From PADDOCK to PLATE

Food Studies

Year 9 | Stage 5

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Curriculum focus

The resources in the Food Studies Teacher Manual help teachers and students understand the importance of a variety of foods, sound nutrition principles and food preparation skills when making food decisions to help better prepare them for their future lives. Students engage in the Virtual Video Excursion/s for one or more industries and use this information to explore the nature of food and food safety, and how to make informed and appropriate food preparation choices when experimenting with and preparing food in a sustainable manner.

How to use this Teacher Manual

The Food Studies Teacher Manual consists of lesson plans and supplementary activities about several agricultural industries in Australia. There are facts about Australian agriculture for your use on page 4, 6, 24, 49 and 60.

First, start with the Springboard Virtual Video Excursions on page 5.

Then, move on to the products or industries within this manual that match your learning aims or interests.

Themes and topics:

- Animal welfare
- Biodiversity
- Communications
- Community
- Drought & natural disasters
- Economics
- Employment
- Environment
- Ethics
- Food miles
- Food security
- Food waste & recycling
- Innovation
- Marketing
- Nutrition
- Pests & diseases
- Profitability
- Seasonality
- Soil & pasture management
- Sustainability
- Technology
- Traceability
- Waste management
- Water security

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Australian Curriculum Links

All Industries | Year 9 | Stage 5

Cross-curriculum priorities

Aboriginal and Torres Strait Islander histories and cultures

Asia and Australia's Engagement with Asia

Sustainability

Lesson 1 **Almond Growing, Past and Present**	· Food history · Food production	Students research the origins of the almond industry in Australia, focusing on considerations of climate in the development of the industry. They look at the state of the almond industry at present.
Lesson 2 **Almond Ag-Tech**	· Food history · Food production · Food issues	Students undertake a research project into specific production methods and technologies used in almond production, past and present. They consider the impact of new innovations on the almond production industry.
Lesson 3 **Electric Nuts**	· Food futures · Food production · Food issues	Students engage with a case study about a large macadamia nut producer in Queensland who uses waste nut product to generate energy. They continue to discuss the ethical and sustainability considerations introduced in Lesson 2.
Lesson 4 **Almond Snack Project**	· Food development · Food handling	Students explore the potential to make their own almond snack project for the canteen and assess its success.
Lesson 5 **Ethics, Efficiency, Energy and Price**	· Food production · Food issues · Food futures	Students engage with one of three case studies about the decisions cherry growers make to reduce energy use, time/labour, and cost.
Lesson 6 **Cherries for Export**	· Food production · Global food	Students look at the opportunities and risks inherent in producing cherries for the export market and the kinds of decisions growers need to make.
Lesson 7 **Decisions and Technologies**	· Food production · Global food	How does technology play into growers' decision-making? Students look at how technology can help with common problems, and explore questions about cost, scale and sustainability.
Lesson 8 **Packaging Problems**	· Food production · Food issues	This lesson prompts students to explore packaging using sustainable materials as they explore what packaging does and propose their own design for a cherry product package.
Lesson 9 **Cooking with Cherries**	· Product development · Food handling	Students explore preservation and decay by looking at how different food preservation techniques alter the taste, texture, aroma and appearance of cherries.
Lesson 10 **Exploring Eggs**	· Food production · Nutrition	Students learn what is in an egg, and research the nutrition of eggs in a human diet.
Lesson 11 **Eggs and Nutrition**	· Food safety · Nutrition · Health	Students explore freshness, safe storing, preparation and handling methods for fresh eggs to reduce the risk of incidence of the bacteria Salmonella.

Australian Curriculum Links

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Lesson 12 **Cooking with Eggs**	· Product development · Food handling	Students cook with eggs and explore the use of eggs in their own food products.
Lesson 13 **Fishy Business**	· Food production · Nutrition	Students explore fish species and tonnage in Australia and report on an additional topic of interest, such as sustainability, nutrition, production and transport.
Lesson 14 **Fish and Flavour**	· Product development · Food handling	Hands-on taste experiments show students the differences between preserved fish and cooked fish (e.g. dried vs baked).
Lesson 15 **Seafood Snack**	· Product development · Food handling	Students develop and assess the success of a marketable seafood product for the school canteen.

Supplementary activity cards relate to these learning outcomes:

Salmonella Disaster – Food safety, Health (Eggs)

Facts about the Australian agricultural industry

- The gross value of Australian agriculture increased by $3.7 billion from 2014–15, to $58.1 billion in 2015–16.
  SOURCE: ABARES, Agricultural Commodities – June Quarter 2017.
- TIn Australia, individuals spent on average $4739 for food in 2015–16. This includes eating out and non-alcoholic beverages. This amount has risen by 16% during the past six years.
  SOURCE: ABS, Household Expenditure Survey, Australia: Summary of Results, 2015–16, Catalogue No.6530.0.
- Food imports, particularly for processed food, accounted for only 15 per cent of household food consumption in Australia in 2015–16.
  SOURCE: Hogan, Linsday. (2017) *Food demand in Australia: Trends and food security issues*. ABARES research report 17.7, Canberra.
- Out of the $58.1 billion worth of food and fibre Australian farmers produced in 2015–16, 77 per cent ($44.8 billion) was exported.
  SOURCE: ABARES, Agricultural Commodities – June Quarter 2017
- More than 99% of Australia's agricultural businesses are wholly Australian owned, owning 88% (or 343.3 million hectares) of Australia's agricultural land. Wholly Australian owned businesses also control 87% of Australia's agricultural water entitlements (or 13.3 million megalitres).
  SOURCE: ABS, Agricultural Land and Water Ownership, 2015–16, Catalogue No. 7127.0. 2017
- As of May 2017, 304,200 people were employed in the Australian farm sector — accounting for about 3% of the national workforce.
  SOURCE: Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, May 2017 Catalogue No. 6291.0.55.003.*
- Across the supply chain agriculture powers 1.6 million jobs.
  SOURCE: Australia's Farm Dependent Economy: *Analysis of the role of Agriculture in the Australian Economy.*
- 216,100 males and 88,100 females are employed in the Australian farm sector
  SOURCE: Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, May 2017 Catalogue No. 6291.0.55.003.*
- Agricultural businesses occupy and manage 48% of Australia's landmass, as such, they are at the frontline in delivering environmental outcomes on behalf of the broader community.
  SOURCE: Australian Bureau of Statistics, *Land Management and Farming in Australia, 2015–2016, Catalogue No. 4627.0.*
- At 30 June 2016 there were 371 million hectares of agricultural land in Australia, a 1.4% increase on the previous year.
  SOURCE: Australian Bureau of Statistics, *Land Management and Farming in Australia, 2015–2016, Catalogue No. 4627.0.*
- Australian primary industries have led the nation in reducing greenhouse gas emissions intensity — a massive 63% reduction between 1996–2016.
  SOURCE: Australian Bureau of Statistics, *Australian Environmental-Economic Accounts, 2017, Catalogue No. 4655*
- Australian water consumption decreased in 2014–15 by 7% from 2013–14. The largest decrease in water consumption was in the agriculture industry.
  SOURCE: Australian Bureau of Statistics, *Water Accounts, 2014, Catalogue No. 4655.*
- Agricultural businesses spend a significant amount on managing pest animals and weeds. An average of $19,620 was spent per agricultural business on undertaking pest animal and weed management activities.
  SOURCE: Stenekes, N, Kancans, R and Binks, B, 2017, Pest animal and Weed Management Survey: National landholder survey results, ABARES research report 17.5, May. CC BY 4.0.
- Australian farmers are among the most self-sufficient in the world, with government support for Australian farms representing just 1% of farming income. By comparison, in Norway it is 62%, Korea 49%, China 21%, European Union 19% and United States 9%.
  SOURCE: OECD (2017), Agricultural Policy Monitoring and Evaluation 2017, OECD Publishing, Paris.

Virtual video excursions

Let's get started

All Industries | Year 9 | Stage 5

If this is your first time teaching with the From Paddock to Plate Schools Program, welcome! When planning your lessons, you may first like to read the Welcome Guide on our website.

www.frompaddocktoplate.com.au/school-programs/

Assessing prior knowledge

Kick off by understanding the level of knowledge your students have of farming in Australia. This will determine your structure of delivery.

- ASK the students to describe and list what they know about farming in Australia.
- EXPLORE the facts about Australian agriculture (page 3).
- BRAINSTORM and gather ideas, questions and information from the class and use this as a platform to begin this unit. What information do students want to confirm, check, debate or explore?
- DISCUSS any questions that arise.

Now is the time to choose and watch a selection of the **From Paddock to Plate Virtual Excursions.**

You can find them all on the From Paddock to Plate website. Log in and choose your year level, subject or industry of interest:

www.frompaddocktoplate.com.au

Ask students to reflect on what they already know about this industry and what the video showed them that was new, or that changed their thinking.

ALMONDS

Almonds | Year 9 | Stage 5

Ask students first to reflect on the *From Paddock to Plate* **Almonds Virtual Video Excursion**:

- How do almonds grow?
- What does an orchard look like?
- What can they say about the paddock to plate journey of almonds and almond products?
- What did they learn that they hadn't considered before?
- What would they like to know more about the almonds industry in Australia?

Facts and Vocabulary - Almonds

Facts about the Australian almond industry

- Australian growers produce approximately 10% of the total volume of almonds grown in the world.
- Orchard area planted to almonds increased by 15.8% or 4,904 hectares in 2016 to now total 35,886 hectares
- The number of almond trees now planted in orchards totals more than 10 million.
- Two million virus tested buds were delivered by the ABA to nurseries for grafting to produce healthy trees
- 2016 production of 82,333 tonnes was slightly less than the 2015 harvested crop
- Australia produced 7.7% of the global crop to remain the world's second largest producer behind the USA that grew 80% of world production
- Almonds were 62% of Australia's total tree nut crop that includes macadamias, walnuts, pistachios, hazelnuts and chestnuts (measured as inshell tonnage)
- 97% of almond orchards are efficiently irrigated using drip systems managed by soil moisture monitoring technology
- Annual per capita consumption of almonds in Australia is increasing strongly and exceeded one kilogram for the first time in 2016/17
- Australia ranks 6th in per capita consumption globally
- Domestic sales tonnage increased by 9.9%
- 46.7% of Australian households purchased almonds in the year ending February 2017
- Almond demand by manufacturers was boosted with 274 new products reaching supermarket shelves in 2016
- Australian almonds were exported to 46 countries
- Almond exports earned the nation $464 million
- For every one tonne of almonds sold in Australia, 2.7 tonnes were sold overseas
- India was the single largest destination for exports
- Europe as a region consumed 43.2% of Australia's almond exports with sales of $200.3 million
- East Asia is an emerging market for Australian almonds taking 13.8% of total exports

SOURCE: ABS, Household Expenditure Survey, Australia: Summary of Results, 2015–16, Catalogue No.6530.0.

Useful words and phrases

- Activated almonds
- Almond meal
- Almond milk
- Australian Stock Exchange
- Bacteria
- Belly dumper
- Biomass
- Blanch
- Conveyor belt
- Deciduous
- Drupe
- Export
- Fertigation
- Foliage
- Geographic diversity
- Hi vis clothing
- Hulling process
- Husk
- Irrigation
- Kernel
- Laser sorter
- Microorganisms
- Non-pollinator
- Pasteurisation
- Pollination
- Prune
- Quality assurance
- Renewable energy
- Salmonella
- Self-pollinator
- Shelling
- Stock feed
- Stock pad
- Stockpile
- Weighbridge

Lesson 1

Almond Growing, Past and Present

Themes

Food history | Food makers | Food in Australia | Climate |

Almonds and history

Students research the history of the almond industry in Australia from 1836, when the first almond orchards were planted on Kangaroo Island (before South Australia had been formed). By the late 1800s almond orchards were established across South Australia where the hot, dry summers and cool, wet winters (a Mediterranean climate) suit the trees perfectly as long as wet winter soils do not lead to rot.

Students may begin with the recommended source material below, and there are additional resources listed under Teacher resources at the end of the lesson.

