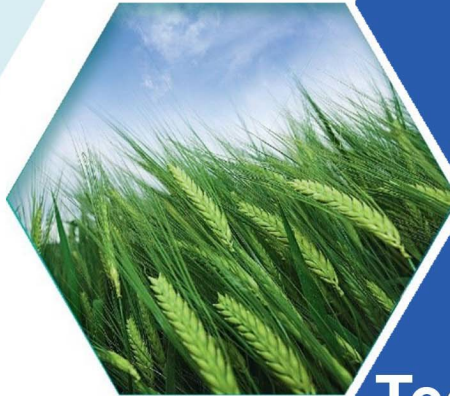


PRIMED

Teacher resource

Year

10



Technologies



Teaching guide: Food and fibre frontiers: Emerging technologies

Resources overview

PRIMED mission

To increase student understanding of agriculture, fisheries, fibre, forestry and food (primary industries) careers to enable Year 7–10 students to make informed career-pathway choices.

About the resource set

These resources provide rich tasks focused on the *Western Australian Curriculum* within a primary industries context.

Throughout this resource, students can gain a deeper understanding of the challenges we face to sustain and support the demand for future food and fibre products. Students will explore both global and local food and fibre production and investigate the role emerging research and technology has in the design of ethical and sustainable products for the future.



Curriculum links

This resource is designed to be a learning pathway for Year 10 Technologies students to develop their understanding of the *Western Australian Curriculum Design and Technologies* content descriptions:

Context:

Food and fibre production ([ACTDEK044](#))

Knowledge and understandings:

Technologies and society ([ACTDEK040](#)) and ([ACTDEK041](#))

Processes and production skills:

- Investigating and defining (WATPPS54) and (WATPPS55)
- Producing and implementing (WATPPS58)
- Collaborating and managing (WATPPS60)
- Designing (WATPPS56) and (WATPPS57)
- Evaluating (WATPPS59)

Resource set structure

The resource set is structured around constructivist learning principles using the 5E model: engage, explore, explain, elaborate and evaluate. It is designed to be flexible so that teachers can use all or parts of the resource that they consider appropriate for their students.

With this combined approach:

1. Students' interest and minds are **engaged** in thinking about the history or agriculture and what the future of food and fibre production could look like.
2. Students **explore** some of the challenges related to future food and fibre production.
3. Students **explain** the role research and development plays in the design of ethical and sustainable food and fibre products for future markets.
4. Students **elaborate** on their understanding of future food and fibre production challenges and undertake guided investigations on a range of primary industry research and development projects that are addressing these challenges. Investigation topics include:
 - Genetic modification
 - Tackling Australia's food waste
 - More than milk
 - New grain growing in WA
 - Selective breeding in agriculture
 - Growing fibre in WA
 - Agricultural systems
 - Emerging markets for Indigenous Australian bushfoods
5. Students **evaluate** their understanding of future food and fibre production.

Educational process	Teaching and learning focus	Resources
Engage	Module 1: Then, now and into the future In this module, students are encouraged to reflect on the history of agriculture and begin to identify what needs to be considered for the future of food and fibre production.	Student worksheets: <ul style="list-style-type: none"> 1.1 Then, now and into the future 1.2 Future food systems Online resources: <ul style="list-style-type: none"> The Agricultural Revolution: Crash Course World History #1 Urban Farming: Fixing the broken food system & improving health Paul Myers TEDxLiverpool
Explore	Module 2: Food and fibre challenges In this module, students will explore some of the challenges we face in Australia and globally relating to food and fibre production.	PowerPoint presentation: <ul style="list-style-type: none"> 2.0 Food and fibre challenges Online resources: <ul style="list-style-type: none"> Human Population Growth – Crash Course Ecology #3
Explain	Module 3: Role of emerging research and technology In this module, students will develop their understanding of Wicked Problems and the challenges we face related to food and fibre production. Then students will identify the role research and development has in agriculture and how design-thinking skills are used to create innovative solutions to help address challenges. Students will make connections between future agriculture practices and meeting the Sustainable Development Goals.	PowerPoint presentation: <ul style="list-style-type: none"> 3.0 Solving problems through research and development Online resources: <ul style="list-style-type: none"> Wicked Problems The Design Thinking Process (Explained By An Expert) Article: <ul style="list-style-type: none"> Is this the Future of Food? Student worksheets: <ul style="list-style-type: none"> 3.1 The Design Thinking Process 3.2 Article review Video: <ul style="list-style-type: none"> Future Food and Fibre Solutions
Elaborate 1	Module 4: Food and fibre research and development in WA This module provides students with the opportunity to complete a series of guided investigations, which cover a range of current topics relating to emerging technologies in primary industries. Teachers have flexibility of how to use these investigations in their classroom.	Student worksheets: <ul style="list-style-type: none"> 4.1 Genetic modification 4.2 Tackling Australia's food waste 4.3 More than milk 4.4 New grain growing in WA 4.5 Selective breeding in agriculture 4.6 Growing fibre in WA 4.7 Agricultural systems 4.8 Emerging markets for Australian bushfoods

