What'll happen to the wattle??!

Guidebook

Space Seed for Asian Future Mission 2

'The 'What'll happen to the wattle??! Project' received grant funding from the Australia-Japan Foundation of the Department of Foreign Affairs and Trade.'

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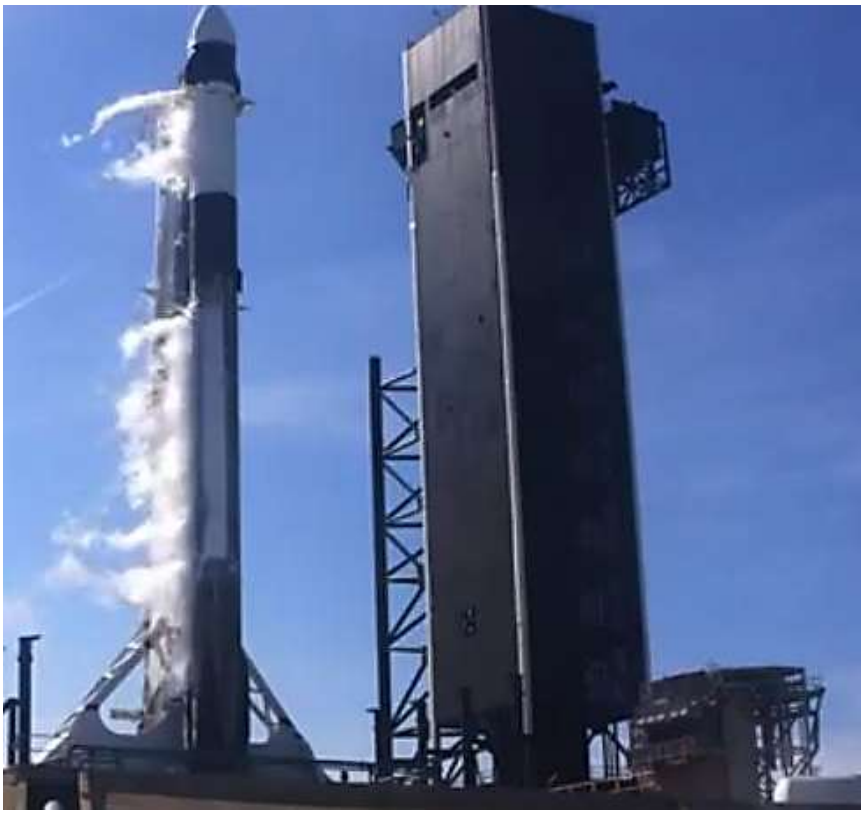

DEFINITIONS

Scarification
Some plant seeds have a rock-hard outer shell that makes it tough, if not impossible, for moisture to penetrate the seed. Seeds like this do not germinate well without some human help. All scarification techniques are designed to remove enough of the hard seed coat or jacket so that tiny embryo deep inside the seed can absorb water.

Scarification is a method of pre-treating seeds to ensure that they germinate and that the seedlings develop into vigorous plants. Without this help, seeds with the hard protective layer will take a long time to sprout - if they germinate at all.

Scarification involves the use of an abrasive material or a tool that can break through the hard shell so the seed can absorb water after planting. We have supplied sandpaper in the kit.

Microgravity
The condition of microgravity comes about whenever an object is in free fall. That is, it falls faster and faster, accelerating with exactly the acceleration due to gravity (1g). As soon as you drop something (like an apple) it is in a state of free fall.

Germination
The beginning of growth, as of a seed, spore, or bud. The germination of most seeds and spores occurs in response to warmth and water.

Monitor
Observe and check the progress or quality of (something) over a period of time; keep under systematic review.

Syringe
A tube with a nozzle and piston or bulb for sucking in and ejecting liquid in a thin stream, used for cleaning wounds or body cavities, or fitted with a hollow needle for injecting or withdrawing fluids.

Sprout
A shoot of a plant.

