Food waste
Year 9 and 10
(Stage Five)

English
Science
Geography
Design & Technologies
Food Technology

Acknowledgements
Founder of From Paddock to Plate, Louise FitzRoy, has produced this national educational resource to be incorporated into the curriculum programs of schools across Australia.

Louise would like to thank everyone involved in the filming of this production including the teachers and students at Monbulk Primary School, Founder of Little Veggie Patch Co, Mat Pember, Director of ZEA Hungry Goods, Rodrigo Castellanos, Biofilta’s Chief Executive Officer, Marc Noyce, Managing Director at Branin Pty Ltd, Ed Meysztowicz and Australian dairy farmer, Peter Hanrahan. Louise would also like to acknowledge all the sponsors and supporters of From Paddock to Plate.

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Year level: 9 and 10
Curriculum focus

This unit highlights several case studies in which food waste plays a prominent role in the activities and operations of schools and organisations showcased in our virtual excursion. Teachers and students will be inspired to turn food waste into compost within the school grounds and create worm farms to encourage prolific vegetable gardens. Students will explore how to grow food in even the most confined city spaces and learn to appreciate the time and effort it takes to produce food to reduce food wastage. The teaching materials provide students with an understanding of where food waste goes after it’s thrown in the bin and how damaging it can be to the environment. The video also profiles different initiatives to recycle food waste and associated packaging, and turn it into useful products to create a sustainable future and assist Australian farmers to feed their animals in times of flood or drought.

In this unit students will:

• see how schools are utilising food waste to grow more food;
• learn how to grow large amounts of food in small spaces;
• discover inventions to turn food waste into useful products that will benefit others;
• visualise what happens to food waste after it is thrown in the bin;
• develop their own initiatives to grow a sustainable future.

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA), downloaded from the Australian Curriculum website in January 2017.

Sample of topics covered for discussion and further consideration

• Food security
• Sustainability
• Biodiversity
• Environment
• Waste management
• Water security
• Drought & natural disasters
• Traceability
• Nutrition
• Food waste & recycling

• Innovation & design
• Technology
• Food miles
• Ethics
• Animal welfare
• Animal health
• Soil & pasture management
• Community
• Pests & diseases
• Economics
Design & Technologies, Years 9 and 10

**Strand**: Design and Technologies Knowledge and Understanding

**PAGE 8 | ACTDEK040** *(Cross-curriculum priorities: Sustainability)*
Critically analyse factors, including social, ethical and sustainability considerations, that impact on designed solutions for global preferred futures and the complex design and production processes involved

**PAGE 11 | ACTDEK041** *(Cross-curriculum priorities: Sustainability)*
Explain how products, services and environments evolve with consideration of preferred futures and the impact of emerging technologies on design decisions

**PAGE 16 | ACTDEK043**
Investigate and make judgments on how the characteristics and properties of materials are combined with force, motion and energy to create engineered solutions

**PAGE 18 | ACTDEK044** *(Cross-curriculum priorities: Sustainability)*
Investigate and make judgments on the ethical and sustainable production and marketing of food and fibre

**PAGE 21 | ACTDEK045**
Investigate and make judgments on how the principles of food safety, preservation, preparation, presentation and sensory perceptions influence the creation of food solutions for healthy eating

**PAGE 23 | ACTDEK046** *(Cross-curriculum priorities: Sustainability)*
Investigate and make judgments on how the characteristics and properties of materials, systems, components, tools and equipment can be combined to create designed solutions

**PAGE 28 | ACTDEK047** *(Cross-curriculum priorities: Sustainability)*
Investigate and make judgments, within a range of technologies specialisations, on how technologies can be combined to create designed solutions

**Strand**: Design and Technologies Processes and Production Skills

**PAGE 29 | ACTDEP048** *(Cross-curriculum priorities: Sustainability)*
Critique needs or opportunities to develop design briefs and investigate and select an increasingly sophisticated range of materials, systems, components, tools and equipment to develop design ideas
Apply design thinking, creativity, innovation and enterprise skills to develop, modify and communicate design ideas of increasing sophistication.

Work flexibly to safely test, select, justify and use appropriate technologies and processes to make designed solutions.

Evaluate design ideas, processes and solutions against comprehensive criteria for success recognising the need for sustainability.

Develop project plans using digital technologies to plan and manage projects individually and collaboratively taking into consideration time, cost, risk and production processes.

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA), downloaded from the Australian Curriculum website in January 2017.
Fun fast facts about food waste

- Australians discard up to 20% of the food they purchase
- This equates to 1 out of every 5 bags of groceries they buy
- Up to 40% of the average household garbage bin is food
- For the average Australian household $1,036 of food is thrown away each year

- This money could be spent on:
  - Enough food to feed the average household for over a month
  - Paying off six months of your electricity bill

- Aussies throw out $8 billion of edible food every year
- Australia wastes 4 million tonnes of food each year
- This equates to 523kg per household, which is the same weight as just over 5 average size fridges!

- Out of the $8 billion what do we waste every year?
  - $2.67 billion of fresh food = 33%
  - $2.18 billion of leftovers = 27%
  - $1.17 billion of packaged and long-life products = 15%
  - $727 million of drinks = 9%
  - $727 million of frozen food = 9%
  - $566 million of takeaways = 7%

- Why is it wasted?
  - We cook too much food
  - Food is mistakenly thrown out before the use-by/best before date
  - We forget about leftovers in the fridge/freezer
  - We don’t know how to use leftovers
  - We buy too much because we don’t stick to a shopping list
  - We often shop when we're hungry so we buy more food than we need
  - We don't check the cupboard or fridge before going shopping
  - We are not planning our meals and menus as much as we could
  - Buying takeaways at the last minute instead of cooking the food we have in/family members changing plans
• Who are the biggest wasters of food?
  o Young consumers (18-24)
  o Households with incomes of more than $100,000 per year
  o Families with children

• When food rots in landfill, it gives off a greenhouse gas called Methane that is 25 times more potent than the carbon pollution that comes out of your car exhaust.

• When you throw out food, you also waste the water, fuel and resources it took to get the food from the paddock to your plate.

