



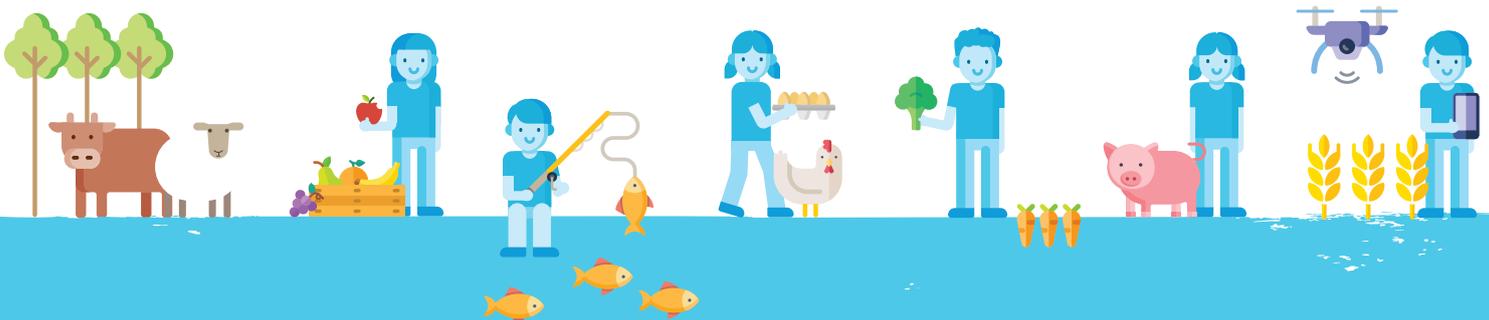
Sustainable Solutions on Farms

Level: 5/6

Lesson One: Biodiversity, Adaptations and Solutions to Support Sustainability

Time: Approx. 120 mins

Key Vocabulary: Biodiversity, sustainability, resources, food, fibre, salinity, germination, living, non-living, adaptations, behavioural, structural, physiological.



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➤ Lesson Overview:

Students will have the opportunity to engage in learning about biodiversity and the importance of protecting it in ecosystems. Throughout this lesson, students will identify concerns in agriculture and suggest ways to control them. They will participate as a team to perform a first-hand investigation into the independence of living and non-living components of an environment.

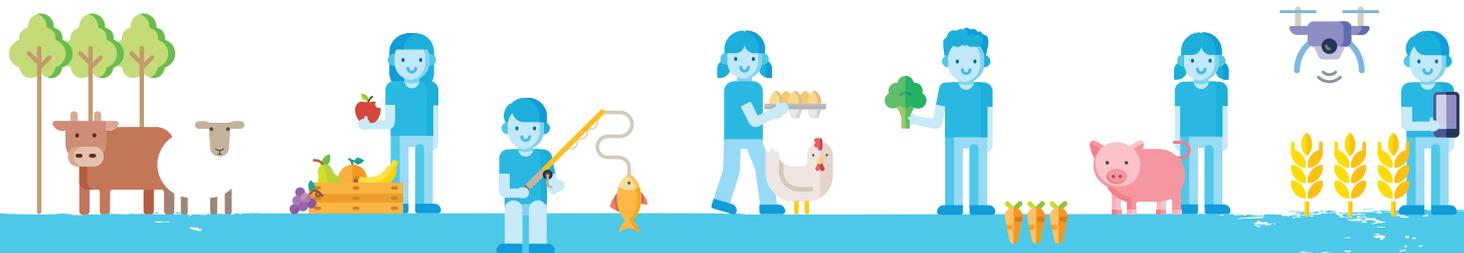
Students will learn about adaptations in living organisms and how they interact with the environment. Finally, students will be provided with a problem-solving task and use elements of 'Design Thinking' to create a prototype of a fantasy farm animal or plant that is super adapted to provide food or fibre in an economically, socially and environmentally sustainable way.