1. Introduction

1.1 Overview of 'What'll Happen to The Wattle??!'

The 'What'll Happen to The Wattle??!' (WHTW) project is the first official 'Seeds in Space' program for Australia. In collaboration with the Japan Aerospace Exploration Agency (JAXA), One Giant Leap Australia Foundation is supported by the Australian Space Agency (ASA) for this 2-year project.

The overall program – 'Space Seed for Asian Future' (SSAF) program is part of the overarching Kibo-ABC collaboration of countries in the Asia-Pacific. The Asian Herbs in Space (AHiS) is Mission 1. Australian schools and community groups have been invited to grow the sweet basil for JAXA as a ground control experiment and share the data collected.

WHTW is Mission 2. A number of Australian schools and community groups have been selected to grow the Golden Wattle seeds that have been to space and compare them to the ones that stayed on Earth but are from the same seed lot.

The Acacia Pycnantha (Golden Wattle) seeds were launched from Cape Kennedy on Monday 7th December 2020 at 3:39 am AEST on the SpaceX 21st Commercial Resupply Services (CRS-21) Launch. https://youtu.be/XVE3WuW0cSE

This is the first-time automatic docking has been used. Here is a link to the docking of CRS -21 - https://youtu.be/QanfvSMrOYk

The Golden Wattle seeds were on board the International Space Station for 6 months before returning to the USA. Once there, they were sent back to JAXA and then sorted and forwarded home to One Giant Leap Australia Foundation Headquarters for distribution to the groups participating in the WHTW project.

1.2 Objectives of the program

- Investigate the effect of microgravity on plant growth and germination in comparison to their counterparts on Earth.
- Encourage scientific research between students, schools, universities, and space agencies across the world.
- Promote environmental and microgravity science.
- Develop interest and skills in scientific space experiments and methodology.
- Inspire further research for students and academics both nationally and internationally.

1.3 Target audience

Participants are from preschools, community groups, schools, and university researchers. Primary school students may wish to carryout simple observation experiments whilst others may complete more complex and detailed experiments.

2. Golden Wattle experiment procedure

2.1 Your kit

Your kit includes the following:

- Seedling starter tray
- A clip lock bag that has wattle seeds that stayed on earth and from the same seed lot as the ones that went to space (labelled 'E' on a yellow sticker)
- A clip lock bag that has wattle seeds that went to space and from the same seed lot as the ones that stayed on Earth (labelled with a star ☆ sticker)
- 2 small containers with lids – marked 'E' and a star ☆ sticker. These are to be used to soak the seeds overnight.
- Osmocote potting mix (not Western Australian locations)
- Sandpaper for scarification
- 20 ml syringe
- Plastic spoon
- Laminated instructions for seed placement
- A mission patch and badge

2.2 Seedling starter tray

The seedling starter tray kit has 3 components. It is a rectangular container made of light plastic with the following characteristics:

- watertight base tray that measures 178 mm by 135 mm by 50 mm. The base tray provides warmth to the plant bed and balances moisture levels.
- seed tray that has 12 cells measuring 38 mm x 38 mm x 50 mm each. This is a perfect cell size to maintain ideal temperature and optimal root growth, plant development, plant starter and seed germination.
- humidity control dome designed to keep the seedlings moist and reduce water evaporation.
- Transparent lid to allow observations without removal.

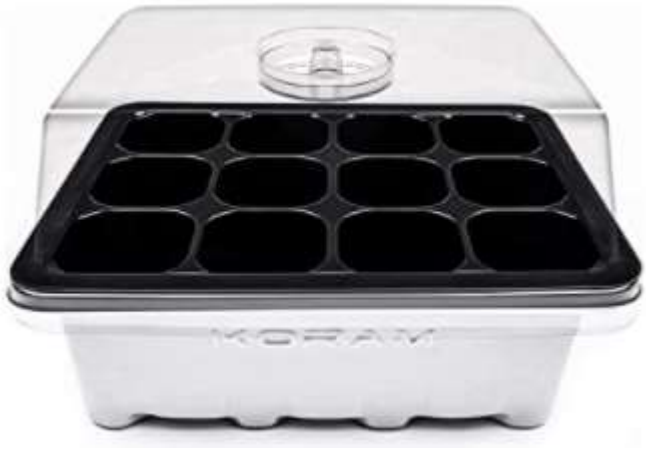

Fig. 2.2 Seedling Starter Tray

2.3 Risk management and safety

When handling the potting mix, ensure gloves and safety glasses are worn.

