Hermitage Research Facility
Schools Plant Science Competition

2023 ‘The Buzz About Bees’

Guidelines

Opens 23 January 2023
Closes 23 June 2023
Awards Day 15 August 2023

Queensland Government

Gold sponsors

Queensland Government

PEST INVADERS! bioQuest QuestaGame

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Selected Seeds

Queensland University of Technology

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Contents

About the competition

The Queensland Government, Department of Agriculture and Fisheries (DAF), Hermitage Research Facility (HRF) Schools Plant Science Competition (SPSC) began in 1997 to help celebrate 100 years of agricultural research at the Hermitage Research Facility. It offers engaging ways for students to gain understanding and skills in key areas identified within the Australian science curriculum.

Our aim is to stimulate an interest in science and agriculture in young people and to promote science and agriculture as a rewarding and exciting career choice. Encouraging the next generation of people who will be involved in agricultural/science careers is crucial to how we will face the future and is a key purpose of the competition.

In 2023 we're putting the microscope on bees to help students realise the impact of the recent Varroa Mite outbreak in NSW on the apiary industry and to discover the crucial role bees play in the viability of agricultural and horticultural industries and in supporting our very survival on this planet! Did you know, the Hermitage Research Facility is also the hub for all Queensland beekeeper registrations!

Who can enter?

The annual DAF Hermitage Research Facility Schools Plant Science Competition is open to all primary and secondary students, from years prep to 12, Australia wide.

Materials required

We provide the required resources to schools (via email) upon registration. Unless otherwise noted, you will need to purchase and/or supply the materials required for experiments/activities.

Entry format

You may submit your project entry in any format, ideally applying 'scientific report writing' style where possible. Acceptable entries, in hard copy or electronic format, include:

- **Scientific report** (handwritten or word processed, compatible with Windows operating systems, e.g., Word, PPT, Publisher, PDF)
- **Scientific or informative poster** (handmade on cardboard sheets (ideal for younger students), or word processed, compatible with Windows operating systems, e.g., Word, PPT, Publisher, PDF)
- **Hard copy display folders, exercise books, scrapbooks, etc** (ideal for your science journal)
- **Virtual format** (e.g., online learning platforms/classrooms – please ensure appropriate logins/passwords are provided to the competition coordinator so judges can access your work)
- **Videos/podcasts/songs/plays** (please ensure audio/visual quality is loud and clear)
- **Any combination of the above**

Contact information

Please contact Kerrie Rubie, Competition Coordinator, for any further information:

www.daf.qld.gov.au/hermitage-competition
Hermitage Schools Plant Science Competition
kerrie.rubie@daf.qld.gov.au
07 4542 6700

Entry classifications

PLANT SCIENCE PROJECT AWARDS	
Classification	**Description**
Whole class	• All students within the class contribute towards the experiment/activity tasks and one entry is submitted on behalf of the whole class. • The entry may contain a compilation of each student's work. • A score is allocated for the entry and students are eligible for overall 1st, 2nd & 3rd class awards. Individual awards generally do not apply to this category.
Small team(s)	• Students work on the experiments/activities in small teams and one (1) or more entries are submitted per team or class. • Each entry may contain a compilation of each team member's work. • Each team entry will be allocated a score and teams are eligible for individual awards. If multiple small team entries are submitted by a class, an average overall "class" score will also be provided and students (collectively) will be eligible for overall 1st, 2nd & 3rd class awards.
Individual(s)	• Students work on the experiments and activities alone, or as part of a class group/team, but they each write up and submit their own entry. • One (1) entry is submitted per student. • Each individual entry will be allocated a score and students are eligible for individual awards. If multiple individual entries are submitted by a class, an average overall "class" score will also be provided and all students (collectively) will be eligible for overall 1st, 2nd & 3rd class awards.
ART IN AGRICULTURE AWARDS	
Classification	**Description**
Individual(s)	• One artwork submitted per student (eligible for individual art awards). • If multiple individual artworks are submitted by a class, then the whole class will be considered for the overall most outstanding school art award.
Small team(s)	• One artwork submitted per small team (eligible for individual art awards). • If multiple team artworks are submitted by a class, then the whole class will be considered for the overall most outstanding school art award.
Whole class	• All students within the class contribute towards the project and one artwork is submitted on behalf of a whole class (eligible for the overall most outstanding school art award only, individual art awards do not apply).

Competition sections

The competition is made up of 3 different sections and you can choose to complete any one or more of the sections.

1

Plant Science Project Awards

A series of hands-on experiments and activities designed to increase students' knowledge, awareness and interest in a specific topic related to agriculture and science.

Select any topic you wish relating to bees and design your own experiments/activities (or follow our pre-designed example), keep a science journal and complete a scientific report, poster, video, podcast or any other creative entry explaining your findings and research, highlighting links to agricultural/horticultural industries, biosecurity, global food security and our daily lives.

and/or

2

Art in AgRiculTure Awards

An art project related to the Plant Science Project Awards topic, linking science with art in a fun, interesting and creative way to enhance learning of the given topic.

Bee creative and get buzzy making a bee themed artwork of any kind, any medium, 2D or 3D!

and/or

3

QuestaGame 'Pest Invaders' BioQuest

Play the world's first mobile game that takes you outdoors to discover, map and ultimately help protect life on our planet. Your sightings contribute to real research and conservation.

Embark on a fun, citizen science adventure that will open your eyes to our beautiful environment and the various organisms that invade our plants. Your mission is to capture (just with photos) as many bees, other pollinators and any introduced/invasive pest animals, weeds and diseases as possible. Life is full of hidden treasurers, but our native environment and agricultural industries are under threat from pests – now is your chance to save it!

Further information on each section is outlined later in this resource

Why study bees?

Honey bees play a vital role in the landscape. They are important for pollinating flowering plants, including agricultural and horticultural crops, trees, and the house garden. Pollination is important for the viability of many agricultural industries, market gardens, orchards, nut and seed production. In fact, pollination contributes an estimated $14.2 billion annually to the Australian economy. Honey bees also produce honey and honey production is estimated to be worth $439 million (in 2019) to the Australian agricultural and horticultural industries. *(Ref: Beekeeping | Department of Agriculture and Fisheries, Queensland (daf.qld.gov.au))*

Australian honey is produced by our hardworking beekeepers to the highest food production standards globally. Here in Australia, honey bees access more diversity in floral resources ideal for honey making than anywhere else in the world, which means Australian honey has the widest range of tastes and colours. By purchasing 100% Australian honey, you're supporting beekeepers who are at the heart of a healthy Australia.

The Australian agriculture industry aims to reach $100 billion of farm gate production by 2030, but without healthy, managed honey bees this target will be unable to be achieved.

One in three mouthfuls of food we eat relies on honey bees for pollination. Farmers work with beekeepers to ensure their horticulture and seed crops, such as almond, apple, avocado, blueberry, macadamia, pumpkin, and watermelon, are pollinated and can grow nutritious fruit, vegetables and nuts. Bees are also critical for the pollination of forage crops for stock feed. Without honey bees, high value crops and livestock would not be able to be produced. Bees help produce a diverse range of food. For example:

- 140 bees are needed to produce one kilogram of macadamias
- 69 bees help produce one kilogram of almonds
- 18 bees are required to pollinate one kilogram of avocados
- 5 bees help grow one kilogram of pumpkin
- 2 bees are needed for one kilogram of watermelon
- The average worker bee will only make around 1/10 of a teaspoon (0.8g) of honey in its lifetime
- It would take about 1,100 bees to make 1kg of honey, and they would have to visit 4 million flowers! *(Ref: https://honeycouncil.ca/industry-overview/bee-facts/)*

Bee related careers

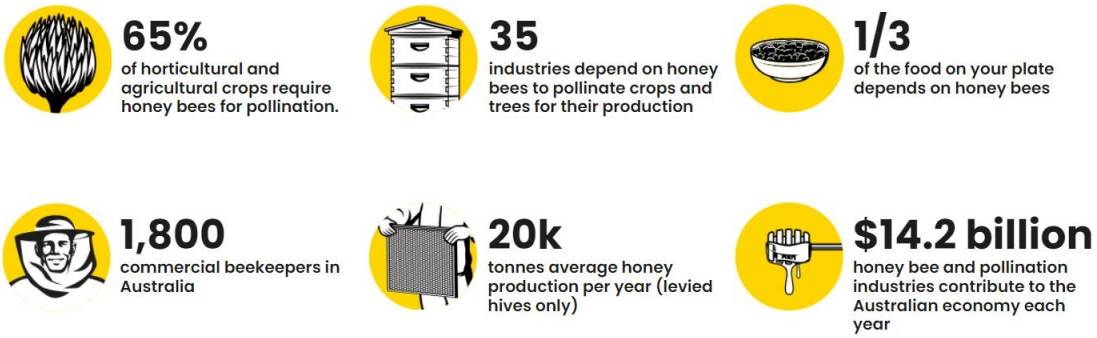
Beekeeper/Apiarist:
Pollination service provider
Honey producer
Biosecurity Officer/ Apiary Inspector:
Surveillance
Compliance
Education
Incident response

Through pollination services, honey bees are at the heart of a healthy Australia, however the industry faces significant challenges, which must be overcome if the industry is to grow its prosperity and resilience, protect the health of the species, and ensure the ongoing production of nutritious foods to nourish communities across the country.

To keep our bees healthy and safe from pests and diseases, DAF contributes to the National Bee Biosecurity Program. This program aims to educate beekeepers on the importance of keeping bees healthy and provides education and awareness on how to identify and manage pests and diseases of bees. DAF also contributes to the National Bee Pest Surveillance Program, that monitors for any exotic pests and diseases coming into the country.

One exotic pest that is causing concern right now is the varroa mite, as it was detected in NSW in 2022. If varroa mites spread across the country, then many of our managed honey bee hives will die, mostly from the diseases they spread. This will cause a lot of disruption and lower food production for a lot of our industries.

Honey bees are livestock, and need food and water, just like any living thing, which means they are highly dependent on their local environment. They are significantly affected by natural disasters. Sadly, the 2019-2020 summer bushfires took a heavy toll on the honey bee industry in Australia, destroying an estimated 15.6 million hectares of native forest, meaning critical nectar and pollen sources for honey bee colonies were lost. Many beehives were also lost to floods in 2022. Despite these challenging circumstances, Australian beekeepers demonstrated resilience and skill to deliver the nation's pollination needs.



(Ref: Home Sweet Home - Australian Honey Bee Industry Council; 220407-AHBIC-Fact-Sheet-The-importance-of-honey-bees-APPROVED_1.pdf (honeybee.org.au); Become a friend of AHBIC - Australian Honey Bee Industry Council)

Honey bees are social insects with a rich behavioural repertoire, an exquisite navigational system, an elaborate communication system, and an extraordinary ability to learn colours, shapes, fragrances, and navigational routes quickly and accurately. *(Ref: Srinivas an MV. Honey bees as a model for vision, perception, and cognition. Annu Rev Entomol. 2010;55:267-84. doi: 10.1146 / annurev.ento.010908.164537. PMID: 19728835.)* Because of this, they have been studied by scientists to unravel the mysteries of how their brains work, including memory, learning and social behaviour. Honey bees have even been studied as a model for vison and perception and to help create autonomous robotic drones that can fly and navigate by themselves!

Bee related careers

Researcher/Entomologist:
Honey bee diseases
Medicinal aspects of honey
Honey bee health
Ecologist
Bee Geneticist
Beekeeping Equipment Supplier
Swarm Catcher
Queen Bee Breeder
Honey Marketer/Exporter

Beekeeping and the apiary industry is another example of the variety of careers in DAF, biosecurity, science (STEM) and the wider agricultural sector. There are so many exciting opportunities for students who want to contribute to keeping communities healthy and prosperous by ensuring everyone in Australia and around the world has access to diverse, healthy and sustainably produced food.

Bee aware (safety note):

Although European honey bees are generally passive, they are unpredictable. If handling bees and beehives you should use a smoker and you must always wear head and face protection (e.g., bee-proof veil). It is highly recommended to wear loose fitting, light-coloured clothes (coveralls) to protect your body from stings. If stung by a bee, flick the barb out with your fingernail and apply appropriate first aid. Seek medical advice immediately if you show any signs of an allergic reaction (Anaphylactic shock).

Hermitage Research Facility
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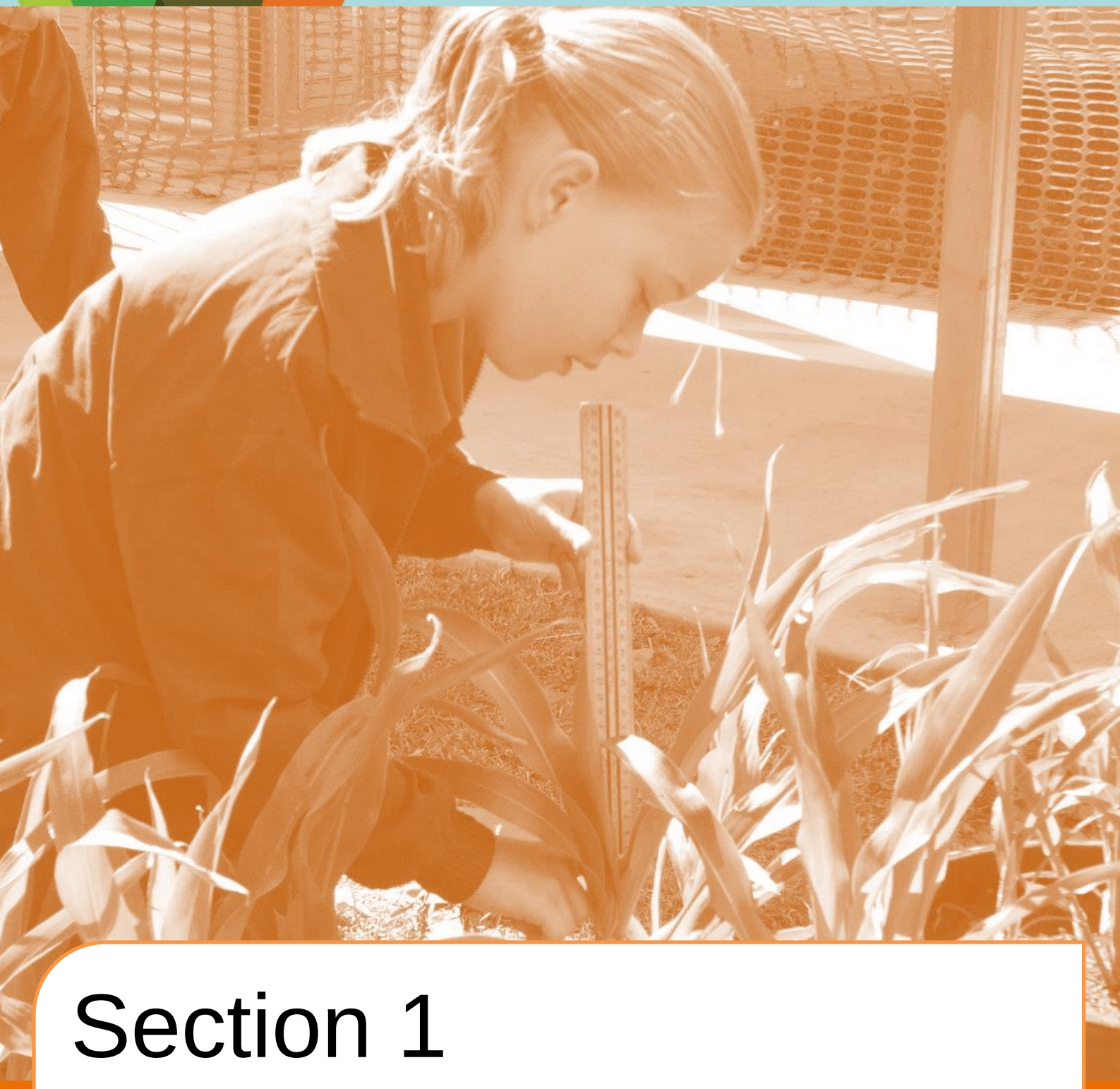


Section 1

Plant Science Project Awards

Science Investigation

Setting the scene

Bees are a crucial part of sustaining life on Earth. They are one of the most important insects on the planet. They are responsible for pollinating plants, which is essential for the survival of many species of plants and animals. Without bees, many plant species would not be able to reproduce and would eventually die off, and the animals that rely on those plants for food would also perish. Bees also play an important role in the pollination of crops. Crops that are not adequately pollinated will produce fewer and smaller fruits and vegetables. This can lead to hunger and malnutrition and economic hardship for farmers. Bees are also a source of honey. Honey is a valuable food source for humans and has medicinal properties. It has been used to treat wounds and burns for centuries. Honey is also used in a variety of cosmetics and skincare products. Overall, bees are vital to the health of ecosystems and the human population. Without them, we would be facing a major crisis.
(Ref: The 12 Reasons Why Bees Are So Important to Human Survival - Beekeeping Trove)

You are free to investigate any topic of interest in relation to bees! Perhaps you'd like to take a closer look at European or native bees under the microscope, discover their fascinating hierarchy and life cycle, learn more about the apiary and beekeeping industry, discover how bees contribute to global food security, uncover the wonderful array of bee end products and their uses, or examine the biosecurity measures in place to help keep our bees safe from nasty pests and diseases?

DID YOU KNOW?
One in three mouthfuls of food we eat relies on honey bees for pollination!

Your task

Design your own scientific experiments or activities (or follow our pre-designed example in this resource), perform research on your chosen topic, compile a project report in any format of your choice (e.g., scientific report (Word, PPT, PDF, Publisher, etc), poster, pod cast, video, etc) and submit your bee project entry to the Hermitage Research Facility by Friday 23 June 2023.

Whichever topic you choose to investigate, apply the **Scientific Method** (if applicable). This means you will pose a question to answer and research. You will then design and perform an experiment or activity to answer this question, taking into account fair testing, what data you will need to collect, making a hypothesis and applying replication. Once completed, you will analyse the data and make conclusions about the results before presenting it as a **scientific report**. Please include a **separate science journal** with your entry which will contain your rough notes/diary entries, raw data, thoughts, sketches, etc.

Please refer to these separate resources for information on:

- How to follow the Scientific Method
- How to produce a Scientific Poster
- How to write a Scientific Review

Investigation ideas

Some topic, experiment and activity ideas include, but are not limited to:

- Apiary (beekeeping) industry in Australia (in relation to agriculture/horticulture industries)
- Bee biosecurity, pests & diseases, recent Varroa Mite outbreak in NSW
- Bee biology/anatomy/lifecycles (microscope/dissection, scientific drawing studies)
- Climate and bees – how do natural disasters (e.g., bushfires, floods) affect honey bees and pollination?
- A day in the life of bees (hierarchy and roles of bees, what do they collect to maintain their hives?)
- Native v's European bees (how do they differ?)
- What type of products do bees produce and how do bees and humans use them?
- Research, describe, taste test and rate different types of honey using a honey flavour wheel (how are different flavours achieved, what are the health/medicinal benefits of honey, etc)
- Pollination experiments
- Design a bee hotel (get your manual arts/tech students involved!)
- Bee mind maps and/or dioramas

Also…

The Crawford Fund International Agricultural Science Awards

Submit a thorough response (within your bee project entry) to either/both topics below to be in the running to **share $1000 worth of prizes** in **The Crawford Fund International Agricultural Science Awards**!

- Compare beekeeping/biosecurity practices between Australia and developing countries (what are their differences?)
- Suggest ways to improve beekeeping practices in developing countries

QUT Most Outstanding Poster Awards

Submit your bee project entry (or part thereof) in scientific poster format to be in the running to **share $200 worth of prizes** in the **QUT Most Outstanding Poster Awards**!

Useful websites/resources

Below is a list of just a few websites that contain bee-related information, useful resources and experiments and activities that may provide ideas for your own investigation and research. Alternatively, you can perform your own google search on bees or contact a local beekeeper or apiary officer to get some other investigation ideas.

Experiment/activity ideas:

Bee Aware Kids - Schools Home and Home (beeawarebrisbane.org)

The European honey bee and its use of native and exotic floral plantings | AgriFutures Australia (contains PDF report) This project answered a series of key questions about how the European honey bee uses native and exotic floral enhancements: What non-crop floral resources are used by European honey bees and how does this change throughout the year? What are the key plant species used outside the crop flowering season? Do European honey bees preferentially forage for pollen from native or exotic plant species?

Love Food? Love Bees! Curriculum Resources - Cool Australia (a range of bee-related curriculum resources for a range of year levels)

Experiment (details of multiple bee research projects undertaken via a US platform for scientific discoveries powered by people)

For the preppies! 20 Engaging Hands-On Activities Exploring Bees for Kids (homeschoolpreschool.net) (check out these engaging activities and crafts that are perfect for exploring bees for kids.

MergedFile (squarespace.com) (PDF file) (honey tasting activity instructions using honey flavour wheel)

Flavor Wheel for Honey Aims to Educate, Support Standardization | UC Davis Honey and Pollination Center

Beeswax food wraps - Double Helix (csiro.au) (make a beeswax food wrap activity)

Bee Hotel - Gardening Australia (abc.net.au)

YouTube videos:

Bee biosecurity online talks - YouTube

Mission Biosecurity: best beekeeping - YouTube (Biosecurity Queensland)

Setting up a honey tasting with a honey flavor wheel - YouTube

Australian Honey Bee Industry Council - YouTube

Wheen Bee Foundation - YouTube

Queensland Beekeepers Association Inc - YouTube

General information/organisations:

Beekeeping | Department of Agriculture and Fisheries, Queensland (daf.qld.gov.au)

Beekeeping in Queensland | Business Queensland

Queensland Beekeepers' Association Inc. (qbabees.org.au)

National Bee Biosecurity Program - Plant Health Australia

Home - Australian Honey Bee Industry Council

Bee Aware

Bee Friendly Farming® (BFF) Australia

Honey Bee & Pollination | AgriFutures Australia

20-057_digital.pdf (agrifutures.com.au): Bushfire Recovery Plan: Understanding what needs to be done to ensure the honey bee and pollination industry recovers from the 2019-20 bushfire crisis.

Save Our Bees Australia – Raising Awareness of Bees in Our Community and Environment

The Wheen Bee Foundation – Registered Charity for Bees

Aussie Bee Website homepage (native bee articles, photos and videos)

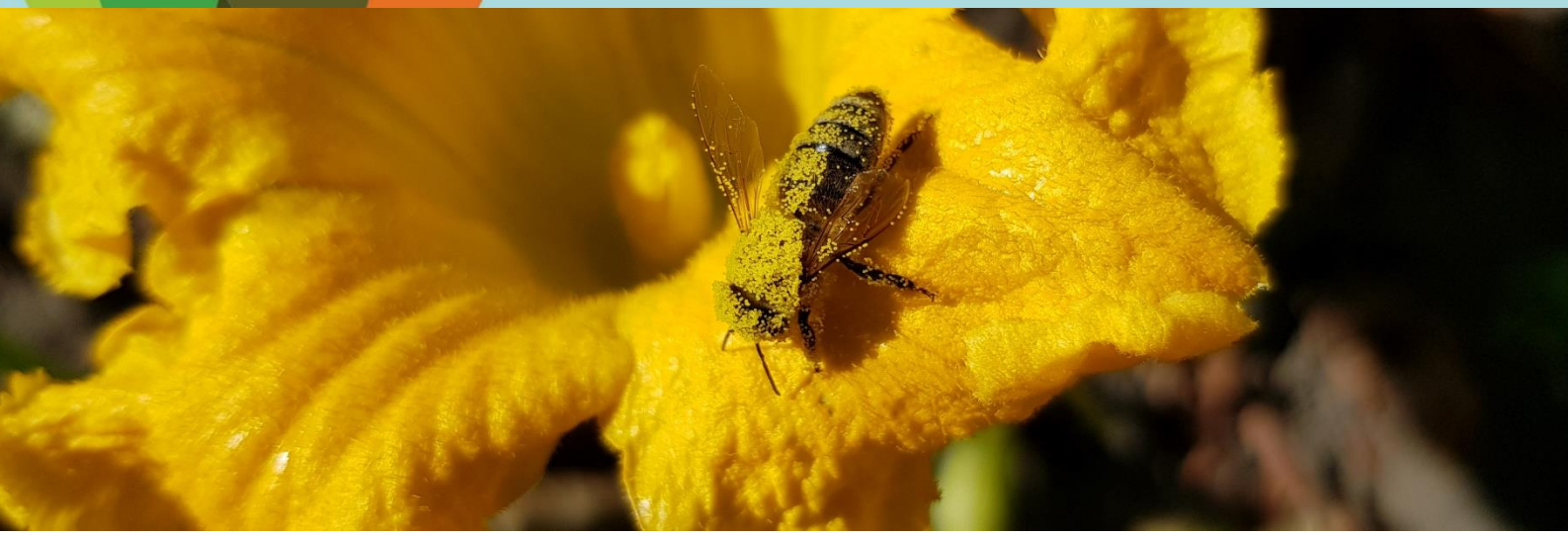
https://sugarbag.net/about (company based in Brisbane which provides stingless bee hives, products, services, advice, information and education resources)

Native Bees - Backyard Buddies

Kin Kin Native Bees – Kin Kin Native Bees are producers of hives of two species of native stingless bees, Tetragonula carbonaria and Tetragonula hockingsi

Front Page Elementor #3915 - www.anba.org.au (Australian Native Bee Association)

Can you beelieve?! Our guide to native bees – CSIROscope



Pre-designed pollination experiment

To bee or not to bee: will your veggies grow?

This is a quick and easy pollination experiment which will highlight the important job bees do in pollinating our horticultural and agricultural crops.

Grow plants that require insect pollination to bear fruit/veggies, cover half the crop with netting and leave the other half uncovered. Will fruit/veggies grow on the entire crop?

For this experiment, we suggest you grow **zucchini** as they should reach flowering/fruiting quite quickly, at around 6 weeks if grown in the warmer, summer months (during Term 1). Other plants you could experiment with (that require pollination for "fruit" to grow) are:

Term 1 (summer):
Check the 'time to flower' for these plants, as some may take longer than a school term to produce flowers/fruits.

- Cucumbers
- Eggplant
- Okra
- Parsley (grow any time)
- Peppers (capsicum, chili)
- Pumpkins
- Squash
- Watermelon

Term 2 (winter):
You will need to grow these plants through to seeding.

- Broccoli
- Brussels sprouts
- Cauliflower
- Collards
- Kale
- Lettuce (grow any time)
- Mustard

DID YOU KNOW?

Bees cannot talk and use vibration as their language. A worker bee scouting for pollen uses an audible code of buzzes, on a 200 cycle per second note with a pulse rate of 35 to the second. On returning to the hive, she will conduct a figure-eight tail wagging 'waggle' dance. The length of time this dance takes and the number of pulses of sound in each buzz indicate distance to the food source.

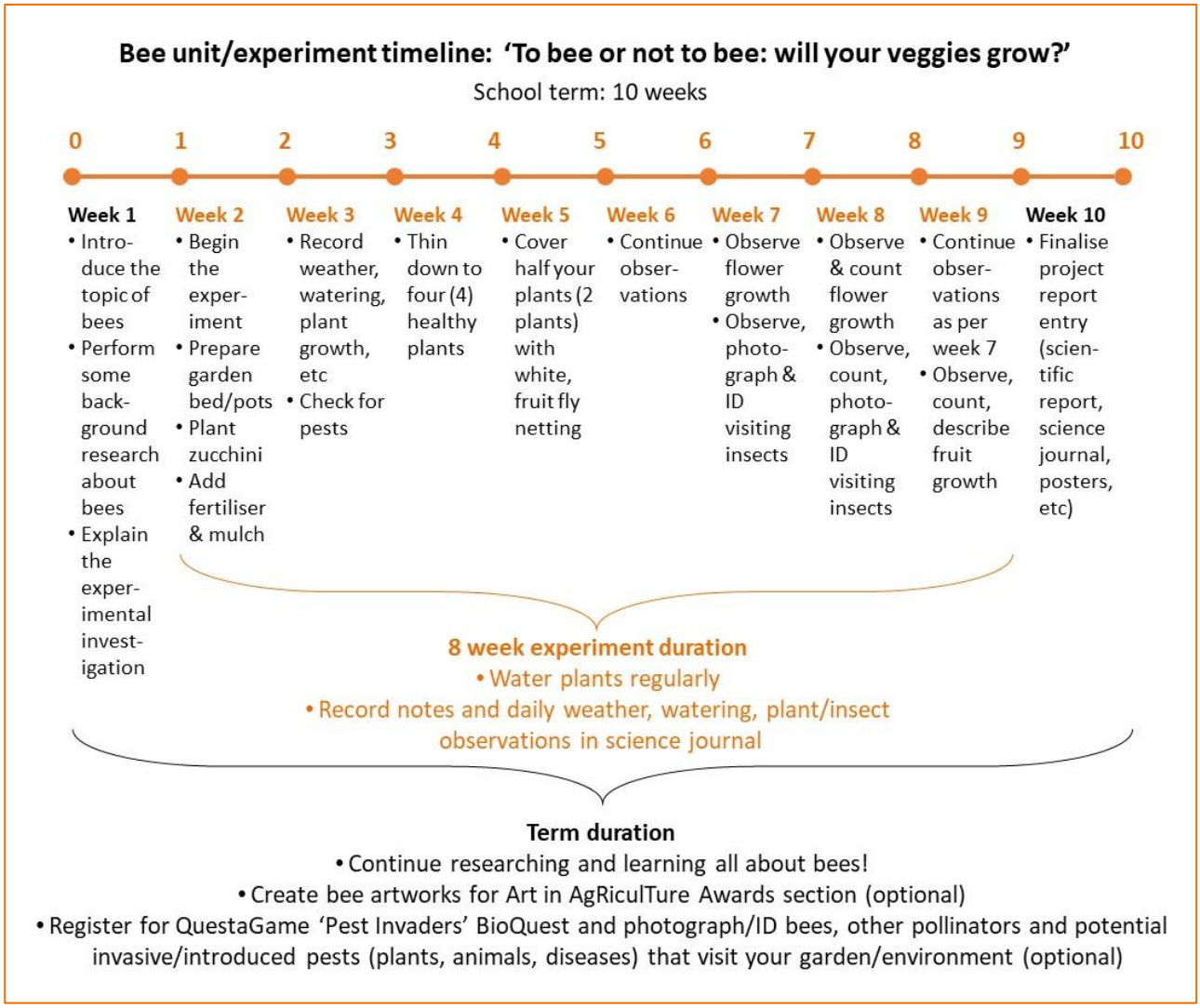
Observe established plants:

Alternately (or as well as) you can do this observational experiment using established plants/tree species at home or the school garden. Simply place some netting over some branches/plants at flowering (to exclude bees and other pollinators) and see if there are any differences in the plant's ability to bear "fruit". Some established plants this will work on include:

- Kiwifruit
- Passion fruit
- Blueberry
- Watermelon

Experiment duration/suggested timeline:

Approximately 6 – 8 weeks



Materials required:

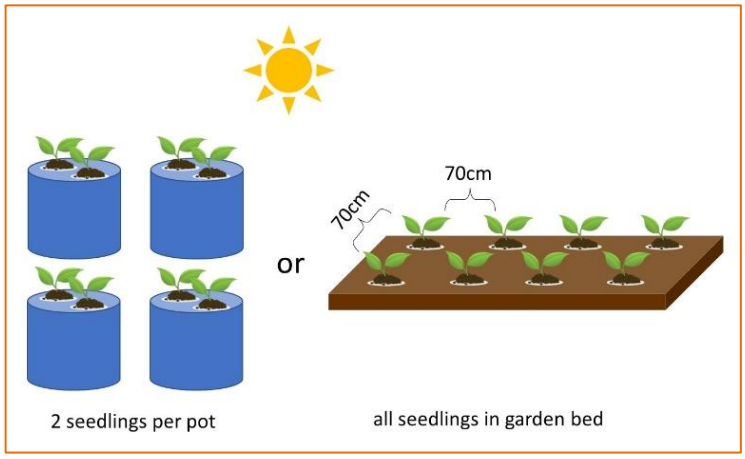
- A garden bed (or at least 4 x pots with a diameter of at least 30-40cms diameter)
- 1 x punnet of zucchini seedlings (using seedlings instead of seeds will save time with this experiment, as you will see flowers and fruits sooner). Most punnets should have 6-8 seedlings. At least 4 healthy plants are required for this experiment.
- Optional: seedlings/seeds of flower species (to help attract bees to your garden)
- Slow-release fertiliser
- White, fruit fly netting (enough to cover half the plants)
- Garden stakes (to hold netting up off plants)
- Shovel(s)
- Trays to place under potted zucchini plants at week 4
- Watering can/hose/sprinkler

Method:

During this experiment take photos of plant growth and visiting insects, research the importance of bees and other pollinators in crop production/food security, and record the weather, watering routine, amount of flowers/fruit per plant, number and species of pollinators that visited your plants/garden (if known) and any other rough notes, sketches, thoughts and ideas in your **Science Journal**.

Now, let's get started!

1. Select a **sunny position** (for potted plants) or a sunny garden bed at school or home for this experiment. Zucchini plants enjoy at least 6 hours of sunshine per day.
2. Plant your zucchini seedlings in a prepared (soil enriched with aged manure and compost) garden bed or pots (1-2 plants per pot). Plant the seedlings so the roots are covered but not the stem, then water in well. If planting in a garden bed, space them approximately **70cm apart**.
3. Sprinkle some **slow-release fertiliser** around your plants.

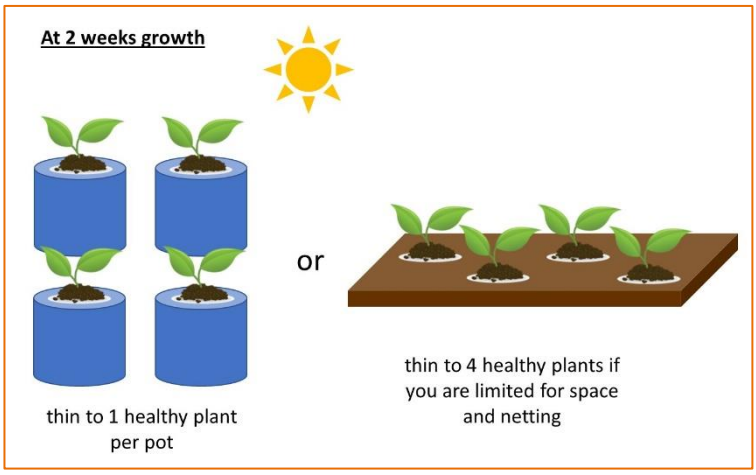


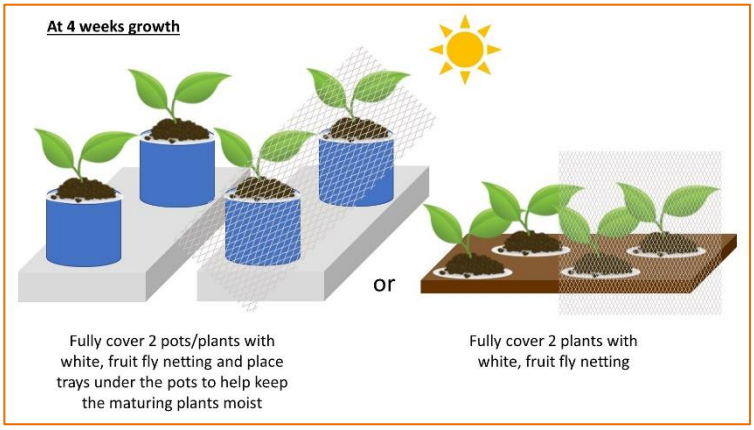
4. Apply some **mulch** (e.g., sugarcane or pea straw) around the base of the plants to help keep the soil moist.

Optional: *You might like to try 'companion planting' by growing some flower species (alyssum, cosmos, daisies, herbs, etc) near your zucchinis, to assist in attracting bees to your garden/pots.*

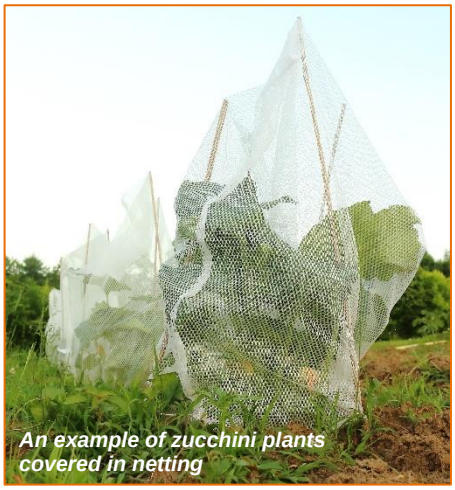
5. **Water your plants** daily during hot dry weather or less often if soil is mulched and the weather is mild. Avoid wetting the foliage (leaves), as this can lead to fungal problems.
6. Watch out for snails and slugs that love to eat young zucchini plants! Remove them if you see them.

7. After **2 weeks**, you can **remove the weakest plants**, leaving 4 strong zucchini plants to continue growing. Note: If you have a large garden bed, you can leave all plants to grow, but remember, they will cover quite a large area!
8. At **week 4** of plant growth, **cover half of your plants with the white, fruit fly netting**. Prop the netting up with stakes so it doesn't touch the leaves, but ensure the netting goes down to the ground.
9. By about **week 6** bright yellow flowers (both male and female flowers on the same plant) will start to form. Male flowers are on a long stalk and female flowers have a tiny zucchini at the base. Count how many flowers your plants produce.
10. Continue to observe the flowering and fruiting over the next 2 weeks, taking note of the following:
    a. Are there little zucchinis developing on the female flowers?
    b. Are there any bees or other pollinators visiting your plants? If so, you might like to identify them and list each species in a table and note if they are harmful or beneficial to your plants.





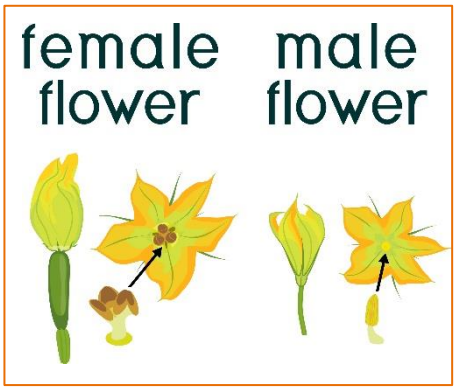
Note: *If you are participating in the QuestaGame section of the competition, take some nice, clear, close-up photos of any bees, other pollinators or potential insect/animal pests that visit your plants/garden and submit them via the mobile gaming app! If you are not joining the 'Pest Invaders' BioQuest, you can include these photos in your Scientific Report.*


An example of zucchini plants covered in netting

11. Refer to your **Science Journal** to gather key information and data and consider the questions below to form the content for your **Scientific Report** and submit your entry to the Hermitage Research Facility by Friday 23 June 2023.

Some questions to answer in your Scientific Report:

1. Have the <u>uncovered</u> plants grown any fruit? How many?
    a. If yes or no, why do you think this is so?
    b. Does the fruit look normal and healthy (describe/draw/photograph their appearance)? If so, why do you think this is so?
2. Have the <u>covered</u> plants grown any fruit? How many?
    a. If yes or no, why do you think this is so?
    b. Does the fruit look normal and healthy (describe/draw/photograph their appearance)? If not, why do you think this is so?



3. Did any bees or other insects visit your plants? If so, what were they doing there? Do you think they were harmful or beneficial to the plant growth?
4. Why are bees and other pollinators so important to agriculture/horticulture and in securing our future global food supply?
5. What biosecurity measures are in place to help protect the Australian honey bee industry?

***Note*: you are permitted to modify, simplify or extend this experiment if you wish to investigate different variables or adapt to students' year level and/or ability.**

Go the extra mile: You may take any tangent, related to the topic, and perform extra experiments, research, excursions, interviews with farmers/industry/researchers, etc. to enhance your learning. At the judges' discretion, extra marks may be awarded to students who "go the extra mile" and immerse themselves in further activities and research over and beyond of what is expected.

Other experiment/activity suggestions

What type of weather do bees like most?

This observational experiment will highlight how the environment affects living things. Visit some flowers in your garden and observe for 10 minutes or so every few days. Are there bees visiting the flowers and if so, roughly how many? At the same time make weather observations, e.g., record the ambient temperature, cloud cover, rain, etc. and then try to relate whether the weather has anything to do with the number of bees and other pollinators that are visiting the flowers.

DID YOU KNOW?
If the honey bee visits a mixed patch of flowers, a special perfume left by the scout bee tells the workers to take nectar from only one source so that honey in the hive is but one honey type.

What colour flowers are bees most attracted to?

Grow a variety of different coloured (red, white, purple, yellow, pink), bee attracting flowers (or visit established flower gardens) and regularly observe bee activity. Roughly count the number of bees visiting the different flowers. Do bees visit particular flower colours more frequently than others? If so, what might this be so?

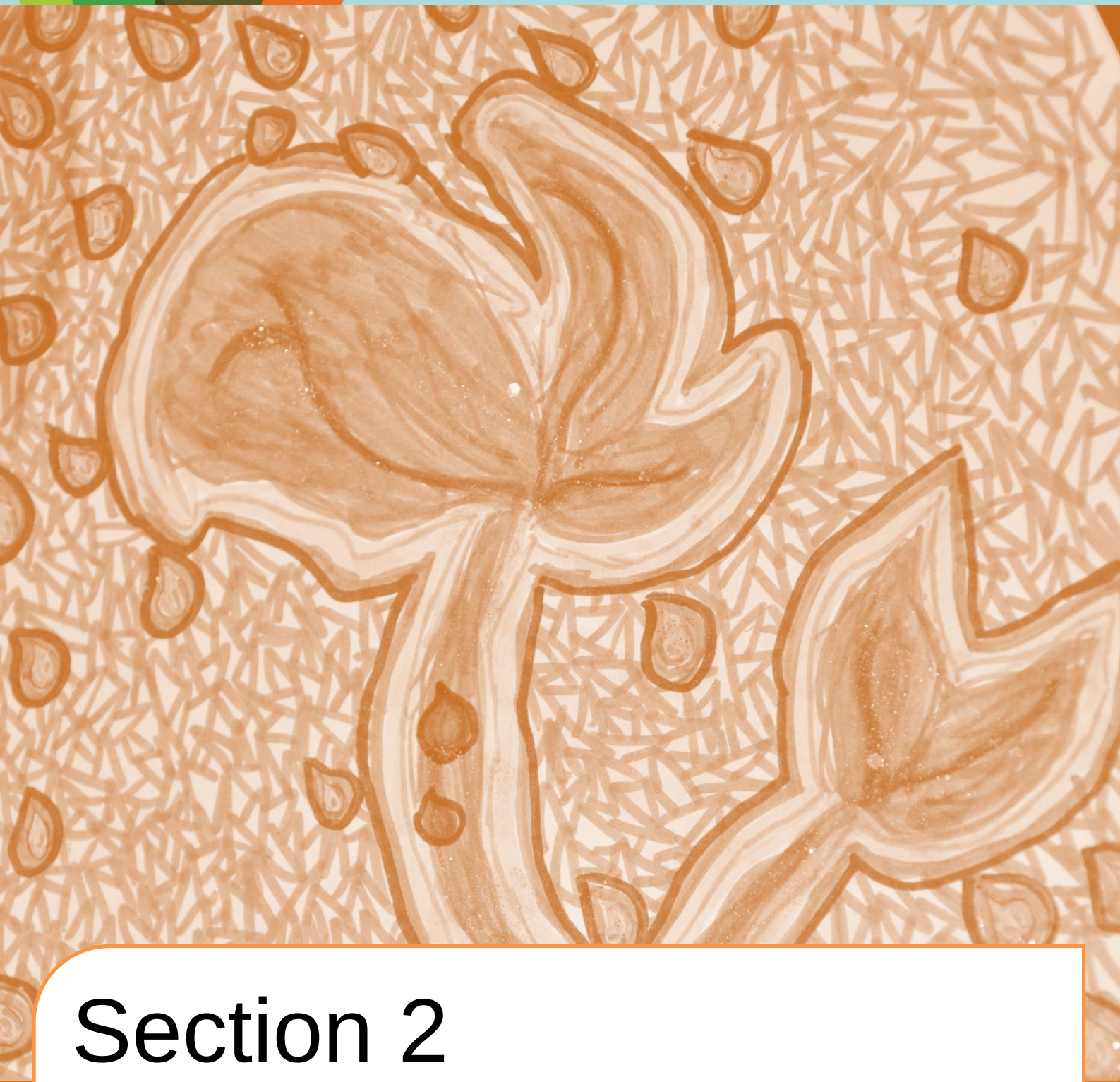
Exotic flowers v's Australian native flowers: which do bees prefer?

Grow a variety of exotic and native flowering plants (or visit established gardens) and observe bee activity. Roughly count the number of bees visiting the exotic plants and the native plants. Do bees seem to prefer exotic or native plant species? Why might this be so? Do you think the flavour of their honey would be affected by the type of plants the bees visit and why?

'Plant Science Project Awards'

A huge range of prizes will be awarded to students who submit excellent entries across all year levels (P-2, 3-6, 7-9 and 10-12)
(see the prize table in this resource for the list of fantastic prizes up for grabs)!

Hermitage Research Facility
Schools Plant Science Competition



Section 2

Art in AgRiculTure Awards

The design brief

Bee creative and get buzzy making a bee themed artwork of any kind, any medium, 2D or 3D!

Here's some suggestions to get your creative juices flowing:

- Draw/paint/sculpt/mosaic/etc a bee(s) going about their buzziness
- Build a model bee, beehive or swarm from recyclable materials, paper mâché, etc
- Draw a scientific sketch of a bee, labelling body parts
- Create a bee diorama
- Design a bee biosecurity alert poster
- Create a bee themed pictorial story book/cartoon series
- Any other areas of interest

Specifications

- Artworks must be submitted **'ready to hang'** (e.g., add velcro dots (hooks) to each corner of lightweight (paper/cardboard) artworks or alternatively you can frame your artwork in ready to hang/stand frames, or attach D rings and picture wire if required.
- You may use **any medium** for your artwork. Please be mindful of the fragility and weight of your artwork(s), particularly if you plan to submit them via post!
- Adult assistance/supervision may be required for young students, particularly if using any sharp materials.
- Ensure each artwork is **clearly labelled with the student's name, year level and school name**.

Submitting your entry

- Submit your **original artwork** (preferred) via post/courier/drop off.
- Alternatively, you can submit a digital version of your artwork (e.g., a photograph or video) but please note, when it comes to judging, a digital version may not create as much visual impact as an original artwork.

'Art in AgRiculTure Awards'

The students who submit the most outstanding entries for this task will receive the following prizes:

Overall school winner & runner-up – trophy and certificate (each)
Individual year level winners – medallion and art/science pack
Individual year level highly commended – art/science magazine or activity book

Hermitage Research Facility
Schools Plant Science Competition

PEST INVADERS!
bioQuest
QuestaGame

Section 3

QuestaGame ‘Pest Invaders’

QuestaGame Pest Invaders BioQuest

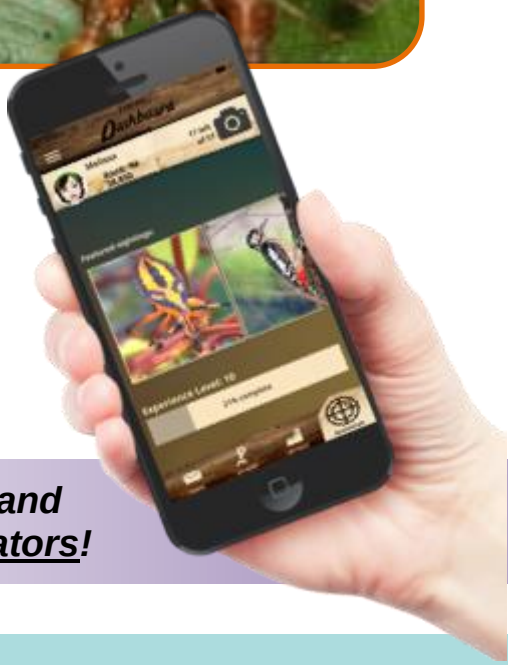
Engage in real-world science via the QuestaGame 'Pest Invaders' BioQuest! Through QuestaGame's outdoor mobile gaming app, your plant pest sightings will be identified by experts and shared with CSIRO's Atlas of Living Australia and the Global Biodiversity Information Facility – the world's premier collection of biodiversity records. Your involvement will also help researchers understand how we can better manage and protect biodiversity in a changing world. This is citizen science at its best!

QuestaGame

To register your team, go to
www.pestinvaders.org/ and download the app!

Who will be crowned Champion Pest Detective in 2023?

Embark on a fun adventure that will open your eyes to our beautiful environment and the various organisms that invade our plants. Start by getting outdoors to capture (just with photos) as many introduced or invasive insect/animal pests, weeds and plant diseases as you can. You'll score gold for every sighting, with extra gold if you can identify what you've found and even more gold if you can find something rare or interesting! Life is full of hidden treasurers, but our native environment and agricultural industries are under threat from pests that attack our plants – now is your chance to save it!



Earn bonus points if you find and identify bees and other pollinators!

WIN PRIZES

QuestaGame Awards

The students and teams who gain the most points from spotting and identifying bees and other pollinators, plant pests, weeds and diseases will receive a range of great prizes and the **'Overall Champion'** will receive **$1000 towards an environment-themed trip to Cairns!**

Australian curriculum linkages

Engaging in the activities provided in this competition supports the ACARA Science Curriculum across the three strands **(*Science Inquiry*, *Science Understanding and Science as a Human Endeavour*)** and the development of understanding of scientific concepts, processes and practices through hands-on experiments and activities inside and outside the classroom. Students also develop scientific inquiry skills including the ability to make predictions, ask questions, use materials, tools and equipment to measure and record observations and use evidence to explain scientific findings.

Across curriculum linkages can be made between multiple sciences (e.g., biology, agriculture, chemistry, geography) and other subjects such as maths, English, ICT and art. Curricula elements/areas (for each year level) that are relevant to the competition's experiments and activities (in general) are detailed in the following table.

AUSTRALIAN CURRICULUM (P-10 SCIENCE)	
Prep	Living things have basic needs, including food and water
Grade 1	Living things have a variety of external features (ACSSU017)
Grade 2	Living things grow, change and have offspring similar to themselves (ACSSU030)
Grade 3	Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ACSSU044)
Grade 4	- Living things have life cycles (ACSSU072) - Living things, including plants and animals, depend on each other and the environment to survive (ACSSU073)
Grade 5	Living things have structural features and adaptations that help them to survive in their environment (ACSSU043)
Grade 6	The growth and survival of living things are affected by the physical conditions of their environment (ACSSU094)
Grade 7	- There are differences within and between groups of organisms; classification helps organise this diversity (ACSSU111) - Interactions between organisms can be described in terms of food chains and food webs; human activity can affect these interactions (ACSSU112)
Grade 8	Cells are the basic units of living things and have specialised structures and functions (ACSSU149)
Grade 9	- Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175) - Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems (ACSSU176)
Grade 10	- The transmission of heritable characteristics from one generation to the next involves DNA and genes (ACSSU184)
AUSTRALIAN CURRICULUM (SENIOR SECONDARY)	
Agricultural Science	- Plant science, animal science and agribusiness (anatomy & physiology of agricultural plants and animals, - Agronomy and animal husbandry, - Agriculture is central to national & international economies, supplying food, fibre and other products
Biology	- Survival and reproduction of species, - Structure and function of living things, - Continuity and change in the living world
Agriculture & Horticulture	Study of plants, insect pests, soils, harvesting, storage
Earth & Space Sciences	- Some of earth's resources are renewable, but others are non-renewable - Water is an important resource that cycles through the environment - Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere and atmosphere
Geography (Core unit 4)	Feeding the world's people: A key element of food production is agricultural systems. Such systems involve inputs to the land and a series of processes, to generate a range of outputs
Chemistry	- Chemical change involved substances reacting to form new substances - Different types of chemical reactions are used to produce a range of products and can occur at different rates
Physics	Energy transfer through different mediums can be explained using wave and particle models
Science 21	Environment, catalysts for discovery, living systems
Science in Practice	- Identify and explain scientific procedures and processes, - Plan investigations, collect, select and record data, use practical scientific skills, - Analyse data, predict outcomes and draw conclusions, - Present scientific data
EEI	Planning and problem solving through hands-on experimentation

Hints and tips

"How to" fact sheet series

A series of fact sheets are available (via email) which provide useful information and tips on how to:

- Follow **'Scientific Method'**
- Produce a **'Scientific Poster'**
- Write a **'Scientific Review'**

Please contact kerrie.rubie@daf.qld.gov.au for a copy of these fact sheets.

Keeping a science journal

It is important that you keep a science journal (a separate exercise book or diary, similar to a rough draft) containing handwritten notes (observation dates/times, temperature/weather recordings, thoughts, ideas, plant health/counts/measurements, etc.), raw data, diagrams, sketches, research notes, details of farm/industry visits/interviews and any other information that relates to the experiments and activities completed. You should then refer to your science journal to write up your final scientific report. Digital scientific journals (e.g., OneNote) are permitted.

Scientific report writing

Scientific reports are used to communicate the results of science experiments and have a formalised structure usually consisting of the following sections:

- **Title** (either a title page or main heading)
- **Abstract** (paragraph summarising the project and tasks)
- **Introduction** (predictions or hypothesis, aims of the experiment, background information on the topic)
- **Materials and methods** (how you set up your experiment/s and activities and the materials used)
- **Results** (a factual account of your findings, observations made, data displayed in tables/graphs, photos/samples/sketches)
- **Discussion or conclusion** (interpretation and explanation of your experiment results, compare outcomes to original hypothesis, explore the importance/significance of your results, how do your results relate to agricultural issues and current information on the topic, outline any new research questions that your results have suggested, include answers to questions outlined with each activity (if applicable), how could the experiments be improved – what you would do differently next time)
- **References or bibliography** (alphabetical list of books, magazines, journals, websites, etc. that were used to source information for your report)
- **Appendices** (other relevant information that is not essential to explain your findings but supports your results and conclusions (e.g., interview questions/answers, notes from farm/industry visits, etc.) – also may include results of other activities/experiments completed)

Note: When aligning this project with the Australian Curriculum, you may be required to follow a different scientific report writing format than mentioned above. You are most welcome to use alternative reporting structures, as relevant to your curriculum requirements.

Submitting your entry

The **closing date** for submission of competition entries is **Friday 23 June 2023** (last day of term 2 for Queensland state schools).

Entry checklist

Plant Science Project Awards (if entering this section):

- ☐ **Project report**
- ☐ **Science journal**

Art in AgRiculTure Awards (if entering this section):

- ☐ **2D artwork** (ready to hang) or **3D Artwork** or
- ☐ **Photos or videos of artwork**

QuestaGame (if entering this section):

- ☐ **Follow instructions on the QuestaGame 'Pest Invaders' website** www.pestinvaders.org/ **to submit sightings/IDs prior to the closing date**

Other:

- ☐ **Each item is labeled** (all reports, posters, journals, artworks, USB sticks, etc. labeled with student name, year level and school name)
- ☐ Completed on-line **'Competition Entry Submission Form'** (submit via our website and include the printed email confirmation with your entry)
- ☐ **Conference Award application** (years 10-12 only, if applying)

Send entries to

(hard copies via post):
DAF Hermitage Schools Plant Science Competition
Hermitage Research Facility
604 Yangan Road
WARWICK QLD 4370

(electronic copies):
- e: kerrie.rubie@daf.qld.gov.au or
- via platforms such as Google Drive/DropBox/WeTransfer or
- USB stick (via postal address above)

(in person):
- Hand deliver (to address above prior to 5pm weekdays)
- Alternative drop-off locations may be organised prior to the closing date (participants will be advised via email of arrangements)

Judging criteria

Plant Science Project Awards

For judging purposes, students are grouped into 4 x year categories (P-2, 3-6, 7-9 & 10-12). The judging team consists of Hermitage Research Facility staff and/or competition sponsors/supporters.

We are only seeking very basic reports from our youngest competitors in years P-2 and teachers/parents are welcome to assist students in writing/compiling their reports. However, we would like to see some evidence of the student's own work (e.g., some of their own writing and/or drawings). As the year levels increase, we will look for more detailed content in the reports.

Students are awarded a total **score out of 50*** based on the following elements evident in their project submission:

Presentation (score out of 10)

- neatness, effort
- grammar/spelling
- layout of text/images
- use of 'scientific report' structure

Content (score out of 20)

- evidence of completed experiments/activities as outlined in the instructions
- content provided in 'abstract/introduction' section
- content provided in 'materials/method' section
- content provided in 'results' section
- content provided in 'discussion/conclusion' section
- science journal content
- demonstrated understanding of the topic and scientific method and process
- "going the extra mile" (evidence of extra experimentation & research into the topic)

Discussions/conclusions (score out of 20)

- was original hypothesis correct or not?
- outline the importance of fair testing
- how do your results compare to current information on the topic/agricultural practices/issues?
- what went wrong and what worked well?
- what would you do differently next time?

** Overall score and weightings may change without prior notice*

Art in AgRiculTure Awards

Judges are looking for artworks that adhere to the brief, plus display elements of creativity, uniqueness, effort and skill, together with a hint of scientific flair!

Competition prize winners will be notified via email in mid-late July

Awards and prizes

Plant Science Project Awards (YEARS 10-12)	
★ **Paul Johnston Memorial Senior Science Awards** *(top two most outstanding entries received)*	**Winner** – **$1000** towards resources for tertiary education & a plaque **Runner up** – **$500** towards resources for tertiary education **or** a subscription to scientific journal(s) of choice & a plaque
★ **Conference Awards** *(awarded to 2 students who submit an excellent plant science project entry plus a Conference Award application)*	**Winners** – Up to **$1000** (each) towards travel and registration costs to attend a relevant industry conference
★ **The Crawford Fund International Agricultural Science Awards** *(most outstanding entry relating to global food security)*	**Winner** – **$350** gift card & medallion | **Runner-up** – **$150** gift card
★ **QUT Most Outstanding Poster Awards** *(awarded to a student/team/class who submits the most outstanding poster entry)*	**Winner** – **$100** gift card & medallion
★ **Highly Commended Awards** *(excellent/high scoring entries)*	**Prize** – medallions
★ **Overall Class Awards** *(class groups with overall highest scores)*	**1st, 2nd, 3rd Prizes** –scientific/educational prize & trophy
★ **Encouragement Prize** *(awarded to student/team/class deserving of recognition for their great effort and enthusiasm)*	**Prize** – scientific/educational prize
Plant Science Project Awards (YEARS 7-9)	
★ **AiA Junior Science Achievement Awards** *(top two most outstanding entries received)*	**Winner** – Medallion & book prize | **Runner up** – Book prize
★ **The Crawford Fund International Agricultural Science Awards** *(most outstanding entry relating to global food security)*	**Winner** – **$300** gift card & medallion | **Runner-up** – **$100** gift card
★ **QUT Most Outstanding Poster Awards** *(awarded to a student/team/class who submits the most outstanding poster entry)*	**Winner** – **$50** gift card & medallion
★ **Highly Commended Awards** *(excellent/high scoring entries)*	**Prize** – medallions
★ **Overall Class Awards** *(class groups with overall highest scores)*	**1st, 2nd, 3rd Prizes** – trophy & scientific/educational prize
★ **Encouragement Prize** *(awarded to student/team/class deserving of recognition for their great effort and enthusiasm)*	**Prize** – scientific/educational prize
Plant Science Project Awards (YEARS 3-6)	
★ **Joe Baker Outstanding Achievement Awards** *(most outstanding entry received)*	**Winner** – Scientific/educational based prize & medallion
★ **The Crawford Fund International Agricultural Science Awards** *(most outstanding entry relating to global food security)*	**Winner** – **$50** gift card & medallion
★ **QUT Most Outstanding Poster Awards** *(awarded to a student/team/class who submits the most outstanding poster entry)*	**Winner** – **$30** gift card & medallion
★ **Highly Commended Awards** *(excellent/high scoring entries)*	**Prize** – medallions
★ **Overall Class Awards** *(class groups with overall highest scores)*	**1st, 2nd, 3rd Prizes** – trophy & scientific/educational prize
★ **Encouragement Prize** *(awarded to student/team/class deserving of recognition for their great effort and enthusiasm)*	**Prize** – scientific/educational prize
Plant Science Project Awards (YEARS P-2)	
★ **Joe Baker Outstanding Achievement Awards** *(most outstanding entry received)*	**Winner** – Scientific/educational based prize & medallion
★ **Young Science Investigator Award** *(entry demonstrating the most enthusiasm and curiosity towards science)*	**Winner** – Scientific/educational based prize & medallion
★ **The Crawford Fund International Agricultural Science Awards** *(most outstanding entry relating to global food security)*	**Winner** – **$50** gift card & medallion
★ **QUT Most Outstanding Poster Awards** *(awarded to a student/team/class who submits the most outstanding poster entry)*	**Winner** – **$20** gift card & medallion
★ **Highly Commended Awards** *(excellent/high scoring entries)*	**Prize** – medallions
★ **Overall Class Awards** *(class groups with overall highest scores)*	**1st, 2nd, 3rd Prizes** – trophy & scientific/educational prize
★ **Encouragement Prize** *(awarded to student/team/class deserving of recognition for their great effort and enthusiasm)*	**Prize** – scientific/educational prize
Art in AgRiculTure Awards (ALL YEAR LEVELS)	
★ **Overall school/class winner and runner-up**	trophy and certificate (each)
★ **Individual winners (per year level)**	art/science pack and certificate (each)
★ **Highly commended (per year level)**	art/science magazine or activity book (each)
QuestaGame Awards (ALL YEAR LEVELS)	
★ **Overall Champion Pest Detective**	**$1000** towards travel/environmental excursion in Cairns
★ **Most Valuable Player (1st, 2nd, 3rd)**	trophy and certificate (each)
★ **Champion Spotter (1st, 2nd, 3rd)**	trophy and certificate (each)
★ **Champion Identifier (1st, 2nd, 3rd)**	trophy and certificate (each)
★ **Best Scoring Find (1st, 2nd, 3rd)**	trophy and certificate (each)
★ **Active Adventurer Prize Draw**	$30 gift card & certificate
★ **Champion Spotters Team (1st, 2nd, 3rd)**	trophy and certificate (each)
★ **Champion Identifiers Team (1st, 2nd, 3rd)**	trophy and certificate (each)

Participation certificates *are provided to each participant who does not receive any of the above Plant Science Project and/or Art in AgRiculTure Awards*

Awards Day & Ag Science Expo

Each year all participants and prize winners of the Schools Plant Science Competition are formally acknowledged at a special Awards Day and Agricultural (Ag) Science Expo, which is held at the department's Hermitage Research Facility in Warwick, Queensland, during National Science Week.

The aims of the day are to:

- Highlight the significance and importance of agriculture and science to our daily lives and promote science and agriculture as a great choice for an exciting and rewarding career.
- Formally recognise and celebrate students' participation and achievements in the competition with DAF staff, competition sponsors and the general community.
- Provide students an opportunity to interact with high profile keynote speakers, scientists, staff and competition sponsors and to learn about DAF's current plant science research projects and other agricultural science industries.

All competition participants, together with their teachers, school principals, family members and the general community are invited to attend the Awards Day and Ag Science Expo.

Program outline

Event time: 8.45am – 2.30pm

Awards ceremony: 9:00am – 11:00am

Ag Science Expo: 11:00am – 2.30pm

- A guided tour of the Hermitage Research Facility including presentations by DAF research staff about sorghum, pulses, barley, grain storage pests, fisheries, biosecurity animal welfare dogs and other projects.
- 'ScienceShow Alley' interactive displays and presentations including drone technology, plant/animal biosecurity, beekeeping, horticulture/entomology, soil health, local high school agriculture displays, careers information, farm machinery, mobile petting zoo and a Street Science performance.
- BBQ lunch for all attendees, from 12:30pm.

Join us for a wonderful day celebrating students' achievements and all things agricultural science!

ASTA science contests

Entries in the DAF Hermitage Schools Plant Science Competition are also eligible for entry in your state Science Teachers Association (STA) Science Contests.

Past DAF Hermitage Research Facility Schools Plant Science Competition major prize winners have entered their projects in the ASTA Science Contests and the previous national BHP Billiton Science Awards and received some fantastic results!

2017 Hermitage competition winners Sophia McQueen and Michelle Springolo with their STAQ Science Contest Awards

2019 Hermitage competition winner Michelle Springolo selected as one of the 26 national BHP Billiton Science Award finalists in 2020

For more information on ASTA Science Contests in your state, please visit:

QLD	Queensland Science Contest – STAQ
NSW	YS Home (stansw.asn.au)
ACT	https://seaact.act.edu.au/science-fair/
VIC	http://www.sciencevictoria.com.au/sts/index.html
WA	http://www.stawa.net/student-activities/science-talent-search/
NT	https://sites.google.com/site/stantsite/08---science-competitions
SA	http://www.sasta.asn.au/student_activities/oliphant_science_awards
TAS	http://stat.org.au/tsts/