The Waste Wise Schools Program

Learning to be Waste Wise

What is Waste?

THE GOVERNMENT OF WESTERN AUSTRALIA

WASTE AUTHORITY
WA...TOO GOOD TO WASTE

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Learning to be Waste Wise activity guide

Introduction

Learning to be Waste Wise is a series of curriculum-linked activity packs written for the Waste Wise Schools Program. Each booklet covers a different topic including a general introduction to waste, the 3Rs, worms and compost. The activities are designed to complement the school's ongoing waste minimisation projects, and to support learning at every stage of a school's Waste Wise journey. In turn, Waste Wise projects provide real-life context to curriculum outcomes while directly involving students in their own learning.

By reinforcing Waste Wise principles through the curriculum in an engaging and practical way, teachers will find it easier to incorporate waste reduction practices in their school. In addition, the involvement of students and the modelling of positive behaviours, reinforces the environmental principles and curriculum outcomes.

The activities are meant to be fun and are designed to promote life-long learning, where students, teachers and the rest of the school community are empowered and enabled to take responsibility for their waste minimisation actions, while developing positive environmental values and promoting long-term behaviour change.

Waste Wise and the curriculum

Waste is a topic that fits easily into every learning area. As such, waste should be integrated into current curriculum rather than used as an 'add on'. Each activity contains curriculum links and a summary of all learning areas and outcomes covered in this booklet is included as well. The Waste Wise Schools Program is also listed as a recognised opportunity to become involved in active citizenship in the scope and sequence for society and environment.

Values education

Underlying the Waste Wise Schools Program is the core value of environmental responsibility. As students learn about environmental conservation and how to preserve its balance for the future, they also learn about social and civic responsibility and their power to choose their way of life and the impact their choices make. Ultimately, the hope is that students feel empowered with their new knowledge and develop environmentally sound values and behaviours.

This booklet

All of the activities in this booklet have been designed to be hands-on and interactive. They can be completed individually or as a unit of work. Activities may also be extended through the 'Going further' ideas provided. Comprehensive background information is provided on each topic in the booklet introduction, while specific background information is provided with each activity as well.

Differentiation

Each activity has been developed for Middle Childhood but is easily differentiated for Early Childhood and Early Adolescence. On each activity, suggestions for simplifying an activity have been given in the 'To simplify' section and suggestions for making an activity more challenging are offered in 'To challenge'.

Reduced paper use

To reduce paper use, the activities in this booklet have been designed to be 'worksheet free'. Questions can be written on the board, overhead projector or interactive whiteboard and students should record answers in a notebook. If photocopying is necessary, consider having students work in groups with one set of directions or questions to share.

Curriculum links

Learning area	Science					English			Mathematics								
	Natural and processed materials		Investigating		Science in daily life	Listening and speaking		Writing	Numbers		Working mathematically	Chance and data				Measurement	
Learning area outcomes	Different materials have different properties, related to their uses	Interactions between and changes to materials	Conducting	Collect and record information relevant to the investigation	Applying scientific ideas/real life links	Context, purpose and audience	Speaking processes and strategies	Writing process strategies	Understand operations	Use a calculator for all four operations	Reason mathematically	Collect and organise data	Represent data graphically	Summarising data numerically	Interpreting data	Compares directly and indirectly and orders things by mass	Measurement units
Investigate your waste	✓			✓						✓						✓	
Timeline of waste																	
Time capsule of waste								✓									
Building a model landfill part 1																	
Building a model landfill part 2		✓	✓														
Disposable culture	✓																
Waste debate						✓	✓										

Curriculum links

Learning area	Society and environment													
Learning area outcomes	Place and space			Resources			ICP			Time continuity and change		Active citizenship	Investigation, communication and participation	
	Human activities influence natural features	Processes between and within features	Natural landscapes and human activities are interrelated	Resources are used to satisfy needs and wants	Resource availability and distribution	Management of resources	Analysing information and critical thinking	Communicating findings and evaluating the investigation	Locating sources and selecting information	Sequencing the past	Change is a feature of all societies	Respect and concern for the environment	Analysing information and critical thinking	Communicating findings and evaluating the investigation
Investigate your waste														
Timeline of waste									✓	✓				
Time capsule of waste							✓				✓			
Building a model landfill part 1	✓		✓										✓	✓
Building a model landfill part 2		✓				✓								
Disposable culture				✓	✓	✓								
Waste debate														

Introduction

"Waste is classified into either organic (living) or inorganic (non-living). Organic waste can include food scraps, paper, grass clippings and other plant material. Inorganic waste includes items such as plastics, glass, aluminium and other metals along with sand and bricks and hazardous waste."

What is waste?

As defined by the *Macquarie Dictionary* (2003), waste is something "to become consumed or spent uselessly or without being fully utilised", "anything unused, unproductive, or not properly utilised", "having served a purpose and no longer in use".

In Western Australia we have also used the following definition: "Waste is the act of using resources inefficiently, excessively or needlessly. The act of wasting results in waste materials that are perceived to have little or no value and therefore discarded. In many cases a material becomes waste because it is not socially acceptable, or economically and environmentally viable for it to be recycled or re-used" (Western Australian Department of Environmental Protection, 2003–2008).

Types of waste

Waste is classified into either organic (living) or inorganic (non-living). Organic waste can include food scraps, paper, grass clippings and other plant material. Inorganic waste includes items such as plastics, glass, aluminium and other metals along with sand and bricks and hazardous waste.

Waste in Australia

In a recent report it was calculated that Australians produce approximately 41 million tonnes of waste every year. This includes municipal waste (households), commercial and industrial waste and construction and demolition waste. Of this waste, 21 million tonnes is disposed of in landfill while the remaining 20 million tonnes are recycled. On average, these figures equate to 1.97 tonnes of waste produced by each Australian every year, of which 995 kilograms are sent to landfill with 975 kilograms being recycled (M.Oke et al 2008).

Waste in Western Australia

Every year, each Western Australian produces 2.5 tonnes of waste on average. This includes municipal waste (households), commercial and industrial waste and construction and demolition waste. Of this 1.7 tonnes are sent to landfill and 800 kilograms are recycled. The WA averages exceed the national averages.