• An estimated 20-40% of fruit and vegetables are rejected even before they reach the shops mostly because they do not match consumers’ and supermarkets’ high cosmetic standards.

• If you add up the foods Australia wastes each year, it’s enough to fill 450,000 garbage trucks. Placed end to end, the convoy would bridge the gap between Australia and New Zealand just over three times.

FoodWise, January 2017

Do Australians actually waste $8 billion worth of edible food each year?

Useful words and phrases

Sustainability
Recycle
Landfill
Greenhouse gas emissions
Methane
Carbon pollution
Compost
Worm farm
Food scraps
Cosmetic standards
Vertical foodwall
Urban sky farm
Fuel consumption
Self-sufficient
Carbon neutral coffee
Food bank
Food security
Freegan
Locavore
Food supply chain
Consumer
Edible
LET’S GET STARTED

Firstly, please read the FP2P Welcome Guide on the FP2P website - www.frompaddocktoplate.com.au/school-programs/

It is important to understand the level of knowledge your students have of food waste in Australia and around the world. This will determine the structure of your delivery for this unit.

- ASK the students to describe and list what they know about food waste.
- DISCUSS the useful words and phrases.
- BRAINSTORM and gather ideas and information from the class and use this as a platform to begin this unit.

It is now a great time to watch the From Paddock to Plate ‘Food Waste’ virtual excursion.

Ask the students to do the follow-on activities below in succession or as standalone lessons.

ACTDEK040
Social | Ethics | Sustainability | Environment | Innovation |
Design | Jobs | Skills | Culture | Technology | History | Genetics

COMPARE the impact of past and present design solutions in the food waste industry.

For example:
- Recycling factories
- Composting equipment
- Worm farm inventions
- Selective breeding
- Automated farms
- Robots
- Permaculture
“So we put the single bin down, they throw what is 90 per cent food in there with other things. And we also try not to handle it by hand too much. That’s not sustainable. You’ve got to do it with machines. We’ve designed this process to be mechanical and also to process at a very high rate. We process this stuff at up to 20 tonnes per hour. What that means is that it has a low cost of production. That’s really important, because at the end of the day the product needs to be affordable. If you’re doing an individual piece of bread every time, the process that is built around that principle, the cost of the product at the end is too high and won’t sell. If it doesn’t sell, there is no point recycling. So we’re getting these products in, thousands of tonnes every year, and we’re processing it with mechanical means at a high rate to create a low cost product which is cattle feed that turns into milk and meat on dairy and beef farms.” (11:19 – 12:32)

“The mill breaks open the packaging that then goes into a sequence of screens. It’s very much like gold panning. Gold is heavy. It sinks to the bottom of a process, the lighter things go to the top. Here, the lighter things are plastic and paper. The heavier things are bread. So if you throw that in the air, the bread will fall down first, while the lighter things will fall down second. We use that simple principle to separate the two. The plastic and the paper get vacuumed off using a big vacuum cleaner, the bread goes into a further process. We do have one person on our machine who controls the starting and the stopping of the machine. That person is the “king” or the “queen” of the machine. They are also taking the strange things out like for example, fabric gloves, bits of machinery, bits of copper cable that came with it. There’s not a lot of that. For every day we’re processing hundreds of tonnes, we probably end up with 20 kilos but those 20 kilos are what forces the material to go to landfill unless we do what we do.” (12:48 – 14:02)

“At the end of the day, a clean product, in this case bread crumb, pours out. We then load that into large trucks and every day that goes out to large farms, to dairy farmers, to beef farmers and within a day it’s turned into milk. That milk comes back to you. So what we’re trying to do is close the loop on food production.” (14:03 – 14:25)

For example:
- ‘The Post Harvest Project looks at food waste before it hits the supermarket shelves by working across the public, private and non-profit sectors to improve harvest-to-plate food preservation in low and middle-income countries. The organization selects a commodity
or small group of commodities and begins a holistic assessment of food waste throughout the supply chain within a country or region. It then identifies problem areas where industry, technology and/or training could reduce waste and ensure partners meet the needs identified in the assessment.’ - www.postharvest.org/home0.aspx

• ‘California Safe Soil provides a full-cycle process that helps supermarkets recycle their organics, improve store hygiene and reduce costs, while also helping farmers save money, increase crop yield and reduce nitrate runoff. Harvest-to-Harvest, the company’s flagship fertilizer product, mechanically grinds and heats food collected from supermarkets, then processes it through enzymatic digestion to obtain a liquid that is pasteurized, screened, stabilized and homogenized to an average particle size of 26 microns. Farmers can use Harvest-to-Harvest to add organic matter to their soil and stimulate soil fertility through existing irrigation equipment. It is certified pathogen free and safe to use on all crops.’ - www.calsafesoil.com

RMIT University released a report in 2013, commissioned by CHEP Australia, titled The Role of Packaging in Minimising Food Waste in the Supply Chain of the Future, which examined where and why food waste occurs along the food supply chain. The report identified a number of opportunities to reduce food waste through packaging improvements. These include:

• Distribution packaging that provides better protection and shelf life for fresh produce as it moves from the farm to the processor, wholesaler or retailer
• Distribution packaging that supports recovery of surplus and unsaleable fresh produce from farms and redirects it to food rescue organisations
• Improved design of secondary packaging to ensure that it is fit for purpose, i.e. that it adequately protects food products as they move through the supply chain
• A continuing shift to pre-packed and processed foods to extend the shelf life of food products and reduce waste in distribution and at the point of consumption
• Adoption of new packaging materials and technologies to extend shelf life of foods (see table below)
• Education of manufacturers, retailers and consumers about the meaning of use-by and best before date marks on primary packaging to ensure that these are used appropriately
• Product and packaging developments to cater for changing consumption patterns and smaller households
• Collaboration between manufacturers and retailers to improve the industry’s understanding of food waste in the supply chain, with greater attention given to where and why this occurs
• More synchronised supply chains that use intelligent packaging and data sharing to reduce excess or out-of-date stock
• Increase use of retail ready packaging to reduce double handling and damage and improve stock turnover, while ensuring that it’s designed for effective product protection and recoverability at end of life.