When scarifying the seeds, be careful using the sandpaper.

The use of boiling or hot water with the seed preparation process can be dangerous. Do not hold the container whilst pouring the hot water into it. Place the container on a stable surface. Let the temperature cool a little before placing the lid on top. Store in a safe place.

2.4 Preparing the seeds.

You will receive two packs of seeds. One has been to space (☆) and one has stayed on Earth (E).

Watch the video about seed preparation on the Seeds in Space website. ***This will explain the scarification process.***

Carefully take the E seeds from their pack. You will ***scarify*** them slightly by using the sandpaper supplied. Be very careful.

Place the boiling/hot water into the small E container supplied. Place the E seeds in the water. Let the water cool before putting the lid on and store in a safe place overnight. Allow the seeds to soak for 24 hours.

Carefully take the ☆ seeds from their pack. You will scarify them slightly by using the sandpaper supplied. Be very careful.

Place the boiling/hot water into the small ☆ container supplied. Place the ☆ seeds in the water. Let the water cool before putting the lid on and store in a safe place overnight. Allow the seeds to soak for 24 hours.

2.5 Placement of seeds

After 24 hours of soaking the seeds, it is time to prepare the seedling greenhouse.

Instructions:
Put on safety glasses and gloves.
Carefully open the bag of Osmocote seedling potting mix.
Using the plastic spoon provided, ***CAREFULLY*** place the potting mix into each cell.

The spoon has a line drawn on the end – use this to measure the distance from the top of the cell to the potting mix. The distance marked on the spoon is 1 cm. Make sure the potting mix is 1 cm from the top of the cell.

The seed raising potting mix contains the elements necessary for plant growth.

When the 12 cells have been filled with potting mix, now it is time to place the seeds.

Position the seedling greenhouse so that the side with the stickers s facing you.

Use the laminated planner from your kit to ensure correct labelling of seeds. This is very important – you need to be able to easily identify each seed.

Starting with container 'E', use tweezers to lift out each seed and place in each cell in the following order (see laminated plan from kit):

E1	E4	S1	S4
E2	E5	S2	S5
E3	E6	S3	S6

STICKERS

Once you have placed the 6 'E' seeds, do the same process with the 6 ☆ or 'S' seeds.

Take a photo. Ensure there is a thermometer next to the greenhouse so you can record temperature!

Using the syringe, CAREFULLY fill it to 20 millilitres with tap water. Give each cell 5 millilitres of water. Fill syringe two more times to complete the task.

Take a photo.

Place the lid on the seedling greenhouse and move it to a place where there is natural light (windowsill).

Log into www.seedsinspace.com.au and the App. Record the date, temperature, and an accurate description of the growing environment. Upload any photos that will be required for your report.

2.3 Growth conditions.

A warm environment is desired for the growth of wattle.

Light is needed for plant growth. When growing indoors, keep the seedling greenhouse as close as possible to a window that has natural light.

3. Data collection

3.1 Seed germination

Observe the seedling greenhouse over the next few days and record any germination of seeds. Take photos and document accurately what is occurring.

Go to section 4 for examples of Science Journal pages.

Log into www.seedsinspace.com.au and the App to record your germination data.

3.2 Observation of plant growth

The more data recorded about plant growing conditions and the more measured characteristics, the better the information will be for analysing investigation results and drawing conclusions for research. All collected data should be recorded regularly in a specifically designed data logbook or using a data sheet.

Records should be made on day zero, day 10, day 20, day 30 and so on. Groups may wish to take more frequent readings and they may be uploaded to the App. The website will only have provision for day zero, 10, 20, 30 and so on. It would be appreciated if information was uploaded to BOTH the website AND the App.