Landfill

Historically, the most convenient form of waste disposal has been to bury waste in landfills. There are environmental problems associated with conventional landfills such as:

- Land clearing – loss of biodiversity and habitats
- Wind-blown waste – litter entering waterways and harming and killing birds and aquatic animals
- Leachate – in unlined landfills, toxins have the potential to pollute soil and groundwater
- Social impacts – visual, smell, noise from trucks travelling to and from site and vermin
- Greenhouse gases – organic material can break down anaerobically (with no oxygen) resulting in the production of methane. Methane is 20 times more damaging than CO_2 and persists in the atmosphere for up to 150 years.

Modern landfills try to reduce these adverse environmental impacts and are specially designed and built to accept our waste, capture bio-gas and collect leachate (WSN, 2006). There are several types of landfills classified according to the type of waste that they are able to accept. Municipal and commercial waste in the Perth metro area is generally sent to a type 3 landfill. This is a lined landfill which accepts putrescible waste, as well as non-hazardous, non-biodegradable waste (Western Australia Department of Environment, 1996).

Decomposition of waste in landfill

For waste to decompose efficiently and aerobically, air, light and moisture are needed. If waste is buried, these essential components of decomposition are missing and subsequently waste will take a lot longer to break down. The Arizona University Garbage Project run by Dr William Rathje has been running for 30 years and has documented the lack of decomposition in landfill sites in America. Some of the items that were found included a 40-year-old newspaper that was still readable, a 15-year-old steak bone with meat still on the bone and a 10-year-old carrot that was still orange on the inside. These items are all organic and break down in less than six months if exposed to all the components needed for decomposition. Non-organic items of waste such as plastic, glass and aluminium take a lot longer to break down and may not even break down at all (Rathje W. et al., 2001). As a result, new technologies are being developed to improve the break down of our waste in landfills and to divert waste from landfill, such as separating organic waste to be composted and recyclable materials to be processed.

Alternative waste treatment

There is a strong drive towards the development of alternative waste treatment (AWT) technologies as alternatives to landfill in Western Australia. Many landfills in Perth are developing or have already developed some of these technologies.

AWT technologies convert waste into energy or useful by-products. The overall aim is to increase the recovery of resources from the waste stream and minimise the impact on the environment. The three main types of AWT include modifications to conventional land-filling, thermal treatment (using heat to decompose waste) and biological treatment (using organisms to process waste such as bacteria or worms). The type of municipal solid waste and the location can affect the kinds of AWT that are used. The objective is to treat our waste in a socially, commercially and environmentally sustainable way (Municipal Waste Advisory Council, 2009).

Resource recovery

Resource recovery is defined as the retrieval of waste and waste by-products that have value. This includes recovering items for recycling, composting, collection of methane for energy and also mining old landfills for metals and plastics that can be recycled. In Perth, most regional councils have a material recovery facility (MRF) which separates recyclable materials. The remaining waste is sent to landfill or undergoes alternative waste treatment.

A history of waste in Australia

Aboriginal people who lived in Australia for over 60,000 years before colonial settlement produced very little rubbish. Archaeologists have found piles of debris consisting of bones, shells and stone tools, called middens. However all the other waste produced was organic and has since decomposed naturally.

Early European settlers also produced little waste. In 1788 when the first European settlers arrived in Australia, they brought animals, plants and products from England including flasks, bottles, metal and other technologies. The food scraps were used to feed their animals and a lot of materials were reused because new things were not easy to obtain or make as they did not have access to many raw materials.

In the 1800s, the township at Botany Bay grew very large as more and more people sailed from England to colonise Australia. With the increase in people and supplies from England, and the establishment of the first meat and vegetable stores, the waste increased. This waste was mostly thrown into the streets and rodents that had hitched a ride on the ships from England multiplied, feeding on the waste and spreading diseases.

In the late 1800s, horses and carts were used to collect waste from households in towns and transport it to land outside the towns to bury. These were Australia's first landfill sites. Residents also often burnt their waste, a practice that continued well into the mid to late 1900s. In the 1890s canning was invented, and metal cans began to arrive in Australia. These were collected and reused by some people but as more cans arrived, there was less need to collect and reuse the metal.

Plastics were invented in the 1930s and following World War II there was an explosion in the production of plastic items. Plastic bags were invented to use for shopping and many food products were packaged in plastic.

Until the 1970s, people continued to burn household waste in their backyards. This was stopped due to air pollution concerns.

In the 1980s recycling started with bottle banks for glass, paper recycling and aluminium cans.

With the awareness that litter was an increasing problem in Australia, and that plastic bags were killing ocean wildlife, the first Clean Up Australia Day was launched in 1990.

Beyond 2000, more people are recycling. In large cities, recyclables are generally collected through the local council household waste collection.

A history of waste – interesting periods in time

In Ancient Greece, people would cover the waste produced in their houses or on the street with a thin layer of dirt. This resulted in a change in elevation in the towns and cities that was approximately 1.4 metres per century.

The earliest waste disposal sites were in Athens in around 500BC. The waste had to be disposed of at sites at least 1.5 kilometres from town.

In the Middle Ages in Europe, waste was disposed of in the city streets. The waste usually consisted of rotten food, bones and other leftovers as well as human waste. 'Gardy-loo' was a phrase used to give people in the streets below warning of waste being thrown from a house.

In the early 14th century, the mayor of London declared that no more waste should be disposed of in the streets. However the practice continued until the Black Plague of 1348 where two-thirds of the population died from the disease spread by fleas from rats breeding in the waste discarded on the streets. After the plague swept through London, the city employed people called 'rakers' to rake up the waste onto boats and transport it out of the city to be buried.

In a recent report it was calculated that Australians produce approximately 41 million tonnes of waste every year. This includes municipal waste (households), commercial and industrial waste and construction and demolition waste.

Due to the industrial revolution in the 18th and 19th, centuries many people left rural areas and moved into urban areas. When living in rural areas with lots of space, people were able to store material to be reused such as scrap metal or old clothes. However, with more people moving to cities, there was less space to store things for reuse. A lot of the rubbish was thrown into the waterways as most cities did not have sufficient waste collection for the ever-expanding population. The industrial revolution led to the increased production of materials, and with this there was an increase in waste products. Factories would also dump these into the waterways which became a breeding ground for diseases, including cholera.

