RESOURCE BOOK OF IDEAS

FOR NATIONAL SCIENCE WEEK 2021

FOOD DIFFERENT by design

Australian Science Teachers Association

national science week 2021

14-22 AUGUST 2021

www.scienceweek.net.au

An Australian Government Initiative

Inspiring Australia

Photo by Sara Scarpa on Unsplash

Acknowledgements

This online curriculum-linked resource was produced by the Australian Science Teachers Association (ASTA).

It is designed to introduce students to the importance of science and technology in solving problems, designing new solutions and driving an evolution in food-based industries.

The materials in this educational resource have been developed by Angela Colliver from Angela Colliver Consulting Services Pty Ltd and designed by Carl Davies, CMD Photographics.

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CONASTA 69 is the national science education conference of the Australian Science Teachers Association, proudly hosted in 2021 by the Science Educators' Assocation of the ACT (SEAACT).

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Minister's Foreword

The Honourable Karen Andrews MP

Minister for Industry, Science and Technology

The Australian Government is a proud supporter of National Science Week, which provides high profile science engagement activities right across the nation. It is also an important opportunity for our science community to celebrate and showcase science to the Australian public and the world.

This year, the school theme for National Science Week is 'Food: Different By Design'. Australia is a leader in food production, and it is science that can supercharge our food future. Our national scientific research agency, the CSIRO, along with Australian industries and entrepreneurs, is already forging bold new ground using science to see into the future, where exciting innovations are waiting to be explored.

Already we've seen examples of Australia's growing alternative protein industry. Last year CSIRO announced a partnership with plant-based meat product start-up V2Foods- a new company formed using CSIRO science, investment from the CSIRO Innovation Fund and in partnership with Competitive Foods.

CSIRO is further reinventing Australia as a leader in food innovation, including developing uniquely Australian plants that can produce omega-3 fatty acids, usually sourced from the world's wild fish stocks. It's a win for the environment, the Australian economy and for global health, with omega-3 oils a key component for childhood development.

We can also already 3D print food, creating new techniques and textures for global consumers to enjoy. It's not hard to imagine our students using 3D printing to design and deliver high-value foods that simply haven't existed before and exploring the possibilities of this rapidly accelerating technology.

Exploring the role of science in food production and sustainable agriculture this National Science Week gives us the opportunity to increase our communities' understanding and support young people being active in a growing area of science-driven research and innovation.

I commend the Australian Science Teachers Association for another excellent publication that will no doubt encourage and inspire our future generations. I look forward to hearing about the inspirational stories and initiatives from within your school communities throughout the 2021 National Science Week.

national science week 2021

An Australian Government Initiative

Inspiring AUSTRALIA

Australian Science Teachers Association

Introduction

National Science Week is Australia's annual celebration of science and technology.

It aims to provide an opportunity to acknowledge the contributions of scientists, STEM (science, technology, engineering and mathematics) professionals, innovators, designers and entrepreneurs to the world of science.

It also aims to encourage an interest in science and STEM among the public. And this year, it also seeks to educate and inspire student's thinking and encourage them to design a range of food solutions.

'Food: Different By Design' is the school theme for National Science Week in 2021.

This is an important theme for teachers and their students which allows them to focus on sustainable food futures. Every day we must eat. Food is our fuel for life. When we consider how to eat, we also need to think about why we need to eat well.

There are many reasons why we eat, with one of them being that nutrients are essential. It is these nutrients that keep us alive. Our bodies are made up of trillions of cells that work together, and they can only do that when there are nutrients present. So, when a person is not getting adequate nutrients, some of the most basic body processes are affected.

In December 2019, the United Nations created two new international days and one new international year devoted to issues relating to food and agriculture. The UN General Assembly adopted resolutions designating 2021 as the International Year of Fruits and Vegetables, 21 May as International Tea Day, and 29 September as International Day of Awareness of Food Loss and Waste.

With this in mind, some of the scientific discoveries, inquiries, activities and themes used in this resource book examine fruits, vegetables, tea and food waste. Other themes include cooking with food, preserving food, bottling food, fermenting food, upcycling food, designing gardens, designing menus, plates and even designing insect-based burgers.

This year's *Resource Book of Ideas for National Science Week* offers teachers and students the opportunity to explore these concepts in addition to this year's theme.

In compiling this resource book and its ideas, we have tried to sample the full breadth of topics and issues that might interest students in early childhood, primary and secondary school settings. We have also attempted to highlight food science, food-based research, food-based industries, food technologies and food innovations at work in Australia and overseas in the case studies and impact stories scattered throughout the resource.

The case studies have also been linked to the UN **Sustainable Development Goals** (SDGs) in acknowledgement of the United Nations' proclamation of 2021 also being the **International Year of Creative Economy for Sustainable Development**.

The following icons can assist teachers in locating activities and case studies that support inquiries in those areas.

How to use this resource book

This resource book provides learning experiences to support your school's involvement in National Science Week 2021.

A suggested learning sequence

The Project-Based Learning (PBL) learning sequences used in some of the learning activities in this book are underpinned by the work of Lee Watanabe-Crockett, the founder of the Global Digital Citizen Foundation.

The PBLs use the Solution Fluency methodology through six phases: Define, Discover, Dream, Design, Deliver and Debrief. The phases of the model are based on the **21st Century Fluencies** created by Crockett et al. (2011).

The Essential Fluencies are outlined extensively in the book *Mindful Assessment* (Crockett & Churches, 2016, published by Solution Tree). See also '**Solution Fluency**' on the Global Digital Citizen Foundation website, and the Solution Fluency video **Solution Fluency** on YouTube (3:13 min).

For reference, the fluencies are:

- **Define:** The 'Define' phase begins with lessons that intellectually engage students with a challenge, problem, question and task. This phase captures their interest, provides an opportunity for them to express what they know about the topic, share understandings being developed, and helps them to make connections between what they know and the new ideas.
- **Discover:** The 'Discover' phase includes activities in which students can explore, investigate, research, read, discuss, gather, organise and compare knowledge and data. They grapple with the challenge, problem, question or phenomenon and describe it in their own words. This phase provides a context and enables students to acquire a common set of experiences they can use to help each other make sense of the new knowledge or understandings.
- **Dream:** The 'Dream' phase enables students to imagine and develop possible solutions and explanations for the challenge, problem, question and task they have experienced. The significant aspect of this phase is that the students' explanations follow substantive conversations and higher-order thinking experiences.
- **Design:** The 'Design' phase provides opportunities for students to apply what they have learned to new situations, to map production processes and so develop a deeper understanding of the challenge, problem, question or phenomenon. It is important for students to extend explanations and understandings, using and integrating different modes, such as diagrammatic images, written language and media.
- **Deliver:** The 'Deliver' phase has two stages—production and publication or presentation. In the production phase, the task comes to life—this is the doing aspect. At the end of this phase, the student task should be completed. Next, they present or publish their work sample to an audience.
- **Debrief:** The 'Debrief' phase provides an opportunity for students to revisit, review and reflect on their own learning and new understanding and skills. This is also when students provide evidence for changes to their understanding, beliefs and skills.

*Source: '**Solution Fluency**', Global Digital Citizen Foundation website.*

Aims

The National Science Week Resource Book, *Food: Different By Design* provides schools with opportunities as follows:

- explore the creative processes at the heart of STEM and their far-reaching influence in differing food contexts;
- develop an understanding of the roles STEM, design and innovation play in understanding and addressing complex, real-world, food-related scenarios;
- discover how STEM has, and is, enabling scientists, researchers, inventors, entrepreneurs, engineers and creative thinkers in growing food-related industries to influence what we might eat;
- discover and envision a range of creative solutions to real-world, food-related scenarios;
- dream and consider the many possible solutions to deal with the challenges posed by how we source, process and consume food;
- design research projects with the goal of sharing exhibitions, events, performances and educational activities, as part of National Science Week;
- design the steps required to create exhibitions, events, performances and educational activities, as part of National Science Week;
- deliver and debrief solutions for real-world, food-related scenarios; and,
- practise and reinforce the STEM messages delivered in the Australian Curriculum Learning Areas, General Capabilities and Cross-Curriculum Priorities.

For schools, there is also the scope for teachers to integrate this resource book into their existing classroom programs.

Teachers can use the learning experiences to plan, publicise, provoke, stimulate, support and inspire their National Science Week festivities. It is recommended that the activities are read and considered well before National Science Week, as many involve preparation and timing considerations.

The 'Solution Fluency' PBL activities require many weeks of work. The standalone activities and fun ideas for science stations referenced to on **page 8** can be undertaken during, before and after National Science Week.

The resource book includes ideas to support students' involvement in investigating, exploring, experimenting, designing, creating and communicating their understandings about past, present and future-focused food industries that make use of scientific, technological, ecological, social and economic knowledge. It also supports students to design, plan and evaluate food-related enterprises, activities, technologies and equipment.

The resource book is complemented by a National Science Week journal or design folio that can be downloaded and printed. It is intended for older students to record their ideas: from defining the problems posed in the suggested activities to debriefing the solutions they devise.

The standalone activities and ideas for classroom work and science fairs found in the 'Have a go at this', 'Design studio', 'Grow' and

'Flavour of the month' sections of this resource book involve the purposeful application of knowledge, experience and resources to invent, design, create and make food-related products, services and environments as well as experiment with scientific concepts of food microbiology in preserving foods, pasteurisation, the freezing of foods, canning foods, freeze-dried foods, fermentation, hydroponics and aquaculture.

Students can discover how yeast, in a warm, moist environment and fed with a little sugar, starts multiplying furiously, converting sugar into carbon dioxide and ultimately, alcohol. They can marvel at the basic chemistry that links bread, wine, yoghurt and cheese, and see how the same genetic science explains cloning, cancer and genetically modified foods. Similarly, they can consider some of human technology's great achievements, like probiotic yoghurt.

The resource book includes case studies and links them to the United Nations Sustainable Development Goals.

The resource book also addresses some of the greatest human challenges ahead, like food supply, food security and food justice, which will need scientific and technical solutions.

Finally, the science of the future foods is also addressed in the book, including: meat grown in a lab; the world of insect farming; plant-based meat, dairy foods, fried chicken and seafood; and vegan eggs made from mung beans.

The 'At a glance' section (**page 7**) gives an overview of activities linked to this resource book.

The 'Looking for PBL Tasks for National Science Week' section (**page 8**) provides an overview of what is involved in each PBL task that uses the Solution Fluency methodology in the resource book.

Curriculum focus

This learning resource has a variety of student activities that link to the Australian Curriculum for science, technologies, mathematics and the arts. It also has many opportunities to integrate the Australian Curriculum's General Capabilities and Cross-curriculum Priorities into schools' learning programs.

STEM, STEAM and PBL are supported in the ideas in this resource book.

Teaching and learning featured in this resource book can therefore be integrated into a range of learning areas and learning contexts in the lead-up to, during and after National Science Week.

At a glance…

The following overview chart provides page references and links to standalone activities and ideas for science fairs. The number in brackets after each activity denotes the page number.

Activity	Foundation–Year 2	Year 3–Year 6	Year 7–Year 10
STANDALONE ACTIVITIES FOR SCIENCE FAIRS			
	Happy lunch making (page 22)	Design and make soups (page 37)	Food production systems (page 76)
	Design and create a salad to go (page 24)	Making mince fabulous (page 39)	Fertilisers (page 77)
	From paddock to plate (page 25)	Design your own tea party (page 41)	Sustainability in food production (page 78)
	Let's mix and make (page 26)	Melting, freezing, heating and cooling using yoghurt (page 42)	Plant perfect (page 80)
	Food is nourishment (page 27)	Where does it come from and how is it made? (page 44)	Design a pollen trap (page 81)
		From the farm gate to your lunch box (page 56)	GM (page 83)
		Design and make a long-handled fishing net to catch fish (page 58)	
		Design and make a water filter (page 59)	
		Square foot gardening—a new food trend (page 60)	
DESIGN STUDIO			
	Design a cheese platter (page 17)	Design and make a 'Jar of Wonder' (page 32)	Design a bug-based burger (page 67)
	Design a vegie snack (page 21)	Design a pizza party (page 36)	It is easy eating green (page 75)
		Design a pasta dish that everyone will love (page 52)	
		Design a nutritional chart showing nutrition in food and foods that people are intolerant or allergic to (page 55)	
GROW			
	Avocados (page 21)	Capsicums (page 35)	Onions and garlic (page 52)
FLAVOUR OF THE MONTH			
	Dairy foods (page 17)	Rhubarb (page 32)	Plant-based meat (page 67)
	Vegetables (page 20)	Zucchini (page 35)	Kale (page 75)
		Tea (page 41)	
		Onions (page 52)	
		Cucumbers (page 55)	

Looking for Project-Based Learning (PBL) Tasks for National Science Week

The following information provides an overview of what is involved in each PBL task that uses the Solution Fluency approach in this resource book.

Foundation–Year 2

Activity 1: Designing with dairy (page 13)

In this learning sequence, students discover what it takes to change milk into other dairy foods. In this unit, they investigate; process and analyse experimental data; record ideas and work completed; and evaluate and reflect on their achievements as well as communicate their findings.

Students will:

- investigate dairy foods;
- discover ways to change milk into other dairy foods;
- make milk, ice cream and butter;
- undertake science investigations;
- observe changes when cooking with dairy foods;
- melt cheese;
- design a healthy snack using dairy foods; and
- create a photographic buffet of snacks and present these as part of National Science Week.

Activity 2: From seed to salad (page 18)

In this learning sequence, students are challenged to explore plant growth to better understand and appreciate what they can do to grow, harvest and then produce a type of food product for others to eat. They also design and produce an environment to produce a lettuce, radish, or sprout seedling for planting in the school vegetable garden. They evaluate their design and suggest improvements where necessary, giving reasons.

Students will:

- explore plant growth;
- design and produce an environment for either a lettuce, radish, or sprout seedling;
- plant seedlings;
- write a procedural text; and
- evaluate their design.

Year 3–Year 4

Activity 1: Preserving (page 30)

In this learning sequence, students explore preserving methods used in modern and traditional societies and then design and make a designed solution for preserving something grown and produced at school or home.

Students will:

- explore preserving methods;
- experiment with how to preserve olives;
- create a labelled drawing;
- write a procedural text;
- preserve a food that was grown at home or school;
- design a recipe for a cookbook; and
- explain a preserving method.

Activity 2: Making bread (page 33)

In this learning sequence, students explore bread baking methods used in modern and traditional societies and then design and make a designed solution for baking a type of bread. They discover how yeast, in a warm, moist environment and fed with a little sugar, starts multiplying furiously, converting sugar into carbon dioxide and alcohol.

Students will:

- investigate methods of making bread;
- learn about the chemistry of yeast;
- experiment with yeast;
- record their observations;
- investigate cultural traditions associated with bread;
- create a visual display;
- investigate methods and technologies used in bread making;
- write a procedural text; and
- design and present a labelled picture recipe as part of National Science Week.

Year 5–Year 6

Activity 1: Sustainable eggs (page 49)

In this learning sequence, students explore production systems used by egg farmers and then design and make an information guide about the importance of producing eggs sustainably.

Students will:

- investigate how eggs are produced in Australia;
- research the Australian egg industry; and
- create and present an information guide that shows how to produce eggs sustainably at home or on a school farm.

Activity 2: Investigate technologies used in food production (page 53)

In this learning sequence, students work in small groups to find out more about technologies used on farms, in fishing and in aquaculture ventures. They investigate technologies used in the primary industry sectors that produce food and complete a design task that could assist in producing food.

Students will:

- investigate technologies used in the primary industry sectors;
- design a fencing system;
- draw labelled sketches;
- complete a scale drawing;
- write an explanation; and
- share their designed solutions as part of National Science Week.

Year 7–Year 10

Activity 1: Pitch a food idea (page 64)

In this learning sequence, students investigate some research that explains how the eating habits of millennials are impacting on the food industry. They design and cook sustainable dishes as well as design a solution and sell their pitch as part of a competition.

Students will:

- discover how the eating habits of millennials is impacting on the food system;
- analyse theories and business ideas;
- explore innovative ideas;
- design and cook a range of dishes;
- re-imagine and design an idea; and
- pitch the idea as part of National Science Week.

Activity 2: Game changing ideas in food (page 71)

In this learning sequence, students investigate a range of new ideas that are changing our food system. They use a variety of thinking strategies, embrace new concepts and learn through trialling, testing and refining ideas. They then design a solution and produce a folio of ideas to explain their entrepreneurial thinking.

Students will:

- research ideas;
- investigate ideas changing our food system;
- design a food solution; and
- create a design folio to share as part of National Science Week.

FOR THE EARLY YEARS OF SCHOOLING

FOUNDATION TO YEAR 2

FOOD

DIFFERENT by design

Australian Science Teachers Association

Dairy Australia

Science is at the core of the dairy industry.

Whether it's genetics, robotics or nutrition, Dairy Australia's Discover Dairy provides all the tools and curriculum linked resources needed to bring the science behind the Australian dairy industry into the classroom. Discover Dairy in your classroom today!

SCIENCE BASED ACTIVITIES

Discover Dairy's inquiry unit resources are filled with suggested activities for different learning areas that align with the Australian Science curriculum.

Visit **dairy.edu.au** to discover science based activities

ONLINE RESOURCE HUB

Dairy Australia's Discover Dairy online resource hub is home to comprehensive range of free, curriculum aligned, innovative teaching tools needed to deliver agriculture lessons within the classroom.

Visit **dairy.edu.au**

PICASSO COWS PROGRAM

Join Dairy Australia's flagship schools' program, Picasso Cows, a guided, curriculum-aligned, interactive learning experience bringing the dairy industry to life in the classroom program. Schools receive an almost life size fibre glass cow to design and decorate all whilst learning about the Australian dairy industry.

Find out more at **Discover dairy**

DISCOVER DAIRY

3003 | Feb 2021

Activity 1: Designing with dairy

Overview: *Explain to the class that they will be exploring dairy foods and that they will discover what it takes to change milk into other dairy foods. In this unit, they will: investigate; process and analyse their experimental data; record ideas and work completed; evaluate and reflect on their achievements; and communicate their findings.*

Background science for teachers and students: Dairy foods

Dairy foods make up an important part of our diet, yet most people rarely think about where they come from or how they are made. In this unit, students explore milk and all the dairy foods that stem from this one ingredient.

Working with milk is remarkably scientific. Using some relatively simple laws of science, students transform milk into cream and fresh butter. They will also explore how dairy foods—when whisked, cooled, dried, warmed up and then cooled—can change properties. They will also prepare a healthy snack using a dairy food.

The essential question

How can we investigate and understand more about dairy foods?

The scenario

National Science Week is searching for schools to discover what it takes to change milk into other dairy foods.

In the past, many homes had a cool dairy room or a 'buttery' that was reserved for making dairy foods. Now it's your turn. What kind of chef will you be and what laws of science will you discover as you make your own dairy foods?

What science investigations can assist you in your mission to make a dairy food? What physical changes might milk undergo to become butter, cream, yoghurt, ice cream and cheese?

Your challenge is to use a range of hands-on activities and videos to help understand what changes occur to milk when we create dairy foods. Are you up for the challenge?

If so, then create a story using photographs or illustrations showing the steps involved in making a healthy snack using one or more dairy foods.

A suggested learning process

Define

Capture students' interest about dairy foods by using photographs and recipe books.

Talk about what the students think they know about how milk can be physically changed to create other dairy foods.

Make predictions and record these ideas. *For example*: 'I predict milk is … to make … '

View a video to explore what happens to milk when it is added to an egg. In this video, milk is added to a beaten egg. Ask students to predict how the milk, when poured into the beaten egg, might physically change. *For example*: 'The white milk changes to look yellow. The milk becomes thicker.'

Talk about how cooking might change the milk and egg mixture. Ask students to make their predictions.

Watch the 'I can cook a Sweetheart Quiche' **episode** of *I Can Cook* (14:20 min) and confirm predictions.

View another cooking episode that has the reverse procedure, where a fresh egg is whisked and then milk is poured into the egg mixture. Ask students to predict how the egg yolk and egg white might be physically changed, firstly when whisked and secondly after having milk added to the mixture. Record the students' predictions and display them. This recipe also involves milk being added to the whisked egg and then the egg and milk being added to flour. Ask students to predict what might physically change when the milk is added to the whisked egg, and then when this mixture is added to flour. Record these additional student's predictions and display them.

Confirm predictions by watching the cooking of a recipe in a video titled '**I can cook toad in the hole**' (13:16 min).

Discuss milk. Ask students to think about what they can do to change the properties of milk, such as thicken it, heat it, or freeze it.

Ask students what they might need to know more about to undertake the challenge set by National Science Week. Might they need to know something about milk and what it can be made into?

Brainstorm what students know about what foods milk can be made into. List key words and ask students to create an annotated drawing that includes pictures and words or descriptions about the dairy foods they know about.

