Department of Education

GOVERNMENT OF WESTERN AUSTRALIA

CURRICULUM RESOURCE MODULE

Biosecurity

YEAR 5

THE STEM LEARNING PROJECT

scitech

STAWA SCIENCE TEACHERS' ASSOCIATION OF WESTERN AUSTRALIA

Acknowledgements

The STEM Learning Project respectfully acknowledges the Traditional Custodians of the lands upon which our students and teachers live, learn and educate.

The STEM Learning Project is funded by the Western Australian Department of Education (the Department) and implemented by a consortium in STEM education comprising the Educational Computing Association of WA, the Mathematical Association of WA, the Science Teachers Association of WA and Scitech. We acknowledge and thank the teachers and schools who are the co-creators of these resources.

The STEM Learning Project would also like to acknowledge the support of the Australian Government, Department of Agriculture; the Australian Government, Department of the Environment and Energy; Barmac Pty Ltd and the Western Australian Government, Department of Primary Industries and Regional Development for their assistance in reviewing the module and providing data.

Copyright and intellectual property

The Department is committed to providing quality information to its customers. Whilst every effort has been made to ensure accuracy, currency and reliability of the information within these documents, the Department accepts no responsibility for errors, omissions or amendments made since the time of publishing. Confirmation of information may be sought from the Department or the originating bodies providing the information. The Department has no control over the content of material published on websites to which users are referred in this resource. It is the responsibility of the internet user to make their own decision as to the relevancy, accuracy, currency and reliability of information found on those sites.

This resource contains various images from iStock, Getty Images and Pixabay used under license.

Attributions: *Microsoft Word, PowerPoint and Publisher, Adobe Photoshop, Illustrator and InDesign, iMovie, Scratch, eBook, Pages, Keynote, Canva, Padlet, Arduino, Little Bits, Popplet, Skitch, Green Screen by Do Ink, Easy Chart, Piktochart, Storyboarder, Plot, Boords, Sway, Seesaw, Class Dojo, QR codes, Numbers, Comic Life, Makeblock, VEX, LegoWeDo and Mindstorm, Edison, Sphero, Hummingbird Robotics Kit, QR Rafter, i-nigma, Aurasma, Garage band, Toontastic, Sketch Up*

Table of contents

The STEM Learning Project

The aim of the STEM Learning Project is to generate students' interest, enjoyment and engagement with STEM (Science, Technology, Engineering and Mathematics) and to encourage their ongoing participation in STEM both at school and in subsequent careers. The curriculum resources will support teachers to implement and extend the Western Australian Curriculum and develop the general capabilities across Kindergarten to Year 12.

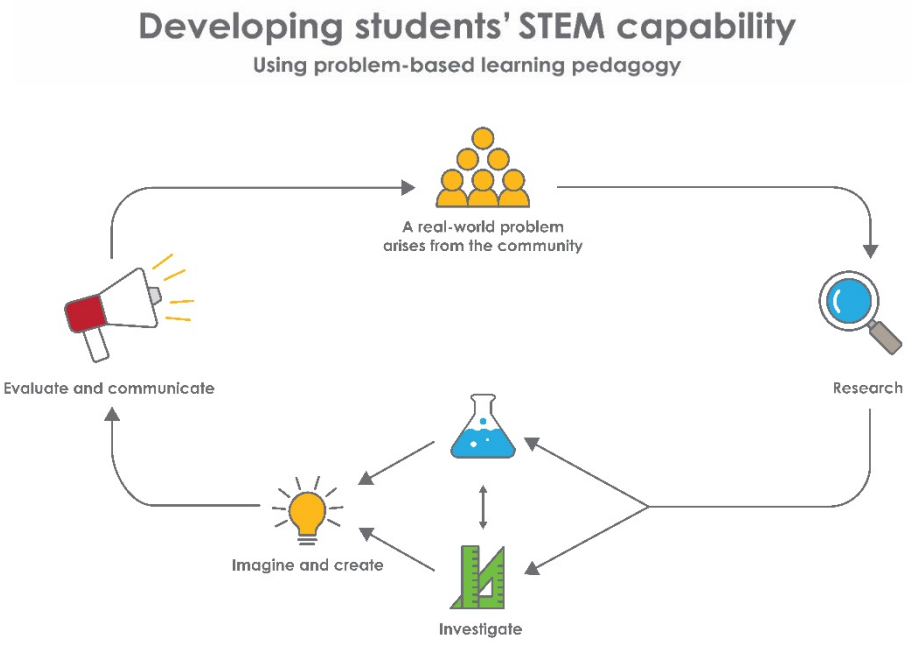
Why STEM?

A quality STEM education will develop the knowledge and intellectual skills to drive the innovation required to address global economic, social and environmental challenges.

STEM capability is the key to navigating the employment landscape changed by globalisation and digital disruption. Routine manual and cognitive jobs are in decline whilst non-routine cognitive jobs are growing strongly in Australia. Seventy-five per cent of the jobs in the emerging economy will require critical and creative thinking and problem solving, supported by skills of collaboration, teamwork and literacy in mathematics, science and technology. This is what we call STEM capability. The vision is to respond to the challenges of today and tomorrow by preparing students for a world that requires multidisciplinary STEM thinking and capability.

The approach

STEM capabilities are developed when students are challenged to solve open-ended, real-world problems that engage students in the processes of the STEM disciplines.



STEM Consortium

Year 5 – Biosecurity

Overview

Food and agriculture are fundamental to human survival. In Australia, agriculture is a very efficient, sophisticated and highly technical industry and our farmers are exceptionally competitive in a global food market.

However, with over two thirds of Australia's population living in major cities, there is a growing disconnection between consumers, food sources and consequently their understanding of food-related issues.

One such issue facing agriculture is biosecurity. Trade has opened opportunities for Australia's economy and people, but at the same time it has also increased the risk of pests (ie introduced insects, feral animals, weeds, diseases) entering the country.

Being an island continent, Australia has been isolated from many pests and diseases that have devastated agriculture in other countries. We are still free from foot and mouth disease, rabies and the bee mite. Quarantine inspections at our airports and ports play a vital role in preventing the entry of pests and diseases carried by international travellers and traded goods.

The arrival of harmful pests and diseases directly threatens the viability of Australia's agricultural industries, including food production and trade. It also negatively impacts Australia's reputation as a producer of safe, quality food products.

Biosecurity has also emerged as a major global issue and will become increasingly important as rising populations drives global food demand to unprecedented levels.

Biosecurity is not something only farmers need to worry about. Everybody can make a difference in improving and protecting our food and environment.

In this module, students explore biosecurity and the role it plays in sustaining our agricultural industries and the wider economy. Biosecurity is vital if Australia is to maintain its food security.

What is the context?

Increased levels of trade and international travel have increased the risk of pests entering Australia and are negatively impacting food production, trade capacity and biodiversity.

What is the problem?

How can we protect Australian food production?

How does this module support integration of the STEM disciplines?

This module provides students with the opportunity to engage with an authentic and relevant ecological issue. Using a multidisciplinary approach, students develop content knowledge that will inform their understanding of and promote advocacy for Australian biosecurity practices.

Science

Students engage in the Science as a Human Endeavour and Biological Sciences strands of the Western Australian Curriculum by investigating the impact pests can have on agriculture and the biosecurity practices used to address these problems.

Students research invasive pests and develop an understanding that living things have structural features and adaptions that help them to survive in their environment (*ACSSU043: Living things have structural features and adaptations that help them to survive in their environment*). When investigating biosecurity control strategies, students appreciate how scientific knowledge is used to solve problems and inform personal and community decisions (*ACSHE083: Scientific knowledge is used to inform personal and community decisions*).

Technology

Students are engaged with technology as they design and create robots. When reflecting on agricultural industries, students recognise that people in design and technologies occupations work to increase the efficiency of food and natural fibre production (ACTDEK021: *People in design and technologies occupations aim to increase efficiency of production systems, or consumer satisfaction of food and natural fibre products*).

After defining the problem, students are asked to describe a set of sequenced steps and make decisions to create solutions (*WATPPS27: Define a problem, and set sequenced steps, with users deciding to create a solution for a given task*). Students are required to communicate alternative solutions, and follow design ideas using annotated diagrams and storyboards including appropriate technical terminology (*WATPPS29: Develop and communicate alternative solutions, and follow design ideas, using annotated diagrams, storyboards and appropriate technical terms*). Students are involved in developing a design brief to evaluate and justify their design processes and solutions (*WATPPS31: Develop negotiated criteria to evaluate and justify design processes and solutions and WATPPS32: Work independently, or collaboratively when required, to plan, develop and communicate ideas and information for solutions*).

When developing their product, students are engaged in computational thinking as they design algorithms that utilise branching (*ACTDIP020: Implement and use simple programming environments that include branching (decisions) and iteration (repetition)*). There are opportunities for students to engage in coding.

The *Design process guide* is included as a resource to help teachers understand the complete design process as developed in the Technologies curriculum.

Mathematics

Mathematical skills are developed as students pose questions and collect data by observation or survey (ACMSP118: *Pose questions and collect categorical or numerical data by observation or survey*). Students construct data displays with and without the use of digital technologies (ACMSP119: *Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies*). Students develop financial literacy skills as they create simple financial plans (*ACMNA106: Create simple financial plans*).

General capabilities

There are opportunities for the development of general capabilities and cross-curriculum priorities as students engage with *Biosecurity*. In this module, students:

- Develop problem solving skills as they research the problem and its context (*Activity 1*); investigate parameters impacting on the problem (*Activity 2*); imagine and develop solutions (*Activity 3*); and evaluate and communicate their solutions to an audience (*Activity 4*).
- Utilise creative thinking as they generate possible design solutions; and critical thinking, numeracy skills and ethical understanding as they choose between alternative approaches to solving the problem.
- Utilise personal and social capability as they develop socially cohesive and effective working teams; collaborate in generating solutions; adopt group roles; and reflect on their group work capabilities through self and peer evaluation.
- Utilise a range of literacies and information and communication technologies (ICT) capabilities as they collate records of work completed throughout the module in a journal; represent and communicate their solutions to an audience using digital technologies in *Activity 4*.
- Communicate and, using evidence, justify their group's design to an authentic audience.

What are the pedagogical principles of the STEM learning modules?

The STEM Learning Project modules develop STEM capabilities by challenging students to solve real-world problems set in authentic contexts. The problems engage students in the STEM disciplines and provide opportunities for developing higher order thinking and reasoning, and the general capabilities of creativity, critical thinking, communication and collaboration.

The design of the modules is based on four pedagogical principles:

- Problem-based learning
  This is an underlying part of all modules with every module based around solving an initial problem. It is supported through a four-phase instructional model: research the problem and its context; investigate the parameters impacting on the problem; design and develop solutions to the problem; and evaluate and communicate solutions to an authentic audience.
- Developing higher order thinking
  Opportunities are created for higher order thinking and reasoning through questioning and discourse that elicits students' thinking, prompts and scaffolds explanations, and requires students to justify their claims. Opportunities for making reasoning visible through discourse are highlighted in the modules with the icon shown here.

- Collaborative learning
  This provides opportunities for students to develop teamwork and leadership skills, challenge each other's ideas, and co-construct explanations and solutions. Information that can support teachers with aspects of collaborative learning is included in the resource sheets.
- Reflective practice
  Recording observations, ideas and one's reflections on the learning experiences in some form of journal fosters deeper engagement and metacognitive awareness of what is being learnt. Information that can support teachers with journaling is included in the resource sheets.

These pedagogical principles can be explored further in the STEM Learning Project online professional learning modules located in Connect Resources.

Activity sequence and purpose

Activity 1

RESEARCH

The importance of agriculture

Students recognise the important role agriculture plays in our everyday lives. Students collect data relating to food sources and use their knowledge to create a community service announcement.

Activity 2

INVESTIGATE

Pests and biosecurity

Students research pests that threaten Australian agricultural industries and identify biosecurity practices that promote pest minimisation. Using this information, students develop a series of informational 'Pest buster' posters.

Activity 3

IMAGINE & CREATE

Robot workshop

Students work in small groups to design and develop an animatronic robot.

They develop and follow a design brief, draw plans, construct a prototype and, after reflection, deliver a product that satisfies the design brief.

Activity 4

EVALUATE & COMMUNICATE

Biosecurity exhibition

Students host a 'Biosecurity exhibition' where an audience engages with animatronic robots to raise awareness of biosecurity strategies, issues and practices.

Background

Expected learning	Students will be able to: 1. Describe how controlling pest organisms can increase the efficiency of food production systems and customer satisfaction with food products. 2. Make links between every day products and the primary industries from which these are derived. 3. Identify the threat pests pose to agriculture and the need to have rigorous biosecurity practices. 4. Establish surveys and contribute to planning and conducting the survey. 5. Collate, tabulate and graph survey data and interpret the findings of the survey. 6. Measure mass using grams and kilograms and connect decimal representations to the metric system. 7. Describe how pests have adaptions that allow them to survive and spread in agricultural environments. 8. Identify biological, chemical and physical approaches to pest minimisation and control. 9. Develop and communicate designs using annotated drawings. 10. Use simple visual programming (coding) software to develop an animatronic robot that meets agreed design criteria. 11. Evaluate the effectiveness of their design processes and solutions, using an agreed set of criteria and personal reflection strategies.
Vocabulary	This module uses subject-specific terminology, some of which is shown in *Teacher resource sheet 1.13: Glossary*. The glossary contains terms that need to be understood, either before the module commences, or developed as they are used.
Timing	There is no prescribed duration for this module. The module is designed to be flexible enough for teachers to adapt. Activities do not equate to lessons; one activity may require more than one lesson to implement.
Consumable materials	A *Materials list* is provided for this module. The list outlines materials outside of normal classroom equipment that will be needed to complete the activities.

Safety notes	There are potential hazards inherent in these activities and with the equipment being used, and a plan to mitigate any risks will be required. Potential hazards specific to this module include but are not limited to: • Possible exposure to cyber bullying, privacy violations and uninvited solicitations when using the internet • Construction tools.
Enterprise skills	The *Biosecurity* module focuses on higher order skills with significant emphasis on the development of the general capabilities and enterprise skills. Enterprise skills include problem solving, communication skills, digital literacy, teamwork, financial literacy, creativity, critical thinking and presentation skills. Further information More information is available from the Foundation for Young Australians in the *New Work Order* six-report series at *www.fya.org.au/our-research-2/#series*.
Assessment	The STEM modules have been developed to engage students in learning experiences in which they solve authentic real-world problems using science, technology, engineering and mathematics capabilities. While working through the module, the following activities will present assessment opportunities: • Concept map • Community service announcement • Pest busters poster • Animatronic robot • Reflection Appendix 1 indicates how the activities are linked to the Western Australian Curriculum. Evidence of learning from journaling, presentations and anecdotal notes from this module can contribute towards the larger body of evidence gathered throughout a teaching period and can be used to make on-balance judgements about the quality of learning demonstrated by the students in the science, technologies and mathematics learning areas.

	Students can further develop the general capabilities of Information and communication technology (ICT) capability, Critical and creative thinking and Personal and social capability. Continuums for these are included in the *General capabilities continuums* but are not intended to be for assessment purposes.

Activity 1: The importance of agriculture

Activity focus 	This activity is designed to raise awareness of the important role agriculture plays in our everyday lives. Students collect data relating to food sources and interpret graphical information relating to trade and the global population. They use their knowledge to create a community service announcement.
Background information	Crops are plants that are cultivated by humans. They are valuable commodities and can be found in a variety of products including processed foods, beauty products, paper and clothing. Australia grows a variety of crops for both domestic use and export. Australia's plant industries have a farm gate value of over $18 billion and contribute over $12 billion to export income. Australia produces much more agricultural produce than it needs for its own population. As a result, about two thirds of Australian agricultural produce is exported to other countries. In Western Australia, 80% of the state's agricultural produce is exported. In past generations many people worked on the land, or at least had a much closer relationship with their food source. Over time with mechanisation, the agriculture workforce has declined in numbers and society has become increasingly disconnected from direct food production. Most of us are food consumers but have little knowledge or understanding of what it means to be a food producer or food production processes, including how food is grown and factors affecting production. Australian food consumers also generally have a limited understanding of biosecurity. Learning more about food and how it is produced will increase awareness of the need to protect food sources.
Instructional procedures	It is recommended that students work in small groups of three to four for all activities. Mixed ability groups encourage peer tutoring and collaboration in problem solving. Collaboration is an important STEM capability. Stimulus pictures have been provided to assist in initiating classroom conversations.

	Students produce a concept map representing their knowledge of agriculture using either *Student activity sheet 1.7: Concept map* or software such as *Popplet*. Refer to *Teacher resource sheet 1.4: Cooperative Learning – Think, Pair, Share* for more information on this cooperative strategy students will use in the activity. For teachers who would like to use *Green Screen by Do Ink* technology, see the *Digital resources* section for links to online tutorials.
Expected learning	Students will be able to: 1. Identify the role agriculture plays in everyday lives (Technologies). 2. Make links between products used every day and the crops from which these are derived (Technologies). 3. Collate, tabulate and graph data relating to food products (Mathematics). 4. Measure mass in grams and kilograms and connect to decimal representations of the metric system. 5. Recognise Australia's role in food production (imports and exports) (Technologies).Locate major Australian trade destinations using a world map (Social sciences). 6. Create and interpret graphical information relating to the global population (Mathematics). 7. Communicate findings using digital media (Technologies).
Equipment required	**For the class:** Whiteboard or interactive whiteboard Devices or laptops Electronic scales Apps and software – refer to *Digital resources* section *Teacher resource sheet 1.5: Picture stimulus – Farms* *Teacher resource sheet 1.8: Picture stimulus – Supermarket*
	For the students *Student activity sheet 1.6: I see, I think, I wonder* *Student activity sheet 1.7: Concept map*

	Student activity sheet 1.9: What's in your lunchbox? – Collecting data *Student activity sheet 1.10: World map – Trade routes* *Student activity sheet 1.11: Population statistics* *Student activity sheet 1.12: Community service announcement – Storyboarding*
Preparation	Organise the incursion and invite a farmer or someone from the CSIRO or the Department of Primary Industries and Regional Development to share industry knowledge about biosecurity practices in Australia.
Activity parts	**Part 1: Concept map** Show the students images of different types of farms. Refer to *Teacher resource sheet 1.5: Picture stimulus – Farms*. Using the pictures, conduct a think-pair-share relating to students' current knowledge about agriculture. Refer to *Teacher resource sheet 1.4: Cooperative learning – Think, Pair, Share*. Use the following as focus questions: • Have you ever lived on or visited a farm? • What do you know about farming and agriculture? • What does it look like? • Where have you seen it? • What do farms produce? • What things threaten the success of a farm? Students organise this information in a concept map, using *Popplet* or *Student activity sheet 1.7: Concept map*. This will be a dynamic document that students will add to over the course of the module.
	Part 2: Incursion An incursion relating to agriculture would be a valuable experience for students (eg a talk by a farmer or someone from the Department of Primary Industries and Regional Development or CSIRO). Before the incursion, students generate questions and wonderings for the presenter using *Student activity sheet 1.6: I see, I think, I wonder*. I see, I think, I wonder is a thinking routine that develops visual literacy and encourages students to make careful observations and thoughtful

interpretations, stimulating curiosity and inquiry. Following the incursion, students update their concept maps with new information.

Part 3: What's in your lunchbox?

Use the ABC Education resource *From paddock to plate* at education.abc.net.au/res/teacher_res/3-paddock-plate.html (or similar) to engage students in the farm to table food production process.

View the following resources to build students' knowledge about the origin of foods:

- *Food from plants and animals* (Better Health Channel, 2012) www.betterhealth.vic.gov.au/health/healthyliving/foods-from-plants-and-animals
- *Plants as food* (DK findout!, 2018) www.dkfindout.com/us/animals-and-nature/plants/plants-as-food/
- *Grain production in Western Australia map* (Department of Primary Industries and Regional Development, 2017) www.agric.wa.gov.au/wheat/grain-production-western-australia-map

Show the students images of supermarket aisles and products. Refer to *Teacher resource sheet 1.8: Picture stimulus – Supermarket*.

Using the pictures as a stimulus, as a class brainstorm the different crops and produce that are grown on farms in Australia. Record the brainstorm digitally using an app such as *Padlet* on the whiteboard.

Pose the question to the class:

- Do you know where the food in your lunchbox comes from?

Plan the following activity in advance and prepare students with gloves and a safe way to handle and weigh food.

Students lay the contents of their lunch boxes out on a clean plastic sheet on their desk. Revisit the brainstorm and ask students:

- Which of your foods came from a farm?
- What type of farming is involved?
- Which of your foods have been processed?

- What do you think the processed food is made from?
- Where do these ingredients come from?

Take one of the processed products and list the ingredients for the students, to help them in the following activity. Guide a class discussion around the idea that farming provides us with fresh produce and what ingredients are used to manufacture processed food products.

Using *Student activity sheet 1.9: What's in your lunchbox? – Collecting data* students list the food items found in their lunch boxes and identify the sources from which the items are processed.

Students use electronic scales to measure the mass of each food item in grams and, for food that is manufactured from more than one food source, approximate the mass of each food source.

To keep the number of different food types manageable, suggest that some can be combined, such as 'grains' instead of the individual grains in multigrained bread and products made from flour.

Have students assist in summing the total mass for each different food type, and record on wall chart or IWB. Add these together to find the overall mass of food from all sources in the students' lunches.

This provides opportunity to introduce students to the relationship between grams, kilograms and decimals. For example, say, "We have divided the total grams by 1 000 to find out how many kilograms of food is contained in our lunches today. What do the digits after the decimal point mean?" Ask:

- What does the first digit represent? (the number of kilograms divided by 10, or how many lots of 100 g)
- What does the second digit represent? (the number of kilograms divided by100 or how many lots of 10g)
- What does the third digit represent? (the number of kilograms divided by1000 or how many grams)
- How would you write 325 grams in kilograms? (0.325 kg)
- How would you write 25 grams in kilograms? (0.025 kg)

Convert the grams to kilograms and discuss with students the ways that this information could be graphed to provide a visual of the food types contained in their lunches that day.

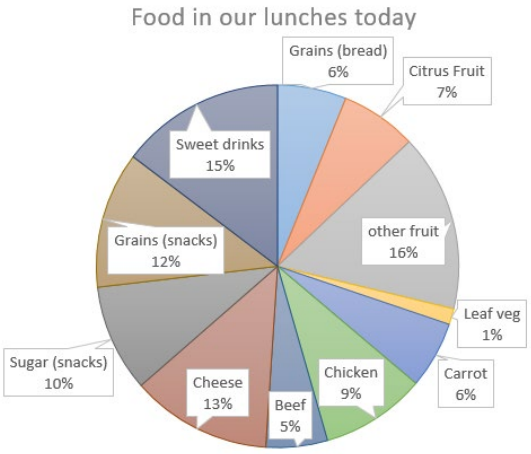
Introduce the idea that because we have a total amount and all our other data forms a part of that amount, a pie graph would be an appropriate way to present the data.

Use a spreadsheet to create a pie graph, showing students how to set up a table, and the resulting graph, choosing from the available options.

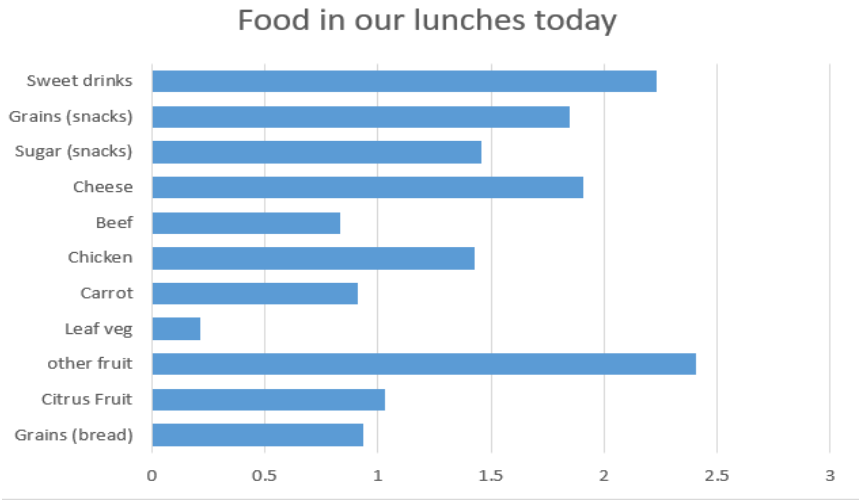
The use of percentages in the pie graph can be explained by referring to their current understanding of fractions as division. The percentages can be added to show that the total is 100%, so each number of percentage points can be written as a fraction of 100.

It can be demonstrated, with a calculator, for example, that 0.934 divided by 15.2 is approximately equal to 6 divided by 100, i.e. 0.06, or 6/100 = 6%. (Note: students at year 5 are not expected to work with percentages but should be introduced to the concept in context, referring to their current knowledge about fractions and decimals.)

Grains (bread)	0.934
Citrus Fruit	1.034
other fruit	2.407
Leaf veg	0.214
Carrot	0.91
Chicken	1.425
Beef	0.835
Cheese	1.905
Sugar (snacks)	1.456
Grains (snacks)	1.85
Sweet drinks	2.23
	15.2



Create a bar graph from the same data (see example below) and ask students to consider which method they believe is better and why.



In their groups, students draw conclusions as they interpret the data. Encourage students to discuss how each method of data representation has enabled them to identify trends and draw conclusions. Students can consider which of their foods came straight from farms to shops and which would be processed before reaching them. They may consider the health aspects of their lunch choices and how this could be improved.

Part 4: Trade routes

Students brainstorm what is meant by the terms below:

- Economy
- Trade
- Import
- Export.

Guide a class discussion about trade, using prior knowledge to answer the following focus questions:

- What types of foods are exported from Australia and why?
- What types of foods are imported into Australia and why?
- Why does Australia need to trade?
- How does trade benefit our economy?

Share with students information about Australia's major agriculture exports and where they are exported to.

Using devices, students work in groups to research and identify Australia's main trade partners and locate these on a world map. They annotate the map to show trade connections between the countries.
This process can be done using *Skitch* software or *Student activity sheet 1.10: World map – Trade routes*.

Using the think–pair–share strategy, students explore the question:

- What do you think could happen if Australia stopped trading with other countries?

Part 5: The global population

Guide the students in a discussion about population using the following focus questions:

- What does population mean?
- What is the global population?
- Do you think the population is increasing or decreasing? Why?

Provide students with links to global population statistics for the last 10 years. Refer to *Digital resources*.

Distribute *Student activity sheet 1.11: Population statistics*. Refer to previous graphing activity and ask students why a pie graph would not be appropriate for these data.

Have students use the information on the worksheet to create a column graph to show the global population trends. Students can use an app such as *Easy Chart, MSExcel* or graph paper. Ask,

- How can the y axis be labelled to show the very large numbers?
- What would a reasonable maximum number be?
- What could the increments be?
- How can the numbers be re-written in a more manageable form. (E.g. in billions rounded to two decimal places.)

Once students have created a column graph and printed a copy (if electronic), have them change the column graph into a line graph by marking with a dot the top centre of each column and then joining the dots. Ask:

- How does this help you see the trend in the graph?
- Why is it not appropriate to turn every column graph into a line graph?

- What aspects would you need to be careful about when creating a line graph? (The time intervals need to be equal and continuous.

In their groups, students analyse the data, discussing these questions:

- What does the data tell us about the global populations?
- What is the trend?
- What would you predict the population to be in 2020?
- How can the line graph help you with that?
- What impact do you think a growing global population have on food production and agriculture?

Students use the think–pair–share strategy to feedback their findings to their peers and the wider class.

Part 6: Community service announcement

Pitch the following to the class:

You have been commissioned by the Australian Government, Department of Agriculture to create a community service announcement that promotes an appreciation of agriculture in Australian society.

Explain that the advertisement should convey a key message decided by the students. Prompt student thinking to develop the key message by asking:

- What is agriculture?
- What is trade?
- What is the importance of trade to Australia's economy?
- What is the impact of the growing global population on agriculture and trade?

Show the students a range of community service announcements (see *Digital resources* section) and identify the techniques used to promote messages.

Using an online tool such as *Storyboarder, Plot, Canva, Boords or Sway* or an offline version such as *Student activity sheet 1.12: Community service announcement – Storyboarding*, students script and storyboard an advertisement. Students could make use of software such as *iMovie* to record, edit and present their advertisements.

	Students could also use *Green Screen by Do Ink* software to enhance their advertisements.
	Part 7: Reflection Students add new learning to their concept maps.
Resource sheets	*Teacher resource sheet 1.4: Cooperative learning – Think, Pair, Share* *Teacher resource sheet 1.5: Picture stimulus – Farms* *Student activity sheet 1.6: I see, I think, I wonder* *Student activity sheet 1.7: Concept map* *Teacher resource sheet 1.8: Picture stimulus – Supermarket* *Student activity sheet 1.9: What's in your lunchbox? – Collecting data* *Student activity sheet 1.10: World map – Trade routes* *Student activity sheet 1.11: Population statistics* *Student activity sheet 1.12: Community service announcement – Storyboarding*
Digital resources	Primary School Resources (FutureAg, 2013) *www.futureag.org.au/resources/primary-school-resources.html*
	Agriculture (Department of Foreign Affairs and Trade, 2015) *dfat.gov.au/trade/topics/pages/agriculture.aspx*
	Databank – World Development Indicators (The World Bank, 2018) *databank.worldbank.org/data/reports.aspx?source=2&series=SP.POP.TOTL&country=WLD#*
	Dirt and Germs – Channel 9 Perth (scottcongdon, 2008) *youtu.be/KIKPWXxdxdg*
	Vitamins – Channel 9 Perth (scottcongdon, 2008) *youtu.be/vlL9G0ugKmM*
	Brush Your Teeth – Channel 9 Perth (scottcongdon, 2008) *youtu.be/I4S3EXa3e8Q*

Western Australia's agriculture and food sector (Department of Primary Industries and Regional Development, 2017) *www.agric.wa.gov.au/western-australias-agriculture-and-food-sector*
Popplet *www.popplet.com*
iMovie *itunes.apple.com/us/app/imovie/id377298193?mt=8*
Green Screen by Do Ink *itunes.apple.com/au/app/green-screen-by-do-ink/id730091131?mt=8*
Green Screen by Do Ink – Video Tutorial *youtu.be/l4YVqbaWoDU*
Toontastic *itunes.apple.com/us/app/toontastic-3d/id1145104532?mt=8*
Skitch *itunes.apple.com/au/app/skitch-snap-mark-up-send/id490505997?mt=8*

Activity 2: Pests and biosecurity

Activity focus

In this activity students research pests that threaten Australian agricultural industries and identify biosecurity practices that promote pest minimisation. Using this information, students develop a series of informational 'Pest buster' posters.

Background information

Identifying pests

Factors that lead to an organism becoming a pest include:

- It has no or insufficient predators
- Control methods are ineffective
- The environmental conditions suit its growth and development and it reproduces quickly
- It has a means of dispersing (ie moving from place to place)
- It feeds on crop plants or infects farm animals.

Pests can include mammals, invertebrates, nematodes, vertebrates, weeds and pathogens.

More information can be found at the Department of Primary Industries and Regional Development website at www.agric.wa.gov.au/pests-weeds-diseases.

Some pests found in Australia

Mediterranean fruit fly (*Ceratitis capitate*)

Fruit flies are damaging insect pests that attack a wide range of fruits and vegetables. By damaging fruits and vegetables, these pests reduce Australia's capacity to sell them in overseas markets.

The adult Mediterranean fruit fly is 3-5 mm long and light brown in colour, with distinct brown bands extending to the wing tips. The female pierces the skin of a fruit to lay her eggs beneath the surface, causing the fruit to start rotting. Larvae (maggots – 12-20 mm long) emerge from the eggs and feed on the pulp of the fruit.

Mediterranean fruit fly is spread by moving infected host fruit out of infested areas.

(Source: Western Australian Government, Department of Primary Industries and Regional Development, www.agric.wa.gov.au/fruit/mediterranean-fruit-fly)

Banana weevil borer (*Cosmopolites sordidus*)

Adults are about 10-12 mm long, hard shelled and have the pronounced snout typical of weevils.

The newly emerged weevil is reddish brown but soon becomes uniformly dull black. The weevils are nocturnal and hide during the day in or around corms (the vertical, fleshy, underground stem that acts as a food-storage structure) or in moist areas near the plant and in the trash. Unusually sluggish in their movements, they feign death when disturbed and seldom fly.

Dispersal is primarily by the introduction of infested suckers and bits for planting. The larvae tunnel within the corm that lies below the soil surface.

When there are large populations, tunnels are found through most of the corm tissue. This tunnelling weakens the plant and renders it susceptible to 'blowdown' in windy weather. In severe cases the young suckers whither and fail to develop.

(Source: Department Barmac Pty Ltd, barmac.com.au/problem/banana-weevil-borer-2/)

Australian plague locust (*Chortoicetes terminifera)*

The Australian plague locust is a declared pest under the *Biosecurity and Agriculture Management Act 2007*.

Emerging nymphs and swarming locusts have the ability to cause severe damage to crops and pastures in agricultural regions, as well as causing damage to horticultural enterprises, sporting grounds, orchards, vineyards and gardens.

(Source: Western Australian Government, Department of Primary Industries and Regional Development, *www.agric.wa.gov.au/invasive-species/australian-plague-locust-overview*)

Red imported fire ants (*Solenopsis invicta*)

Red imported fire ants have the capacity to form 'super colonies' with multiple queens. The ants are 2-6 mm long, reddish-brown in colour and very aggressive. They can sting en masse and cause blistering and sometimes an allergic reaction.

These ants are opportunistic feeders that are omnivorous and prey on invertebrates, vertebrates and plants. They destroy seeds and scavenge for food.

For example, some ground-dwelling native bees and Thynid wasps are very 'species-specific' and only pollinate native terrestrial orchids. Feeding on the orchids competes with the native bees and wasps, disrupting the natural pollination of these plants.

Red imported fire ants can be spread through the movement of infested materials such as pot plants, soil, mulch and timber.

(Source: Australian Government, Department of the Environment and Energy, *www.environment.gov.au/biodiversity/invasive-species/insects-and-other-invertebrates/tramp-ants/red-imported-fire*)

Green snail *(Cantareus apertus*)

Green snails can significantly damage a wide range of plants, including leafy vegetables, cereal crops, lucerne, lupins, pasture grasses and native plants.

It is established in areas around Perth.

Green snails are smaller than the common brown species and have an olive-green shell and white flesh. They can breed very quickly, resulting in up to 1,000 young snails per square meter.

The damage caused by the green snail is similar to the common garden snail – it feeds on the surfaces of young leaves, often only penetrating shallowly and leaving a 'windowpane' effect. Older snails eat holes in the leaves and may reduce them to veins only.

During summer (December to March), green snails lie dormant below the soil surface and do not pose a risk.
Green snails can be carried on harvested vegetables, nursery stock and bales of hay.

(Source: Western Australian Government, Department of Primary Industries and Regional Development, www.agric.wa.gov.au/plant-biosecurity/green-snail-declared-pest)

Tomato potato psyllid *(Bactericera cockerelli)*

The Tomato potato psyllid is a tiny insect pest that attacks the Solanaceae family of plants (potato, tomato, eggplant, capsicum, chilli).

The adult Tomato potato psyllid resembles small winged cicadas in appearance but is the size of an aphid. The body is brownish and has white or yellowish markings on the thorax and a broad white band on the abdomen. Wings are transparent and held vertically over the body.

When present in a crop, noticeable signs include:

- Severe wilting of plants
- Yellowing of leaf margins and upward curling of the leaves
- White sugar-like granules which coat the plant leaves and stems.

(Text source: Australian Government, Department of Agriculture, www.agriculture.gov.au/about/media-centre/communiques/tomato-potato-psyllid-2;

Image source: Plant Biosecurity CRC, www.agriculture.gov.au/pests-diseases-weeds/plant/zebra-chip#see-if-you-can-identify-the-pest)

Biosecurity

Pests, weeds and diseases pose serious risks for primary producers as they can impact on agricultural production and market vitality.

Biosecurity protects our economy, environment and the community by managing the risk of animal and plant pests and diseases entering or spreading in Australia.

Australia has world class biosecurity systems that help ensure Australia's food security and food safety.

Australia has extensive global trade connections. Live animals and plants, plant material, animal products and foods from overseas can all introduce agricultural pests into Australia. This has the potential to impact our agricultural industries and damage our unique environment.

(Source: Australian Government, Department of Agriculture, *www.agriculture.gov.au/biosecurity*)

Quarantine

Quarantine plays an important role in keeping Australia free from pests.

Goods coming into Australia are subject to biosecurity control through quarantine inspections. Goods presenting an unacceptable level of biosecurity risk, regardless of their place of origin, may be subject to biosecurity management activities.

Travellers coming into Australia must comply with a variety of biosecurity measures. Some of these include:

- Fruit bins
- Vaccinations
- Declaration of goods
- Inspection of goods
- X-ray technology
- Detector dogs.

In addition to having controls on goods that can enter Australia from overseas, Australia also has rules and regulations about the movement of goods between and within states and territories.

Pests can be spread from one part of Australia to another through the movement of:

- Plants or plant products
- Animals or animal products
- Soil
- Agricultural machinery and recreational equipment
- People and vehicles moving through infected areas.

Therefore, there are restrictions on what people can take across states, territories or quarantine borders within Australia. These restrictions are in place to minimise the risk of spreading pests.

(Source: Australian Government, Department of Agriculture, *www.agriculture.gov.au/biosecurity*)

Eradicating pests

Australian farmers use a range of biological, chemical, physical and cultural control methods to manage pests.

Biological control

Biological control is the use of living organisms to control pests. A natural enemy such as a parasite, predator or pathogen is introduced into the environment of a pest or, if already present, is encouraged to multiply and become more effective in reducing the number of pest organisms.

While biological control can be an effective and environmentally sound means of controlling pests, some strategies have led to the introduction of invasive species such as the venomous cane toads (*Bufo marinus*).

As such, biological control must be carefully considered before organisms are released into the environment.

(Source: Australian Government, Department of the Environment and Energy, *www.environment.gov.au/biodiversity/invasive/weeds/management/biological-control.html*)

Chemical control

Chemical control is the use of chemicals to control pests. These include:

- Fungicides
- Insecticides
- Nematocides
- Rodenticide
- Herbicides
- Pesticides.

The use of chemicals provides farmers with a relatively quick pest treatment. However, the use of chemicals requires great care. Chemicals have the capacity to cause a variety of health issues. Excessive use of chemicals can be washed into water courses, be harmful to native animals and may also impact on the quality of the produce.

(Source: Australian Government, Department of the Environment and Energy, *www.environment.gov.au/biodiversity/invasive/weeds/management/chemical-control.html*)

Mechanical and physical control

Mechanical and physical control involves the removal of pests by physical or mechanical means. The aim is to eradicate pests or to make the environment unsuitable for them. Some examples include:

- Weeding
- Grazing
- Burning
- Trapping or shooting
- Slashing
- Barriers such as fencing.

(Source: Australian Government, Department of the Environment and Energy, *www.environment.gov.au/biodiversity/invasive/weeds/management/physical-control.html*)

Cultural controls

Cultural control methods relate to the use of farming systems and practices that reduce pest establishment, reproduction, dispersal and survival. For example:

- Selecting crops or varieties that are pest resistant
- Seed choice

- Crop rotation
- Hygiene measures such as burning prunings from diseased plants
- Managing irrigation so that humid conditions, that favour the spread of fungal diseases, are not created.

(Source: Australian Government, Department of the Environment and Energy, *www.environment.gov.au/biodiversity/invasive/weeds/management/cultural-control.html)*

Monitoring and reporting pests

Monitoring is looking for signs of pest and disease presence. This could include formal government department programs, or a producer looking for signs and symptoms in animals or plants.

If in the monitoring process something looks unusual or significant, enquiries or reports can be made to state government agriculture agencies.

Raising awareness

One of the cornerstones of effective biosecurity is the concept of 'come in clean and leave clean'.

Come in clean means your body and vehicle should be free of plant, insect or animal material (and any associated diseases) that could potentially become a pest.

To promote this message and to raise public awareness, strategies have been put into place by the government to promote issues relating to the importance of quarantine and rigorous biosecurity practices.

Instructional procedures

Students use a jigsaw cooperative structure to conduct research (see *Teacher resource sheet 1.2: Cooperative Learning – Jigsaw*).

Students continue to work in small groups.

Students use this information to create a poster either software (eg *Keynote, Canva, Piktochart*) or *Student activity sheet 2.3: Biosecurity booklet*.

