Chapter 6.

Waste Minimisation

Terms and concepts

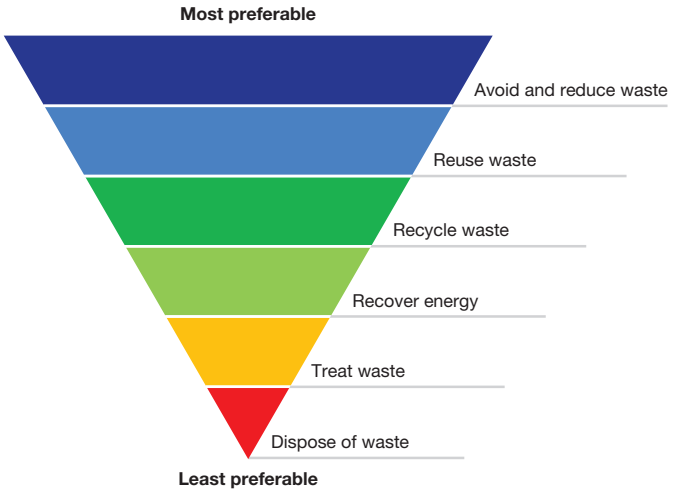
Waste, zero waste, management, waste minimisation, hierarchy, greenhouse gases, methane, energy, avoid, reduce, reuse, recycle, recover, treat, dispose, disposable, circular economy, linear, economy, organic.

Background Information

Each day we use resources and materials and create waste. Our Earth has a limited capacity to absorb waste. The CSIRO states that Australia is one of the largest generators of waste in the world, with each person contributing, on average, 540 kg of household waste per year. The waste management hierarchy is a way of thinking about how we can reduce our waste in many different ways.

Avoid, Reduce, Reuse and Recycle (ARRR) is the easiest way of remembering the waste management hierarchy. It means that the best way to manage your waste is to **Avoid** it, **Reduce** it, **Reuse** it and then **Recycle** it.

The Waste Management Hierarchy is a nationally and internationally accepted guide for prioritising waste management practices. It sets out the preferred order of waste management practices, from most to least preferred. The further the activity moves up the waste management hierarchy, the more greenhouse gases are avoided and the less water and energy consumed.



The Coal Loader demonstrates a number of examples of the waste management hierarchy on site, including:

1. **AVOID** and **REDUCE WASTE** – this is the most preferred option as it creates the least amount of waste and it uses the least amount of energy. For example:
   - deciding not to buy things we don't really need eg, colour photocopiers.
   - using reusable cups and plates for our meetings instead of disposable ones.
   - Buying goods in bulk (rather than lots of smaller packages)
2. **REUSE WASTE** – waste is reused and very little energy is consumed to do this. Sometimes this is called upcycling. For example:
   - Reuse old street signs which have been made into a coffee table.
   - Scrap paper for notes/phone messages.
   - Purchase second hand items to reuse them eg,office chairs.
3. **RECYCLE WASTE** – when materials from waste streams are broken down and reprocessed into either a very similar product (this is a closed loop) or a new product (open loop). These processes usually use a lot of energy. For example:
   - Recycling all paper waste.
   - Plastic bottles and containers are reprocessed to make outdoor furniture.
4. **RECOVER ENERGY** and TREAT WASTE – The Coal Loader is not involved in these processes which usually use a lot of energy to deal with waste.
5. **DISPOSE OF WASTE** – This occurs when waste is sent to landfill. This might happen at the Coal Loader when visitors leave items which have to be disposed of eg. plastic bags and face masks.

   The CSIRO is developing strategies so that Australia develops a circular economy rather than what it is now a linear economy – where goods are produced, consumed and thrown away. What does the circular economy look like?