ANALYSE the factors that influence design and professional designers and technologists.

For example:
• Time
• Access to skills
• Knowledge
• Expertise

EXPLAIN how the life cycle of a product can influence decision-making related to design and technologies, for example rethinking products to provide for re-use and selecting materials for a product that have lower carbon footprints.

Use the Paddock to Plate app to contact farmers around Australia to find out other design solutions being developed.

ACTDEK041
Environment | Sustainability | Technology | Design | Services |
Ethics | Social | Water security | Productivity | Employment |
Labour | Pest management | Skills shortage | Food security |
Drought | Prices | Global market | Seasonality | Competition |
Mental health | Careers

RESEARCH ASSIGNMENT
DRAW a timeline to DEMONSTRATE the evolvement of creativity, innovation and design in the agriculture industry in Australia.

Text reference:
• ‘In the past seven decades, Australian agriculture has made massive leaps in technological development and innovation:
  ➢ Mechatronic engineer Dr Cheryl McCarthy is researching the use of drones to automatically detect hot spots in crops, and
will soon be one of the few people in Australia licensed to operate unmanned aerial vehicles commercially.

- Agricultural engineer and biosecurity expert Paul Kamel traps moths in a device that allows him to photograph them under a microscope and upload the image, to help spot incursions early.
- Plant pathologist Dr Cassy Percy is investigating better ways of using phenotyping to learn more about resistance to crown rot disease.
- Food expert Lindsay Brown has been investigating the potential of recycling food waste. He has begun clinical trials to look at how the waste products of foods such as wine can be utilised, and made into functional foods which could improve health.
- Precision agriculture expert Troy Jensen has been developing technology which can measure and quantify the spatial capacity of farms in terms of things like fertiliser use.

A Dutch robotics expert is developing a robot that will assist egg producers around the world. The robot will collect eggs, boost productivity and monitor the welfare of chickens.' - *The future of farming: Innovation in Australian agriculture*, ABC Rural, 3 December 2015

**Teacher resource:**

EXPLORE the ways commercial enterprises respond to challenges and opportunities of technological change, for example carbon footprint.

EXPLAIN the consequences of social, ethical and sustainability decisions for products, services and environments, for example Marc wanting people to become more food self sufficient to reduce food miles and therefore reducing our impact on the environment.

“From an urban sky farm to a vertical food wall – who says you can’t grow your own food and manage your own food waste in even the most confined spaces. Meet Marc. Marc is the man behind this system, which is capable of producing over 130kg of vegetables per year in a tiny 4m2 space. According to the Australian Bureau of Statistics, this food wall could produce enough fresh vegetables to meet the average vegetable consumption of two Australians, 56kg per person, for an entire year.” (6:43 – 7:16)
“Fresh produce in a typical Australian food basket may travel a combined 21,000km – or more than half way around the earth - from its origins to our plate. We could save all that fuel by growing food locally and turning our cities into catchments and food bowls.” (7:16 – 7:33)

“The system behind the food wall is really easy. We collect water from a roof, into a tank, then we put that into the bottom of the garden bed and it waters from the bottom, up. Instead of a traditional garden which wastes a lot of water being fed from the top, down and evaporating. So we capture that water for the plant to use as is required in a wicking action. Wicking action is like a tree root. It sucks the water up out of the ground. We’re doing the same as nature does, only in a container so the water is available to the plant all the time and exactly how much it needs. (8:08 – 8:46)

“This café isn’t a typical café that sends its waste to landfill. It’s changed its attitude towards sustainability, by composting on site and taking its little tiny roof area and collecting that water to grow food. How good’s that?” (8:47 – 9:03)

PREDICT the impact of emerging technologies in the food and farming sector.

DESIGN ASSIGNMENT
RECOGNISE some of the main challenges that farmers face.

DESIGN a technology that you believe will assist growers to overcome one of these problems.

For example:
- Price takers and not price setters (price is dictated by supermarkets, not the grower)
- The weather is beyond a grower’s control; drought and floods can destroy a farmer’s income if they devastate vegetable crops; infrastructure/seed needs to be replaced if growers are to maintain livelihood and earn an income again
- Increasing input costs including labour, energy, fertiliser, seed, packaging etc.
- Mental health and wellbeing
- Access to land for expansion
- Availability of skilled labour and training programs
- Red tape of government regulations
- Lack of infrastructure to support scale production including cold storage/refrigeration and processing facilities
- Plenty of restaurant demand but there is no transportation to get the produce there to make it a viable business
- Regulations are too often "one size fits all"
- Consumer understanding of seasonality
- Managing pest and plant disease issues
- Consumers misinformed about pesticide residue
- Consumers believe organic is the only safe food option
- Must grow what people are buying: meeting growing/changing market demand
- Competing against cheaper imports of inferior quality

Summary of Opportunities and Challenges Facing Fruit and Vegetable Grower, Governor’s Council for Agricultural Development Interviews May-July 2012