➤ Students Will Learn To:

- Identify the terms 'sustainability' and 'biodiversity' and understand how they relate to resource use and food and fibre production.
- Identify how salinity (physical environment) can impact the germination of mung bean seeds (living environment) and how this relates to food and fibre production.
- Observe connections in farming ecosystems.
- Understand areas of concern in farming ecosystems.
- Observe adaptations in organisms and understand how these are related to the environment and affect an organism's survival.
- Solve problems with creative solutions.

➤ Victorian Curriculum Outcomes:

VCSSU073, VCSSU074, VCSSU075, VCSIS082, VCSIS084, VCSIS088, VCDSTC035, VCELY366, VCDSCD039



Learning Tasks

INTRODUCTION

What is Biodiversity (5 mins)

Students will watch a short video on biodiversity to initiate a conversation about biodiversity and why it is important to all ecosystems.



SOURCE: What is Biodiversity, WWF International (3.05)

URL: <https://youtu.be/US58f-Sw00k>



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ACTIVITY ONE

Modelling Biodiversity and Sustainability

(10 mins)

The teacher will develop their students understanding of biodiversity within agricultural environments and how this relates to their world.

- a) The teacher will gather and present to the class a large clear container filled with various items. Items should be representations of biodiversity in the environment and relate to world examples and agricultural ecosystems. Suggestions include paper, rocks, model farm animals, native animals, exotic animals, flowers, wrapped food, toys and water bottles.
- b) The teacher will quickly remove all items from the container, sharing them out to students. When all items have been given out, the teacher states to the students that “everything is now gone from the container”. Some students should have missed out and not received anything.
- c) The teacher will discuss with their students that this container represents a model of the Earth. The container was filled with the things we need, use and enjoy, like the images displayed in the video link. These are the resources in our ecosystem. The teacher will explore the following questions with their students:
 - If everything is taken out of the ecosystem what happens?
 - What does this mean to us?
 - Why are all the things in the bowl needed?
 - How can people prevent this from happening?
 - How could a farmer prevent this from happening within their farm ecosystem?
- d) Students should be encouraged to contribute and share their ideas. Ideas may include:
 - taking only what is needed, making sure some resources are put back into the container, thinking of an alternative product to use than the original, giving resources time to regenerate if they can.

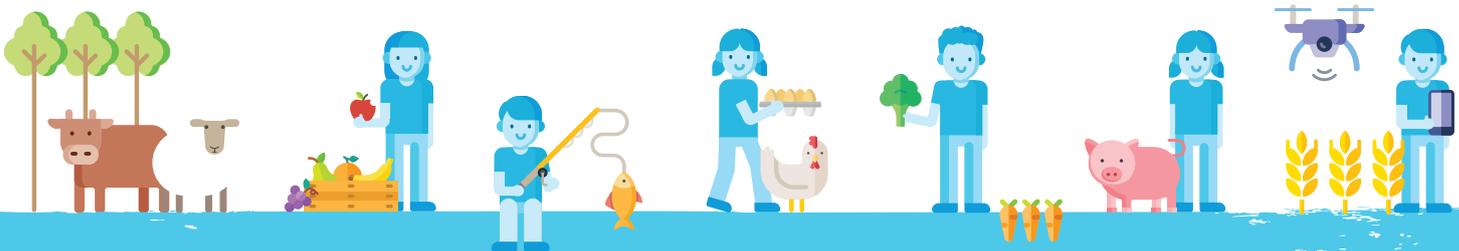
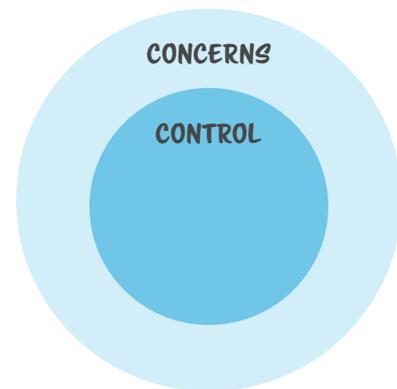


ACTIVITY TWO

Circle of Concern in Agricultural Ecosystems (15 mins)

A circle of concern will be used to highlight what students already know about issues in agriculture. Students will be given the opportunity to identify that for all problems that are faced, solutions can be investigated.

- The teacher will lead a whole class discussion about what students already know to be issues or problems that farmers and agricultural ecosystems in Australia face. The teacher will draw a large circle on the board (or on large butchers' paper) and a medium circle within the first circle, labelled as shown below. The teacher will write "Loss of biodiversity" as an issue/concern in the outer circle to model the task.
- In groups, students will record (on the large 'circle of concern') their own ideas about issues and problems that they are aware of in the outer circle. Answers may include: overuse of resources; cutting down trees; pests and diseases; bushfires; pollution; using too much water; droughts, etc. A [Salinity, stimulus \(2.1\)](#) can be provided to assist groups during this activity.
- After five minutes the teacher will stop groups and read/discuss some of the issues that students have recorded in the 'circle of concern'.
- The teacher will then ask students:
 - What are some of the ways that they (the students) or other people have control over/can fix the problems in the circle of concern?
- The teacher will write "growing a variety of species of plants and animals" as a means of addressing the first issue of loss of biodiversity within the inner circle labelled "control".
- Students will be given an additional five minutes to record their ideas within the inner circle. Responses may include: planting more trees; not using as many resources; not wasting food; not using chemicals; eating less meat.
- After five minutes the teacher will again read some of the responses students have collated.

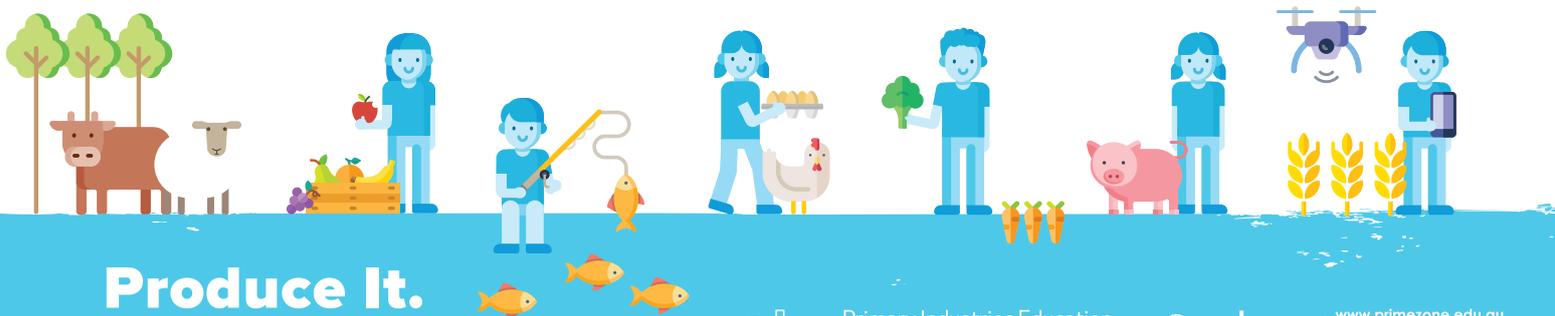


ACTIVITY THREE

Salinity Demonstration (5 mins)

Students will gain an understanding of how salinity occurs and how this physical factor impacts the living environment.

- a) The teacher will highlight the concern of salinity in farming environments and discuss with students the effect of soil salinity by referring to this [Salinity, stimulus \(2.1\)](#) picture.
- b) To understand how salinity occurs in a soil profile, the teacher can model the profile in the following way:
 - Use two jars and pour a layer of layer of salt into each. Cover the salt with small rocks or pebbles, then a layer of soil above the pebbles. Finally, in one jar add a layer of grass or similar ground cover but in the second jar omit this final step.
- c) The teacher can explain and demonstrate with Jar One (with plant material) that as water is slowly poured (to simulate rain) the plant roots absorb most of the water and would use this before it reaches the lower layers of the soil profile. This is what should occur in ecosystems where trees and grasses are maintained in the environment.
- d) The teacher can then explain that in Jar Two (no ground cover) this represents instances when the land was cleared of trees. When water is poured into this jar (to represent rain) the water reaches the layers below more quickly and in greater amounts. This will dissolve the salt, eventually causing the salts to rise with the water, reaching the root zone and killing the plants.



ACTIVITY FOUR

The Effect of Salinity on the Germination of Mung Bean Seeds (30 mins)

In this activity, students have the opportunity to observe the effects of salinity on seed germination by participating in a hands-on experiment. This investigation explores the interdependence of the living and non-living environment.

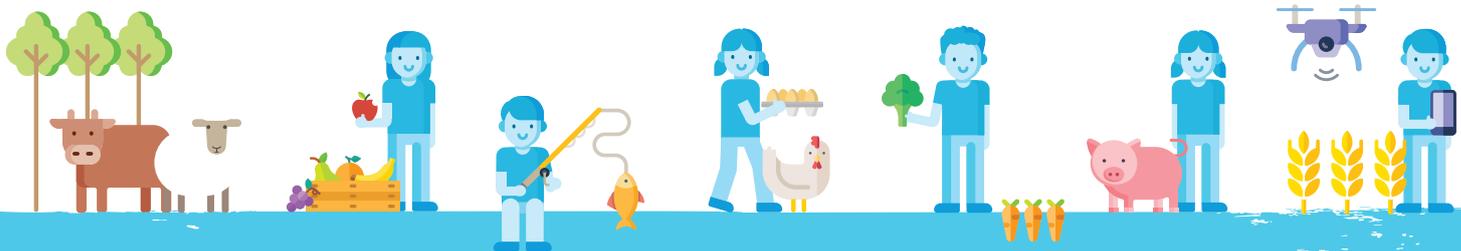
Depending on the time available, the teacher can set up most of the practical work very quickly prior to the students engaging with the activity, or alternatively, students can set up the experiment with the teacher. (An appendix has been included for instructions on measuring solutions if needed).

- a) The teacher will introduce the concept that some soils have the presence of high amounts of salt, and this impacts our biodiversity, sustainability and agricultural production.
- b) Students will be allocated into groups at desks/benches. Refer to the table below for materials that should be available to students in order to complete this activity. Groups can refer to their [Things To Do checklist \(4.1\)](#) if they are unsure of the steps to follow.

Group Name	Materials for Individuals	Materials for Group
Distilled water or tap water	<ul style="list-style-type: none"> • 1 x Student Salinity, worksheet (4.2) • 1 petri dish • Cotton wool balls (amount will depend on dish size) • 10 seeds 	<ul style="list-style-type: none"> • 2 x 500ml spray bottle of distilled water or tap water • 1 x Student Salinity, worksheet (4.2)
4% salt solution	<ul style="list-style-type: none"> • 1 x Student Salinity, worksheet (4.2) • 1 petri dish • Cotton wool balls per student (amount will depend on dish size) • 10 seeds 	<ul style="list-style-type: none"> • Approx. 2 x 500ml spray bottle of 4% salt solution • 1 x Student Salinity, worksheet (4.2)

**Seed and cotton wool number will vary depending on dish size used.*

**If petri dishes are unavailable, plastic plates, cups, ziplock bags, etc. can be used as an alternative.*



- c) Students will cover the bottom of their dish with cotton wool. Spread the cotton wool into shape so there are no spaces visible on the bottom of the dish.
- d) Students will arrange their Mung Bean (or other suitable) seeds evenly over the cotton wool. Each student should use the same number of seeds in their container.
- e) On a suitable surface (outside, school desk that can be wiped, plastic sheet protector, etc.) students will spray their seeds and cotton wool until it is damp/wet, but no water is pooling in the bottom of the dish (approximately ten to twenty sprays).
- f) When all students at the desk have completed this with their allocated solution, label the dishes, group them and store them in an appropriate area of the classroom where they can be observed for one to two weeks for germination. Signs should be displayed near the experiment to remind the class to water their seeds, ensuring they remain damp.
- g) After students have packed up the activity, they should use a pencil and ruler to copy the scientific diagram of their experimental set-up onto their [Student Salinity worksheet \(4.2\)](#).
- h) Dishes will need to be sprayed approximately once or twice a day to keep the cotton wool very moist. Each dish in the class should receive the same number of sprays per day from the relevant solution.
- i) Students will observe germination during this time and at the conclusion of the allocated time (one to two weeks), the class can calculate the total number of seeds that germinated for each solution and compare the results. [Class Recording worksheet \(4.3\)](#) for the whole class observation have been supplied.

Students should observe over the period of time that the seeds receiving distilled/tap water should germinate and those that are being sprayed with 4% salt solution should have little-to-no germination. This shows a relationship of how the physical conditions in the environment affect living things.

It can also be highlighted that if all our soils are saline, farmers won't be able to grow the plants we need for food and fibre, and that scientists are trying to breed plants that are salt tolerant and can grow in soils that are already saline.

ACTIVITY AT A GLANCE:

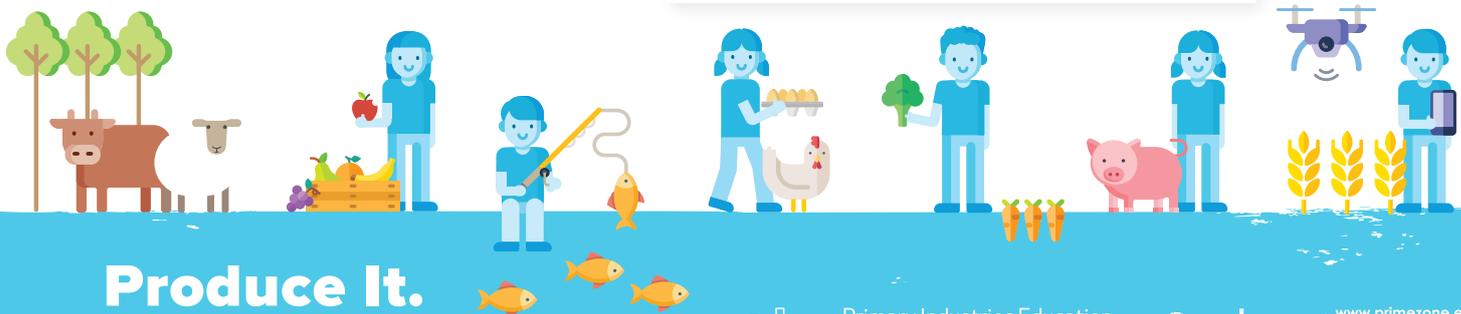
The Effect of Salt on the Germination of Seeds

THE SOLUTION THAT OUR GROUP IS USING IS: _____

0% SALT	0% SALT	4% SALT	4% SALT
Solution (How much salt?)	Number of seeds that germinated in your dish?	Observations (What did the seeds look like at the end?)	
0% salt			
4% salt			

Conclusion: If salt is present in the water, the amount of seeds that germinated _____

Draw a picture of your dish with the cotton wool and seeds in the space below. Label the important parts of the diagram.



ACTIVITY FIVE

Designing a Super Farm Organism to Fix a Wicked Problem/Concern (10 mins)

Students will associate problems with solutions and design a prototype to address issues facing food and fibre production.

- The teacher will introduce how farmers and scientists are seeking ways to improve features in their food and fibre production. Some features that they are trying to improve are introducing plants and animals that are suited to the problems that may have been mentioned in the Circle of Concern (Activity Two), e.g., salt tolerant and drought tolerant plants. Some improvements aim to make the food and fibre more desirable for consumers, for example, seedless watermelons, sheep with less wrinkles, more milk production in a day or Mung Beans that can be used in place of eggs for allergy / nutritional / ethical reasons.
- The teacher will show the following multimedia stimulus (source can be accessed in the Resource Book of Ideas: ‘Food Different by Design, Australian Science Teachers Association’) demonstrating how mung beans are being used as an alternative to egg products. This source highlights how the food and fibre industry is researching solutions and creative ways to use products.

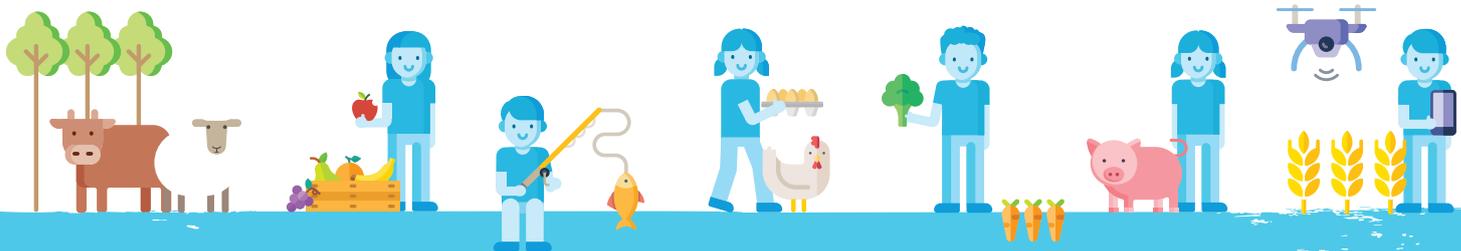
 **SOURCE:** Ten Steps, Mung Beans into Eggs, More from JUST Egg (2.17)
<https://vimeo.com/322941061>



FOOD DIFFERENT by design
Case study

Turning mung beans into eggs

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



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- c) The teacher will introduce a class challenge and pose the following project to students. The [Can You Help?, worksheet \(5.1\)](#) should be handed to students as the challenge is set.

Class challenge details:

- Yan Yan Gurt West farm is in need of a new product that supports sustainability in Victoria. The product/organism can be mythical and as imaginative as students like; it does not have to be real.
 - Students need to design a living organism that can produce food and/or fibre and is profitable (economic sustainability).
 - The living organism needs to satisfy social sustainability by supplying a type of food and/or fibre that is important to people.
 - The organism needs to be super adapted and must not harm the environment, instead it must enhance or improve the environment in some way as it is being produced/grown on the farm (environmental sustainability).
 - Students will need to consider what adaptations the animal/plant will have (structural, behavioural, physiological), as well as what it looks like, sounds like, how it interacts with other organisms in the environment, etc.
- Before students begin generating ideas and designing their prototypes, the teacher will need to ensure that students have an understanding of how adaptations and the environment are related/connected.



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ACTIVITY SIX

Defining Adaptations (15 mins)

Students will briefly observe adaptations in animals and plants and determine why adaptations are important in living things. This information will assist students with their animal/plant prototypes (Activity Seven).

- The teacher will define an adaptation as “a characteristic of an organism, that helps it to be successfully suited to the places where it lives”. They will explain that some adaptations are behavioural (something an organism does to survive, e.g. penguins huddling in winter to conserve energy and stay warm), structural (a physical feature the organism has that helps it survive e.g. a giraffe’s long neck to reach food source) and others are physiological (a response occurring in the organism’s cells that helps it to survive e.g. sweating to keep cool).
- The teacher will provide the [Different Adaptations, worksheet \(6.1\)](#) to observe the above examples. Students will record one structural, behavioural and physiological adaptation of a merino sheep, as provided by the teacher.
 - Structural: fine, strong wool (makes the sheep suitable for arid climates)
 - Behavioural: Bunching/flocking together (to protect themselves when they feel threatened).
 - Physiological: Concentrated urine (to conserve water)
- The teacher will select two toy animals/or pictures (one adapted to a warm environment and the other to a cold environment) e.g. a reptile and a penguin, and hold them in their hands so students can observe them. The teacher will propose the following scenario:
 - We have all just been transported to Antarctica. Discuss if these animals will survive and why or why not.
 - If the animals will not survive, explain how the species would need to adapt/change to survive – what features would need to change?
- The teacher will link the above scenario to the idea that “adaptations are linked to environmental conditions”. This should be further extended to provide an understanding that environmental conditions can affect the growth and survival of living organisms.



- e) The teacher will hand out the [Adaptations, stimulus \(6.2\)](#) material to students to highlight adaptations of different organisms and encourage them to generate ideas for their challenge. Additionally, students can observe a resource table and view stimulus materials from various industries such as: Meat and Livestock Australia; Cotton Australia; Dairy Australia; ForestLearning; Vegepod; and Woolmark, to allow students to visualise agricultural fibres and products and gain ideas for an organism they could create.

➤ **EXAMPLES OF RESOURCE SAMPLES:**

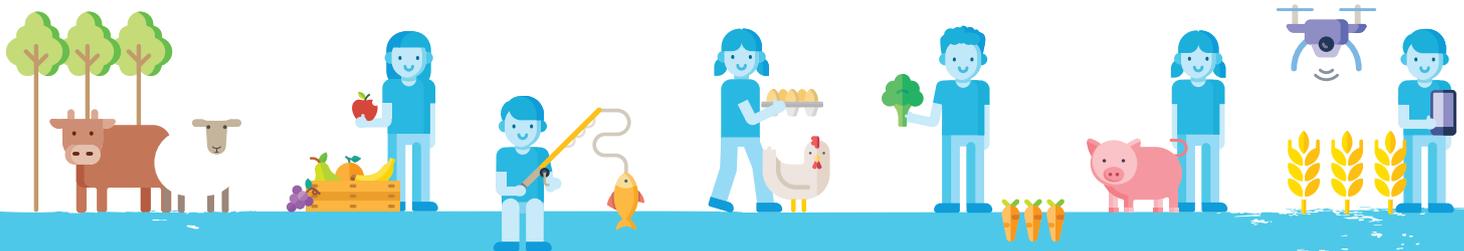


i **FOR INFORMATION:** regarding ordering stimulus materials contact:

Victorian Education Officer: Allison Arnott

Email: Allison.arnott@piefa.edu.au

Mobile: 0483 869 592



ACTIVITY SEVEN

Ideate and Make a Prototype of a Super Farm Organism (30 mins)

Students will use their problem solving and design skills to create a prototype of a sustainable organism that addresses a number of criteria.

- The teacher will provide students with the [Create a Super Organism, worksheet \(7.1\)](#) for their imaginary farm organism and remind them of the components of the challenge.
- Students will be given twenty-minutes to design and create their organism for display and presentation.
- Teachers can allow students to work individually or in groups to create their organism and provide them with a range of craft and natural materials (e.g. sticks, leaves, feathers, paper, cardboard, seeds, ribbons, playdough, Lego, etc.) in order to build a prototype for display.
- The teacher will roam during the activity and remind students to incorporate adaptations and ideas of independence and sustainability into their designs.
- After the allocated time, students will present their super farm organisms, detailing the features and adaptations they have included.

▶ ACTIVITY AT A GLANCE:



DESIGN A SUPER FARM ORGANISM

TASK. Imagine you are a farmer/scientist and you need to create a NEW *super/fantasy farm organism* that will provide the most amazing food and/or fibre to people. Design an organism that has adaptations to make it suitable for a particular environment and is so sustainable that it IMPROVES the environment as you produce it.

What is your organisms name? _____

Draw a picture of your organism and label it's important features.

What food or fibre does your organisms produce? _____

How does your new organism improve the environment? _____



Appendix

Effect of Salinity on the Germination of Seeds

Calculations for Measuring Salt Solution

- With a set of scales, the teacher will weigh the correct amount of salt and place it into the labelled spray bottles using a funnel.

To create a 4% Solution: 4 grams of salt would be needed in 100mls of water, therefore, to create a 4% solution in 500mls of water, five times this amount of salt is needed. $4 \text{ grams} \times 5 = 20 \text{ grams}$ of salt will need to be weighed and mixed with 500mls of water. Pour the salt into the bottle using the funnel, mix with water until dissolved.

Summary of Solutions

Solution	Amount of Salt (grams)	Amount Water to Add (mls)
Distilled water or tap water	0	500
4% salt solution	20	500

Australiancurriculum.edu.au. 2021. Sustainability. [online] Available at: <<https://www.australiancurriculum.edu.au/f-10-curriculum/cross-curriculum-priorities/sustainability/>> [Accessed 4 March 2021].