Discover

Ask students to use colourful language and describe the different appearances and shapes of the dairy foods they find on Dairy Australia's *Discover Dairy* **webpage**.

Create a 'Word Wall' in the class describing the different appearances and shapes of dairy foods.

Undertake some 'scientific research' and ask students think about what might have happened to the milk to make the butter, cream, yoghurt, powered milk, ice cream and cheese.

Ask students to record their predictions.

Talk with the class about milk, fresh from the cow, having both cream and milk mixed. The cream is less dense than the milk, so the cream rises to the top where it can be skimmed off to leave behind skim or light milk. Or, the cream can be blended in to make full-cream milk—scientists call this being homogenised or "all the same".

Explain that butter is made from cream, which by being whisked or churned, turns into butter. In groups, students will use cream to make butter.

Make butter using clean jars with tight-fitting lids, a marble and different types of cream, including pouring cream, light cream, whipping cream, double cream, thickened cream, sour cream and crème fraîche. Ask students to experiment with another way of making butter.

Use iPads and time how long it takes to make butter.

Find out what students now know about how cream, when whisked, can change properties and become butter.

Encourage students to tell, write or draw their ideas. Display these for future reference.

Model how butter can be made another way using the following tools and ingredients. You will need:

- An electric whisk
- Two mixing bowls
- Clean perforated kitchen wipe or cheese cloth
- 500ml cream (35% milk fat) at room temperature
- A sieve
- A plastic plate

Ask students to:

- Pour the cream into the first mixing bowl and beat for approximately 5–6 minutes or until the cream starts to thicken.
- Line the sieve with the clean kitchen wipe or cheese cloth and sit it over the second bowl.
- Pour the cream mixture onto the cloth, gather the sides of the cloth around the mixture to form a tight ball and squeeze out as much buttermilk as possible into the bowl below.
- When this is done, remove the butter left inside the cloth and refrigerate.
- The butter is now ready to be spread on bread or crackers.

Ask students to watch the milk and cream change, talk about what is happening and why, then record their ideas as a word chain describing the changes as they occurred.

For example: Whisk cream—butter comes together into clusters—butter separates from the buttermilk.

Talk with the students about the butter needing to be refrigerated or frozen to prevent it from spoiling. Ask questions about whether these cooling processes might change the properties of the butter too.

Transform the student-made butter by blending herbs and spices with it.

Brainstorm the types of herbs that might add flavour to the butter. (*For example*, freshly chopped garlic, parsley, thyme, basil or fennel).

Experiment with adding flavourings by first bringing the butter to room temperature, flattening the butter into a rectangle on a sheet of greaseproof paper, sprinkling the flavourings over the top and rolling the butter up to form a cylinder. Wrap up and store the cylinder in a refrigerator or freezer until solid and then slice before using it.

Model the creation of ice cream with *Full-Time Kid's* YouTube **video** (1:29 min).

Talk with the students about how the video demonstrated how milk changed it properties this time when it was cooled.

Ask students to watch the cream change, talk about what is happening and why, then record their ideas as a word chain describing the changes that occurred this time when making ice cream.

Invite students to compare observations too.

Discuss questions like:

- What can we do to milk and cream to change it into ice cream?
- Can we possibly change ice cream back into milk and cream? Why or why not?

As a class, think about the properties of cheese and how they might change when heat is added. Ask students to visualise cheese melts, macaroni cheese and melted cheese on a pizza.

Provide a table for students to record their thinking.

Before and After

This is ....
It looked like this before it melted
It looked like this after it melted
Write about the differences ....

Ask questions like:

- What changes do you think can happen to cheese?
- Why do you think that?
- What does cheese need to melt?
- How can we do that?

Talk about what type of cheese might melt the fastest: grated cheese, sliced cheese, or a block of cheese.

With teacher assistance, compare the melting rates of 5 grams of grated cheese; 5 grams of sliced cheese; and 5 grams of cheese in a block or cube. Melt these on a slice of toast.

Provide a table for students to record observations of what happens.

My science record

Question: Which type of cheese melts fastest? **5 grams of grated, sliced or cubed cheese.**
I predict: ....
I observed that: ....
It looked like: ....
.... **melted fastest.**

Talk about which style of cheese would be best to use when making a pizza, macaroni cheese and a cheese melt. Discuss why students made their choices.

Form pairs to write a short, illustrated record about the science involved in making cheese meals.

Share the students' science understandings with others.

Dream

Ask students to visualise being in a kitchen, with the help of an adult if needed, and creating a healthy snack using a dairy food. What might that snack be?

View recipes on the *KidsHealth* website showing how to make:

- **Cream Cheesy Cucumber Sandwiches**
- **Yoghurt on the Go**
- **Milkshake**

Ask students to imagine the steps involved in making their healthy snack using one or more dairy foods.

Challenge students to think about the materials, tools, equipment and ingredients they will need to make their healthy snack using a dairy food.

Ask students to imagine how they are going to create a story using photographs or illustrations to help tell the story about how to create a healthy snack that uses one or more dairy foods.

Invite students to think about how they might photograph or find photographs to help tell the story about how to create their chosen healthy snack that uses one or more dairy foods.

Design

Ask students to decide on their healthy snack that incorporates a dairy food.

Invite students to design the front cover of their story that will record the steps involved in making their chosen snack using a dairy food.

Talk about the importance of a good title and ask students to decide on a title for the title page.

Ask students to draft the steps involved in making their chosen dairy snack recipe.

Ask students to gather the materials, tools, equipment and ingredients needed, and then to demonstrate each step involved in making the healthy snack for a friend.

Invite students to make the healthy dairy snack using one or more dairy foods.

Invite a peer class group to the class and ask students to explain how their healthy snack that uses a dairy food is made to this audience and seek feedback on their ideas.

Deliver

Ask students to communicate how their healthy snack is made and write, illustrate, or photograph the steps involved from start to finish.

Share stories showing the steps involved in making a healthy snack using dairy foods.

Create a photographic buffet of snacks using dairy foods and enjoy a day of learning about healthy snacks that include a dairy food.

Set up tables or booths in the class and invite students, teachers and parents to enjoy the students 'Dairy Designs'.

Debrief

Ask students to reflect on their learning. Ask students to:

- draw something new they learnt about how dairy foods can be changed;
- describe their favourite memory of creating butter;
- talk about what they learned about how to make ice cream;
- recall which form of cheese melted the fastest when heated on a piece of toast; and
- record what was learned about writing and illustrating stories with different steps showing how to make a healthy snack using a dairy food.

Curriculum connections

Australian Curriculum: Science

Foundation, Year 1 and Year 2

Science

Year 1

Science Understanding: Chemical Sciences

Everyday materials can be physically changed in a variety of ways ACSSU018

Science as a Human Endeavour—Nature and development of science

Science involves observing, asking questions about, and describing changes in, objects and events ACSHE021

People use science in their daily lives, including when caring for their environment and living things ACSHE022

Science Inquiry Skills

Respond to and pose questions, and make predictions about familiar objects and events ACSIS024

Participate in guided investigations to explore and answer questions ACSIS025

Use informal measurements to collect and record observations, using digital technologies as appropriate ACSIS026

Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions ACSIS027

Compare observations with those of others ACSIS213

Represent and communicate observations and ideas in a variety of ways ACSIS029

Technologies

Foundation, Year 1 and Year 2

Design and Technologies—Processes and Production Skills

Explore needs or opportunities for designing and the technologies needed to realise designed solutions ACTDEP005

Generate, develop and record design ideas through describing, drawing and modelling ACTDEP006

Use materials, components, tools, equipment and techniques safely to make designed solutions ACTDEP007

Use personal preferences to evaluate the success of design ideas, processes and solutions, including their care for environment ACTDEP008

Sequence steps for making designed solutions and working collaboratively ACTDEP009

General Capabilities

Literacy, Critical and creative thinking, and Personal and social capability.

Flavour OF THE MONTH

Dairy foods

Milk is a natural drink filled with eight essential nutrients including protein and calcium. Excess milk can be upcycled in recipes like paneer, which is a type of cottage cheese used in Indian cooking.

DESIGN studio

Design a cheese platter

Design a mixed cheese platter for friends to share.

Did you know the bacteria *Enterococcus faecalis* is used to flavour Greek feta cheese and Portuguese picante cheese? Cheesemakers use a menagerie of fermenting microorganisms including a number of varieties of bacteria, moulds and yeasts. The most basic step in making cheese is fermenting milk with bacteria that converts its sugars to lactic acid. The milk curdles and then rennet is added. The enzymes in the rennet separate the solid curds from the milky whey and salt is then added; sometimes moulds are introduced too.

FOOD DIFFERENT by design

Case study

Australian dairy farmers

Australian dairy farmers use a range of sustainable practices on farm to raise their cows and produce milk. Many farmers also have robotic dairies where the cows milk themselves. Australian dairy farmers use sensors and tracking devices that give them the ability to track a cow's activity levels, health and other key behaviours (like reproduction activity) to increase output and overall herd wellness.

Use Dairy Australia's resources on the **Dairy Matters** platform to find additional information about how dairy cows are farmed, raised and produced in managed environments on Australian dairy farms, and how milk is processed in a plant and then used to produce other dairy products.

Learn more about the industry's **sustainability framework and 2030 goals**.

Activity 2: From seed to salad

Overview: *Explain to the class that they will be exploring plant growth to better understand and appreciate what they can do to grow, harvest and then produce a type of food product for others to eat. They will also design and produce an environment to produce a lettuce, radish, or sprout seedling for planting in the school vegetable garden. They will also evaluate their design and suggest improvements where necessary, giving reasons.*

Background notes for students: What is agricultural science?

Have you ever wondered why most plants begin as a seed? If you have ever asked questions like this, then you were thinking like an inquiring scientist. The word 'science' comes from the Latin word that means 'knowledge'. Science is a way of creating knowledge about the natural world that starts with a question and then tries to answer that question with lots of evidence and logic.

Science is more of a process than a body of knowledge and scientists are continually testing and revising their ideas, and as new knowledge is gained or new observations are made, ideas may be replaced with new ideas.

Agricultural science is a different kind of science—it is multidisciplinary, and you learn about the relationship between plants, animals, soil and climate.

The essential question

What happens when we understand the steps involved to get from a seed to a food product?

The scenario

The school canteen is searching for classes to grow a range of salad ingredients for the canteen's 'Summer Menu'.

In the past, salad ingredients have been purchased from local supermarkets. Now it's your turn to help the canteen source local, fresher, salad ingredients. What kind of salad ingredient will you grow and what laws of science will you discover as you discover what plants need to grow?

What science investigations can assist you in your mission?

Your challenge is to grow a salad ingredient, harvest it, and then help the school canteen produce and prepare a salad.

A suggested learning process

Define

Capture students' interest and share the story **Growing Vegetable Soup** by Lois Ehlert.

Display the cover and subsequent pages on an electronic whiteboard and talk about the story's messages.

Choose a selection of ideas to discuss and extend. *For example*: Where are the seeds? Where are the plants? What are they given to help them grow? What else helps them grow into plants?

Discover

Pose the question: 'What's the salad ingredient you might like to grow?'

Discuss students' ideas.

Create a list to show what has been discussed.

Categorise the different salad ingredients and make word lists for each category. *For example*: 'Types of sprouts'; 'Types of lettuce'; 'Types of herbs'; 'Other salad ingredients'.

Undertake some 'scientific research' into the scientific steps involved in growing seeds into plants. Think about using the library, talking to a gardener, or searching for ideas online.

Talk about how some seeds can be:

- grown in soil,
- grown without soil, and
- grown in a jar.

Talk about how sprouts can be grown between a few layers of damp paper towel in the bottom of a recycled container and how lettuce and herb seeds need to be grown in soil.

Set up workstations with recycled containers, soil, paper towel, seeds, water and gardening tools.

Form groups and invite students to select from growing radishes, lettuce, or sprouts as well as plan the steps involved in growing one teaspoon of seeds.

Ask students to undertake their planting and then create a visual representation to plot the steps involved.

Revisit the story 'Growing Vegetable Soup' and brainstorm what else is needed to help seeds grow. Discuss where the pots containing seeds might best be placed in order for them to receive what they need (i.e., sunlight and regular watering). Support students to construct a procedural text: 'How to make your own...'

Ask students to observe their planted seeds regularly and keep a diary of observations.

Ask the students to estimate and measure elements of their seedlings regularly. Make tables with headings such as time, date, size and note observations over several weeks.

Talk with students about the seedlings needing to be planted in the school garden later and needing to be protected from damaging weather conditions.

Invite students to design and produce an environment for their lettuce, radish or sprout seedling in the school vegetable garden. How might it be protected from birds, rabbits, pests, heat in summer, or frosts in winter?

Whilst watching the salad ingredients grow, ask students to imagine a salad menu item that they might share with the canteen … a new type of filling for a salad sandwich, wrap or roll?

Dream

Ask students to visualise the steps involved in harvesting and preparing their salad ingredient for the canteen. Ask students to record their ideas.

Brainstorm and develop possible solutions.

Ask students to imagine the actions and steps involved.

Challenge students to think about the materials, tools and equipment they will need.

Ask students to imagine how they might help the school canteen produce and prepare a salad.

Design

Ask students to design their:

- environment for their lettuce, radish, or sprout seedling in the school vegetable garden;
- salad filling for healthy eating and service in the school canteen.

Ask students to plan what illustrations will complement the text within their designs.

Invite a peer class group to the class and ask students to explain their concepts to this audience and seek feedback on their ideas.

Deliver

Create the designs.

Prepare a display of students' designs.

Visit a local preschool, kindergarten, Foundation class or day care centre to share and discuss their ideas with younger children.

Read aloud and share the ways to produce an environment for the production of a lettuce, radish or sprout seedling, stopping periodically to ask younger students to find the picture or object or idea that was just read about.

Share ways to prepare and use the salad ingredients in new salad fillings for a salad sandwich, wrap or roll.

Debrief

Ask students to recall what they discovered about: what seeds need in order to grow into a plant; what types of environments can be produced to protect seedlings and plants in the school vegetable garden from damaging weather conditions and pests; and what salad fillings can be prepared for healthy eating and service in the school canteen.

Talk about what they might still like to discover and whether there is anything they would like to change in their designs.

Ask students to evaluate their designs and suggest improvements where necessary, giving reasons.

Share photos and students' work samples via National Science Week's online community. ASTA always enjoys seeing pictures of classroom learning. Share photos via email at **nscwk@asta.edu.au** or share what has been created via **Facebook**, **Instagram** or **Twitter** with #scienceweek. Please ensure that you have parental permission prior to posting any images of students.

Curriculum connections

Australian Curriculum: Science

Foundation, Year 1 and Year 2

Design and Technologies

Explore how plants and animals are grown for food, clothing and shelter and how food is selected and prepared for healthy eating ACTDEK003

Design and Technologies—Processes and Production Skills

Explore needs or opportunities for designing, and the technologies needed to realise designed solutions ACTDEP005

Generate, develop and record design ideas through describing, drawing and modelling ACTDEP006

Use materials, components, tools, equipment and techniques safely to make designed solutions ACTDEP007

Use personal preferences to evaluate the success of design ideas, processes and solutions including their care for environment ACTDEP008

Sequence steps for making designed solutions and working collaboratively ACTDEP009

Science

Biological sciences

Living things have basic needs, including food and water ACSSU002

Science as a Human Endeavour—Nature and development of science

Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013, ACSHE021, ACSHE034

People use science in their daily lives, including when caring for their environment and living things ACSHE022

Foundation

Science Inquiry Skills

Pose and respond to questions about familiar objects and events ACSIS014

Participate in guided investigations and make observations using the senses ACSIS011

Engage in discussions about observations and represent ideas ACSIS233

Share observations and ideas ACSIS012

Physical Sciences

The way objects move depends on a variety of factors, including their size and shape ACSSU005

Year 1

Science Inquiry Skills

Pose and respond to and pose questions and make predictions about familiar objects and events ACSIS024

Participate in guided investigations to explore and answer questions ACSIS025

Use informal measurements to collect and record observations, using digital technologies as appropriate ACSIS026

Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions ACSIS027

Compare observations with those of others ACSIS213

Represent and communicate observations and ideas in a variety of ways ACSIS029

Year 2

Science Inquiry Skills

Pose and respond to questions, and make predictions about familiar objects and events ACSIS037

Participate in guided investigations to explore and answer questions ACSIS038

Use informal measurements in the collection and recording of observations, using digital technologies as appropriate ACSIS039

Use a range of methods to sort information, including drawings and provided tables , and through discussions compare observations with predictions ACSIS040

Compare observations with those of others ACSIS041

Represent and communicate observations and ideas in a variety of ways ACSIS042

General Capabilities

Literacy, Numeracy, ICT capabilities, Critical and creative thinking, Personal and social capability, and Ethical understanding.

Flavour OF THE MONTH

Vegetables

At any time of the year, there is always some vegetable at its peak. Most vegetables need to be cooked slightly before they can be frozen. Vegetables usually eaten raw, such as radishes, lettuce, cabbage, cucumbers, onions and celery, do not freeze well as they lose their crispness when thawed.

Design a vegie snack

This is one way to make vegie scrap crackers.

You can use carrot scraps, beetroot scraps, sweet potato, red onion, parsley, spinach, capsicum, or broccoli.

Place one third of a cup of chia seeds and one cup of water in a bowl.

Stand for fifteen minutes to soften.

Place the chia mixture in a food processor with one and a half cups of plain flour, 250 grams of carrot scraps chopped into small pieces, and one tablespoon sea salt flakes. Process until a sticky dough forms and place mixture between two baking-paper-lined baking trays. Then, using a scraper, thinly spread the mixture to create a rectangle that is 1mm thick.

Lastly, bake in a 170 degree Celsius or a 150 degree Celsius fan-forced oven for 45 minutes. Stand in the oven for 2 hours to cool completely. Serve with a dip of your liking.

Your challenge is to design an appetising vegetable snack. Might you add vegies to cakes and muffins, or soups, or dips?

Source: adapted from the Woolworths Fresh magazine, Issue 168, September 2020, page 64.

Avocados

The avocado is a tree from Central Mexico. It has beautiful large leaves and fleshy fruits, each of which contains a noticeably big seed. Believe it or not, these seeds are easy to germinate and to grow into a new avocado tree.

Firstly, extract the seed from the fruit.

Position it with the pointy end up and stick 4 cocktail sticks or toothpicks into it. Then, balance it on the top of an old drinking glass and fill the glass with water.

Place the glass in a dark cupboard. Check on it every few days. It will take a few weeks for the seed to split and root.

As the seed grows, the young plant needs sunlight and is best placed on a windowsill.

When it gets to 30 cm or so tall, pot it up using regular potting compost. Keep it in bright light, warm (10–30 degrees Celsius) and keep the compost moist.

If you live in a temperate area (with a cold winter), your avocado plant can grow outdoors during the summer but bring it inside during winter months.

In tropical, subtropical and warm temperate areas, you can grow your avocado plant outside year-round.

Source: Local Safari, The Jane Goodall Institute Australia, 2020, page 113.

FOOD DIFFERENT by design

Case study

Aussie goat meat inspires US chefs

Read about how Meat and Livestock Australia's North America team recently worked with US chef Grant Morgan, founder and chef of Chopped Thyme Culinary Innovation, Dallas, to develop a recipe using Australian goat meat for one of the US food service industry's most influential publications: *Flavor & The Menu* magazine.

Grant is best known for his work with the premium fast, casual restaurant, Velvet Taco, and that expertise is on full display with this new recipe: the **G.O.A.T (Greatest Of All Time) taco**, made with true Aussie goat.

Grant used Australian goat leg for the dish, braising it in coconut milk, chicken stock and jerk seasoning.

To build the taco, he spooned jerk sauce onto a grilled flour tortilla, added acidic green cabbage slaw, braised goat meat, pickled mango and habanero–pineapple relish, and then garnished the taco with fried leeks.

Have a go at this

Activity 3: Happy lunch making

Few of us jump for joy at the idea of organising and preparing packed lunches.

Plan, prepare and pack a lunch that children will enjoy and one that ensures plenty of energy for physical and mental activity, giving emphasis to fruit and vegetables.

Instant lunch foods can include:

- almonds
- dried apricots
- banana chips
- cashews
- dates
- dried figs
- fruit leathers
- raisins
- prunes
- walnuts
- juice boxes

Another idea might be to make sushi.

Sushi was developed in its present form in the nineteenth century. In Tokyo, it was the fast food of the time—and in many ways still is.

There are four main types.

- Rice rolled in sun-dried seaweed with ingredients in the centre, known as maki-zushi or norimaki.
- Rice pressed in a mould, topped with cured or salted fish, known as oshi-zushi or bo-zushi.
- 'Fingers' of rice with a slice of fish, seafood or omelette on top, known as nigiri-zushi.
- Bowls of rice with other ingredients mixed through or arranged on top, known as chirashi-zushi.

