Flight Club

FUTURE MAKERS TEACHER RESOURCE

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM | Queensland Government

Future Makers Overview

Future Makers is an innovative partnership between Queensland Museum and Shell's QGC business aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future. The program has a particular focus in the Gladstone and Western Downs regions.

Through a three-pillar approach incorporating education engagement, community engagement and research, Future Makers is focussed on getting students, teachers and the community engaged and aware of the value of STEM, while also researching evidence-based approaches for improving student participation and performance.

Future Makers provides a number of opportunities and resources for teachers in the Gladstone and Western Downs regions. Teachers can attend the free teacher professional development workshops that take place in Gladstone and Chinchilla. During these workshops, teachers are guided through interactive topics and given resources that have direct links to the Australian Curriculum. Teachers can also access our free online learning resources to use in their own classroom. These resources include STEM career videos and videos of leading industry professionals with direct links to the Australian Curriculum. From Palaeontologists to Chemical Engineers, Future Makers can help bring STEM subjects to life by having leading industry professional visit classrooms and chat to students about a career in STEM and facilitate interactive activities with students. Teachers in the Western Downs and Gladstone regions can request a leading industry professional to visit their classroom.

To find out more visit www.futuremakers.org.au. If you would like to contact the Future Makers team, please email info@futuremakers.org.au or call 07 3842 9220.

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Cover Image: Queensland Museum, Gary Cranitch

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Workshop Overview

"For once you have tasted flight you will walk the earth with your eyes turned skywards, for there you have been and there you will long to return."
LEONARDO DA VINCI

The ability to take to and remain in the skies has captivated humans for thousands of years. Our efforts to achieve flight have often been inspired by the natural world, including the unique features and adaptations of the animal kingdom.

This workshop investigates how members of the animal kingdom achieve flight, and how biological understandings can be combined with design and technologies concepts to support and extend student engagement with science.

This workshop has been structured using the 5E's instruction model.
The following topics and concepts are explored in each aspect of the workshop:

ENGAGE	Introduce and explore the overarching inquiry question: What is flight?
EXPLORE	Test, challenge and refine understandings of flight. Categorise a variety of stimuli using prior knowledge and understanding to determine if they definitely, maybe or do not fly.
EXPLAIN	Develop knowledge and understandings about the flight-related adaptations of specific animals, and how these adaptations support survival within diverse environments. Explore and identify the forces that affect flight.
ELABORATE	Students complete the Flight Club design challenge. **With challenge course:** Design and construct a 'flying' creature with the adaptations needed to survive in and move through the challenge habitat. **Without challenge course:** Design, create and present a bird with adaptations suitable for survival in [Australian habitat].
EVALUATE	Evaluate and reflect on performance in design challenge. Explore how workshop content can be adapted to further student engagement with science.

Workshop Resources

ENGAGE

What is Flight?

In this activity, students participate in a community of inquiry to unpack the significant elements of flight. This process provides students with an opportunity to reach a deep, shared understanding of the concepts and issues underpinning the inquiry topic.

The community of inquiry is a structured, dialogic process that requires participants to ask open inquiry questions, listen and think, share ideas and consider alternative viewpoints. Problematic issues and concepts are discussed collaboratively within a supportive learning environment where all views are considered and respected. Reflecting on thinking is integral to the process.

The following engagement protocols are used during the community inquiry process:

- Listen attentively
- Build on and connect ideas
- Respect self, others and place
- Disagree reasonably and respectfully
- There may be many responses considered to be correct

In this activity, students firstly consider how they would respond to the overarching inquiry question:

What is flight?

Students may choose to respond to this question with a definition, a single word or phrase, or use their own life experiences to provide a context for their response/s.

Students then share their response/s with a peer, before participating in a whole-class discussion. Key points, words and phrases should be recorded throughout the discussion and remain on display for the entire unit of work. This provides students with an opportunity to refer back to, edit and refine their response to the inquiry question. The aim here is to develop a strong conceptual definition of flight by the end of the unit.

A similar process can be applied to a variety of inquiry topics using different question stems, including: What is...? Why might we...? How might we...?

Curriculum Links

General Capabilities

Literacy: Composing texts through speaking, writing and creating

Critical and Creative Thinking: Inquiring; Reflecting on thinking and processes

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EXPLORE

Does it Fly?