Students RESEARCH and DISCUSS answers to key questions including:

- Where were the first almond orchards established in Australia?
- Are there any documented sources that tell or reveal the cultural identity of the first expert almond growers in Australia? If not, why might this be?
- What are the characteristics of soil and climate that favour almond growing?
- Where are the main regions of almond production today?
- What are the prospects for almond growing in Australia in the near future?
- What are some of the factors contributing to this situation?

As a part of their research project, students begin to DRAW a timeline to DEMONSTRATE the introduction of key techniques and technologies in the almond industry in Australia, such as the conveyor belt machinery (so innovative and astounding in 1945 in the source below), and the use of bees to aid pollination (probably a very old practice).

They will add to this timeline in future lessons.

Lesson 1: Almond Growing, Past and Present (continued)

Recommended source material:

'Almonds were first planted in Australia on Kangaroo Island in 1836 and soon spread to private gardens throughout Adelaide and other South Australian towns due to the state's suitable Mediterranean climate. The modern industry's major variety Nonpareil was imported from California in 1882 and by the end of the 1800s, small commercial almond orchards of an acre or two were established near Adelaide. The scale of orchard plantings has changed dramatically since then with almonds being well suited to highly mechanised production. Large scale orchards are now located in the Riverland, Sunraysia and Riverina regions of Australia. The availability of suitable deep loam soils close to the Murray River facilitated the rapid growth of almond plantings during the early and mid 2000s.'

– Australian Almonds, Almond Board of Australia: http://australianalmonds.com.au/documents/Industry/Stats%20Reports/Almond%20Insights%202014-15%20LR.pdf

'Early in the settlement of South Australia, the climate was recognised as being suitable for almond production. Introduction of almonds to South Australia occurred on Kangaroo Island before formal proclamation of the state. By the early 1900's, commercial almond production was spread across the Adelaide Plains around the city of Adelaide. As Adelaide's urban areas expanded in the 1920's and 1930's, the almond industry became concentrated in the western suburbs (especially around the Marion, Edwardstown, Brighton areas), and developed in the Willunga and Southern Vales districts. Plantings subsequently expanded on the Northern Adelaide Plains (Virginia, Two Wells, Angle Vale) in the 1960's and 1970's, and then into the Riverland and Murray Valley areas.'

– Government of South Australia – History of Agriculture – Almonds in SA: https://pir.sa.gov.au/aghistory/industries/horticulture/almonds

'A Progressive Orchardist. (1945)

An almond orchard with 2500 trees in full bloom. That is what we saw a few days ago when privileged to visit the attractive home of Mr W. Smith of Bamawm, at which we were entertained by the owner and his charming sister. We had never seen a more arresting sight, and snowflakes could not have produced a picture so deep and extensive to hold the eye to such a memorable extent. Nor was the attractiveness of this beautiful and prosperous-looking scene confined to the almond blossoms. The home itself and its surroundings are in keeping. Solid concrete structures—storerooms, "garage, sheds, operating room (in which is installed ingenious machinery for shelling the nuts), all having that substantial, solid appearance that time and weather could not deteriorate. In addition to the almond orchard, citrus fruit, apples, pear, peach, and a wide variety of other fruit trees, together with shrubs, flowers, cacti, and ornamental trees of all sorts met the eye when approaching the homestead...'

Lesson 1: Almond Growing, Past and Present (continued)

Recommended source material (continued):

'...Our attention was held very closely when Mr Smith showed us the plant for shelling almonds, the ingeniousness of which is all the more remarkable because it was home made, except for the engine power used for driving it. Scraps of machinery picked up at sales formed the greater part of its manufacture, and the whole thing is worked out with different sized pulleys to meet the speed necessary to carry the nuts through to remove the shells. The nuts travel over at least half a dozen moving cleat-lined belts, for nature has not fashioned the pesky little nut' with a uniformity that all will yield their coat in just the same way. The only drawback is that at present the production has outgrown the capacity of the machinery to do the work, and Mr Smith is casting about for something that will handle it in a speedier way. Manpower shortage on the farm has held the work up, and bags and heaps of untreated nuts—to us it looked like tons —emphasise the need for something capable of keeping pace with the production. Nothing has been left to chance in the efforts to preserve this orchard from the ravages of seepage, for there are some miles of underground drainage, with 3in. to 4in. pipes laid some 6ft. 6in. below the surface, with lined examination vents here and there to make sure that the system is working properly. And on the farm numerous beehives are kept for pollination purposes, and among the blossoms the hum of these indispensable little workers can be heard.'

– AN ALMOND ORCHARD. (1945, September 8). The Riverine Herald (Echuca, Vic. : Moama, NSW : 1869 - 1954; 1998 - 2000), p. 8. Retrieved August 16, 2019, from http://nla.gov.au/nla.news-article116616815

'Almonds are grown along the Murray Valley in South Australia, Victoria and New South Wales, with plantings also located in Western Australia. There are five major growing regions in Australia encompassing:

- Adelaide and the Riverland (South Australia)
- Sunraysia (Victoria)
- Riverina (New South Wales)
- Swan Valley (Western Australia)'

– Australian Nut Industry Council – About Almonds: https://nutindustry.org.au/about-almonds/

Lesson 1: Almond Growing, Past and Present (continued)

"The almond industry is really interesting in the world at the moment. It's dominated, predominantly, by California in the US, but Australia is actually the second largest grower of almonds in the world, which is really interesting, with about 10 per cent of total volume."

(1:14 – 1:27)

"In terms of these trees, these trees are approximately 12 years old. The trees themselves, will start producing nuts after about two years, but really become productive at about seven years of age and stay productive for about another 10 years. Once they start getting too old, they start producing less nuts and so at certain points in time, like after about 20 years, we'll actually pull the trees out and put young ones back in."

(3:03 – 3:26)

Teacher resources:

- National Library of Australia – Trove – Search for 'almond & orchard' limited to Australian results: https://trove.nla.gov.au/result?q=almond+orchard
- Case Study: Pollination Aware – Almonds (PDF): https://www.agrifutures.com.au/wp-content/uploads/publications/10-108.pdf
- Agriculture Victoria – Almonds: http://agriculture.vic.gov.au/agriculture/horticulture/fruit-and-nuts/nuts/almonds
- Museums Victoria – Horse-drawn sledge in an almond orchard at Burnley Agricultural College, 1946 (photo): https://collections.museumvictoria.com.au/items/783546

Lesson 2

Almond Ag-Tech

Themes

Food history	Food makers	Food in Australia	Food futures	Innovation
Technology	Ethics			

Research project

Students RESEARCH and COMPARE the past and present designed solutions in the almond industry.

For each chosen innovation, they work in pairs to answer these questions:

- What problem was this innovation introduced to solve?
- What process or technology did this innovation replace?
- What was its economic, environmental or social effect?

Innovations students may choose from include (but are not limited to) the following. Some of these examples are shown in the video and several quotes below provide information and time stamps to find this material. Other innovations will require further research:

- Grafting fruiting wood onto rootstock.
- Greenhouses.
- The traditional of harvesting almonds by lying nets on the ground and tapping the branches so that the nuts fall into the nets.
- Using turbines to move air on frost-prone nights.
- Using conveyor belts to facilitate grading and sorting the nuts.
- Processing plant design that aims to eliminate contamination with wash basins, hairnets and slippers conveniently available.
- Orchard planting design to reduce fire risk.
- A biomass energy plant that uses almond waste product to produce renewable energy such as steam and electricity.
- Techniques and processes designed to increase pollination.
- De-husking machinery. Imagine de-husking all these almonds by hand!
- Robotics and automated fruit farms.
- Sensors.
- Plant breeding.
- Permaculture.

Lesson 2: Almond Ag-Tech (continued)

Students 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.

"This is the most exciting time of the year. About February, March in Australia each year, the trees behind me are ready to drop their fruit. Naturally the nuts will drop on the ground and then what we can do is try and accelerate that process by shaking them. So, we take specially designed machine that grabs the trunk of the tree and shakes it for up to three seconds and all the nuts fall onto the ground. Once the nut has been sitting on the ground for three days, we get these huge sweeping machines that have big blowers. The blowers push all the almonds into a small pile and they sit there for another two days and then a huge truck turns up and we load them into a semi-trailer and that semi-trailer is then driven to our processing plant."

(5:15 – 5:56)

"Once it gets to the processing plant, each truck goes through a weighbridge. At the weighbridge we look at how much does it weigh, what is the moisture of the nuts, what farm did it come from, what variety is it, what size are they. All that information is entered into a computer and then we can trace all of our product from the farm all the way to the finished product. Once it's gone through the weigh bridge, the almonds are then transported to a stock pad, where the truck tips up on its side and unloads all of the almonds onto the stock pad. Those almonds are then pushed up into a pile by a huge loader."

(5:57 – 6:33)

"That product could sit there from three days up to a couple of months and gets called up by the processing plant. When the processing plant wants to take the hull and the shell off the product, it's picked up by a huge loader and put into a belly dumper. That belly dumper is then driven up to our pre-cleaning area. The pre-cleaning area is there to take the sticks, stones and rubbish that might have been on the farm floor, we take all that rubbish out. Once that's been completed, the cleaner product then goes through out hulling process. The hulling process is a number of big grinders that take the hull off."

(6:34 – 7:13)

Extending timelines

Students add to their timeline of technology, begun in the previous lesson. Begin to explore the ethical and sustainability implications of innovations. For example, if a new process is cheaper but causes environmental harm, is it acceptable? This theme will be explored further in the next lesson.

Recommended source material:

'During the 1600s several techniques were used to protect horticultural crops against the cold. These included glass lanterns, bell jars, cold frames and hot beds covered with glass. In the seventeenth century, low portable wooden frames covered with an oiled translucent paper were used to warm the plant environment much as plastic row covers do today. In Japan, straw mats were used in combination with oil paper to protect crops from the severe natural environment. Greenhouses in France and England during the same century were heated by manure and covered with glass panes. The first glass house built in the 1700's, used glass on one side only as a sloping roof. Later in the century, glass was used on both sides. The glasshouse was used for fruit crops such as melons, grapes, peaches and strawberries and only rarely for vegetable production. The developers of this new technology kept market profitability in mind: they produced crops which appealed to the wealthy and privileged, the only people who could afford the luxury of fresh fruit produced out of season in greenhouses. The development of hydroponics has not been rapid. In the U.S., interest began to develop in the possible use of complete nutrient solutions about 1925. Greenhouse soils had to be replaced at frequent intervals or be maintained from year to year by adding large quantities of commercial fertilizers. As a result of these difficulties, research workers in certain U.S. agricultural experiment stations turned to nutrient solution culture methods as a means of replacing the natural soil system with either an aerated nutrient solution or an artificial soil composed of chemically inert aggregates moistened with nutrient solutions.

– College of Agriculture and Life Sciences, The University of Arizona

'This is a true story. Except that it is not magic. The fruit of the oil palm tree (Elaeis guineensis), which grows in tropical climates, contains the world's most versatile vegetable oil. It can handle frying without spoiling, and blends well with other oils. Its combination of different types of fats and its consistency after refining make it a popular ingredient in packaged baked goods. Its low production costs make it cheaper than frying oils such as cottonseed or sunflower. It provides the foaming agent in virtually every shampoo, liquid soap or detergent. Cosmetics manufacturers prefer it to animal tallow for its ease of application and low price. It is increasingly used as a cheap raw material for biofuels, especially in the European Union. It functions as a natural preservative in processed foods, and actually does raise the melting point...'

Lesson 2: Almond Ag-Tech (continued)

Recommended source material (continued):

'... of ice-cream. Palm oil can be used as an adhesive that binds together the particles in fibreboard. Oil palm trunks and fronds can be made into everything from plywood to the composite body of Malaysia's national automobile. Worldwide production of palm oil has been climbing steadily for five decades. Between 1995 and 2015, annual production quadrupled, from 15.2m tonnes to 62.6m tonnes. By 2050, it is expected to quadruple again, reaching 240m tonnes. The footprint of palm oil production is astounding: plantations to produce it account for 10% of permanent global cropland. Today, 3 billion people in 150 countries use products containing palm oil. Globally, we each consume an average of 8kg of palm oil a year. Of this, 85% comes from Malaysia and Indonesia, where worldwide demand for palm oil has lifted incomes, especially in rural areas – but at the cost of tremendous environmental devastation and often with attendant labour and human rights abuses. Fires set to clear forests and create land for more palm plantations are the top source of greenhouse gas emissions in Indonesia, a country of 261 million people. The financial incentive to produce more palm oil is helping to warm the planet, while destroying the only habitat of Sumatran tigers, Sumatran rhinos and orangutans – driving them towards extinction.'

– *How the world got hooked on palm oil* by Paul Tullis, The Guardian, 19 February 2019: https://www.theguardian.com/news/2019/feb/19/palm-oil-ingredient-biscuits-shampoo-environmental

'A team of scientists at Clemson University's Coastal Research and Education Center has unveiled a robotic system that grafts disease-resistant roots to robust plant tops. "Grafting has been done all over the world for about 60 years, but when done by hand, it's very slow and labor intensive," said vegetable expert Richard Hassell. "The robot does it much faster than a human can do it. This reduces labor costs while at the same time enhancing healthy robust growth because the same clean cut is made every time.'

– *Robot makes plant grafting a snap* by Marc Zienkiewicz, Michigan Farm News, 25 March 2016

'[Mr Rogers's] farm is wired up like a lab rat. Or, to be more accurate, it is wirelessed up. Moisture sensors planted throughout the nut groves keep track of what is going on in the soil. They send their results to a computer in the cloud (the network of servers that does an increasing amount of the world's heavy-duty computing) to be crunched. The results are passed back to the farm's irrigation system—a grid of drip tapes (hoses with holes punched in them) that are filled by pumps. The system resembles the hydroponics used to grow vegetables in greenhouses. Every half-hour a carefully calibrated pulse of water based on the cloud's calculations, and mixed with an appropriate dose of fertiliser if scheduled, is pushed through the tapes, delivering a precise...'

Lesson 2: Almond Ag-Tech (continued)

Recommended source material (continued):

'...sprinkling to each tree. The pulses alternate between one side of the tree trunk and the other, which experience has shown encourages water uptake. Before this system was in place, Mr Rogers would have irrigated his farm about once a week. With the new little-but-often technique, he uses 20% less water than he used to. That both saves money and brings kudos, for California has suffered a four-year-long drought and there is social and political, as well as financial, pressure to conserve water. Mr Rogers's farm, and similar ones that grow other high-value but thirsty crops like pistachios, walnuts and grapes, are at the leading edge of this type of precision agriculture, known as "smart farming".

– The Economist, Technology Quarterly, 11 June 2016: https://www.economist.com/technology-quarterly/2016-06-09/factory-fresh

'In a shed near Toowoomba, researchers at the University of Southern Queensland are developing the tools and techniques they think will dominate farming practice by 2025.

- 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.
- Crown rot is a disease caused by fungus, which survives in the stubble of its host plant, limits water movement from the soil and causes browning of the stem. It can be a major headache for the grains industry, causing significant yield losses, particularly in wheat crops. Plant pathologist Dr Cassy Percy is investigating better ways of using phenotyping to learn more about resistance to the 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. "For example, when we make red wine most of the stuff gets thrown out [and] gets used as compost," Mr Brown said.
- 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. However, to do so requires advanced technology such as auto- steer tractors, which Mr Jensen said already existed. But farm equipment could be even more advanced in the future. "The idea behind fully autonomous, driverless tractors is a possibility," Mr Jensen said.'

– *Drones as common as tractors? Farm technology in 2025* by Robin McConchie , Craig Zonca and Arlie Felton-Taylor, ABC Rural, 27 October 2015: https://www.abc.net.au/news/rural/2015-10-27/drones-driverless-tractor-farming-in-2025/6888352

Lesson 2: Almond Ag–Tech (continued)

Recommended source material (continued):

> 'The Low Impact Harvester is a mobile, harvesting machine which is structured like a mobile production line and mini packing shed. It allows the vegetable grower to pick, wash and pack the vegetables ready for transportation, in the field where they are grown.'
>
> – The New Inventors, ABC Television

"In terms of hull storage which is by–product or a waste product from the almonds, we put them in these huge storage piles. They're transported from the factory to these piles by these giant screws, or these augers, as they are called."

(7:14 – 7:28)

"At the moment with our waste material, we generate about 50,000 tonnes of waste material and we sell it as a stock feed to farmers. They provide that nutrition for cows and we sell that throughout the season."

(7:28 – 7:40)

"You can imagine all these nuts coming through. We take the hull off, so what's left is the kernel with the shell on it. We take them through a number of sheer rollers, to take the shell off. So from the product that came in, we took the hull off, we took the shell of and that leaves us with the kernel. All that kernel is then cleaned and sorted by size. So we'll have the smaller nuts in one bin, we'll have the larger nuts in another bin. Each of those bins has a full QA done, so that's quality assurance where we test the moisture, we look for defects like scratches, insect damage or mouldy nuts and all of that information is also entered into the computer and then each bin is taken and stored in the warehouse."

(7:41 – 8:26)

"From the warehouse as a customer might require some nuts, we'll take whatever the customer's specifications are, we'll pick a bin out of the warehouse. That bin is then tipped upside down onto these conveyors where again the nuts are sorted for more stones and any other foreign material that might be in there."

(8:27 – 8:46)

Lesson 2: Almond Ag-Tech (continued)

"The almonds then go through a number of laser sorters. Laser sorters are looking for any type of defect. What we're trying to do is have the perfect looking nut and taking little white spots out or any other defects in the nuts."

(8:47 – 8:58)

"Once the nuts have gone through all of the sorters, you'll have a perfect product. That product is either packed in plastic or packed in a carton or packed in a bag and then that process goes through a metal detector. It is then palletised using a robot system and that robot system then automatically shrink wraps it sitting on a pallet."

(8:59 – 9:20)

"If pasteurising is required, which is a kill step for microorganisms like salmonella, we'll put it into a huge chamber. It will sit there for about eight hours. It's a steam process that basically cooks the nuts to make sure all of the nasties are killed."

(9:22 – 9:36)

"Once that process has been completed, we'll then put the nuts in their end packaging. That packaging will then go to another factory, which we turn into the finished product."

(9:37 – 9:45)

"We have a number of sustainable initiatives running at the moment. We recycle our water. All our waste we're trying to regenerate into products like fertilisers that we can reuse."

(10:19 – 10:30)

"Our biggest initiative over the next 12 months is to put a biomass recycling plant in place, which will take our waste product which is hull and shell and burn it to create electricity and steam and provide enough power to run our own plant, but also provide power for the local neighbourhood."

(10:31 – 10:49)

"The factory was commissioned in 2008. It was about $40 million worth. We've got state-of-the-art equipment. You'll see that there are huge vibrators, so it's huge scale. Not many people need to operate it. It's fully automatic. It runs 10 tonnes an hour and we run the factory for about six months of the year."

(10:53 – 11:11)

Lesson 2: Almond Ag-Tech (continued)

"We have quite stringent food safety practices and procedures put in place from the floor of the farm itself, so our practices of keeping the farm clean, to the way that we transport it to the processing plant. Within the processing plant we take up to four different samples and do full QA analysis to ensure that the product is kept safe."

(11:12 – 11:35)

"Most of our equipment actually comes from overseas, so our processing equipment comes from the US and some of our other equipment may come from Europe."

(13:31 – 13:38)

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

Lesson 3

Electric Nuts

Themes

Food issues	Food futures	Food makers	Food in Australia	Innovation
Technology	Ethics	Biomass energy		

Ethical production

Students INVESTIGATE and DEBATE the ethical and sustainable production and marketing of food, using examples from what they now know of the system of almond mass production.

Students REVIEW their research into emerging production technologies and methods in terms of the productivity, profitability, sustainability and renewable energy potential for ach innovation.

Recommended source material:

> '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)

Case Study – Renewable Energy from Nut Waste

In this case study, students EXPLORE the technologies being used to produce renewable energy from nut waste in Australia.

In response to the case study, students create a short presentation to EXPLAIN how this method of shell and nut use compares to other options including briquetting, pelletising, composting and vermiculture.

Lesson 3: Electric Nuts (continued)

Case Study

'Suncoast Gold Macadamias biomass cogeneration facility in Queensland claims to be the world's first and only plant to produce electricity from waste macadamia nut shells. The plant aims to convert 5000 tonnes of shell waste into biofuel to generate renewable energy. The shells used to be sent to landfill, used as garden mulch or burned to produce heat. The shell husks from the macadamia nuts are burnt in a 6 MW steam boiler. The steam is used to dry the nuts and power a 1.4 MW steam turbine, generating renewable energy for the site and for export to the grid. The plant produces about 5500 MWh of renewable electricity each year, reduces landfill waste, and reduces greenhouse gas emissions by more than 5100 tonnes of carbon dioxide a year.'

– Suncoast Gold Macadamias Biomass Cogeneration Facility, Queensland: https://www.power-technology.com/projects/suncoast-gold/

'Not only does Suncoast Gold Macadamias generate its own power it also supplies 8,100 megawatt hours of renewable GreenPower energy into Queensland's electricity grid.That's enough to power more than 1260 households a year or a town around the size of Daylesford in Victoria, Ceduna in Western Australia or Charleville in Queensland*.This innovative waste-to-energy project cuts Australia's greenhouse gas emissions by around 7,500 tonnes per annum – equivalent to taking about 1800 cars off our roads. Suncoast Gold Macadamias is one of the world's largest processors of macadamias and a major player in the global macadamia market, with exports to more than 20 countries including Japan, Europe and the United States. It processes 6000 tonnes of nuts a year which yields about 4000 tonnes of shell waste.As its business has grown so has the problem of what to do with all those nut shells. The nut shells are burnt to power a 6 megawatt steam boiler which produces nine tonnes of high-pressure steam per hour.Some of the steam is passed through a heat exchanger to dry the macadamia nuts and to reduce the kernels water content. The majority of the steam however is passed through a 1.5 megawatt steam turbine to generate approximately 9,500 megawatt hours per annum of clean, renewable GreenPower electricity. Suncoast Gold Macadamias consumes up to 1,400 megawatt hours per annum for all their electricity needs, with the remaining 80% being exported as GreenPower and traded in the national electricity market.'

– Greenpower Case Study – Suncoast Gold Macadamias (PDF): https://www.greenpower.gov.au/Homes/Common-Questions/~/media/5387E03F5B784A448903612993AD56F9.pdf

Lesson 3: Electric Nuts (continued)

Recommended source material (continued):

'Waste-to-energy plants are just one of the ways waste can be used to generate accredited GreenPower. Australia is leading the way in terms of the technology needed to convert waste to clean, green energy. But if we are to reduce greenhouse pollution from electricity then more Australian households and businesses need to purchase accredited GreenPower to help fund the long-term development of clean, renewable energy in this country. The result will be a better, brighter future for all Australians.'

– GreenPower, voluntary government accredited program: https://www.greenpower.gov.au/

'Though often categorized as "clean energy," many U.S. biomass projects have been attracting criticism for causing significant pollution. A recent report (link below) analyzing 88 emissions permits found that, compared to coal plants, biomass plants emit more nitrogen oxides, volatile organic compounds, particulate matter, and carbon monoxide, as well as nearly 50 percent more carbon dioxide for every megawatt-hour of electricity produced. The concern is that burning wood is inherently polluting, plus biomass plants extract relatively little "useful" energy for the pollution they emit.'

– CityLab: www.citylab.com

Teacher resources:

- Agrifutures: https://www.agrifutures.com.au/
- Greenpower: https://www.greenpower.gov.au/
- Partnership for Policy Integrity (PFPI) – Trees, Trash, and Toxics: How Biomass Energy Has Become the New Coal (PDF): www.pfpi.net/wp-content/uploads/2014/04/PFPI-Biomass-is-the-New-Coal-April-2-2014.pdf

Lesson 4

Almond Snack Project

Themes

Nutrition	Health	Food safety	Processed foods	Food preparation
Technology	Preservation	Food waste		

Student project

In groups, DESIGN, PRODUCE and CREATE a healthy almond snack for the canteen using a range of techniques to ensure optimum nutrient content, flavour, texture and visual appeal.

Here are some ways to enjoy Australian almonds:

- Mix Australian almonds with dried fruit for a tasty and healthy snack
- Sprinkle oven or dry roasted almonds through your next curry, stir fry or salad
- Crushed almonds are delicious over fresh fruit and yoghurt
- Mix crushed almonds with breadcrumbs and your favourite herbs to make a crunchy coating for chicken or fish.

– Select Harvests

Students DEVELOP criteria to assess the success of their recipe for appearance, nutrition and flavour.

They EXPLORE and DOCUMENT marketing strategies that they propose to promote the item at the canteen. Prompt them to use food photography and digital technologies to assist their promotional strategy.

Students define a goal or measurement of success for their snack (e.g. it sells X units in the first month). As they develop their ideas, remind students to ASSESS and MODIFY their idea during the development stage with this outcome in mind.

Optional: Have the class SURVEY other students at the school to estimate the popularity of the proposed healthy snack through the marketing campaign.

CHERRIES

Cherries | Year 9 | Stage 5

Ask students first to reflect on the ***From Paddock to Plate*** **Cherries Virtual Video Excursion**:

- How do cherries grow?
- Do cherries grow in bunches, pairs or single fruit along a branch?
- What does a cherry orchard look like?
- What can they say about the paddock to plate journey of cherries and cherry products?
- What did they learn that they hadn't considered before?
- What would they like to know more about the cherry growing industry in Australia?

Facts and Vocabulary - Cherries

Facts about the Australian cherry industry

- Cherries are a small, plump stone fruit and a member of the Rosacea (rose) family that also includes almonds, peaches, apricots and plums.
- The top four cherry producing countries (Turkey, USA, Iran and Italy) account for approximately 50% of the world's cherry production.
- Australia is a relatively small cherry producer by world standards, only producing approximately 0.5% of the world's total cherry production.
- Currently up to 15,000 tonnes of Australian cherries are produced every year with 30% exported. This number is expected to rise to 20,000 tonnes and 50% exported by 2020.
- The Australian industry is spread over six states with around 2,845 hectares under production and 485 grower enterprises currently operating.
- New South Wales and Victoria are the two largest producers of cherries. Tasmania has had a rapid expansion in plantings and is currently the third highest producer. It has a strong export focus, enhanced by its relative pest and disease freedom. South Australia is the fourth largest producer with a significant proportion of its production sold interstate and a small percentage also exported. Both Western Australia and Queensland are relatively small producers primarily focusing on their domestic markets.
- Australian cherries are available from mid/late October to late February, depending on the state and seasonal calendar due to climatic variation, varieties and growing season.
- There are two main cherry species:
- Sweet cherries (Prunus avium L.) are often sold as just generic fresh cherries.
- Sour cherries (Prunus cerasus L.) are mostly used in processed products such as freezing, canning and juices or typically preserved and used in cooking or for making cherry brandy.
- Today there are over 50 varieties grown and many more are being developed in Australia.
- Sour cherries are more commonly grown in Europe but some plantations exist in Victoria South Australia and Tasmania.
- The most well known sour cherry is the Morello.
- A study published in the American Journal of Clinical Nutrition found that sour cherries ranked 14 in the top 50 foods for highest antioxidant content per serve – and are among well-known 'superfoods' such as red wine, berries and dark chocolate.

SOURCE: Cherry Growers Australia Inc.

Useful words and phrases

- Bird damage
- Blossom
- Certified organic
- Cherry season
- Cherry variety
- Commercially available
- Cool store
- Cross compatibility
- Cultivar
- Domestic market
- Earwigs
- Export
- Fertigation
- Fertiliser
- Flowering
- Frost
- Fruit maturity
- Fruit set
- Grading equipment
- Gross value
- Growing season climatic conditions
- Global cherry production
- Hail netting
- Hand picked
- Harvest
- Irrigation
- Microclimate
- Morello
- Orchardists
- Packing shed
- Pollenisers
- Providence
- Pruning
- Rootstock
- Seasonality
- Shelf life
- Sour cherries
- Sweet cherries
- Sweetheart
- Thinning
- Topography
- Tree vigour
- Verticillium wilt fungus

Lesson 5

Ethics, Efficiency, Energy and Price

Themes

Food makers	Food in Australia	Climate	Ethics	Food security
Energy efficiency	Resource management	Careers		

Sustainable tech?

Discuss with the class whether or not a high-tech orchard can be sustainable or not. What do students think? Why?

In this lesson, students will explore and debate the ethical and sustainable considerations involved in growing and marketing fruit in Australia to explore this theme further.

Farming for a return

First, share this quote and discuss it with the class. What does it mean? Where does conflict lie in the food production chain?

> 'The farmer's interest is focused on getting the best return from his [or her] produce, which usually equates to maximum price for unlimited quantities. Manufacturers want least cost, best quality produce from the farmer so that [they] 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)

Case studies

Introduce the case studies below. These four case studies show fruit businesses that see the benefit in adjusting or refining their processes to save energy, benefiting the environment and increasing productivity at the same time.

These producers have carefully assessed how people on their farms do what they do, and how the farm or production facility can be better designed for efficiency of resources, saving energy and labour. A positive motivating result is usually reduction in cost as well as saved resources.

Assist groups of students to choose a case study, or assign one to them. Provide time for them to read the case study and answer the questions. Each group presents their case study to a group who looked at a different case study, explaining what happened and providing their answers to the questions below their case study.

Case Study One – Refrigeration at Newton Brothers

At Newton Brothers pack house and cold storage in Manjimup, WA, approximately 70% of the business's total electricity is used for cold storage.

The facility produces and packs around 7,680 tonnes of apples, pears and stone fruit annually. It has two cold store facilities with 27 individual cold storage rooms. From May 2012 to April 2013, the business consumed over 1.2 million kWh of electricity at a cost of just over $350,000 (excluding GST) for the year.

Recommended source material:

> 'Newton Brothers operates a HCFC-based refrigeration system from a fixed head pressure set- point (at condensing temperatures between 35°C and 40°C), and the condenser fans are cycled to maintain this set-point. A reduction in head pressure is possible during low load periods, and in cold ambient conditions the opportunity exists to reduce compressor power use. Re-setting the condenser fan cycling pressure switch settings means the condenser fans will activate more frequently, but the overall refrigeration system will operate more efficiently.'
>
> – Apple and Pear Australia Ltd – Case story 9: Head pressure reduction (PDF): http://apal.org.au/wp-content/uploads/2013/07/CS9-EEIG-TAS-and-WA.pdf

Questions for students:

- What was the problem Newton Brothers was trying to solve?
- Was it a cost, ethics or an energy use problem?
- How does their solution relate to efficiency, energy, economics, ethics and sustainability? Be specific.

Case Study Two – Cold Store Doors at Cunich Orchard

The E.F. Cunich & Co. (Cunich) Orchard in Young, NSW, produces around 220 tonnes of cherries and stone fruit per annum. It is a small enterprise compared to other facilities.

The Cunich Orchard includes a pack house and two cold store rooms. Together, they consumed just under 79,500 kWh of electricity between June 2012 and July 2013. Electricity usage by the pack house and cold store rooms represent 85% of the orchard's total usage, costing around $21,500 (excluding GST) for the year.

Recommended source material:

'Installing a new automated sliding door for one of the cool store rooms using an electric, automated tracking system enables the door to be opened and closed on demand using either:

- radio control (remote control clicker),
- motion detection,
- photo eyes; or
- induction loop activators.

The opportunity ensures the working room door remains closed when access to the room by staff is not required. It reduces cold air loss and the electricity and costs associated with re-cooling the air. Staff can access the room without the need to disembark from forklifts, reducing the time and effort taken to move fruit in and out of the working room.'

– Apple and Pear Australia Ltd, Case story 5: Automated cool room doors (PDF): http://apal.org.au/wp-content/uploads/2013/07/CS5-EEIG-Young.pdf

Questions for students:

- What was the problem Cunich Orchards was trying to solve?
- Was it a cost, ethics or an energy use problem?
- How does their solution relate to efficiency, energy, economics, ethics and sustainability? Be specific.

Case Study Three – Bright Days at Caernarvon Orchard

Caernarvon Orchard in Orange, NSW (which features on the Paddock to Plate app) produces and packs approximately 4,500 tonnes of apples and 800 tonnes of cherries per annum which makes it a medium sized orchard. Lighting accounts for approximately 5% of their annual electricity use and costs about $3,400 per year.

The pack house has been designed so that the level of lighting and its placement matches the activity happening in that space. The design also takes into account the height of the ceilings and the availability of natural sunlight in each area. All of the lighting is manually controlled, requiring the staff to turn lights on and off as they enter or exit a work area.

Recommended source material:

> 'In total, the pack house uses 28 T8 fluorescent tubes and 16 High Bay (Metal Halide) lighting fixtures, all with magnetic ballasts. The lights operate for 45 hours per week for 46 weeks of the year, resulting in about 15,500 kWh of electricity consumption per year. Electricity and cost savings can be made at Caernarvon Orchards by replacing both the existing T8 fluorescent tubes and the High Bay (Metal Halide) lighting fixtures with more efficient bulbs. By implementing lighting efficiency opportunities, Caernarvon could reduce the electricity it consumes for lighting by about 68% and save over $2,300 (excluding GST) annually. The orchard's total electricity consumption could reduce by 4% annually.'
>
> – Apple and Pear Australia Ltd – Case story 6: LED lighting (PDF): http://apal.org.au/wp-content/uploads/2013/07/CS6-EEIG-Orange.pdf

Questions for students:

- What was the problem Caernarvon Orchard was trying to solve?
- Was it a cost, ethics or an energy use problem?
- How does their solution relate to efficiency, energy, economics, ethics and sustainability? Be specific.

Lesson 5: Ethics, Efficiency, Energy and Price (continued)

Case Study Four – Automated Lettucs Farm in Japan

In the hills between Kyoto, Osaka and Nara prefectures, surrounded by technology companies and startups, Spread Co. is preparing to open the world's largest automated leaf-vegetable factory.

Its new Techno Farm, expected to open as early as this month, will push efficiency further, yielding 648 heads of lettuce a square meter annually, compared with 300 heads at its Kameoka farm and only 5 in an outdoor farm. It will use only 110 milliliters of water a lettuce — 1 percent of the volume needed outdoors — as moisture emitted by the vegetable is condensed and reused.

Recommended source material:

> 'For decades, vertical farms that grow produce indoors without soil in stacked racks have been touted as a solution to rising food demand in the world's expanding cities. The problem has always been reproducing the effect of natural rain, soil and sunshine at a cost that makes the crop competitive with traditional agriculture. Spread is among a handful of commercial firms that claim to have cracked that problem using a mix of robotics, technology and scale. Its new facility in Keihanna Science City will grow 30,000 heads of lettuce a day on racks under custom-designed lights using light-emitting diode. A sealed room protects the vegetables from pests, diseases and dirt. Temperature and humidity are optimized to speed growth of the greens, which are fed, tended and harvested by robots.
>
> – *As high-rise farms go global, Japan's Spread leads the way* by Aya Takada, The Japan Times, 1 November 2018: https://www.japantimes.co.jp/news/2018/11/01/business/tech/high-rise-farms-go-global-japans-spread-leads-way/#.XZudFi1L2qQ

Questions for students:

- What was the problem Spread Co. was trying to solve?
- Was it a cost, ethics or an energy use problem?
- How does their solution relate to efficiency, energy, economics, ethics and sustainability? Be specific.

Lesson 6

Cherries for Export

Themes

Food makers	Food in Australia	AgTech	Export markets	Ethics
Energy efficiency	Resource management	Asia		

"Everyone has a little love affair with cherries. Everyone loves cherries and it's quite surprising when you give someone a kilo of cherries in a lovely little pack like that, they think they're winning in the lotto almost you know. So, it's really nice and we get a lot of pleasure out of it."

(7:58 – 8:13)

Asia's love affair with cherries

Read the quote above, then as a class, discuss the huge impact of export markets on Australian fruit growers, particularly in the high-end fruit markets such as cherry growing.

Explore why and how Australia is placed to take advantage of this global economic trend.

Discuss what students know or can infer about the opportunities as well as the risks cherry orchardists may face when catering to a highly competitive overseas market.

Start a list of ideas on the board. It might look something like this:

Opportunities	Risks
• Access to a large population (big market) • A growing Asian middle class as disposable income • Australia is close enough to air freight produce quickly • etc...	• Unpredictable climate events affecting growing conditions (e.g. drought) • Cost of labour in Australia is high • Competition from growers worldwide • etc...

Students read the following source material and discuss in pairs before adding any more risks and opportunities to the board:

Lesson 6: Cherries for Export (continued)

Recommended source material:

'Cherry growers in Tasmania spending millions to stay ahead in export boom

Australia's cherry industry has had a bumper year, with exports nearly double that of last season and good prices lifted by high-end fruit coming out of Tasmania. It is good news for Tasmanian growers who are spending big on cherry orchards and processing facilities. Fourth-generation fruit grower Howard Hansen is investing heavily in a new type of rain-cover, the first in Australia. He has put up 80 kilometres of the high-tech material, pitching it over the rows of fruit and joining long sheets together with huge zips. … "It's a ventilated rain-cover. We need the fruit to be as firm as possible because we are competing against the Chilean fruit that's arrived by ocean. Ours is all air freighted, it needs to be firm and late and we need the rain-covers to achieve that." The new covers are designed to let the rain fall down the pitch and between the rows. In contrast to other designs, it is waterproof and open to natural airflow. "That's been the problem in the past, they modify the temperature and humidity too much, the temperature and humidity cause the fruit to be earlier and also cause it to be softer," Mr Hansen said. The covers were put to the test early on with a late and heavy summer rainfall. "[One] night we had 18 millimetres of rain and they [were] picking there [the next day] just like they do a normal day. Ordinarily after that amount of rain we would have to have a few days off to firm the fruit up a bit but we also would have lost a decent percentage of it," Mr Hansen said. Mr Hansen has also spent $3 million on new cherry sorting technology, including a production line containing infrared cameras that check the fruit for defects. The new technology sorts through about 10 tonnes of cherries an hour, allowing the company to process 80 or 90 tonnes a day. "At the rate we're packing at the moment, the way we did this four years ago we would have needed 450 people to do what this 24 lanes of machinery is doing," Mr Hansen said. Mr Hansen is the first in his family to seriously diversify away from traditional apple growing and every year his cherry crop is bigger than the last. "The two complement each other very well. The best thing is the work for our staff," he said. "We'll have some of our pickers that might start work thinning apples in October and we can keep them thinning apples, pruning cherries, picking cherries and then picking apples all the way till the middle of May." Cherries account for 75 per cent of the company's revenue and that is why Mr Hansen is spending millions on technology to try to keep ahead of the game. "We're investing in some new orchards because we think we need to be expanding our scale to remain competitive with lower per kilo prices," he said. "We're trying to extend our season by planting later varieties, we're still got an apple business as well and we're investing in new varieties of apples which we think will be in demand in Australia. And then there's the insurance policy of the rain covers — we've spent just under $5 million on rain covers this year."

– *Cherry growers in Tasmania spending millions to stay ahead in export boom* by Fiona Breen, ABC News, Landline: https://www.abc.net.au/news/2016-04-16/cherry-growers-spending-millions-to-stay-ahead-in-boom/7326412

Going digital

After using the cues in this source material to add to the class lists of risks and opportunities, next brainstorm the technology solutions producers like Howard Hanson are using to mitigate (reduce) risk, take advantage of opportunities – all the while retaining a focus on efficiency, energy and resource savings, and cost.

As a class, DISCUSS about how advanced technologies are used to enhance food production systems.

BRAINSTORM technologies in farming with the whole class. Here are a few examples to get you started:

- Global positioning system (GPS) for tracking vehicles and positioning them accurately.
- Sensors and smart technologies such as soil moisture sensors and automated flow adjusters for irrigation and other water-saving technologies and methods.
- Smart technologies to detect light levels in production facilities.
- Automated mechanical components linked to motion sensors, used to activate doors, air vents, shade or sun panels and rain canopies.
- Automatic weighing machines, plus weight-activated sensors for sorting, portioning and packing fruit.
- Automatic sorting machines.
- Robotic harvesters and pickers.
- Economic price watch software checking for the optimum moment to pick, pack and sell fruit for the best price.

Return from investment

To finish the lesson, bring students back to the purpose of businesses making adjustments to save energy, time, and money.

For many business owners, the costs of implementing advanced technology is weighed against the potential higher yield and better price for their fruit. When the price differential per tonne is not substantial, economic gains can only be made by large-scale farms. Explore this concept with students, perhaps be reviewing the quote below from the video:

"We only grow 10 to 15 tonnes of cherries so we do it all by hand, but that works quite well and the pickers seem to enjoy that particular when the cherries are nice. If you were a bigger grower you've got to be mechanised, but we're not in that category. You'd need 100 tonnes or there abouts to justify grading equipment."

(4:35 – 5:00)

Lesson 6: Cherries for Export (continued)

DISCUSS the effect of product processing and advertising on demand and price. If time permits, in their groups, students ANALYSE and DRAW the marketing chain of Australian-grown cherries for export and find out the price difference between top-quality and low-grade fruit.

Revisit the table of opportunities and risks from the beginning of this lesson and discuss:

- Do students think a higher export price always outweighs the risks of growing for export?
- Do students feel there are other concerns not being addressed such as the environmental cost of air freighting produce, or the demand for water to grow fruit?
- What are the ethical as well as economic decisions a fruit grower needs to make?

Lead students in a CRITIQUE of the system of mass-producing cherries, taking into account ethics and sustainability considerations.

Teacher resources:

- ABC News – Australian cherry growers export bumper crop to China via the trade through Hong Kong: https://www.abc.net.au/news/rural/2016-03-08/cherry-exports-record-record-growth/7229970
- Australian Financial Review – Cherries and stonefruit in demand by Asia but access and quarantine issues plague the industry: https://www.afr.com/companies/cherries-and-stonefruit-in-demand-by-asia-but-access-and-quarantine-issues-plague-the-industry-20160322-gnoltv
- Weekly Times – ANZ Report: Australian vegetable exports into Asia to grow: https://www.weeklytimesnow.com.au/agribusiness/horticulture/anz-report-australian-vegetable-exports-into-asia-to-grow/news-story/19a1a1d55d59375a07f5fdad553b330a

Lesson 7

Decisions and Technologies

Themes

Food makers | Food in Australia | AgTech | Innovation | Ethics

Cherry varieties

In groups or as a class, discuss the consequences of social, ethical and sustainability decisions for products, services and environments, by working through one example from the video.

In this example, Harvey plants a variety of cherries bred for specific purposes rather than using all of his orchard space for one variety.

ASK students why this might be the case, then review the video from about 2:50 to hear what Harvey has to say.

Make a list of the influences and pressures Harvey is responding to, such as: availability of produce over a longer season, the need to pick cherries over several weeks or months rather than in one great rush, and the qualities consumers look for in cherries.

REVISIT your class list of Risks and Opportunities from the previous lesson and discuss:

- Do any of these – or new – risks and opportunities present themselves because of Harvey's decision?

The aim is for students to recognise some of the main challenges and complex decisions that cherry growers face.

"Cherries are a very short-growing fruit. We have cherries that blossom in October and start fruiting in November so the cycle of cherries is quite short. Some other stone fruits are similar, but we also have cherries that grow over quite a long period of time."

(2:50 – 3:08)

"The early cherries are harvested in November and the late cherries are harvested in as late as February, so there's quite a range of cherries and there are thousands of varieties of cherries."

(3:09 – 3:20)

Lesson 7: Decisions and Technologies (continued)

"It's easier having different varieties so we can manage our picking. We can get over one variety and then a week later start a new variety."

(3:20 – 3:31)

"There's forever the search to grow the perfect cherry and consumers love big, juicy cherries. We have a mid to late season variety called Sweetheart. That really lives up to its name. It's large, it's sweet, it's juicy and it's a light burgundy colour so it's got all the attributes of a love affair with a cherry."

(3:32 – 3:53)

Did you know?

'By 2070, there may be 40% more months of drought in eastern Australia.'

– CSIRO 2007

Design Assignment

Given what they have learned about the challenges and decisions facing cherry growers, students will DESIGN a technology that they believe will assist growers to overcome one of these challenges or help mitigate a risk associated with one of the decisions.

Students choose one problem from the list below or from their class lists of risks, and work in pairs or groups to devise a technology solution to alleviate the risk or solve the problem. Remind students that technologies include refinements to processes (how people do things), designed environments, and equipment or machinery including communications technology.

Problems growers face (add those the class came up with in this and previous lesson):

- Growers are price takers, not price setters (the 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 cherry crops; infrastructure/seed needs to be replaced if growers are to maintain livelihood and earn an income again.
- High and increasing input costs including labour, energy, fertiliser, seed, packaging etc.
- Mental health and wellbeing for the grower in tough years such as drought.
- Access to / cost of land for expansion of growing operations.
- Availability of skilled labour and training programs for labourers.
- The time and energy it takes to understand, track changes to and comply with, government regulations, and that regulations are too often "one size fits all" for huge and small businesses.
- Lack of infrastructure to support larger-scale production including cold storage / refrigeration and processing facilities.
- The situation in which there is plenty of demand for fruit from restaurants but there is no transportation to get the produce there quickly enough to make it a viable business.

Lesson 7: Decisions and Technologies (continued)

- Consumer understanding of seasonality is not very clear (people demand cherries in winter).
- Managing pest and plant disease issues in the orchard.
- Consumer concerns about pesticide residue and belief that organic is the only safe food option.
- Growers must grow what people are buying (because they don't set the price): this is a risk is the market's demands shift to new varieties, times of year, new quantities.
- New orchards take time to become productive; trees don't produce fruit from day 1 when planted.
- Competing against cheaper imports of inferior quality.

– Adapted from: *Summary of Opportunities and Challenges Facing Fruit and Vegetable Grower*, Governor's Council for Agricultural Development Interviews May–July 2012

Recommended source material:

'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 by John Quiggin, Australian Research Council Federation Fellow, School of Economics and School of Political Science and International Studies, University of Queensland

Lesson 8

Packaging Problems

Themes

Design	Innovation	Recycling	Waste management	Packaging
Food safety				

Packaging perils and pitfalls

Take an overview by gathering images of packaging for cherry and fruit products in Australia. This can be done either by visiting supermarkets in person to take photos or by surveying several super market websites. Look for products with frozen, dried, juiced and otherwise processed cherries in them.

(If this proves difficult locally, expand your search to include other fruit grown in Australia such as mangoes, peaches, and grapes.)

If you can gather a few examples of packaging and allow students to handle them, this will be very useful.

As a class EXPLORE what packaging does, including (but not limited to) the following:

Protecting food against:	**Packaging films must be:**
• contamination by dirt (contact with surfaces and hands); • contamination by micro-organisms (bacteria, moulds, yeasts); • contamination by parasites (mainly insects); • contamination by toxic substances (chemicals); and • influences affecting colour, smell and taste (off-odour, light, oxygen) loss or uptake of moisture (evaporation or water absorption).	• flexible; • strong; • light weight; • odourless; • hygienic (clean and toxicologically harmless); • easy to recycle / sustainable; • resistant to hot and cold temperatures; • resistant to oils and fats; • a good barrier against gasses; • sealable; and • low-cost.

Lesson 8: Packaging Problems (continued)

Use the examples you have gathered to illustrate as many of these requirements as possible.

Students CRITIQUE the design of cherry and other fruit packaging that you have found with particular attention to the needs of the food product (does it need to be kept cool, dry, protected from light, etc?) and the environmental consequences of specific packaging materials.

Prompt them to explore how well the design responds to sustainability issues, e.g. collapsible packaging or pouches taking less space than inflexible shapes such as cans, thereby reducing transport costs and energy use.

Design task

Given what they have learned, students DESIGN their own sustainable packaging for cherries or a cherry product. Their aim is to minimise environmental impact as well as to reduce costs and energy use in production.

Students must be able to JUSTIFY their decisions when selecting from a broad range of materials, systems, components and processes.

For example:

- Selecting locally sourced packaging materials, or materials produced from a waste source such as rice hulls.
- Looking at emerging materials such as compostable packaging.
- Choosing packaging produced via low-emissions techniques.
- Using light-weight materials that reduce transport costs in rural Australia.

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

"They stay in cool store overnight and then are taken to our packing shed and is packed into either one kilo boxes or five kilo boxes."

(7:20 – 7:28)

Short Documentary

Students 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 – Waste Deep: www.sustainabletable.org.au/Hungryforinfo/WasteDeep/tabid/144/Default.aspx

Lesson 8: Packaging Problems (continued)

Packaging Covenant

Students EXPLORE the Australian Packaging Covenant (APC). What is this initiative and is it relevant to the fruit industry?

- Australian Packaging Covenant Organisation: www.packagingcovenant.org.au

REDcycle

Students FIND OUT more about the REDcycle Program that has teamed up with major supermarkets and brands in Australia to make it easier for consumers to keep their plastic packaging out of landfill. DISCUSS how you and your school can get involved in this initiative.

- REDcycle: http://redcycle.net.au/redcycle/

Recommended source material:

'Corn on trays, apples sliced in containers, lettuce wrapped in plastic and sweet potatoes peeled and displayed on polystyrene trays. It's the modern-day obsession with faster food that is creating a tsunami of waste swamping Sydney. And there is no need for it — fruit and vegies already come in nature's own packaging that doesn't clog our household garbage bins. There has been a 170 per cent increase in waste over the past 20 years, with two-thirds of that coming from food packaging. And there is a growing call for supermarkets to stop pandering to our time-poor society and obsessive parents by providing peeled fruit and vegetables in plastic. "Waste has a growth of 7.8 per cent annually and two-thirds of that growth is food packaging," said Mike Ritchie, from waste consultancy group MRA Consulting.'

– *Cost of convenience: Fruit and vegetables packaged in plastic the source of increasing waste in Sydney* by Jane Hansen, The Daily Telegraph, 29 May 2016: www.dailytelegraph.com.au/news/nsw/cost-of-convenience-fruit-and-vegetables-packaged-in-plastic-the-source-of-increasing-waste-in-sydney/news-story/fcadfb7a60783375f1beba46ac60227f

'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: www.washingtonpost.com/lifestyle/food/ten-fruits-and-vegetables-youre-storing-wrong/2014/10/21/a7d8adb6-4b44-11e4-891d-713f052086a0_story.html

Lesson 8: Packaging Problems (continued)

Recommended source material (continued):

'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: www.change.org/p/woolworths-and-coles-supermarkets-stop-wrapping-small-portions-of-herbs-vegetables-and-fruit-in-plastic-and-styrofoam/responses/30570

'Shopping at the supermarket inevitably results in a trash bin overflowing with plastic refuse. Whether it's juice, meat, fruit, or other food items, it's all packaged in plastic. The quantities are enormous –– Germany alone produces roughly 5.7 million tons of it each year. Although the majority of people conscientiously put these packaging into their yellow recycling bins, only about 42 percent of the waste gets "reincarnated" as diapers, fleece pullovers, stuffed animals, and the like. The rest is sent to waste incineration plants, where it is converted into energy. Black plastics in particular suffer this fate because it has thus far been impossible to sort them by material type. Conventional sorting systems operate specifically within the near-infrared range, which in general allows them to categorize plastics. But what works especially well for most plastics fails for black ones: the soot that gives them their dark color absorbs most of the signal, so the optical system cannot see these substances. At the same time, the need to recycle these dark plastics has become more urgent, because any efforts to meet the EU thresholds for car recycling programs will have to include black plastics.'

– *Sorting black plastics according to type*, Fraunhofer-Gesellschaft, Science Daily, 1 June 2016: www.sciencedaily.com/releases/2016/06/160601083922.htm

Lesson 8: Packaging Problems (continued)

Recommended source material (continued):

'Everyday food items are being sold in "excessive" oversized plastic packaging up to twice the size of the contents, a Telegraph investigation has found. Retailers are selling popular products with roomy wrapping which is often difficult to recycle. Many of the worst offenders identified by this newspaper are supermarket own-brand items. An Aldi Salmon Fillet measuring under 5cm across is sold in non-recyclable packaging 17cm wide, while a bag of Milky Way Magic Stars measures 17cm high and the stars inside reach around 5cm.'

– *Revealed: The scandal of everyday food items being sold in 'excessive' wasteful plastic* by Callum Adams, The Telegraph, 19 July 2019: https://www.telegraph.co.uk/news/2019/07/19/revealed-scandal-everyday-food-items-sold-excessive-wasteful/

'So which Easter tradition came first? The packaging or the egg? The answer is of course not that surprising (it's the egg). The tradition of giving people eggs at spring time has roots in ancient pagan festivals and exists in the history of a range of religions. It is only in recent decades that the amount of packaging around a hollow chocolate egg has become a noticeable problem – partly because of a rise in the number of eggs sold. It's true that some manufactures have made progress in reducing packaging, with a big focus on reducing plastics. Many popular eggs are wrapped in just a layer of foil and a card box (plus any wrappers that come on accompanying confectionary). But this does not mean the problem has gone away. A report by Which? revealed that around a quarter of the total weight of Easter eggs sold in the UK is taken up by the plastic and cardboard packaging they are wrapped up in. The outer packaging of one of the top-ten selling brands tipped the scales at 152g of a 418g product (36.4%). According to the environmental charity Friends of the Earth, Easter egg makers are still failing when it comes to plastic waste. This leads to some 3,000 tonnes of packaging waste each year. But it is too easy to blame the manufacturer – after all, we buy the eggs. And the packaging does play some role in protecting the chocolate from damage and contamination – otherwise you may end up with food waste (which is actually far worse).'

– *Easter eggs: hunting for a solution to excessive packaging* by Elliot Woolley, The Conversation, 12 April 2019: http://theconversation.com/easter-eggs-hunting-for-a-solution-to-excessive-packaging-115317

Did you know?

- There has been a 170 per cent increase in waste over the past 20 years, with two-thirds of that coming from food packaging.

  – *Cost of convenience: Fruit and vegetables packaged in plastic the source of increasing waste in Sydney* by Jane Hansen, The Daily Telegraph, 29 May 2016

- 'Aussies throw out $8 billion worth of edible food every year and 33 % of this amount is fresh food like vegetables!
- An estimated 20-40% of fruit and vegetables are rejected, even before they reach the shops, mostly because they don't match the consumers' and supermarkets' high cosmetic standards.
- If you add up all the food 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.
- The hidden impact? 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.
- What are the environmental effects? When food rots with other organics in landfill, it gives off a greenhouse gas called methane, which is 25 times more potent than the carbon pollution that comes out of your car exhaust.'

  – www.lunchalot.com/foodwaste.php

Lesson 9

Cooking with Cherries

Themes

Cooking | Food safety | Nutrition | Food preparation | Food preservation

Food safety

Taste it

Students TOUCH, SMELL and TASTE fresh cherries picked straight from a tree (when they are in season).

DISCUSS the difference between fresh cherries and foods made out of cherries.

Students RESEARCH the nutrition differences between fresh, stewed, roasted, dehydrated, pickled, juiced and glacé cherries.

"I have, I've eaten too many cherries. Every cherry season I tend to eat too many first up and then don't touch them again until the end of the cherry season. Yes, it's very hard not to eat a lot of cherries. We allow our pickers to eat of course. Once again they'll usually eat for the first half hour of harvest and then they won't touch another cherry."

(6:19 – 6:43)

Cook it

Students EXAMINE the relationship between cooking and processing foods and the impact on nutrient value and aesthetics.

For example: if you were to cook fresh cherries by the methods listed below, how would the flavor, aroma, texture and appearance be affected?

Methods:

- Boiling
- Canning
- Dehydrating
- Freezing
- Frying
- Pickling

Lesson 9: Cooking with Cherries (continued)

- Roasting
- Sautéing
- Steaming

Would you prefer to eat cherries fresh or stewed? Fried or dried? Covered in chocolate or frozen in yoghurt?

DISCUSS whether fresh fruit has more nutrients than products containing dried, cooked or otherwise processed fruit.

Recommended source material:

'A study commissioned by the Victorian Cherry Association has conclusively concluded that "fresh cherries are indeed very beneficial in maintaining good health".

- Cherries have only 224 kilojoules (54 calories) per 100 grams and virtually no fat.
- Vitamins E and C and the flavonoids found in cherries and other fruits may slow ageing and they may slow or even reverse the symptoms of neurological diseases such as Alzheimer's and Parkinson's.
- Sweet cherries contain 16 antioxidants, plus a suite of other compounds with beneficial health benefits. Cherries may benefit people suffering from chronic inflammatory conditions such as gout, pancreatitis, or prostitis, as well as allergic conditions including asthma, hay fever, eczema and hives because they contain the compounds cyanidin and quercetin.'

– The Cherry Growers Association of South Australia:
www.cherriessa.com.au/cherries-your-health/

"We just walk along and taste them and have a look at the colour, the size and have a bit of a taste. If they're ready to go, they are nice and sweet."

(6:08 – 6:18)

In pairs or groups, students INVESTIGATE these questions:

- What does ripeness of fresh fruit (like cherries), have to do with flavour?
- Can this be measured? How?
- Why is the firmness of cherries so important to growers? (Why do consumers prefer firm fruit?)
- Are all varieties of cherries the same colour when ripe? Why not?

Add questions to the list to help students focus on the observational skills they will need to use in the kitchen when choosing and cooking with fresh fruit.

Researching cherry products

Students conduct online research (perhaps using supermarket websites) into processed foods using cherries (cherry ice cream, cherry chocolate, muesli with dried cherries, cherry fruit leather, etc.) The survey of packaging you did in Lesson 8 may assist with this.

Students EXPLORE how the food industry creates a new fruit product for market. This podcast will be useful:

- BBC Food Programme (podcast) – Ice Cream factory: https://www.bbc.co.uk/programmes/b00tnjsz

In pairs, students discuss and prepare a shared statement about these considerations in developing a new product:

- food safety;
- product shelf-life (preservation);
- ease of production (preparation);
- appearance (presentation); and
- flavour and sensory perceptions.

Cherry chompers

As a class, CONDUCT sensory assessment testing of a range of foods to determine how characteristics might be used in food product development.

If time permits, engage students in preparing some of the cherries below by, for example, using a dehydrator to dry cherries.

Try:

- Eating a spoonful of fresh cherries and then a spoonful of dried cherries.
- Eating a dried cherry on top of a sliver of goat's cheese.
- Drying cherries completely and grinding them to a powder before tasting them.
- Chopping pitted fresh cherries, mixing with a few ripped fresh mint leaves and a pinch of sea salt.
- Freezing dried cherries and tasting some dried cherries frozen, some unfrozen.
- Cutting cherries in half and frying them. Try a touch of butter or coconut oil in the pan.
- Freezing fresh pitted cherries in liquids of your choice, e.g. orange juice, milk, sweet tea.

Hands on

In the kitchen, students EXPERIMENT with food preservation methods such as pickling, bottling, drying and freezing cherries to determine changes to the taste, texture and aroma compared to fresh fruit.

Lesson 9: Cooking with Cherries (continued)

Ensure students explore the causes of food decay and some of the ways it occurs in daily life, 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 cherries in the fridge or cool room rather than leaving them out at room temperature for long periods of time.

Recommended source material:

> '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 –18°C 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

Project

In groups, DESIGN, PRODUCE and CREATE a healthy cherry 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.

Visit the ***From Paddock to Plate*** recipe section to find our delicious cherry recipes.

Lesson 9: Cooking with Cherries (continued)

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 cherry 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 find local cherry growers 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.*

- App Store: https://itunes.apple.com/us/app/paddock-to-plate/id1012377466?mt=8
- Google Play: https://play.google.com/store/apps/details?id=com.mavinapps.produce

EGGS

Ask students first to reflect on the *From Paddock to Plate* **Eggs Virtual Video Excursion**:

- How often do chickens lay an egg?
- What sort of environment do farmers build to keep their chickens happy and healthy?
- What can they say about the paddock to plate journey of Australian eggs?
- What did they learn that they hadn't considered before?
- What would they like to know more about the egg farming industry in Australia?

Facts and Vocabulary - Eggs

Facts about the Australian egg industry

- Australians consume an average of 213 eggs per person per year.

  SOURCE: Agrifutures Australia
- With the ability to manage larger flocks and the advent of mechanisation, the number of egg farms in Australia has decreased since the late 1970s from 3,200 in 1979 to 337 today.

  SOURCE: Agrifutures Australia
- There are 19 millions hens in farms across the country.

  SOURCE: Egg Farmers of Australia
- Approximately 15 million eggs are produced daily to meet domestic consumption.

  SOURCE: Egg Farmers of Australia
- The egg industry contributes 1.6 billion dollars to the Australian economy.

  SOURCE: Egg Farmers of Australia
- About half of all eggs are bought by consumers in supermarkets and grocery stores, the rest go to food manufacturers, restaurants, cafes and other food outlets.

  SOURCE: Egg Farmers of Australia
- The 12 (dozen) packs of eggs are most popular, with 83% of all grocery eggs sold in this pack size at 79% value.

  SOURCE: Australian Egg Corporation Limited (AECL)
- Hens are kept in two main types of production systems; cage and cage-free, which includes barn and free range systems. Many producers run more than one type of production system and in some cases more than one production system is operated on the same farm. These farms vary in size from less than 1,000 hens to over 500,000 hens. Farms with flocks of 20,000 - 60,000 are most common.

  SOURCE: NSW Department of Primary Industries
- Approximately 55% of hens are kept in cage production systems with the remaining in cage-free systems.

  SOURCE: NSW Department of Primary Industries
- Most aspects of egg farm operations are the same across all production systems – ie shed design, bird genetics, nutrition, routine husbandry, and egg collection and handling.

  SOURCE: NSW Department of Primary Industries
- The most common egg production system world-wide is cage, with approximately 80% of all eggs produced in this way.

  SOURCE: NSW Department of Primary Industries

Useful words and phrases

- Air cell
- Albumen
- Artificial insemination
- Avian
- Barn laid
- Battery cages
- Beak-trimming
- Best practice
- Biosecurity
- Blastoderm
- Blastodisc
- Bloom
- Breed
- Brooding
- Buffer distances
- By-product
- Calcium
- Candling
- Chicks
- Closed flock
- Clutch
- Coop
- Embryo
- Feed hopper
- Flock
- Free range
- Hatchery
- Hen welfare
- Layer
- Manure
- Omega-3 fatty acids
- Omnivorous
- Organic
- Pathogen pressure
- Poultry
- Pullet
- Roost
- Scotophase
- Scratch feed
- Shell membrane
- Stocking density
- UV steriliser
- Yolk

Lesson 10

Exploring Eggs

Themes

Food production | Food makers | Food in Australia | Food issues | Nutrition |

Review video

After watching the ***From Paddock to Plate*** **Eggs Virtual Video Excursion**, ask students to tell you one or more thing that surprised them about eggs or the way eggs are handled in a large production facility.

Here are a few potential examples to get you started:

"We have what's called a turner and it makes sure that all of the eggs are pointing downwards, because we want the egg pointing down in the carton so that it keeps better. It keeps the air cell at the top basically."

(5:43 – 6:00)

"We don't wash our eggs, because eggs have a natural antibacterial bloom and the mother hen puts that on to the egg to keep the egg nice and fresh. If you wash the egg that bloom is removed and the egg doesn't keep as well."

(6:01 – 6:20)

"We use UV light to sterilise the egg, so that if there is any dirt or germs on the egg, it is removed. The UV light only activates with the surface of the egg and the shell. Nothing inside."

(6:21 – 6:37)

Did you know?

- The surface of each eggshell can contain as many as 17,000 tiny pores.

Egg-sploring eggs

If possible, hand around eggs for students to look at. Crack some into a bowl and explore the pigment of the shell on the outside (which may differ to the inside), the texture of the outer shell and of the membranes on the inside of the shell.

Explore the yolk and the white of the egg. Students may hold the common misunderstanding that the yolk itself forms into a baby chick. Explain that this is not the case, that the yolk provides a rich source of food for the growing embryo. If you can see it in one of the eggs you have cracked, point out the small mass of cells called the blastodisc or germinal disc, which, if fertilised, will grow into an embryo that develops into a chick. Most commercial eggs are unfertilised, so this will not occur and can be very hard to see in commercial eggs. Many educational diagrams of eggs fail to label the germinal disc altogether, however there are basic diagrams for several stages of the development of the embryo here at Enchanted Learning that show this clearly:

- Egg and embryo development:
  https://www.enchantedlearning.com/subjects/birds/info/chicken/egg.shtml

Egg diagrams

Students research and draw a diagram of the structure of a hen's egg. They find out and write a short text explaining how an egg is formed inside a chicken. Resources below will assist, or you could direct students to other authoritative sources.

Teacher resources:

- Hedegaard – The structure of the egg:
  http://en.eggs.dk/the-egg/structure-of-the-egg.aspx
- Extension – How does a hen make an egg?
  https://articles.extension.org/pages/71258/how-does-a-hen-make-an-egg
- 4H Virtual Farm – The parts of an egg:
  https://www.sites.ext.vt.edu/virtualfarm/poultry/poultry_eggparts.html
- The Poultry Pages – Chicken egg:
  https://www.chickens.allotment-garden.org/eggs/structure-egg/

Eggs and nutrition

Students research the nutritional benefits and the guidelines for the healthy consumption of eggs. Provide sufficient time for them to create a short written report, poster, 5-minute presentation or podcast about eggs and human nutrition.

Be sure to establish criteria for the authority and credibility of the sources students use. The recommended source material below should assist.

Recommended source material:

> 'If there was such a thing as a perfect food, eggs would be a contender. They're readily available, easy to cook, affordable and packed with protein. "The egg is meant to be something that has all the right ingredients to grow an organism, so obviously it's very nutrient dense," says Christopher Blesso, associate professor of nutritional science at the University of Connecticut in the US...'

Recommended source material (continued):

'...Eating eggs alongside other food can help our bodies absorb more vitamins, too. For example, one study found that adding an egg to salad can increase how much vitamin E we get from the salad. But for decades, eating eggs has also been controversial due to their high cholesterol content – which some studies have linked to an increased risk of heart disease. One egg yolk contains around 185 milligrams of cholesterol, which is more than half of the 300mg daily amount of cholesterol that the US dietary guidelines recommended until recently. Does that mean eggs, rather than an ideal food, might actually be doing us harm? Cholesterol, a yellowish fat produced in our liver and intestines, can be found in every one of our body's cells. We normally think of it as "bad". But cholesterol is a crucial building block in our cell membranes. It also is needed for the body to make vitamin D, and the hormones testosterone and oestrogen. We produce all the cholesterol we need on our own, but it's also found in animal produce we consume, including beef, prawns and eggs, as well as cheese and butter. Meanwhile, along with prawns, eggs are the only food high in cholesterol that are low in saturated fat. "While the cholesterol in eggs is much higher than in meat and other animal products, saturated fat increases blood cholesterol. This has been demonstrated by lots of studies for many years," says Maria Luz Fernandez, professor of nutritional sciences at the University of Connecticut in the US, whose latest research found no relationship between eating eggs and an increased risk of cardiovascular disease. The discussion on the health effects of eggs has shifted partly because our bodies can compensate for the cholesterol we consume. And when it comes to eggs, cholesterol may pose even less of a health risk. Cholesterol is more harmful when oxidised in our arteries, but oxidisation doesn't happen to the cholesterol in eggs, says Blesso. "When cholesterol is oxidised, it may be more inflammatory, and there are all kinds of antioxidants in eggs that protect it from being oxidised," he says.'

– *The truth about eating eggs*, BBC Future, 17 September 2019: http://www.bbc.com/future/story/20190916-are-eggs-good-for-you

'First and foremost, eggs are a meatless source of complete proteins. Complete proteins contain essential amino acids that your body cannot produce itself, and which must come from the diet. This makes eggs a great food choice for vegetarians, who may otherwise struggle to get these essential amino acids with meat and fish cut from their diet. Fat, both saturated and unsaturated, is another macronutrient found in eggs. Luckily, most of that fat is of the unsaturated, heart-healthy variety that your body needs for keeping cell membranes healthy, protecting internal organs, and helping with absorbing fat-soluble vitamins. And all this is before we even touch upon the micronutrients...'

Lesson 10: Exploring Eggs (continued)

Recommended source material (continued):

'... Eating just two large eggs will provide your daily reference intake of vitamin B12, which is essential for keeping your metabolic and nervous systems healthy, among other things. Eggs are a great source of vitamin D, too, which the body needs for absorbing calcium, and keeping bones healthy. They are also one of the few foods that contain iodine, a mineral that's essential for keeping your thyroid glands, which produce the hormones that control your metabolism, functioning properly. It is true that eggs contain small amounts of cholesterol. However, unless you have high cholesterol levels and have been advised by a doctor to cut down or cut out your intake, there's no reason to avoid eggs, because all the good stuff makes up for that extra little bit of cholesterol.'

– *Why eggs are healthy* by Rozzie Batchelar, a nutritionist in Jamie Oliver's food team, 7 September 2015: www.jamieoliver.com/news-and-features/features/why-eggs-are-healthy/#eqWfL1mhVhj2JCFx.97

Lesson 11

Eggs and Nutrition

Themes

Food safety | Nutrition | Health

Hands on

Students TOUCH, SMELL and TASTE fresh eggs as well as other egg products including powdered/dehydrated egg. (Of course, follow allergy procedures for students with egg allergies.)

Students find out what the difference is, nutritionally, between boiled, poached, baked, scrambled and fried eggs. Do any of these preparation methods significantly alter an egg's nutritional value?

Students INVESTIGATE and CATEGORISE "good" fats and "bad" fats. DISCUSS the cholesterol level found in eggs.

As a class, EVALUATE methods of testing the freshness of eggs. EXPERIMENT by placing several eggs in a jug of water and see if any float! Which way up do they float? Can students observe bubbles on the shell of an egg when floating in water? Why might these appear?

EXPLAIN why eggs should not be washed with water (see Jan's response below).

"We don't wash our eggs, because eggs have a natural antibacterial bloom and the mother hen puts that on to the egg to keep the egg nice and fresh. If you wash the egg that bloom is removed and the egg doesn't keep as well."

(6:01 – 6:20)

Egg research projects

In groups or pairs, students FIND and LIST safe storing, preparation and handling methods for fresh eggs to reduce the risk of incidence of the bacteria Salmonella.

Students may engage with one of the following as a project arising from this lesson:

- EXPLORING methods of preserving and storing eggs to retain nutrients, including traditional techniques from diverse cultures.
- IDENTIFYING the difference between grain-fed and pasture-fed hens and EXPLAINING whether a bird's diet effects the flavour and yolk colour of the eggs they produce.
- RESEARCHING the legal definitions of free-range, pasture raised and barn raised eggs in Australia. EXPLORING what this means for labelling.
- EXPLAINING how a double-yolk egg is formed and why.

- EXPLORING processes and regulations in Australia designed to ensure the health and safety of products from the commercial egg industry.

Projects can be completed as homework or in additional sessions. Source material below may assist.

> "Our feed is a mixture of grains with soya and canola oil added. We don't use synthetic yolk colourants and therefore our yolk colour may vary. We believe that everything a hen does affects her and the egg she lays. And that a happy hen is a healthy hen."
>
> – Margaret River Free Range Eggs

"On the day that the eggs are graded, we date stamp the egg carton and we put four weeks on them from that date. When they go out onto the shelf, the consumer knows when those eggs were laid by the date stamp and how long those eggs will last in the refrigerator."

(7:33 – 7:51)

"When the carton is full, the processor takes them along and closes the egg carton, date stamps them (that date stamp is very important for the consumer) and then all of the cartons are put into outer boxes and back into the cool room. After 24 hours, they go out to the retailers."

(7:52 – 8:09)

"Temperature is critical for egg freshness. If you keep an egg in the refrigerator, between 5 and 13 degrees, it will keep very well for four weeks. However if you have it at a higher temperature the gas exchange is accelerated, there is an air cell in the egg, and the freshness of the egg deteriorates much faster. It's always good to keep your eggs cool and best in the fridge."

(9:00 – 9:31)

"Eggs are the most natural food available to man. They contain all of the nutrients that people need, except I think they are low in vitamin C. They've even got minerals and micronutrients that we don't know about yet. It's all natural."

(11:18 – 11:37)

Lesson 11: Eggs and Nutrition (continued)

"There are so many issues in the egg industry at the moment including methods of production and standards of hen welfare. Like any food, it's important that people know where their food is coming from and how it's produced and so it's always better to support local producers. You've got a much better idea of how that food is produced and you're supporting the local producer and the local economy."

(11:48 – 12:13)

"I love being an egg farmer. I especially like being a free-range egg farmer because it's challenging and it's also rewarding. I love being proud of the fact that I am producing a really good natural food in the best possible environment."

(12:14 – 12:28)

"Even though the economical rewards may not be great, we're passionate about what we do and passionate about the great product that we produce for the community."

(12:30 – 12:38)

Lesson 12

Cooking with Eggs

Themes

Food safety | Food preparation | Health | Preservation

Getting started

As a class, DISCUSS how many times a week students eat eggs, and brainstorm a list of the different cooking methods that they use. Create a list of recipes and dishes that include eggs, from egg on toast to omelettes, muffins, meringues, egg drop soup, soufflé and hundreds more.

Visit the ***From Paddock to Plate*** website recipe section to find our delicious egg recipes.

Hands on in the kitchen

As a class, EXPERIMENT with food preservation methods such as dehydrating and pickling eggs to determine how these processes change the texture, taste and aroma of eggs.

In pairs students EXPLORE and RECORD their observations about how these food preparation techniques affect the sensory properties (flavour, appearance, texture, aroma) of eggs.

Students propose uses of each of the preservation methods they try where the process would provide convenience as well as nutrition. For example: Dehydrating eggs into a powder to take on long camping trips or expeditions.

Taste comparisons

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

For example:

- Cooking and tasting free range eggs and caged eggs to compare their properties.
- Exploring the texture, yolk size and runniness of the albumen (white) of one-day versus 7-10 day old eggs.
- Boiling eggs for different lengths of time, then cutting and comparing the texture of soft, semi-hard and hard0boiled eggs.

Maintain practical focus on food safety and handling – reminding students how the causes of food spoilage can often be addressed when preparing, cooking, presenting and storing food items. For example, by developing a comprehensive checklist of considerations for safe and hygienic food storage and preparation including danger zone temperatures for a food service.

Student project

In groups, DESIGN, PRODUCE and CREATE a healthy egg snack for the canteen using a range of techniques to ensure optimum nutrient content, flavour, texture and visual appeal.

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

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

Students SURVEY their peers at the school to determine the popularity of their healthy egg snack through the marketing campaign. Remind students that they can and should MODIFY their recipe to accord for feedback where this will improve the result.

*Use the **Paddock to Plate** app to find local egg farmers to source fresh eggs 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 produce.*

- App Store: https://itunes.apple.com/us/app/paddock-to-plate/id1012377466?mt=8
- Google Play: https://play.google.com/store/apps/details?id=com.mavinapps.produce

Activity card:

Salmonella Disaster

DISCUSS and EXPLORE the difference between a natural disaster and an epidemic.

In 2019 a major outbreak of salmonella in the poultry egg industry in NSW came under investigation. Watch the video and read the ABC News article about the outbreak:

- ABC News: Salmonella egg contamination could result in significant chicken cull: https://www.abc.net.au/news/2019-03-23/salmonella-egg-contamination-could-cause-bird-cull/10931996

EXPLORE the information about probable causes of the outbreak, and the ensuing actions taken to protect public health.

Students construct an argument about the reasons for the outbreak and whether or not the response was sufficient and appropriate to the level of risk.

FISH

Ask students first to reflect on the *From Paddock to Plate* **Fish Virtual Video Excursion**:

- What does a typical day on a fishing boat look like?
- What can they say about the paddock to plate journey of Australian fish?
- What did they learn that they hadn't considered before?
- What would they like to know more about the fishing industry in Australia?
- What would they like to learn about how fish are processed and marketed in Australia and worldwide?

Facts and Vocabulary - Fish

Facts about the Australian fish industry

- Australia's wild capture fisheries and aquaculture industries contribute almost $3 billion a year to Australia's economy.

  SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017

- More than 14,000 people are directly employed by the commercial fishing and aquaculture sectors and many of these jobs are based in regional areas.

  SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017

- Australia's Exclusive Economic Zone extends 200 nautical miles from the coast and is the world's third-largest fishing zone (8.1 million square kilometres).

  SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017

- Around 300 boats operate in Commonwealth fisheries.

  SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017

- More than 3.5 million Australians are recreational fishers.

  SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017

- On average, Australians eat 140 serves of seafood every year.

  SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017

- The volume of fishery and aquaculture production increased by 4 per cent between 2006–07 and 2016–17. During this period, the pattern of production changed significantly, shifting from the production of wild-catch stocks toward production of aquaculture products.

  SOURCE: Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)

- Asia remains a major export destination for Australian fishery and aquaculture products. However, the pattern of Australian fishery and aquaculture exports has shifted towards the south-eastern China and Vietnam region. The major export product is rock lobster.

  SOURCE: Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)

- Australia's apparent consumption of seafood increased, on average, at an annual rate of 0.8 per cent between 2006–07 and 2016–17, increasing 9 per cent overall in this period. Owing to faster population growth, apparent per person consumption of seafood declined over the same period, from 15 kilograms per person on an edible equivalent basis in 2006–07 to 13.9 kilograms per person in 2016–17.

  SOURCE: Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)

Useful words and phrases

- Acoustic survey
- Algal bloom
- Artisan fishing
- Anadromous
- Antarctic convergence
- Aquaculture
- Beam trawling
- Benthos
- Biotoxins
- Bottom trawling
- Bycatch
- Casting
- Catadromous
- Cephalopods
- Cetacean
- Crustaceans
- Dredging
- Ectothermic
- Elasmobranch
- Endemic
- Estuary
- Farmed fisheries
- Fecundity
- Founder effect
- Gametes
- Ghost nets
- Habitat
- Hatchery
- Individual transferable quota (ITQ)
- Invertebrates
- Mariculture
- Marine mammal
- Meristics
- Migration
- Oceanodromous
- Plankton
- Shoaling
- Spawning
- Sustainable fishing
- Tag and release
- Threatened species
- Vertebrates
- Wild fisheries

Lesson 13

Fishy Business

Themes

Food production | Food makers | Food in Australia | Food issues | Nutrition |

Review video

After watching the *From Paddock to Plate* **Fish Virtual Video Excursion**, ask students to tell you one thing they found interesting or memorable about the fishing industry in Australia.

Here are some quotes from the video to get you started:

Food transport and production

"For air freight, we chill the product down quickly and then put it in foam eskys with gel packs and that's what goes on the plane."

(7:00 – 7:15)

Processing and food choices

"These days there are a lot of chemicals in foods and I prefer natural foods. We should support our farming industry and our fishing industry instead of buying all of these imported foods. I know we haven't got enough sometimes, but we should always choose Australian first."

(7:36 – 7:58)

Local food and sustainability

"I'm a big fan of sustainability. Catching the fish that you are going to eat. Using it from your environment. Not necessarily from your front door like I am here, but from your region. To keep the fishing industry sustainable, I think it's a matter of management."

(8:08 – 8:26)

Nutrition

"Anything fresh is good. Fish is an extremely healthy protein, very easy to digest, low in fat, high in vitamins and tastes good."

(8:27 – 8:34)

Sustainability

> "Sustainable seafood is about eating seafood today, tomorrow and into the future. It is about ensuring the ongoing vitality of the marine environment, the species that call it home, and the communities that it supports."
>
> – Oliver Edwards, Founder of GoodFishBadFish, www.goodfishbadfish.com.au

Deep sea data

Students find and ANALYSE data about the types and tonnage of fish caught in Australian waters last year.

- Government of Australia, Fisheries Data – Department of Agriculture: www.agriculture.gov.au/abares/research-topics/fisheries/fisheries-data

Working individually or in pairs, students write and present a report detailing the following questions as a minimum.

- According to the data source, what species represented the largest percentage of last year's catch?
- What are the main purposes and products to which these species are put?
- Why are some species more valuable (fetch a higher price) than others on the seafood market?
- Does this give rise to any questions about sustainability? What are they?

Work with students to DEFINE and ADD additional inquiry topics and themes to their project, relating to personal interest – the four quotations above are designed to introduce four themes or groupings that may pique student interest, but any topic covered in the video virtual excursion could spark additional inquiry topics and themes.

Examples of additional topics or themes include but are not limited to:

- Food transport – How has cold transport for fish evolved in recent decades and what does this mean for Australian fish export and import
- Food production – What are the methods and technology used to process fish and how is automation changing this?
- Food processing – What key species are made into food products in Australia and where are these sold (import/export)?
- Food choices – How have changing trends in consumption (e.g. health concerns) affected demand for seafood?
- Local food and sustainability – What should consumers and restaurants consider about local versus global supply and sustainability in fisheries and production?
- Nutrition – What are the evidence-based benefits of consumption of seafood?

Allow time and resources for students to complete and present their projects.

Lesson 14

Fish and Flavour

Themes

Food safety | Nutrition | Health | Hands on skills

Hands on

Students TOUCH, SMELL and TASTE fresh fish. (Of course, follow allergy procedures for students with seafood or shellfish allergies.)

With your guidance, students EXPERIMENT with food preservation methods such as drying, curing and smoking fish. Additionally, EXPERIMENT with cooking techniques such as baking, poaching and grilling. Students RECORD observations for each method.

EXPLAIN how the food preservation and preparation techniques above affect the sensory properties of the fish you have chosen to taste (i.e. changes to flavour, appearance, texture, aroma).

DISCUSS how cooks choose the appropriate method/s when designing foods for specific situations, such as dehydrating fish to take on camping trips.

Fish and fish products

After tasting fresh (plain) fish, with your guidance students CONDUCT sensory assessment testing of a range of fish foods to determine how characteristics might be used to enhance food solutions.

Examples include (but are not limited to) these taste experiments:

- Tasting saltwater fish and freshwater fish
- Comparing frozen fish to fresh fish of the same species
- Sampling wild and farmed fish
- Taste testing a variety of dried fish products
- Comparing fresh fish (e.g. tuna) to canned fish of the same species.

Spoilage and safety

Based on both hands-on sessions, students DETERMINE how the causes of food spoilage can be addressed when preparing, cooking, presenting and storing fish. They LOOK at standards for safe handling of fish and seafood products before creating a poster or checklist.

Lesson 15

Seafood Snack

Themes

Food safety | Nutrition | Health | Hands on skills

Project

In groups, students DESIGN, PRODUCE and CREATE a healthy fish snack for the canteen using a range of techniques to ensure optimum nutrient content, flavour, texture and visual appeal. Encourage them where needed to MODIFY their idea to generate an optimum outcome.

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

They EXPLORE various marketing strategies to promote the item at the school canteen as if it were in a healthy eating campaign. Encourage them to USE food photography and digital technologies to assist their promotional strategy.

DISCUSS and approve project plans with each group.

After student groups have had time to research, test and produce their recipe and promotional material, have groups SURVEY their peers in the wider school community to determine the popularity of their healthy fish snack through their marketing campaign.

*Use the **Paddock to Plate** app to locate fishers to source fish for this unit of work. Also use the app and **From Paddock to Plate** book to see how those in the fishing industry express their viewpoints on the nutritional content of the food that they produce.*

- App Store: https://itunes.apple.com/us/app/paddock-to-plate/id1012377466?mt=8
- Google Play: https://play.google.com/store/apps/details?id=com.mavinapps.produce