Years ago, who would have thought that children would be ordering and eating sushi?

With its clean, fresh flavours and great good looks, sushi has never been so popular. It's delicious as a quick snack or as part of a more substantial Japanese dinner, and makes perfect finger food.

The term 'sushi' is used for dishes based on 'sumeshi', meaning vinegared rice. Classic ingredients are sushi rice, cucumber, salmon, tuna, prawn, crab and smoked salmon.

Could you design a type of *nigiri-zushi* served in lettuce 'boats'? They look very pretty and are also easier to pick up.

Publish the recipe you design and make it a part of National Science Week 2021 and the International Year of Fruits and Vegetables.

Photo by Joanna Kosinska on Unsplash

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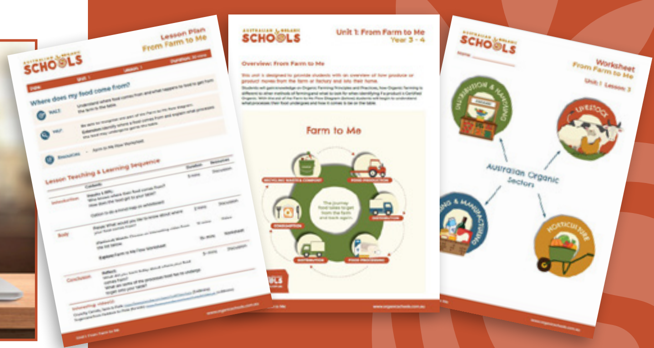


Have a go at this

Activity 4: Design and create a salad to go

Salads make a good addition to packed lunches.

Design a salad that can be made ahead of time and refrigerated overnight.

How many colours of the rainbow might you include?

Tomatoes are red, lettuce is green, carrots are orange, capsicum can be red, green or yellow and beetroots … What colour are they?

Use the bowl below to design your salad to go.

Have a go at this

Activity 5: From paddock to plate

Capture students' interest and view a sample of website materials, videos, print materials and social media sites that represent where our food comes from, how it is produced, and/or ways to cook with some foods.

Learn about the potato story from paddock to plate with **George the Farmer**. YouTube (6:10 min)

Draw a flow chart explaining how potatoes get from the farm to the recipe that is featured in the video.

Play the Australian Meat Processor Corporation's 'Paddock to Plate' **digital interactive** showing the journey of how beef, lamb and goat meat are used in recipes.

Document the different steps involved in getting beef, lamb and goat meat from the farm to the recipes featured in the interactive.

Explore how to make your own **butter, sour cream, buttermilk and ice cream** on the Dairy Australia website.

Extension activity: Record how these dairy products are produced.

Discover different recipes and how to cook with **eggs** on the Australian eggs website.

Record two recipes that include eggs as an ingredient.

Play an **interactive** to develop an understanding of the dairy food group (one of the five food groups that are important for good health).

Have a go at this

Activity 6: Let's mix and make

Learn how to mix and make a salad dressing.
View the Cooking with Kids, Inc. video **How to Make Salad Dressing - for Kids!** *(2:29 min).*

Talk about how, in science, 'a mixture' refers to a material that is made up of two or more substances.

Provide students with 2 plastic cups, a handful of strawberries, cherries, grapes, or other available fruit, half a cup of vanilla yoghurt and a sprinkling of cinnamon.

Ask students to observe and record the colour, smell and texture of each ingredient.

Ask students to observe each ingredient and predict what it will do when added together to create a mixture.

Experiment with mixing butter or cream cheese with a variety of herbs, crushed nuts and spices. (*For example*, freshly chopped chives, parsley, thyme, basil or fennel, breadcrumbs, paprika or crushed nuts).

Challenge students to create flavoured butter.

Ask students to reflect on their predictions and observations and answer questions like:

- Were they similar or different?
- How is it similar to … ?
- How is it different from … ?
- What might this mixture be used for?
- Does it remind you of other mixtures? What are they called? What are they made up of?

Experiment with adding flavourings by flattening some butter into a rectangle on a sheet of greaseproof paper, sprinkling the flavourings over the top and rolling up the butter to form a cylinder. Wrap up the cylinder and store it in a freezer to set and then slice before using it.

Find out what students now know about how foods, when mixed, can change and combine to make tasty new meals or snacks.

Encourage students to tell, write or draw their ideas. Display these for future reference.

Photo by Felicia Buitenwerf on Unsplash

Have a go at this

Activity 7: Food is nourishment

Our food is the only way our body can get the nutrients it needs to keep us alive. From providing us with energy to healing that tiny cut on a finger, our food choices impact everything our body does.

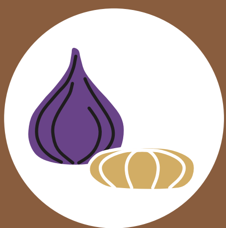
Use the cards below and design a game that can remind us to choose a wide variety of whole foods, as opposed to processed foods, which often have very few nutrients.

Bananas
Contain B-group vitamins, vitamin C, potassium, magnesium

Avocados
Contain vitamin E, monounsaturated fats, B-group vitamins, fibre

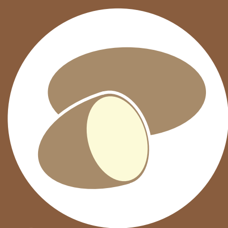
Carrots
Contain Beta-carotene (vitamin A), potassium

Eggs
Contain B-group vitamins, iron, vitamin A, vitamin E, selenium, carotenoids, protein



Figs
Contain calcium, magnesium, fibre

Lemons
Contain vitamin C, citric acid



Potatoes
Contain vitamin C, potassium

Spinach
Contains folate, calcium, magnesium, phosphorus, vitamin C, carotenoids (vitamin A), B-group vitamins

Mushrooms
Contain vitamin D, B-group vitamins

Tomatoes
Contain lycopene, carotenoids (vitamin A), vitamin C


Photo by Sophie Mikat on Unsplash

FOR THE PRIMARY YEARS OF SCHOOLING

YEARS 3 TO 4

FOOD

DIFFERENT by design

Australian Science Teachers Association

Activity 1: Preserving

Overview: *Explain to the class that their task will be to explore preserving methods used in modern and traditional societies and then design and make a designed solution for preserving something grown and produced at school or home.*

Background notes for students: Preserving

Knowing how to preserve food has been essential throughout human history.

There are many ways that food can be preserved. You can make your own preserves by bottling, pickling, drying, fermenting, salting, freezing and cooking.

Many of these techniques are still in place today and are still used for preserving produce.

The essential question

What happens when we understand the preserving methods used in modern and traditional societies?

The scenario

All over the world, families share their traditional recipes. Some are handed down from parents to their children. Your challenge is to investigate a collection of preserving methods and recipes and then illustrate the steps involved in preserving your chosen food that is grown and produced at school or at home. Then you will contribute your recipe and the steps involved in preserving a food type to a cookbook for a class fundraiser.

A suggested learning process

Define

Share the essential question with the class and talk about 'preserving methods' and how they have been used by different cultures over time to make different food types.

Brainstorm known ways that foods may have been preserved by people and cultural groups over time.

Present the scenario, assign pairs or small groups, if appropriate, and ask students to define the task they have been set.

Ask students to draw something you think of when they hear the phrase 'preserved food'.

Ask questions to establish students' prior understandings about technologies that are used to preserve different foods. *For example*:

- What technologies and equipment might be used to grind up coffee beans, peppercorns, cumin seeds, wheat, or grains into finer particles?
- What technologies and equipment might be used to preserve fresh fruits like peaches, apricots, cherries and pears?
- What technologies and equipment might be used to produce frozen vegetables?
- What technologies and equipment might be used to make jam?
- What technologies and equipment might be used to dry herbs?
- What technologies and equipment might be used to de-husk wheat?
- What sort of preserved food does someone you know produce?
- What sort of preserved product might you design from something grown at school or at home?

Discover

Capture students' interest and share a variety of fresh, processed, canned, pickled, frozen, dried, pasteurised, powdered and freeze-dried food types.

For example: fresh fruit and vegetables; eggs; UHT milk; bread; dried herbs; peppercorns; frozen vegetables; a jar of jam; powdered milk; freeze-dried coffee; rock salt; dried fruit; processed smallgoods; a packet of sugar; a can of fish; dried meat like beef jerky; pasteurised milk; a packet of rice or lentils; pickled onions or gherkins; processed cheese.

Talk about the different foods and find out what students might know about how these foods were produced and the technologies used to make them. Ask questions like:

- What is the name of the food?
- How might it have been prepared?
- What technologies, tools and equipment might be required to prepare it?

Talk with the students about the range of technologies, tools and equipment they think might have been used to produce some of the foods introduced in the earlier activity.

Invite parents, grandparents and carers to visit the class and bring along an example of, or a recipe for, a food they have preserved. Create a class display of the 'preserved foods' and recipes.

Ask students to discover and list the types of preserved foods they can find at home.

View the video **How to preserve food in glass jars** and find out more about how you can preserve foods like cherry tomatoes in jars.

Invite students to think about a food that they could preserve that is grown at school or at home.

Ask students to research and investigate the methods and technologies used for preserving their chosen food grown at school or home and to record their design ideas.

Ask students to communicate their ideas by drawing and writing a description of what they might preserve and how they might preserve it.

Talk about procedural writing, and practice writing a procedure for preserving olives.

For example:

Preserving Olives

Step 1: Always use fresh and clean olives.

Step 2: Make sure all tools are clean.

Step 3: Into a large saucepan, measure and add 1 litre of cold water and half a cup of salt.

Step 5: With adult help, bring the salty water to the boil.

Step 6: Remove the salty water from the heat.

Step 7: Allow the salty water to cool for 10 minutes.

Step 8: Place the olives in clean glass jars.

Step 9: With adult help, pour the warm salty water over the olives.

Step 10: Seal immediately.

Dream

In pairs or small groups, envision or dream of the many possible solutions to designing and making a recipe to preserve a food that is grown at school or at home?

Further develop ideas for possible solutions using sketches and labels.

Ask students to visualise their most creative solution.

Invite students to think about what materials, tools, equipment and ingredients they will need to make their solution a reality.

Design

Invite students, in pairs or small groups, to begin drafting their designs for their solutions.

Ask students to draft the steps involved in making their items.

Ask students to gather the materials, tools and equipment needed and then design and create the solution.

Ask students to illustrate the steps involved in preserving their chosen food type.

Students contribute their labelled drawing and procedure to a cookbook.

Invite a peer class group to the class to hear from the students and find out more about preserving food.

Deliver

In pairs or small groups, showcase the creations and associated messages.

Classes host a 'Preserving: The Year 4/5 Way Day' and invite students, teachers and parents to discover what the class knows about preserving methods used in modern and traditional societies.

Debrief

Ask students to reflect on their learning and draw something they learnt that was new.

Ask students to describe what worked well and not so well in their efforts to use preserving methods and to preserve a food that was grown at school or at home, and then used in a cookbook.

Curriculum connections

Technologies

Design and Technologies—Knowledge and Understanding

Investigate food and fibre production and food technologies used in modern and traditional societies ACTDEK012

Design and Technologies—Processes and Production Skills

Generate, develop and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques ACTDEP015

Select and use materials, components, tools and equipment using safe work practices to make designed solutions ACTDEP016

Evaluate design ideas, processes and solutions based on criteria for success developed with guidance and including care for the environment ACTDEP017

Plan a sequence of production steps when making designed solutions individually and collaboratively ACTDEP018

General Capabilities

Literacy, Numeracy, ICT capabilities, and Critical and creative thinking.

Flavour OF THE MONTH

Rhubarb

This is a great vegetable to grow and then stew with apples. Rhubarb is a perennial plant, and if you look after it, it will continue to grow and provide flavoursome stalks for many years.

Rhubarb needs to be planted in full sun and it can be grown from seed or from the crowns of existing rhubarb stalks. Rhubarb needs well-drained, fertile soil and regular watering.

DESIGN studio

Design and make a 'Jar of Wonder'

Create your own decorative jar using paints, tape, coloured paper and ribbon. Fill it with homemade jams, spiced nuts or dry ingredients for a classic cake or biscuit mix.

FOOD DIFFERENT by design Case study

BioBag World Australia

Farmers in Cambodia are using our new BioAgri compostable mulch film for growing watermelons, tomatoes and sweet melons via the **iDE Innovation Lab** and Climate Smart Commercial Horticulture in Cambodia.

Their results show that 50 days after planting tomatoes, the mulch starts to disappear and after 70 days, more than 50% has returned to the earth as organic matter, with no microplastics or toxic residues left behind.

Farmers using traditional plastic mulch film are still finding pieces of black plastic 40 years later, because plastic takes hundreds of years to decompose.

Activity 2: Making bread

Overview: *Explain to the class that their task will be to explore bread baking methods used in modern and traditional societies and then design and make a designed solution for baking a type of bread.*

Background notes for students: Bread

Bread is eaten by almost every culture on Earth. People could be eating: *mantou*, a steamed bread bun on the roadside in northern China; *pandesal* or 'salt bread' in the Philippines; or *balep korkun*, a type of bread made from barley in central Tibet. The Irish eat 'soda bread', and Swedish people eat *limpa*, a round loaf flavoured with cumin, fennel and orange. In Iceland, people eat *rugbraut*, a dense and dark rye bread while in Nepal, Burma and India *naan, roti* or *chapatti* bread are eaten with curries. *Arepas* or *cornbread* is a favourite in Venezuela and Columbia as is *pitta bread* in the Middle East. Iran's national bread is called *sangak*, a long triangular whole-wheat sourdough flatbread while *baguettes* are a favourite in France.

Almost any variety of grain can be turned into bread, making it one of the most diverse foods in the world. Archaeologists have found evidence of the baking of simple flatbreads dating back 30,000 years and at the Metropolitan Museum of Art in New York, there is bread there on display that is around 3,500 years old. This bread was discovered in the tomb of an Egyptian *Senenmut* (a powerful government official) and dates to the time of Hatshepsut and Thutmose the third, around 1478 BC.

Yeast is used to make bread. Yeast is a living organism. Given moisture, food and warmth, yeast will grow and release carbon dioxide. The carbon dioxide forms bubbles, which are trapped in the dough, making it expand and rise.

Source: Jessica Grynberg, **The Bread and Butter Project**

The essential question

What happens when we understand bread baking methods used in modern and traditional societies?

The scenario

Bread has many varying styles and processes in different cultures, from a sweet French brioche to the humble flatbread that is eaten in the Middle East.

Your challenge is to investigate different types of bread eaten by family and friends and research who makes what type of bread and what methods they use.

Then illustrate the steps involved in making bread in a labelled picture recipe supported with a procedure on how to make and bake bread in a modern or traditional society that uses an ingredient grown by farmers all over the world … flour!

Finally, contribute your picture recipe and the steps involved in baking bread to an instructional 'how to make bread' book for the school library.

A suggested learning process

Define

Share the essential question with the class and talk about 'bread' and how it has been baked and eaten by different cultures over time.

Brainstorm known types of bread and record these for future reference.

Present the scenario, assign pairs or small groups if appropriate, and ask students to define the task they have been set.

Ask students to draw a Y-Chart describing what they see, feel and smell when they hear the phrase 'freshly baked bread'. Share Y-charts and students' ideas about what freshly baked bread looks like, smells like and makes students feel.

Ask questions to establish students' prior understandings about technologies and equipment that are used to make and bake bread. *For example*: mixing bowls, ovens, measuring spoons, cups and jugs, oven gloves, baking trays, weighing scales, cooling racks, clean hands ...

Discover

Capture students' interest and share a variety of **images of different types of bread**.

Talk about the different types of bread and find out what students might know about how these foods were produced and technologies used to make them. Ask questions like:

- What is the name of this type of bread? (Display a range of breads, flat breads, white, wholemeal rye, Turkish, brioche, sourdough).
- How might it have been prepared?
- What technologies, tools and equipment might be required to prepare it?

Talk with the students about the range of technologies, tools or equipment they think might have been used to produce some of the foods introduced in the earlier activity. Ask students to draw their ideas.

Ask students to bring to school a slice of a type of bread they eat, or its packaging. Discuss the varieties and how they all begin the same way with flour, water and yeast.

Brainstorm and record ideas about where the students think bread comes from.

View a video to find out **where bread comes from** and ask students to design a flow chart showing the steps involved in growing, harvesting, milling and producing bread.

Explore **how bread is made in factories** and listen for the things that are put into the bread dough. Talk about what happens to the little balls of dough and which ingredient makes this happen.

Talk about 'yeast' and how it makes bread rise when mixed with warm water.

Discover how yeast in a warm, moist environment and fed with a little sugar, starts multiplying furiously, converting sugar into carbon dioxide and alcohol.

Marvel at the basic chemistry that links bread, wine, yoghurt and cheese.

Using a small plastic drinking bottle, a balloon, one cup of warm water, one tablespoon of sugar and one packet of dry yeast, challenge students to show how a balloon and bottle might be used to demonstrate how a gas can be created to make bread rise.

Invite students to try this simulation another way. Use:

- a small snap lock sandwich bag,
- 1 tablespoon of dry yeast,
- a spoon, and
- 1/2 cup of warm water.

Using a third option, students can use:

- a clean empty 1.25 litre soft plastic drink bottle,
- 1/2 cup of warm water,
- 1 tablespoon of dry yeast,
- a balloon,
- a small funnel, and
- a spoon

Remind students that the objective is to capture the gas that makes bread rise.

Invite students to discuss their observations of what is happening.

Ask questions like:

- How was the dough changed by cooking?
- Can you undo these changes and turn the bread back into dough?
- Can bread still rise after it is cooked?
- Why do you think this?

Experiment with yeast and discover whether fresh yeast or dry yeast works best to make a loaf of bread. Ask students to share their hypothesis, make observations as one loaf of bread is made with fresh yeast and another with dry yeast, and then record findings and their conclusions. (Note: Fresh yeast will keep for a week if stored in an air-tight container and if kept in a cool place.)

Invite parents, grandparents and carers to visit the class and bring along an example of, or a recipe for, a type of bread they have baked and discuss any cultural traditions associated with the bread, how it's baked, or when it's eaten.

Create a class display of the 'traditions and cultural connections' that are discovered after each visit.

Ask students to think about their task and begin researching and investigating the methods and technologies used for baking bread and also to record ideas for a labelled picture recipe supported with a procedure about how to make and bake bread in a modern or traditional society.

Talk about picture recipes and how to design them. View a range of samples. *For example*, page 15 in the **George the Farmer Pulse Party** resource and this **Pinterest** collection.

Revisit how to write a procedure with the class.

Dream

In pairs or small groups, envision or dream about the many possible solutions to creating a picture recipe supported with a procedure on how to make and bake bread in a modern or traditional society.

Further develop ideas for possible solutions using sketches and labels.

Ask students to visualise their most creative solution.

Invite students to think about what materials, tools, equipment and ingredients they will need to make their solution a reality.

Remind students that their solution needs to include a labelled picture recipe supported by a procedure on how to make and bake bread in a modern or traditional society, and that it also needs to be usable for a 'How To Make Bread' book for the school library.

Design

Invite students, in pairs or small groups, to revisit the audience and purpose of their designed solution.

Invite students to develop a suitable plan to achieve their goal.

Ask students to begin drafting their designs for their solutions.

Ask students to draft the steps involved in making their items.

Ask students to gather the materials, tools and equipment needed and then design and create the solution.

Ask students to illustrate the steps involved in creating a picture recipe supported with a procedure on how to make and bake bread in a modern or traditional society.

Invite a peer class group to the class to hear from the students and find out more about making and baking bread.

Deliver

In pairs or small groups, showcase the creations and associated messages.

Students host a 'How Traditional and Modern Societies Make and Bake Bread Day' and invite students, teachers and parents to discover what the class knows about bread baking methods used in modern and traditional societies.

Debrief

Ask students to reflect on their learning and draw something they learnt that was new.

Ask students to describe what worked well and not so well in their efforts to create a picture recipe and supporting procedure, and its use in the 'how to make bread' book for the school library.

Curriculum connections

Technologies

Year 3 and Year 4

Design and Technologies—Processes and Production Skills

Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques ACTDEP015

Select and use materials, components, tools and equipment using safe work practices to make designed solutions ACTDEP016

Evaluate design ideas, processes, and solutions based on criteria for success developed with guidance and including care for the environment ACTDEP017

Plan a sequence of production steps when making designed solutions, individually and collaboratively ACTDEP018

Year 3 and Year 4

Design and Technologies—Knowledge and Understanding

Explore how plants and animals are grown for food, clothing, and shelter and how food is selected and prepared for healthy eating ACTDEK003

Design and Technologies—Processes and Production Skills

Explore needs or opportunities for designing, and the technologies needed to realise designed solutions ACTDEP005

Generate, develop and record design ideas through describing, drawing and modelling ACTDEP006

Use materials, components, tools, equipment and techniques to safely make designed solutions ACTDEP007

Sequence steps for making designed solutions and working collaboratively ACTDEP009

Science

Science Inquiry Skills

Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013, ACSHE021, ACSHE034

Science as a Human Endeavour—Nature and development of science

Science involves making predictions and describing patterns and relationships ACSHE050, ACSHE061

Science as a Human Endeavour—Use and influence of science

Science knowledge helps people to understand the effect of their actions ACSHE051

General Capabilities

Literacy, Numeracy, ICT capabilities, Critical and creative thinking, and Personal and social capability.