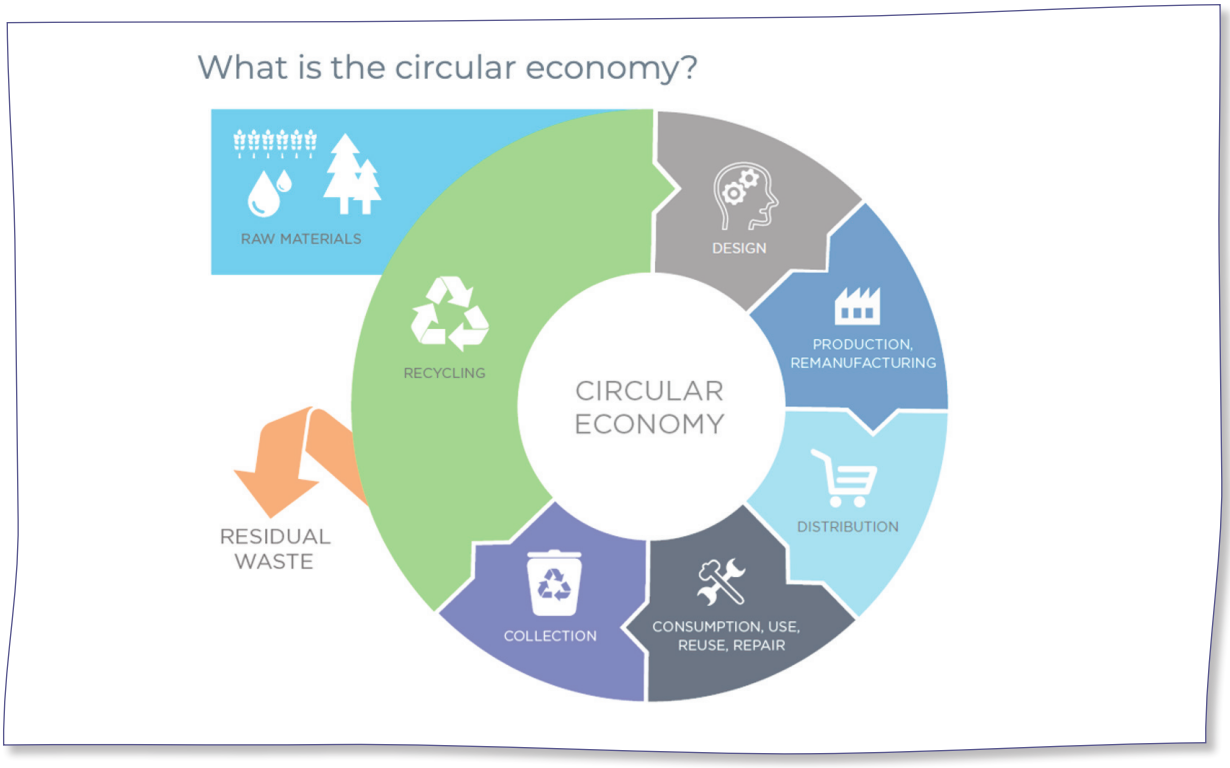


Diagram X – adapted from CSIRO circular economy

SYLLABUS LINKS

- Geography Stages 1-5
- Curriculum Priority Sustainability – Geography – Stage 2, 3 and 5
- Science and technology and Science Stages 1 and 4
- Curriculum Priority Sustainability – Science -Stages 2 and 4

Further Information

Refer to websites such as:

- North Sydney Council, EZEC (Environmental and Zoo Education Centres) eg, Observatory Hill EEC and Field of Mars EEC
- NSW Government Environment, Land and Water – Waste and Recycling
- NSW EPA, Return and Earn, Planet Ark,
- CSIRO – circular economy
- NSW Sustainable Schools

Activity 1 – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques.

Activity Summary:

Students will identify, categorise and locate the different ways the Coal Loader Centre for Sustainability is avoiding, reducing and recycling waste.

Inquiry Questions:

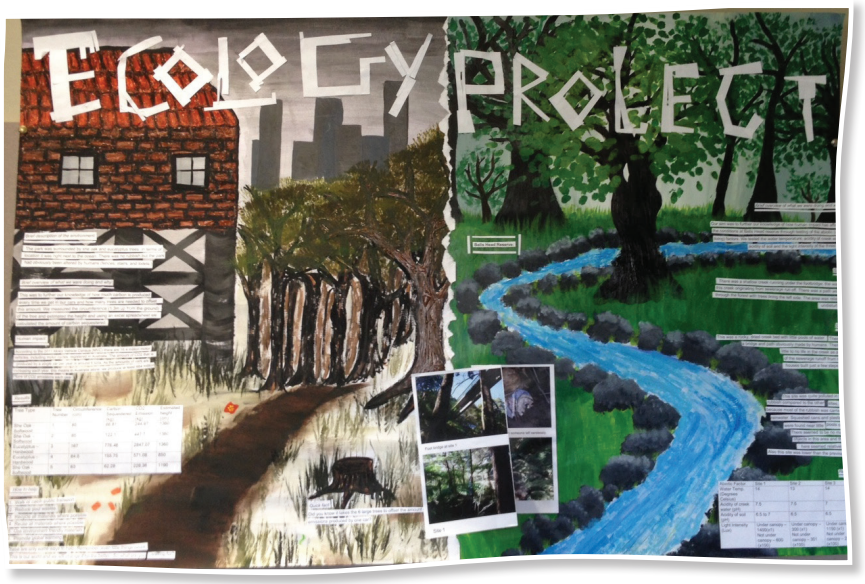
1. What, where and how are the ways in which the Coal Loader Centre for Sustainability manages its waste?
2. What categories do these strategies fall into in the waste management hierarchy?
3. How can 'the circular economy' help us think about our waste management?

Syllabus Outcomes:

- Identifies ways in which people interact with and care for places. GE1-2
- Explains interactions and connections between people, places and environments. GE3-4
- Discusses management of places and environments for their sustainability. GE4-5

Materials and preparation:

- Students to bring a clipboard, copy of the worksheet and writing equipment.
- A4 laminated Coal Loader Map.
- Teachers and students view link to view how local students thought about rubbish in the North Sydney *https://youtu.be/VOrdjlvLIE4*
- Before visiting the Coal Loader teachers should lead a class discussion on the waste management hierarchy.



Activity 1 – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

Name .....

Location – Outside the Caretakers cottage or on Jacaranda Square.

1. Start discussion with students based around Inquiry questions, that is,
What, where and how are the ways in which the Coal Loader Centre for Sustainability manages its waste?

2. Teacher to guide students around the Coal Loader's caretaker's cottage and gardens.

Teacher to hand out the laminated maps.

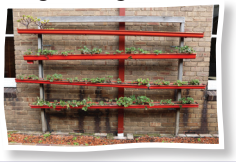
Use the map on the next page, diagram X to mark the start of your waste minimisation trail.