Students test their thoughts and ideas about what constitutes flying. In this activity, students categorise a variety of stimuli to determine if the stimuli definitely, maybe or do not fly. Stimuli can include objects and specimens, as well as text excerpts, videos and images. This categorising ideas activity should result in good discussion and debate as students tease apart what flight is and what flight is not.

In order to begin this activity, a wall or floor space is divided into three sections, and each section is provided a heading - 'Definitely' 'Maybe' and 'No'. Divide students into small groups of two or three and supply each group with at least two stimulus items to categorise.

After receiving the stimuli, students should determine if the stimuli definitely, maybe or does not fly. Students use their prior knowledge about each stimulus and recall past discussions about flight in order to complete this task. Students should also provide reasons to justify their decision. Student groups then take turns to share their decision with the class group, and add their stimuli to the relevant category.

The ability for stimulus material to change categories throughout the sharing process, and even throughout the unit of work, should be emphasised to the class group. Students should also be encouraged to reflect on the position of their stimuli after all have been categorised, and have an opportunity to change their minds, again justifying reasons for changes, if deemed necessary. Particular attention should be paid to stimulus in the 'Maybe' category, as the goal is to have no stimulus in this section by the end of the unit.

At the conclusion of this activity, students can return to and extend their initial definition of flight.

Curriculum Links

General Capabilities

Literacy: Composing texts through speaking, writing and creating

Critical and Creative Thinking: Inquiring; Reflecting on thinking and processes; Analysing, synthesising and evaluating reasoning and procedures

Does it Fly? Resources

The following resources can be used to support student engagement with this activity. You may choose to select other resources that better suit your classroom context and learner needs.

Digital

Aeroplane - Avro Baby
Queensland Museum, Collection Online.

The Flying Fish Woodcut Illustration
Guillaume Rondelet. 1554.
Queensland Museum, Google Arts and Culture.

Wingsuit Gliding through the 'Crack' Gorge in Switzerland
Red Bull. YouTube. 27 December, 2011.

A Robot that Flies like a Bird
Markys Fischer, TED Talk. YouTube. 22 July, 2011.

Mobula Rays
BBC. YouTube. 13 May, 2015.