Flavour OF THE MONTH

Zucchini

Zucchini (or courgette) is a summer vegetable, and both the flower and the actual zucchini can be eaten.

Zucchini plants like full sun and are frost sensitive. It is best to plant them in well-mulched soil in spring. They also need regular watering around the base of the plant rather than over the leaves. There is a scientific reason for this, as watering the leaves encourages fungus to grow on them.

GROW

Capsicums

There are two types of capsicum you may come across: chilli peppers, which are generally finger-shaped and produce a hot flavour; and bell peppers, which are sweet and crunchy to eat. They can both be grown in the same way.

Collect the seeds from a fruit and leave them to dry for a few days. Then, plant the seeds on top of a pot of compost, covering them with a thin layer of the material. Water well. Pepper plants are best grown indoors in warm, sunny conditions. It can take three months before they flower and produce fruit.

Capsicums and chillies contain different amounts of a chemical called capsaicin—this is what can make them taste hot in our mouths.

*Source: **Local Safari**, The Jane Goodall Institute Australia, 2020, page 120.*

DESIGN studio

Design a pizza party

Your job is to create a good base tomato sauce and add the toppings you like.

Why not even design a fruit pizza?

You will need:

- pizza bases,
- watermelon,
- banana,
- blueberries,
- grapes,
- any other fruit you like.

Talk about the science of chemistry. Ask students if they can recall a science experiment where substances are mixed. Share recollections as a class.

Talk about how, in science, 'a mixture' refers to a material that is made up of two or more substances.

Undertake some 'scientific research' and in pairs provide students with a range of potential ingredients for making a good base tomato sauce for any pizza. *For example*, provide each pair with a bowl and spoon, a cup of diced tomatoes, a pinch of ground black pepper, a pinch of salt, 1 teaspoon of tomato sauce and 1 teaspoon of olive oil.

Ask students to observe and record the colour, smell and texture of each ingredient.

Ask students to observe each ingredient and predict what it will do when added to the tomato base mixture.

FOOD DIFFERENT by design

Case study

3 GOOD HEALTH AND WELL-BEING | 8 DECENT WORK AND ECONOMIC GROWTH | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | 11 SUSTAINABLE CITIES AND COMMUNITIES | 12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Eclipse Foods is making ice cream from plants

For vegans, ice cream has always been a little elusive. Sure, there are good plant-based ice creams on the market, but they usually cannot match the original, for one reason or another. The co-founders of **Eclipse Foods** say their new plant-based ice cream does match dairy's taste, and it matches it so closely that even a dairy-loving omnivore won't be able to tell the difference.

Eclipse was co-founded by Thomas Bowman and Aylon Steinhart, both veterans of the relatively new plant-based food scene. Bowman, who was formerly the Director of Research and Development at JUST, Inc., maker of JUST Egg, is now the chef and food scientist at Eclipse.

He spends countless hours tinkering with plant proteins to get it all just right, making plant-based dairy-like sour cream, cheese and ice cream. The ice cream is the only product available to the public so far.

The food science magic behind plant-based ice cream

Since the company's founding, Bowman has been busy trying to reverse-engineer all things dairy, whether it's milk, ice cream or cheese, and tinkering with plant ingredients until he finds the right one for the job.

The ice cream contains canola oil, *for example*, since the frozen nature of the product means you can get away without needing a saturated fat. Bowman says cheese is different. It needs that saturated fat, which is why he uses rice bran oil to make Eclipse cheese (still under development).

Eclipse avoids common allergens like soy and dairy, as well as what Bowman calls the "expensive biotech" processes that can drive up the cost of a plant-based food.

Eclipse ice cream is made from ingredients like potato, corn, cassava, canola oil and cane sugar.

In fact, according to the chef, it's actually the processing that makes the difference.

"We go through the exact same pasteurizers, the exact same homogenizers ... heat exchanges ... chilled holding tanks, where it's right on the same machine." Dairy processing is so well-developed, says Bowman, that Eclipse is able to take advantage of systems already in place. "We're not reinventing the wheel here," he adds.

Edinger and Gray have been making all sorts of creations since they got their hands on it: a strawberry rhubarb ice cream, a semifreddo that gets a textural boost from the addition of aquafaba from chickpeas and even a vegan crème anglaise.

Have a go at this

Activity 3: Design and make soups

Soups are quite different all over the world.

In Japan, they are broth like, clean and fresh. In France, they are smooth, silky and finished with cream. In Italy, they are chunky, full of flavour with vegetables and herbs. Design, make and write up the recipe card for a soup with lots of vegetables or fruits.

My recipe is called :

....

It's made of :

Ingredient	amount
....	....
....	....
....	....
....	....
....	....
....	....
....	....
....	....

It looks like this when it's finished :

This is how you make it :

....

....

....

....

....

....

....

Then, talk with students about the difference between fruits and vegetables, as some of them can be tricky.

Ask students to list fruits and vegetables that they eat and know of.

Can you tell the difference between vegetables and fruits? Find out what students know. Note that, botanically, fruits and vegetables are classified depending on which part of the plant they come from. A fruit develops from the flower of a plant and contains seeds, whereas the other edible parts of the plant are categorised as vegetables, like the stalk of spinach.

Share lists and then introduce the tricky ones like tomatoes, capsicums and avocados, that are actually fruits.

Brainstorm and record ways fruit and vegetables can be used in recipes. *For example*, raw fruit and vegetables can be sliced into bite-sized pieces and used with dips. Avocados can be smashed and spread on toast...

Make predictions about what recipes could be created using fruit and vegetable ingredients. *For example*, what could you create with a bendy bunch of carrots, the whole of a white cabbage (including the stem), a green and red capsicum, a grater, bowl and some mayo?

DESIGN studio

Know the lingo

Use the following list of cooking words to help you design and create the recipe card in the activity above.

Chop: cut into small pieces

Cover: put plastic, foil, or waxed paper over food to keep air out

Dice: cut into small cubes

Grate: rub an ingredient across the smallest holes on a grater to make into small pieces

Knead: work with dough on a counter to make it smooth

Measure: a specific amount of an ingredient

Mix: stir ingredients together so a mixture looks the same all over

Slice: holding the food firmly in the board, cut into thin flat pieces

Have a go at this

Activity 4: Making mince fabulous

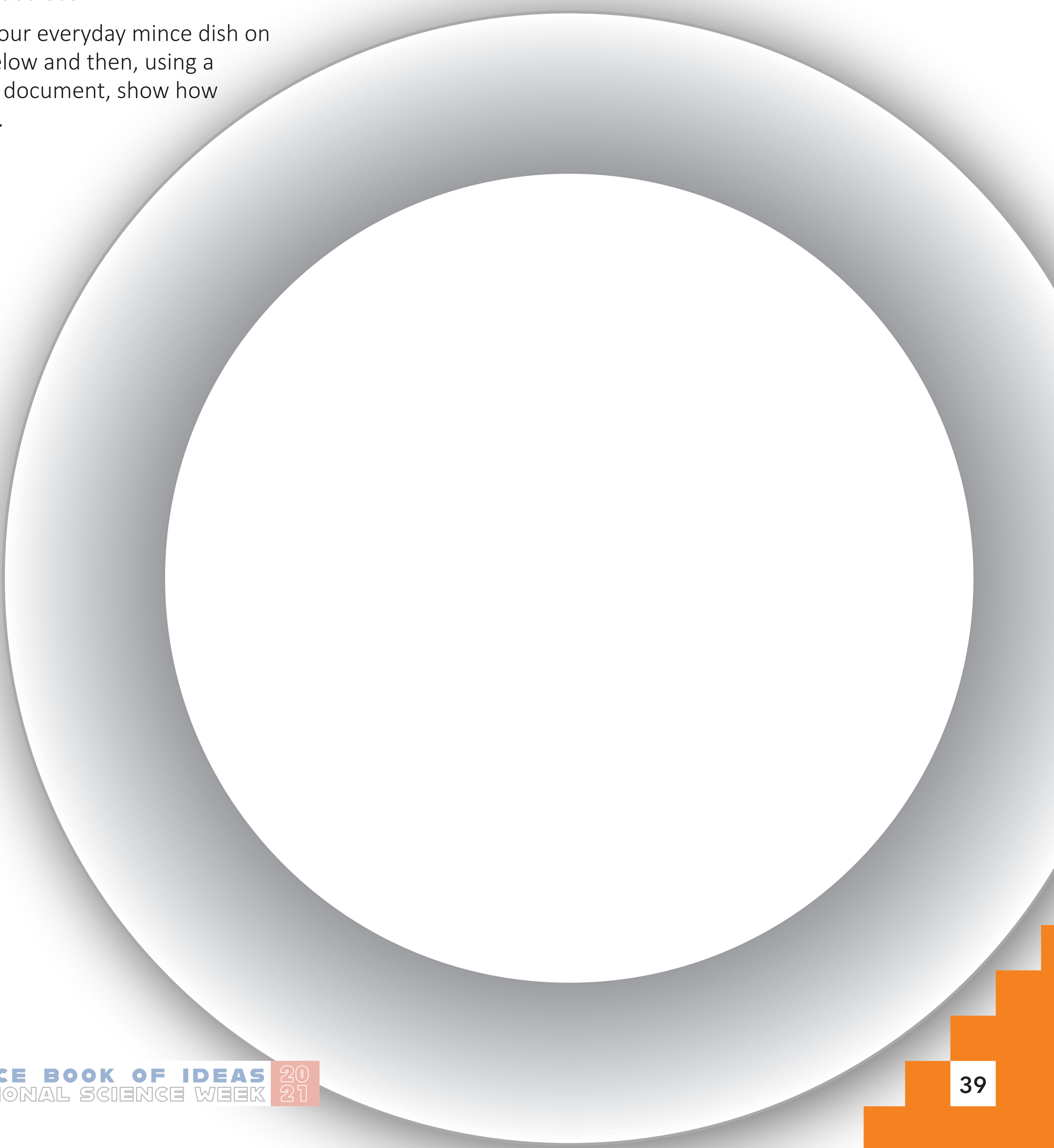
Did you know that mince is one of the most versatile and economical cuts of meat available?

Mince absorbs flavours and seasonings and is used throughout the world in a variety of dishes. It is mince that is enjoyed by a Greek family when they sit down to a tasty *Moussaka*, which is mince stuffed into an eggplant or aubergine.

It is mince that is stuffed into small rice paper dumplings by a Chinese chef in a busy dim sum restaurant, and it is mince that is used to form hamburgers in many parts of the world.

You can use chicken mince, lamb mince, pork mince or beef mince to design your everyday mince into something fabulous.

Showcase your everyday mince dish on the plate below and then, using a 'procedure' document, show how you make it.



Make a recipe with mince, bendy carrots or beans, floppy celery and soft tomatoes.

Hypothesise how you might transform the ingredients into something tasty and healthy.

I hypothesise that ....

....

....

....

....

Justify your recipe ideas and write about the ways in which recreating a recipe with these ingredients can be useful.

....

....

....

....

....

Write or draw the steps involved in making your recipe with these ingredients.

Think about and write about what happens when we are curious like scientists and investigate questions and make fascinating discoveries?

....

....

....

Have a go at this

Activity 5: Design your own tea party

Here at ASTA we believe in pairing tea and cake in the same way restaurants pair wine with food.

Some of us like a strong tea and enjoy it with a slice of classic *sacher torte*. The full-bodied, smooth, malty flavour of the tea is the perfect match for the rich chocolate in the cake.

However, others in the team are partial to a scone, and they enjoy it spread with butter, jam and cream. They pair their scones with lighter teas, as lighter teas are the perfect accompaniment for sweet treats.

Our ASTA Board Members like smoked, scented and spiced aromatic teas … what might you pair with these teas?

Your task is to design an afternoon tea menu where individual flavours allow each item to complement each other.

Taking Tea

The leaves of the evergreen bush, Camellia sinensis, can be manufactured into black, green, oolong or white tea, depending on how it is processed. The climate, soil and topography are essential conditions required in tea growing. The quality of the leaves depends on when and where they were picked, the climate, the soil conditions and the altitude of the plants. For a tea plant to flourish, it needs to grow at elevations of between 300 and 2,000 metres above sea level. It also requires temperatures of between 10–27 °C, up to two and a quarter metres of rainfall each year, a slightly acidic soil and good drainage. The main countries that offer these ideal growing conditions are China, India, Sri Lanka, Japan and Taiwan. Some tea is also grown on the Atherton Tablelands in far north Queensland.

Today, taking afternoon tea either by going out to do so or by enjoying it at home, has become popular again, with many kinds of savouries, cakes and tea breads forming the basis of delectable and indulgent occasions.

Flavour OF THE MONTH

Tea

The leaves of the small shrub, *Camellia sinensis*, have been used to make tea for thousands of years. Tea originated in China – connoisseurs during the Tang Dynasty (618–906AD) crushed steamed and bound-together leaves to make a sort of tea powder that was then mixed with a variety of flavourings.

Sung Dynasty (960–1279AD) tea drinkers whipped ground tea into hot water until it was frothy, which sounds rather like an incredibly early tea cappuccino. It was not until the Middle Ages that tea drinkers in China (1368–1644AD) developed tea as we know it today. Steamed leaves were dried, added loose to water and then left to steep, before being poured into white porcelain cups to display its colour. Drying the leaves allowed the tea to oxidise to a coppery red colour and made it easier to store while preserving its essential characteristics. It also meant that it was fit to travel to other countries.

Although tea drinking has become inextricably linked with the English, it was in fact introduced to Europe by Portuguese and Dutch traders in the early seventeenth century. Tea had reached London by 1658, although it took the marriage of Charles II to Catherine of Braganza (a Portuguese princess) to make it wildly fashionable.

Have a go at this

Activity 6: Melting, freezing, heating and cooling using yoghurt

Undertake some 'scientific research' with yoghurt and provide students, in pairs or small groups, with a range of potential ingredients for making a frozen yoghurt pop. For example, provide some small paper cups, wooden popsicle sticks a cup of yoghurt and some plastic wrap.

Ask students to observe and record details about each ingredient.

Ask students to observe each ingredient and predict what it will do when added to the yoghurt mixture.

Provide students with a table to complete. *For example*:

Yoghurt: Before and After	
Draw a picture *before* freezing	**Draw a picture *after* freezing**
Describe the yoghurt. **It is**	**Describe the yoghurt.** **It is** ....
Write about the differences.	

Have students follow instructions to make a **[Frozen Yoghurt recipe](#)** and then ask them to observe the end result and compare theirs and other students' recipes.

Additional recipes that involve freezing can include **Frozen Hot Chocolate** and **Fruity Frozen Yoghurt Bites**.

Find out what students now know about how melting, freezing, heating and cooling can affect the shape of different dairy foods.

Encourage students to tell, write or draw their ideas. Display these for future reference.

Form pairs to write a short, illustrated record about how melting, freezing, heating and cooling can affect the shape of different dairy foods.

Design, make and share your design as part of National Science Week.

Share photos and students' work samples via National Science Week's online community. The Australian Science Teachers Association always enjoys seeing pictures of classroom learning. Share photos via email at **nscwk@asta.edu.au** or share what has been created via **Facebook**, **Instagram** or **Twitter** with #scienceweek. Please ensure that you have parental permission prior to posting any images of students.

Photo by Annie Spratt on Unsplash

Have a go at this

Activity 7: Where does it come from and how is it made?

Most people know that milk comes from a cow, but many do not know where other foods come from. Most of us buy our food, and the things we use, from shops. But is that where they came from?

Before most foods get to a shop they are grown by a farmer or caught by fishers. Sometimes, these foods are not much changed from when they were harvested, like fruit, vegetables and seafood, but other times they are changed a lot. Sometimes, food gets processed. Some foods are added to other ingredients to make other types of food. *For example*, milk is used to make cheese while grain is ground up to make flour for bread, pasta, biscuits and cakes.

Your task is to work in pairs to design and produce a '**Paddock to Plate**' type presentation about your chosen food showing its progress from the beginning through to the end product.

Think about different ideas that could be explored. *For example*: 'From seed to salad'; 'From grass to glass'; 'From paddock to plate'; 'From farm to fork'; 'From boat to belly'; and 'From pond to plate'.

Pick your preferred production process to summarise using visual representations.

Lastly, produce labelled drawings or models to explain the process or system that is used to produce your chosen food item.

Photo by Mark Caldicott on Unsplash

FARM TO FORK

EDUCATIONAL GAME CREATING A VIRTUAL WORLD IN WHICH THE PLAYER MANAGES THE POTATO SUPPLY CHAIN, STARTING WITH ON-FARM PRODUCTION, THROUGH PROCESSING, MARKETING, CONSUMPTION AND WASTE MANAGEMENT

- AIMS TO EDUCATE STUDENTS ABOUT THE HEALTH, ENVIRONMENTAL, ECONOMIC AND SOCIAL REALITIES OF FOOD PRODUCTION SYSTEMS
- CO-DESIGNED WITH YOUNG PEOPLE AND TEACHERS TO ENGAGE STUDENTS IN SCIENCE, TECHNOLOGIES, HUMANITIES AND HEALTH TOPICS WITH A FOCUS ON FOOD SYSTEMS AND SUSTAINABILITY
- PROVIDES AN IMMERSIVE TOOL AND KEY INFORMATION WITH GAME LEVELS, CHALLENGES AND DECISION MAKING TO ENHANCE LEARNING
- SUPPORTED BY TEACHING RESOURCES MAPPED TO WESTERN AUSTRALIAN AND AUSTRALIAN CURRICULUM YEAR 6 TO YEAR 9

GAME - APP STORE FOR IPAD: HTTPS://TINYURL.COM/FARMTOFORKECUAPP

TEACHING MATERIALS: HTTPS://TINYURL.COM/FARMTOFORKECUGAME

Photo by Jennefer Zacarias on Unsplash

Questacon
The National Science and Technology Centre

Spark Your Students' Curiosity!

In Canberra

Explore the mysteries of science through interactive and hands-on experiences in themed exhibition galleries. Perfect for self-guided exploration, the galleries encourage discovery and curiosity as students explore the science behind our world. Students can see fascinating science demonstrations, star in a *Spectacular Science Show* and take a piece of Questacon home with them from the *Questacon Shop*. Guided *Q by Night* experiences are also available after hours.

Professional Development Workshops

Engineering is Elementary is an exciting and immersive hands on professional learning opportunity for primary school teachers. The free inquiry learning workshops build teacher capacity to deliver STEM units of work with a multidisciplinary approach, while also providing practical experience and resources. The teacher developed and delivered workshops provide assessment strategies and activities to engage students in engineering education.

Engineering is Elementary workshops will be delivered across Australia in 2021 through in-school or online workshops. For more information and to register for our workshops, visit the Questacon website.

National Programs

Questacon is on tour in regional Australia in 2021 and is also offering virtual programs. With exciting and educational science shows for primary students, and workshops for high school students and teachers, there is something for your whole community*.

Term 1: Canberra region and Tasmania

Term 2: Central Queensland and Northern Territory

Term 3: Victoria

Term 4: Tasmania

For further information on specific programs and tour dates visit the Questacon website.

Can't Come To Questacon? We'll Bring A Virtual Excursion To You!

Questacon delivers engaging workshops via videoconference to schools across Australia, from one hour workshops to ongoing cross-curricular projects. Whether interacting with the innovation process or connecting with scientists across Australia, students and teachers can explore STEM through interactive, real time experiences.

Bookings are essential for all Questacon programs including gallery experiences.

Contact us at **bookings@questacon.edu.au** or visit our website for more information.

*Program delivery dates and locations are subject to change in line with public health guidelines and travel restrictions.

www.questacon.edu.au

Australian Government

Questacon
The National Science and Technology Centre

FOR THE PRIMARY YEARS OF SCHOOLING

YEARS 5 TO 6

FOOD

DIFFERENT by design

Australian Science Teachers Association

INSPIRE YOUR YEAR 5 & 6 STUDENTS TO EAT HEALTHY, WASTE LESS FOOD AND BECOME CHANGE-MAKERS WITH THE OZHARVEST FEAST PROGRAM!

OZHARVEST FEAST™ FOOD EDUCATION AND SUSTAINABILITY TRAINING

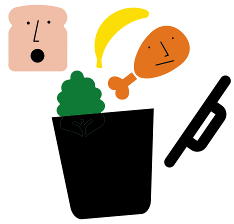
FEAST is a project-based learning STEM program focusing on food and fibre and the cross-curriculum priority of sustainability which runs for a whole term. Students are challenged to design their own recipes and together they create a low waste, healthy eating cookbook for the school.

OzHarvest has funding available for eligible primary schools to sign up and get unlimited access to:

- A 10-week curriculum package
- Hot and cold recipe booklets
- Kitchen kits for cooking in the classroom
- Electric frying pans
- Teacher training
- Ongoing support

WWW.OZHARVEST.ORG/FEAST

DON'T LET THIS OPPORTUNITY GO TO WASTE AND SIGN UP!



'Chicken Farming in the Living World' School Resources

Chickens are fascinating animals and provide students with an interesting subject matter to discuss the many aspects of our living world, including:

- the interactions between humans and animals;
- how we create food from animals;
- how scientific knowledge influences our living world;
- what a managed ecosystem looks like in the context of a broader natural ecosystem.

'Chicken Farming in the Living World' offers unique curriculum content within the 'Living World' strands of the K-10 New South Wales Science syllabuses and is also aligned with the Biological science strand of the Australian curriculum.

EXPLORE THE RESOURCES AVAILABLE at **chicken.org.au**

AUSTRALIAN CHICKEN MEAT FEDERATION acmf

Activity 1: Sustainable eggs

Overview: *Explain to the class that their task will be to explore production systems by egg farmers and then design and make an information guide about the importance of producing eggs sustainably.*

Background notes for students: Production systems

Currently, there are three main production systems used by egg farmers in Australia and these are termed: cage, barn-laid and free range.

In addition, eggs are produced by numerous 'backyard' flocks housed in various backyard systems.

The egg industry has changed over the years from one characterised by many smaller family businesses to one that is now dominated by larger, vertically integrated farms. These farms raise pullets, mix feed, as well as produce, package, market and distribute their eggs. In the early 1900s, many farmers had chickens and collected eggs for their own use or for sale to friends, neighbours and the local grocer. Today, there are fewer but larger farms that produce eggs for Australian consumers and some export markets.

Many years ago, farmers moved to housing chickens in cages, as this provided many benefits to the management, animal welfare and productivity as their flock sizes grew. More recently, there has been a decline in building new caged housing systems and new farms are often free-range or barn systems due to consumer perceptions relating to hen welfare, hen health and environmental management.

The essential question

Why is it important for eggs to be produced sustainably?

The scenario

The egg industry is made up of dedicated and specialised egg farmers who produce the eggs we love to eat. There are also backyard egg farmers and schools that farm chickens and produce eggs too.

Research the industry and smaller producers that produce all of our eggs.

In groups, your challenge is to develop questions about how eggs are produced and then use a range of sources and images to help you create an information guide that uses a sequence of instructions to explain how to produce eggs sustainably at home or on a school farm.

Form your group and start thinking about the importance of producing eggs sustainably.

A suggested learning process

Define

Ask students to consider the questions:

- 'What do all hens need to be productive?'
- 'How might egg farmers raise and house chickens to produce eggs?'
- 'What might the three main production systems used by Australian egg farmers include?'
- 'How might each production system have advantages and disadvantages?'
- 'What might the advantages and disadvantages in relation to hen health and well-being; the environment; and sustainability considerations be?'
- 'How might we design a sustainable way to produce eggs at home or on the school farm?'

Capture students' interest and find out what they know about what every hen needs to produce eggs. *For example*, all hens need to have adequate food, water, ventilation and stable social groups as well as being of the appropriate age and free of pests and diseases.

Talk about how any production system design needs to provide:

- enough room for the hens, noting that there are 'minimum standards' that are set out by the Department of Primary Industries in each state and territory;
- protection from draughts, cold, wind and rain;
- protection from predators like foxes, dogs, feral cats and eagles;
- enough feeders and waterers for the number of hens in the flock;
- ventilation holes, preferably ones that can be opened and closed depending on outside temperatures;
- some type of insulation and climate control system to protect birds against the cold and heat;
- a suitable spot to lay eggs;
- enough nests for egg-laying for all hens, if nests are provided;
- enough perches for all hens, if perches are provided;
- enough doors/flaps (known as "popholes") for the hens to enter and exit through if birds have access to a range area (preferably the system design needs one that can be locked at night to stop predators entering);
- access points for humans, for ease of cleaning and maintenance, and regular inspections; and
- a foraging area, if birds are free-range or in furnished cages, where hens can scratch and forage for food and have a supply of 'grit' provided, to aid their digestion.

Discover

Talk about the Australian egg industry, its farmers and the production systems it uses to raise and farm hens. Talk about the differences between keeping chickens and producing eggs commercially and in backyards or on school farms.

Create a classroom display about what is now known about egg production.

If you keep poultry at school, discover the fundamentals of keeping chickens in schools. Learn about how one school in New South Wales raises and houses its hens to produce eggs. View videos on the dedicated PoultryHub educational webpage '**Keeping chickens in schools',** which includes information about:

- housing requirements,
- feeding and watering,
- routine management, and
- bird health and behaviour.

Create a concept map documenting new understandings.

If your school has a farm, involve students in talking to the agriculture teacher or agriculture students about the production system used at your school.

Interview family or friends who raise chickens and produce eggs to learn more about the production system they use.

Discover information about the **cage and free-range systems** on YouTube (3:38 min).

Learn from a **South Australian egg farmer** and discover how he farms 1,500 hens per hectare. Consider his views about sustainable production systems on YouTube (5:15 min).

Discover more about the features of a **free-range production system** that stocks 20,000 hens per hectare on YouTube (6:47 min).

Refocus students on their task to create an information guide that uses a sequence of instructions to explain how to produce eggs sustainably at home or on a school farm.

Talk with the students about the types of resources used by domestic egg farmers in their production processes. *For example*, soil for foraging areas, water to wash down the sheds, electricity to power machines, water for the hens, feeding systems for the hens.

Ask questions about what it might mean to use these resources 'sustainably'? Check students' understanding of terms like 'sustainable use', 'sustainable resource management', 'sustainable water use', 'water conservation', 'sustainable energy use', 'energy conservation', 'waste management', 'natural vegetation replenishment', 'restoration of vegetation cover', 'preventing pollution', etc.

Brainstorm the known 'natural resources' used by egg farmers. *For example*: sunlight, soil, minerals, water, air, vegetation/plants …

As a class, identify and define terms that students are uncertain of. Once defined, ask students to explain the meanings of the terms to someone else.

Talk about the word 'sustainability'. As a class, consider the differences between 'environmental sustainability', 'economic sustainability' and 'social sustainability'.

For example: When a farmer thinks of being economically sustainable, they might ask themselves a question like 'Are we sustainably profitable?' or 'What do we need to do to make sure that the farm provides a living for our family into the future?'.

When a farmer thinks of being socially sustainable, they might ask themselves a question like 'Are we behaving in such a way that the community would support us into the future?' or 'How should we be involved in our community, so as to motivate it to support us into the future?'.

When a farmer thinks of being environmentally sustainable, they might ask themselves a question like 'Are we maintaining our farm and its natural assets for future generations?' or 'How can we observe and enhance the farm's natural habitat so that future farmers can succeed on it?'.

Expand the topic and talk about sustainable practices used at home or on school farms that produce eggs. Consider: waste management, water re-use, resource recovery and planting trees and shrubs to provide shade. Ask students to visualise what sustainable egg production and farming at home or on a school farm might look like, sound like and feel like?

Think about issues such as the farm's environmental footprint, sustainable management practices to conserve soils, improve water-use efficiency, reduce and re-use waste, recycle effluent and minimise energy usage.

Ask students to develop criteria describing the standards they feel describe 'sustainable' egg production and farming at home or on a school farm. Share these as a class and display ideas for future reference.

Dream

Ask students to form into their groups and visualise and discuss how they want to represent the information they have gathered from a visual and writing perspective.

Ask questions to stimulate the possible ways of designing and creating their information guide. *For example*:

- So, what do you want to make the information guide about?
- How will the group bring the topic alive for viewers?
- How will you grab their attention?
- What is it about this topic that you want everyone to know?
- How will you use your ideas?
- How will you approach drafting your text?
- How will you write a sequence of instructions?
- How will your text inform, entertain, inspire thought and perhaps action?

Develop possible solutions by brainstorming ideas.

Introduce a range of digital storytelling tools and apps. *For example,* **Tellagami**.

Design

Ask students to decide on the type of information brochure and the topics they will include in their design. Will it be digital or in paper form?

Invite students to think about developing a project plan outlining the planning and production steps required to produce their information brochure.

Talk about the importance of a clear layout and design that makes it easy for an audience to understand and interpret the information given.

Talk about the importance of sourcing digital photos and information correctly.

Talk about ethical and respectful behaviour when using digital media and in an online environment.

Work with students to help them understand appropriate digital citizenship and online behaviour and seek commitments to respecting themselves, others, and intellectual property.

Ask students to draft the steps involved in making their chosen digital or non-digital work samples.

Ask students to gather the materials, tools and equipment needed and then plan each step involved in creating the digital and/or non-digital work samples.

Invite students to start creating the information brochure.

Talk with students about how they might share and present their information brochure with an audience?

Ask students to explain how they plan to create and finalise their information brochure to another peer in the class and seek feedback on their ideas.

Deliver

Ask students to design and create their information brochure about how to produce eggs sustainably at home or on a school farm.

Ask students to share their information brochure about how to produce eggs sustainably at home or on a school farm to others for critique and assessment.

The following are suggested points to consider in each presentation:

- How much do the students know about the subject matter?
- How well have they used their chosen medium?
- Did they use a sequence of instructions?
- What is unique or eye-catching about their visual style?
- What concepts on the subject matter have they chosen to emphasise?
- Have they missed anything out?

View presentations of the students' information brochures and enjoy a day of showcasing what has been discovered about how to produce eggs sustainably at home or on a school farm.

Debrief

Ask students to do the following.

Reflect on their understanding of, and all aspects involved in, producing the information brochure on how to produce eggs sustainably at home or on a school farm. Since information brochures are largely made to inform, ask students to reflect on their project. How do they feel they represented their research? How well did they use a sequence of instructions? Did they inform people about how to produce eggs sustainably at home or on a school farm?

Identify and describe the most surprising thing they learned about the production systems used by egg farmers in Australia to produce eggs.

Evaluate their information brochure and write about whether their work:

- matched the definition of the task,
- included a sequence of instructions,
- used a clear layout and design, and
- provided others information about how to produce eggs sustainably at home or on a school farm.

Write about the quality of their planning, their finished information brochure and whether they enjoyed the task.

Curriculum connections

Science

Year 5 and 6

Science as a Human Endeavour—Nature and development of science

Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions ACSHE081, ACSHE098

Science as a Human Endeavour—Use and influence of science

Scientific knowledge is used to solve problems and inform personal and community decisions ACSHE083, ACSHE100

Technologies (ACARA, 2015b)

Year 5 and Year 6

Design and Technologies—Knowledge and Understanding

Examine how people in design and technologies occupations address competing considerations, including sustainability in the design of products, services and environments for current and future use ACTDEK019

Investigate how and why food and fibre are produced in managed environments and prepared to enable people to grow and be healthy ACTDEK021

Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use ACTDEK023

Design and Technologies—Process and Production Skills

Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions ACTDEP024

Generate, develop and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques ACTDEP025

Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions ACTDEP026

Negotiate criteria for success that include sustainability to evaluate design ideas, processes and solutions ACTDEP027

Develop project plans that include consideration of resources when making designed solutions individually and collaboratively ACTDEP028

General Capabilities

Literacy, ICT capability, Critical and creative thinking, Ethical understanding, and Personal and social capability.

Flavour OF THE MONTH

Onions

Eye-watering when peeled, sliced and diced raw, but sweet when cooked, onions are a staple in most cooking recipes. Onions are used in soups, stews, roasts, risottos, stir-fries, salads, curries and pastas.

Onions like to grow in the cooler months in full sun. Onion plants need watering, however they do not like being over fertilised.

GROW

Onions and garlic

Onions and garlic are bulbs. When planted, they produce green 'tubes' known as onion or garlic tops. Both are essential cooking ingredients that are easy to grow and can be started off indoors. For best results, buy freshly harvested, live onions and garlic (not preserved).

All you need to do is place your onion or garlic bulb on the top of a jar of water. Make sure it is the right way round though, with the pointy bit at the top. After a few days, you will start to see roots growing down from the base.

It is now time to plant it in a pot. You will need some stones in the bottom of the pot (to help with drainage) and some potting compost. Make sure the whole bulb is covered by the compost, with just the green tubes showing.

Place on a windowsill or grow in your garden during summer. Keep watered and, eventually, it will flower.

Source: Local Safari, The Jane Goodall Institute Australia, 2020, page 118.

Hydroponics

Onions are one of the easiest plants to grow using hydroponics. The term derives from the Greek word hydro (water) and ponos (labour). This soil-free cultivation method lets water do the work of distributing food to the plant.

The nutrients dissolve in water, and plants feed themselves by drawing the nutrient-rich water into their roots.

In hydroponic growing, the plant root is suspended in an oxygenated nutrient solution or packed in a medium (such as stones or perlite) that is saturated with a solution. By doing this, the plant's roots get their nutrient-rich water without needing soil.

Your task is to design a hydroponics system and grow either a salad green or herb.

FOOD DIFFERENT by design Case study

Turning mung beans into eggs

There is a reason most plant-based companies start their product lines with a burger. Sure, figuring out the aroma, sizzle and taste of beef is a challenge, but mushing plant protein into a patty is far easier than trying to replicate the **light and fluffy** texture of scrambled eggs. Still, that's exactly what **JUST, Inc.** is aiming to do with its plant-based egg product made from an ancient nitrogen-fixing legume—**mung beans**. View the **video** (2:13 min) to appreciate the science behind the technology and process used.

DESIGN studio

Design a pasta dish everyone will love

Italian chef Gennaro Contaldo says pasta should be made with love using water, flour and eggs—three everyday ingredients.

In Italy, most children would know how to make pasta. Spaghetti, lasagne, linguine, tagliatelle, penne, macaroni … Which type might you like to use in your dish?

Traditionally, Italians do not add much sauce to their pasta—barely enough to cover the strands. However, if you prefer a generous amount, go for it.

Make a dip to go with your pasta dish. Talk about the science of chemistry. Ask students if they can recall a science experiment where substances are mixed. Share recollections as a class.

Talk about how, in science, 'a mixture' refers to a material that is made up of two or more substances.

Undertake some 'scientific research' and provide students, in pairs, with a range of potential ingredients for making a dip. *For example*, provide each pair with a bowl and spoon, a cup of Greek or natural yoghurt, half a leftover diced cucumber, a pinch of ground black pepper, a pinch of salt, 1 teaspoon of lemon juice and 1 teaspoon of olive oil.

Ask students to observe and record the colour, smell and texture of each ingredient.

Ask students to observe each ingredient and predict what it will do when added to the yoghurt mixture.

Follow instructions to make a 'Tzatziki' recipe (*for example,* combine all ingredients mentioned above in a bowl and refrigerate for 2 hours), and ask students to observe the end result and compare theirs and other students' recipes.

Ask students to reflect on their predictions and observations and answer questions like:

- 'Were they similar or different?';
- 'How is it similar to … ?';
- 'How is it different from … ?';
- 'What might this mixture be used for?';
- 'Does it remind you of other mixtures? What are they called? What are they made up of?'.

Share your pasta dish and dip as part of National Science Week 2021.

Activity 2: Investigate technologies in food production

Overview: *Explain to the class that their task will be to work in small groups to find out more about technologies used on farms, in fishing and in aquaculture ventures.*

Explain that each group will investigate technologies used in the primary industry sectors that produce food and complete a design task that could assist in producing food.

Background notes for students: Farms

Much of the food and fibre our communities rely upon begin on some sort of farm. Whether the agricultural produce come from a field, a fishery, a piggery, or a free-range farm there was a natural or managed environment responsible for its growth.

In Australia, farmers make up less than 1% of the population, yet they provide 93% of the food consumed here. This is so, even though Australia is the driest inhabited continent with 35% of the country receiving so little rain it is classified as desert.

Our landscapes are fragile and our natural resources are fixed, so we must learn how to harness them without depleting or degrading them.

Excitingly, our farmers are rising to the challenge and are successfully addressing the call for innovation and change. Australian agriculture has also led the nation in reducing greenhouse gas emissions—by a massive 40% in the last 40 years. Extensive research by Australian scientists has delivered drought resistant and water and fertiliser efficient crops.

(Source: Flannery, Tim. The weather makers: How man is changing the climate and what it means for life on earth. Grove Press, 2006)

It is exciting to see new technologies, new breeds of plants, new management practices revolutionising the way Australian farmers produce food and fibre. And this is happening out in our paddocks today. In the future, sensors, automation, engineering and genetics are only going to be more impressive.

This world is calling out for us to have a collective mindset. The challenge is: how do we foster this? The spirit of problem-solving runs deep within agriculture. Give a farmer a pair of pliers and some wire, and they can fix almost anything. But we cannot tackle the challenges of the 21st century and beyond, with 19th century thinking and technology.

The essential question

What happens when we understand how farmers use technologies?

The scenario

Your challenge is to design a fencing system to keep sheep and cattle safe and keep feral animals out of a cattle and sheep farm. Your design needs to allow for the occasional entrance of farm vehicles.

Remember, foxes and rabbits like to dig under fences and cats are good climbers. Kangaroos also often jump over farm fences.

Your design needs to suggest ways of preventing these animals from entering the paddocks. You need to draw sketches to show your ideas and use labels to clearly show each feature.

Then, decide on a solution and complete a scale drawing of it.

Make your scale model and write an explanation detailing how the fence will be effective.

Then, share and explain your design as part of a 'Meet the Inventors' TV show, in which you explain the key features of your design or technology.

A suggested learning process

Define

Capture student interest and find out what they know about farms and the technologies used on them.

Talk with students about what they know about farms, whether they have ever visited one, have a family member who owns one, or knows of someone who farms and uses a range of technologies to help in the production of a food.

Discuss the diversity of farms that exist in Australia. Introduce terms like fishery, piggery, free-range farm, cattle station, dairy farm, sheep farm, oyster farm, tree farm, cotton farm, vineyard, cherry farm, worm farm, macadamia nut farm, garlic farm, blueberry farm, mixed farm, etc.

Ask students to record what they know about farms, what technologies they use, what they produce, and for whom?

Introduce the term 'technology'. Ask students what a technology might be.

Share different examples of technology. *For example:*

- a farmer using zero tillage cropping;
- a flower grower using liquid fertiliser in overhead sprinklers; and
- an irrigation specialist designing a water-efficient drip system.

When discussing technologies, introduce the terms 'new', 'appropriate', 'shelter', 'food', 'clothing', 'Aboriginal and Torres Strait Islander Peoples', 'colonial', 'communication' and/or 'digital' technologies.

Establish an area of the classroom that can be set aside for an evolving visual display of different categories of technologies.

Present the scenario again, assign pairs or small groups if appropriate, and ask students to define the task they have been set.

Discover

Brainstorm ideas about how technologies might be used on farms, in fishing and aquaculture. List key words and create a flow chart to show links between them.

Collate the ideas and add these to the class visual display of different categories of technologies.

Talk with the students about how exciting technology is as a subject to study. Describe how it provides opportunities to solve all sorts of problems in a practical way by designing and making things.

Explore the **videos** in the Junior Landcare program. After viewing, discuss the range of different things students designed and made.

Talk with the students about how learning in the design and technologies subject involves creating designed solutions. Reflect on the designed solutions created by the students featured in the Junior Landcare videos and the many steps involved in their work.

Outline to students, with suitable visual aids, some of the significant innovations developed in the agricultural sector, examples follow.

- John Ridley's wheat stripper (1843)
- James Harrison's rack wool press (1865)
- J.A.B. Higham's mechanical shearing machine (1866)
- Robert and Clarence Smith's stump-jump plough (1876)
- James Alston's self-operating windmill for pumping subartesian water (1880s)
- H.V. McKay's harvester (1885)
- **Drones in Agriculture**
- **Danielle Gould**—Founder, Food + Tech Connect
- **Miku Jha**—Founder and CEO, AgShift

Dream

In pairs or small groups, envision or dream about the many possible design solutions.

Further develop ideas for possible solutions using sketches and labels.

Ask students to visualise their most creative solution.

Invite students to think about what materials, tools, equipment and ingredients they will need to make their solution a reality.

Design

Invite students, in pairs or small groups, to begin drafting their designs for their solutions.

Ask students to gather the materials, tools and equipment needed and then design and build the solution.

Invite students to prototype and test their model, evaluate its ability to keep out feral animals and protect cattle and sheep, and where necessary redesign their solution.

Ask groups to talk about how they solved any problems that emerged as they designed, built, tested and adjusted their models.

Deliver

In pairs or small groups, showcase the models they designed.

Host a 'STEM Day' as part of National Science Week and invite students, teachers and parents to discover what students can do.

Share photos and students' work samples via National Science Week's online community. The Australian Science Teachers Association always enjoys seeing pictures of classroom learning. Share photos via email at **nscwk@asta.edu.au** or share what has been created via **Facebook**, **Instagram** or **Twitter** with #scienceweek. Please ensure that you have parental permission prior to posting any images of students.

Debrief

Ask students to reflect on their learning and answer the following questions.

- What worked and what did not?
- How could you improve on what you have done?
- What are three things you learned that you did not know before?
- What are three things that surprised you?
- What was your most inspiring moment in the challenge?
- How can you apply what you have learned to other challenges, now and in the future?

Curriculum connections

Science

Year 5 and Year 6

Science as a Human Endeavour—Nature and development of science

Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions ACSHE081, ACSHE098

Science as a Human Endeavour—Use and influence of science

Scientific knowledge is used to solve problems and inform personal and community decisions ACSHE083, ACSHE100

Science Inquiry Skills

With guidance, pose clarifying questions and make predictions about scientific investigations ACSIS231, ACSIS232

Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks ACSIS086, ACSIS103

Compare data with predictions and use as evidence in developing explanations ACSIS218, ACSIS221

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts ACSIS093, ACSIS110

Technologies (ACARA, 2015b)

Year 5 and Year 6

Design and Technologies—Knowledge and Understandings

Examine how people in design and technologies occupations address competing considerations, including sustainability in the design of products, services and environments for current and future use ACTDEK019

Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use ACTDEK023

Design and Technologies—Processes and Production Skills

Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions ACTDEP024

Generate, develop and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques ACTDEP025

Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions ACTDEP026

Develop project plans that include consideration of resources when making designed solutions individually and collaboratively ACTDEP028

General Capabilities

Literacy, ICT capability, Critical and creative thinking, Ethical Understanding and Personal and social capability.

Flavour OF THE MONTH

Cucumbers

Cucumbers are a summer vegetable. They are crunchy, nourishing and hydrating and are commonly used in pickles, salads, dips and even cold soup.

Cucumbers like to be grown in full sun with shade in hotter climates. They can be grown on a trellis or in rows in garden beds or even in paddocks. Cucumbers need lots of water around their root zone and regular doses of fertiliser.

GROW

Grow a windowsill jungle

There is an amazing range of plants you can grow at home—all from the fruit and vegetables you probably have in your kitchen—to create your own windowsill jungle. Many of our favourite foods are seeds, bulbs, tap roots or the tubers of plants, that you can easily encourage to grow. Let us see how they differ.

A **seed** is the dispersal part of a plant. As well as the embryo (which grows into the new plant), it also has a supply of food.

A **bulb** consists of a short stem surrounded by fleshy leaves that act as food storage organs during dormancy.

A **tap root** is a large central root that is also used as a storage organ. **Tubers** are swollen underground stems also used for food storage. Which one might a cucumber be?

To grow any plant successfully, they need to have four requirements: sunlight, the right temperature, soil and water.

Source: Local Safari, The Jane Goodall Institute Australia, 2020, page 112.

DESIGN studio

Design a nutrient chart showing the nutrients in our food and the foods that some people are intolerant or allergic to

Protein, fat and carbohydrate (sugar and starch) are found in the foods in our diet. Proteins supply the building blocks for our tissues, and fats and sugars provide the fuel for our metabolism to generate energy. Energy comes from major nutrients, not vitamins.

Food intolerances and allergies affect many people and symptoms vary person to person. Nuts, milk, wheat, yeast, onions and sugar are common foods that can affect some people.

FOOD DIFFERENT by design

Case study

4 QUALITY EDUCATION | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | 11 SUSTAINABLE CITIES AND COMMUNITIES | 14 LIFE BELOW WATER

AI for fishing sustainably

View and listen to an episode of CSIRO's *SCOPE*, the children's program on Network 10, where they showcased their **sustainable fishing project WANDA®**. This is software that uses advanced mathematical and computing techniques such as deep learning—a subset of AI (Artificial Intelligence)—to automatically detect and identify fish species, helping make fishing more sustainable.

Have a go at this

Activity 3: From the farm gate to your lunchbox

Most of us buy our apples from supermarkets, markets, or shops. But is that where they came from originally? Where are they produced and processed for us to eat?

Most people know apples come from a tree, but many do not know how the apples on the trees are produced, processed and delivered to supermarkets.

Did you know that apples are grown on farms? They like a sheltered site, in full sun, with fertile, well-drained soil that has a slightly acid pH of about 6.5.

Farmers know that apple trees are best planted in July and August, while they are dormant. They also know that most apple trees need to be cross-pollinated with other trees that flower at the same time, and it is insects such as bees that carry the pollen from one tree to another.

Farmers fertilise their apple trees in spring, and sometimes spread a mulch of well-rotted manure or compost in a circle around the apple trees.

It is in early summer that the fresh apples ripen, and farmers harvest them for sale to supermarkets, markets and shops.

Did you know that sometimes apples can be kept in cold storage rooms for sale later in the year too? And that **wax coatings** are sometimes sprayed onto apples to make them look shinier?

Photo by Vince Fleming on Unsplash

Design an infographic that communicates the journey of how apples get from the farm gate to you and remember to identify and sequence the process (steps) of converting 'on-farm' apples into a product suitable for retail sale.

Then, create an infographic to present your understandings about how apples are converted into a product suitable for retail sale. Great examples of infographics can be found at **information is beautiful** and **Daily infographic** websites.

Why not share it with your local supermarket during National Science Week and show what you know about how Australian farmers grow healthy and nutritious apples that might end up in your lunchbox.

Have a go at this

Activity 4: Design environmentally friendly packaging

Context: *Dairy foods are packaged differently all over the world.*

Task: Your task is to design packaging that is effective and environmentally friendly for a suite of two dairy foods.

Investigate: Investigate the ways that milk, cheese, yoghurt, cream, ice cream and butter are packaged. Visit the local supermarket and take note of the materials that are used to support the contents, the size and shape of the package, and the information that is provided for consumers.

Resources: Dairy foods; packaging; Google SketchUp

Produce: Produce packaging for two dairy foods. Label your design and include any relevant information including what material it is made from, the size (in grams or millilitres) and a Nutrition Information Panel. Give your product a name and illustrate it.

Extension: Create a marketing slogan to advertise your product.

Photo by Eiliv-Sonas Aceron on Unsplash

Have a go at this

Activity 5: Design and make a long-handled net for catching fish

Your challenge is to design and make a net for catching fish being bred in tanks.

You will need:

- tools for cutting wire,
- netting,
- some fabric,
- plastic flywire,
- stocking or pantyhose,
- a length of wooden broomstick, and
- some wire.

Identify criteria for success using visual representations such as a flowchart.

Think about the safety precautions you need to take when using wire.

Choose a tool suitable for cutting and bending wire. Consider some methods of joining your material to the wire.

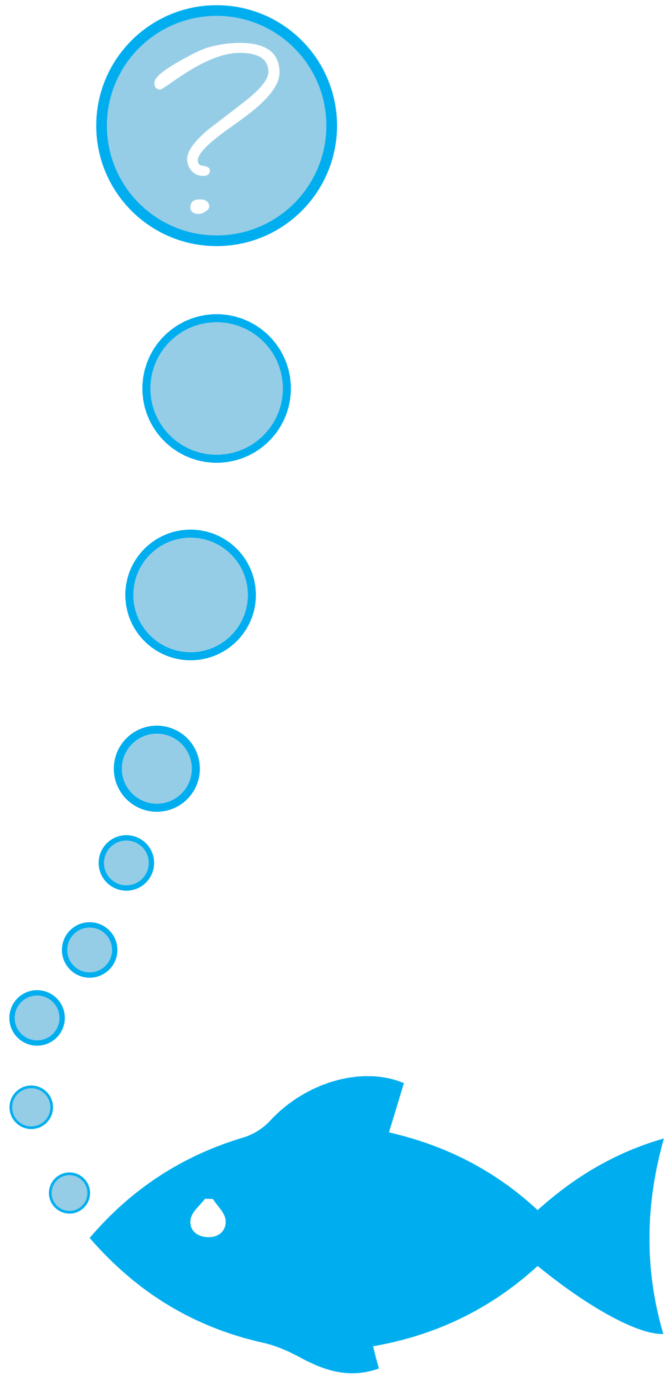
Draw designs for your net and label the parts.

Select your best design and make your net.

Use your net. Was it successful? How could you improve on it?

Write a paragraph about this task. Include details on the quality of your planning and your finished model as well as how well you worked with other students.

Share photos and students' work samples via National Science Week's online community. The Australian Science Teachers Association always enjoys seeing pictures of classroom learning. Share photos via email at **nscwk@asta.edu.au** or share what has been created via **Facebook**, **Instagram** or **Twitter** with #scienceweek. Please ensure that you have parental permission prior to posting any images of students.



Have a go at this

Activity 6: Design and make a water filter

Mussel growing begins in a tank and these tanks have filters that keep the water clean.

Your challenge is to design and construct a simple water filtration system.

You will need:

- some 2 litre plastic bottles;
- some yoghurt or margarine containers;
- tubing;
- filtering materials: e.g. some cotton wool, fine sand, charcoal, coarse sand, fine gravel, coarse gravel; and
- water.

Draw a labelled drawing of the water filter you made and describe how it works. Identify criteria for success using visual representations such as a flowchart.

Write a paragraph about this task. Include details on the quality of your planning, your finished model, how well you worked with other students and if you enjoyed the task.

Finally, deliver it as part of National Science Week in 2021.

Share photos and students' work samples via National Science Week's online community. The Australian Science Teachers Association always enjoys seeing pictures of classroom learning. Share photos via email at **nscwk@asta.edu.au** or share what has been created via **Facebook**, **Instagram** or **Twitter** with #scienceweek Please ensure that you have parental permission prior to posting any images of students.

Have a go at this

Activity 7: Square foot gardening—a new food trend

Community gardens have become increasingly popular in recent years as groups of people become more concerned about food production and transport processes that contribute greenhouse emissions to the atmosphere. In environments where space is a premium, a search for ways to get the most out of a little has led to various grassroots projects that aim to bring neighbourhoods together in a shared space to grow their favourite fruit, herbs and vegetables, reduce food miles and live more sustainably.

The objective of this task is for students to work in groups to design their own vegetable garden as a form of experiencing the farming process. Inform them they must work to a set budget, which may be provided by the school or set at a reasonable expectation should families provide the materials.

Each group will:

- grow three different items of produce;
- create a garden that occupies a restricted amount of space;
- take ten weeks between planting and harvest (this could be extended in slow-growing conditions);
- use a spreadsheet to keep track of costs and items supplied (including the total amount bought and amount used).

Students will need to consider the following parameters.

- Soil type.
- Fertilisers used.
- Pest protection.
- Container type.
- Water scheduling.
- Plant density and arrangement.

Inform students that, while the activity is ultimately competitive, those groups who cooperate and share in the purchase of resources will have lower costs.

At the end of the ten weeks, all produce is to be harvested, washed and weighed and then enjoyed. Acknowledge the group with the greatest mass of usable produce.

FOR THE SECONDARY YEARS OF SCHOOLING

YEARS 7 TO 10

FOOD

DIFFERENT by design

Australian Science Teachers Association

Learning Experiences for **Years 7, 8, 9 and 10**

Activity 1: Pitch a food idea

Overview: *Explain to the students that they will investigate some research that explains how the eating habits of millennials are impacting on the food industry. They will design and cook sustainable dishes, and they will also design a solution and try to sell it as part of a 'Pitch' competition.*

Background notes for students: Millennials and their eating habits

Millennials are defined as people born between 1981 and the mid 2000s.

Food consumption is an interesting topic and studies have shown that millennials are preparing food at home less and consuming food that has been pre-prepared more often.

Pre-prepared and convenience foods are foods made by someone else, i.e., the food industry, food services or retail outlets.

Because consumers are increasingly eating meals made by someone else, is it therefore important that sustainable food alternatives are made sufficiently available and accessible at the many varied locations where food is ordered, shopped for and eaten?

The essential question

What benefits accrue for food technologies when we have an understanding that consumers are eating meals made by someone else more than ever before, and therefore it is important that healthy and sustainable dishes are available and accessible at the many varied locations where food is ordered, shopped for and eaten?

The scenario

Discover how people in the food industry are working with new ideas, technologies and entrepreneurs to re-imagine how food can be selected, prepared and delivered to customers.

Investigate how entrepreneurs are designing prepared plates of food, food bowls and technologies like mobile ordering and delivery apps to make eating more convenient and accessible.

Then, as part of a design team, re-imagine how a type or selection of food can be prepared using a 'health and sustainability lens' and explain your selection of food, your preparation and cooking techniques, your recipe and food safety practices in a folio of ideas to explain your entrepreneurial thinking.

Your design team is also tasked with selling your idea as part of a food tech and sustainability 'Pitch' competition.

A suggested learning process

Define

Share the essential question with the class and talk about the tasks that need to be addressed.

Present the scenario, assign teams, if appropriate, and ask students to define the task they have been set.

Discuss how our ecological footprint is influenced by what we eat, how food is produced, how far it has travelled, how it is packaged, prepared and cooked, the portion size and how we dispose of what is left.

Talk with students about how exciting food technology is as an area of study. Describe how it provides opportunities to solve all sorts of problems in a practical way by designing and making things and changing and adapting things that are already in existence.

Talk with students about how learning in 'Food Technologies' involves creating designed solutions. Also, introduce the term '**design thinking**' and the five phases of the design process: Discovery, Interpretation, Ideation, Experimentation and Evolution.

Introduce students to some of the steps involved in designing and making in 'Design and Technology' and 'Technology Mandatory'.

Talk about:

- deciding on a need;
- defining the scope of what is going to be designed and made and planning a sequence of production steps;
- developing the design;
- selecting and using materials, tools and equipment to make the designed solution;
- making the design solution; and
- evaluating the design, its ideas, processes and solution.

Talk with students about millennials who are preparing food at home less and consuming food that has been pre-prepared more often. Ask students to read about the latest findings about the **eating habits of millennials**.

Discover

Capture student's interest and discuss how investors are currently investing in food companies and start-up businesses. *For example*, view a YouTube video discussing how Rabobank's **Food Bytes** initiative enables game-changing entrepreneurs to bring new products to consumers using a 'pitch' that sells their ideas (1:48 min).

Go further and explore **20 startups that pitched at FoodBytes** and discover their innovative ideas.

Read about a Melbourne start-up, **EatClub**, that is tackling the ever-growing impact of food delivery services on the Australian hospitality industry by providing restaurants with a service to incentivise customers to dine at their venues during slower or off-peak times via live app notifications.

As a class, undertake a range of activities.

Focus on the meaning of nutritious food. Ask students to define what nutritious foods are.

Introduce the **Australian Dietary Guidelines** that provide up-to-date advice about the amounts and kinds of foods we need to eat for good health and well-being. Talk about how the Australian Dietary Guidelines encourage us to enjoy a wide variety of nutritious foods from the five food groups every day.

Brainstorm what the five food groups might be. Discover the nutritious foods found in each **food group**.

Brainstorm what is known about traditional and contemporary approaches to selecting, preparing and cooking food from the five food groups. *For example*: 'My grandparents …', 'My parents select and cook …', 'Teenagers of my age …'

Talk about how the characteristics and properties of different foods determine preparation techniques. *For example*, the basic principle of egg cookery centres around the properties of the proteins in both the yolk and the white to coagulate (thicken) when heated. Talk about the uses of eggs in cookery. *For example*, as breakfast foods, binding, coating other foods, as a garnish, in pasta and pasta dishes, in pastries, dough, cake mixtures, soufflés, meringues, biscuits.

Repeat this discussion with different food groups.

Discuss food safety principles and practices when preparing and cooking food. *For example*: safety is important in the science laboratory and no food or drinks are permitted, additionally, safety and hygiene are especially important when preparing or eating food. Washing your hands is one of the simplest ways to prevent the spread of the germs that can cause food poisoning. You need to wash your hands before you prepare food and also again if you go to the toilet, cough, sneeze, eat, drink, touch your hair, head or body or touch your phone. Cross contamination happens when harmful bacteria spread from one food to another via surfaces, hands, or equipment. It can happen if equipment, such as a chopping board, is used for raw food preparation and then used for cooked or ready to eat food.

Talk about storing food safely. *For example*, many foods can grow harmful bacteria if they are left at room temperature. Items such as cooked and raw meats, poultry, seafood, dairy products and leftover cooked foods need to be stored below 4 degrees to halt the growth of harmful germs.

Talk about defrosting. *For example*, the best way to defrost any food product is to remove it from the freezer ahead of time and defrost in the fridge. Never leave food to defrost at room temperature.

Discuss the safety principles of reheating food. *For example*, Make sure leftovers are always reheated until steaming hot all the way through, with no cold patches. It is important to be careful reheating food, etc. Talk about concepts like 'farm-to-plate', 'farm to fork', 'grass-to-glass', 'paddock-to-plate', and brainstorm how buying locally produced and seasonal ingredients might contribute to a sustainably produced product.

Similarly, discuss low ecological footprints and cooking techniques. Ask questions like: 'How might chefs select ingredients and cook food with a low ecological footprint?'

Go deeper in discussions about 'low ecological footprints' and consider which cooking methods might have the lower ecological footprints. Talk about stir frying versus roasting, using a BBQ versus a microwave, or cooking on a BBQ versus an electric stove.

Focus on the serving of food and ask questions like: 'How might chefs use sustainable serves of food, sustainable catering and sustainable waste management?'

Brainstorm and record ways to **reduce food footprints**; make eco-friendly food and product choices; reduce food loses; reduce food waste emissions; avoid waste from the plate; and avoid wastage during cooking.

Read **Shrink your food footprint** for information and record the key messages that could assist when planning how to ensure a low ecological footprint whilst selecting ingredients and whilst also serving them and managing any waste.

Use a **Plus–Minus–Interesting** (PMI) chart to identify the advantages, disadvantages and interesting ideas about how ingredients in a recipe can be selected, prepared and cooked whilst keeping a low ecological footprint in mind.

Ask students to demonstrate their understandings by answering the following question: 'What are the important issues we need to keep in mind when planning, preparing and cooking our dishes while sourcing sustainably produced food, eco-friendly ingredients and avoiding any food waste?'

Refocus on the task and ask students, in design teams, to envision a sample of sustainable food selections for millennials who prefer consuming pre-prepared food, and also to think about how a type or selection of food can be prepared using a 'health and sustainability lens'.

Ask each design team to share what their research has told them and what they still must accomplish within the task with their peers, the teacher and family.

Discover a change maker named **Steven Satterfield** who is a chef and author of a cookbook with recipes that use foods that might be wasted like carrot tops and apple cores. Explore how he transforms these foods into sauces, salads, stews, desserts and more.

Discover a change maker like Ronni Kahn who is the force behind the food rescue organisation **OzHarvest**. Consider the types of recipes that might be appealing to millennials that use rescued foods that might otherwise be wasted.

Discuss how these change makers are in the solution business and how they all built or designed things with a purpose in mind.

In design teams, ask students to brainstorm the food preparation method and recipe for a dish that they are re-imagining. Remind students that it needs to be healthy and sustainable.

Ask each design team to share what their research has told them and what they still have to accomplish within the task.

Engage students in **how to develop a pitch**. Review pitches made in Shark Tank for ideas.

Dream

Ask design teams to create a vision for their dish that they are re-imagining.

Ask teams to use all the knowledge they have gathered to visualise a creative and appropriate solution for how a type or selection of food can be prepared using a 'health and sustainability lens' that they know about and are excited to innovate on.

Ask students to discuss which recipe they will use.

Use the following ideas and questions to stimulate the possible ways of designing and creating their work samples.

- Consider which recipe you will prepare and the ingredients and equipment you need to cook it.
- How will you cook the dish with a low ecological footprint?
- What sustainable approaches to cooking and waste management might be possible?
- What will you make your 'pitch' about?
- How will you bring the topic alive for others?
- How will you grab their attention?
- What is it about your dish that you want everyone to know?
- How will you use your ideas?
- How will you approach writing your draft script for the 'pitch'?

Ask students to consider the many possible ways that they can design their ideas. Talk about the use of research, working sketches, food photography, drawings, experimentation, or video samples.

Ask students to develop possible solutions by brainstorming ideas.

Ask students to imagine the steps involved in designing and cooking the dish that they are re-imagining.

Challenge students to think about the materials, tools and equipment they will need to design and cook their individual work samples. Will they use locally sourced food, seasonal ingredients, foods that may have been wasted? What food safety principles and practices will they observe and use? Will they use digital or non-digital equipment and tools to record the processes they use?

Also, ask students to envision the 'pitch' that will be used to sell their ideas as part of a food tech and sustainability 'Pitch' competition.

Design

Ask students to document design ideas for a sustainable and healthy dish that they are re-imagining, and document ideas in their folio to explain their entrepreneurial thinking.

Ask students to develop a work plan to outline everything that is needed, who is responsible, when it is to be undertaken and how it will be undertaken.

What?	How?	When?	Who?	How can our product and processes be improved?

Invite students to implement their plans and test out the recipe for their dish using appropriate food safety principles and processes.

Talk about how the students might use a blog, food photography, display folder, digital presentation, or a combination of these, to show evidence of their design and production process.

Ask students to draft the steps involved in making and cooking their chosen recipe.

Talk about the importance of a clear layout of information and a clear design that makes it easy for an audience to understand and interpret the information given.

Talk about the importance of sourcing graphics, photos and information correctly.

Review rules on personal safety, group safety and classroom and furniture safety with the students. Ask students to establish a workstation and to gather the materials and tools they require. Talk about storing their work samples safely and keeping a record of the processes they use to create it.

Remind students to record the steps involved in making their chosen recipe.

Talk with students about how they might share and present their designs to an audience?

Ask students to explain how they plan to finalise and create their designs with another peer in the class and seek feedback on their ideas.

Remind each design team that they are also tasked with selling their ideas as part of a food tech and sustainability 'Pitch' competition.

Deliver

Invite students, teachers and parents to attend a function to taste and celebrate the dishes of food that have been created.

Host the function and serve the students' dishes that use healthy and sustainable approaches to cooking.

Encourage students to explain to the guests how they designed and created their dishes, what ingredients were used, the way it was prepared, the equipment and techniques used to ensure it is healthy and was created with a low ecological footprint.

Host a 'Pitch' competition and ask students to 'pitch' the idea behind the dish they created.

The following are suggested points to consider in each 'pitch' presentation:

- How much do the students know about the subject matter?
- How much do they know about the science behind their solution?
- How well have they used their chosen medium?
- What is unique or eye-catching about their visual style?
- What concepts about the subject matter have they chosen to emphasise?
- Have they missed anything out?

Debrief

Ask students to retell their findings about the ways people in the food industry are working with new ideas, technologies and entrepreneurs to re-imagine how food can be selected, prepared and delivered to customers.

Ask students to evaluate their designs, dish and pitch, and then write about whether their designs and product matched the definition of the task and were feasible.

Ask students to write about the quality of their planning, their finished dish and pitch, and whether they enjoyed the task.

Ask questions like: "What would you do differently next time?"

Flavour OF THE MONTH

Plant-based meat

Plant-Based Burgers

The Impossible Patty—the plant-based burger made with GMOs and "fake blood"—is created by a company called Impossible Foods.

'Impossible' meat consists of potato and genetically modified soy proteins, but it also gets a flavour boost from genetically engineered leghemoglobin or "heme", the ingredient that replicates beef's iron-rich meaty taste.

Yet, even though it is made with GMOs and multi-syllabic ingredients, Impossible's burgers are not actually all that weird or inexplicable.

Impossible's ingredients include yeast extract, cultured dextrose (a preservative), modified food starch (a binder) and mixed tocopherols (antioxidants). While these ingredients may, or may not, be considered "clean" by Lightlife, they serve a purpose, whether it be by thickening or binding or preventing spoiling, and are all considered **safe** by the FDA.

DESIGN studio

Design a bug-based burger

Your challenge is to design a bug-based burger. Will it be based on crickets, maggots, or worms?

Check out the insects being farmed in Queanbeyan, NSW by a company called **Goterra**.

Did you know that the ecological footprint of insect farming is low? In South Australia's Riverland, **citrus and grain farmer Tim Schubert and his son Zachary have installed two shipping containers** in which to raise insects.

Their aim is to subsidise their farming income in the lean seasons with insects, which require a fraction of the water of livestock or chickens.

Curriculum connections

Technologies

Years 7 and 8

Design and Technologies—Knowledge and Understanding

Investigate the ways in which products, services and environments evolve locally, regionally and globally and how competing factors including social, ethical and sustainability considerations are prioritised in the development of technologies and designed solutions for preferred futures ACTDEK029

Analyse how food and fibre are produced when designing managed environments and how these can become more sustainable ACTDEK032

Design and Technologies—Process and Production Skills

Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas ACTDEP035

Generate, develop, test and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques ACTDEP036

Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions ACTDEP037

Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability ACTDEP038

Use project management processes when working individually and collaboratively to coordinate production of designed solution ACTDEP039

Years 9 and 10

Design and Technologies—Knowledge and Understanding

Explain how products, services and environments evolve with consideration of preferred futures and the impact of emerging technologies on design decisions ACTDEK041

Investigate and make judgements on the ethical and sustainable production and marketing of food and fibre ACTDEK044

Design and Technologies—Process and Production Skills

Investigate and make judgements, within a range of technologies specialisations, on how technologies can be combined to create designed solutions ACTDEK047

Develop, modify and communicate design ideas by applying design thinking, creativity, innovation and enterprise skills of increasing sophistication ACTDEP049

Work flexibly to effectively and safely test, select, justify and use appropriate technologies and processes to make designed solutions ACTDEP050

Evaluate design ideas, processes and solutions against comprehensive criteria for success recognising the need for sustainability ACTDEP051

Develop project plans using digital technologies to plan and manage projects individually and collaboratively taking into consideration time, cost, risk and production processes ACTDEP052

General Capabilities

Literacy, ICT capability, Critical and creative thinking, Ethical understanding, and Personal and social capability.

Cross-curriculum Priority

Sustainability.

FOOD DIFFERENT by design

Case study

World's largest urban farm

Read about the **world's largest roof-top farm** in Paris, France.

Did you know that the French are leading the war on food waste?

In 2015, the French government passed a law that forbids supermarkets from throwing out food. Supermarkets must donate any unsold food that is still edible to charity.

Military food bar

The Department of Defence has developed a high-energy, gut-friendly snack bar to meet the specific health and nutritional needs of military personnel.

Optimal nutrition is essential for our troops who, like professional athletes, need to be in peak condition. Not getting enough energy and nutrients can lead to poor performance both physically and mentally and have adverse health effects in the long term.

The bars are made using raw, green banana flour, which is a type 2 resistant starch, shown to be high in fibre and beneficial for gut health. Resistant starch is not broken down in the small intestine in normal digestion processes. It moves through to the large intestine where it preferentially feeds protective microbial flora and improves intestinal health whilst providing a sustained source of energy.

The bar delivers one megajoule of energy, reducing hunger and providing extra fuel for the body during extended physical activity. It is fortified with essential vitamins and minerals, including calcium and vitamin D to improve bone health.

Photo by Should Wang on Unsplash

Bring innovation to your classroom with a fast-paced national hackathon

ANSTO's National Science Week
Hackathon
16-18 August, 2021

Use the Hackathon to engage with the essential question in Activity 2: Game Changing Ideas in Food

PRIZES TO BE WON

- Design game-changing solutions for healthy people and a healthy planet
- Address stage 4 and 5 curriculum-linked science content
- Be mentored by industry-leading experts
- Teacher Professional Development session in Design Thinking

Australian Government | ANSTO Science. Ingenuity. Sustainability.

DF GN

In partnership with the Design Factory Global Network

Register your interest

www.ansto.gov.au/hackathon

Activity 2: Game changing ideas in food

Overview: *Explain to the students that they will investigate a range of new ideas that are changing our food system. They will be provided with opportunities to use a variety of thinking strategies, embrace new concepts and learn through trialling, testing and refining ideas before they then design a solution to sustainably produce food and produce a folio of ideas to explain their entrepreneurial thinking.*

Background notes for students: Technology and agriculture

Australian agriculture has come a long way in the past ten years. Through the application of technology, almost every agricultural process has been improved or made more efficient.

Technology has been applied to an endless list of agricultural practices and processes. Areas include farm machinery, livestock handing, farm facilities, feeding capabilities, agronomy, processing technologies, waste management, improved water efficiencies, resource recovery, transportation, communication and banking. The remote sensors, satellites, artificial intelligence (AI) and robotics are all now viable technologies in agriculture and the food system in general.

The essential question

What benefits accrue in agriculture when we understand how traditional and contemporary approaches are used in conjunction with advancing technologies when designing sustainable products and solutions for a secure and sustainable food future?

The scenario

Discover how farmers, producers and processors are working with new ideas, technologies and entrepreneurs to re-imagine how food can be produced, processed and delivered to customers.

Investigate how remote sensors, satellites, artificial intelligence (AI), robotics and the Internet of Things (IoT) are now part of producing food.

Then, as part of a design team, re-imagine a production method or system to sustainably produce food and produce a folio of ideas to explain your entrepreneurial thinking.

A suggested learning process

Define

Share the essential question with the class and talk about the tasks that need to be addressed.

Present the scenario, assign teams, if appropriate, and ask students to define the task they have been set.

Much of the food and fibre our communities rely upon begin on some sort of farm. Whether the agricultural produce comes from a field, a forest, a fishery, a piggery or a cattle or sheep farm, there was a natural or managed environment responsible for its growth.

Find out what students already know about farms and the technologies used on them.

Introduce the terms 'new technologies', 'appropriate technologies', shelter technologies', 'food technologies', 'clothing technologies', 'Aboriginal and Torres Strait Islander Peoples technologies', 'colonial technologies', 'communication technologies', 'digital technologies', etc.

Talk with the students about how exciting technology is as an area of study. Describe how it provides opportunities to solve all sorts of problems in a practical way by designing and making things as well as changing and adapting things that are already in existence.

Talk with the students about how learning in 'Design and involves creating designed solutions. Also, introduce the term '**design thinking**' and the five phases of the design process: Discovery, Interpretation, Ideation, Experimentation and Evolution.

Introduce students to some of the steps involved in designing and making in 'Technology Mandatory'.

Talk about:

- deciding on a need;
- defining the scope of what is going to be designed and made and planning a sequence of production steps;
- developing the design;
- selecting and using materials, tools and equipment to make the designed solution;
- making the design solution; and
- evaluating the design, its ideas, processes and solution.

Discover

Capture students' interest and discuss how investors are currently investing in food and agriculture companies and start-up businesses. *For example*, discuss how in Australia, **AgriFutures** in partnership with a start-up from the University of Sydney, has developed a pilot program to engage high school students in remote and regional Australia to solve the problems facing agriculture using innovation and an entrepreneurial mindset.

As a class, undertake the following activities.

Collectively determine what is known about traditional and contemporary approaches to producing food products.

Discuss how advancing technologies are being integrated into traditional and contemporary approaches and methods.

Investigate Episode 14 of Series 18 of the ABC program *Catalyst* entitled '**Farmer Needs a Robot**' and explore the way robots can change the traditional and contemporary approaches to moving cattle, tackling weeds and planting seed.

Discuss the use of robots and brainstorm where and how robots could enhance farming operations, reduce manual handling and provide a consistent flow of product in other areas of agriculture.

Explore how **robots are being used in the Australian meat processing industry** and brainstorm ideas about the way the X-ray machines add value to the red meat industry.

Delve deeper and find out how robotics and automated systems are being used to reduce production costs and increase quality and safety at **Gundagai Meat Processors** (GMP).

Undertake a SWOT analysis. Talk about 'SWOT' being an acronym for Strengths, Weaknesses, Opportunities and Threats and how a SWOT analysis can help identify vital areas to either improve or emphasise.

Model the use of a SWOT analysis using the GMP example. Analyse whether the automated system that uses robotics is enhancing the quality of the product and whether production methods are improved.

In design teams, ask students to do the following:

- Go further and find out about a **state-of-the-art rendering plant** that processes waste from an abattoir and that can be operated from a mobile phone. Record the different technologies involved to process the waste, enhance systems used within the plant, and run the plant.
- Undertake a SWOT analysis and analyse whether the technologies and automated systems add value to the company's principles of sustainability.

As a class, do the following:

- Talk about artificial intelligence (AI) and machine learning. Explain to the students that, hypothetically, it is possible for machines to learn to solve any problem relating to the physical interaction of things within a defined or contained environment by using AI and machine learning.
- Explain that the principle of artificial intelligence is one where a machine can perceive its environment, and through a certain capacity of flexible rationality, take action to address a specified goal related to that environment. Machine learning is when the machine receives large quantities of similar sets of data that can be categorised into specified protocols, whereby its ability to rationalise increases, allowing it to better "predict" on a range of outcomes.

In design teams, ask students to do the following.

- Investigate the application of AI and discover how pigs are raised using AI technology in China. Talk about the use of machines that can identify the pigs by their face and vocalisations. Explore how this technology can also track all the pigs' activities and vital signs, and flag issues like pregnancy, sickness, or sedentariness.
- Find out about **99 technologies that are changing the future of agriculture in Africa**.
- Investigate the use of a contemporary method of producing food and hydroponics and its role in **urban farming**. Data cited in the linked article might inspire thinking about how mini farms could be designed as part of the unit.
- View a video for information about a **Mini Farm Project**. Investigate and record the different technologies involved in its operation.

For further inspiration, ask the design teams to discover more about an **accelerator network** in Orange in NSW that is working with the following cohort of entrepreneurs:

- SOOS Technology is developing a solution to the egg-production industry's greatest challenge – male chick extermination. Every year, 7.5 billion male layers are exterminated since they cannot lay eggs nor be used for meat production.
- OVO Technology is developing sex reversal technology for the broiler industry, meaning increased meat production with the same resources.
- Nutrivert is developing replacements for antibiotics in livestock production, the largest pharma market on earth.
- Leading Edge DC is building a network of highly connected edge data centres to provide reliable internet and direct cloud connectivity across regional Australia.
- Himikara: Himifarms is connecting customers directly with farms/farmers using an on-demand technology-enabled precision farming platform.
- Black Box Co is an innovative SaaS (Software as a Service) product for the livestock industry. It ingests data captured within production systems, cleans, refines and disseminates this data through multiple proprietary algorithms to create data driven informed insights for the livestock industry.
- The BioScout System is an integrated hardware and software platform that uses ground-based data and artificial intelligence to track and analyse the spread of airborne diseases on farm fields.
- Autonomous Pivot (AP) has developed a solution for the pivot farming industry saving the farmer time, money while optimising yield. AP have developed the world's first on-pivot non-invasive mobile soil moisture sensor.
- Arugga AI Farming: Arugga is developing an autonomous robot for treating and monitoring individual plants in greenhouses.

Ask each design team to share what their research has told them and what they still have to accomplish within the task.

Invite the design teams to research other innovators in the industry, perhaps those who are focusing on sustainability principles, ethical handling principles, or work, health and safety principles.

In design teams, ask students to brainstorm the production method or system that they are re-imagining.

Dream

Ask design teams to create a vision for the production method or system that they are re-imagining.

Ask teams to use all the knowledge they have gathered to visualise a creative and appropriate solution for a production method or system that they know about and are excited to innovate on.

Ask students to visualise what the solution will appear like in the future.

Ask students to consider the many possible ways that they can design their idea. Talk about the use of research, working sketches, models, drawings, 3D modelling, experimentation, or photographic samples.

Ask students to develop some possible solutions by brainstorming ideas.

Ask students to imagine the steps involved in designing the production method that they are re-imagining.

Challenge students to think about the materials, tools and equipment they will need to design their individual work samples. Will they use digital or non-digital equipment and tools?

Also, ask students to use the National Science Week Journal/Design Folio to record their thinking.

Design

Ask the students to explain how they plan to approach the task of re-imagining design ideas for a production method or system. They should include descriptions about how they will prepare, action and document this process and produce a folio of ideas explaining their entrepreneurial thinking.

Talk about how the students might use a model, prototype, blog, display folder, digital presentation, or a combination of these, to show the evidence of their design and production process.

Ask students to draft the steps involved in making their chosen design.

Talk about the importance of a clear layout for information and a clear design that makes it easy for an audience to understand and interpret the information given.

Discuss the importance of including information in the design about how the production method or system and their technologies might:

- manage water, energy and waste productively and sustainably;
- treat the livestock ethically;
- produce food sustainably;
- reduce manual handling and repetitive work;
- reduce the risk of injuries;
- maintain equipment;
- collect data;
- make money or save money; and/or,
- help market a quality product credibly.

Talk about the importance of sourcing graphics, photos and information correctly.

Review rules on personal safety, group safety and classroom and furniture safety with the students. Ask students to establish a workstation and to gather the materials and tools they require. Talk about storing their design safely and keeping a record of the processes they use to create it.

Remind students to record the steps involved in making their chosen digital or non-digital design.

Talk with students about how they might share and present their designs to an audience.

Ask students to explain how they plan to finalise and create their designs with another peer in the class and seek feedback on their ideas.

Remind each design team that they are also tasked with documenting their design thinking in their design folio.

Deliver

Ask students to design and create the individual design samples required in this unit.

Ask students to share their designs with others.

Video student presentations and, if possible, enjoy a day of learning about how game changing ideas might pioneer a better food future.

Debrief

Ask students to retell their findings about the ways Australian farmers, producers and processors are working with new ideas, technologies and entrepreneurs to re-imagine how food can be produced, processed and delivered to customers.

Ask students to evaluate their designs and write about whether their design:

- matched the definition of the task,
- used a clear layout and design,
- was feasible, and
- included sources of the ideas and information each design piece used.

Ask students to write about the quality of their planning, their finished design, and whether they enjoyed the task.

Invite students to reflect on the learning by completing a self-assessment activity. Ask questions like:

- How has my/our attitude and behaviour changed because of my learning?
- How well did I/we contribute to any team-learning activities?
- How can I/we apply what I/we have learned to another topic?

Curriculum connections

Science

Years 7, 8, 9 and 10

Science as a Human Endeavour—Use and influence of science

Solutions to contemporary issues that are found using science and technology, may impact other areas of society and may involve ethical considerations ACSHE120, ACSHE135

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity ACSHE121, ACSHE136

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science to affect people's lives, including generating new career opportunities ACSHE160, ACSHE194

Values and needs of contemporary society can influence the focus of scientific research ACSHE228, ACSHE230

Science as a Human Endeavour—Nature and development of science

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures ACSHE223

Technologies

Years 7 and 8

Design and Technologies—Knowledge and Understanding

Investigate the ways in which products, services and environments evolve locally, regionally and globally and how competing factors including social, ethical and sustainability considerations are prioritised in the development of technologies and designed solutions for preferred futures ACTDEK029

Analyse how food and fibre are produced when designing managed environments and how these can become more sustainable ACTDEK032

Design and Technologies—Process and Production Skills

Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas ACTDEP035

Generate, develop, test and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques ACTDEP036

Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions ACTDEP037

Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability ACTDEP038

Use project management processes when working individually and collaboratively to coordinate production of designed solution ACTDEP039

Years 9 and Year 10

Design and Technologies—Knowledge and Understanding

Explain how products, services and environments evolve with consideration of preferred futures and the impact of emerging technologies on design decisions ACTDEK041

Investigate and make judgements on the ethical and sustainable production and marketing of food and fibre ACTDEK044

Design and Technologies—Process and Production Skills

Investigate and make judgements, within a range of technologies specialisations, on how technologies can be combined to create designed solutions ACTDEK047

Develop, modify and communicate design ideas by applying design thinking, creativity, innovation and enterprise skills of increasing sophistication ACTDEP049

Work flexibly to effectively and safely test, select, justify and use appropriate technologies and processes to make designed solutions ACTDEP050

Evaluate design ideas, processes and solutions against comprehensive criteria for success recognising the need for sustainability ACTDEP051

Develop project plans using digital technologies to plan and manage projects individually and collaboratively taking into consideration time, cost, risk and production processes ACTDEP052

Cross-curriculum Priority

Sustainability.

General Capabilities

Literacy, ICT capability, Critical and creative thinking, Ethical understanding, and Personal and social capability.

Flavour OF THE MONTH

Kale

Kale plants can provide us with an abundance of nutritious leafy greens. Kale contains sulforaphane, vitamin C, vitamin K, B-group vitamins, iron, calcium, magnesium, carotenoids and assists our body in many ways.

Kale plants like full sun, water and good soil. They are prone to cabbage moth and therefore need protecting with insect-excluding mesh.

DESIGN studio

It is easy eating green

Celebrate all things green and fresh. Design a bowl of green bliss and savour the taste of fresh vegetables. Share it as part of National Science Week 2021 and the International Year of Fruit and Vegetables.

FOOD DIFFERENT by design

Case study

3 GOOD HEALTH AND WELL-BEING

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Yerrabingin roof-top farm

Learn about a new **roof-top farm** in Sydney and discover what it can grow. Then, consider designing a community garden in your area … At a public library maybe?

Use your knowledge and understanding of sustainable design and use science, technology, engineering and mathematics to create a new space for growing food.

Create posters, develop and present Computer Aided Designs and/or 3D models of your ideas and share as part of National Science Week 2021.

Have a go at this

Activity 3: Food production systems

What makes food and fibre production systems interesting to study is their wide diversity and commonalities throughout the world.

Some are focused on producing crops and stock for export, others are devoted to crops for domestic consumption, and some are small crops for family consumption and regional or local demand.

Some are highly mechanised, others are not. Some use genetic technologies, others don't. Some are using pesticides exclusively for pest and weed management while others are using integrated pest or weed management techniques. Some use drones to move their stock, some use helicopters and some use stock horses.

There are many strategies used in food production systems, such as: crop rotations, adding organic matter to soils, enhancing the farm's biodiversity values, using efficient irrigation methods, integrating animals into broadacre farming, retaining stubble, direct seeding, direct drilling, using contour ploughing, integrating trees onto properties, and using farm or property planning as part of a strategy in developing sustainable farming systems.

Explain to the class that they will be using a range of activities and websites containing information about food and fibre production systems in Australia to develop an understanding of:

- where our food comes from in Australia;
- how primary producers produce food in Australia;
- how different systems and technologies are used to produce, process, distribute and retail food in Australia; and
- how the physical conditions of the landscape in agricultural environments might impact, or influence, the system design and production practices for food and fibres in Australia.

Inform the students that, after investigating the current practices, they will also be encouraged to envision alternatives and explain how food and fibre products, services and environments can evolve with the consideration of preferred futures and the emergence of new ideas and technologies that could be used in food and fibre production.

Have a go at this

Activity 4: Fertilisers

Just as you need a balanced diet to grow up strong and healthy, plants and crops also need the right balance of nutrients. While most of their cellular material is based on the glucose they produce by absorbing carbon dioxide and combining it with water in photosynthesis, they still need to produce a range of amino acids and fats to make enzymes, cell membranes and hormones. To do this, they need elements like nitrogen, phosphorus and potassium. On top of that, many plants need small amounts of 'trace' minerals like magnesium and zinc.

It was discovered by ancient farmers that it was difficult to keep growing crops in the same field year after year. However, leaving a field sit for a season or two, or growing certain crops like chickpeas, would revive the soil. Adding fertiliser in the form of plant and animal waste (such as compost) also gave it back the nutrients previous harvests had removed.

Explain to students the importance of nutrients, such as nitrogen, being replenished in the soil, especially in a changing climate when increased storm events and rainfall might cause stress on soil and reduce its quality. Ask them to use the internet to complete a web scavenger hunt for the following items.

- A copy of the nitrogen cycle.
- An explanation of the 'Haber Bosch' process.
- A definition of 'eutrophication'.
- An example of a plant that has a symbiotic relationship with nitrogen-fixing bacteria.
- Names of the elements contained in 'potash'.

Use their responses to construct a concept map titled 'Fertilisers'. Discuss with students the importance of soil fertilisers and the challenges farmers face in using them.

Share photos and students' work samples via National Science Week's online community. The Australian Science Teachers Association always enjoys seeing pictures of classroom learning. Share photos via email at **nscwk@asta.edu.au** or share what has been created via **Facebook**, **Instagram** or **Twitter** with #scienceweek. Please ensure that you have parental permission prior to posting any images of students.

FOOD DIFFERENT by design

Case study

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | 14 LIFE BELOW WATER

Fish X

Discover more about the FRDC **Fish X** program that looks for people with big ideas in the fisheries and aquaculture industries.

It is all about the data

Learn about **Farm Mojo,** which is a machine-learning-based mobile application that helps shrimp farmers achieve more sustainable farming practices through data. Read about how it helps aquaculture farmers achieve maximum efficiency by regulating the feed inputs in their systems, how it assists with early disease prediction, timely actions, and can reduce the operational costs of an aquaculture farm.

Have a go at this

Activity 5: Sustainability in food production

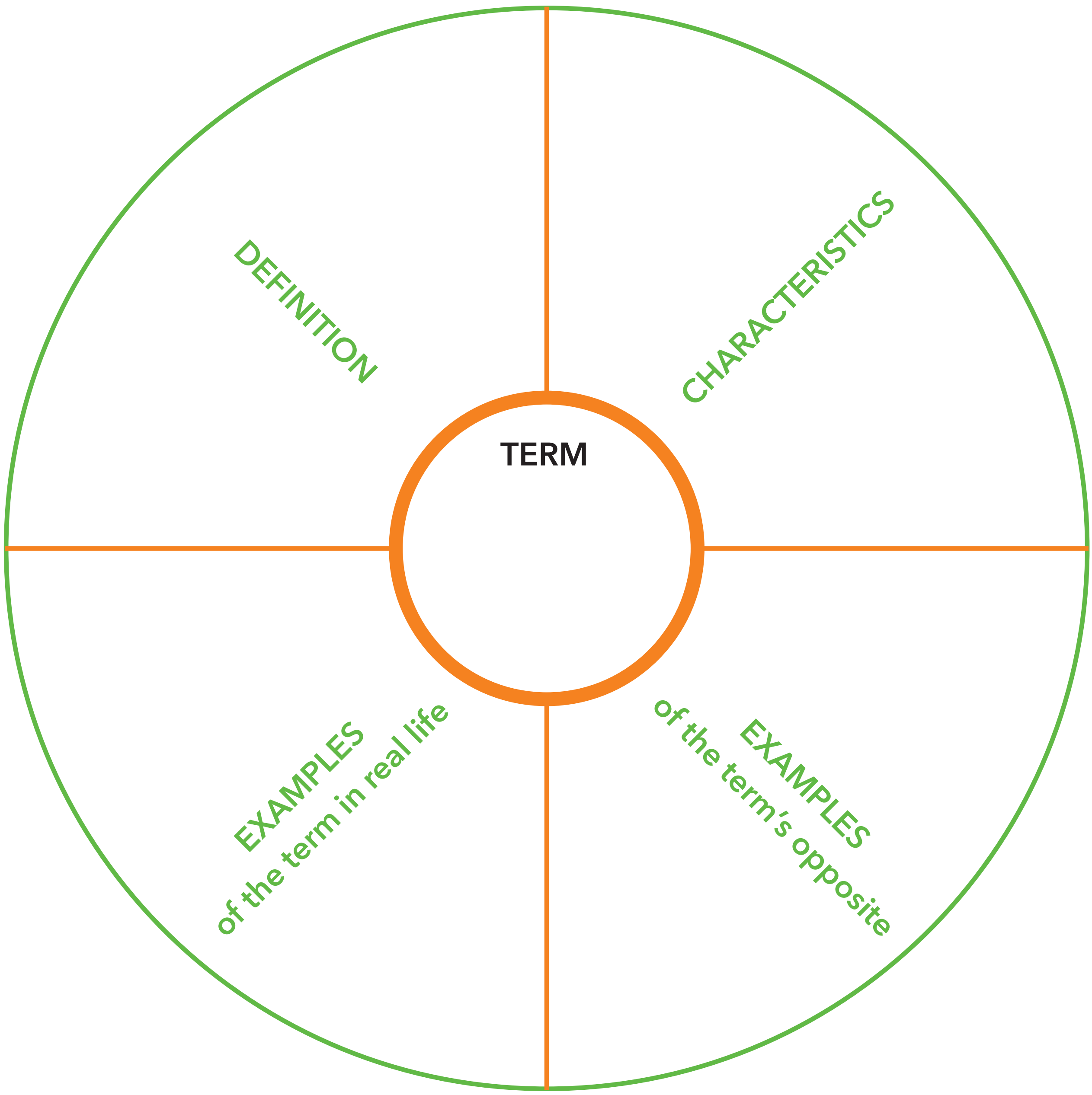
Talk about the word 'sustainability'.

As a class, consider the differences between 'environmental sustainability', 'economic sustainability', 'social sustainability' and 'political sustainability'.

Ask students to develop a concept map describing what they know about sustainable food production, including small scale, large scale and commercial scale production in food and fibre production industries.

As a class, build on understandings by sharing concept maps and ideas.

To take this a step further, ask students to define the meaning of 'sustainability' as it applies to food production. The following graphic may assist students to record and refine their ideas. It can also facilitate discussion and clarification of the terms.



Sustainable resource management

Talk about resource management. What does it mean? Brainstorm a list of terms that might be associated with the idea of resource management.

Consider land, water, pest, energy, emissions, catchment, weed and waste management in agricultural contexts.

Discuss why it is important to produce food on a sustainable basis, ensuring sustainable production practices are used.

Talk with students about what might need to be sustained about 'food and fibre production systems'. *For example*:

- food supplies and adequate nutrition over time;
- the environmental quality of farm systems and ecosystems affected by food and fibre production and practices;
- the cultural integrity of farming communities;
- food and fibre quality;
- food and fibre diversity;
- food safety; and
- food security.

Invite students to record ideas and understandings and present them as part of National Science Week.

Share photos and students' work samples via National Science Week's online community. The Australian Science Teachers Association always enjoys seeing pictures of classroom learning. Share photos via email at **nscwk@asta.edu.au** or share what has been created via **Facebook**, **Instagram** or **Twitter** with #scienceweek. Please ensure that you have parental permission prior to posting any images of students.

Have a go at this

Activity 6: Plant perfect

Different plants have evolved to survive almost everywhere on the planet, from the hottest deserts to some of the coldest reaches of the globe. Changes in their environment have allowed those plants with the most appropriate traits to survive. Those with the thickest skins could hold in more water in dry climates, while plants with thick stems could climb higher than those surrounding them and catch more sunlight. Having deeper roots, brighter flowers, bitter leaves, darker colours, or spikier bark has been the difference between life and extinction for many species.

Humans have also played a key role in picking plants to survive, selectively breeding plants to pass on special traits in their genes. Carrots, for instance, were not naturally long, sweet and orange, but rather white, thin and bitter. Bananas were once smaller and red. A great deal of fruit, vegetables and grains have become tastier, bigger and more nutritious over the centuries as farmers picked only the best of their crop to grow again next year.

Ask students to consider what traits plants need for growth and survival within a particular ecosystem. They can either make a selection of their own or choose from the following environments.

- Coastal
- Desert
- City
- Woodland
- Plains
- Mountains

Ask them to design a plant that would be suitable for that environment. They must take into consideration the following factors.

- Catching sunlight
- Absorbing water
- Absorbing soil nutrients
- Growing time
- Ease of harvest
- Pest control
- Protection from the extremes of weather

Discuss with the students which seasons would be most suitable for germination and harvest. Ask them if it is an annual plant or a perennial plant. How much energy must the plant devote to growing parts that will not be harvested? How much energy must the plant devote to its product?

Have a go at this

Activity 7: Design a pollen trap

New plant and animal breeds suited to a greater variety of climate conditions will be required in the future as agriculture and food production continue to adapt.

Introduce the concept of plant reproduction to the class by discussing with them what they know about making new plants. Most will be quite familiar with the idea of planting seeds and will probably associate seeds with fruit and flowers. Some will even know about cuttings and cloning.

Discuss how flowering plants release pollen that is typically carried either on the wind or by animals such as bees, flies, or small mammals like flying foxes and mice.

Hand out different types of flowers to students and ask them to discuss why they have the shape, colour, or size that they do.

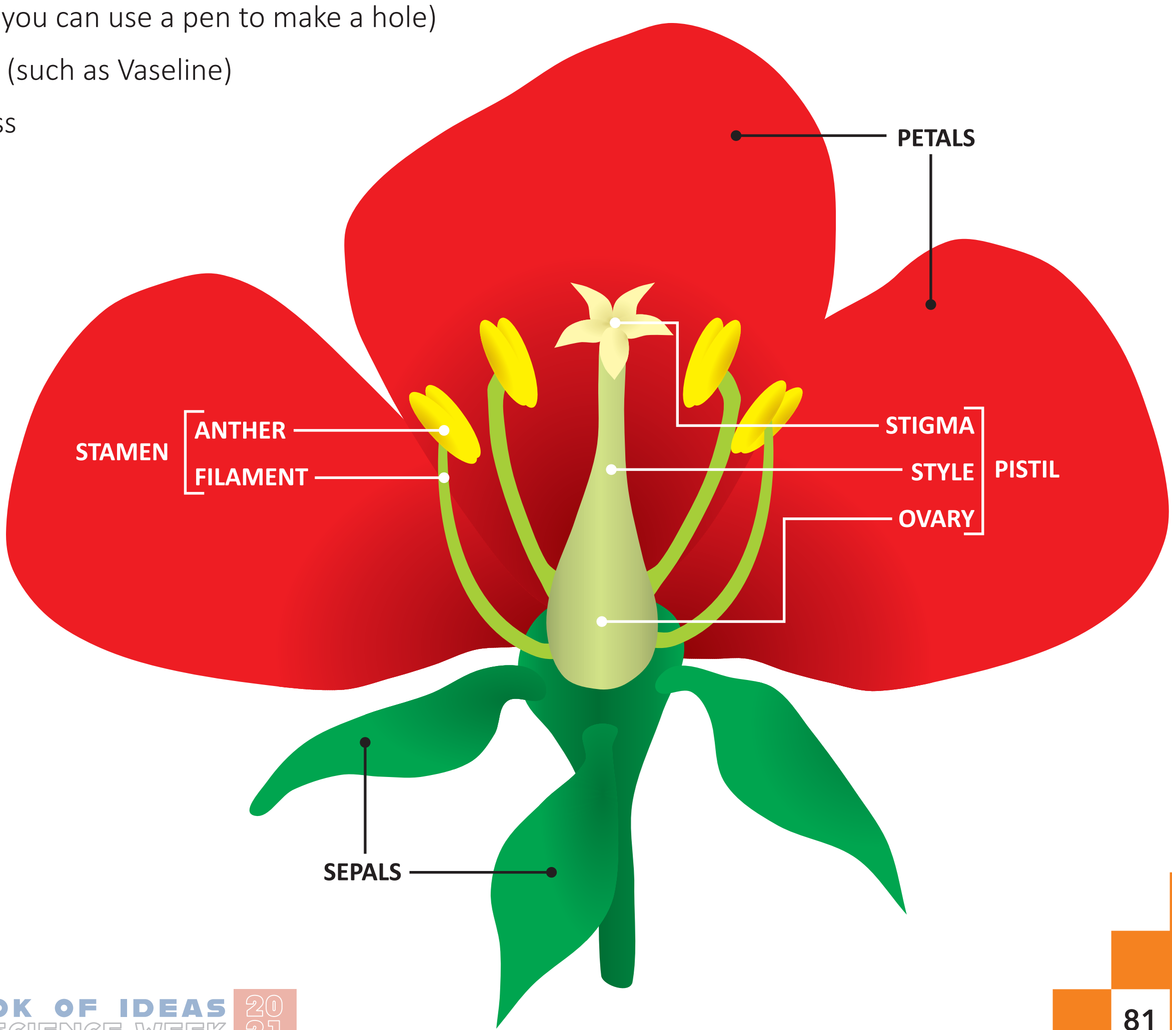
Ask them how they think they disperse their pollen.

Using a flower specimen, ask students to name as many of the flower's parts as possible. Note that not all the parts will be present or visible on all flowers—discuss why this might be the case.

Engage students in the pollen-trapping activity.

You will need the following items.

- A few small rectangles white cardboard or stiff white paper
- String
- A hole punch (or you can use a pen to make a hole)
- A petroleum jelly (such as Vaseline)
- A magnifying glass
- A Pen or pencil



Instructions

1. Use the hole punch to make a hole in each piece of cardboard.
2. Smear a thin layer of petroleum jelly on one side of each piece of cardboard.
3. Using the string, hang the bits of cardboard outside in different places.

   - You can hang them from a tree, near some flowers, near your door or anywhere else you can think of.

   - If you are hanging them from a tree, just tie a loose loop around the branch, so you do not damage the tree.
4. On the back of the cardboard, write where you are hanging it.
5. After a few days, take the cardboard down again.
6. Look at what has stuck to the surface of the cardboard.

What is going on?

On the card, you should see some dust and dirt. If you look closely, you may also notice some yellow grains. This is pollen. Depending on where you put them, you may find the cards have different amounts of pollen on them.

Flowering plants create pollen as part of their reproductive process. It is produced in a part of a flower called the stamen and contains some of the genetic information from the plant that created it. When the pollen from one plant is transferred to a part of another flower called the pistil, the genetic material in the pollen joins with some special cells in the new flower, which then grow into seeds. This is called pollination. Pollination normally takes place between two separate plants of the same species, although there are a few plants that can pollinate themselves.

Pollen can travel from one plant to another in different ways. Some plants rely on insects that visit their flowers to spread the pollen. Others just release the pollen into the air where it floats around and hopefully lands on the pistils of another plant of the same species. It can be extremely hard to see pollen in the air because it's so small, but this is what you have caught on your cardboard. It is this airborne pollen that often triggers hayfever. If you have a hand lens or microscope, use these to inspect the pollen —pollen grains from different species have different shapes.

On its own, pollen does not harm people. People who suffer from hayfever have immune systems that react to pollen as though it was a dangerous substance, like a virus or bacterium. Hayfever is normally caused by specific types of pollen, so sometimes people will find they only suffer from hayfever in particular places, depending on what plants are found there.

Photo by Masaaki Komori on Unsplash

Have a go at this
Activity 8: GM

Some people equate GM (genetically modified) foods with 'artificial' preservatives or pesticide residues. Given that GM food crops are often developed to reduce pesticide or preservative use, is this a justified concern?

Modern biotechnology is increasingly playing a role in developing new crop and pasture varieties adapted to changing climates.

A number of plant traits likely to be important for adapting to climate change include heat tolerance, water-use efficiency, nitrogen-use efficiency, water-logging tolerance, frost resistance, pest and disease resistance as well as a reduced dependence on low temperatures to trigger flowering or seed germination. Research is being undertaken into developing GM varieties with these traits.

In a changing climate, new plant and animal breeds suited to changing climate conditions will be needed. Plants, bacteria and animals with the required characteristics can sometimes be developed by selective breeding. This selects for bacteria, plants or animals with the desired genes but often takes a long time and is limited by the range of characteristics available.

Genetic modification is the use of biotechnology on living things—such as bacteria, plants and animals—to change their genes. This might involve inserting one or more genes (often from another organism) into their genome, allowing them to produce a new protein, or 'silencing' an existing gene, or bunch of genes, so they no longer work. By doing this, biotechnologists can give organisms new traits, such as an increased resistance against pests or an ability to produce additional nutrients. Some advantages of genetic modification are that it can be faster than selective breeding and can provide a wider range of possible characteristics.

Of course, the products of genes can often perform multiple tasks. Predicting the results can be difficult and requires a great deal of research. Getting it wrong could create a range of problems that would need to be managed. Also, of concern to some people is the treatment of GM organisms as expensive products.

The ethics and values surrounding GM agriculture are diverse and complicated.

To determine what some people think about an issue, some organisations will often use a survey. However, their responses can often depend more on the question and how it is asked, than their real opinion or their behaviour.

Ask students to come up with their own survey questions on genetic modification for parents and a selection of school staff and students. Discuss with them how they could write and deliver the questions to get information that showed a public response in favour of genetic modification, and how they might write and deliver questions that could show the public was not in favour of it.

Come up with a set of criteria with the students that might help get them the least-biased results.

Photo by Louis Reed on Unsplash

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