<p>Elaborate 2</p>	<p>Module 5: Design Challenge Teachers are encouraged to explore a design challenge linked to a local primary industry example that is relevant to their student cohort and suitable to the facilities available within the school.</p>	<p>Resources to be determined by the teacher once the Design Challenge theme is selected.</p>
<p>Evaluate</p>	<p>Module 6: Reflection Students review their investigations and reflect on what they have learnt about the future of food and fibre production.</p>	<p>Student worksheets:</p> <ul style="list-style-type: none"> • 6.1 Reflection • 6.2 Skills and attributes

Learning resources and sequence

Module 1: Then, now and into the future

(approximately 2- 3 hours)



Learning intentions

Students will be able to:

- Identify past agricultural practices.
- Outline the impacts agricultural development has had on human life and the planet.
- Discuss the future of ethical and sustainable agricultural practices.

Background information

This module will introduce students to the future of food production, fibre production and the role emerging technologies will play in ensuring our future food, and fibre supply is secure, sustainable and ethical.

Students will be required to reflect on the history of agricultural practices and begin to explore what innovative ideas people have come up with to help ensure agricultural practices are sustainable into the future.

History of Agriculture

By reflecting on past agricultural practices, including Aboriginal and Torres Strait Islander perspectives, we can critically review the advantages and disadvantages of different farming practices and use these experiences to develop more sustainable practices for the future.

Additional reading:

- [Deadly Story – Food and Agriculture](#)
- [Bruce Pascoe: Aboriginal Agriculture, Technology and Ingenuity](#)

Useful definitions:

- The Oxford University Press dictionary (Lexico.com) (2021) defines **ethical** as: Relating to moral principles or the branch of knowledge dealing with these, avoiding activities or organizations that do harm to people or the environment
- The Oxford University Press dictionary (Lexico.com) (2021) defines **sustainable** as: The state of being free from danger or threat. Avoidance of the depletion of natural resources in order to maintain an ecological balance.
- The Oxford University Press dictionary (Lexico.com) (2021) defines **security** as: The state of being free from danger or threat.

Refer to the [PRIMED](#) Year 7 and 8 Technologies Food and fibre production resources for further information on the Triple Bottom Line approach towards sustainability.

Jobs in food and fibre production:

The job opportunities in Australian agriculture are wide and varied. There are job opportunities in both urban, regional and remote locations. To guide conversations with your students about people who work in agriculture and job opportunities in agriculture, seek further information via the links below.

- [Snapshot of Australia's Agricultural Workforce](#)
- [An overview of jobs in the environment and agriculture sector](#)
- [My Future](#)
- [Career Harvest](#)
- [Careers in Grain](#)
- [My Skills - Agriculture and Food Processing](#)

Additional reading:

- [The Development of Agriculture](#)
- [The fourth agricultural revolution is coming – but who will really benefit?](#)

Resources and equipment

Access to computers for research

Student worksheet:

- 1.1 Then, now and into the future
- 1.2 Future food systems

Video

- [The Agricultural Revolution: Crash Course World History #1](#)
- [Urban Farming: Fixing the broken food system & improving health | Paul Myers | TEDxLiverpool](#)

Instructions for suggested activities

Introduction

1. Students complete Student worksheet 1.1.
Teachers may prefer to display the images from the 'Modern day agriculture' section to the class as a group and complete a review and discussion of the images as a class.
2. Class discussion page 4:
 - How do you think technology has changed the way we practice agriculture? Consider the social, economic and environmental impacts of technology in agriculture.
 - How has technology changed the types of jobs people do in agriculture?
Teachers are to guide students in a discussion about how job roles within agriculture have changed as more and more technology and machinery is used to produce food and fibre.
3. Watch the video [The Agricultural Revolution: Crash Course World History #1](#). Students to complete a summary on Student worksheet 1.1.
4. Discuss with students the terms below, and how they relate to food and fibre production:
 - ethical
 - sustainability
 - security
5. Students complete Student worksheet 1.2.

Watch: [Urban Farming: Fixing the broken food system & improving health | Paul Myers | TEDxLiverpool](#)

Additional Activity:

Watch ABC's [Back in Time for Dinner](#) and discuss food and fashion from a previous decade and how it compares to today.

How has innovation and technology affected these changes?

Module 2: Food and fibre challenges

(approximately 2-3 hours)



Learning intentions

Students will be able to:

- Identify some of the challenges facing future food and fibre production globally and in Western Australia (WA).

Background information

“The global demand for food and fibre is expected to increase by 70 to 100 percent by 2050 as a result of a number of additional influences.”

Source: Foresight. The Future of Food and Farming (2011) Final Project Report. The Government Office for Science, London.

There are a range of factors that will affect our ability to produce enough food and fibre to meet global demands into the future. Some of these factors are listed below.

- Population growth
- Food security
- Changes in dietary preferences
- Sustainability of land and water resources
- Climate change
- Pollution and land degradation
- Ethical food and fibre production
- Biosecurity

Additional teacher reading:

[The Future of Food](#) CSIRO Article summaries a range of factors that are affecting the future production of food in Australia.

[WA Food Security Plan Report](#) has developed a thorough understanding of how productivity constraints like; climate change, salinity, biosecurity, soil acidity, groundwater depletion and plateauing productivity increases will affect our farmers’ capacity to keep producing enough food.

[Food Community](#) is an online food network platform connecting government and community food stakeholders. Access to the website does require a free registration. Many factsheets and case studies about WA food security are available to registered members.

[The State of Food and Agriculture](#) is a global report available from the Food and Agriculture Organisation of the United Nations.

Resources and equipment

Access to computers for research

PowerPoint presentation:

- 2.0 Food and fibre challenges

Video

- [Human Population Growth – Crash Course Ecology #3](#)

Instructions for suggested activities

- Use PowerPoint 2.0 to introduce student thinking about the future of food and fibre production.

Slide 1: Title page

Slide 2: Use the statement to spark a conversation with the class and begin their thinking about the future.

Slide 3, 4 and 5: Class discussion - Ask the question 'What do you think are the biggest challenges we face today, related to the production and consumption of food and fibre?' Use slide 4 and 5 to assist conversations if students provide limited responses.

Slide 6: As a class facilitate a brief investigation into population growth by watching the video on the slide and discussing the graph. Consider what impact this rapid population growth will have on future food and fibre production.

Slide 7: Students now complete a [Webquest](#) individually on another future challenge that has been identified. Suggested topics are included on slide 5, however others can be added.

This Webquest could be completed as a [Jigsaw](#) activity or any other information sharing strategy suitable for your classroom and students.

Remind students of sourcing information from reliable sources, for example government .gov websites and education .edu sites can generally be trusted as reliable sources.

Module 3: The role of emerging research and technology (approximately 2-3 hours)



Learning intentions

Students will be able to:

- Define the term Wicked Problems.
- Recognise how design-thinking skills are used in research and development projects.
- Identify how design thinking skills are used to address the challenges facing future food and fibre production.
- Explore who is working to resolve challenges in food and fibre production and how they are addressing these challenges.

Background information

The drivers behind the changes in Australia's food and agribusiness industries

According to CSIRO Professors Cole and Noakes, there are three main global trends influencing the future of agribusiness in Australia:

- Sustainability – population growth, waste management, clean and green food production, cost of production, environmental costs
- Health and wellness – prevention of diseases, demand for fresh, tasty and healthy food is on the increase and driving innovation in food production
- Desire for premium products – The global luxury food market is set to grow, which drives innovation in the production of premium quality food

Wicked Problems

A wicked problem is a social or cultural problem that is difficult or impossible to solve for many reasons:

- incomplete or contradictory knowledge
- the number of people and opinions involved
- the large economic burden
- the interconnected nature of these problems with other problems.

Refer to [Wicked problems: Problems worth solving](#) for more information.

United Nations Sustainable Development Goals

Are global strategies working towards global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice.

Refer to the [United Nations Department of Economic and Social Affairs – Sustainable Development](#) for more information.

[World's Largest Lesson](#) is a free online resource. Registration is required to access a range of classroom materials. World's Largest Lesson promotes use of the Sustainable Development Goals in learning so that children can contribute to a better future for all.