Groups should have registered for BOTH the https://seedsinspace.com.au/whtw/ and the App.

The following are the basic characteristics that will be observed, measured, and recorded:

- ➢ Germination rate: Record the number of seeds that sprout and the date that each sprout appeared. Monitor how many of the seeds sprout within the first two weeks.
- ➢ Plant height: Measure and record this measurement in millimetres.
- ➢ The number of leaves: Count and record.

An extra dimension could be measuring the leaves.

It is very important to describe accurately the growing conditions under which the experiment is conducted. A photo can be a valuable asset for this.

4. Comparison of data

4.1. Points of comparison

The wattle seeds may or may not grow well. Think about why some grew well and why some did not. Then, it is a learning opportunity to acknowledge that there could be a difference between the space environment and its effect and affect on the seed germination rate and growth.

You may compare growth such as stem length, leaf size, leaf color, number of leaves.

4.2. How to write a report

The structure of a general experiment report is as follows.

(1). Experimenter's name (Your name)
(2). Date and duration of the experiment
(3). Objective: What is the experiment aiming to observe?
(4). Experimental method: How you prepared the seedling greenhouse, the growing environment, what kind of work and how did you do it?
(5). Results: What kind of results did you get? (Please use “Plant growth records, photographs, Graph, Table, etc.” to make it easy to understand.)
(6). Discussion: What did you think of the obtained experimental results? (For example, what is the cause of the difference in growth between the ISS and the ground? What are the results of the two different seed lots?)

4.3 A science journal

A science journal is a record of observations, experiences, and reflections. It contains a series of dated chronological entries. It can include text, drawings, sketches, measurements, labelled diagrams, photographs, spreadsheets, and graphs.

By using a science journal, students are engaged in a real science situation as they keep a record of their observations, ideas, and thoughts. Students are able to use the journal to reflect on their learning. They will see evidence of how their ideas have changed and developed over the time of the science experience.

Students keeping a science journal enables students to experience and understand how scientists work. It also aligns to the Australian Curriculum in Science, English and Mathematics.

Student journal examples on the following pages.

What'll Happen to The Wattle??!			
School/Group:			
Seed type: Golden Wattle			
Date Seeds Planted:			
Dates of Germination			
Earth Seeds (E)		Space Seeds (star)	
E1		S1	
E2		S2	
E3		S3	
E4		S4	
E5		S5	
E6		S6	

Describe the growing conditions:

What'll Happen to The Wattle??!

Seed type: Golden Wattle

Date:

(use one page for each data collection date)

Seed	Height	Number of Leaves	Other information
S1			
S2			
S3			
S4			
S5			
S6			
E1			
E2			
E3			
E4			
E5			
E6			

What'll Happen to The Wattle??!

Seed type: Golden Wattle

Seed Name: S1 S2 S3 S4 S5 S6
E1 E2 E3 E4 E5 E6

Date	Height	Number of Leaves	Other information

Suggested Scientific report template.

Aim:

Background Information:

Hypothesis:

Equipment:

•	•	•
•	•	•
•	•	•
•	•	•

Risk Assessment:

Risk	Mitigation

Method/Procedure:

1.
2.
3.
4.
5.
6.
7.
8.

Results

Discussion

Conclusion

Suggested Journal Entry Page

Investigation:	
Name:	Date:
Time:	Location:
Environmental Conditions:	

Qualitative Observations:

Quantitative Measurements

Notes:

5. Useful information

5.1. Websites

➢ AHiS portal site
https://iss.jaxa.jp/en/kuoa/ssaf/2020.html

5.2 Our research

Scarification
https://www.theseedcollection.com.au/blog/our-blog/how-scarification-brings-stubborn-slow-germinating/

https://www.gardeningknowhow.com/ornamental/trees/acacia/acacia-seed-propagation.htm

https://hilo.hawaii.edu/affiliates/prism/documents/lesson6seedgermination.pdf

https://www.biologycorner.com/worksheets/germination.html

6. Australian Curriculum and Outcomes - Science

Some suggested Australian Science Curriculum Links (https://www.australiancurriculum.edu.au/f-10-curriculum/science/)