To solve this problem in Britain, rural landfill sites were built for waste disposal and the rubbish bin was invented in 1875 for households to store rubbish before collection. In America, the first incinerator was built in 1885 but it wasn't until the 1920s that the first landfill sites were built and swamps were often used as landfill sites, then sold off once the swamp was filled as land.

Waste in the future

As we move forward in the 21st century we are faced with environmental challenges on a new scale. Climate change is an issue affecting us all. Our rate of consumption and waste production has direct impacts on climate change, especially when you consider the whole lifecycle of a product and the waste and greenhouse gases which are produced at every step.

The good news is that people are now aware of the reasons for and impacts of our changing climate and are starting to make some changes especially in developing new techniques and technologies in waste treatment. However, as we are the producers of waste either directly or indirectly through our consumption habits, there is always more we can do.

We need to think about what we buy, reduce our consumption, reuse items instead of buying new or disposable items and recycle whatever else we can.

Key words

Aerobic: in the presence of oxygen.

Alternative waste treatment technology: technology that converts waste into energy or useful by-products, designed to recover more resources from the waste stream while minimising the impact on the environment (Municipal Waste Advisory Council, 2009).

A waste treatment technology that focuses on diverting waste away from landfill, maximising the recovery of resources and minimising the impact on the environment (WSN, 2005).

Anaerobic: in the absence of oxygen.

Biodegradable: able to be broken down by the action of very small living things like bacteria.

Bio-gas: the gas generated from the breakdown of organic waste in the absence of oxygen. It is composed mainly of methane and carbon dioxide. A small amount of hydrogen sulphide is also present.

Climate change: the name given to describe changes across our world. It can be caused by processes internal to the earth, external forces such as variations in sunlight intensity or, more recently human activities.

Decomposition (noun), to decompose (verb): to rot or putrefy.

Disposal (noun), to dispose (verb): to get rid of.

Greenhouse gases: a group of naturally occurring gases that can trap heat near the earth's surface.

Landfill: an area where wastes are placed in the ground, compacted and covered.

Leachate: liquid that filters through the waste in the landfill; it is made up of rainwater and the liquid from the breakdown or leaking of the waste.

Material recovery facility (MRF): a facility where recyclable items are separated into different streams.

Methane: an odourless flammable gas, formed from decaying organic matter. It has 21 times the greenhouse effect of carbon dioxide.

Municipal waste: waste that comes from a district (municipality) which has its own local government.

Putrescible waste: that part of the waste stream that will spoil or decay. When placed in landfill this waste breaks down to produce bio-gas and a liquid called leachate.

Recycling: to treat waste, empty bottles, old tins etc, so that new products can be manufactured from them.

Waste/rubbish: having served a purpose and no longer of use, anything left-over or superfluous.

Windrow: a heaped line or row of organic matter.

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Other resources

Eastern Metropolitan Regional Council education website: R-Gang needs you to help us recycle waste
www.rgang.org.au

Mindarie Regional Council, Schools and Students
www.mrc.wa.gov.au/Schools---Students.aspx

Rivers Regional Council, Schools
www.rrc.wa.gov.au/schools.htm

Southern Metropolitan Regional Council, The regional Resource Recovery Centre
www.smrc.com.au/go/what-we-do/regional-resource-recovery-centre-rrrc-/green-waste-processing-facility-gwpf

UK Waste education website: Change Works resource for life
www.changeworks.org.uk/education_minisite/index.html

US Waste education website: US Environmental Protection Authority
www.epa.gov/waste/education/index.htm

For more information go to
www.wastewise.wa.gov.au

Investigate your waste

Aim:

Students will conduct a mini waste audit in the classroom, examine the waste produced over the course of a typical day and observe how much waste they are responsible for as a class.

Curriculum links:

Learning area	Outcome	Aspect
Science	Natural and processed materials	• Different materials have different properties and these properties can be related to their uses • Collect and record information relevant to the investigation
Mathematics	Number Measurement	• Use a calculator for all four operations • Compares directly and indirectly and orders things by mass

Background information:

Waste is classified into either organic (living) or inorganic (non-living). Organic waste is food scraps, paper, grass clippings and other garden waste (green waste). A large proportion of the waste thrown out by schools is organic waste, such as garden and food waste. By reusing and recycling organic waste alone, most WA families and schools could cut their contribution to landfill by more than half.

Inorganic waste includes plastics, glass, aluminium and other metals, materials such as sand and bricks and hazardous household waste. Both organic and inorganic waste can be divided into categories such as 'reduce' to examine if it was really necessary, 'reuse' if there are ways to use it, 'recycle' if it was made from materials such as plastics, paper, glass, aluminium or other metals, 'compost' if it is organic or rubbish.

Note: This audit does not replace the whole-school audit which is required to become an Accredited Waste Wise School.

Resources:

- Bag to collect waste
- Rubber gloves or tongs
- Newspaper
- Large table or a few desks pushed together

Activity:

1. Remove all bins from the classroom at the start of the day and replace with one plastic bag. This should be placed in a bin for ease and tidiness. Over the course of the day, whatever would normally go into the various classroom bins instead goes into the single plastic bag. Include classroom materials, food waste and packaging. Consider omitting tissues and instead keep a written tally of those used so they don't have to be handled again.
2. At the end of the day, weigh the bag and record the weight in the waste audit table. On a sheet of newspaper, spread out the day's waste and sort into the following categories: reduce, reuse, recycle, compost and rubbish. Weigh items in each category if possible (amounts could be too small to get an accurate number). Count the number of items in each category.

3. Copy the waste audit table onto the whiteboard or a piece of butchers paper and have students record the class results.
4. Examine the items in each category. How can you reduce, reuse and recycle the items at school?

Waste categories	Weight of waste (Kilograms) (optional)	Number of items	Items/weight of waste produced per week	Items/weight of waste produced per month	Items/weight of waste produced per year
Reduce					
Reuse					
Recycle					
Compost					
Rubbish					
Total of all waste					

To simplify:

- The student record sheet can be made using pictures that are available in the Waste Wise clip art file or from supermarket catalogues.
- Make a record of the waste as it is produced rather than collecting the waste in a bag.