Expected learning	Students will be able to: 1. Identify the features and adaptations of pests that help them to survive and thrive in their environment (Science). 2. Investigate biosecurity strategies that can be used to minimise pests (Science). 3. Organise and display findings into an informational poster (Science, Mathematics and Technologies).
Equipment required	**For the class:** Interactive whiteboard Devices or laptops Software (eg *Keynote, PowerPoint, Piktochart, Canva*) *Teacher resource sheet 2.5: Pest buster poster (example)* **For the students:** *Student activity sheet 2.1: Some pests found in Australia* *Student activity sheet 2.2: What is a pest?* *Student activity sheet 2.3: Biosecurity booklet* *Student activity sheet 2.4: Fact sheet poster*
Preparation	Print out required resource sheets.
Activity parts	**Part 1: What is a pest?** To assess students' prior knowledge, facilitate a brainstorm discussion about potential threats to our farmed food sources. Refer to *Student activity sheet 2.1: Some pests found in Australia*. Introduce the concept that a pest is any organism that is unwanted or is damaging a valued resource. Focus the students on the idea of pests. Pose the following questions to stimulate student thinking: • What is a pest? • Name three types of pests? • How do you know if something is a pest? What are the criteria? • What impact do they have on agriculture and the environment? Record ideas on the whiteboard.

Distribute *Student activity sheet 2.2: What is a pest?*, one per group.

Students work in groups using ideas from the whiteboard to complete the worksheet and feedback their findings to the class.

Part 2: Biosecurity

Introduce the term 'biosecurity' to the class by breaking the word biosecurity into syllables and discuss the two parts – *bio* and *security*.

- Bio refers to life and living things. It is from the Greek word bios meaning life or way of living. Biology is the study of living things.
- Security refers to protection from risk or danger.

As such, biosecurity could be interpreted as the protection of living things from some sort of risk or danger.

Refer students to *Student activity sheet 1.10: World map – Trade routes*.

Highlight that pests and diseases could be introduced into Australian food production systems and spread between places. Students should be aware that not all pests are imported. Native organisms can become pests if there are changes to their environment or if their range changes.

Pose the question:

- Why do you think biosecurity is important to Australian farmers?

Facilitate a discussion to encourage students to consider biosecurity. Some reasons include:

- Protects food production systems, so they can keep producing high volumes of good quality food
- Protects Australia's markets for food (much of what we produce in Australia is exported to other countries)
- Protects the environment from damage and promotes biodiversity.

Provide one *Student activity sheet 2.3: Biosecurity booklet* to each group. Alternatively, the booklets could be digital. For example, the students could access the information via a platform such as *Seesaw* using *QR codes* and record information on their devices.

STEM Consortium

Working in their groups, students research:

- Quarantine practices
- Biological pest control
- Chemical pest control
- Physical or mechanical pest control
- Monitoring of pests
- Where to find local information about pests and biosecurity.

This information could be shared at the *Biosecurity exhibition* in *Activity 4*.

Part 3: Pesky plant pests

Using a jigsaw strategy (refer to *Teacher resource sheet 1.2: Cooperative Learning – Jigsaw)*, students research the pests impacting Australian farming.

Refer students to *Student activity sheet 2.1: Some pests found in Australia*. Students select either a pest listed on the worksheet or one of their own choice and collect the following information:

- Scientific name
- Distribution of the pest in Australia
- Physical signs of the pest's presence
- Features or adaptations the pest has that enables it to survive, reproduce and become a pest in Australia
- Problems the pest causes
- Biosecurity measures used to minimise the spread and impact of this pest.

Part 4: Pest busters

Show students examples of informational posters and explain they will be creating a *Pest buster* poster about a problem pest.

Distribute *Student activity sheet 2.4: Fact sheet poster*, one per group.

	Design your own poster Using the examples of informational posters, as a class identify their key features. These include types of text (headings, information etc), graphics, statistics and call to action. The Piktochart article *How to make an eye-catching poster* has more information, see *Digital resources*. Students work collaboratively with their group to create a *Pest buster* informational poster. Students can use software (eg *Microsoft Publisher, Adobe Photoshop, Illustrator and InDesign, Comic Life, Canva, Keynote, Numbers, Easy Chart*) to create the poster. See *Teacher resource sheet 2.5: Pest buster poster (example)* which was produced using *Canva*.
	Part 5: Reflection Students add their new learning about pests and biosecurity to their concept maps.
Resource sheets	*Student activity sheet 1.10: World map – Trade routes* *Teacher resource sheet 1.2: Cooperative Learning – Jigsaw* *Student activity sheet 2.1: Some pests found in Australia* *Student activity sheet 2.2: What is a pest?* *Student activity sheet 2.3: Biosecurity booklet* *Student activity sheet 2.4: Fact sheet poster* *Teacher resource sheet 2.5: Pest buster poster (example)*
Digital resources	*Invasion curve animation, Biosecurity Council of WA | Department of Primary Industries and Regional Development* (Department of Agriculture and Food WA, 2015) *youtu.be/Ho2oXhtGmNQ*
	Redlegged Earth Mite (Agriculture Victoria, 2007) *www.agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/redlegged-earth-mite*
	Connect: Western Australia (Pest Smart WA, 2015) *www.pestsmart.org.au/connect/wa/*
	Western Australia's agriculture and food sector (Department of Primary Industries and Regional Development, 2017) *www.agric.wa.gov.au/western-australias-agriculture-and-food-sector*

Australian Plague Locust landholder control strategies for NSW (Department of Primary Industries NSW, 2018) www.dpi.nsw.gov.au/climate-and-emergencies/locusts/program-control-strategies/plague-locust-brochure

How to fold a sheet-of-paper into an 8-page zine (Umami design, 2013) blog.umamidesign.com/ud-content/2013/09/ud_130918_zine-instructions.jpg

Banana Weevil Borer (Barmac Pty Ltd, 2018) barmac.com.au/problem/banana-weevil-borer-2/

Arriving in Australia (Australian Government, Department of Agriculture, 2017) www.agriculture.gov.au/SiteCollectionDocuments/arriving-english-factsheet.pdf

Cane toad found in Perth front yard (WA Today, 2010) www.watoday.com.au/wa-news/cane-toad-found-in-perth-front-yard-20101116-17v29.html

Major pests (Australian Interstate Quarantine, 2017) www.interstatequarantine.org.au/major-pests

What is biosecurity and what are we doing about it? (CSIRO, 2014) youtu.be/20WAT1vt6gE

Tackling biosecurity threats with robots and sensors (CSIRO, 2015) www.csiro.au/en/Research/BF/Areas/Protecting-Australias-agricultural-industries/Robot-technology

Our Robots (Australian Centre for Field Robotics (ACFR) at the University of Sydney, 2017) confluence.acfr.usyd.edu.au/display/AGPub/Our+Robots

Drone helicopters versus 'purple plague': CSIRO takes on invasive biosecurity threat (News.com.au, 2014) www.news.com.au/technology/environment/drone-helicopters-versus-purple-plague-csiro-takes-on-invasive-biosecurity-threat/news-story/e8af26511010858fef35cc84c070b774

	How to make an eye-catching poster (Piktochart, 2019) *piktochart.com/blog/how-to-make-a-poster/*
	MyPestGuide Reporter app (Western Australian Government, Department of Primary Industries and Regional Development) *itunes.apple.com/au/app/mypestguide-reporter/id1032560930?mt=8*

Activity 3: Robot workshop

Activity focus

In this activity, students engage with the design process to develop an interactive animatronic robot. The aim of the animatronic is to raise awareness of and promote advocacy for Australian biosecurity practices.

Background information

Animatronics refers to the use of robotic devices to imitate a human or an animal. To create a robot, students will need to engage with the design process.

Design process

This will require students to develop and follow a design brief, draw annotated plans and construct a working prototype that satisfies the design brief. The design brief should be developed by the students with teacher support. It should be made available to students to guide the design process. See *Design process guide* for elaboration.

Coding and computational thinking

Students will need to use coding software to produce an animatronic robot. This may mean having to lead the students in coding and computational thinking activities. An example of coding software is *Scratch*, see the *Digital resources* section for a link to an instructional video.

Students can also make use of peripheral technology, such as a *Hummingbird Robotics Kit* or *Little Bits*, to create an engaging and interactive robot. Other options include:

- *Makeblock* – *www.makeblock.com*
- *VEX* – *www.vexrobotics.com/vexiq*
- Lego robotics: *LegoWeDo* – *education.lego.com/en-au/product/wedo-2* and *Mindstorms* - *www.lego.com/en-us/mindstorms*
- *Edison* – *meetedison.com/robotics-lesson-plans*
- *Sphero* – *tickleapp.com*

Video tutorials or online instructions will be useful for students to view prior to planning.

Instructional procedures	**Creating the design brief** The teacher should act as a facilitator during this activity. By collaboratively developing the design brief, students are given ownership of the creative process as well as being informed of the expectations required of the design. See *Teacher resource sheet 3.1: Design brief* for an example template. Students design and build their robots working in the same groups as the previous activity. **Construction** Students may need access to construction tools that are best used with adult supervision. **Coding** If students are unfamiliar with coding software and digital peripherals, whole class activities relating to this may be required to give students an opportunity to learn and practise the required skills.
Expected learning	Students will be able to: 1. Use simple visual programming (coding) software to develop a robot that presents information relating to biosecurity and pest minimisation that meets agreed design criteria (Technologies). 2. Identify biological, chemical and physical approaches to pest minimisation and control (Science). 3. Develop and communicate design action plans and designs using annotated drawings (Technologies). 4. Work collaboratively to design and develop an animatronic robot (Technologies).
Equipment required	**For the class:** Interactive whiteboard Devices or digital cameras Construction materials – see *Materials list* Software such as *Arduino, Hummingbird Robotics Kit, Little Bits, Makey Makey, Green Screen by Do Ink, QR Rafter, i-nigma, iMovie, Aurasma, Garage band, Toontastic, Scratch, Skitch, Sketch Up, Popplet.*

Preparation	Organise additional adult supervision for the use of construction tools. Ensure students have access to the chosen coding software.
Activity parts	**Part 1: Robot objectives** Introduce the task to the students: *Today we are going to design a robot that can teach people about pests and some ways we can stop them. This is the tricky part though…we also want to have fun!* As a class decide on the objectives for the robot. These should be: • Raise awareness (inform) • Develop advocacy (inspire to action). View online videos by searching 'animatronic insects'. This will enable students to gain an understanding of what they will be designing.
	Part 2: Market research Show students a range of robots available on the market and through class discussion identify common features. Prompt questions can include: • What do they look like? • How do they move? • What materials are they made from? • What software or hardware do they use? Write student responses on the whiteboard. Circle the features students think are the most important. Use the example template in *Teacher resource sheet 3.1: Design brief* to help students work in groups to create their design brief for the robots.
	Part 3: Action plan Students use the design brief to create a blueprint (annotated diagram) which will be used to build their robot. Working collaboratively in their groups, students complete *Student activity sheet 3.2: Action plan* and include: • Design brief • Team member information • Materials list

- Blueprint.

This information will be used to inform the building of the robot. Action planning is an important skill for project management roles.

Part 4: Build the robot

Students will need to access coding software to develop their robots (see *Digital resources*). At this stage students may also access peripheral technology to incorporate into their game. See *Background information* for further explanation.

Working in their groups, students use information from the action plan to build their robot. Remind students that the design brief required the robots to inform people about the problem, raise awareness of biosecurity and to be enjoyable to use.

Using a range of construction materials, students build their robot prototype and prepare for testing and refining.

Support students to document their construction process and capture digital images of the design process.

Part 5: Test and modify

Working in their groups, students test their robots and evaluate the effectiveness of their design. Students record their reflections on *Student activity sheet 3.3: Prototype troubleshooting*.

Questions to prompt student thinking can include:

- What problems did you experience?
- What were the reasons for your problem?
- How did you fix these?
- What is the most useful thing you learnt?

Provide students with an opportunity to modify their robot to address any issues arising from their group reflections.

Part 6: Class reflection

Discuss the design process and how well the robots satisfied the design brief.

Prompt student reflection with questions such as:

- What will people learn from your robot?
- Has your robot been successful in engaging your audience? Why or why not?

Resource sheets	*Materials list* *Design process guide* *Teacher resource sheet 3.1: Design brief* *Student activity sheet 3.2: Action plan* *Student activity sheet 3.3: Prototype troubleshooting*
Digital resources	*How to explain algorithms to kids* (Tynker, 2018) *www.tynker.com/blog/articles/ideas-and-tips/how-to-explain-algorithms-to-kids*
	Scratch Video Tutorials (Scratch) *scratch.mit.edu/help/videos/*
	Scratch: Getting started (Hummingbird Robotics Kit, 2017) *www.hummingbirdkit.com/learning/scratch*
	Hummingbird Beginner: Horse (cmurobotics, 2012) *www.youtube.com/watch?v=I44ZGa7-Aqs*
	Hummingbird Intermediate: Dog (cmurobotics, 2012) *www.youtube.com/watch?v=wsbxHDP8eQY*
	Hummingbird Advanced: Dragon (cmurobotics, 2012) *www.youtube.com/watch?v=FlusxMHVAVo*
	How to use Hummingbird Robot Kits in Schools (Travis Lape, 2015) *www.youtube.com/watch?v=37IKi9qchJI*
	Animatronics (littleBits, 2018) *littlebits.com/challenges/animatronics*

Arduino www.microsoft.com/en-au/p/arduino-ide/9nblggh4rsd8?activetab=pivot:overviewtab
Makey makey makeymakey.com
Green screen by Do Ink itunes.apple.com/au/app/green-screen-by-do-ink/id730091131?mt=8
QR Rafter itunes.apple.com/au/app/qrafter-qr-code/id416098700?mt=8
i-nigma itunes.apple.com/au/app/i-nigma-qr-code-data-matrix-and-1d-barcode-reader/id388923203?mt=8
iMovie www.apple.com/au/imovie/
Aurasma itunes.apple.com/au/app/hp-reveal/id432526396?mt=8
Garage band itunes.apple.com/au/app/garageband/id408709785?mt=8
Toontastic itunes.apple.com/au/app/toontastic-3d/id1145104532?mt=8
Skitch itunes.apple.com/au/app/skitch-snap-mark-up-share/id425955336?mt=12
Sketch-up www.sketchup.com
Popplet popplet.com

Activity 4: Biosecurity exhibition

Activity focus

In this activity students host a *Biosecurity exhibition* where an authentic audience, such as parents, carers, duty teachers, farmers and scientists engage with the robots.

The goal of the session is to raise awareness and promote advocacy of biosecurity strategies.

Background information

Students host a *Biosecurity exhibition* event where participants interact with the robots. This will be promoted within the school and, where possible, the local community.

Students will need support to prepare for the event. Some considerations teachers may have to make include:

Venue

- Where will the event be held? Is there enough space?

Invitations

- Who will be invited to attend?
- Which experts will you invite?
- How will you raise awareness of the event?

Example promotional materials have been included to give students and teachers some ideas. Refer to *Teacher resource sheet 4.1: Sample flyer*.

Digital infrastructure

- Do you have access to wi-fi and power supply?
- Will the technology be available and charged (if battery powered)?

Instructional procedures

This activity provides an opportunity for cross-curriculum assessment with literacy, listening and speaking. It also provides a rich opportunity for assessing students' understanding of science and technology principles and processes.

Presentation skills

Students may need information about effective presentation skills such as voice clarity, projection, volume, pitch and tone. Time constraints should be set for presentations and all students should be able to speak.

Students will need support and scaffolding to help them prepare for their presentation. To scaffold cooperative

	group work, each member of the group could have a role and responsibility. For example, one could be the content director, one the media director and a third the presentation director. See *Teacher resource sheet 1.1: Cooperative learning – Roles*. Depending on students' prior knowledge or ability, time may need to be allocated to developing oral presentation skills. Presentation options include creating a comic strip, *eBook*, poster in *Pages, Sway, Keynote or PowerPoint* or simple *iMovie* (or similar), which can then be shared through a digital platform such as *Connect, Seesaw* or *Class Dojo*, added to a class blog, or shared on the interactive whiteboard. Students may require explicit instruction when using these apps. To enable the completion of the design process students should be given time to make improvements to their work based on feedback received from the presentations. This could be in groups or as a private reflection in learning journals. Time should be taken to discuss how to give constructive feedback and how to take feedback positively. There is the opportunity to evaluate students' development of the general capability of Personal and social capability using *Teacher resource sheet 4.4: Peer and visitor feedback*.
Expected learning	Students will be able to: 1. Work collaboratively to develop a presentation on their robot (Technologies). 2. Evaluate the effectiveness of the design processes used and solutions, using an agreed set of criteria and personal reflection strategies (Technologies). 3. Develop and communicate design ideas to an authentic audience (Technologies).
Equipment required	**For the students**: Finished robots *Pest busters* posters Digital photos *Student activity sheet 4.5: Self-evaluation* *Student activity sheet 1.0: Journal checklist*

Preparation	Print the following for the audience: Each group's completed *Student activity sheet 2.4: Biosecurity booklet* *Teacher resource sheet 4.2: Incoming visitor card* *Teacher resource sheet 4.3: Question prompts* *Teacher resource sheet 4.4: Peer and visitor feedback*
Activity parts	**Part 1: Event preparation** **Set up** Students identify where they want to hold the event and plan how they want to set up their space with the goal of attracting visitors. **Promotion** Students develop promotional material to raise awareness of the event and promote participation from the wider school community. As such it should include: • Event details (where, when, who, what etc.) • Engaging typography and graphics. Promotional material can be distributed around the school, newsletters and the school website. Refer to *Teacher resource sheet 4.1: Sample flyer*. It can be created in a variety of different ways using a range of different tools or software. Graphic design software such as *Canva, Microsoft Word* or *Pages* can be used to develop the promotional materials. **Incoming visitors** Students will develop incoming visitor cards for visitors to sign before entering the exhibition. Refer to *Teacher resource sheet 4.2: Incoming visitor card*. These cards will be used to promote the importance of quarantine and border controls. Copies of *Student activity sheet 2.4: Biosecurity booklet* will be handed to visitors by the exhibitors (each group will have photocopies of their book completed in *Activity 2*). Alternatively, a digital option, such as using QR codes, could be used.

	Displays Groups display their *Pest busters* posters and arrange a room where the community service announcements from *Activity 1* will be broadcast to visitors.
	Part 2: Biosecurity exhibition Before the visitors enter the exhibition space, they will be given a list of questions relating to biosecurity. This will provide discussion points for the visitors and exhibitors. Refer to *Teacher resource sheet 4.3: Question prompts*. Students facilitate the experience by providing visitors with instructions on how their robot works and information relating to biosecurity and pests. Students are encouraged to collect data by taking photos or videos of the exhibition.
	Part 3: Feedback Provide a feedback book for visitors to write reflections about their experience. Refer to *Teacher resource sheet 4.4: Peer and visitor feedback*
	Part 4: Self-reflection and evaluation Using the *Six Thinking Hat* thinking routine, students reflect on the experience. Refer to *Student activity sheet 4.5: Self-evaluation*. These will include the following types of reflection: Yellow: Positive, Black: Negative, Red: Feelings, Green: Recommendations for next time. For more information see de Bono Thinking Systems at *www.debonothinkingsystems.com/tools/6hats.htm*. Students complete *Student activity sheet 1.0: Journal checklist*.
Resource sheets	*Student activity sheet 1.0: Journal checklist* *Teacher resource sheet 1.1: Cooperative learning – Roles* *Student activity sheet 2.4: Biosecurity booklet* *Teacher resource sheet 4.1: Sample flyer* *Teacher resource sheet 4.2: Incoming visitor card* *Teacher resource sheet 4.3: Question prompts*

	Teacher resource sheet 4.4: Peer and visitor feedback *Student activity sheet 4.5: Self-evaluation*
Digital resources	How to design an exhibition space (Pinterest, 2018) *www.pinterest.com.au/explore/exhibition-space/?lp=true*
	Pop-up exhibitions (The Design Museum, 2018) *designmuseum.org/whats-on/pop-up-exhibitions*
	iBooks Author *www.apple.com/au/ibooks-author*
	Book Creator *itunes.apple.com/au/app/book-creator-for-ipad-create/id442378070?mt=8*
	Sway *www.microsoft.com/en-au/p/sway/9wzdncrd2g0j?activetab=pivot:overviewtab*
	Pages *itunes.apple.com/au/app/pages/id361309726?mt=8*
	Keynote *itunes.apple.com/au/app/keynote/id361285480?mt=8*
	Seesaw Digital Portfolio *web.seesaw.me*
	Class Dojo *www.classdojo.com*
	Connect Resources *connect.det.wa.edu.au/*

Appendix 1: Links to the Western Australian Curriculum

The *Biosecurity* module provides opportunities for developing students' knowledge and understandings in science, technologies and mathematics. The table below shows how this module aligns to the content of the Western Australian Curriculum and can be used by teachers for planning and monitoring.

BIOSECURITY Links to the Western Australian Curriculum	ACTIVITY			
	1	**2**	**3**	**4**
SCIENCE				
SCIENCE UNDERSTANDING				
Biological sciences: Living things have structural features and adaptations that help them to survive in their environment (ACSSU043)		●		
SCIENCE AS A HUMAN ENDEAVOUR				
Nature and development of science: Scientific knowledge is used to inform personal and community decisions (ACSHE083)		●	●	
DESIGN AND TECHNOLOGIES				
KNOWLEDGE AND UNDERSTANDING				
Food and fiber production: People in design and technologies occupations aim to increase efficiency of production systems, or consumer satisfaction of food and natural fibre products (ACTDEK021)		●		
PROCESS AND PRODUCTION SKILLS				
Investigating and defining: Define a problem, and set sequenced steps, with users deciding to create a solution for a given task (WATPPS27)		●		
Designing: Develop and communicate alternative solutions, and follow design ideas, using annotated diagrams, storyboards and appropriate technical terms (WATPPS29)			●	
Evaluating: Develop negotiated criteria to evaluate and justify design processes and solutions (WATPPS31)			●	

BIOSECURITY Links to the Western Australian Curriculum	ACTIVITY			
	1	**2**	**3**	**4**
DIGITAL TECHNOLOGIES				
PROCESS AND PRODUCTION SKILLS				
Digital implementation: Implement and use simple programming environments that include branching (decisions) and iteration (repetition) (ACTDIP020)			●	
MATHEMATICS				
STATISTICS AND PROBABILITY				
Data representation and interpretation: Pose questions and collect categorical or numerical data by observation or survey (ACMSP118)	●			
Data representation and interpretation: Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies (ACMSP119)	●			
MEASUREMENT AND GEOMETRY				
USING UNITS OF MEASUREMENT Using units of measurement: Choose appropriate units of measurement for length, area, volume, capacity and mass (ACMMG108)	●			

Further information about assessment and reporting in the Western Australian Curriculum can be found at: k10outline.scsa.wa.edu.au/home.

Appendix 1B: Mathematics proficiency strands

Key ideas

In Mathematics, the key ideas are the proficiency strands of understanding, fluency, problem-solving and reasoning. The proficiency strands describe the actions in which students can engage when learning and using the content. While not all proficiency strands apply to every content description, they indicate the breadth of mathematical actions that teachers can emphasise.

Understanding

Students build a robust knowledge of adaptable and transferable mathematical concepts. They make connections between related concepts and progressively apply the familiar to develop new ideas. They develop an understanding of the relationship between the 'why' and the 'how' of mathematics. Students build understanding when they connect related ideas, when they represent concepts in different ways, when they identify commonalities and differences between aspects of content, when they describe their thinking mathematically and when they interpret mathematical information.

Fluency

Students develop skills in choosing appropriate procedures; carrying out procedures flexibly, accurately, efficiently and appropriately; and recalling factual knowledge and concepts readily. Students are fluent when they calculate answers efficiently, when they recognise robust ways of answering questions, when they choose appropriate methods and approximations, when they recall definitions and regularly use facts, and when they can manipulate expressions and equations to find solutions.

Problem-solving

Students develop the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively. Students formulate and solve problems when they use mathematics to represent unfamiliar or meaningful situations, when they design investigations and plan their approaches, when they apply their existing strategies to seek solutions, and when they verify that their answers are reasonable.

Reasoning

Students develop an increasingly sophisticated capacity for logical thought and actions, such as analysing, proving, evaluating, explaining, inferring, justifying and generalising. Students are reasoning mathematically when they explain their thinking, when they deduce and justify strategies used and conclusions reached, when they adapt the known to the unknown, when they transfer learning from one context to another, when they prove that something is true or false, and when they compare and contrast related ideas and explain their choices.

Source:
www.australiancurriculum.edu.au/f-10-curriculum/mathematics/key-ideas/?searchTerm=key+ideas#dimension-content

Appendix 2: General capabilities continuums

The general capabilities continuums shown here are designed to enable teachers to understand the progression students should make with reference to each of the elements. There is no intention for them to be used for assessment.

Information and communication technology (ICT) capability learning continuum

Sub-element	Typically by the end of Year 2	Typically by the end of Year 4	Typically by the end of Year 6
Create with ICT **Generate ideas, plans and processes**	use ICT to prepare simple plans to find solutions or answers to questions	use ICT to generate ideas and plan solutions	use ICT effectively to record ideas, represent thinking and plan solutions
Create with ICT **Generate solutions to challenges and learning area tasks**	experiment with ICT as a creative tool to generate simple solutions, modifications or data representations for audiences or purposes	create and modify simple digital solutions, creative outputs or data representation/ transformation for purposes	independently or collaboratively create and modify digital solutions, creative outputs or data representation/ transformation for audiences and purposes
Communicating with ICT **Collaborate, share and exchange**	use purposefully selected ICT tools safely to share and exchange information with appropriate local audiences	use appropriate ICT tools safely to share and exchange information with appropriate known audiences	select and use appropriate ICT tools safely to share and exchange information and to safely collaborate with others

Critical and creative thinking learning continuum

Sub-element	Typically by the end of Year 2	Typically by the end of Year 4	Typically by the end of Year 6
Inquiring – identifying, exploring and organising information and ideas **Organise and process information**	organise information based on similar or relevant ideas from several sources	collect, compare and categorise facts and opinions found in a widening range of sources	analyse, condense and combine relevant information from multiple sources
Generating ideas, possibilities and actions **Imagine possibilities and connect ideas**	build on what they know to create ideas and possibilities in ways that are new to them	expand on known ideas to create new and imaginative combinations	combine ideas in a variety of ways and from a range of sources to create new possibilities
Generating ideas, possibilities and actions **Seek solutions and put ideas into action**	investigate options and predict possible outcomes when putting ideas into action	experiment with a range of options when seeking solutions and putting ideas into action	assess and test options to identify the most effective solution and to put ideas into action
Reflecting on thinking and processes **Transfer knowledge into new contexts**	use information from a previous experience to inform a new idea	transfer and apply information in one setting to enrich another	apply knowledge gained from one context to another unrelated context and identify new meaning

Personal and social capability learning continuum

Sub-element	Typically by the end of Year 2	Typically by the end of Year 4	Typically by the end of Year 6
Social management **Work collaboratively**	identify cooperative behaviours in a range of group activities	describe characteristics of cooperative behaviour and identify evidence of these in group activities	contribute to groups and teams, suggesting improvements in methods used for group investigations and projects
Social management **Negotiate and resolve conflict**	practise solving simple interpersonal problems, recognising there are many ways to solve conflict	identify a range of conflict resolution strategies to negotiate positive outcomes to problems	identify causes and effects of conflict, and practise different strategies to diffuse or resolve conflict situations
Social management **Develop leadership skills**	discuss ways in which they can take responsibility for their own actions	discuss the concept of leadership and identify situations where it is appropriate to adapt this role	initiate or help to organise group activities that address a common need

Further information about general capabilities is available at:
k10outline.scsa.wa.edu.au/home/p-10-curriculum/general-capabilities-over/general-capabilities-overview/general-capabilities-in-the-australian-curriculum

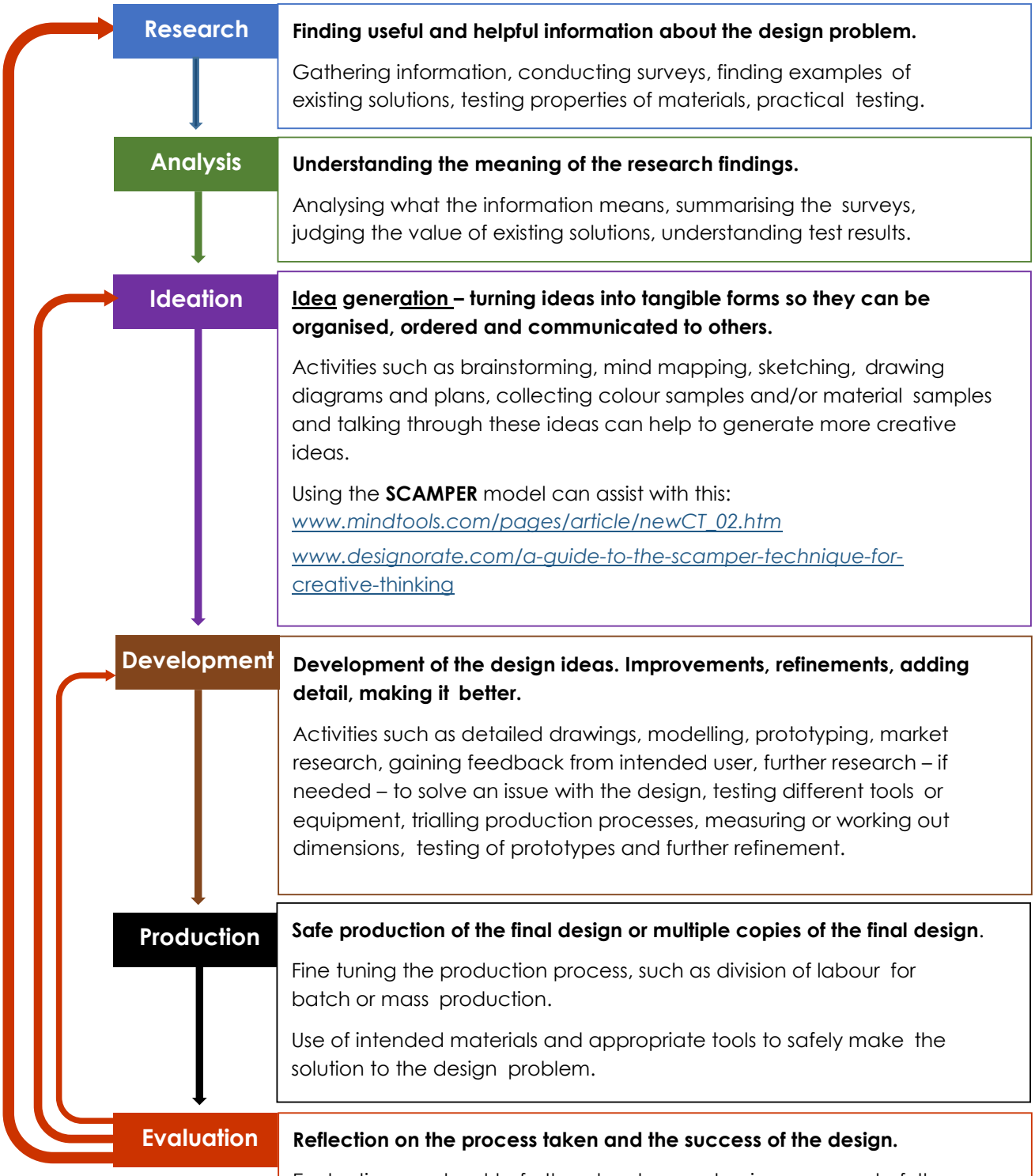
Appendix 3: Materials list

The following materials are required to complete this module.

Construction materials and tools

- Cardboard
- Tape
- Scissors
- Rulers or measuring tape
- Paint
- Glue
- Butcher paper
- Expanding foam
- Modelling clay
- Cereal boxes
- Toothpicks
- Pipe-cleaners
- Straws
- String
- Rubber bands
- Construction paper
- Wooden craft sticks
- Cellophane
- Balsa wood
- Sharp knife
- Hot glue gun
- Robots
- Appropriate software
- Electronic scales

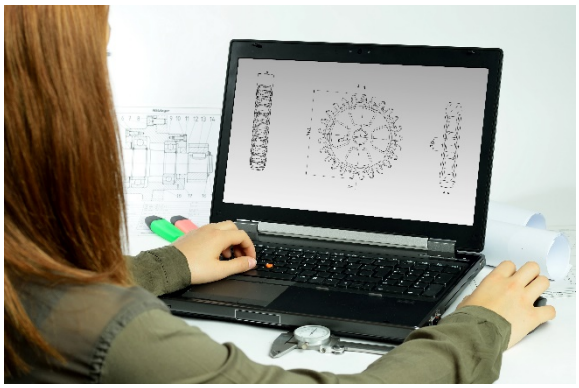
Appendix 4: Design process guide



STEM Consortium

Appendix 4B: Drawing in the design process

Incorporating the design process into the STEM modules will often result in the need for students to draw plans of their designs. This can be done at a simple level using hand drawn sketches or at a more technical level using computer-aided design (CAD).



istockphoto.com

By developing skills using industry standard software, students may be well-placed to explore future career pathways.

There are several CAD software options, two free examples are detailed below. *Autodesk* is a third package that is also free for educational use.

Tinkercad

- Format: Web-based app requiring internet access via a browser
- Purpose: A simple, online 3D design and 3D printing app
- Home: *www.tinkercad.com*
- Blog: *blog.tinkercad.com*
- Tutorials: *www.tinkercad.com/learn*
- Feature: Connects to 3D printing and laser cutting.

SketchUp

- Format: Can be downloaded and installed on devices, or used in a browser
- Purpose: Enables students to draw in 3D
- Home: *www.sketchup.com* 'Products' '*SketchUp Make*'
- Help centre: *help.sketchup.com/en*
- Blog: *blog.sketchup.com*
- Tutorials: *www.youtube.com/user/SketchUpVideo*. From beginner tool tips to intermediate and advanced modelling techniques, the video tutorials help to build *SketchUp* skills.

Appendix 5: Reflective journal

When students reflect on learning and analyse their own ideas and feelings, they self-evaluate, thereby improving their metacognitive skills. When students self-monitor or reflect, the most powerful learning happens.

istockphoto.com

Journaling may take the form of a written or digital journal, a portfolio or a digital portfolio. Early childhood classrooms may use a class reflective floor book with pictures of the learning experience and scribed conversations.

Teachers can model the journaling process by thinking aloud and showing students how they can express learning and thoughts in a variety of ways including diagrams, pictures and writing.

Journals are a useful tool that gives teachers additional insight into how students value their own learning and progress, as well as demonstrating their individual achievements.

The following links provide background information and useful apps for journaling.

Kidblog – digital portfolios and blogging *kidblog.org/home*
Edmodo – for consolidating and storing class notes and learning materials *www.edmodo.com*
Explain Everything™ – a screen casting, video and presentation tool all in one *Explaineverything.com*
Popplet – allows you to jot down your ideas and then sort them visually *Popplet.com*
Seesaw – for capturing work completed by students in class, using a device's camera function *Web.seesaw.me*
Connect – the Department of Education's integrated, online environment *connect.det.wa.edu.au*
Evernote (a digital portfolio app) *evernote.com*
Digital portfolios for students (Cool tools for school) *cooltoolsforschool.wordpress.com/digital-student-portfolios*

Appendix 6: Student activity sheet 1.0: Journal checklist

As an ongoing part of this module, you have been keeping a journal of your work.

Before submitting your journal to your teacher please ensure you have included the following information.

- Tick each box once complete and included.
- Write N/A for items that were not required in this module.

istockphoto.com

Your name and group member's names or photographs	
An explanation of the problem you are solving	
Your notes from *Activity 1*	
Your notes from *Activity 2*	
Your notes from *Activity 3*	
Your notes from *Activity 4*	
Student activity sheet 1.6: I see, I think, I wonder	
Student activity sheet 1.7: Concept map	
Student activity sheet 1.9: What's in your lunchbox? – Collecting data	
Student activity sheet 1.10: World map – Trade routes	
Student activity sheet 1.11: Population statistics	
Student activity sheet 1.12: Community service announcement - Storyboarding	
Student activity sheet 2.2: What is a pest?	
Student activity sheet 2.3B: Farmers' market (blank)	
Student activity sheet 2.4: Biosecurity booklet	
Student activity sheet 2.5: Fact sheet poster	
Student activity sheet 3.2: Action plan	
Student activity sheet 3.3: Prototype troubleshooting	
Student activity sheet 4.5: Self-evaluation	

Student activity sheet 1.0: Journal checklist	

Appendix 7: Teacher resource sheet 1.1: Cooperative learning – Roles

Cooperative learning frameworks create opportunities for groups of students to work together, generally to a single purpose.

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

When students are working in groups, positive interdependence can be fostered by assigning roles to group members.

istockphoto.com

These roles could include:

- working roles such as Reader, Writer, Summariser, Time-keeper
- social roles such as Encourager, Observer, Noise monitor, Energiser.

Teachers using the *Primary Connections* roles of Director, Manager and Speaker for their science teaching may find it effective to also use these roles for STEM learning.

Further to this, specific roles can be delineated for specific activities that the group is completing.

It can help students if some background to the purpose of group roles is made clear to them before they start, but at no time should the roles get in the way of the learning. Teachers should decide when or where roles are appropriate to given tasks.

istockphoto.com

Appendix 8: Teacher resource sheet 1.2: Cooperative learning – Jigsaw

Cooperative learning frameworks create opportunities for groups of students to work together, generally for a single purpose.

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

The jigsaw strategy typically has each member of the group becoming an 'expert' on one or two aspects of a topic or question being investigated. Students start in their cooperative groups, then break away to form 'expert' groups to investigate and learn about a specific aspect of a topic. After developing a sound level of understanding, the students return to their cooperative groups and teach each other what they have learnt.

Within each expert group, issues such as how to teach the information to their group members are considered.

<table>
<tr><td>Step 1</td><td>Cooperative groups
(of four students)</td><td colspan="2">1 2 3 4</td><td colspan="2">1 2 3 4</td></tr>
<tr><td>Step 2</td><td>Expert groups
(size equal to the number of groups)</td><td>1 1</td><td>2 2</td><td>3 3</td><td>4 4</td></tr>
<tr><td>Step 3</td><td>Cooperative groups
(of four students)</td><td colspan="2">1 2 3 4</td><td colspan="2">1 2 3 4</td></tr>
</table>

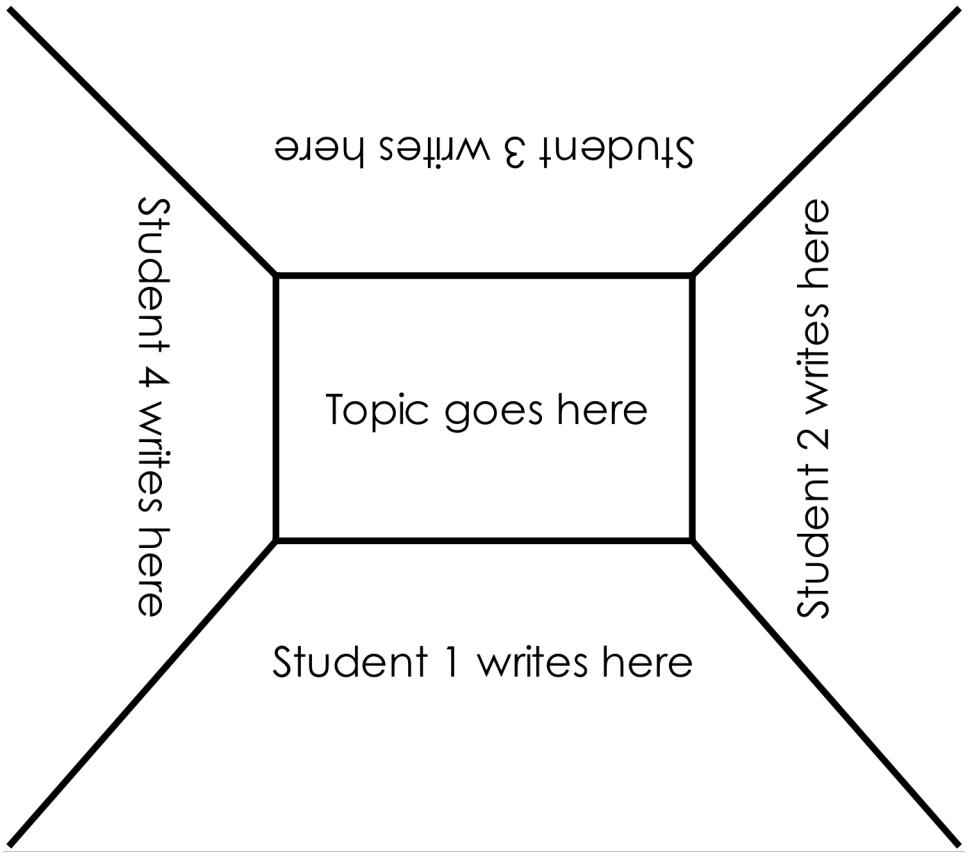
Appendix 9: Teacher resource sheet 1.3: Cooperative learning – Placemat

Cooperative learning frameworks create opportunities for groups of students to work together, generally for a single purpose.

istockphoto.com

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

The placemat strategy involves students working collaboratively to record prior knowledge about a common topic and brainstorm ideas. It also allows teachers to readily see the contribution of each student. The diagram below shows a typical placemat template.



STEM Consortium

Appendix 10: Teacher resource sheet 1.4: Cooperative learning – Think, Pair, Share

Cooperative learning frameworks create opportunities for groups of students to work together, generally to a single purpose.

istockphoto.com

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

In the 'think' stage, each student thinks silently about a question asked by the teacher.

In the 'pair' stage, students discuss their thoughts and answers to the question in pairs.

In the 'share' stage, the students share their answer, their partner's answer or what they decided together. This sharing may be with other pairs or with the whole class. It is important also to let students 'pass'. This is a key element of making the strategy safe for students.

Think-pair-share increases student participation and provides an environment for higher levels of thinking and questioning.

istockphoto.com

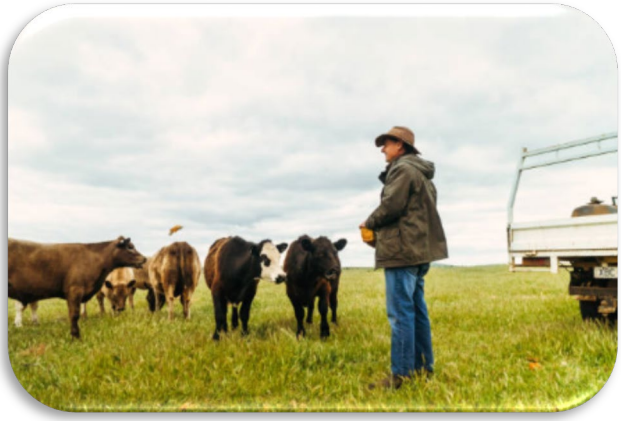
Appendix 11: Teacher resource sheet 1.5: Picture stimulus – Farms

gettyimages.com.au

gettyimages.com.au

pixabay.com

pixabay.com



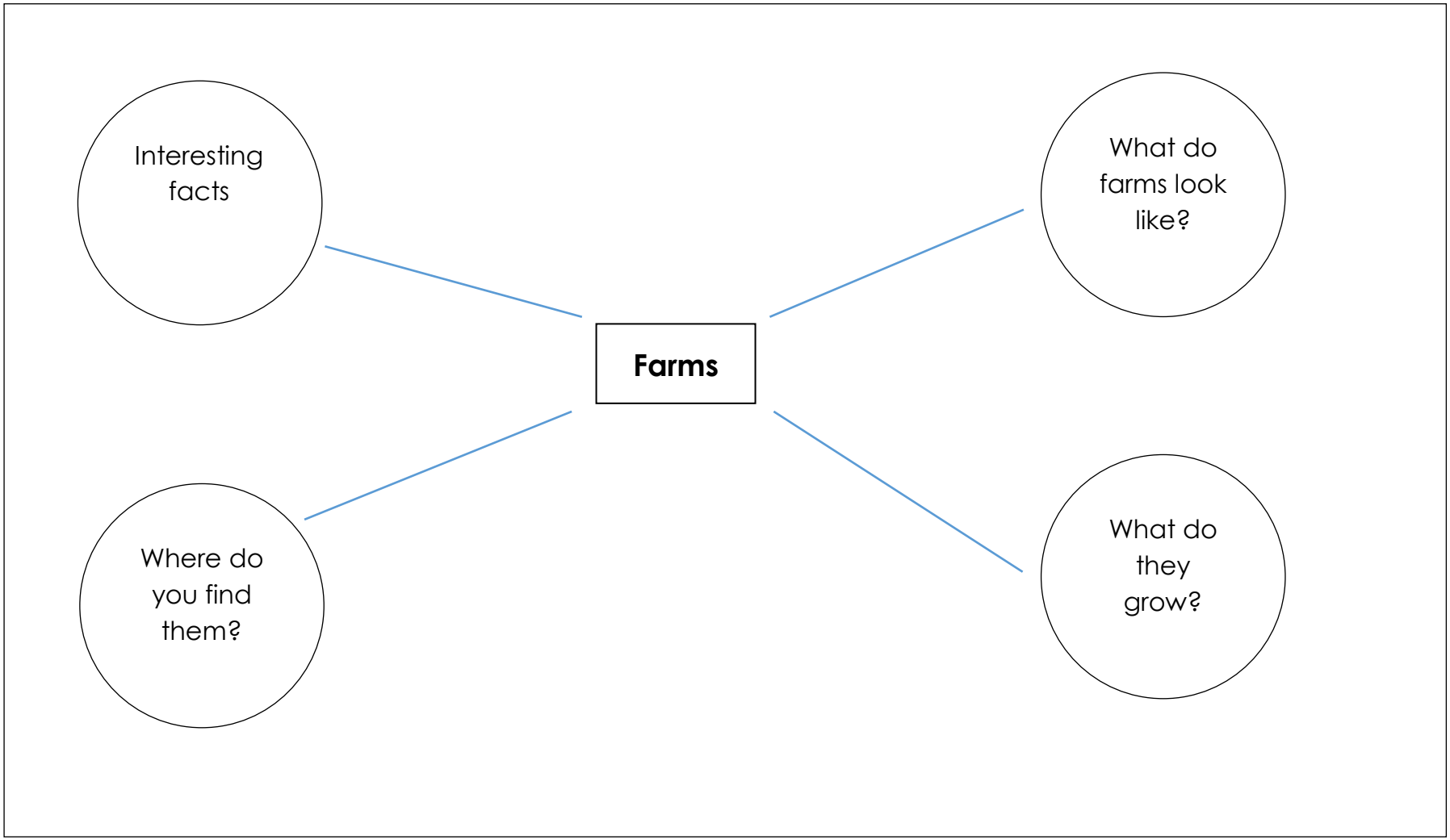
gettyimages.com.au

gettyimages.com.au

- Appendix 12: Student activity sheet 1.6: I see, I think, I wonder

What do you see when you look at these images?  *pixabay.com*
What are you thinking about as you look at these images?  *pixabay.com*
What are your wonderings (questions)?  *pixabay.com*

Appendix 13: Student activity sheet 1.7: Concept map



STEM Consortium

Appendix 14: Teacher resource sheet 1.8: Picture stimulus – Supermarket

pixabay.com

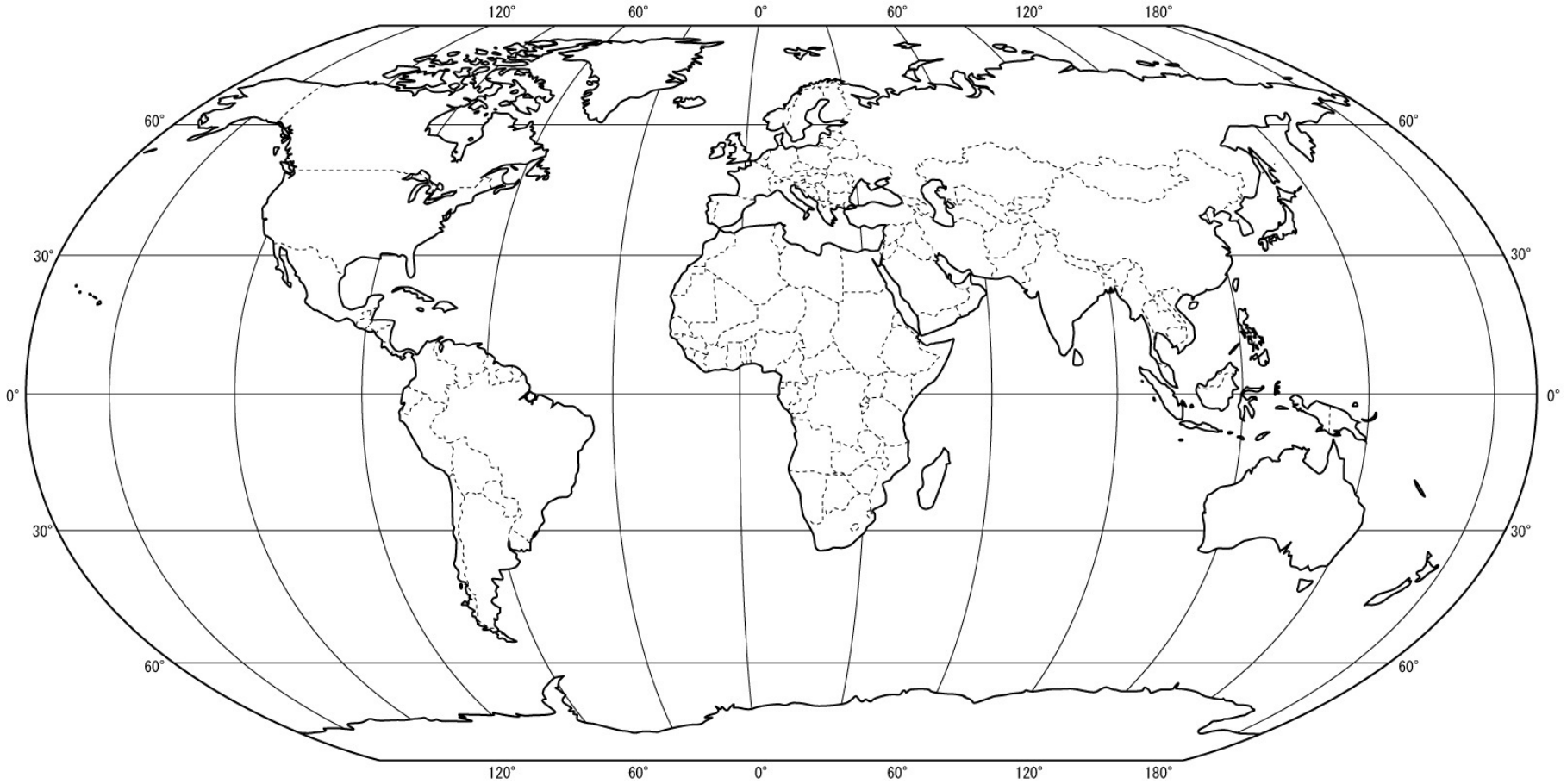
gettyimages.com.au

gettyimages.com.au

Appendix 15: Student activity sheet 1.9: What's in your lunchbox? – Collecting data

Name of product	Natural or manufactured	Crop or source
Apple	Natural	Tree
Multigrain bread	Manufactured	Wheat, barley, flax, millet, oats, yeast

Appendix 16: Student activity sheet 1.10: World map – Trade routes



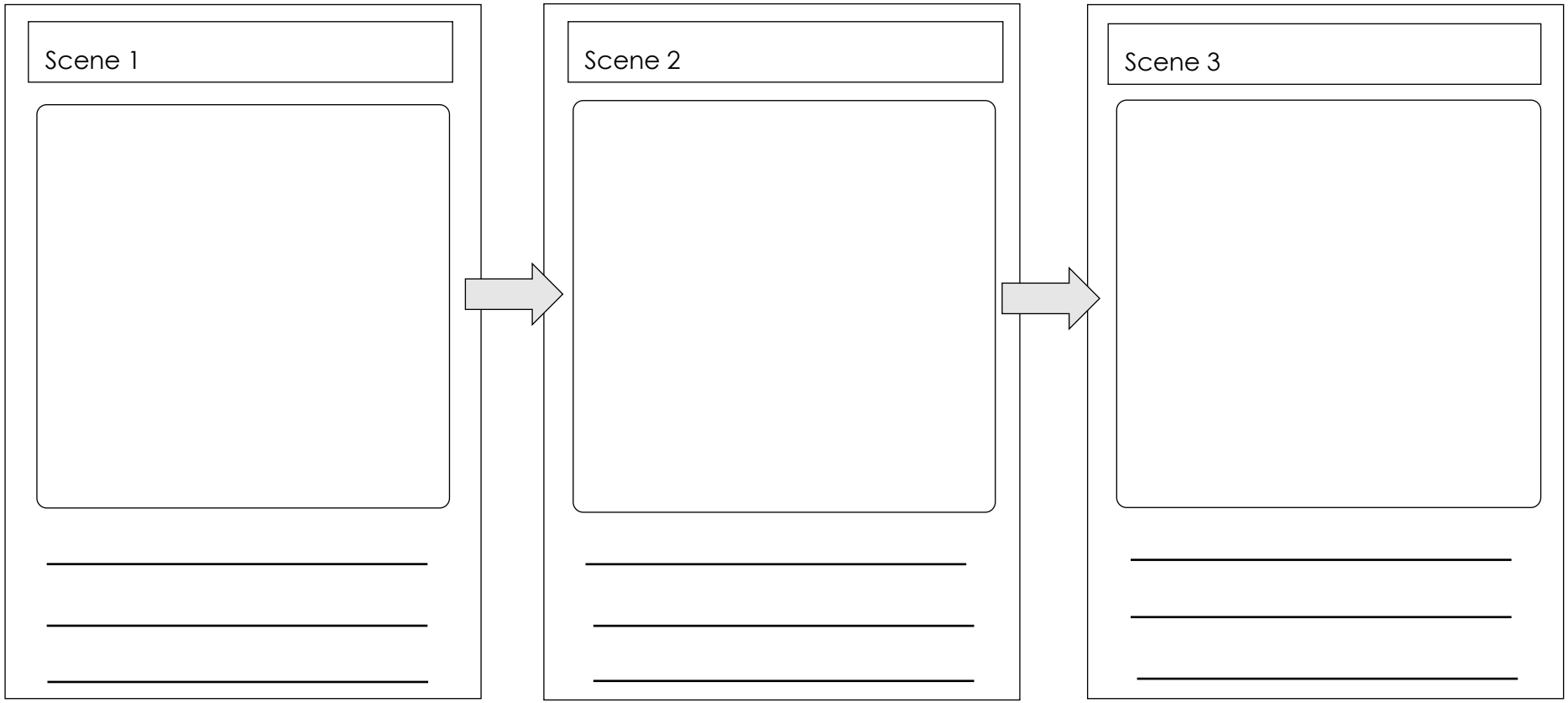
Source: Stones of Erasmus by *Greig Roselli* is licensed under a *Creative Commons Attribution-Noncommercial 3.0 United States License*.

Appendix 17: Student activity sheet 1.11: Population statistics

Global population statistics			
2009	6,847,214,549	2014	7,268,986,175
2010	6,930,656,699	2015	7,355,220,411
2011	7,012,843,635	2016	7,442,135,578
2012	7,097,400,665	2017	7,550,262,101
2013	7,182,860,114	2018	7,632,819,325

Source: The World Bank:
databank.worldbank.org/data/reports.aspx?source=2&series=SP.POP.TOTL&country=WLD#

Appendix 18: Student activity sheet 1.12: Community service announcement – Storyboarding



Appendix 19: Teacher resource sheet 1.13: Glossary

agriculture	The science, art or occupation concerned with cultivating land, growing crops and feeding, breeding, and raising livestock; farming.
animatronic	The technology connected with the use of electronics to animate puppets or other figures.
biological control	The control of pests by interference with their ecological status (eg by introducing a natural enemy or pathogen into the environment).
disease	A pathogenic agent in a host that has the potential to have a negative effect.
established pest	An established pest or disease has self-sustaining populations in Australia and is not considered eradicable. It may be distributed widely across Australia or in a particular region.
exotic pests	Exotic pests or diseases are not native to, or established in, Australia and may not have predators or be subject to other natural population control mechanisms.
export	To ship (commodities) to other countries or places for sale, exchange, etc.
food security	An economic and social condition of ready access by all members of a community to safe and nutritionally adequate food.
import	To bring in merchandise or commodities, from a foreign country for use, sale, processing, re-export or services.
nematode	Any unsegmented worm of the phylum *Nematoda*, having an elongated, cylindrical body; a roundworm.

pathogen	Any disease-producing agent, especially a virus, bacterium, or other microorganism.
pest	A pest is any animal, plant, invertebrate or pathogen with the potential to have a negative effect in a region.
quarantine	Strict isolation procedures imposed to prevent the spread of disease.
trade	The act or process of buying, selling or exchanging commodities, either wholesale or retail, within a country or between countries.
weed	A plant growing where it is not wanted, especially one that grows on cultivated ground to the exclusion or injury of the desired crop.

Appendix 20: Student activity sheet 2.1: Some pests found in Australia

agric.wa.gov.au

Red imported fire ant
Solenopsis invicta

agric.wa.gov.au

Green snail
Cantareus aperus

agric.wa.gov.au

Mediterranean fruit fly
Ceratitis capitata

agric.wa.gov.au

Tomato potato psylid
Bactericera cockerelli

agric.wa.gov.au

Australian plague locust
Chortoicetes terminifera

barmac.com.au

Banana weevil borer
Cosmopolites sordidus

Appendix 21: Student activity sheet 2.2: What is a pest?

What is a pest?

A pest is:

Factors that make an organism a pest:

Factor 1	Factor 2
Factor 3	Factor 4

Impact:

Environment	Economy	Fauna and flora

Examples of pests:

Vertebrates	Invertebrates	Nematodes	Pathogens	Weeds

Appendix 22: Student activity sheet 2.3: Biosecurity booklet

Contents

Quarantine

Prevention

Biological Control

Eradication

Chemical Control

Eradication

Biosecurity in Australia

pixabay.com

Contacts

Reporting

Pest and Disease Information Service

08 9368 3080

My Pest Guide

Monitoring

Eradication

Physical Control

Eradication

Appendix 23: Student activity sheet 2.4: Fact sheet poster

Pest busters: Fact Sheet

Pests & Biosecurity

Where is the pest found?

Scientific name:

What does it look like?

s-media-cache-ak0.pinimg.com

Problems	Signs of infestation	Physical signs of pest presence

How do they spread?	Biosecurity measures

Appendix 24: Teacher resource sheet 2.5: Sample Pest buster poster

Pest busters

Australian Plague Locust

Chotoicetes terminifera

agric.wa.gov.au

Features and adaptions

- Small in appearance compared to grasshoppers
- Large dark spot on the tips of the hind wings and red shanks on the hind leg
- 25 mm – 42 mm long
- Mature within two weeks of becoming adult
- Lay on average 40 eggs
- Able to migrate long distances.

Impact

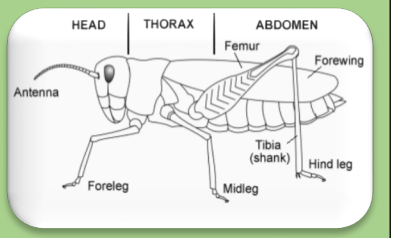
Swarms can cause severe damage to grain crops. Adult locusts can cause significant damage to the heads of wheat crops by chewing the awns and the bracts surrounding the developing grain. Swarms of locusts have been known to cause up to 10% loss of crop.

Signs of infestation

Form bands that may extend kilometres and are often visible from the air.

gettyimages.com.au

gettyimages.com.au



agriculture.gov.au

Biosecurity: Control measures

Chemical
Spraying of insecticides on egg beds and bands

Biological
Naturally occurring soil fungus, Metarhizum.

Monitoring
Aerial monitoring of crops and early reporting.

agriculture.gov.au

Appendix 25: Teacher resource sheet 3.1: Design brief

Animatronic design brief
Design an interactive animatroic that will teach people about pests and the importance of biosecurity in Australia.

Your animatronic	
	Completed
Information	
Information about pests	
Information about biosecurity	
Design	
Represent Western Australian pest	
Use household materials	
Integrates technology/robotics	
Be programmable – use of code	
User experience	
Be interactive – use of sensors	
Be animated – use of servos	

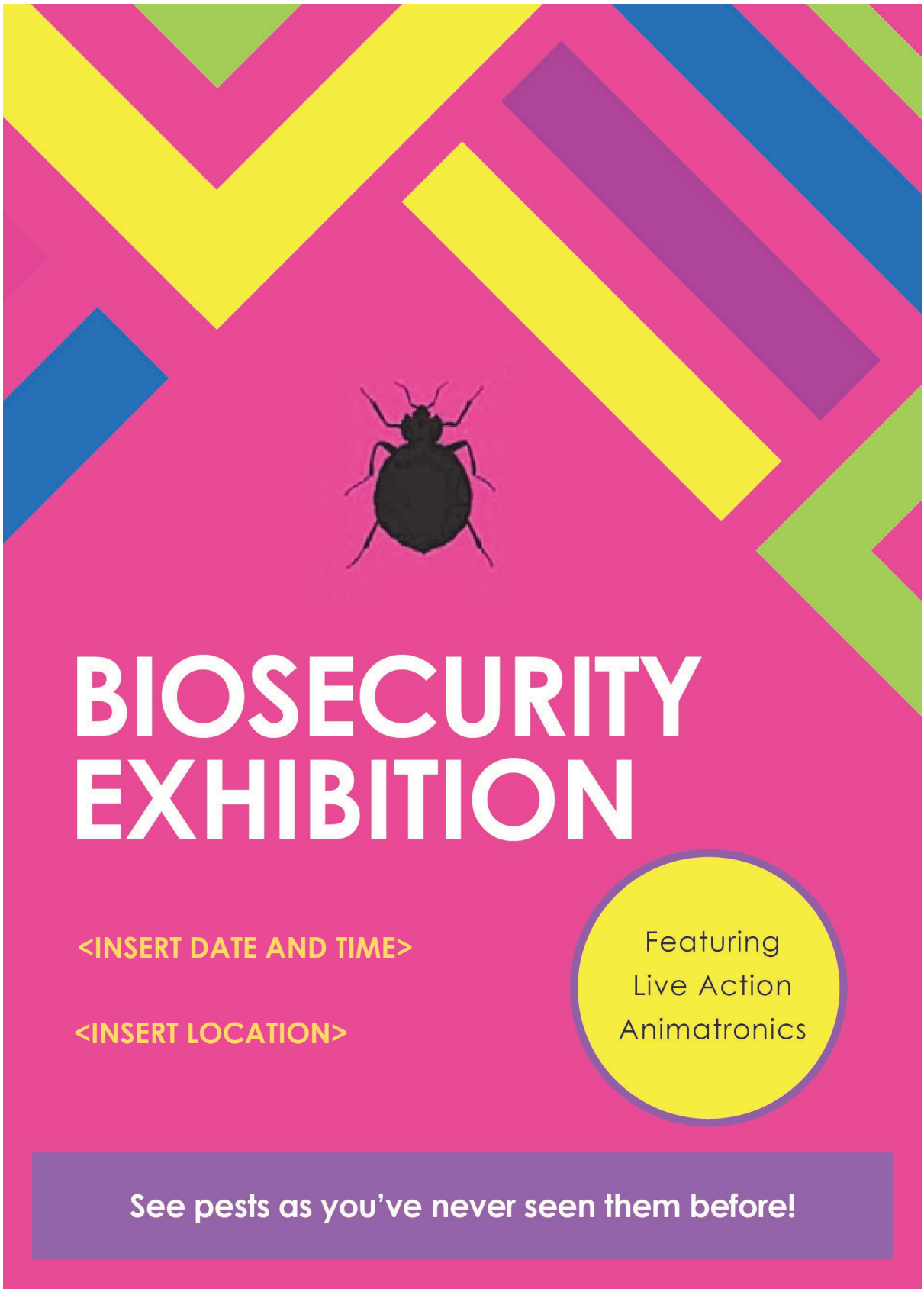
Appendix 26: Student activity sheet 3.2: Action plan

<table>
<tr><th colspan="2">Design brief</th></tr>
<tr><td colspan="2"></td></tr>
<tr><th>Team members</th><td rowspan="4">Blueprint (annotated diagram)</td></tr>
<tr><td></td></tr>
<tr><th>Materials</th></tr>
<tr><td></td></tr>
</table>

Appendix 27: Student activity sheet 3.3: Prototype troubleshooting

Problem	Reason for the problem	Possible changes to your design to solve the problem

Appendix 28: Teacher resource sheet 4.1: Sample flyer



STEM Consortium

Appendix 29: Teacher resource sheet 4.2: Incoming visitor card

Incoming visitor card. Biosecurity Exhibition

PLEASE ☒ AND ANSWER EVERY QUESTION - IF UNSURE, YES ☒

Are you bringing into the exhibition

- Goods that may be prohibited or subject to restrictions? Yes ☐ No ☐
- Meat, poultry, fish, seafood, eggs, dairy, fruit, vegetables? Yes ☐ No ☐
- Grains, seeds, bulbs, straw, nuts, plants, parts of plants, traditional medicines or herbs, wooden articles? Yes ☐ No ☐
- Animals, parts of animals, animal products including equipment, pet food, eggs, biological, specimens, birds, fish, insects, shells, bee products? Yes ☐ No ☐
- Soil, items with soil attached or used in freshwater areas? Yes ☐ No ☐
- Have you been in contact with farms, farm animals, wilderness areas or freshwater streams or lakes etc in the past 30 days? Yes ☐ No ☐

Declaration *The information I have given is true, correct and complete.*

Incoming visitor card. Biosecurity Exhibition

PLEASE ☒ AND ANSWER EVERY QUESTION - IF UNSURE, YES ☒

Are you bringing into the exhibition

- Goods that may be prohibited or subject to restrictions? Yes ☐ No ☐
- Meat, poultry, fish, seafood, eggs, dairy, fruit, vegetables? Yes ☐ No ☐
- Grains, seeds, bulbs, straw, nuts, plants, parts of plants, traditional medicines or herbs, wooden articles? Yes ☐ No ☐
- Animals, parts of animals, animal products including equipment, pet food, eggs, biological, specimens, birds, fish, insects, shells, bee products? Yes ☐ No ☐
- Soil, items with soil attached or used in freshwater areas? Yes ☐ No ☐
- Have you been in contact with farms, farm animals, wilderness areas or freshwater streams or lakes etc in the past 30 days? Yes ☐ No ☐

Declaration *The information I have given is true, correct and complete.*

Appendix 30: Teacher resource sheet 4.3: Question prompts

Questions for the exhibitors

- What is the pest?
- Is it a native or introduced species?
- Why is it biosecurity risk?
- What biosecurity measures are in place to minimise the spread of this pest?
- What can I do?

Questions for the exhibitors

- What is the pest?
- Is it a native or introduced species?
- Why is it biosecurity risk?
- What biosecurity measures are in place to minimise the spread of this pest?
- What can I do?

Appendix 31: Teacher resource sheet 4.4: Peer and visitor feedback

Please provide us with some feedback about our Biosecurity Exhibition.

Did you have fun? What did you learn? What will you do with this new information?

Appendix 32: Student activity sheet 4.5: Self-evaluation

Animatronic reflection

Photograph or drawing

What did you make?	How did you feel about your robot?
 pixabay.com	 pixabay.com
What did you like about your robot?	**What could you have done better?**
 pixabay.com	 pixabay.com

What would you do differently?
 pixabay.com

Notes

Notes