Year	Science Understanding	Science as a Human Endeavour	Science Inquiry Skills	Achievement Standards
Foundation	ACSSU002 Biological sciences	ACSHE013 Nature and development of science	ACSIS014 Questioning and predicting ACSIS011 Planning and conducting ACSIS233 Processing and analysing data and information ACSIS012 Communicating	Students describe the behaviour of familiar objects. They suggest how the environment affects them and other living things. Students share and reflect on observations and ask and respond to questions about familiar objects and events.
Year 1	ACSSU017 Biological sciences ACSSU211 Biological sciences	ACSHE021 Nature and development of science ACSHE022 Use and influence of science	ACSIS024 Questioning and predicting ACSIS025 Planning and conducting ACSIS026 Planning and conducting ACSIS027 Processing and analysing data and information ACSIS213 Evaluating ACSIS029 Communicating	Students describe changes in their local environment and how different places meet the needs of living things. Students respond to questions, make predictions, and participate in guided investigations of everyday phenomena. They follow instructions to record and sort their observations and share them with others.
Year 2	ACSSU030 Biological sciences	ACSHE034 Nature and development of science ACSHE035 Use and influence of science	ACSIS037 Questioning and predicting ACSIS038 Planning and conducting ACSIS039 Planning and conducting ACSIS040 Processing and analysing data and information ACSIS041 Evaluating ACSIS042 Communicating	Students describe changes to objects, materials and living things. Students pose and respond to questions about their experiences and predict outcomes of investigations. They use informal measurements to make and compare observations. They record and represent observations and communicate ideas in a variety of ways.
Year 3	ACSSU044 Biological sciences	ACSHE050 Nature and development of science ACSHE051 Use and influence of science	ACSIS053 Questioning and predicting ACSIS054 Planning and conducting ACSIS055 Planning and conducting ACSIS057 Processing and analysing data and information ACSIS215 Processing and analysing data and information	Students group living things based on observable features and distinguish them from non-living things. They describe how they can use science investigations to respond to questions. Students use their experiences to identify questions and make predictions about scientific investigations. They follow procedures to collect and record observations and suggest possible reasons for their findings, based on patterns in their

			ACSIS058 Evaluating ACSIS060 Communicating	data. They describe how safety and fairness were considered and they use diagrams and other representations to communicate their ideas.
Year 4	ACSSU072 Biological sciences ACSSU073 Biological sciences	ACSHE061 Nature and development of science ACSHE062 Use and influence of science	ACSIS064 Questioning and predicting ACSIS065 Planning and conducting ACSIS066 Planning and conducting ACSIS068 Processing and analysing data and information ACSIS216 Processing and analysing data and information ACSIS069 Evaluating ACSIS071 Communicating	Students describe relationships that assist the survival of living things and sequence key stages in the life cycle of a plant or animal. They identify when science is used to understand the effect of their actions. Students follow instructions to identify investigable questions about familiar contexts and make predictions based on prior knowledge. They describe ways to conduct investigations and safely use equipment to make and record observations with accuracy. They use provided tables and column graphs to organise data and identify patterns. Students suggest explanations for observations and compare their findings with their predictions. They suggest reasons why a test was fair or not. They use formal and informal ways to communicate their observations and findings.
Year 5	ACSSU043 Biological Sciences	ACSHE081 Nature and development of science ACSHE083 Use and influence of science	ACSIS231 Questioning and predicting ACSIS086 Planning and conducting ACSIS087 Planning and conducting ACSIS090 Processing and analysing data and information ACSIS218 Processing and analysing data and information ACSIS091 Evaluating ACSIS093 Communicating	Students analyse how the form of living things enables them to function in their environments. Students discuss how scientific developments have affected people's lives, help us solve problems and how science knowledge develops from many people's contributions. Students follow instructions to pose questions for investigation and predict the effect of changing variables when planning an investigation. They use equipment in ways that are safe and improve the accuracy of their observations. Students construct tables and graphs to organise data and identify patterns in the data. They compare patterns in their data with predictions when suggesting explanations. They describe ways to improve the fairness of their investigations, and communicate their ideas and findings using multimodal texts.