Going further:

- Write instructions for a waste reduction plan for the classroom using the 3Rs. Refer to the '3Rs – Reduce, Reuse, Recycle' fact sheet and the 'Checklist of Waste Wise Actions for your School' in your Waste Wise Way manual.
- Conduct a similar waste audit at home, tallying how much waste is reused, recycled, composted or put out in the bin for landfill in one day, over a week or on a weekend.

Timeline of waste

Aim:

Students will investigate disposal methods of the past and construct a timeline detailing how waste was disposed of at various intervals in human civilisation to show the changes in waste disposal over time.

Curriculum links:

Learning area	Outcome	Aspect
Society and Environment	Time, continuity and change ICP	• Sequencing the past • Change is a feature of all societies • Continuity and heritage are features of all societies • Locating sources and selecting information • Analysing information and critical thinking
English	Writing	• Writing process strategies

Background information:

There are a number of historical moments that can be discussed and related to waste, such as the invention of plastics, the plague in England or the first landfill in Ancient Greece. Archaeologists also study debris consisting of bones, shells and stone tools called middens. By studying the materials people used in the past, we can develop a better understanding of life at different periods of time in human history.

This activity varies depending on the level of the students. Teachers can either pass out the information about the history of waste or students can use resources/internet to research their own information. Students can focus on Australian or world history. Students will develop an understanding of the history of consumerism and waste and will then be empowered to discuss the problems associated with it.

See the introduction for detailed information about the history of waste.

Resources:

- Information about the history of waste (see the *What is Waste* introduction)
- Books and websites with information about waste history ('The Stinking Story of Rubbish' by Katie Daynes is a good one to start with)

Activity:

1. Encourage students to brainstorm current waste disposal practices and the waste disposal practices of the past. Examples of focus questions include:
   a. How do we dispose of waste at school? At home? Where does it go?
   b. How do you think waste was disposed of in 1900? How about 1800? What about 1,000 years ago?
   c. How is the waste that we dispose of today different from the waste thrown out at these earlier points in history?

   Record the brainstorm notes on the board for all the students to view while completing the exercise.

2. Read the information about human waste practices over time (provided in the introduction) or one of the books on the history of waste.
3. Have the students construct a timeline. Students can draw the timeline in a notebook using pictures and labels to show the significant historical points along the timeline. Alternatively, students can make a human timeline. Have students stand at certain distances apart and act out waste activities from different times.

To simplify:

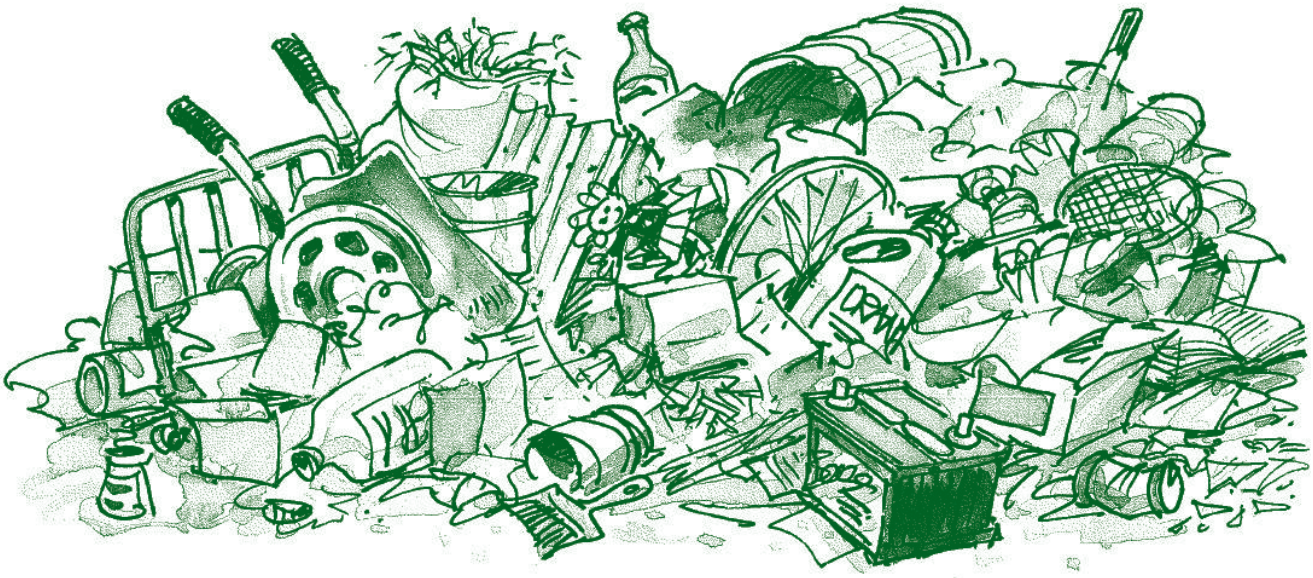
- The students learn about a specific time, such as the Middle Ages in England. Compare the waste produced then with the waste produced today and how the waste disposal methods compare.

To challenge:

- The students can work individually or in small groups to research a specific time period in terms of the types of waste created and how waste was transported and disposed of. Students can investigate how waste was handled historically in communities and/or councils local to the school. This could make up a larger long-term project.
- The students interview grandparents or an older neighbor about how waste collection has changed in their lifetime, what kind of waste they produced and how they disposed of it.

Going further:

Ask the students to close their eyes and use their imagination. Imagine it is the year 2050, all people are working together peacefully and our environment is healthy. What does it look like? Do we have rubbish? Is there any litter? Do we recycle? What does our packaging look like? Have students record their ideas as a short story or poem.



Time capsule of waste

Aim:

Students will understand that certain waste materials will not break down easily in a landfill and that these materials will have an impact on the future.

Curriculum links:

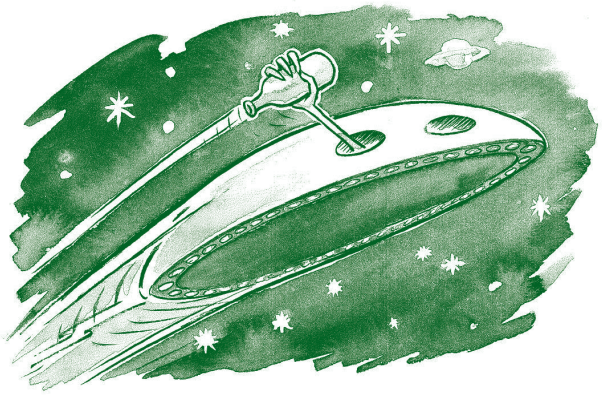
Learning area	Outcome	Aspect
Society and Environment	Time, continuity and change Investigation communication and participation	• Change is a feature of all societies • Interpretations and perspectives may vary • Analysing information and critical thinking
English	Writing	• Writing process strategies

Background information:

One of the problems associated with landfill sites is the process of decomposition or breakdown of various materials. For waste to decompose or biodegrade, air, light and moisture are needed. If waste is buried, these essential components of decomposition are missing and subsequently waste will take a lot longer to break down. Organic materials break down in less than six months if exposed to all the components needed for decomposition, but may take many years if they are not. Non-organic manufactured items of waste such as plastic, glass and aluminium take a lot longer to break down and may not even break down at all (Rathje W. et al., 2001).

Resources:

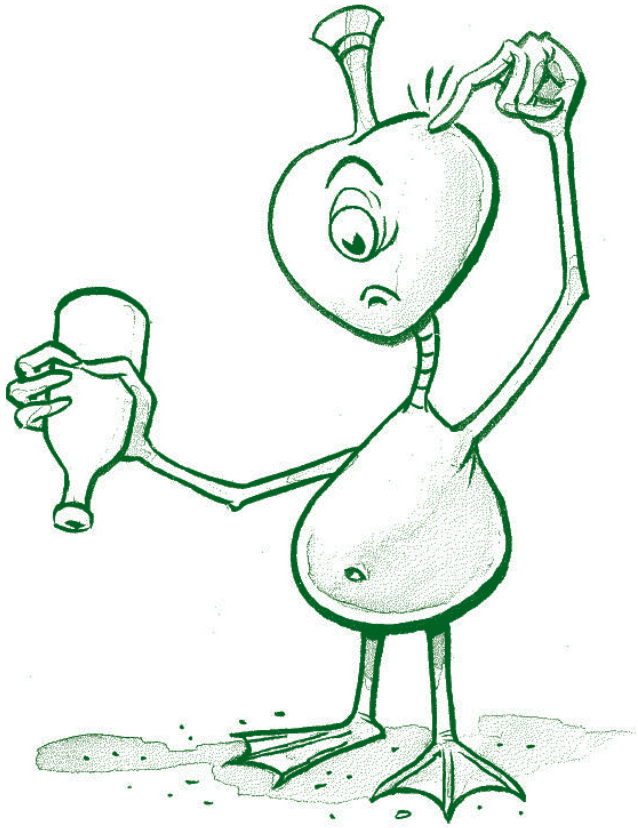
- Plastic three-litre juice bottle
- Paper and pencils for letter writing



Activity:

1. Discuss the following:
   - What is waste?
   - Where does our waste go when we throw it out?
   - What happens at a landfill site?
   - What are the benefits of using landfill sites to make our waste 'disappear'?
   - Does our waste really 'disappear'?
2. Explain what a time capsule is. Explain that the class is going to make a time capsule and they are all going to write a short note that someone will read in the future. Students may like to write about the state of the environment at the moment or about Waste Wise activities in which they have been involved.
3. Have each student sign and date the letter then place in the plastic bottle with a 'Time Capsule' label.
4. Explain to students that when plastic is buried within a landfill site, it takes a long time to decompose. Since plastic has only been in existence for 80 to 90 years, scientists can only guess that it takes anything from 100 to 1,000 years to decompose. Therefore, the time capsule could be recovered from the landfill site with the message still intact in the year 2109 or 3010!

5. Have the class move outside to the waste skip and place the time capsule in the skip destined for landfill. Ask the students some questions (examples below) in order for each student to write a reflection on the completed activity:
   a. How did you feel about throwing the time capsule in the waste skip? Do you feel the same when you throw waste in the bin at home?
   b. Do you think the waste that we throw away today will cause problems for us in 50 years? How and why?
   c. Imagine the world 500 years from now. What do you think people of the future will think about the way we have disposed of today's waste?
   d. What should we all be doing to limit the amount of waste we are leaving for future generations to worry about?
6. After the students have completed writing their reflection, retrieve the time-capsule from the bin so it can be properly recycled. Explain to the students that the plastic will be recycled.



To simplify:

- Write a class letter about the waste that the school produces and your plans for how you are going to work to reduce it, to put into the capsule.

To challenge:

- For older students, skip the initial discussion and simply have students write a letter to be included in a time capsule. When students have finished, place all of the letters in the plastic bottle. Tell students you are now going to send their letters somewhere where they will remain for a long, long time. Nonchalantly drop the bottle of letters into the waste bin. Students will be shocked, bewildered, amused etc. Now have the discussion about how slowly things break down in landfill and how plastic will be around for a long time. Have students reflect on their feelings at having their letters thrown in the bin versus how they feel when they usually throw a bottle in the bin. Retrieve the bottle at the end of the lesson so it can be recycled.

Building a model landfill part 1

Aim:

Students will learn that burying waste in the ground can lead to a number of negative environmental impacts.

Curriculum links:

Learning area	Outcome	Aspect
Society and Environment	Investigation, communication and participation	• Analysing information and critical thinking • Communicating findings and evaluating the investigation
	Place and space	• Human activities influence natural features • Natural landscapes and human activities are interrelated

Background information:

Historically, the most convenient form of waste disposal has been to bury waste in landfills. Convenience often comes with a cost and in this instance the costs are associated with a degraded and polluted environment. Some of the environmental issues of sending waste to landfill include land clearing, windblown waste, leachate, social impacts, burying potential resources and the production of green house gases.

Resources:

- Butchers paper for brainstorming
- Spreadsheet to record family waste

Activity:

1. Have students brainstorm the topic 'items of waste commonly sent to landfill'. These are items that go into our rubbish bins. Encourage students to think about what they have thrown away over the past two days. Alternatively, as homework, you could encourage students to record everything they (and/or their families) have thrown in the rubbish bin for two days before this activity. Ideally, this would be conducted over the weekend when students are contributing to household waste.

NB: When recording the items thrown away, students must remember not to include items currently recycled.

2. Back in the classroom, students compile a list of the rubbish items that have been recorded. This could be carried out as a whole class or group activity. Encourage students to make a special note of the items on their lists that may be considered hazardous waste, such as all batteries, paint, oil, pesticides, cleaners etc. These are items that can cause particular harm to soil and ground water and this is something that should be discussed when looking at the mini landfill model in the following lesson.
3. Once you have created your list(s) discuss some of the environmental issues associated with landfills, Including the following:
   - Land clearing – may result in loss of biodiversity and habitats.
   - Wind-blown waste – can generate litter in waterways and other terrestrial areas (this can occur when wind blows through landfills where waste has not yet been buried or covered right away).

- Leachate – can cause soil and ground water pollution in unlined landfills when items such as batteries, pesticides, petrol, paint, and/or oil is dumped in rubbish bins (when they shouldn't be). When rain filters through the landfill it will pick up the liquids from these items and create a toxic liquid called leachate.
- Social impacts – no-one wants to live near a landfill sites as they are not very pretty to look at, they may smell, are often quite loud due to large machinery, create dust and often attract vermin.
- Burying resources – sending waste to landfill is often just that – a huge 'waste', and much of our waste is considered valuable as it can be recycled into something new. Some landfills are now mined for these materials.
- Greenhouse gas – methane is generated when organic waste, such as paper and food scraps, break down in landfill. Methane gas is generated under anaerobic conditions (without oxygen). Methane is 20 times more potent than CO_2 (in regards to its ability to capture and hold heat in our atmosphere). Methane persists in the atmosphere for approximately 100 to 150 years and is a significant contributor to global warming and climate change.

4. Now that students have completed the preliminary work on landfill sites, waste disposal and the associated environmental impacts, inform students that they will be applying their knowledge to the Building a model landfill part 2 activity.

Going further:

- Write a short story of a product that has become a waste item. Encourage students to write about the product from the time it was bought to the point of its disposal to landfill and how it might affect the environment along the way.

Building a model landfill part 2

Aim:

Students will learn that burying waste in the ground can lead to a number of adverse environmental impacts when they make and observe mini landfills.

Curriculum links:

Learning area	Outcome	Aspect
Science	Natural and processed materials investigating	• Interactions between and changes to materials
Society and Environment	Resources Place and space	• Management of resources • Processes between and within features

Background information:

There are several types of landfills classified according to the type of waste that they are able to accept. Municipal and commercial waste in the Perth metropolitan area is generally sent to a type 3 landfill. This is a lined landfill which accepts putrescible waste. Non-hazardous, non-biodegradable waste is also accepted (Western Australia Department of Environment, 1996).

This type of landfill has holes or cells dug for collecting waste. Each cell opened is lined to prevent waste from coming into contact with the surrounding soil and groundwater. Cells also have a leachate collection system to extract the liquid that percolates through the landfill cell. Pipes run through the landfill and then run into a leachate pipe, which extracts the leachate to be treated (WSN Environmental Solutions, 2006 & Eastern Metropolitan Regional Council (EMRC)).

In this activity, two or three mini landfills are constructed, one that is lined and one that is not, to show the impact rubbish can have on the soil, ground water, surrounding land/water, and the air, if not properly managed. The third mini landfill option is to construct an illegal dump site or mini tip/rubbish dump.

Resources:

- Soil
- Gravel (i.e. fish bowl gravel)
- At least two two-litre plastic soft drink bottles
- Plastic bag
- Two different coloured sponges
- Red food colouring
- Scrap paper
- Optional (for illegal dump) used battery, small plastic scraps (to be piled to form 'dump' on top of soil)

Activity:

1. Review the concepts from 'Building a model landfill part 1'. Explain to students the purpose behind the construction of the mini landfills, for example the effect on soil and groundwater.
2. To create the mini landfills follow directions below.

Making mini landfills:

a. Take two-litre soft drink bottle and cut off bottom (about 10 centimetres from base).
b. Place the top upside down into the base to use as a holder while you layer your landfill 'ingredients'.
c. There are four to six layers in each landfill depending on the landfill each group is making.
d. The layers should be added in the following order: gravel, blue sponge, soil, (plastic bag liner in lined landfill), yellow sponge (with added food colouring), soil, paper/plastic flakes (see diagram).
e. Keep bottle cap on while layering – it will be removed once the landfills are complete to watch the water flow through.

3. Each layer represents what would typically be found in an Australian landfill. For example, there are typically three different types of landfills that would be lined as follows:

Lined landfill (sanitary landfill): from bottom to top

- Gravel = bedrock or impermeable clay that would hold or contain water (the water table) in a specific area under ground.
- Blue sponge = ground water, which may be water that a community sources its drinking and irrigation water from.
- Soil = just that – native soil (in WA that probably consists of sand).
- Gravel (thin layer) = the impermeable material (such as clay) that they often add below the liner as an extra safety to prevent leachate from entering soil.
- Plastic bag liner = the thick plastic liner that prevents leachate from entering the soil and ground water.
- Yellow sponge = the layer of rubbish that would be relatively evenly spread and compacted before being buried. Food colouring can be added to the sponge here to represent leachate (the idea is that when water is poured through, the leachate will move into the soil and ground water.
- Soil = a layer of soil to cover the rubbish in order to prevent excess smell, pests from being attracted to the waste and plastic bags blowing into waterways and terrestrial environment.
- Paper/plastic flakes = litter that often blows from the landfill before it has a chance to be buried.

Unlined landfill:

- All layers in the unlined landfill are the same as above except without the thin gravel layer and plastic bag liner. It is with this mini landfill that students can see how leachate affects the soil and ground water.

Illegal dump/rubbish tip:

- Gravel, blue sponge and soil layers are all the same here. However, the yellow sponge should be torn or cut into smaller pieces and piled on top of the soil along with a battery, plastic and paper flakes, and perhaps a few twigs. This is to demonstrate that in these dumps/tips any type of rubbish is simply piled on the ground.

4. Once the mini landfills are complete, prepare them for the water to flow through. You will have to remove the cap and add food colouring to water (if you did not add it to the yellow sponge). Have lined and unlined landfills standing side by side so you can compare the differences. Pour about 250 milli-litres of water through slowly and watch what happens (pour more if necessary). Note that if you did add colouring to the sponge and you find it does not allow much colouring to filter through add some to the water that you are pouring in.

   The lined landfill should hold its water, however if you add a lot of water it will likely leak through, which can represent what can happen in a real landfill if that liner becomes punctured or too old. Note that the blue sponge should remain dry, showing that the liner prevents contamination of the ground water.

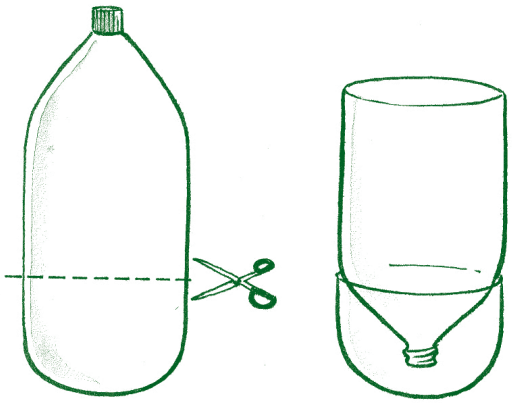
   The water in the unlined landfill should filter through to the bottom of the soft drink bottle (holder). You should also see the blue sponge change colour as the food dye seeps through. This shows how the ground water can become contaminated – you should have pink water collecting in the bottom of the bottle/holder.

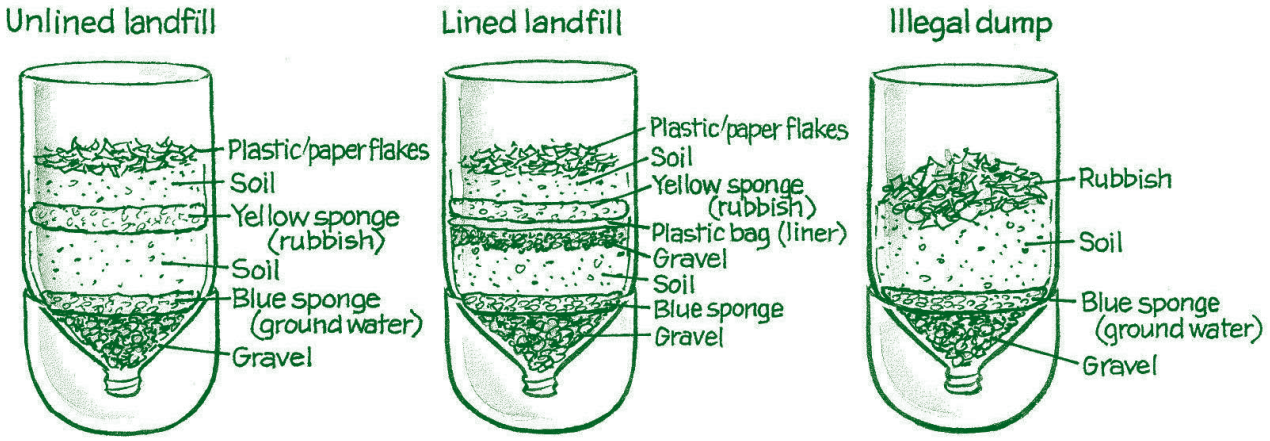
   In the illegal dump/tip you should find that the leachate (pink water) filters through the landfill quite quickly and again the blue sponge will change colour.

   At this point students should be able to see the impacts that waste can have on ground water and soil. Now you can discuss further some of the other environmental impacts that were mentioned earlier. For example, if the paper/plastic flakes (very top layer) didn't get too wet, have one of the students blow gently on the landfill to displace the paper/plastic. Have them recognise that in a real landfill situation this rubbish/litter could affect the surrounding land and water. You can also reiterate some of the issues in regards to atmospheric pollution in the form of greenhouse gases.

To simplify:

Leachate is a difficult concept for students to understand. Immersing a tea bag in warm/hot water to demonstrate how the stained water disperses, will help students to better understand the concept.





Disposable culture

Aim:

Students will learn that behaviour and attitudes in relation to waste have changed over time.

Curriculum links:

Learning area	Outcome	Aspect
Society and Environment	Resources	• Resources are used to satisfy needs and wants • Resource availability and distribution
	Time, continuity and change	• Management of resources • People events and ideas • Continuity and heritage are features of all societies
Science	Natural and processed materials	• Different materials have different properties and these properties can be related to their uses

Background information:

In today's society we seem to have a disposable culture, although it hasn't always been this way. If you speak to parents and grandparents you may find that products were not as disposable as they are today and that we didn't produce as much waste then as we do now.

This activity can be done as part of a homework assignment or you can organise for parents and grandparents to visit the class to be interviewed, or even take students to visit retirees at the local retirement village.

Resources:

- Paper, pens
- Tape recorder
- Camera (optional)

Activity:

1. Introduce the activity by encouraging students to brainstorm the disposable items that are available to buy compared to reusable and recyclable items. Talk to students about the amount of waste we have now and about how it hasn't always been this way. Tell students about the history of waste, as detailed in the introduction to this chapter.
2. Ask the students if they have ever spoken to their older family members about what life was like when they were young. Ask students to think of some questions they could use to ask people about the waste they produced when they were young. Consider questions such as:
   - How was food packaged?
   - Did you grow your own food?
   - What happened when something was broken?
   - What did you do with your food scraps?
   - What did you carry your groceries in?
   - How was your lunch packed for school?