Text references:
- ‘The current drought in Australia has been associated with across-the-board increases in food prices. In the two years from September 2005 to September 2007, food prices increased at twice the rate of the Consumer Price Index. Fresh fruit and vegetables have been worst hit, with increases of 43% and 33% respectively. The ANZ Bank (2007) identifies the drought as a primary contributor to these soaring food prices. However, Australia’s drought is occurring in a global context where numerous factors are combining to drive prices upwards. Regional projections suggest that south-eastern Australia will be adversely affected by changes in rainfall patterns, as well as by rising temperatures, which increase the severity of drought. By 2070, there may be 40% more months of drought in eastern Australia, and conditions will be worse in a high-emissions scenario. (CSIRO 2007) Fresh produce is generally hardest hit in times of drought. The markets for fresh fruit and vegetables are largely domestic, which limits the ability to compensate for reduced production in drought periods. In 2002-03, for instance, the real gross value of vegetable production in Australia declined by 9% and took several years to recover. (ABARE 2007). This led directly to consumer price increases, with the chief executive of AUSVEG ascribing a 13% increase in vegetable prices to drought conditions and water restrictions (Sydney Morning Herald 2004) – Drought, climate change and food prices in Australia, by John Quiggin, Australian Research Council Federation Fellow, School of Economics and School of Political Science and International Studies, University of Queensland
- ‘Between 2015 and 2050, the world’s population is expected by the United Nations to increase by 2.47 billion, with 735 million of those new mouths living in Asia. Feeding those additional people will be a challenge for the region — and an opportunity for Australia. But it is
also more complex than just feeding hundreds of millions of additional people; as these countries become more and more wealthy, and develop large middle classes, they will be demanding — and be able to afford — more protein-rich food. Every extra tonne of poultry grown for the market requires another two tonnes of grain to be grown and harvested and milled as feed. And as the population keeps climbing the global area of arable land keeps shrinking. ANZ Bank, in its report on the global soft commodity opportunity for Australia and New Zealand, said both countries could more than double the value (in real terms) of annual agricultural exports by 2050, meaning an additional $710 billion being added to Australia’s export bottom line over the next four decades. But, the bank’s analysts add, both countries need to rediscover their direction and momentum to drive a new era in agriculture. And the cost will be considerable: between now and 2050, Australia will need capital investment in food production of some $600bn, with a further $400bn to support farm turnover. So how well is Australia placed to play its part in feeding Asia? ANZ cites the rising demand for food, and for higher protein diets, and the spectre of increased biofuels production — and noting that at the same time that little or no new land and water is coming into production, and some land is being lost to farming. The bank sees the prospect of demand for agricultural products could double by 2050. The bank’s report says it would be a mistake to blame just droughts as the cause of Australia’s production variables. It says that many industries in both Australia and New Zealand, including red meat production, have not performed to their full potential. “Closer scrutiny reveals many issues have not received sufficient attention and have now put at risk the international competitive positions of agricultural industries in both countries,” the report adds. ANZ identifies seven problem areas.

- One, farmers face significant challenges in raising sufficient capital, and farm debt levels are already high. New business structures are needed, including equity partnerships, variants of share farming and the use of off-take agreements common in mining.
- Two, skilled labour shortages have intensified and the farmer population is ageing. The image of agriculture has to be boosted, to attract new workers and with better education platforms.
- Three, there are the land-use conflicts with Australia still lacking an efficient water market. Better use should be made of each litre of water.
- Four, more research and development is needed.
- Five, farms perform at substantially different levels, with many still delivering poor yields.
Six, supply chains need to be improved and costs lowered.

And, seven, marketing has to get better. The bank says further work is needed to understand consumer needs and wishes, and innovation is needed to break into new markets.

In a recent interview, National Farmers’ Federation president Brent Finlay saw the biggest issue facing the industry as finding a way to take full advantage of the free-trade agreements with South Korea, Japan and China (and now with the prospect of an FTA with Indonesia). After that, the challenges included improving the infrastructure to move farm products, and farmers needing better connectivity with improved telephone and internet services. Without those being addressed, one is left to conclude, we might miss the bus when it comes to Asia’s food opportunities.’ – In The Zone: Population explosion challenge for farmers by Robin Bromby, The Australian Business Review, 12 May 2016

Teacher resources:

- [www.acfonline.org.au/sites/default/files/resources/Climate_change_and_food_prices_in_Australia.pdf](http://www.acfonline.org.au/sites/default/files/resources/Climate_change_and_food_prices_in_Australia.pdf)

DID YOU KNOW?

- ‘By 2070, there may be 40% more months of drought in eastern Australia’ - CSIRO 2007

ACTDEK043

Energy | Mechanics | Engineering

EXAMINE and EXPLAIN the interaction between material properties and function of a common system, such as tractor brakes.

ANALYSE the relationship between materials of properties, forces and safety in engineered systems such as bridges.

EXPLAIN the way common machines combine properties of materials and force, motion and energy in, for example, cranes on building sites.

EXPERIMENT

ASK the students to form a hypothesis before this activity and then DISCUSS findings at the conclusion of the activity.
DESIGN and BUILD a crane and see how heavy a load it can lift.

BRAINSTORM the following ideas with the students:

- How will you keep the crane’s arm from breaking off the box as it lifts a load?
- How will you stop a heavy load from pulling the arm to the left or right?
- How will you wind and unwind the cable so the hook can go up and down?

**Materials needed per crane:**

- cardboard box (shoebox size or bigger)
- 3 strips of corrugated cardboard (5 x 28 cm)
- paper clip
- large paper cup
- 3 sharpened pencils
- scissors
- smooth string (e.g. fishing line or kite string)
- tape
- weights (e.g., batteries, pennies, marbles, or gravel)

1. **BUILD** the arm of the crane by holding the string up and away from the crane’s body. Use one, two, or all three cardboard strips to DESIGN your arm. Then attach it to the box.
2. Next, **MAKE** a take-up reel that allows you to shorten and lengthen the cable.
3. **ADD** the string, hook, and cup.
4. **RUN** the string through the arm. **ATTACH** it to the take-up reel and hook.
5. **POKE** holes in each side of the cup near the rim.
6. **MAKE** a handle for the cup and slip it onto the hook.

TEST, EVALUATE and REDESIGN.

What’s your crane’s breaking point when you add weight to the cup?

Engineers IMPROVE their designs by testing them. The steps they follow are called the design process. Try some ideas and build an improved version.

1. **REINFORCE** the arm of the crane if the load rips it off. Add cardboard supports or cut slits in the box to hold the arms. Also add tape to the top and underside of the box.
2. **RENEW** the cardboard of the arm if it crumples, using several pieces of cardboard.
3. USE extra cardboard or string to add support if the load pulls the arm to the side.
grain crop under normal Earth conditions.’ - NASA plans to grow potatoes in Mars-like conditions, ABC Online, 23 December 2015

- ‘Mark Watney may have grown potatoes on Mars, but Scott Kelly just grew the first flower aboard the International Space Station. Over the weekend, the astronaut tweeted a photo of a zinnia flower that bloomed while orbiting in space. Nasa today said the achievement paves the ways for ‘autonomous gardens’ that could provide astronauts with food on a trip to Mars. This achievement will help researchers get closer to growing food crops that can help astronauts survive long space missions. The resident gardener shared the flower’s debut with the rest of the world this past Saturday, something he has been working on the space lab since March 2015. ‘First ever flower grown in space makes its debut! #SpaceFlower #zinnia #YearInSpace,’ he wrote in his tweet, adding: ‘Yes, there are other life forms in space!’ - Nasa’s plan for ‘robogardens’: Space agency says first flowers ever grown in space pave the way for Mars missions by Stacy Liberatore, Daily Mail Australia, 19 January 2016

- ‘In a plot that could have been borrowed from the Matt Damon blockbuster The Martian, the US space agency and the International Potato Centre (CIP), a non-profit organisation, will attempt to exploit the expertise available in Peru, home of world’s favourite tuber, a nation of more than 4,000 varieties. Initially, the CIP will attempt to grow the potatoes in its laboratories in Lima, in conditions simulating those on Mars, including extreme ultraviolet radiation and drastic temperature variations. It will use soil from Pampas de la Joya, an area in the northern Atacama Desert, where growing conditions are close to those on Mars. The Atacama is the driest place on Earth with less than 1mm of average annual rainfall, while Pampas de le Joya’s unusual geology means that it lacks basic nutrients and is devoid of organic matter. If the lab tests are successful, researchers will then plant potatoes in the desert itself. The research could be applied both to an attempt to colonise Mars and, on Earth, to farming in tropical areas hit by rising temperatures and drought as a result of climate change.’ - Potatoes on Mars: Peruvian team tests if vegetable will grow on Red Planet by Simeon Tegel, Independent, 22 January 2016

- ‘NASA has already grown food in soil designed to mimic what we know so far about the pH and chemical makeup of real Martian dirt. Scientists have successfully grown over a dozen kinds of crops in the simulated grit. It’s worth noting that a typical diet on Earth is the product of around 1,000 crops, Bugbee said. While we can’t grow all those on Mars right away, it’s a good start. And crops on Mars would have other uses beyond food. Mars’ thin atmosphere has a lot of carbon dioxide, which plants use to store energy from the sun. Plants take in carbon dioxide and release oxygen, so crops could be critical if humans ever attempt to transform Mars into a more hospitable
planet — one with a breathable atmosphere.’ - *Could we really mix feces into Martian dirt and grow potatoes?* By Kelly Dickerson, Tech Insider, 29 September 2015

**Teacher resources:**
- [www.dailymail.co.uk/sciencetech/article-3405573/Mark-Watney-proud-flowers-bloom-space-one-day-food-Mars-explorers.html](http://www.dailymail.co.uk/sciencetech/article-3405573/Mark-Watney-proud-flowers-bloom-space-one-day-food-Mars-explorers.html)

THINK about how digital technologies could be used to enhance food production systems. As a class, BRAINSTORM your ideas and then select the top three concepts agreed on by everyone. Divide the class into three groups. Give one idea to each group to develop into a prototype.

**Examples:**
- Global positioning system (GPS) for managing animals and sewing food crops more efficiently and effectively.
- Automated animal feeding or milking
- Smart technologies for increasing the efficiency of energy, water and nutrients: conservation agriculture, site-specific nutrient management, low-cost drip irrigation and other water-saving irrigation technologies.
- Harvest and postharvest technologies that save labour, reduce grain losses and improve product quality: combine harvest, drying and storage.
- Take advantage of cheap information (mobile/smart phones, internet, social media, videos, remote sensing, soil and weather data, etc.) to provide digital agriculture solutions for farmers (access to information, knowledge, inputs and markets).
- New business models for smallholder farming: test, promote, and support new farming enterprises and integrated value chains that link farmers to the market.

FIND an example of an intensive production system and an extensive production system. COMPARE their environmental impacts and contribution to food and fibre production.

INVESTIGATE the interdependence of plants and animals in food and fibre production.

ANALYSE and DRAW the marketing chain of several Australian foods.
OUTLINE the effect of product processing and advertising on demand and price.

Text reference:
• ‘The farmer’s interest is focused on getting the best return from his produce, which usually equates to maximum price for unlimited quantities. Manufacturers want least cost, best quality produce from the farmer so that he can sell it at competitive, but profitable, prices. Traders and retailers want high quality and reliable supplies from the manufacturer or farmer, at the most competitive prices. Consumers are interested in obtaining high quality products at low prices. Clearly, there are conflicting interests here.’ – Food and Agriculture Organization of the United Nations (FAO)

ACTDEK045
Food safety | Food security | Nutrition | Health | Packaging | Processed foods

DEBATE differences in the heath and nutritional value of organic and non-organic foods.

DISCUSS the relevance of food’s nutritional content in relation to sustainably feeding the projected future population to achieve food security for Australia and the world.

Text reference:
• ‘Jodie Goldsworthy is the director of Beechworth Honey in NSW and says there are research papers which suggest pollination can increase crop yield by 25 per cent. That, if you think about it, is an astonishing figure.’ – BlueNotes, 11 December 2015

EXPLORE how the principles of food safety, preservation, preparation, presentation and sensory perceptions influence the creation of vegetable products for healthy eating.

EXPRESS how the principles of food safety, preservation, preparation, presentation and sensory perceptions influence the creation of vegetable products for healthy eating.

EXPERIMENT with food preservation methods such as pickling, canning, drying and freezing vegetables to determine changes to food structure and how these impact on designing healthy food solutions.
‘The natural course of things is decay. Our olfactory and visual senses will tell us when something is past its natural deadline. But rotting food is economically unviable in today’s commercially driven marketplace, and food scientists are always looking for more cost-effective ways of prolonging shelf life. In theory, it’s a win-win situation: the food industry maximises profits and we the consumers don’t have to constantly shop for fresh food. Of course, food preservation is not a new science. Before the days of refrigeration, meat and fish would either be slaughtered and cooked immediately, or preserved by salting. Preservation was essential to the peasant family when food was scarce over the winter months: meat and fish were salted and wild plants, peas and beans were dried. Rightly or wrongly, with the help of preservation techniques you can now buy seasonally produced food all year round. But don’t expect your food to taste the same, and preserved food is never as good as the fresh original. Whereas refrigeration slows the process of spoilage, deep freezing at –18ºC virtually halts all spoilage by rendering the water in food unavailable to micro-organisms to grow. They do, however, remain alive and resume activity once defrosted. Nutrient loss is generally small. The quality of frozen food depends largely on how soon it is frozen after harvesting. Frozen fruit and vegetables may actually contain more vitamins than their “fresh” counterparts which have been left to languish for days on end on shop shelves. Frozen vegetables such as peas are ideal stand-bys for when you have run out of fresh produce. However, some produce, such as strawberries, cannot retain their shape well when frozen, and frozen fruit and vegetables rarely taste as good as the fresh variety.’ - Frozen, tinned and dried food – even the most health-conscious of us keep a supply to fall back on, by Maria Davies, Institution for Optimum Nutrition, 2006

EXPLAIN how the food preparation techniques above affect the sensory properties (flavour, appearance, texture, aroma) of different foods.

CONDUCT sensory assessment testing of a range of foods to determine how characteristics might be used to enhance food solutions.

For example:

• Eating a spoonful of fresh peas and then a spoonful of frozen peas
• Taste testing a variety of milks
• Comparing freshly squeezed juice to commercial juices
• Eating nuts straight from the shell alongside nuts shelled prior to packaging
DETERMINE how the causes of food spoilage can be addressed when preparing, cooking, presenting and storing food items.

For example:

- Developing a comprehensive checklist of considerations for safe and hygienic food storage and preparation including danger zone temperatures for a food service
- Storing vegetables in the fridge rather than leaving out on the bench at room temperature to spoil

PROJECT

In groups, DESIGN, PRODUCE and CREATE a healthy snack for the canteen using a range of techniques to ensure optimum nutrient content, flavour, texture and visual appeal. Don’t be afraid to MODIFY your idea to generate the most optimum outcome.

DEVELOP criteria to assess the success of your recipe in terms of appearance, nutrition and flavour.

EXPLORE various marketing strategies to promote the item at your canteen as if it were in a healthy eating campaign. THINK about using food photography and digital technologies to assist your promotional strategy.

SURVEY the students at the school to determine the popularity of your healthy snack through your marketing campaign.

DETERMINE and APPLY criteria for evaluating the credibility of the websites where information is sourced.

Use the Paddock to Plate app to locate farmers to source produce for this unit of work. Also use the app and From Paddock to Plate book to see how farmers express their viewpoints on the nutritional content of the food that they grow.

ACTDEK046 • ACTDEP050

Design | Technology | Environment | Transport | Economics |
Sustainability | Innovation | Recycling | Waste management |
Packaging | Food safety | Bacteria

CRITIQUE the design of food packaging that you see in the supermarket to identify environmental consequences of material selection and how well the design responds to sustainability issues.
DESIGN your own packaging for different foods to maximise sustainability and reduce risks in production.

JUSTIFY decisions when selecting from a broad range of technologies – materials, systems, components, tools and equipment.

For example:
- Selecting locally sourced and sustainable materials
- Look at emerging materials
- Choosing packaging produced with low-emissions
- Less weight to reduce transport costs in rural Australia

SKETCH your design and then DELIVER a pitch to the class as if you selling this packaging to a food company. ENHANCE your argument by emphasising long-term application, functionality and impact.

SHORT DOCUMENTARY
WATCH this short documentary called ‘Waste Deep’ filmed by the team at Sustainable Table. It ‘shows how food and plastic waste can be avoided, drawing attention to much of the unnecessary packaging that is choking our lives, oceans and animals. It also gives an insight into the environmental and social impacts of our wasteful ways.’ – Sustainable Table, www.sustainabletable.org.au/Hungryforinfo/WasteDeep/tabid/144/Default.aspx

“As being part of a five-star sustainable school we ask that our students bring in rubbish-free lunches. So they bring little containers in their lunchboxes, which is reducing our waste. The other thing that we ask them to do if they do bring in wrappers is to take that home and that has reduced our waste between 85 to 95 per cent.” (2:22 – 2:40)

“Since reducing our food packaging we have saved money to spend on school resources and we feel we are making a difference to the environment and that the students’ lunches are so much more healthier.” (2:43 – 2:53)

Text references:
- ‘An airtight plastic bag is the worst choice for storing vegetables, according to Barry Swanson, professor emeritus of food science at Washington State University. And don’t pack veggies tightly together, either; they need space for air circulation or they’ll spoil faster.’ – Ten fruits and vegetables you’re storing wrong by Candy Sagon, The Washington Post, 21 October 2014
• ‘It’s the supermarket gripe driving us crazy. Where we once were happy to pick up an individual sweet potato or choose a nice looking pair of tomatoes, we are now faced with shrink-wrapped cucumbers, individually packaged heads of lettuce and handfuls of basil leaves encased in their own container with lid. Customers are up in arms about excessive packaging for their fresh produce in our supermarkets and grocers. And a West Australian shopper has decided to do something about it, launching a change.org petition to stop Woolworths and Coles from wrapping small portions of herbs, vegetables and fruits in plastic and Styrofoam. “The world is overloaded with plastic. Consumption of disposable plastic is a major contributor to plastic pollution,” Pat Lowe, of Broome, says in her online petition. “These items may be used for a day, or just a minute, but remain in the world forever. Plastic does not disintegrate. Wrapping fresh food in plastic is an unnecessary use of non-biodegradable materials, which is leading to the proliferation of harmful waste, much of which is ending up in our oceans.” – Customers up in arms about excessive packaging by James Law, News Limited, 14 March 2015

• ‘We are mindful of the need to minimise our waste and over the past five years we’ve been making good progress to improve our recycling rate which has increased to 70% this year. We expect this trend to continue as we continue to work with the waste industry on new technology that can recycle more of our waste as well as consumer waste. We are also helping our customers with their waste by providing recycling solutions. Hopefully, you’ve heard about our soft plastics recycling program with RED Group that’s now available in 480 Coles stores across Australia where customers can bring back their soft plastics – including bread bags, biscuit packs, plastic bags and polypropylene shopping bags - to be recycled and turned into useful things like outdoor furniture for schools and, most recently, trolley bays at one of our new stores. Approximately 280 tonnes of plastic was returned to our supermarkets by customers for recycling via this program in the past year. We understand some consumers would prefer not to have organic produce packaged in plastic. It’s something we’ll continue to review but we don’t have an easy solution for this right now.’ – Coles’ response to Pat Lowe’s petition to reduce food packaging

Teacher resources:
  o www.washingtonpost.com/lifestyle/food/ten-fruits-and-vegetables-youre-storing-wrong/2014/10/21/a7d8adb6-4b44-11e4-891d-713f052086a0_story.html
RESEARCH the Australian Packaging Covenant (APC). What is this initiative and is it relevant to the agriculture industry?

EXPLAIN what the REDcycle Program is. How does this Program assist schools in Australia?

Teacher resources:
- [www.packagingcovenant.org.au](http://www.packagingcovenant.org.au)

**FOOD FOR THOUGHT**

*There’s nothing wrong with a bit of mould, right?*

- ‘It’s a wonder the human race managed to survive before the advent of a date sticker telling us when we should be eating certain foods by, but survive we did. Mostly we sniffed our food and decided whether to eat it or not. These days, around half of us go by the date label printed on the packaging, and will often throw away food that is safe to eat. According to the Waste Resources Action Programme (Wrap), an organisation that promotes sustainability, we throw away 4.2m tonnes of food every year in the UK, which, aside from the financial costs, has a huge impact on the environment. We buy too much, or we cook too much, or we forget to store leftovers properly. But the biggest reason for throwing food away is because we don’t use it in time, and, in many cases, we simply look at the date on the packet rather than the contents – and that date might be OK to ignore. In February, a supermarket opened in Denmark that only sells food past its sell-by date. In the UK, online retailer Approved Food sells “short-dated” goods – defined as approaching or past their best-before date.’ - *There’s nothing wrong with a bit of mould: chefs on food waste and using leftovers* by Emine Saner, Angela Hartnett, Tamal Ray, Ruby Tandoh & Thomasina Miers, The Guardian, 21 March 2016

Here’s what those in the “foodie world” think…

- **Angela Hartnett, Chef and restaurateur**
  “At work, people are paying money so you’re going to use the best and if something is substandard, you’re not going to serve it. But at home I’m not going to throw odd bits of lettuce in the bin. I had a bit of pancetta at home, and it had a bit of mould on it. There’s nothing wrong with that because it’s a smoked, cured meat. If I think something is off, I throw it away, but if I think it’s fine, I eat it. I wouldn’t throw something out just because of the sell-by date. If
there is veg that feels a bit wilted, I would cook it, not throw it away. I admit there is some confusion. I’m never sure about eggs – whether to keep them in the fridge or at room temperature – but eggs never really stay around for long enough in my house for me to worry about whether they’re fresh or not.”

**Ruby Tandoh, Food writer and cook**

“A strong survival instinct runs in my family. We don’t take unnecessary risks. My dad has waged a lifelong campaign against licking batter from the mixing bowl: he sees sorrow, salmonella and certain death in every drop of uncooked egg. My sister gave us her Christmas chocolates because their best-before date was in a month’s time and one of the Maltesers was shaped like a peanut. I’ve inherited this sell-by date cautiousness, which is a really uncool thing to say in the food world. If you’re into food, you’re meant to be into all of the food, including the soggy, smelly and seemingly unsavoury bits. When eggs are even a day past their best-before date, I agonise: I hold them to my ear and whisper to them and float or sink them in water. If all looks OK, I will then, just to be careful, cook them until they’re rubber-hard. I want to be better at eating resourcefully and sustainably, though. I want to learn just to scrape off the mouldy bits, go dumpster diving and eat nose-to-tail.”

**Tamal Ray, Baker, G2 columnist and junior doctor**

“I’ve got a pretty liberal attitude to best-before dates but even I have my limits. Once, I was on a placement at uni with a girl who made a giant pot of beef bolognese. She forgot to put it in the fridge. It lay in the corner of our sweltering kitchen for three days, incubating by the window until it had grown a thick layer of mould. She came in while I was making a cup of tea and realised she’d left it out. Right in front of me, she skimmed off the mould and tucked in. Misreading my look of horror, she offered the pan to me. “Fancy a bit?” “Uh no, I’m good thanks,” I replied, scuttling off to retch. The only time I ever really pay attention to best-before dates now is when I’m buying food. Once it’s home, I just rely on my senses. If it looks, smells and feels all right, then it’ll be fine to eat.”

**Thomasina Miers, Chef and Guardian columnist**

“I smell it and look at it, and if something smells or looks off then it’s off. I find yoghurt normally lasts at least a week past its date. I don’t leave raw meat lying around for long but I will happily leave leftover spag bol in the fridge for four or five days. I’ve had onions that have lasted for weeks in the fridge. In my parents’ house, we’ve found a ketchup bottle that was 10 years old that was fine to use. I’m very careful with some things. The easiest thing with which to give yourself food poisoning is raw chicken. Cooked rice is never in our fridge for longer than a day or so, because it can harbour bacteria – but, equally, stir-fried rice is one of the staple leftovers meal we have.”
THINK and WRITE a list of all the innovations and inventions in the kitchen designed to increase the shelf life of foods, reduce food waste and enhance food safety.

ACTDEK047
Design | Environment | Sustainability | Transport | Technology | Waste management | Productivity | Profitability

DISCUSS environmental sustainability with students and what it means to them. BRAINSTORM ideas.

Text reference:
- ‘Environmental sustainability is about making responsible decisions that will reduce your business’ negative impact on the environment. It is not simply about reducing the amount of waste you produce or using less energy, but is concerned with developing processes that will lead to businesses becoming completely sustainable in the future.’ - Small Biz Connect (funded by the NSW Government)

EXAMINE the environmental factors that farmers need to be aware of when growing produce.

For example:
- ‘…pollution and contamination of soil, water, air and food resulting from the use of farm chemicals…’
- ‘…degradation of natural resources, especially the deterioration in the available quantity and quality of soil and water…’
- ‘…disturbance and reduction of biotopes and wildlife habitats (eg. on the Great Barrier Reef) and with reduction in wildlife species and loss of biological and genetic diversity of plants and animals…’

Teacher resource:
CASE STUDY
EVALUATE and JUSTIFY the use and best combination of traditional, contemporary and emerging technologies for food production in India.

DETERMINE how technology could be used in India to improve the productivity of the country’s vegetable industry.

Text references:
• ‘Apart from the yield, the farmer has been able to successfully market his produce in New Delhi, Ahmadabad, Mumbai, Indore markets and has been able to earn Rs.10-15 lakh a year. This is something big in vegetable cultivation. Because, being a short term crop (3-4 months), and having a lower shelf life, fast disposal is important for both growers and buyers. In fact, with the money he earned from his crops, Mr. Patidar has bought additional lands (from an acre he has increased the land holding to about 4.5 acres) to try his success formula in an expanded area. “I use all the scientific technologies such as seed treatment, integrated pest management, nutrient management and water conservation methods in my field. I have set up drip irrigation for all the crops and presently grow capsicum and papaya in addition to tomatoes and chillies,” says the farmer. Mr. Patidar is also credited with designing a tractor operated bund maker and fertilizer drill for making ridges in fields in which papaya, tomato, and chilli are cultivated. The device consists of two (six feet long and 1.4 feet width) iron plates. One end of the plates are joined together in a “V” shape and fitted with a frame. A fertilizer drum with a pulley system is attached to this. Adjustments are provided to suit the size and fertilizer application amount for farmers. The machine is priced at Rs. 8,000 and is quite popular among farmers who are used to growing papaya, tomatoes and chilli crops traditionally and this requires more labour and takes time.’ - Innovative methods in vegetable growing bring good yields by M.J. Prabu, The Hindu, 4 August 2015
• ‘Vertical farming, drip irrigation, soil solarisation and the like were terms that mystified Deepak Khatker, a 40-year-old farmer, when he first visited the Indo-Israel Centre of Excellence for Vegetables here a couple of years ago. Intrigued, he adopted the Israeli farming skills and, within months, saw production increase a staggering five-fold. “We have traditionally grown wheat and barley in our fields but the techniques taught at the centre forced me to give vegetables a try,”
Khatker, a resident of Sheikhpura Khalsa village in Karnal district, about 100 km from the national capital, told IANS. Of the over seven hectares of land that Khatker owns, around three hectares are currently being used to cultivate vegetables using Israeli know-how. "I am growing cherry tomatoes, seedless cucumbers, brinjals and coloured capsicums. The production on my land is four to five times when compared with other farmers not using these technologies," he added. Situated 145 km from Haryana capital Chandigarh, the centre opened in January 2011 and is spread across six hectares. Built for Rs.6 crore (Rs 60 million) by the Indian government, it was set up following the signing of the Agriculture Cooperation Agreement between India and Israel in 2008. Experts from Israel regularly visit the centre and organize free training sessions for farmers, teaching them "protective agriculture" to increase their crop yields while using fertiliser and water optimally. The experts also visit the farms if needed. In addition, corporates and professionals are also taught ways to produce quality vegetable seedlings at a nominal fee. "The idea is to transfer applied research and technologies to the farmers in various states across India. While Israel has already entered into agreement with seven state governments to set up these centres, the most successful model has been Haryana," Israeli Embassy spokesman Ohad Horsandi told IANS.

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-- Revolutionising Indian farming with Israeli technology by Gharaunda (Haryana), Business Standard, 2 March 2014

• ‘Eventually, farmers came up with a multilayer seed sowing technique in which seeds/seed-tubers of three different vegetable crops i.e. colocasia, potato and green leafy vegetables are now being sown in the deep, middle and top soil layers, respectively and simultaneously in a single crop field. By using this new technique, popularly called as multilayer cultivation, farmers tried to maximize production from a unit area.’ - Multilayer vegetable farming: Small holder community innovates for improved production by Prakash Singh, Girish C.S. Negi, LEISA India | Volume 15 no. 4 | December 2013
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CONSIDER the environment, current farming systems in place and socioeconomic status of communities, including the benefits and constraints on design ideas in terms of functionality, structural significance and aesthetic form.

CREATE production flow charts using digital technologies to ensure efficient, safe and sustainable sequences.

Teacher resources:
USE the Paddock to Plate app to FIND and VISIT a local farmer’s property to INVESTIGATE technologies being used on this farm to assist productivity and environmental sustainability.

**Use the Paddock to Plate app and From Paddock to Plate book to locate farmers who will be able to provide excursion recommendations.**

**If this is not possible, make observations from the From Paddock to Plate virtual excursions.**

**DID YOU KNOW?**

‘By buying locally grown food you’ll be strengthening your community by investing your food dollar close to home. Only 18 cents of every dollar, when buying at a large supermarket, go to the grower. 82 cents go to various unnecessary middlemen. Cut them out of the picture and buy your food directly from your local farmer.’ – Local Harvest, www.localharvest.org.au/why-is-local-important/

**Local community | Media**

PRESENT an argument about how farming and agriculture is represented and portrayed in society through the media, by your friends, your parents and other role models. You must PRESENT a point of view and justify your position in order to persuade other about this issue. Include texts that integrate visual, print and audio features. CONSIDER all attitudes, opinions, values and beliefs.

SUMMARISE data, from students’ own findings from investigations and secondary sources and use scientific understanding to identify relationships and draw conclusions and evaluate claims based on evidence.

What conclusion can you draw?
Reflect

What have the students learnt from this unit?

- What is something new that you have learnt about reducing food waste in Australia?
- Describe what you know about sustainable farming practices.
- How might you help others know more about how Australian farmers grow food?
- What have you learnt about food security and food packaging?
- What questions do you have about growing food, utilising food waste and reducing rubbish at your school?
- What piece of work are you most satisfied with?

Websites (viewed January 2017) - As content of the websites suggested for research purposes in this unit is updated or moved, hyperlinks may not always function.