Year 6	ACSSU094 Biological Sciences	ACSHE098 Nature and development of science ACSHE100 Use and influence of science	ACSIS232 Questioning and predicting ACSIS103 Planning and conducting ACSIS104 Planning and conducting ACSIS107 Processing and analysing data and information ACSIS221 Processing and analysing data and information ACSIS108 Evaluating ACSIS110 Communicating	Students describe and predict the effect of environmental changes on individual living things. Students explain how scientific knowledge helps us to solve problems and inform decisions and identify historical and cultural contributions. Students follow procedures to develop investigable questions and design investigations into simple cause-and-effect relationships. They identify variables to be changed and measured and describe potential safety risks when planning methods. They collect, organise and interpret their data, identifying where improvements to their methods or research could improve the data. They describe and analyse relationships in data using appropriate representations and construct multimodal texts to communicate ideas, methods, and findings.
Year 7	ACSSU111 Biological sciences	ACSHE119 Nature and development of science ACSHE223 Nature and development of science ACSHE120 Use and influence of science ACSHE121 Use and influence of science	ACSIS124 Questioning and predicting ACSIS125 Planning and conducting ACSIS126 Planning and conducting ACSIS129 Processing and analysing data and information ACSIS130 Processing and analysing data and information ACSIS131 Evaluating ACSIS132 Evaluating ACSIS133 Communicating	Students predict the effect of human and environmental changes on interactions between organisms and classify and organise diverse organisms based on observable differences. Students describe situations where scientific knowledge from different science disciplines and diverse cultures has been used to solve a real-world problem. They explain possible implications of the solution for different groups in society. Students identify questions that can be investigated scientifically. They plan fair experimental methods, identifying variables to be changed and measured. They select equipment that improves fairness and accuracy and describe how they considered safety. Students draw on evidence to support their conclusions. They summarise data from different sources, describe trends and refer to the quality of their data when suggesting improvements to their methods. They communicate their ideas, methods and findings using scientific language and appropriate representations.
Year 8	ACSSU150 Biological sciences	ACSHE134 Nature and development of science ACSHE226 Nature and	ACSIS139 Questioning and predicting ACSIS140 Planning and conducting ACSIS141 Planning and conducting	Students examine the different science knowledge used in occupations. They explain how evidence has led to an improved understanding of a scientific idea and describe situations in

		development of science ACSHE135 Use and influence of science ACSHE136 Use and influence of science	ACSIS144 Processing and analysing data and information ACSIS145 Processing and analysing data and information ACSIS146 Evaluating ACSIS234 Evaluating ACSIS148 Communicating	which scientists collaborated to generate solutions to contemporary problems. They reflect on the implications of these solutions for different groups in society. Students identify and construct questions and problems that they can investigate scientifically. They consider safety and ethics when planning investigations, including designing field or experimental methods. They identify variables to be changed, measured, and controlled. Students construct representations of their data to reveal and analyse patterns and trends and use these when justifying their conclusions. They explain how modifications to methods could improve the quality of their data and apply their own scientific knowledge and investigation findings to evaluate claims made by others. They use appropriate language and representations to communicate science ideas, methods, and findings in a range of text types.
Year 9	ACSSU175 Biological sciences ACSSU176 Biological sciences	ACSHE157 Nature and development of science ACSHE158 Nature and development of science ACSHE160 Use and influence of science ACSHE228 Use and influence of science	ACSIS164 Questioning and predicting ACSIS165 Planning and conducting ACSIS166 Planning and conducting ACSIS169 Processing and analysing data and information ACSIS170 Processing and analysing data and information ACSIS171 Evaluating ACSIS172 Evaluating ACSIS174 Communicating	Students analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people's lives. Students design questions that can be investigated using a range of inquiry skills. They design methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They analyse their methods and the quality of their data and explain specific actions to improve the quality of their evidence. They evaluate others' methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.