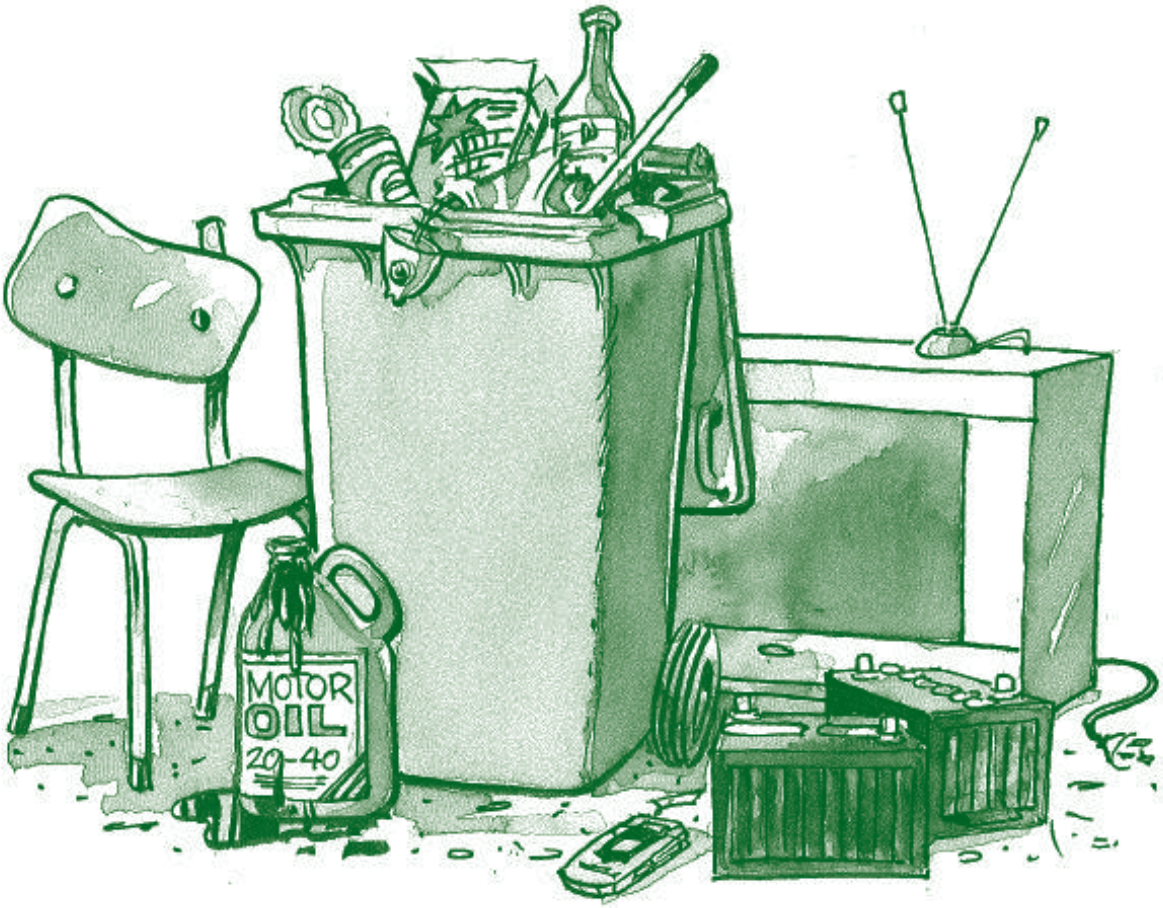
3. The students should write a list of questions in a logical sequence and practise them in preparation for their interview.
4. The students carry out the interview and record it if possible.
5. The students then analyse their answers to see how things are different in their lives when compared to the lives of the people they interviewed.

To simplify:

Invite one or two grandparents into the classroom and ask them to speak to children. Children can ask questions. Students then create a drawing to illustrate what waste management was like in the past and what it is like today.

To challenge:

Have students analyse the responses they got to their questions. What can they learn about society and how it has changed from their interview? Are there changes that the students can make to the way they live that will result in the production of less waste?



Waste debate

Aim:

Students understand that there are different viewpoints on the topic of waste disposal within the Western Australian community by holding their own debate.

Curriculum links:

Learning area	Outcome	Aspect
English	Listening and speaking	• Context, purpose and audience • Speaking processes and strategies
Society and Environment	Active citizenship	• Respect and concern for the environment

Background information:

Due to our consumption habits we produce waste every day. The conventional way to deal with this waste has been to bury it in landfill. As we continue to fill up existing landfill sites, we create the need to clear more land for new sites, which can further threaten remnant bushland and the flora and fauna living there. Other potential environmental problems from landfill include:

- the pollution of surface or groundwater by leachates (toxic liquid created from rain filtering through rubbish) in unlined landfills
- the release of greenhouse gases in the form of methane, which is 20 times stronger than carbon dioxide as a greenhouse gas, and remains in the atmosphere for 100 to 150 years
- the creation of nuisance odours and dust
- the release of pollutants into the atmosphere in the event of fire
- the distribution of 'wind-blown waste', such as plastic bags, that may find its way into waterways and neighbouring terrestrial sites.

It is important that students are aware that this is our waste and landfills are dealing with it for us. Managing waste is a challenge, but more efficient treatment technologies are being developed and experimented with to reduce the adverse effects of landfills. These are called alternative waste treatment (AWT) technologies.

There is a strong drive towards the development of AWT technologies as alternatives to landfill in Western Australia. Many regional councils in Perth are developing or have already developed some of these technologies.

AWT technologies convert waste into energy or useful by-products. The overall aim is to increase the recovery of resources from the waste stream and minimise the impact on the environment. The three main types of AWT include modifications to conventional land-filling, thermal treatment (using heat to decompose waste) and biological treatment (decomposition by organisms such as bacteria or worms). The type of municipal solid waste and the location can affect the kinds of AWT that are used. The objective is to treat our waste in a socially, commercially and environmentally sustainable way (Municipal Waste Advisory Council, 2009).

Resources:

- Resources for research and access to the internet

Activity:

1. Place the students into small groups. Groups will choose or be assigned a topic to research and will prepare a short debate with equal teams assigned to the pros and cons of the topic. Students will need sufficient time to research their topic before presenting the debate.

   Possible topics include:

   1. Transporting waste from areas that no longer have sufficient landfill space to other areas
   2. Charging residents for waste disposal based on the weight of their rubbish bin at collection each week
   3. Continually building landfills to accommodate waste being produced in Western Australia
   4. Increasing or decreasing the landfill levy (the amount the community pays to dispose of waste)
   6. Extended producer responsibility – should companies be more responsible for the waste produced as a result of their products?

To simplify:

- Students fill in a simple graphic organiser listing the pros and cons of landfills.

To challenge:

- Students role play a council meeting where the building of a new landfill is being investigated. Stakeholders represented at the meeting could be local councillors, local environment groups, local homeowners, landfill management committee members, town planners and State Government waste management representatives. What different opinions would exist among the stakeholders?