Additional reading:

- [Primary Industries Development Research Highlights 2021](#)
This report displays the vast number of research and development projects supported by Department of Primary Industries and Regional Development in WA.
- [National Farmer Federation Food, Fibre & Forestry Facts – A summary of Australia's Agriculture Sector](#)
This report will provide teachers with some statistical background information on primary industries in Australia.
- [Food Industry Innovation](#)
This report is a summary of the growth of Western Australia's premium food and beverage industry supported by Department of Primary Industries and Regional Development in WA.

Design Thinking Process

Design Thinking is a design methodology that provides a solution-based approach to solving problems. Design Thinking considered the needs of people and can be useful in tackling complex problems that are difficult to define.

Additional Reading:

- [Design Thinking Bootleg](#)
- [5 Stages in the Design Thinking Process](#)

Future Food and Fibre Solutions- Video Summary

Project title:

Three-dimensional food printing: a novel tool for improving nutrition across all age groups.

Filming location: Future Foods and Digital Gastronomy (FF&DG) laboratory, Edith Cowan University, Joondalup

Research Team:

Liezhou Zhong, postdoctoral research fellow, Institute of Nutrition Research, Edith Cowan University

Dammy Adu, postdoctoral research fellow, Institute of Nutrition Research, Edith Cowan University

Project description/background:

Almost half of the 190 000 residents in Australian residential aged care facilities (RACFs) are either malnourished or at risk of becoming malnourished. The risk of being malnourished is highest in the around 30 per cent of residents with difficulties in tasting, chewing and swallowing. The Royal Commission into Aged Care Quality and Safety has compiled substantial evidence about deficiencies in food quality, presentation, choice, and malnutrition at Australian RACFs. This is particularly evident for fruit and vegetable (F&V) intake, a cornerstone for maintaining a healthy diet.

On the other hand, 20 – 40 per cent of all fruits and vegetables grown in Australia never leaves the farm gate due to the high rate of rejection based on the marketing specifications. This is responsible for over one third of the 7.3 million tonnes of food waste, with an estimated value of \$20 billion each year and accounts for over 5 per cent of Australia's greenhouse gas emissions. Australia has aimed to halve its food waste by 2030, aligning with the United Nation's Sustainable Development Goal. Therefore, diverting cheap "imperfect" F&V from landfill or stock feed to human consumption in RACFs will help Australia achieve the 2030 target, and create financial returns to farmers, businesses and consumers.

Furthermore, this project will use 3D fruit and vegetable printing to address the nutrition literacy, knowledge of food waste and sustainability in children and adolescents. The novel technology can transform edible F&V into "cool" products, which can be a powerful tool for stimulating and improving young people's food and nutrition literacy and attitude towards intakes of F&V. An additional benefit of the project is that it promises to raise young people's awareness of food waste and may (in the sustainability phase) contribute to reducing food waste by finding uses for 'ugly' or imperfect fruit and vegetables.

Overall, this project will bring together world-renowned researchers in F&V bio-actives, residential aged care, food science, behavioural sciences, health promotion with chefs to design and develop three-dimensionally (3D) printed food models that will: (i) connect RACF residents receiving texture modified foods (TMF) with food and nutrition services based on their preferences, identities, histories and health conditions; (ii) provide appealing, flavourful, semi-personalised, healthy, nutrient-dense F&V based food options; (iii) reduce overall food costs and farm wastage (namely aesthetically imperfect but perfectly edible and unspoilt). It will also develop educational resources to build food and nutrition literacy in children and adolescents in order to contribute to healthy eating habits necessary for healthy development in this population. Together, we will provide a practical, cost-effective, and evidence-based approach to reduce preventable malnutrition, improve food enjoyment in RACF residents and food/nutrition literacy in young Australians.

(Source: Dammy Adu)

Resources and equipment

PowerPoint presentation:

- 3.0 Solving problems through research and development

Online Resources:

- [Wicked Problems](#)
- [The Design Thinking Process \(Explained By An Expert\)](#)

Video:

- Future Food and Fibre Solutions

Article:

- Is this the Future of Food?

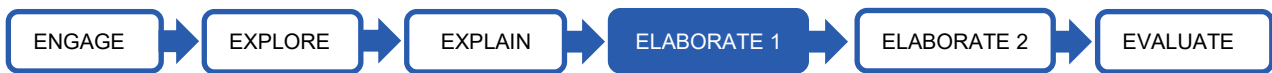
Student worksheet:

- 3.1 The Design Thinking Process
- 3.2 Article review

Instructions for suggested activities

1. Introduce the concept Wicked Problems to students using PowerPoint 3.0 - The role of emerging research and development. Slide 2-4 introduces wicked problems.
2. Slide 5 – Ask students “What has to be done to address some of these wicked problems?” Facilitate a class discussion on this question.
3. Slide 6 – Review the connection food and agriculture has to the Sustainable Development Goals.
4. Slide 7 – Watch [The Design Thinking Process \(Explained By An Expert\)](#) explore the link design thinking skills have to solving wicked problems.
5. Slide 8 and 9 – Explain the role research and development has in primary industries.
6. Slide 10 and 11 Explain to students that both government and private enterprise are involved in research and development within primary industries in WA. If you choose students could further explore the role of some of the Research and Development Corporations listed in slide 11.
7. Watch - Future Food and Fibre Solutions Video, guide students to complete Student worksheet 3.2 when reviewing the video or conduct a group discussion at the end about how the research project fits the Design Thinking Process.
8. Read and review the article *Is this the Future of Food?* by J. Brammer (29 August 2021)
9. Complete Student worksheet 3.1 Article review. Print this on A3.
10. Close the lesson with a discussion about the information presented in the article. Ask students about their thoughts on some of the future foods mentioned in the article.

Module 4: Food and fibre research and development in WA (approximately 7-8 hours)



Learning intentions

Students will be able to:

- Identify a range of emerging research and technologies being practiced in primary industries in WA.
- Explain how innovation is preparing WA primary industries for the future.
- Critically review a range of current innovations in primary industries.

Background information

This module includes a selection of guided investigations covering the following topics:

- Genetic modification
- Tackling Australia's food waste
- More than milk
- New grain growing in WA
- Selective breeding in agriculture
- Growing fibre in WA
- Agricultural systems
- Emerging markets for Australian bushfoods

Links to recommended sources of information and further reading are provided within the investigation pages.

Symbols within the resources



When this symbol appears in the resources, students are encouraged to consider their thoughts on the question or statement.



When this symbol appears in the resources, students are required to complete an activity either within the document or in a workbook or portfolio.

Strategies for teaching critical thinking and ethical dilemmas

Teachers can engage students and encourage them to participate in critical thinking and ethical dilemma discussions in many creative and innovative ways. It is suggested that teachers use the resources provided in this module and deliver them in a way that best suits the needs of their students.

Ideas for classroom strategies include:

1. Opinion continuum

Set up a continuum line in the classroom with one side of the room 'strongly agree' and the other side 'strongly disagree'. Students position themselves on the line in relation to their thoughts and views of a topic. This can be used to allow students to consider their views on any topic. For further information, visit [Think Differently](#).

2. Fold the line

Set up a continuum and once students have positioned themselves on the line according to their views on the topic, ask them to 'fold the line' by pairing up with person on the other end of the continuum to them. Then guide the pairs to share their thoughts with one another.

3. Ethical Decision Making

Use [A Framework for Ethical Decision Making](#) to guide students through this process

4. Six Thinking Hats

This strategy aims to investigate an issue from a variety of perspectives, but in a clear, conflict-free way.

For further information, visit [The de Bono Group](#).

5. Circle Talk Strategy

This technique involves a large group of students, such as the whole class, forming two circles – an inner circle and an outer circle. Students in the inner and outer circle find partners and face each other. For further information, visit [Connect](#).

[THE TOOLBOX Strategies and organisers for your classroom](#) on Department of Education's Connect has a range of resources and strategies teachers might like to explore.

[Critical Thinking for Teachers and Students](#) provides a summary and examples of classroom strategies for developing critical thinking skills.

Resources and equipment

Facilities for online research.

Student Worksheets:

- 4.1 Genetic modification
- 4.2 Tackling Australia's food waste
- 4.3 More than milk
- 4.4 New grain growing in WA
- 4.5 Selective breeding in agriculture
- 4.6 Growing fibre in WA
- 4.7 Agricultural systems
- 4.8 Emerging markets for Australian bushfoods

Instructions for suggested activities

The purpose of these guided investigations is to spark ideas for students to develop their critical thinking and ethical decision-making skills.

Teachers can facilitate this module in many ways and are encouraged to use the guided investigation activities in a way that best suits their students.

Please note:

- Not all topics are required to be delivered.
- Additional topics can be added.
- Students could complete the investigations individually or in a group.
- The whole class could complete all or some of the investigations.
- The class could be divided into groups and topics allocated, researched then shared.
- Teachers might like to use some of the critical thinking and ethical dilemma strategies listed above to develop additional activities.
- Students could be asked to present a summary of their research in various formats.

Additional practical activities could be added to these resources to provide hands on learning for the students.

For example:

- Prepare recipes using some of the emerging new foods, eg lupins, bushfoods, alternative proteins to compliment Student worksheets 4.1 – 4.8.
- Complete a recipe using the whole product, demonstrating minimalizing food waste to complement Student worksheet 4.2.
- Use samples of alternative fabrics for students to touch and feel to complement Student worksheet 4.6.
- Grow some produce in the classroom or school garden.
- Conduct a milk tasting and nutritional evaluation of milk and milk alternatives to complement Student worksheet 4.3

Examples for Student worksheet 4.8 Emerging markets for Australian bushfoods Webquest WA Bushfood Businesses

[Tucker Bush™](#) promotes Bushfoods through the sale of native Australian edible plants as well as a range of dried herbs. They also provide a school program including how to create a bushfood garden at your school.

[Bindi Bindi Dreaming](#) provides a range of cultural experiences from walks, talks, bush tucker tastings and catering using bushfoods.

[Noongar Land Enterprise Group](#) was formed to help develop commercially viable Noongar land-based businesses.

[Maalinup Aboriginal Gallery](#) offer bushtucker talks and tastings. Learn about local food, and hunting and gathering practices in the South West of WA.

[Mayi Harvests Native Foods](#) is an Indigenous Australian-owned and operated business that harvests Australian Native Foods.

[Gather Foods](#) provides a range food and hospitality services with a focus on the use of premium native foods.

Module 5: Design Challenge



Learning intentions

Students will be able to:

- Create a design solution to a problem related to future food and fibre production.

Background information

Teachers should guide students through the [design thinking](#) process to allow students to create a design solution to a problem.

Taking a local context that is suitable for the needs of the students and the facilities in the school is important. This will provide students with the opportunity to apply their knowledge of local primary industries and develop their design thinking skills to create and trial innovative future design solutions that are relevant to them. There are various ways this could be approached and teachers are encouraged create a task that is of interest to their students.

Instructions for suggested activities

Design Challenge ideas

Examples include:

- Students select one of the wicked problems addressed in Module 3 and research it further. Students could investigate –
 - how this wicked problem is impacting their local community/environment
 - the initiatives (people/projects) that are currently working to resolve the problem
 - what the government (local, state and federal) is doing to address the problem
 - create their own design solution to this problem.
- Invite a local primary producer to come and speak to your students about their area of expertise or take the students on a site visit to experience primary industries first hand. (Links to suitable contact can be made through the PRIMED program lead teachers or the regional DPIRD ambassadors). The focus of the presentation should be on the challenges they face in their industry and the innovative ways in which the industry has evolved. Students can then identify a challenge faced by local primary producers, research it further, apply design thinking skills to propose a solution to this current challenge, and create and trial the solution.
- Design a recipe to display a new emerging food product. For example, lupin, insects or Barley MAX.
- Design and create an innovative growing system to grow herbs or salad leaves in the classroom or for the home.
- Design and create an edible school garden or a bush tucker trail with native plants.

Module 6: Reflection

(approximately 2-3 hours)



Learning intentions

Student will be able to:

- Review their learning from the previous modules.
- Create a summary of their understandings of future food and fibre production in the format of a visual academic scrapbook.

Background information

Futuring is a term that refers to the systematic thinking of future trends, picturing possible outcomes and planning for the future.

A futurist is a person who actively explores predictions and possibilities about the future based on current trends.

For more information, explore [Five Principles for Thinking Like a Futurist](#)

[Academic Scrapbooking](#) is a creative way to present information in a visual manner.

Resources and equipment

Facilities for online research

Student worksheet:

- 6.1 Reflection
- 6.2 Skills and attributes

Instructions for suggested activities

1. Student complete Student worksheet 6.1 Reflection individually.
2. Students can prepare the academic scrapbook in digital or print format.
3. Students complete Student worksheet 6.2 Skills and attributes.

Additional activity

Students select a primary industries job/career that is of interest to them. They research the skills, attributes, qualifications and other essential information for the chosen career and prepare a job advertisement of the role.

Acknowledgements

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