Year 10	ACSSU184 Biological sciences ACSSU185 Biological sciences ACSSU189 Earth and space sciences	ACSHE192 Nature and development of science ACSHE194 Use and influence of science ACSHE230 Use and influence of science	ACSIS198 Questioning and predicting ACSIS199 Planning and conducting ACSIS200 Planning and conducting ACSIS203 Processing and analysing data and information ACSIS204 Processing and analysing data and information ACSIS205 Evaluating ACSIS206 Evaluating ACSIS208 Communicating	Students evaluate the evidence for scientific theories that explain the origin of the universe and the diversity of life on Earth. They explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review. Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes.
Stage 6 Biology	ACSBL015 Unit 1: Biodiversity and the interconnectedness of life ACSBL019 Unit 1: Biodiversity and the interconnectedness of life ACSBL021 Unit 1: Biodiversity and the interconnectedness of life ACSBL022 Unit 1: Biodiversity and the interconnectedness of life ACSBL044 Unit 2: Cells and multicellular organisms ACSBL047 Unit 2: Cells and multicellular organisms ACSBL049 Unit 2: Cells and multicellular organisms ACSBL050 Unit 2: Cells and multicellular organisms ACSBL052 Unit 2: Cells and multicellular organisms ACSBL053 Unit 2: Cells and multicellular organisms ACSBL026 Unit 3: Heredity and continuity of life ACSBL029 Unit 3: Heredity and continuity of life	ACSBL008 Science as a Human Endeavour (Units 1 & 2) ACSBL009 Science as a Human Endeavour (Units 1 & 2) ACSBL010 Science as a Human Endeavour (Units 1 & 2) ACSBL011 Science as a Human Endeavour (Units 1 & 2) ACSBL012 Science as a Human Endeavour (Units 1 & 2) ACSBL013 Science as a Human Endeavour (Units 1 & 2) ACSBL014 Science as a Human Endeavour (Units 1 & 2) ACSBL037 Science as a Human Endeavour (Units 1 & 2) ACSBL038 Science as a Human Endeavour (Units 1 & 2) ACSBL039 Science as a Human Endeavour (Units 1 & 2) ACSBL040 Science as a Human Endeavour (Units 1 & 2) ACSBL041 Science as a Human Endeavour (Units 1 & 2) ACSBL042 Science as a Human Endeavour (Units 1 & 2) ACSBL043 Science as a Human Endeavour (Units 1 & 2) ACSBL068 Science as a Human Endeavour (Units 3 & 4) ACSBL069 Science as a Human Endeavour (Units 3 & 4)	ACSBL001 Science Inquiry Skills (Biology Unit 1) ACSBL002 Science Inquiry Skills (Biology Unit 1) ACSBL003 Science Inquiry Skills (Biology Unit 1) ACSBL004 Science Inquiry Skills (Biology Unit 1) ACSBL005 Science Inquiry Skills (Biology Unit 1) ACSBL006 Science Inquiry Skills (Biology Unit 1) ACSBL007 Science Inquiry Skills (Biology Unit 1) ACSBL030 Science Inquiry Skills (Biology Unit 2) ACSBL031 Science Inquiry Skills (Biology Unit 2) ACSBL032 Science Inquiry Skills (Biology Unit 2) ACSBL033 Science Inquiry Skills (Biology Unit 2) ACSBL034 Science Inquiry Skills (Biology Unit 2) ACSBL035 Science Inquiry Skills (Biology Unit 2) ACSBL036 Science Inquiry Skills (Biology Unit 2) ACSBL061 Science Inquiry Skills (Biology Unit 3) ACSBL062 Science Inquiry Skills (Biology Unit 3)	

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SKETCHES AND NOTES: