm farming.
- Research the full economic costs of waste and landfills to society.

## Science

### Living World – Ecology, level 4

- Research and investigate the changes in microbial and animal life that occur in a hot composting system over the time it takes to go from scraps to compost.
- Compare the changes in the life forms present with their adaptations that appear over time. Also compare the environmental and habitat changes that are occurring in the compost over time.

### Planet Earth and Beyond, level 4 and 5

- Research the effects of a landfill on soil, water and the atmosphere. Compare this with the effects of a compost system on surrounding soil and water environments and on the atmosphere.

### Material World – Properties and changes of matter, level 4

- Develop ways to easily group materials commonly found in school waste and consider why some materials cannot be composted by researching the key questions below (students can use this knowledge to decide which types of waste materials typically found at school can be recycled or put in an organic waste system and which must go to landfill).

**Note:** Additional teaching notes about these key questions and more questions can be found on the teaching resources page at <http://efs.tki.org.nz/>

**Key questions:**

- Why can't a waxed cardboard container lined with foil (such as a juice box) be composted?
- Why can't a waxed cardboard plastic coffee cup be recycled through an organic recycling system, while a potato starch coffee cup can be?
- Cornstarch biodegradable bags are becoming a popular alternative to regular plastic bags. What are the differences between the two types and what happens to each in an organic recycling system?
- How can you easily distinguish the following materials from each other: paper, plastic, waxed paper and metal packaging?
- At large scale composting plants very specific rules are followed, e.g. there must not be any foreign matter like metals or treated timber present in the organic materials to be composted. Why are such rules essential to the organic recycling process?

## Mathematics and Statistics

**Number and Algebra - level 4 and 5**

- Conduct a waste audit. This will require students to:
  - use a calculator, and
  - perform decimal operations.
- Calculate the number of composting systems needed in the school, dependent on various factors like number of students in the school roll, how the systems will be used, and which types of systems best meet the particular needs of the school.

**Statistics - level 4 and 5**

- Conduct a waste audit. This will require students to:
  - use data displays to analyse data and communicate findings,
  - calculate the percentage of organic waste that can be diverted from landfill, and
  - investigate the costs and the financial savings.

**Geometry and Measurement – level 4 and 5**

- Conduct a waste audit. This will require students to:
  - accurately weigh, read and record information, and
  - convert measurement units.

## Technology

**Technological Practice - level 4**

Before or during the development of organic recycling systems:

- Carry out and evaluate the results of a waste audit to determine the quantities of organic material produced per day. Then use this information to determine which composting system would best fit your school's needs.
- Design and construct a composting system that will suit these needs.
- Research and design a worm bin using various materials and taking into account dimensions, location and the specific requirements of worms, i.e. temperature, moisture and light.
- Create a worm farm based on research and design.

Once school organic recycling systems are established:

- Conduct a waste audit and evaluate the results in order to determine the effectiveness of the school organic collection system(s).
- Evaluate the effectiveness of the composting system.
- Design modifications or improvements to the system to make it perform more efficiently.



## English/Media Studies

### Listening, Reading, and Viewing - level 4 and 5

- Ask a compost expert to visit your class or school to share information about composting, worm farming and bokashi.

### Speaking, Writing, and Presenting - level 4 and 5

- Write newspaper articles for the school magazine/newsletter/local paper about the school's organic recycling system.
- Document the process of conducting a school waste audit and of setting up an organic recycling system.
- Create a "mockumentary" on the process of composting. Link in with Science teachers doing a year 9/10 unit investigating the ecology of compost piles.
- Write letters to companies about their use of compostable packaging.
- Get students to share and present views to the board of trustees or the community about what their school can do to reduce organic waste.
- Debate the merits of using composting systems instead of landfills.
- Create an advertisement to encourage students to use the school composting system or to sell a compost product.
- Write and perform role-plays about building a compost, worm farm or bokashi.

## Health/PE

### Healthy Communities and Environments - level 5

- Evaluate the impact school waste systems have on people's wellbeing at school and determine what enhancements an organic waste recycling system could have on people. Use these results to take action to improve people's wellbeing

## The Arts – Dance/Drama/Music/Visual Arts

### Developing ideas - level 4 and 5

- Visually document the process of conducting a school waste audit and setting up an organic recycling system, using photographs or artwork.

### Communicating and interpreting - level 4 and 5

- Visually document the processes of carrying out the waste audit and designing and building the school organic waste system,
- Create short dramatic pieces to market the composting system to the rest of the school, or to educate others on how to use it.

## Cross-curricular learning

There are also opportunities for secondary school teachers to incorporate cross-curricular learning with Year 9 and 10 students. The following example links to the Science, Social Studies, Technology and Health and PE curricula and includes the action component found in each of these curricula.

### Research task on how to reduce waste

1. Compare the 3 organic recycling systems (composting, worm farming and Bokashi). Look at:
  - the advantages and disadvantages of each,
  - the materials that can be recycled through each system, and
  - the possible set-up and ongoing costs of each.
2. Investigate different situations where these waste systems could be used. Possibilities could include:
  - a family of four with a large vegetable garden,
  - a couple living in a flat with a small garden,
  - your school, or
  - three friends living in an apartment.
3. Develop criteria to help you decide what is the most sustainable organic recycling solution for each situation. Criteria can be expressed as a question such as one of the following: Will there be garden waste that needs to be recycled? How much space is there for an organic recycling system? Will food scraps be produced everyday?

Sharing information:

- Students could debate their criteria and make decisions in groups.

Taking action:

- From the debates and by using the decision-making criteria, select the best system for organic recycling at your school, then plan and carry out this action.
- Your school may already have an effective organic recycling system. In this case, students can select the best system for their home situation, then plan and carry out this action.

## Years 11-13, NCEA, Level 6 and up



This section provides links to level 6-8 of the 2007 New Zealand curriculum and connects to level 2 achievement standards using organic waste recycling as a context for authentic learning.

### Science

Organic waste recycling can be used as an authentic learning context for level 6-8 investigation, participation and contribution and for level 6 'Planet Earth and Beyond - Interacting Systems' (developing an understanding of how the geosphere, hydrosphere, atmosphere and biosphere interact to cycle carbon around the Earth).

### Achievement Standards

The following achievement standards can use organic waste recycling as a context for authentic learning as described below. Further details of this unit can be found on <http://efs.tki.org.nz/>

#### **AS90810 Level 2 Education for Sustainability Standard 2.1 (Internal, 6 credits)**

Plan, implement and evaluate a personal action that will contribute towards a sustainable future.

#### **AS90811 Level 2 Education for Sustainability Standard 2.2 (Internal, 4 credits)**

Describe the consequences of human activity within a biophysical environment in relation to a sustainable future.

#### **AS90312 Level 2 Science Standard 2.1 (Internal, 4 Credits)**

Carry out a practical scientific investigation with supervision.

#### **AS90771 Level 2 Science Standard 2.2 (Internal, 3 Credits)**

Research information and present a scientific report.

Context for **AS90309** and **AS90311 Level 2 Chemistry (Externals)**

#### **Landfill and composting decomposition processes**

Investigate the difference in decomposition processes and carbon outputs that occur in compost bins (aerobic) versus in landfills (anaerobic). Compare the effects of carbon dioxide (produced in compost bins) with methane (produced in landfills) on the atmosphere. Methane is considered to be 21 times worse for the atmosphere in terms of global warming. Larger landfills have the facility to collect and burn off methane (sometimes used for electricity production), but many small landfills still exist in New Zealand where this does not happen. Consider the social and economic implications of collecting and burning methane versus not doing this. Decide on actions that could be taken to reduce methane production in landfills and to reduce the effects of methane production in landfills. Evaluate and take appropriate actions.

# Composting information and facts for teachers



This section contains additional information on composting, worm farming and bokashi systems for teachers, including definitions and interesting facts.

Check out the *Create your own Eden Guide to Composting at School* for further information about what type of composting system to choose for your school; what you can and can't put into the different types of system; and how to set up, maintain and monitor your school system.

Selected learning activities, relevant books and websites, along with a glossary are also supplied at [www.createyourowneden.org.nz](http://www.createyourowneden.org.nz).

There is a range of activities suggested for each type of composting system. Refer back to the curriculum integration section for links with specific levels of the NZ curriculum.

## Composting

### Definition

Traditional composting is a process, which mimics nature by 'recycling' organic material. Organic material is broken down by bacteria, fungi and other beneficial insects and micro-organisms. Aerobic composting enables us to recover the nutrients from nitrogen containing food scraps and garden waste (green waste) and from carbon containing dried leaves, sawdust, hay, and paper (brown waste).

Compost results from the decomposition of organic matter. Compost adds nutrients, minerals and beneficial soil organisms to the soil as well as improves the composition and structure of soil.

### Process

Composting is made by layering green waste (providing nitrogen) and brown waste (providing carbon), which then combine and make a balanced carbon-nitrogen soil. The process uses moisture and heat to complete the decomposition process in around 10 weeks. The green waste can be sourced from the school grounds and from students' lunch boxes. It should not, ideally, contain bread or meat, as these components can attract unwanted pests.

### Benefits

- » Improves soil structure.
- » Enhances the capacity of soil to retain nutrients and moisture.
- » Avoids over-fertilizing plants through the slow-release of nutrients.
- » Reduces the need for fertiliser.
- » Enhances aeration of soil and reduces the threat of soil becoming overly compact.
- » Improves root growth, increasing the amount of fruit and vegetables that plants produce.
- » Improves water infiltration into soil and drought tolerance of plants.
- » Protects plants from disease.
- » Increases amounts of micro-organisms and earthworms in soil.
- » Diverts organic waste from landfills into compost, making it a useful product that indirectly helps to reduce the negative environmental effects of methane gas and leachate production.

### Interesting Composting Facts

- » Mature compost can be used to make a compost tea.
- » Plant waste + moisture + warmth + air + micro-organisms + time = compost.
- » You can put 'poo' in the compost, as long as it is from a vegetarian animal. A meat eating animal's faeces can carry diseases which pass through to the soil and ultimately end up in the vegetables.
- » Compost and soil are not dead, they are alive and should contain living things.
- » There are more micro-organisms in a teaspoonful of soil than there are humans alive on the planet.
- » Soil with not much compost or humus in it will blow away in the wind very easily – this is called erosion.
- » Putting compost in your soil feeds the soil and makes it strong and healthy.
- » Compost can be produced in as little as 2 weeks, but usually takes 6 months to a year to produce.

## Composting Learning Activities

- » Research what can go into a compost bin and what should be kept out. (English)
- » Set up a full school composting system or build a miniature compost in class (see the related learning activity at [www.createyourrowmeden.org.nz](http://www.createyourrowmeden.org.nz)). (Technology)
- » Investigate the difference between conditions in a compost bin and in a landfill. (Science)
- » Find out about the composting soil/foodweb. (Science)
- » Bury different types of waste (including non-compostable materials) to find out how long they take to decompose (see the related waste timeline learning activity at [www.createyourrowmeden.org.nz](http://www.createyourrowmeden.org.nz)). (Science)
- » Look in your school compost bin and identify the bugs, insects and animals you find (see the related decomposer scavenger hunt learning activity at [www.createyourrowmeden.org.nz](http://www.createyourrowmeden.org.nz)). (Science)
- » Draw a picture of a tree and indicate where you would feed it compost (labeling the feeder roots and drip line, etc). (Science)
- » Identify 'browns' and 'greens' that are suitable for composting. (Science)
- » Test the temperature and pH of your compost from set-up to when the compost is ready. (Science)
- » Investigate 'hot' and 'cold' composting techniques. (Science)
- » Investigate the different claims of compostable packaging. Put samples (e.g. bags or packaging materials) into your school compost bin and monitor how they break down over time. (Science Investigating)

**These are suggested activities only. Refer back to the curriculum integration section for links with specific levels of the NZ curriculum.**



# Worm farming



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## Definition

Worm farming is the process of using tiger worms in an artificial ecosystem to convert organic waste into nutrient-rich fertiliser. Worm waste (also known as worm castings and liquid worm tea) is produced when the tiger worms digest food and paper waste. These products provide beneficial nutrients for soil, which encourages plant growth. This process is also called 'vermiculture'.

## Process

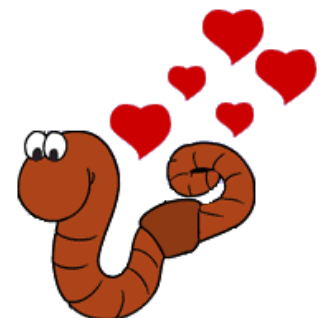
Worm farming uses the same principles as composting, but does not generate heat, making it a form of cold composting. Worm castings are made by setting up a worm farm for a community of tiger worms and feeding them certain food scraps from lunchboxes and the staff room, as well as dampened brown waste such as paper and packaging. Value is added to the materials when they are eaten and excreted by the worms. Two products are produced in a worm farm, worm castings (solid soil conditioner) and worm tea (liquid fertiliser), both which have high levels of nitrogen, phosphorous and potassium compared to ordinary soil. This makes them valuable for your plants' leaf growth, root and stem strength and flower and fruit production.

## Benefits

- » Improves soil structure.
- » Enhances the capacity of soil to retain nutrients and moisture.
- » Avoids over-fertilizing plants through the slow-release of nutrients.
- » Reduces the need for fertiliser.
- » Enhances aeration of soil and reduces the threat of soil becoming overly compact.
- » Improves root growth, increasing the amount of fruit and vegetables that plants produce.
- » Improves water infiltration into soil and drought tolerance of plants.
- » Protects plants from disease.
- » Increases amounts of micro-organisms and earthworms in soil.
- » Diverts organic waste from landfills into worm castings and worm tea, useful products that indirectly help to reduce the negative environmental effects of methane gas and leachate production.
- » Enhances plants' leaf growth, root and stem strength and flower and fruit production.
- » Contains high levels of nitrogen, phosphorous and potassium (NPK) compared to ordinary soil.
- » Provides children with a fun activity - feeding and maintaining worm farms.

## Interesting Worm Facts

- » Tiger worms have 5 hearts.
- » Tiger worms can't see or hear, and they have no bones, teeth or lungs.
- » Tiger worms breathe through their skin.
- » Each tiger worm will eat its weight in food every day.
- » If you cut a worm in half it will die.
- » If there were no worms, 30cm of rubbish would build up on the earth's surface every year! We need worms to break down things that were once living so their goodness and nutrients can be recycled back into the environment to help more plants grow.
- » Earthworms are hermaphrodites, which means each worm is both male and female at the same time; but it still takes two worms to reproduce.
- » The composting tiger worm can mate and lay an egg every 7–10 days.



## Worm Farm Learning Activities

- » Investigate the dilution required for vermin liquid / worm tea – how and why? (Maths, Science)
- » Draw a worm and label the anatomy. (Science)
- » Measure and discuss the pH of your worm bin. (Science)
- » Design a worm bin for your school or home. (Technology)
- » Investigate worm reproduction – will the bin overflow? (Science, Maths)
- » Build a miniature worm farm (see the related learning activity at [www.createyourowmeden.org.nz](http://www.createyourowmeden.org.nz)). (Technology)
- » Look in your school worm farm and identify what you find (see the related decomposer scavenger hunt learning activity at [www.createyourowmeden.org.nz](http://www.createyourowmeden.org.nz)). (Science)
- » Get students to role-play 'living in a worm farm'. (Arts and Drama)
- » Compare worm castings with finished compost. See the related growing with compost learning activity at [www.createyourowmeden.org.nz](http://www.createyourowmeden.org.nz). (Science)
- » Research why certain foods must be kept out of the bin. (Science)
- » Work out the bin surface area and amount of worms needed to dispose of your school food waste. (Maths)

**These are suggested activities only. Refer back to the curriculum integration section for links with specific levels of the NZ curriculum.**



# Bokashi



## Definition

Bokashi is a method that uses beneficial micro-organisms to ferment organic matter anaerobically (without air) in a sealed container (followed by traditional composting or burying directly into the soil) to produce a solid and liquid soil conditioner. This system was developed in Japan the name means 'fermented organic matter'.

## Process

Two buckets are used, one fitting inside the other. The top bucket has holes so that a liquid is distilled out of the top bucket. Food waste is layered with the Bokashi Compost-Zing in the bottom bucket. Compost-Zing is a fermented wheat-bran mixture containing effective micro-organisms (EM), which ferments the food. The bucket should not be opened and exposed to air more than once a day, as it is an anaerobic (without air) process. Once the layers are added, the mixture is compressed and then sealed into the first bucket with the second bucket. Once the bokashi is full, it is sealed for about a week (7-14 days) so the fermentation process can complete. The Bokashi is then buried in the ground or placed into a compost bin to decompose.

## Benefits

- » Speeds up the decomposition of food in an odour controlled environment.
- » Safely decomposes meat, bread and cooked products.
- » Improves soil structure, as fermented food releases nutrients as it breaks down in the soil.
- » Enhances the capacity of soil to retain nutrients and moisture.
- » Reduces the need for fertiliser.
- » Enhances aeration of soil and reduces the threat of soil becoming overly compact.
- » Improves root growth, increasing the amount of fruit and vegetables that plants produce.
- » Improves water infiltration into soil and drought tolerance of plants.
- » Protects plants from disease.
- » Increases amounts of micro-organisms and earthworms in soil.
- » Diverts organic waste from landfills helping to reduce the negative environmental effects of methane gas and leachate production.

## Interesting Bokashi Facts

- » Bokashi is based on an ancient, Japanese composting system.
- » Compost can be made using the Bokashi method within 6-8 weeks (based on a household family of 4).
- » After the Bokashi Compost-Zing ferments the food, it remains looking exactly the same as when it first went in. It only starts to decompose when it is introduced to the air.
- » The micro-organisms in the Compost-Zing are the same as those that clean our water for reuse.

## Bokashi Learning Activities

- » Research what goes into a Bokashi bucket. (English)
- » Find uses for Bokashi liquid and what products it can replace. (Science)
- » Research the ingredients of Compost-Zing. (Science)
- » Find out the meaning and origins of the term 'Bokashi'. (English)
- » Look at the left-over food in your lunchbox. What can go into the bokashi bucket? (Science)
- » Create a word find for students using [www.puzzlemaker.com](http://www.puzzlemaker.com) (English)
- » Write a story about a piece of fruit destined for landfill or for the Bokashi bucket. (English)
- » Make a poster telling others about your school or home Bokashi system. (English)
- » Do a survey of your family. Would Bokashi be suitable for your home? (Social Studies)
- » Compare and contrast worm tea (vermi-liquid) and Bokashi liquid. (Science)



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