As students walk around the area add each feature to the map, by writing the number onto the correct location on the map on the next page.

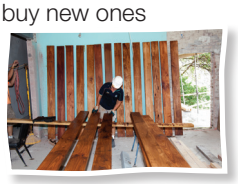
Start outside the Caretaker's cottage and discuss the kitchen and office inside the cottage without going into the cottage.

a. For each of the strategies listed in the table, ✓ tick when you see it (some have photographs in table below) and write down whether it can be categorised as:
AVOID and **REDUCE (AR), REUSE (RU) OR RECYCLE (RC)?**
Write a few words explaining **Why** this category? (First one has been done for you)

b. As you walk to each feature, **write** the number on the **map** on the next page.

Item or process	Tick ✓	WASTE HIERARCHY – Avoid and Reduce (AR), Reuse RU), Recycle (RC) WHY?
1. Compost 		**RC** – Food scraps are broken down into soil.
2. Worm Farm 		
3. Vertical garden made from old guttering 		
4. E-waste, batteries, phones collected for recycling 		

Activity 1 – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

5. Restore old floorboards rather than buy new ones 		
6. Bricks from original building used for pathways 		
7. Street signs used for art 		
8. Bottles and cans collected for recycling		
9. Chickens eat food scraps 		
10. Tools and items are repaired rather than sent to landfill 		
11. Second hand computer		
12. Office waste paper bins		
13. Scrap paper as notepad		
14. Not buying commercial cleaners 		
15. No use of disposable Items eg.plastic cups		

Activity 1 – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

16. Original horse-hair ceilings kept and restored 		
17. Rent or borrow equipment from CL 		**AR** – Reduces the need for companies to make more equipment, so it saves on materials and saves you money.
18. OTHER?		

3. Can you identify three strategies from the list above that you could use for your waste management at school and at home?.

SCHOOL HOME

1. _____

2. _____

3. _____

4. Can you identify two strategies from the Centre's waste management strategies which support the idea of the circular economy?

1. _____

2. _____

Activity 1 – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

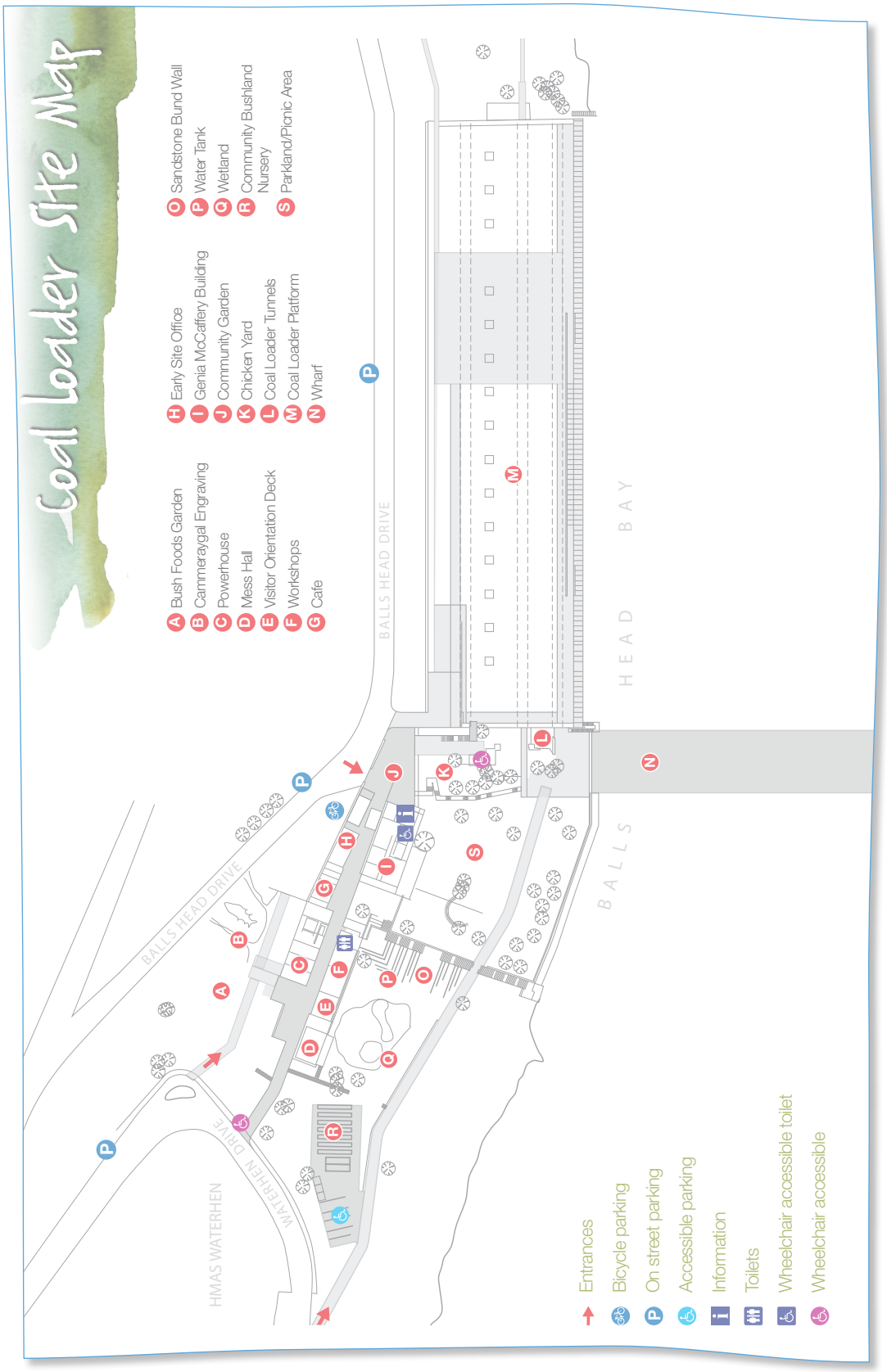


Diagram X – Waste Minimisation Trail Map

Activity 2 – Student Worksheet
An investigation into compost bins and worm farms at the Coal Loader.

Activity Summary:

Students will investigate the Coal Loader Centre's compost bins and worm farms to find out how they work, why they are important and where they fit into the waste management hierarchy and circular economy.

Inquiry Questions:

1. How do the compost bins and worm farms function at the Coal Loader Centre?
2. Why are compost bins and worm farms important to the environment and waste management?
3. How do compost bins and worm farms link to the waste management hierarchy and the circular economy?

Syllabus Outcomes:

- Identifies ways in which people interact with and care for places. GE1-2
- Explains interactions and connections between people, places and environments. GE3-4
- Discusses management of places and environments for their sustainability. GE4-5
- Identifies how plants and animals are used for food and fibre products. ST1-5LW-T
- Explains how food and fibre are produced sustainably in managed environments for health and nutrition. ST3-5LW-T
- Identifies that materials can be changed or combined. ST1-6MW-S

Materials and preparation:

Before visiting the Coal Loader teachers should lead a class discussion on the waste management hierarchy.

- Teachers to use the reference posters 'Compost', 'Why Compost', 'Worm Farming' and 'Four easy steps to successful worm farming' for class discussion. See online North Sydney Coal Loader Learning Guide Appendix 2 or as a laminated class set at the Coal Loader.
- Students to bring a clipboard and writing equipment.
- A4 Coal Loader Map.

Activity 2A – Student Worksheet
An investigation into compost bins and worm farms at the Coal Loader.

Name .....

Location – Coal Loader Community Garden (between the Caretaker's cottage and the CL Platform). Start at the Compost sign.

Duration – 30 minutes.

1. Start discussion with students based around Inquiry questions, that is,
What, where and how are two ways in which the Coal Loader Centre for Sustainability manages its food and garden waste?

Did you know?

Composting is a natural process. Composting naturally recycles organic matter eg, leaves and food scraps into a valuable mix of nutrients and fertilisers which look like soil. Composting uses the natural processes of rotting and decomposing, which in turn relies on the activity of microorganisms to break down materials.

2. From the Compost sign:

a. What does food waste produce when it goes into landfill?

_____

_____

b. Composting is an easy way of doing three things, what are they?

_____

_____

_____

3. Can you name three items from the kitchen and from the garden that can go into your Compost bin?

Kitchen

_____

_____

_____

Garden

_____

_____

_____

_____

Activity 2A – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

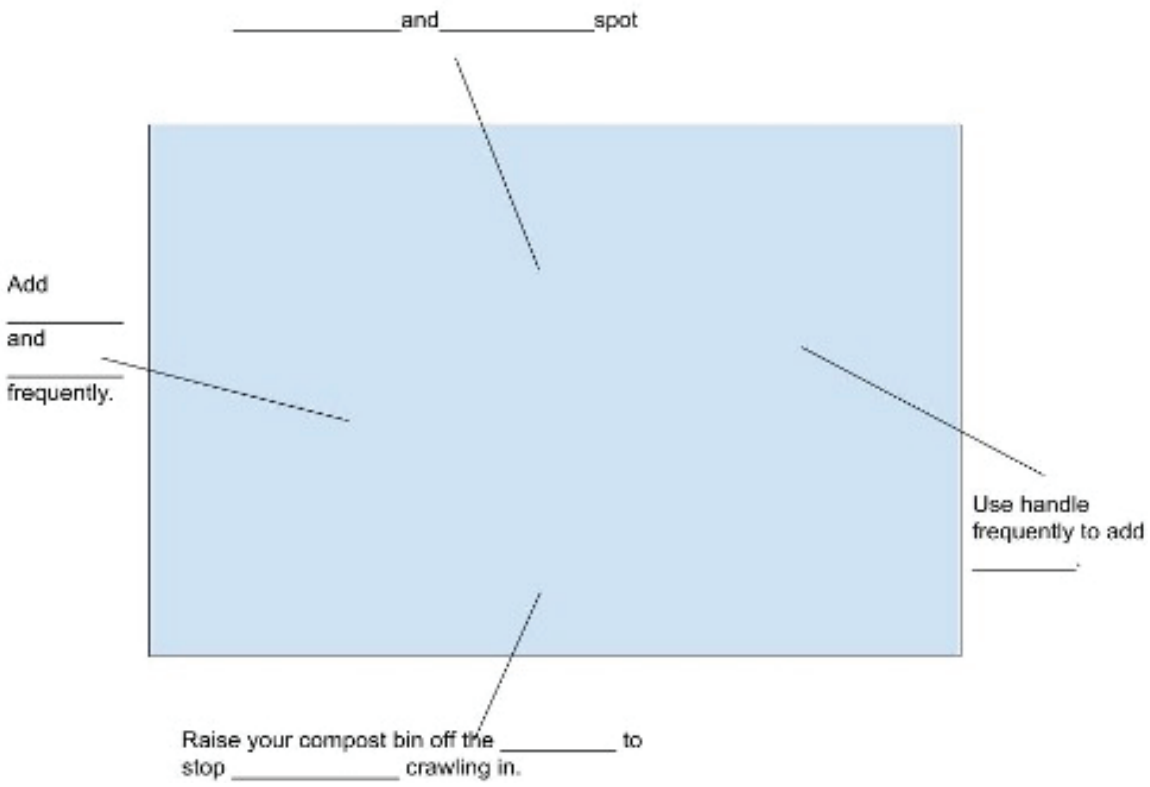
3. Find the Compost bin in the community garden.

a. Draw a simple diagram of the compost bin and fill the labels in using the words in the **word bank** below:

Word Bank:

Air, shady, food scraps, insects, ground, garden scraps, sunny.

Your sketch of the compost bin.



Activity 2A – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

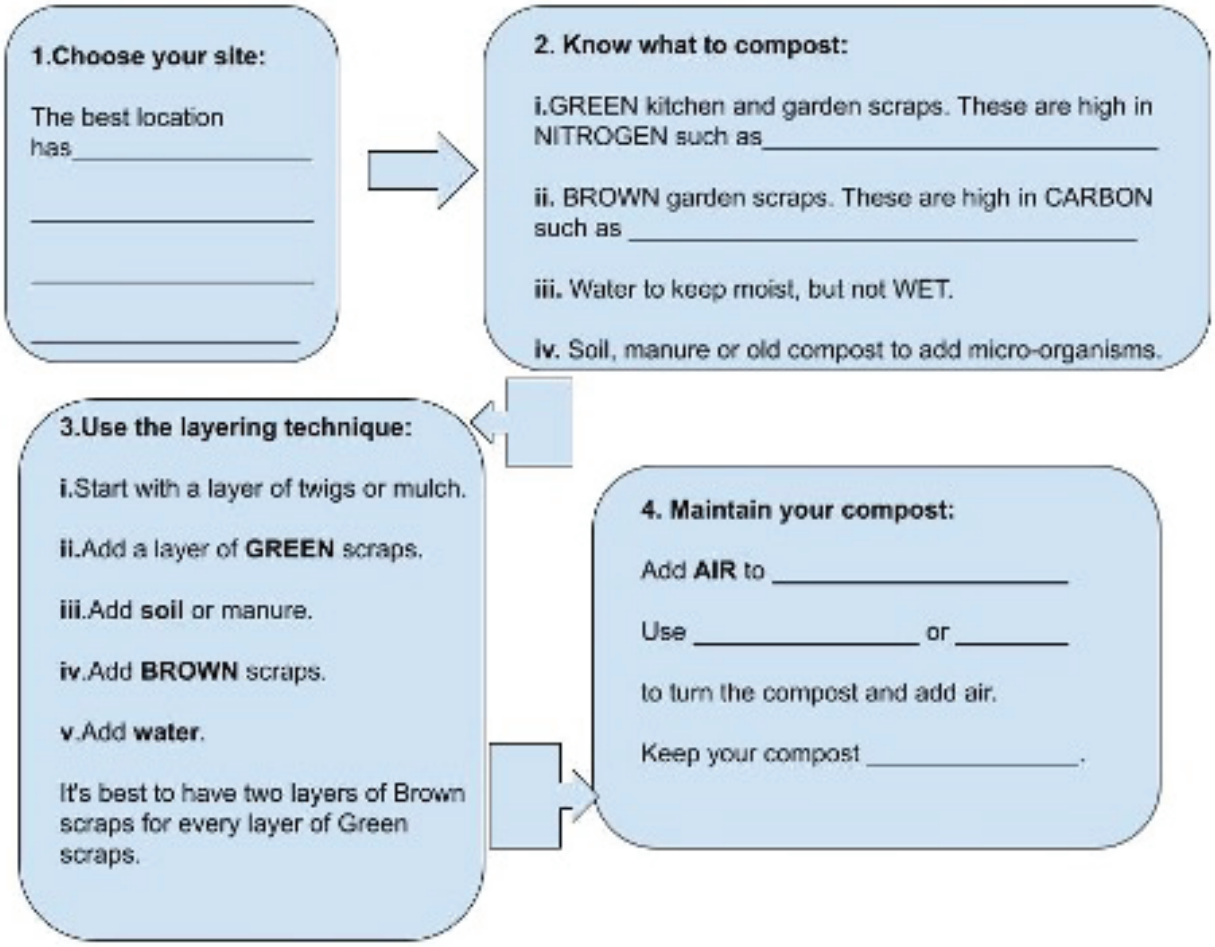
4. Teacher to distribute laminated reference posters of COMPOST AND WORM FARM.
Read the laminated reference poster 'Compost – Nature's gift to the garden' and answer the following questions:

a. Name two advantages of using compost on your garden.

_____

_____

b. There are **FOUR** important steps to make great compost. Fill in the steps:



c. Composting requires a good balance of all the elements and layers. Write down a problem and a solution that you might have if your compost is out of balance.
(see the Compost Q and A for ideas)

_____

_____

d. Composting can be thought of as being part of the **RECYCLE** category in the waste management hierarchy. Explain why it is in this category.

_____

_____

Activity 2B – Student Worksheet
An investigation into compost bins and worm farms at the Coal Loader.

Name .....

Location – Coal Loader Community Garden (between the Caretaker's cottage and the CL Platform). Start at the Worm farm.

1. Start discussion with students based around Inquiry questions, that is,
What, where and how are two ways in which the Coal Loader Centre for Sustainability manages its food and garden waste?

Did you know?

Composting and worm farming are similar, and different! Composting uses microorganisms to break down food and garden scraps into nutrients. Worm farms use red or tiger worms (a type of earth worm) to recycle organic matter eg, leaves and food scraps into worm castings (worm droppings that look like soil) and worm tea (liquid that looks like tea). Worm castings and worm tea both provide nutrients for your soil.

Find the Worm Farm in the community garden.

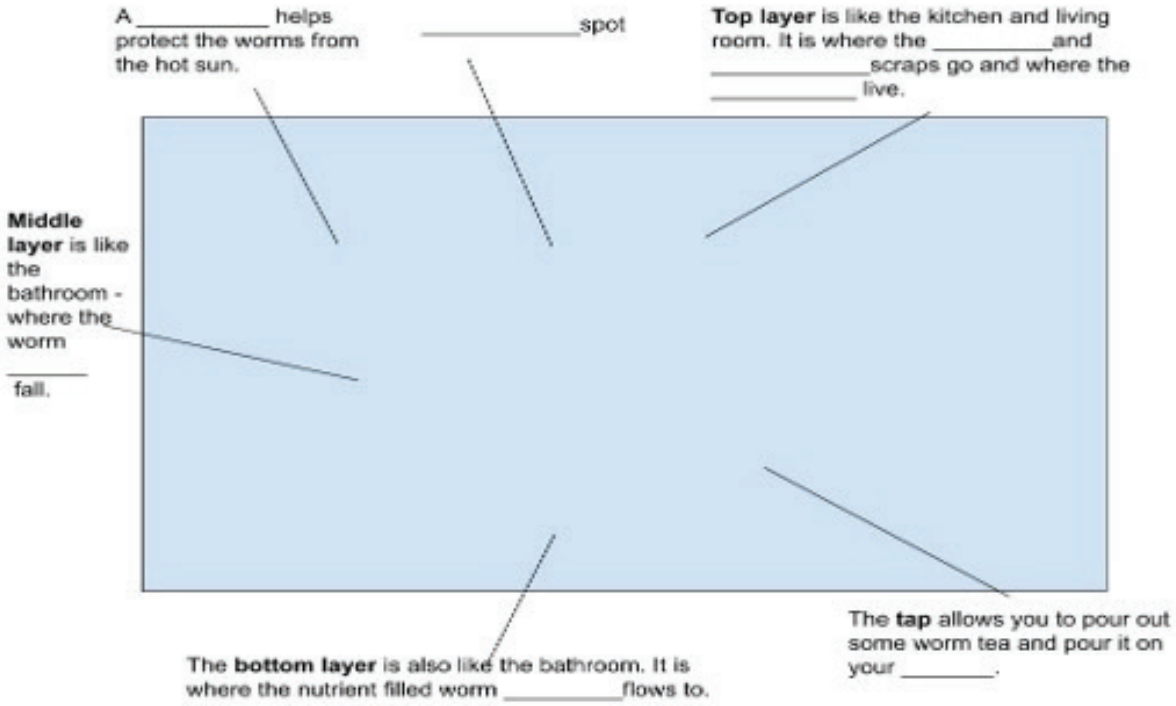
b. Draw a simple diagram of the worm farm blow, and fill in the labels using the words in the **word bank** below:

Word Bank:

Food, paper, worms, castings, tea, liquid, garden, shady, blanket.

Activity 2B – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

Use the Worm Farming poster and the words in the word bank to help you fill in the gaps.



My sketch of the worm farm.

4. Read the Worm Farming poster and answer the following questions:

a. Name three foods you should collect and feed to worms in a worm farm?

_____

_____

_____

b. Describe the box and bedding layer that worms like in a worm farm.

_____

_____

_____

c. Name two conditions that worms need to thrive in a worm farm

_____

_____

Activity 2B – Student Worksheet
An investigation of the Coal Loader Centre's waste minimisation techniques. *continued*

d. Worm farming requires a good balance of all the elements and layers. Write down a problem and a solution that you might have if your worm farm is out of balance. (Read 'Worm Farming Q and A' for ideas)

_____

_____

e. Worm farming can be thought of as being part of the RECYCLE category in both the waste management hierarchy and the circular economy. Explain why it is in this category.

_____

_____

Activity 3 – Product Life Cycle Analysis.

Pre and post activities and resources – for home or back at school

Activity summary:

This activity will demonstrate that all products have life cycles that can be studied to estimate the ecological impact of the product. Students are challenged to research and analyse the life cycle of one product, the orange juice popper, compared to another that could meet the same need with a lower ecological impact, the orange.

Inquiry Questions:

1. How does the life cycle of an orange juice popper compare with that of an orange?
2. What is the ecological impact of both products?

Syllabus Outcomes:

- Explains interactions and connections between people, places and environments. GE3-4
- Discusses management of places and environments for their sustainability. GE4-5
- Explains how food and fibre are produced sustainably in managed environments for health and nutrition. ST3-5LW-T

Materials and preparation:

- Orange juice popper
- Orange

Activity 3 – Student Worksheet Product Life Cycle Analysis.

Background Information:

What is a product life cycle?

Just as living things are born, get older, and die, products also complete a life cycle. Each stage of a product's life cycle can affect the environment in different ways.

Some products, such as an orange juice popper, have many different components for example the tetra box carton, the straw, the plastic wrap to encase the straw, the ink on the label, the lining, as well as the juice itself, each of which has its own life cycle. The stages of a product's life cycle usually include:

- **Design** – A product's design can influence each stage of its life cycle and in turn the environment. Design affects which materials will be used to manufacture a product. For example, cheaper materials are often less durable, which means the product will have a short useful life. Product design can also prevent waste in many ways. Products can be designed with modular components that can be easily replaced so that the entire product does not have to be thrown away if only one piece breaks.
- **Materials Extraction** – All products are made from materials found in or on the earth. "Virgin" or "raw" materials, such as trees or ore, are directly mined or harvested from the earth, a process that can create pollution, use large amounts of energy, and deplete limited natural resources. Making new products from materials that have already been used (recycled materials) can reduce the amount of raw materials we need to take from the earth.
- **Materials Processing** – Once materials are extracted, they must be converted into a form that can be used to make products. For example, paper is made from trees, but the wood has to undergo several different processes before we can use it.
- **Manufacturing** – Products that are made in factories require a great deal of energy and water to create. The manufacturing process can also produce pollution. Many products require the use of packaging as well, to prevent spoilage, damage, contamination, and tampering.
- **Packaging & Transportation** – The use of packaging can protect products from damage and provide product information. However, packaging consumes valuable natural resources and when used excessively can be wasteful. Some packaging can be made from recycled materials. Finished products are transported in trucks, ships, planes, and trains to different locations where they are sold. All of these forms of transportation burn fossil fuels, which can contribute to global climate change.
- **Use** – The way products are used can impact the environment. For example, products that are only used once create more waste than products that are used again.
- **Reuse/Recycling/Disposal** – Using a product over and over again prevents the need to create the product from scratch, which saves resources and energy while also preventing pollution. Recycling or re-manufacturing products also reduces the amount of new materials that have to be extracted from the earth. Throwing a product away means that it will end up in a land-fill and will not be useful again.

Renewable versus non-renewable resources

A renewable resource is one that can be replaced by nature eg sun, wind, water (and oranges!)

Non renewable resources cannot be replaced by nature once they have been used. eg: oil, coal, petroleum

Activity 3 – Student Worksheet
Product Life Cycle Analysis. *continued*

In this activity you will be asked to consider the life cycle of two different products, an orange juice popper and an orange.

Complete the table below, which looks at the life cycle of the popper and the orange.

	Orange juice popper	**Orange**
		
What is this product made from?		
What materials are used to make it?		
Are they renewable or non renewable resources?		
Where did the components come from?		
Who made them?		
Where was it made?		
How is it packaged?		
How is it transported to market?		
What are the inputs and outputs of each? eg soil, air, water, fertilisers		
What will happen to the item at the end of its life?		

Activity 3 – Student Worksheet
Product Life Cycle Analysis. *continued*

Class Discussion:

1. Which product do you think has the lower environmental impact? Discuss your reasons why.
2. Could you answer all the questions about each product? What information is missing and where could we go to find this out?

Using all the information you have gathered as a class help piece together a product life cycle for both the popper and the orange. You could draw pictures or construct a mind map or flow diagram similar to the one below to represent the different stages in the products life or you might like to use the following headings.

1. Raw materials
2. Transport
3. Manufacturing and packaging
4. Distribution
5. Use by consumer
6. Disposal or recycling

At every stage be sure you consider both the inputs eg soil, air, water, fertilisers etc, and the outputs eg waste, emissions to air and water etc

Discuss the differences between the two product life cycles. Which would you choose to buy? What could be done to reduce the environmental impact of the orange juice popper?

Extension

The Coal Loader Cafe is trying to decide how to best provide orange juice to its customers. The Cafe owners have narrowed the decision down to the following two products. They would like to order orange juice that the customers will love and that will have the lowest impact on the environment.

Organic Valley Juice	Colo River Oranges
• Organically grown oranges	• Farm grown oranges
• Packaged in 500ml bottles for convenience	• No packaging must squeeze own juice
• Grown in Valencia, Italy renowned for best oranges	• Grown on the Colo River (1hr from Sydney)
• Placed into cold storage to keep fresh	• No storage. Stays on tree until order taken
• Plastic bottles can be recycled	• Orange skins can be composted onsite
• Transported via air for speedy delivery	• Driven to Coal Loader Cafe (1hr drive)
• Company employs over 1200 people internationally	• Employs 12 people from the Colo River area

Which product would you choose to use in the Coal Loader cafe? Explain the factors behind your decision.

Activity 4 – School Low Waste Lunch Campaign.

Pre and post activities and resources – for home or back at school

Activity Summary:

This activity will challenge students to design a campaign that will engage the whole of the school community to reduce waste by packing a low waste lunch. The ultimate goal is that everyone including the school canteen would participate and over time permanent changes can be made. Essential to the campaign is monitoring participation and measuring the amount of waste avoided from landfill. A waste audit is conducted both prior and post campaign to measure results.

Inquiry Questions:

1. How much school waste is going to landfill in the form of packaging and uneaten food?
2. What strategies can the school community use to reduce our waste going to landfill?

Syllabus Outcomes:

- Explains interactions and connections between people, places and environments. GE3-4
- Discusses management of places and environments for their sustainability. GE4-5
- Explains how food and fibre are produced sustainably in managed environments for health and nutrition. ST3-5LW-T

Materials and preparation:

Before undertaking a low waste lunch campaign, a waste audit should be undertaken without the knowledge of the whole school. A select group of students (eg environment group) could participate in the audit. The audit methodology has been provided.

Materials required for your audit:

- Gloves for all students participating
- Large plastic sheets, or tarp for bin contents
- Tongs
- 3 buckets or large containers
- Scales
- Waste Audit Sheet
  A template can be found at these websites:
  NSW Education – *education.nsw.gov.au/teaching-and-learning/curriculum/sustainability/teaching-and-learning/waste*
  NSW EPA – *www.epa.nsw.gov.au/your-environment/waste/reducing-your-household-waste/love-food-hate-waste*
- Camera

Conducting the audit:

After lunch, on the day you have chosen, students empty all the school playground rubbish bins (not including recycling or compost bins) onto large plastic sheets or tarps.

1. Weigh your empty buckets
2. Label buckets: recyclables, compostable material, and garbage
3. The students use gloves and tongs to sort the materials into the labelled buckets
4. Weigh each bucket once it is full
5. Subtract the weight of the empty bucket to give the true weight of the waste
6. Record your results on the waste audit recording sheet.

The audit process should be repeated immediately after a low waste lunch campaign.

Further information:

See websites:

- Sustainable schools NSW – *https://sustainableschoolsnsw.org.au/*
- NSW Department of Education – *education.nsw.gov.au/teaching-and-learning/curriculum/sustainability/teaching-and-learning/waste*
- Kimbriki – *https://kimbriki.com.au/education-centre/*
- NSW EPA – *www.epa.nsw.gov.au/your-environment/waste/reducing-your-household-waste/love-food-hate-waste*

Activity 4b – Student Worksheet
Low Waste Lunch campaign.

Introduction:

Low Waste Lunches are a great way to get us all to think about the *rubbish* or *waste* that we are throwing in the bin. Many of us throw things out every day without considering the environmental impact of what we are doing.

This activity will challenge you to design a campaign that will engage the whole of the school community to reduce waste by packing a low waste lunch. Before running your Low Waste Lunch campaign you will need to conduct a pre campaign waste audit. This audit needs to have your teacher's permission but must not be revealed to the whole of school community until after the audit has taken place. This is essential to be able measure the impact of your campaign on the amount of waste going to landfill.

Packing a low waste lunch is easier than you think, and they are often much healthier as they encourage us to eat more fresh food!

Low Waste Lunches:

AVOID:

- × Plastic wrap and foil
- × Disposable items like plates knives and forks
- × Paper lunch wrap
- × 'Gimmicky' packaged items e.g. chips, biscuits, small yoghurts, individually wrapped serves of food

ALWAYS:

- ✓ Use re-useable containers and drink bottles that can be washed out
- ✓ Choose items with reusable, recyclable or compostable packaging
- ✓ Pack cheese & biscuits or yoghurt from larger containers into a reuseable smaller container

Activity 4B – Student Worksheet
Low Waste Lunch campaign. *continued*

Activity: The Low Waste Lunch Campaign

How you design your campaign is totally up to you however we have provided some key questions to get you thinking.

1. Who will you involve in the campaign? Think about allocating key roles and responsibilities.

2. What will be your key messages and focus?

3. What sort of educational materials or marketing strategies will you use?

4. Will your low waste lunch challenge take place on just one day or more frequently eg every week?

5. Why will people want to participate?

6. Will you offer incentives for student participation?

7. How will you communicate the results from the pre and post campaign waste audit?

8. How will you ensure that the waste reduction results will continue beyond the life of the campaign?

Activity 4B – Student Worksheet
Low Waste Lunch campaign. *continued*

Extension

- Present your pre and post campaign audit results to your school Principal and request that the school designates one day each week as a Low-Waste Food Day (or Nude Food Day)
- Is your school canteen on board? Are some of the wasteful items being sold really necessary? Can they be avoided or replaced with less wasteful alternatives? Work with the canteen and the P & C to begin to address these issues.

Past school waste audits have found that the amount of uneaten food in the bins is enormous. In fact it is a problem not just faced at school, NSW households throw away more than $2.5 billion worth of edible food per year!

Your future campaigns could encourage students to come up with ideas for creating low waste lunches from last night leftovers. Log on to *www.lovefoodhatewaste.nsw.gov.au* for more information.

Waste Wander

Walk around the Coal Loader site and find these features: