YEAR 7
GRAIN BIOSECURITY

2016 Teaching Resources
Secondary Schools

CONTENTS

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Acknowledgments

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CRC PLANTbiosecurity

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NSW GOVERNMENT Department of Primary Industries

Fresh Growth for your Business
Dianne Fullelove & Associates Pty Ltd

BACKGROUND

BACKGROUND

This unit of work has been designed to allow students to develop an understanding of the Australian agricultural industry and the importance of plant biosecurity in the context of integrated pest management.

AIM

This unit of work has been designed to allow students to develop an understanding of the Australian agricultural industry and the importance of plant biosecurity in the context of integrated pest management. The links between agriculture and the role of pest insects are explored and students gain an insight into the taxonomy and classification process of organisms. Students will undertake an insect surveillance exercise and then learn to identify the insects they collect. They will also learn how to record data and take measurements of abiotic factors e.g. weather.

INSTRUCTIONS

The lesson plans in this resource package are designed to cultivate a student's understanding of biosecurity by investigating what biosecurity is, in the context of a grain cropping system, and the organisms and processes involved in biosecurity surveillance. They will also explore the concept that biosecurity is a shared responsibility and gain insight as to how biosecurity threats are reported and managed. Whilst examples have been provided on the grain industry the package can be adapted for local agricultural situations as the principles behind biosecurity management remain the same. All student handouts have been included as well as a number of PowerPoint presentations to maximise class engagement.

LESSON 1	Overview of the Australian grain industry and the connections between paddock and plate
LESSON 2	Introduce the concept of taxonomy and investigate how insects are classified
LESSON 3	Students undertake a classification exercise and prepare for the surveillance work
LESSON 4 & 5	Students go into the field to undertake an insect surveillance exercise
LESSON 6	Students examine and classify the insects they caught during the surveillance activity
LESSON 7	Students collate and examine their findings from the surveillance exercise

SYLLABUS OUTCOMES NATIONAL CURRICULUM

SCIENCE UNDERSTANDING

Nature and Development of Science

ACSHE119 – Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed peoples understanding of the world

ACSHE223 – Science knowledge can develop through collaboration and connect ideas across the disciplines of science

Use and Influence of Science

ACSHE120 – Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations

ACSHE121 – Science and understanding influence the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management

ACSHE224 – People use understanding and skills from across the disciplines of science in their occupation

Questioning and Predicting

ACSIS124 – Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge

Planning and Conducting

ACSIS125 – Collaboratively and individually plan and conduct a range of investigation types, including field work ad experiments, ensuring safety and ethical guidelines are followed

ACSIS126 – In fair tests, measure and control variables, and select equipment to collect data and accuracy appropriate to the task

Processing and Analysing Data and Information

ACSIS129 – Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate

ACSIS130 – Summarise data, from student's own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions

Evaluating

ACSIS131 – Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected and identify improvement to the method

Communicating

ACSIS133 – Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate

SYLLABUS OUTCOMES NSW CURRICULUM

This resource is intended to meet or contribute to the following outcomes for Stage 4 Science as outlined in the NSW Syllabus developed by the Board of Studies, Teaching and Educational Standards NSW, 2012.

SCIENCE STAGE 4

Living World
LW1 – There are differences within and between organisms; classification helps organise this diversity
LW4 – Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed peoples understanding of the world
LW5 – Science and technology contribute to finding solutions to conserving and managing ecosystems

Chemical World
CW4 – Students describe, using examples, how science knowledge can develop through collaboration and connecting ideas across the disciplines of science

Physical World
PW4 – Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations

Earth and Space
ES3 – Science knowledge influences the choices people make in regard to the use and management of the Earth's resources
ES4 – Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management

Questioning and Predicting
WS4 – Students question and predict by identifying questions and problems that can be investigated scientifically; making predictions based on scientific knowledge and their own observations

Planning Investigations
WS5.2 – Students plan first-hand by collaboratively and individually planning a range of investigation types, including field work, experiments, surveys and research
WS5.3 – Students choose equipment or resources for an investigation by selecting equipment to collect data with accuracy appropriate to the task

Processing and Analysing Data and Information
WS7.2b – Students analyse data and information by constructing and using a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate
WS7.2d – Students analyse data and information by using scientific understanding to identify relationships and draw conclusions based on students' data or secondary sources
WS7.2f – Students analyse data and information by reflecting on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected

Conducting Investigations
WS6 – Students conduct investigations by collaboratively and individually conducting a range of investigations, including fieldwork and experiments, ensuring safety and ethical guidelines are followed

Problem Solving
WS8 – Students solve problems by using identified strategies to suggest possible solutions to a familiar problem

Communicating
WS9 – Students communicate by presenting ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate

LESSON 1

FOOD FOR THOUGHT

Aim: To capture student's interest and determine what they know about Australian crops and plant biosecurity and introduce the concept that agriculture is a human influenced ecosystem.

INTRODUCTION

- Introduce the topic of crops in Australia and ask what is a crop? What are some of the different types of crops grown in Australia?
- Show the video/s "Australian Agriculture: The greatest story never told" and/or "Farming for the Future".
- Discuss why agriculture is important to our way of life and display the population growth chart (**Lesson 1: Appendix 1**, also available as a PowerPoint presentation), note the peaks post agricultural revolutions.
- Ask students what a farmer needs to grow a crop? Answer: water, nutrients, sun, healthy plants or seed, no or low pest and disease presence.
- Discuss the implications of pest management on agricultural crops.
- Ask students how a farmer would know if a crop has pests or diseases?
- Add the following words to the word wall: **CROPS, AGRICULTURE, BIOSECURITY**.

ACTIVITY | WHAT'S IN MY LUNCHBOX?

- Distribute the **Lesson 1: What's in my lunchbox?** worksheet.
- Complete the worksheet exercises looking at the contents of student lunchboxes and diets and establishing what crops produce what types of food products. If access to student lunchboxes is not possible, discuss what the class ate for dinner last night.
- Refer to the **Lesson 1: Teacher Resource - What's in my lunchbox?** in the Background Information for support to complete this exercise.
- Consider displaying the "The Crops in Australia" PowerPoint presentation as background images whilst completing the exercise.
- Introduce the concept of biosecurity – what is it? Why is it necessary? Explain that biosecurity monitoring is conducted around the country and one key area of focus is monitoring for pest insects that might affect the agricultural industry.

CONCLUSION

- Discuss the information compiled on the agricultural industry.
- Explain that in the next lesson students will be learning more about insects and how to identify them. Hand out the **Lesson 1: Homework** to be completed at home.

RESOURCES

- Hard copies of **Lesson 1: What's in my lunchbox?** and **Lesson 1: Homework**
- Contact a local farm to organise field work for later in the program (if possible).
- Videos/presentations:
  - Australian Agriculture: The greatest story never told – www.youtube.com/watch?v=fFUZ_j2cCe0
  - Farming for the Future – www.youtube.com/watch?v=OSLNi8in2iU
  - The Crops in Australia – www.crcplantbiosecurity.com.au

NOTE

Where field work within a live commercial grain crop is not feasible an alternative may be to conduct the insect surveillance exercise within the school agricultural plot. If a crop is not available to use (on or beyond school grounds) consider conducting the exercise on school grounds within a native garden or equivalent.

For the purposes of this unit it would herein be referred to as the "crop". The ultimate purpose of the exercise is for the students to learn what is involved in insect surveillance operations and whilst working in a live crop is ideal it is acknowledged that this is not always possible.

BACKGROUND INFORMATION

TEACHER RESOURCE | WHAT'S IN MY LUNCHBOX?

The following table lists some of the common foods produced by Australian crops.

Wheat	Bread, scones, pasta, noodles, breakfast cereals, cakes, biscuits, pastries, burghal, semolina, couscous, pizza crust, muffins
Barley	Pearled barley for soup, porridge, bread, biscuits, soup, malt
Rice	Cooked rice, risotto, sushi, breakfast cereals, spirits, bread, congee (rice porridge)
Maize (corn)	Tortillas, polenta, popcorn, hominy, cooked vegetable, corn syrup, cornbread, breakfast cereals (cornflakes), taco shells, cornflour (thickening agent)
Oats	Rolled oats, bread, cookies, oatmeal, muesli, snack bars
Rye	Ryebread (pumpernickel), crispbread
Millet/sorghum	Cooked grain, flat bread, porridge
Lentils	Cooked grain (common in stews and curries)
Chickpeas	Flatbread, cooked grain (used in salads, curries and stews), hummus, felafels
Peas/beans	Cooked vegetables, baked beans, fresh in salads
Soybeans	Tofu, tempeh, soy sauce, miso, soy milk, cooked grain, common food additive, vegetable oil, SoyNut butter, dairy and meat product substitutes (vegie burgers)
Sunflower	Vegetable oil, sunflower seeds
Pears	Raw fruit, juice, dried fruit, stewed
Grapes	Sultanas, fresh fruit, raisins, juice, vinegar, jam
Citrus	Fresh fruit, juice, oil used for flavouring, perfume and aromatherapy, marmalade
Sugarcane	Sugar, molasses, ethanol, bioelectricity, bioplastics

BACKGROUND INFORMATION CONTINUED

KEY MESSAGE

Biosecurity is the protection of the economy, environment and community from the negative impacts of pests and diseases. It is a shared responsibility and requires involvement from everyone in the community including the general public, producers, industry and government.

WHY IS BIOSECURITY NECESSARY?

Australia is an island nation and is naturally free from many pests and diseases that cause significant problems elsewhere in the world.

Australian agriculture interacts with domestic and international markets. Industry demands products that are free from pests and disease in order to maintain market access.

Some pests and diseases can cause severe harm to agricultural industries reducing the quantity and quality of fresh produce and increasing production costs. They can also affect human health and by employing stringent biosecurity protocols we can help prevent harm to human populations.

Australia has unique ecosystems and flora and fauna that are found nowhere else in the world. It is critically important for Australia's biodiversity to protect our natural resources.

HOW DOES BIOSECURITY WORK?

Key biosecurity goals include:

- Preventing the entry of new pests and diseases into Australia (or into a new state or region)
- Quickly finding, containing and eradicating, where possible, new outbreaks before they spread
- Managing established pests and diseases to achieve eradication where possible or at least minimise the harm they cause to industry and the environment
- Ensure that industry is equipped with appropriate surveillance, response and management strategies to respond to biosecurity threats and help to facilitate Australia's current global market access
- Continual review and improvement to Australia's biosecurity mitigation measures, particularly as new information comes to light.

THE AUSTRALIAN GRAIN INDUSTY

On a global scale Australia is a relatively small grain producer, however due to low domestic consumption a significant amount of grain is exported each year, effectively helping to feed the world. Broadly there are two types of grain crops – summer and winter crop varieties:

- Summer crops: rice, millet, maize (corn), beans, soybeans;
- Winter crops: wheat, barley, rye, triticale, peas, lentils, chickpeas, lupins.

The grain industry started in Australia in 1788 shortly after the arrival of the First Fleet with a wheat crop planted in the Sydney region. The harsh climate and lack of agricultural expertise among the convicts saw little success from the first harvests. As the colony expanded westwards huge areas of land went under cultivation and saw wheat become Australia's most important crop. Wheat was first exported from Australia in 1845.

The grain industry in 2010-11 was the largest category of food exports from Australia and accounting for 24% of total agricultural exports (Australian Bureau of Statistics).

Grain is grown in every state but is predominantly produced in the "grain" belts as demonstrated in Figure 1.

SCIENCE JOURNALS

- Scientists used them to record ideas, observations, methods and results of their research.
- Provide each student with a journal at the start of the unit.
- Model a science journal entry for students: it should be dated and contain their ideas and observations. Encourage them to be creative using drawings, diagrams, tables etc.
- Make time each lesson for students to record their ideas, exercises and observations.

WORD WALLS

- An ongoing organised display of key words that provides visual reference for students throughout the unit of study.
- Gradually add new words to the wall as the unit progresses. They can be printed on cards and taped or pinned to the wall.
- Refer to the word wall during the unit, especially for assistance with spelling.

Figure 1: Australia's Grain Growing Regions

LESSON 1 WHAT'S IN MY LUNCHBOX?

Open a lunchbox within your group and write down what plant crops were used to make each item in the lunchbox. What was the most common food item?

LUNCHBOX ITEMS	DESCRIPTION	WHAT CROP(S) WAS IT MADE FROM?
eg. Rice snax	*Rice biscuits*	*Rice*

LESSON 1 HOMEWORK

Ask your parents or someone involved in the agricultural industry (e.g. farmer, crop association group) the following questions and record the answers in your Science Journal.

? What is the biggest pest found on your farm or home vegie patch? How do you control it?

? Do you have a pest monitoring program on your farm or home vegie patch? What does it involve?

? How much of the crop is lost due to pest insects?

? What do you do to stop pest insects coming onto your farm or home vegie patch?

? Do you use any beneficial insects on your farm or home vegie patch? List them and how they are used.

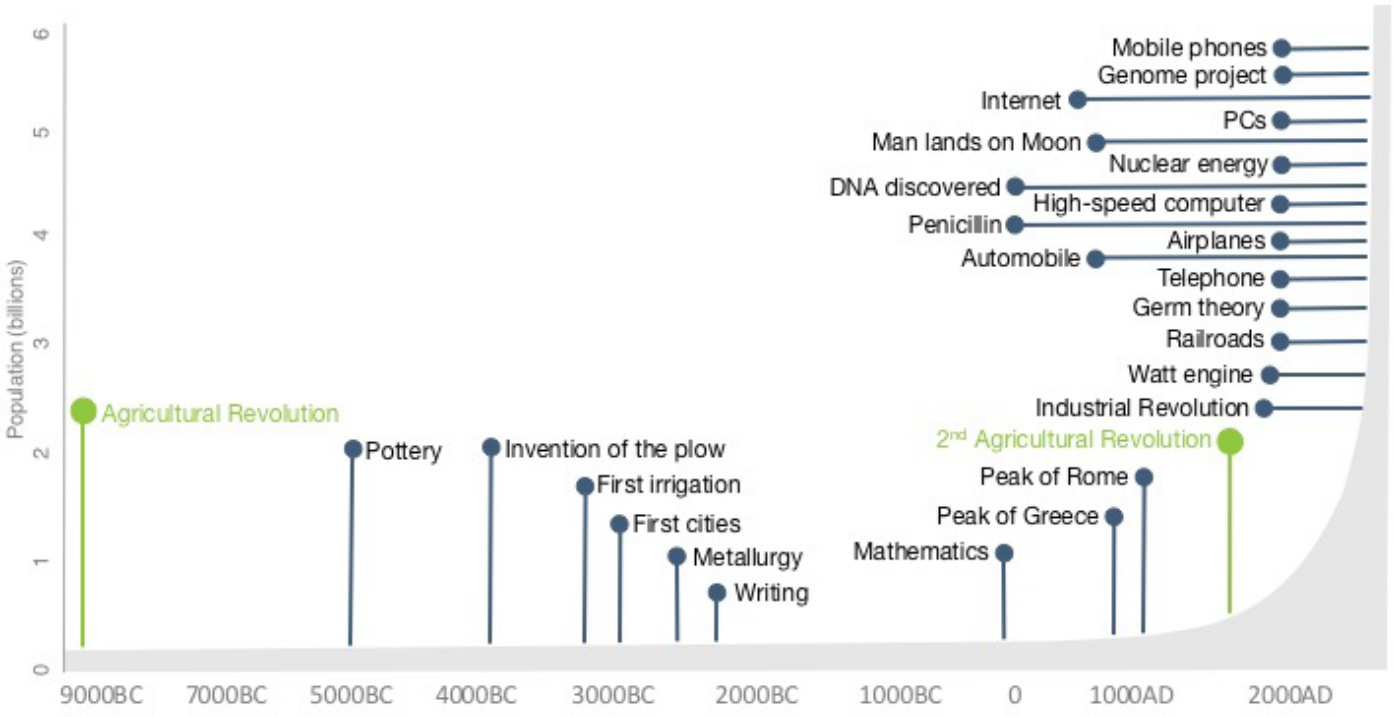
? What do pest insects mean to:
- Farmers?
- Consumers (people who eat the crop)?

? If pest insects are damaging crops how does this affect how much land we need to grow crops?

Industry group contacts for student research:

- Plant Health Australia: www.planthealthaustralia.com.au/national-programs
- Grains Research and Development Corporation: www.grdc.com.au
- Grain Producers Australia: www.grainproducers.com.au
- State Government Department of Agriculture in your state
- State Primary Industries in your state

LESSON 1 HUMAN POPULATION GROWTH CHART



LESSON 2

FRIEND OR FOE?

Aim: To introduce the concepts behind the classification of living things and learn how to use a classification key.

INTRODUCTION

- Revise Lesson 1 and why biosecurity is important to our way of life.
- Ask students why is the control of pest insects so important in agricultural crops?
- Ask students if they have travelled overseas? They may have come across the Australian Customs Incoming Passenger Card (refer Background Information) distributed by customs at the airport. Ask students why they think this might be important and how this might affect our farms and the food we eat.
- Outline to students that scientists called Biosecurity Officers are employed to help farmers identify pests within their crop.

  Biosecurity Officers also monitor points of entry around the country to check for signs of new pests so that they can be contained and managed as quickly as possible before they inflict damage on Australia's environment and agricultural industries. They monitor insects by trapping and collecting, identifying and recording the insects they find. This process is called surveillance and the class as a whole will be conducting a pest surveillance exercise as part of this unit.
- Explain that this lesson, students will explore the taxonomy of insects and learn how to identify and classify them.

ACTIVITY | CLASSIFICATION

- Show the video *"A Film about Carl Linnaeus"* to explain the concept of classification.
- Facilitate a *"Classify our Class"* activity. Nominate several students and work with the class to divide them into different groups until each student has been identified by a unique set of characteristics.
  - Start with obvious physical differences and move to more specific statements e.g. is the student male or female? Do they wear glasses or not? Do they have blue eyes or brown eyes?
  - Each statement or question must have 2 choices generally with a yes or no type response to allow progression to the next level.
  - Set up the key as a flowchart as outlined in the Classify our Class example in the Teacher Background.
  - Ask the students if there were certain features that were better for classifying.
- Add **CLASSIFICATION** to the word wall.
- Display the PowerPoint presentation **Lesson 2: Insect Classification**. Follow through the insect classification exercise (utilising the CSIRO "What Bug is That?" key in Appendix 3) with the class as a whole to improve competency of classifying insects. The animations in the presentation help to take students step by step through the process. You can discuss the contents of **Appendix 2: Hints for using keys** with the class as well as this will help eliminate a few key difficulties with using classification keys for the first time. If necessary, either display or print and hand out to the class.

CONCLUSION

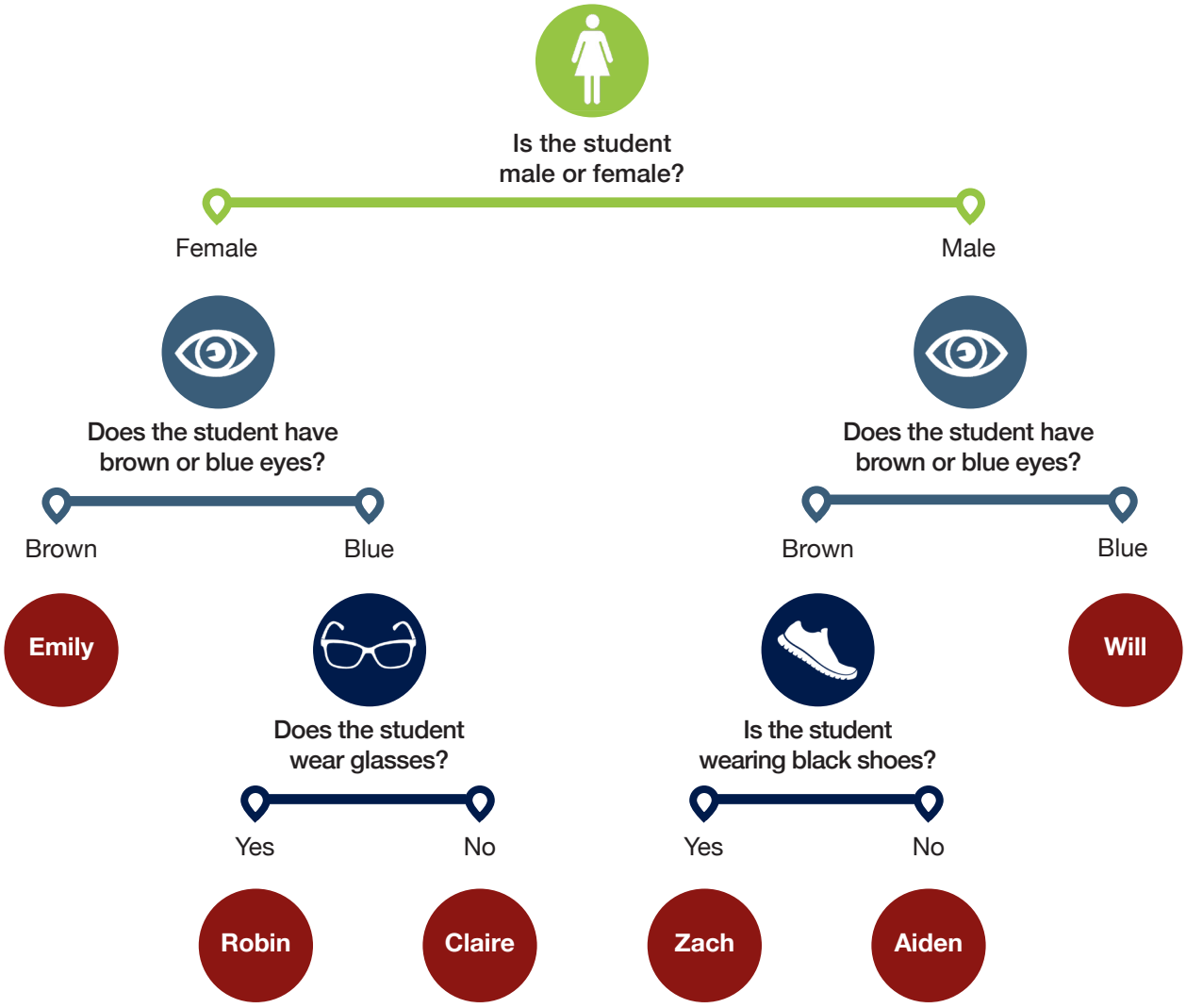
- As a group identify some of the features that are useful for classifying insects.
- Explain that in the next lesson students will be developing their own insect key.

RESOURCES

- Computer and smart screen access to display presentations to the class.
- Video “A Film about Carl Linnaeus” http://www.youtube.com/watch?v=Gb_IO-SzLgk&noredirect=1
- PowerPoint presentation **Lesson 2: Insect Classification**
- **Appendix 3: CSIRO “What Bug is That?” key**

BACKGROUND INFORMATION

CLASSIFYING OUR CLASS EXAMPLE



BACKGROUND INFORMATION CONTINUED

INSECT CLASSIFICATION

Appendix 2: Hints for using Keys
Appendix 3: CSIRO Invertebrate Key

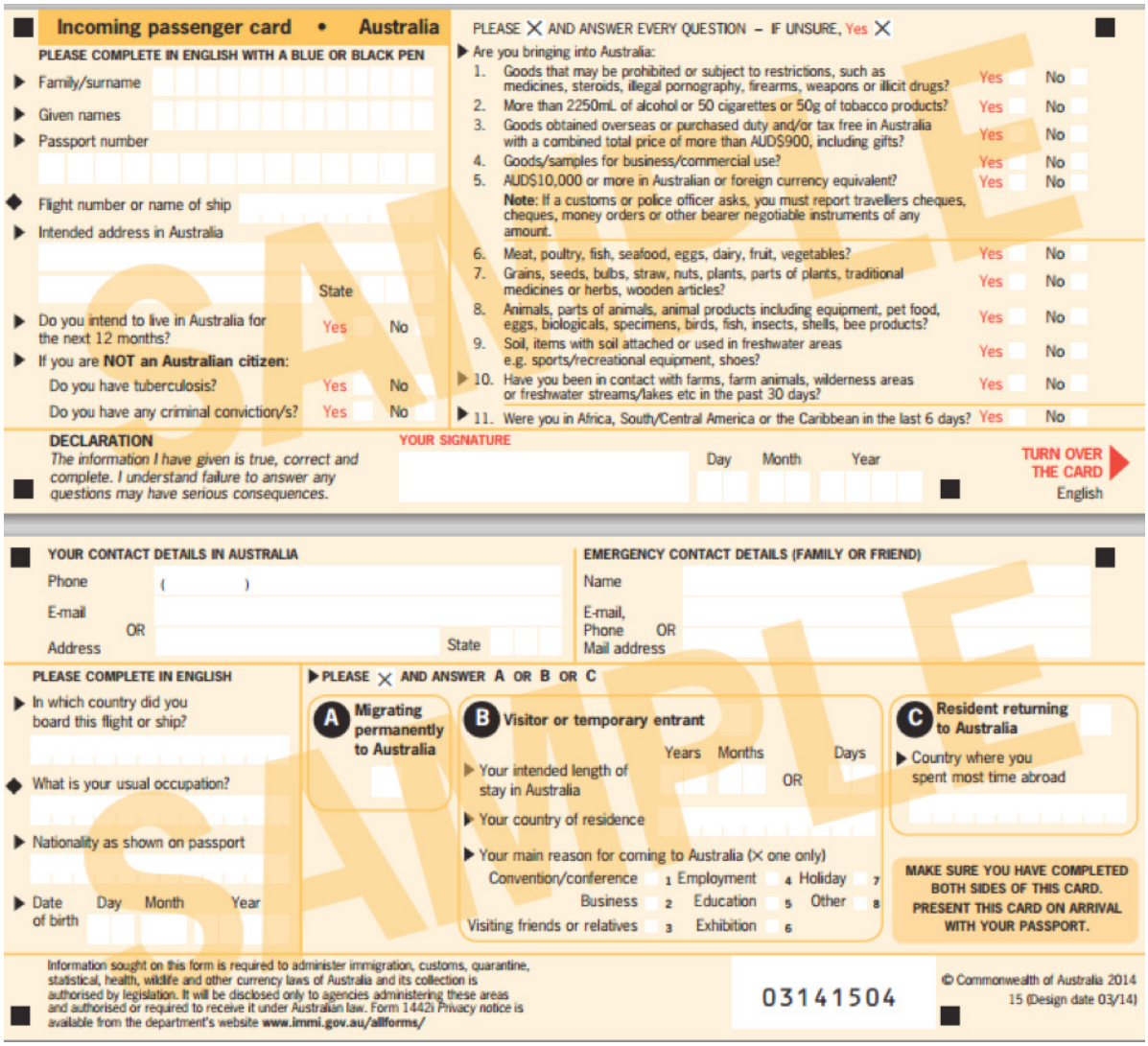
- www.ento.csiro/education/key/couplet_01.html - CSIRO Online Invertebrate Key
- www.ento.csiro.au/education/about.html - CSIRO key support
- www.ento.csiro.au/education/glossary.html - CSIRO key glossary
- www.youtube.com/watch?feature=player_embedded&v=YFNLiTPcaBU – hints on ID
- www.qm.qld.gov.au/microsites/wild/identify-insects.asp
- www.youtube.com/watch?v=YFNLiTPcaBU
- www.youtube.com/watch?v=Ogh7_ITZ3Xg – introduction to insect taxonomy

STATE GOVERNMENT BIOSECUTIRY LINKS

- www..dpi.nsw.gov.au – NSW Department of Primary Industries
- www.agriculture.vic.gov.au – Vic Department of Agriculture and Water Resources
- www.daf.qld.gov.au – Qld Department of Agriculture and Fisheries
- www.pir.sa.gov.au – SA Primary Industries and Regions
- www.agriculture.gov.au – ACT Department of Agriculture and Water Resources
- www.nt.gov.au/d/Primary_Industry - NT Department of Primary Industry and Fisheries
- www.agric.wa.gov.au – WA Department of Agriculture and Food
- www.dpiwe.tas.gov.au/agriculture - TAS Department of Primary Industries, Parks, Water and Environment

BACKGROUND INFORMATION CONTINUED

CUSTOMS INCOMING PASSENGER CARD



Incoming passenger card • Australia

PLEASE COMPLETE IN ENGLISH WITH A BLUE OR BLACK PEN

- Family/surname
- Given names
- Passport number
- Flight number or name of ship
- Intended address in Australia
- State
- Do you intend to live in Australia for the next 12 months? Yes No
- If you are **NOT an Australian citizen**:
  - Do you have tuberculosis? Yes No
  - Do you have any criminal conviction/s? Yes No

PLEASE ✕ AND ANSWER EVERY QUESTION – IF UNSURE, Yes ✕

Are you bringing into Australia:

1. Goods that may be prohibited or subject to restrictions, such as medicines, steroids, illegal pornography, firearms, weapons or illicit drugs? Yes No
2. More than 2250mL of alcohol or 50 cigarettes or 50g of tobacco products? Yes No
3. Goods obtained overseas or purchased duty and/or tax free in Australia with a combined total price of more than AUD$900, including gifts? Yes No
4. Goods/samples for business/commercial use? Yes No
5. AUD$10,000 or more in Australian or foreign currency equivalent? Yes No
   Note: If a customs or police officer asks, you must report travellers cheques, cheques, money orders or other bearer negotiable instruments of any amount.
6. Meat, poultry, fish, seafood, eggs, dairy, fruit, vegetables? Yes No
7. Grains, seeds, bulbs, straw, nuts, plants, parts of plants, traditional medicines or herbs, wooden articles? Yes No
8. Animals, parts of animals, animal products including equipment, pet food, eggs, biologicals, specimens, birds, fish, insects, shells, bee products? Yes No
9. Soil, items with soil attached or used in freshwater areas e.g. sports/recreational equipment, shoes? Yes No
10. Have you been in contact with farms, farm animals, wilderness areas or freshwater streams/lakes etc in the past 30 days? Yes No
11. Were you in Africa, South/Central America or the Caribbean in the last 6 days? Yes No

DECLARATION
The information I have given is true, correct and complete. I understand failure to answer any questions may have serious consequences.

YOUR SIGNATURE Day Month Year

TURN OVER THE CARD

English

YOUR CONTACT DETAILS IN AUSTRALIA

Phone ( )
E-mail OR Address
State

EMERGENCY CONTACT DETAILS (FAMILY OR FRIEND)

Name
E-mail, Phone OR Mail address

PLEASE COMPLETE IN ENGLISH

- In which country did you board this flight or ship?
- What is your usual occupation?
- Nationality as shown on passport
- Date of birth Day Month Year

PLEASE ✕ AND ANSWER A OR B OR C

A Migrating permanently to Australia

B Visitor or temporary entrant

- Your intended length of stay in Australia Years Months Days OR
- Your country of residence
- Your main reason for coming to Australia (✕ one only)
  - Convention/conference 1
  - Employment 4
  - Holiday 7
  - Business 2
  - Education 5
  - Other 8
  - Visiting friends or relatives 3
  - Exhibition 6

C Resident returning to Australia

- Country where you spent most time abroad

MAKE SURE YOU HAVE COMPLETED BOTH SIDES OF THIS CARD. PRESENT THIS CARD ON ARRIVAL WITH YOUR PASSPORT.

Information sought on this form is required to administer immigration, customs, quarantine, statistical, health, wildlife and other currency laws of Australia and its collection is authorised by legislation. It will be disclosed only to agencies administering these areas and authorised or required to receive it under Australian law. Form 1442i Privacy notice is available from the department's website **www.immi.gov.au/allforms/**

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15 (Design date 03/14)

FIVE KINGDOM CLASSIFICATION

There are 7 levels of classification: KINGDOM, PHYLUM, CLASS, ORDER, FAMILY, GENUS and SPECIES. The highest classification level, KINGDOM, incorporates organisms that share only a few key features. Modern taxonomy recognises five kingdoms:

- Animalia (animals);
- Plantae (plants);
- Fungi (fungi);
- Procaryota (bacteria);
- Protoctista (algae, protozoans, slime moulds).

Moving down through the levels, organisms are grouped into smaller and smaller groups. Individuals within each group become more alike until one is left with a group of all the same type of organism i.e. all the same species.

LEVEL OF CLASSIFICATION	RELATED GROUPS	
KINGDOM	Animalia	Birds, mammals, worms, starfish
PHYLUM	Arthropoda	Insects, crustaceans, spiders, scorpions
CLASS	Insecta	All insects
ORDER	Hymenoptera	Bees, wasps, ants, sawflies
FAMILY	Formicidae	All ants
GENUS	*Myrmecia*	Estimated 4,000 species
SPECIES	*Myrmecia desertorum*	Only bulldog ants

PHYLUM ARTHROPODA - THE INSECTS

Over 95% of all animals on earth are invertebrates.

Invertebrates are found in almost all habitats and range from sponges, corals and sea stars to insects, crabs and worms.

Over 80% of all invertebrates belong to the Phylum Arthropoda which includes spiders, crustaceans, centipedes, millipedes and insects.

All arthropods have in common:

- A segmented body and paired limbs
- Exoskeleton with flexible legs
- Bilateral symmetry (one side of the body is a mirror image of the other).

Insects account for over 75% of all animal species.

Insects generally have a 3-part body plan: a head, thorax (supports 6 legs and may have 1-2 pairs of wings) and abdomen.

Different insect Orders may have some structures absent, greatly modified or reduced and some juvenile stages can appear vastly different from the adults.

Most insects undergo metamorphosis or change during their life cycle. Some only increase in body size, some have gradual stages of development with each successive stage (nymph) slightly more developed than the last. Some insects undergo complete or abrupt metamorphosis and have distinct life stages: **egg > larvae > pupa > adult.**

LESSON 2 APPENDIX 2: HINTS FOR USING KEYS

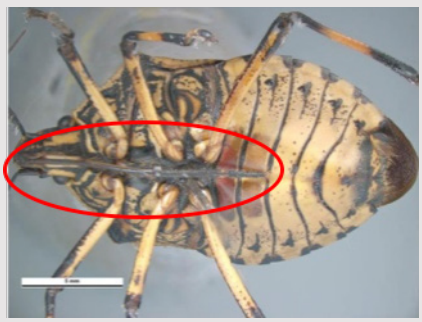
1. Do you have an adult?[1]

a) If you have a nymph of an insect that undergoes gradual or incomplete metamorphosis (e.g. grasshopper, true bug, and stick insect) some keys will work to at least Order. Nymphs may be recognised by the wing buds, or developing wings present in later growth stages.

b) If you have a caterpillar or larvae of an insect that undergoes abrupt or complete metamorphosis (e.g. butterfly, beetle, wasp, ant, beetles, flies) most keys will not work.

2. What is a "true bug"?

There is a group of insects called bugs. Not all insects are bugs, therefore we call the members of the Order Hemiptera 'True bugs' and these include aphids, leafhoppers, cicadas etc. True bugs are characterised by sucking mouthparts called a rostrum, a strong straw like structure usually held between the front pair of legs[2].



3. Does your insect have wings?

a) Can you see segments of the abdomen from above? If so, you may have an adult insect as many insects never have wings.

[1]Text and images are used with permission from the Queensland Museum's "Backyard Explorers" Leaders guide © The State of Queensland (Queensland Museum) 2010-2014) or where otherwise acknowledged.
[2]Image sourced from: www.padil.gov.au

3. Does your insect have wings continued...

b) If not, there may be wings covering the abdomen. The forewings may be hardened into protective coverings called elytra which protect membranous hindwings underneath, such as in beetles.

c) The forewings may be leathery and have the hind wings folded beneath as in grasshoppers and crickets[2].

d) Just the base of the forewings may be leathery. The forewings and hindwings fold over each other forming a cross as in some true bugs[2].

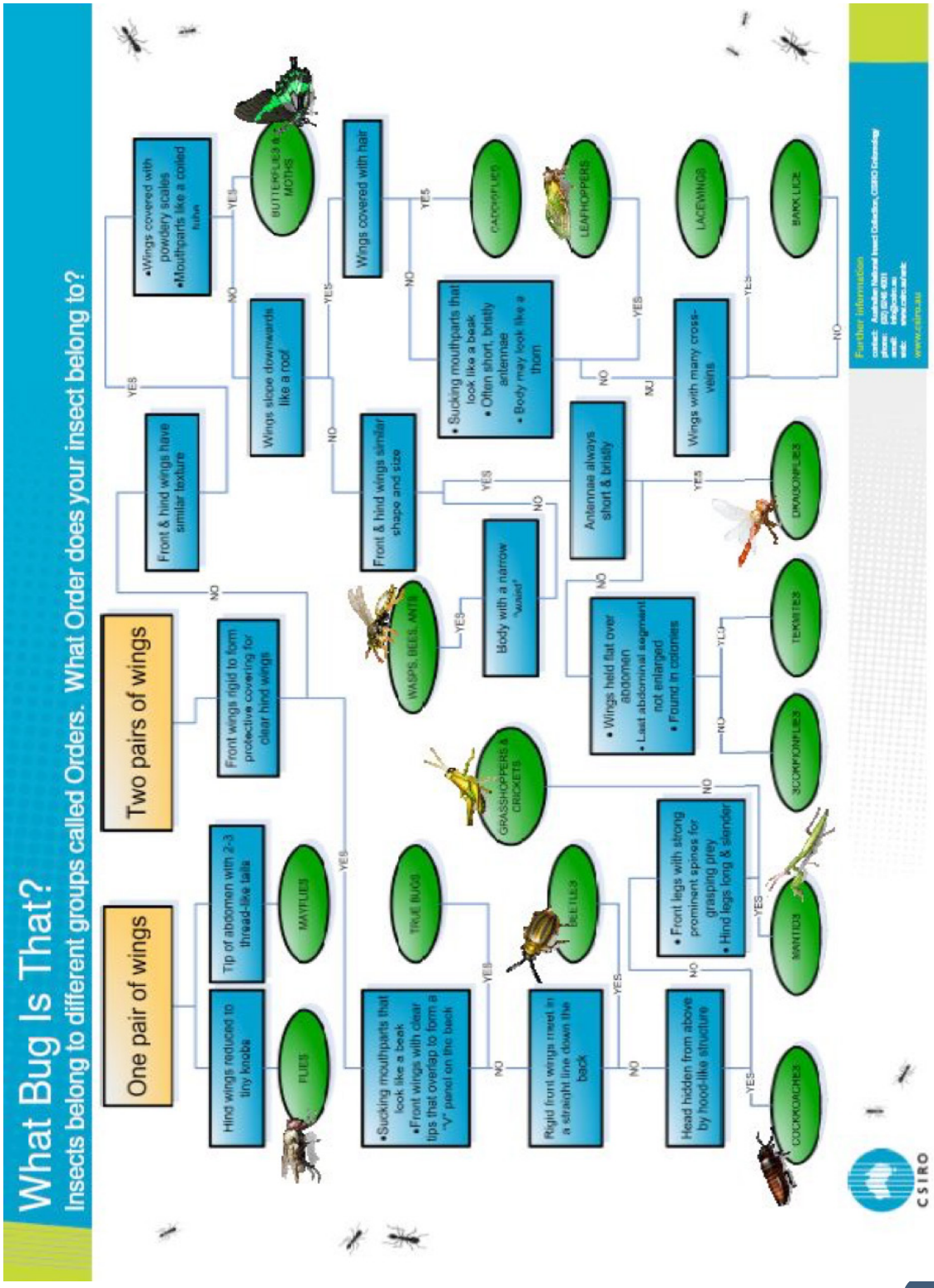
4. How many pairs of wings?

Flies and mosquitos have only one pair of wings. The hind wings have been reduced to halters (little sticks with knobs on the end behind the forewings). Wasps and bees may appear to have only one pair of wings but the 2 pairs of wings are actually hooked together. Most other flying insects will have two pairs of wings.

5. What do the mouthparts look like?

Insects broadly have one of two types of mouthparts: chewing or sucking, depending on their food source. To see the mouthparts of an invertebrate you often need to look at the ventral side of the head, so turn them over. There are several variations of the sucking mouthparts including the siphon as seen in butterflies and the sponge as seen in flies.

LESSON 2 APPENDIX 3: INSECT CLASSIFICATION KEY



LESSON 3

WHAT'S BUGGING THE FARM?

Aim: Students will learn how to identify common insects by creating their own classification key. Students will also prepare their insect monitoring traps for the next lesson.

INTRODUCTION

- Explain to students that this lesson they will be creating their own classification keys in order to identify common insects found in crops.
- Explain that the class will be conducting a trapping exercise using pitfall and sticky traps. The traps and all the equipment required for the surveillance exercise will be prepared and compiled this lesson.
- Explain that a range of environmental parameters are recorded when conducting scientific work and ask students to brainstorm what kind of data can be collected in the field e.g. temperature, location, crop type and growth stage, humidity, wind speed and direction, height of the sticky trap.

ACTIVITY | CREATING A KEY

- Split the class into two groups – A and B. Each group will be given a list of insects and will need to create a key to identify the insects on their list.
- Group A will then swap insect lists and keys with Group B (and vice versa) and each group will have to identify the insects using the key created by the other group.
- Hand out to each group the **Lesson 3: Creating a Key** worksheet and either a **Group A** or **Group B** list and allow students to work through the exercise. A list of the relevant insect Orders for this exercise is provided in the Background Information.
- Alternatively: You may opt to conduct the classification exercise as a class and display the insect images on a smart screen and use the CSIRO Online Invertebrate Key to improve students' classification skills.
- Add the words **SURVEILLANCE** and **ENTOMOLOGIST** to the word wall.
- Halfway through the lesson hand out to students the **Lesson 3: Field Work Planner** worksheets. Students will need to undertake some minor preparations (as outlined in the worksheet) for their pitfall traps and will need to collect the remainder of the equipment as listed in the worksheet in preparation for the field work the following lesson. Display **Lesson 3: Field Work Planner** PowerPoint presentation and quickly run through the field work procedure and how to prepare their traps. You may also opt to show the video "Setting Pitfall traps".

CONCLUSION

- Explain to students that in coming lessons they will be acting as citizen scientists by conducting surveillance within a local crop (or the school).

RESOURCES

- Hard copies of Lesson 3: Creating a Key and group sets of Lesson 3: Group A List or Group B List worksheets to the class
- Laptop and smart screen/projector to display videos and presentations
- Field equipment as listed in Lesson 3: Field Work Planner
- Videos/presentations:
  - Collect Insects: Pitfall Traps – www.qm.qld.gov.au/microsites/wild/collect-insects.asp
  - Lesson 3: Field Work Planner PowerPoint presentation

BACKGROUND INFORMATION

INSECT COLLECTION RESOURCES

www.qm.qld.gov.au/microsites/wild/index.asp

www.extension.entm.purdue.edu/401Book/default.php?page=home

www.ento.csiro.au/education/collecting.html

www.australianmuseum.net.au/Uploads/Documents/9382/The%20Invertebrate%20Collection%20Manual.pdf

www.youtube.com/watch?v=OhIJ8eNbhnI – what is an insect?

TEACHER ANSWERS | CREATING A KEY

Queensland Fruit Fly – Order Diptera

Red Scale Parasitoid – Order Hymenoptera

Ladybeetle – Order Coleoptera

Glassy Winged Sharpshooter – Order Hemiptera

Citrus Fruit Borer – Order Lepidoptera

Bean Thrips – Order Thysanoptera

Crusader Bug – Order Hemiptera

Brown Lacewing – Order Neuroptera

TRAP TYPES

A pitfall trap is a partially buried container that traps active ground dwelling invertebrates such as beetles, spiders and ants. The organism walks to the edge and falls in and due to the sheer sides cannot get out. Some type of liquid preservative is added to the traps to preserve specimens until collection. There are a range of designs but only one will be used for the class exercise.

A sticky trap is a flat piece of card covered in a non-drying tacky glue that is erected on a garden stake or hung from a tree. They are often yellow in colour to attract insects and generally attract active flying invertebrates, typically plant pests or their predators. Sticky traps can be purchased from hardware or garden stores and come ready to install in the field.

TRAP PLACEMENT

Regardless of the type of trap used the following protocols are typically adopted to ensure an accurate representation of the insect population being sampled:

- Place traps in a “typical” part of the crop i.e. not near unusual objects such as buildings, dams, powerlines, fences etc.
- Conduct the trapping within the crop, at least 2-5m from the edge to minimise the trapping of insects travelling alongside the crop (they may not always be travelling through or living with the crop).

LESSON 3 CREATING A KEY

Draw a key that would allow someone else to identify the insects (to Order level) on your list. Use common features and yes or no type questions using insect body parts such as wing number or type, mouthparts, size, shape, antennae. Swap with the other group and identify insects using their key.

Key title:			
Insects identified:	1.	2.	3.
Key:			

LESSON 3 GROUP A LIST

INSECT 1: QUEENSLAND FRUIT FLY

(BACTROCERA TYRONI)

LOCATION: NSW, QLD (not in SA or WA)

BIOSECURITY RISK: HIGH priority

PRIMARY HOSTS: All commercial fruit varieties except pineapple and strawberries.

DESCRIPTION: Wasp-like, red/brown with yellow markings, about 8mm long, red eyes, one pair of wings.

DAMAGE CAUSED: Feeds and lays eggs in fruit; larvae eat the inside of the fruit and the fruit rots.

Top view

Head (top view)

Wing

Head (side view)

Abdomen

INSECT 2: RED SCALE PARASITOID

(Aphytis melinus)

LOCATION: NSW, SA

BIOSECURITY RISK: NONE - Beneficial

PRIMARY HOSTS: Citrus crops, passionfruit, olives, walnuts, roses, ivy, pawpaw.

DESCRIPTION: About 2mm long, yellow, chewing mouthparts, two pairs of membranous wings, wasp.

DAMAGE CAUSED: Lays eggs onto pest scale insects and the larvae eat the scale insect.

Top view

Side view

Head

INSECT 3: LADYBEETLE

(Coelophora inaequalis)

LOCATION: Australia-wide

BIOSECURITY RISK: NONE - Beneficial

PRIMARY HOSTS: Most crops and ornamental plants (wherever their prey is found).

DESCRIPTION: Shiny, patterned black, orange and red, chewing mouthparts, two pairs of wings, hardened wings form elytra, soft hindwings.

DAMAGE CAUSED: Predates on aphids, mites and moth eggs; important beneficial predators in crops especially early in the season.

Ventral view (underneath)

Mouthparts

Top view

Wings

INSECT 4: GLASSY WINGED SHARPSHOOTER

(Homalodisca vitripennis)

LOCATION: Not yet in Australia

BIOSECURITY RISK: HIGH priority

PRIMARY HOSTS: Citrus plus over 100 other plant species like grape, almond and peaches.

DESCRIPTION: 12-14mm long, dark brown colouring paler underneath, upper parts of head dotted, two pairs membranous wings are see through with reddish veins, sucking mouthparts.

DAMAGE CAUSED: Feeds on plants and causes damage however biggest risk is transmitting bacteria and causing infection

Top view

Mouthparts

Head

Wings

LESSON 3 GROUP B LIST

INSECT 1: CITRUS FRUIT BORER

(Citripestis agittiferella)

LOCATION: Not yet in Australia

BIOSECURITY RISK: HIGH priority

PRIMARY HOSTS: Citrus.

DESCRIPTION: About 10mm long, grey/brown, 2 pairs soft wings covered in scales, sucking mouthparts.

DAMAGE CAUSED: Larvae tunnel through the fruit causing it to deform and rot.

Top view

Wing

Abdomen (underneath)

Head/mouthparts

INSECT 2: BEAN THRIPS

(Caliothrips fasciatus)

LOCATION: Not yet in Australia

BIOSECURITY RISK: HIGH priority

PRIMARY HOSTS: Citrus, pastures, beans, peas, ornamental plants.

DESCRIPTION: About 1mm long, two pairs of wings, forewings fringed with hairs and folded over back when at rest, chewing mouthparts, no cerci.

DAMAGE CAUSED: Adults shelter in cavities of oranges causing deformities

Top view

Wing (fringed)

Antennae

INSECT 3: CRUSADER BUG

(Mictis profana)

LOCATION: Australia-wide

BIOSECURITY RISK: HIGH Priority

PRIMARY HOSTS: Citrus, grain, fresh flowers, ornamentals, grapes, beans and peas.

DESCRIPTION: Brown with yellow cross on the back, about 2.5cm long, leathery forewings with membranous hindwings, sucking mouthparts.

DAMAGE CAUSED: Feeds on young plants causing shoots to die back.

Top view

Mouthparts

Wings

Ventral side (underneath)

INSECT 4: BROWN LACEWING

(Micromus tasmaniae)

LOCATION: Australia-wide

BIOSECURITY RISK: NONE - Beneficial

PRIMARY HOSTS: All field crops

DESCRIPTION: Long antennae, prominent eyes, 8mm long, mottled brown, two pairs clear membranous wings held tent-like over the back when resting, chewing mouthparts.

DAMAGE CAUSED: Adults and larvae predate on soft bodied insects such as aphids, moth eggs, small larvae, mites, whiteflies and scale insect

Top view

Wings

Head/mouthparts

LESSON 3 FIELD WORK PLANNER

CHECKLIST: TRAP SETUP

- [ ] 2 pieces of plain paper
- [ ] HB pencil
- [ ] Scissors
- [ ] GPS
- [ ] Weather data recorder
- [ ] Camera
- [ ] Twist ties
- [ ] Garden stake
- [ ] Disposable gloves
- [ ] Preservative (water & detergent)
- [ ] Trowel
- [ ] 2 icecream containers with lids
- [ ] 1 meat tray
- [ ] 2-4 tent pegs
- [ ] 1 sticky trap
- [ ] 3-4 paperclips
- [ ] Box to place equipment in per group

CHECKLIST: TRAP COLLECTION

- [ ] Disposable gloves
- [ ] OHP transparency with grid
- [ ] Specimen bottles
- [ ] Cling wrap
- [ ] Fine sieve
- [ ] Long-term preservative (eg, ethanol)

LABEL PREPARATION

Create two labels for each trap: • One for set up • One for collection	Cut copy paper to size and write in HB pencil	• Location • Date • Collector's name • Crop type/stage • Trap type	**Location:** Cummins Farm **Date:** 11/12/15 **Collector's name:** J. Smith **Crop type/stage:** Grain/vegetative **Trap type:** Pitfall trap

TRAP PREPARATION

Ice-cream containers Cut a hole in the middle of 1 ice-cream lid using scissors. Leave an edge of 1-2cm. You should have one normal lid and one that looks like a donut.	**Meat trays** Take the meat tray and cut off the short ends so the tray makes a tunnel along the long sides.	**Sticky trap** Add the sticky trap and its labels to the equipment box.	**Equipment box** Place all of the traps, labels and other equipment listed above in the equipment box.

LESSON 4

LAYING THE TRAPS

Aim: Students will work collaboratively to undertake their insect surveillance exercise. They will experience hands-on scientific methodologies such as correct sampling and labelling techniques and recording of local abiotic data.

INTRODUCTION

In this lesson the students will travel to the field work site (either a local farm or within the school grounds) to conduct the insect surveillance activity.

Explain to the class that they will be collecting insects that live within and travel through this crop. Their insect samples will then be taken back to the classroom and identified using an invertebrate key.

It is important to bear in mind that in the event the surveillance exercise is being conducted within a live crop the biosecurity needs of the farm must be taken into consideration. Further guidance on this issue is provided in the Background Information.

If time has passed since the last lesson you may need to consider replaying the video *Collect Insects: Pitfall Traps*

ACTIVITY | LAYING THE TRAPS

Travel to the field site with equipment boxes.

Upon arrival ask students what type of crop they are in and its growth stage. You may consider asking the farm manager to discuss the following:

- The crop cycle.
- What has been done to this crop so far this season?
- What and how much does this farm produce?
- What happens to the crop when it is harvested and is it destined for local or international markets?
- What insects does the farmer find most often in the crop and how do they identify them?
- What are the common pests and beneficial insects found?
- How much damage do pests inflict on this crop?
- How does the farmer manage pests within this crop e.g. chemical spraying, IPM etc.?

Lead a brief class discussion to decide on trap locations (refer to Background Information for guidance).

Hand out **Lesson 4: Field Work – Laying the Traps** worksheets among the groups and work through the labelling and trap installation procedures as outlined.

Allow students time to record their trap location (GPS coordinates) and weather data in their Science Journals. Keep a photo journal of the equipment and procedures.

CONCLUSION

Remind students that the purpose of this surveillance exercise is to identify pests within the crop and monitor for any biosecurity threats. Whilst conducting the sampling they too must assist with the biosecurity needs of the farm to ensure they are not accidentally transporting weeds, pests and diseases.

RESOURCES

- Hard copies of **Lesson 4: Field Work** – Laying the traps worksheets to each group.
- Field equipment as listed in **Lesson 3: Field Work Planner**
- Access to a local crop or the school agricultural plot/gardens and the necessary transport for that location.
- If necessary the video Collect Insects: Pitfall Traps – www.qm.qld.gov.au/microsites/wild/collect-insects.asp

BACKGROUND INFORMATION

FARM BIOSECURITY

When conducting any work on an operating farm it is vital to ensure that a few basic protocols are followed to protect the biosecurity of the property. Weeds, pests and diseases are easily and often accidentally transported around the landscape. Biosecurity protocols are designed to reduce the risk of accidental transmission. Farm biosecurity measures include:

- Adopt a "Come Clean Go Clean" policy and ensure that you, your vehicle and equipment arrive (and depart) the property free from mud, dirt and plant material.
- Do not take plant matter to or from the property, it may contain diseases and/or very tiny pest insects.
- Stick to designated roads, parking areas and paths at all times (except for when setting the traps within the crop and then only go in as far as absolutely necessary).
- If provided, utilise wash down bays and foot baths as directed by the farmer.
- Do not visit other farms immediately after conducting the field work.
- Refer to www.planthealthaustralia.com.au/wp-content/uploads/2012/11/Biosecurity-Manual-for-Grain-Prducers.pdf for further information on grain farm biosecurity.

TRAP LOCATION

- Traps should be located between 2-5m from the edge of the crop to minimise edge effects.
- Groups should be set about 5m apart and sticky and pitfall traps (from the same group) can be placed about 1m apart.
- In grain crops sticky traps are tied to a garden stake with string. The trap should be hung vertically and if possible facing into the breeze. The trap needs to be located just below the leaf line so that it doesn't easily tangle in the branches of the tree.
- Pitfall traps must be buried so the soil surface is level with the top of the container as demonstrated in PowerPoint Presentation **Lesson 3: Field Work Planner ppt**.
- Place traps in a "typical" part of the crop i.e. not near unusual objects such as buildings, dams, powerlines, fences etc.
- Accurately record the trap location so that it may be found again at collection time.
- Record environmental parameters such as weather observations.

LESSON 4 FIELD WORK LAYING THE TRAPS

1

Location

- Decide on appropriate trap locations
- Place traps 2-5m from edge of the crop (walk between plants not on them)
- Choose a “typical” part of the crop (i.e. not near something unusual)
- Sticky traps and pitfall traps can be set about 1-2m apart
- Place each group about 5m apart

2

Labelling

- Take 2 labels from the equipment box (leave the other 2 labels for collecting the traps)
- Sticky Trap: clip label to the trap with paperclips
- Pitfall trap: place label in the trap in the preservative

3

Sticky trap

- Open the sticky trap as per the instructions on the trap (there are twist ties for this if necessary)
- Push garden stake into the ground. Attach trap to stake with twist ties. The **bottom of the trap** should be level with the **top of the crop**.
- Face trap into the breeze with long sides pointing up and down.

4

Pitfall trap

- Fit the ice-cream containers together one inside the other
- Firmly attach Lid 1 (with hole) onto the containers. Attach Lid 2 (no hole) over the top of Lid 1
- Dig a hole into the soil big enough to fit the trap so the top is level with the ground. Place trap into the hole and adjust if necessary
- Return soil to the edge of the container DO NOT get soil in the trap or you will have to empty and start over
- Very carefully remove Lid 2, leave Lid 1 in place
- Add preservative to the trap (at least 3 cm deep) and add label
- Cover the trap with the meat tray roof. Peg down with tent pegs or a rock

5

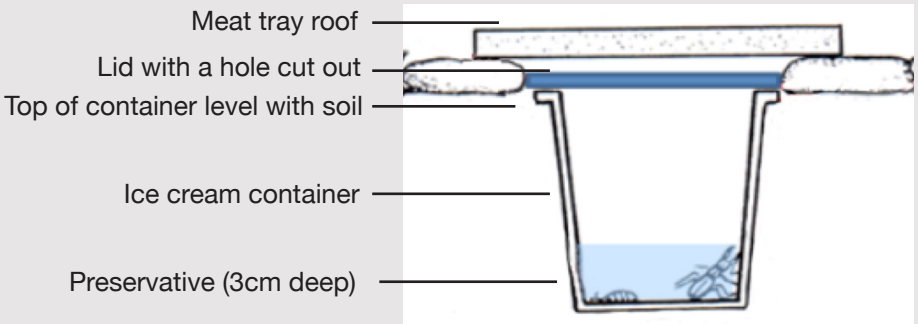
Record

In your science journal:

- Draw a map of the field site and record your trap location
- Record GPS location
- Record weather data (temperature, humidity, wind speed/direction)
- Trap data: trap owners, crop type/growth stage, date

STICKY TRAP

PITFALL TRAP



REMEMBER: Lid 2 (no hole) is removed fromthe trap once in the ground.

LESSON 5

COLLECTING THE TRAPS

Aim: Students will work collaboratively to undertake their insect surveillance exercise. They will experience hands-on scientific methodologies such as correct sampling and labelling techniques and recording of local abiotic data.

INTRODUCTION

In this lesson the students will travel back to the field work site to collect their traps used in the insect surveillance activity.

If time permits the students may begin sorting the pitfall trap samples ready for classification of their specimens next lesson, but this will be dependent on lesson duration and the distance to/from the field site.

Sorting can be undertaken next lesson and the traps merely stored once they are collected. Both options have been presented in this lesson plan.

Remind students of the necessary biosecurity protocols required when entering/exiting the farm.

If necessary consider replaying the Collect Insects: Pitfall Traps video to refresh students on how to collect the pitfall trap specimens.

ACTIVITY | COLLECTING THE TRAPS

Travel to the field site with equipment boxes.

Hand out **Lesson 5: Trap Collection Methods** worksheet and allow the class time to work through the collection exercise and record their observations.

Make sure students fill in the holes left by the pitfall traps once the traps have been removed.

As a class discuss any unexpected observations of the traps and how effective the traps appear to have been in trapping insects within the crop.

Collect all traps and equipment and return to class to either store or commence sorting the samples.

Storing the Samples

- If, due to time constraints, the specimens are not able to be sorted this lesson they need to be stored correctly in preparation for next lesson.
- Sticky Traps: place trap in an airtight container and leave in a refrigerator;
- Pitfall Traps: ensure specimens are stored within a sealable container (e.g. specimen jar) and there is enough preservative in the jar to cover all of the specimens. Leave in a cool location out of direct sunlight.

Sorting the Samples

- It is likely this will occur next lesson due to time constraints.
- The specimens on the sticky traps are not able to be removed so they do not require sorting.
- The pitfall traps are sorted for easier identification of the specimens. Sorting the specimens into “like” insects assists the students in identifying the differences between different insect Orders and also speeds up the classification process.
- Follow the instructions outlined in **Lesson 5: Sorting the Pitfall Trap Samples**.

CONCLUSION

Explain to students that they have now completed the surveillance exercise and the next step is to classify and identify their specimens in order to determine if they have discovered any pest species.

RESOURCES

- Hard copies of **Lesson 5: Trap Collection Methods worksheet** to each group.
- Field equipment as listed in **Lesson 3: Field Work Planner.**
- Video *Collect Insects: Pitfall Traps* – www.qm.qld.gov.au/microsites/wild/collect-insects.asp
- Access to the crop or the school agricultural plot/gardens used in last lesson and the necessary transport for that location.
- OHP transparencies printed with a grid (enough for 1 per sticky trap) if sticky traps have no grids printed on them. If traps have a grid on them already a roll of cling wrap is used instead of the OHP transparencies.
- If sorting the samples this lesson:
  - Science/laboratory room;
  - Copies of **Lesson 5: Sorting the Pitfall Trap Samples** worksheet for each group;
  - Equipment as listed in **Lesson 5: Sorting the Pitfall Trap** Samples.

BACKGROUND INFORMATION

Collecting the Traps

- www.qm.qld.gov.au/microsites/wild/collect-insects.asp
- www.ento.csiro/education/collecting.html
- www.australianmuseum.net.au/Uploads/Documents/9382/The%20Invertebrate%20Collection%20Manual.pdf

LESSON 5 TRAP COLLECTION METHODS

Data

In your Science Journal record:
- Date of collection
- Name of trap collectors
- Weather data
- Any unusual observations

Prepare collection labels
Be sure to collect all equipment and traps at the end.

Sticky Trap

01 Pick one student to put on disposable gloves

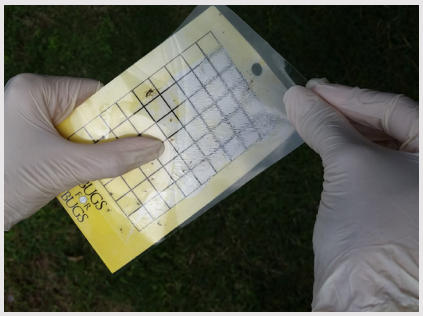
02 This person carefully removes the trap from the tree. Hold the trap with both hands at the non-sticky ends. Attach a collection label to the trap.

03 If the trap has a GRID on it take a piece of cling wrap and carefully place over the trap. Keep it as smooth as possible. Cut off any excess or fold it behind. DO NOT REMOVE once laid as this will pull insects from the trap.

04 If the trap HAS NO GRID on it, take a OHP transparency printed with a grid and place over the trap. DO NOT REMOVE once laid, as it will pull the insects off.

03

04



Pitfall Trap

01 Pour contents of trap (preservative and insects) through a fine sieve into a clean ice cream container. Wash out any soil, sticks and leaves.

02 Wash the dirty water out of the ice cream container

03 Knock the sieve against the side of the clean ice cream container. Add a long-term preservative (eg, ethanol) - just enough to cover the specimens.

04 Pour the preservative along with the specimens into a specimen jar or bottle with a lid. Secure the lid.

03

04

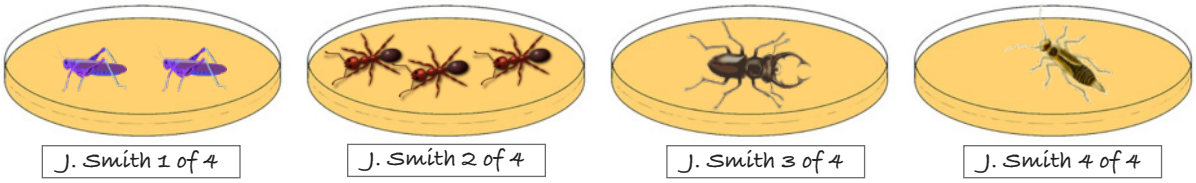
LESSON 5 SORTING THE PITFALL TRAP SAMPLES

EQUIPMENT

- Dissecting microscope with light OR 15X or 10X hand lens
- 1-2 dissecting trays
- 1-2 dissecting tool sets (straight or curved/fine needle, soft tweezers)
- 10-12 petri dishes with lids or a shallow dish
- Masking tape and fine tipped marker pen
- Long-term preservative e.g. ethanol or methylated spirits
- Specimen jars for larger insects/non-insects

METHOD

1. Gently swirl the specimen jar so that the insects are mixed into the preservative
2. Carefully pour some (preservative + insects) into a petri dish – only enough so that the insects form a shallow layer in the petri dish
3. Using a teasing needle or tweezers gently lift into separate petri dishes any large insects or non-insects such as centipedes, spiders or lizards
4. Add preservative so that those specimens are covered. NOTE: if the non-insects/large insects are too large for a petri dish place them into a specimen jar and cover with preservative
5. Under a dissecting microscope sort the insects into groups of similar looking insects and place each new group in a separate petri dish (one petri dish = one type of insect)



6. Place lids on the petri dishes and secure with masking tape (over the lid and sides) to hold it firm (**NOTE**: if classification is to happen straight after the sorting don't tape the petri dishes until the end of the lesson)
7. Label each petri dish (write on the tape with marker pen) with your name and a number each petri dish (e.g. J. Smith 1 of 10, 2 of 10 etc.) so they can be identified next lesson
8. Place all of your group's petri dishes on a dissecting tray and store out of direct sunlight until time to classify

LESSON 6

WHAT IS BUGGING THE FARM?

Aim: Students will use an online key to classify the insects they collected in the surveillance exercise.

INTRODUCTION

Students will be using an interactive online classification key developed by the CSIRO to identify their insect specimens collected during the surveillance exercise. Insects will be identified down to Order level to provide students with an insight to the differences between different types of insects.

For the purpose of this exercise only insects will be identified. Spiders, mites, centipedes, millipedes etc. are not covered and if trapped will be set aside in the non-insects category.

The classification tool to be used is the CSIRO Online Invertebrate Key. There are additional resources provided below to assist with the insect identification process.

Given the complexity of the insect world classification can be tricky.

Consider inviting a professional entomologist to assist with insect identification:

- Local entomologist (refer to local farming organisations that assist with pest management e.g. Elders, Wesfarmers, farm produce stores)
- Local tertiary institutions particularly if they offer entomology related subjects
- State government departments associated with the management of primary industries (for a full list refer to Lesson 2)
- Online insect identification systems such as the MyPestGuide app developed by the Western Australian Department of Agriculture. It is a free app that can be utilised to submit insect sightings for identification.

ACTIVITY | CLASSIFICATION

If the class didn't sort their pitfall trap samples in Lesson 5 refer to the notes and instruct the class to sort their samples ready for classification.

Consider refreshing the students learning on classification by showing the videos "Hints on Identifying Insects" and/or "Using an online Interactive Key" to direct students how to use the online key.

Hand out **Lesson 6: Gotcha! Insect Classification** worksheet. It's advised to first demonstrate the classification to the whole class before allowing independent work by the groups.

To maximise access to the microscope consider splitting the groups into pairs and divide each groups' trap contents amongst the pairs.

Provide the sorted specimens to the class and allow them to commence the classification exercise. Insects will only be identified to Order level.

A **Grain Biosecurity Threats** poster has been developed for this exercise to assist in the identification of any potential biosecurity threats (although it is unlikely that any threats will be found) and a link has been provided in the Background Information for the Biosecurity Manual for Citrus Producers provided by Plant Health Australia with further biosecurity threat descriptions.

Hand out the **Lesson 6: Data Sheet** for students to record the results of the classification exercise as they go. The data for each group and the class will be collated next lesson.

Update the word wall with any new terms.

CONCLUSION

Explain that of the 86,000+ known insect species in Australia less than 1% are considered to be economic pests. Classifying insects within a crop can be used to identify pest species including biosecurity threats and allow for their control.

Discuss with the class their findings. Did one type of trap work better and why? What insects were easier or harder to identify and why?

RESOURCES

- Laptop and smart screen/projector to display the videos and interactive online key.
- Hard copies for each group **Lesson 6: Gotcha! Insect Classification, Lesson 6: Data Sheet**

BACKGROUND INFORMATION

STATE GOVERNMENT BIOSECURITY LINKS

- www.dpi.nsw.gov.au/content/agriculture/broadacre/pests-diseases
- www.agriculture.vic.gov.au – Vic Department of Agriculture and Water Resources
- www.daf.qld.gov.au – Qld Department of Agriculture and Fisheries
- www.pir.sa.gov.au – SA Primary Industries and Regions
- www.agriculture.gov.au – ACT Department of Agriculture and Water Resources
- www.nt.gov.au/d/Primary_Industry - NT Department of Primary Industry and Fisheries
- www.dpiwe.tas.gov.au/agriculture - Tas Department of Primary Industries, Parks, Water and Environment

INSECT CLASSIFICATION

- www.ento.csiro/education/key/couplet_01.html - CSIRO Online Invertebrate Key
- www.ento.csiro.au/education/about.html - CSIRO key support
- www.ento.csiro.au/education/glossary.html - CSIRO key glossary
- www.youtube.com/watch?feature=player_embedded&v=YFNLiTPcaBU
- www.qm.qld.gov.au/microsites/wild/identify-insects.asp
- www.youtube.com/watch?v=YFNLiTPcaBU
- www.planthealthaustralia.com.au/wp-content/uploads/2012/11/Biosecurity-Manual-for-Grain-Producers.pdf

LESSON 6 GOTCHA! INSECT CLASSIFICATION

Equipment

- Dissecting microscope with light
- 1-2 dissecting tool sets (teasing needle, soft tweezers)
- Petri dishes of sorted insects
- Sticky traps from the field work
- Long-term preservative e.g. ethanol or methylated spirits

Sticky Trap

01 Select one column on the trap (can be any column)

02 Classify the insects found in each square of that column using the CSIRO Invertebrate Key

03 Record your results in your data sheet

04 Calculate the total number of insects on the trap for each insect Order

05 Check the rest of the trap for any "new" insects that were not in the "counted" column. Record any new data on your data sheet

06 Be on the lookout for any biosecurity threats as found in the Biosecurity Manual for Grain Producers – Plant Health Australia or Grain Biosecurity Threat poster

01

Pitfall Trap

01 Select a petri dish

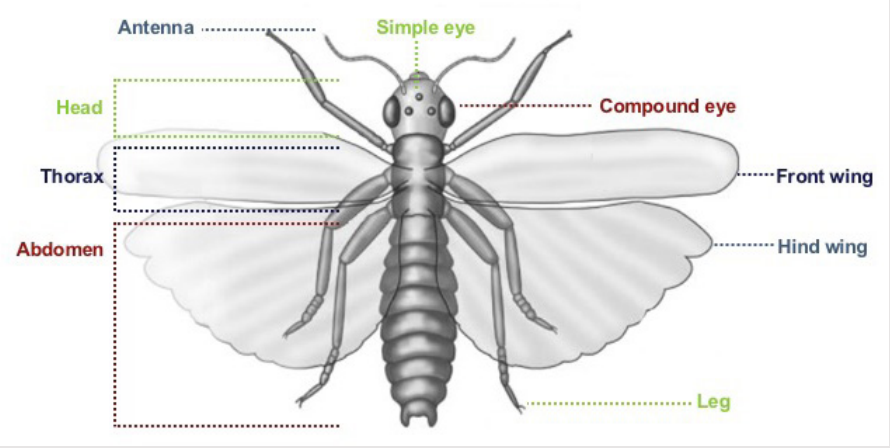
02 Classify the insects found in each petri dish using the CSIRO Invertebrate Key

03 Record your results in your data sheet

04 Calculate the total number of insects in the trap for each insect Order

05 Check the rest of the petri dishes for any "new" insects that haven't yet been identified. Record any new data on your data sheet.

06 Be on the lookout for any biosecurity threats as found in the *Biosecurity Manual for Grain Producers - Plant Health Australia or Grain Biosecurity Threat poster*



LESSON 6 DATA SHEET

Name:	Class:	Crop type:

GPS Coordinates:	Growth Stage:

Weather data:

	Trap Setup	Collection
Date:		
Temperature:		
Wind speed:		
Humidity:		

Trap Type:	Insect Order:	Common name:	Number collected:

ST: Sticky trap
PT: Pitfall trap

Trap Type:	Insect Order:	Common name:	Number collected:

Total number of insects collected: Pitfall traps: _____ Sticky traps: _____

LESSON 7

KEEPING OUR EYES PEELED

Aim: Students will draw conclusions from their findings on the insect surveillance exercise and discuss in context of biosecurity.

INTRODUCTION

In this lesson students will revise and summarise their findings from the insect surveillance exercise. Data will be collated for the class and examined to draw conclusions on the abundance of certain insects.

ACTIVITY | CLASSIFICATION

Briefly collate the class data set using the PowerPoint presentation **Lesson 7: What's Bugging the Farm?** and/or hand out the **Lesson 7: Data Collation** worksheet. Teachers can populate the embedded tables and graphs within the presentation (to add data to the graph in the presentation > click on the graph > click on the Design tab > click on edit data > the embedded Excel spreadsheet will open > enter data into the spreadsheet and it will automatically populate the graph > close the spreadsheet to view the graph).

Discuss the results of the exercise and any unexpected outcomes.

Update the word wall with any new terms.

Compare your findings with the lists of known biosecurity threats (which can be found on your relevant state government biosecurity website, listed in **Lesson 2**).

Identify the type of insects trapped in terms of diet, i.e. herbivore, carnivore or omnivore and identify which species could be a plant pest vs. possible plant pest predators.

Although unlikely, in the instance that a potential biosecurity threat is discovered during the surveillance exercise it should be reported to the local state authorities relevant for your school. A protocol for how to report a suspected biosecurity threat has been outlined below. If utilising specialist entomologists during the classification exercise they can assist with this.

Prompt class discussion by asking why is it important to identify exotic pest species early in their arrival to Australia? What would happen if surveillance of exotic pests was not done?

CONCLUSION

Insect surveillance is a vital tool for identifying what insects exist in our environment, especially for monitoring biodiversity and biosecurity.

If a threat is discovered it must be reported so that appropriate action can be taken. It is also vital for the farmer to know what pests exist in their crop so they can take the appropriate control action.

RESOURCES

- Laptop and smart screen/projector to display presentation
- PowerPoint presentation **Lesson 7: What's Bugging the Farm?**
- Hard copies of **Lesson 7: Data Collation** worksheet if not using the digital presentation (print double sided).

BACKGROUND INFORMATION

ONLINE IDENTIFICATION RESOURCES

- www.grdc.com.au/uploads/documents/GRDC_BPG_BeneficialInsects.pdf
- www.grdc.com.au/Resources/Ute-Guides/Insects
- www.books.google.com.au/books?printsec=frontcover&vid=ISBN0643067582&redir_esc=y#v=onepage&q&f=false
- http://anic.ento.csro.au/ants/
- www.ipm.uconn.edu/documents/raw2/Identifying%20Some%20Pest%20and%20Beneficial%20Insects%20on%20Your%20Sticky%20Cards/2010Sticky%20percent20Card%20percent20PhotosIPMCompatibilityMode.pdf
- www.ces.ncsu.edu/depts/ent/notes/O&T/production/stickycard/sticky.pdf

BIOSECURITY REPORTING PROTOCOL

If an insect is suspected as being a biosecurity threat it must be reported

Call the **Exotic Plant Pest Hotline 1800 084 881** and provide details of your find such as the location, plant affected, suspected pest and if possible email clear photos

A specialist will confirm the identity of the insect in question.

If the insect is deemed to be a biosecurity threat government agencies and affected industries are notified and a Response Plan is activated.

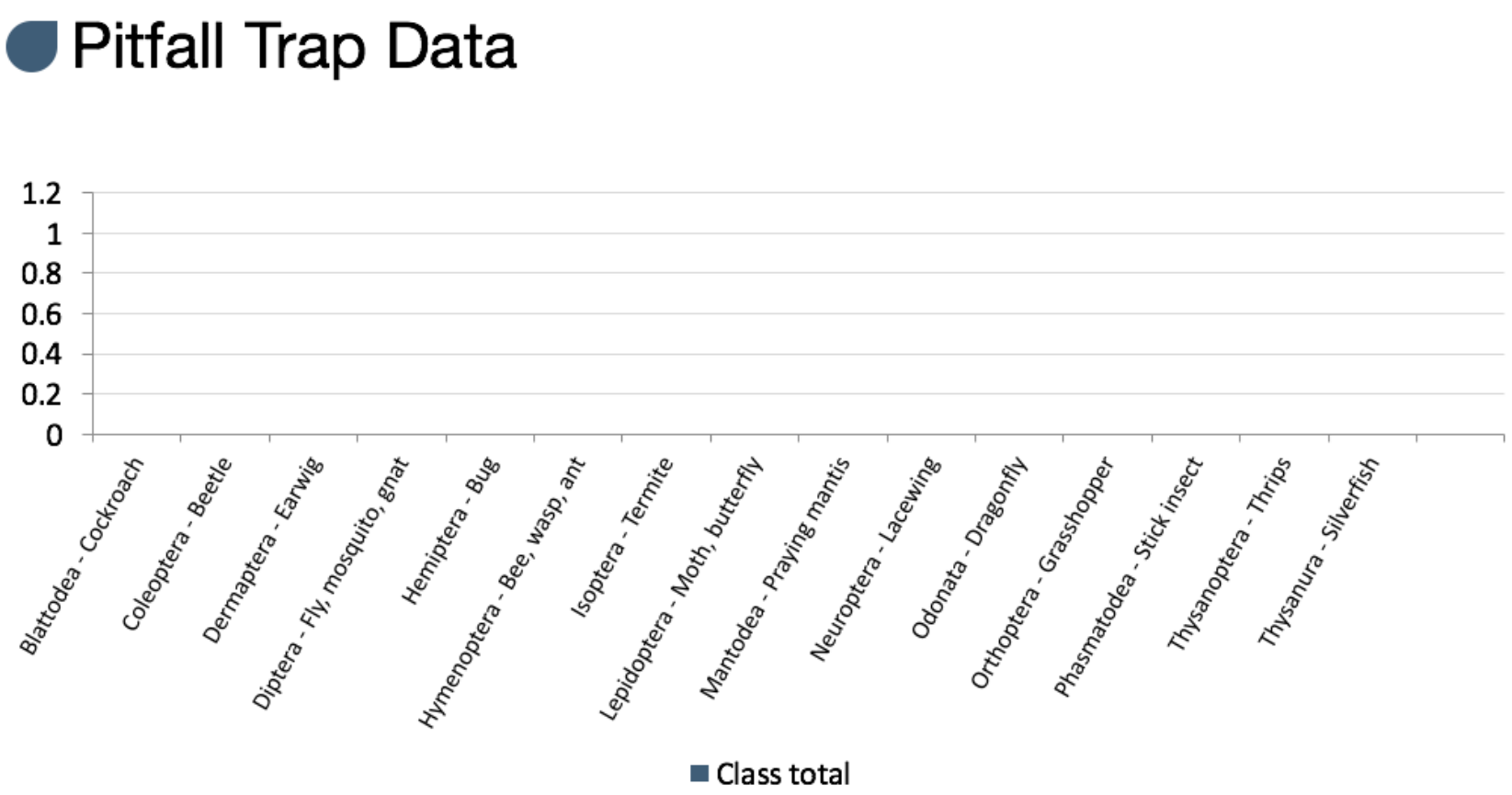
If possible the insect population is eradicated; otherwise it is contained and managed.

The affected property may have restrictions placed on who and what can come and go from the farm for a time.

LESSON 7 DATA COLLATION

	STICKY TRAP		PITFALL TRAP	
	YOUR GROUP	CLASS TOTAL	YOUR GROUP	CLASS TOTAL
TOTAL NUMBER OF INSECTS TRAPPED:				
NUMBER OF INSECT ORDERS FOUND:				
LIST INSECT ORDERS FOUND:				
MOST COMMON INSECT ORDER TRAPPED:				
ANY POTENTIAL BIOSECURITY THREATS? WHAT ORDER DID THEY BELONG TO?				

Prepare a column graph showing the results of your data compared with the class date for each insect Order, for each trap type




Sticky Trap Data
1.2
1
0.8
0.6
0.4
0.2
0
Blattodea - Cockroach
Coleoptera - Beetle
Dermaptera - Earwig
Diptera - Fly, mosquito, gnat
Hemiptera - Bug
Hymenoptera - Bee, wasp, ant
Isoptera - Termite
Lepidoptera - Moth, butterfly
Mantodea - Praying mantis
Neuroptera - Lacewing
Odonata - Dragonfly
Orthoptera - Grasshopper
Phasmatodea - Stick insect
Thysanoptera - Thrips
Thysanura - Silverfish
Class total