Objects

Paper plane

Whirly bird

Seeds from the Rosewood or Tipuana tree *(Tipuana tipu)*

Images

Gliding animal

Insect

Pterosaur

Drone

Hot air balloon

Catapult

Asteroid

Spacecraft

Southern flying squirrel, *Glaucomys volans*

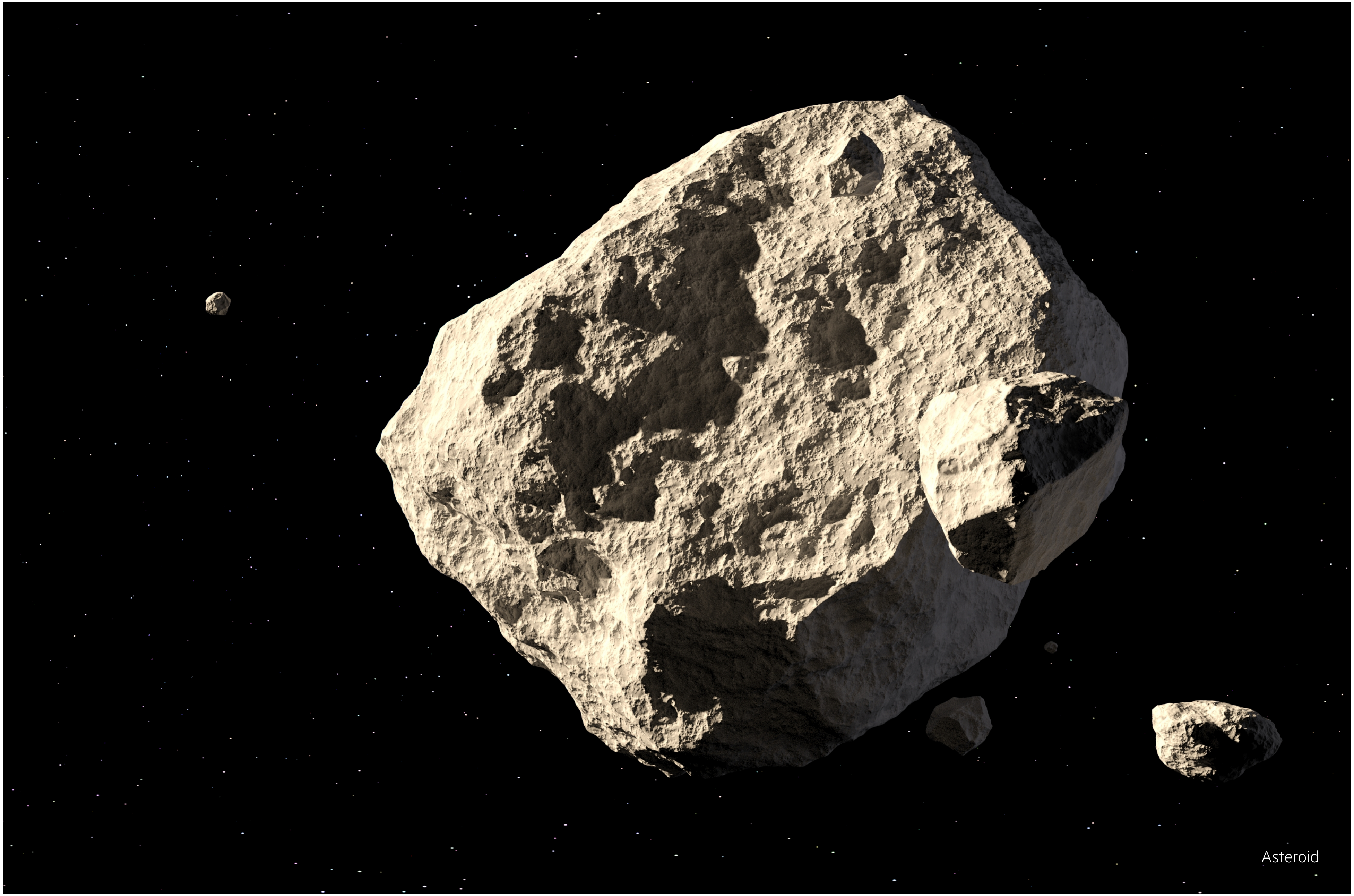
Dainty swallowtail, *Papilio anactus*. QM, Jeff Wright

Pterosaur


Drone

Hot air balloon


Catapult



Asteroid


Space craft

EXPLAIN

Flight Adaptations

Students develop knowledge and understanding about the flight-related adaptations of specific animals, and how these adaptations support survival in various environments. Students use the following table to research and record information about these adaptations, classifying the adaptation as structural, functional or behavioural, then identify how the adaptation helps the animal move through the air and/or survive in its environment. Students could begin their research by viewing the flight adaptations video presented by Paul Oliver, Senior Curator of Vertebrates at Queensland Museum.

Students could also identify the forces that are acting on these animals as they move through the air, including lift, drag, thrust and gravity. Students can represent the forces acting on different animals in various stages of flight using force-arrow diagrams. They can also identify how researched features and adaptations serve to increase or decrease the effects of these forces.

Curriculum Links

YEAR 5

Science Understanding

Living things have structural features and adaptations that help them to survive in their environment *(ACSSU043)*

Science Inquiry Skills

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts *(ACSIS093)*

YEAR 6

Science Understanding

The growth and survival of living things are affected by the physical conditions of their environment *(ACSSU094)*

Science Inquiry Skills

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts *(ACSIS110)*

YEAR 7

Science Understanding

Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object *(ACSSU117)*

Science Inquiry Skills

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate *(ACSIS133)*

General Capabilities

ICT: Investigating with ICT

Flight Adaptations

- Record the adaptation that allows the animal to move through the air
- Classify the adaptation based on its type (structural, functional or behavioural)
- Identify how the adaptation helps the animal move through the air and/or survive in its environment

Adaptation	Type of Adaptation	Survival Advantage

Forces of Flight

Draw force-arrow diagrams to represent the forces acting on the bird at each stage of flight. Include lift, drag, thrust and gravity.

ELABORATE

Flight Club Challenge

In the Flight Club Challenge, students connect biological understandings of flight adaptations with design and technologies concepts to design, construct and evaluate 'flying' creatures. This design challenge can be completed with or without movement through a challenge course, inspired by Queensland habitats; both options are described in further detail below.

1. Divide students into small groups.

   Assign each group an Australian habitat:
   Arid Outback, Open Forest, Rainforest and/or Coastal Intertidal.

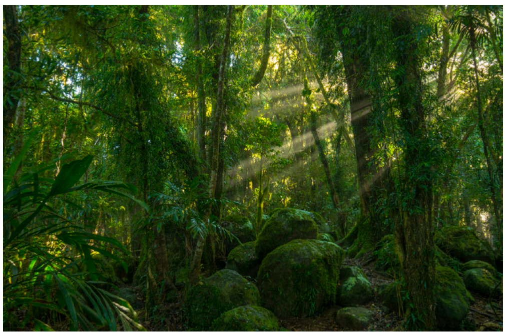
   Provide students with an opportunity to share their knowledge and experiences about their assigned habitat. Depending on their year level, students can also answer the following questions:

   What are the biotic (living) and abiotic (non-living) features of this habitat?

   What adaptations would an animal need to survive in this habitat?

Queensland Museum, Gary Cranitch

Queensland Museum, Jeff Wright



Queensland Museum, Gary Cranitch

Queensland Museum, Gary Cranitch

   Students record the main points from their conversation about the habitat and share their learning with the class. Alternatively, students could participate in a jigsaw activity, whereby new groups are formed featuring a representative student from each original habitat group. Students then become the 'expert' about their habitat and take turns sharing their learning with a smaller group of their peers.

2. Students are introduced to the design challenge:

   With challenge course:

   Design and construct a 'flying' creature with the adaptations needed to survive in and move through the challenge habitat.

   OR

   Without challenge course:

   Design, create and present a 'flying' creature with adaptations suitable for survival in [Australian habitat].

   If engaging with the challenge course option, please note the following:

   - Students should be inspired by all animals that are capable of moving through the air (i.e. those that are capable of unpowered and powered flight).
   - The challenge course can be constructed in a variety of ways.

     For example, the course could be based around the school playground. Alternatively, the course could be constructed using classroom furniture or recyclable materials. Students could even be involved in the design process, using digital systems, classroom resources and design and technologies tools, equipment and techniques to complete this task.
   - Specific obstacles featured in the challenge course could involve:
     — Movement between objects
     — Movement up, under, around and through objects
     — Picking up and dropping off items

3. Share or negotiate any specific challenge requirements, restrictions or criteria for success with students. These may include:
   - Size of student groups.
   - Type of animal to be created. This could be general (i.e. a real or imagined animal capable of powered or unpowered flight) or specific (i.e. a bird).
   - Materials to complete challenge, including number of balloons or balloon pumps.
   - If a monetary value is assigned to various materials, how much each material will cost to purchase and the total budget for each group.
   - Time limit to complete challenge.

4. Students work in their groups to complete the challenge. During this phase, students brainstorm and generate ideas and solutions to the challenge, and experiment with the implementation of these ideas.

Students should consider the features and structural, functional and/or behavioural adaptations their animal will need to survive in the chosen habitat such as body shape, wing shape and size, beak, feet and bone density. They generate a labelled diagram of their animal, including an explanation of each feature and how these will help the animal survive in its habitat or how the adaptations respond to the biotic and abiotic factors within the habitat. Students could also provide their animal with a scientific name, using the Exploring Binomial Names activity sheet. Students then construct their animal from recycled materials.

Queensland Museum, Peter Waddington

If engaging with the challenge course option, students should be encouraged to test and refine their design as often as possible through the course within the allocated time limit. They can also identify the forces acting on their designed animal as it moves through the course, and how these forces could be increased or decreased in different ways. Students could also construct force-arrow diagrams that identify the type, size and direction of forces that are acting on their creature as it moves through the course.

Queensland Museum, Peter Waddington

5. Students reflect on and evaluate their designs.

   The following questions may be used to guide this process:

   - What new knowledge/understandings helped you to make decisions about your animal design?
   - Are there any further adaptations that could improve your design?
   - What were the main challenges you experienced during the design process? How did you overcome these?
   - What key science/design learning have you taken from this experience?
   - How could you apply this knowledge and understanding to your learning in other contexts?
   - What more would we like to know about flight?

Curriculum Links

YEAR 5

Science Understanding

Living things have structural features and adaptations that help them to survive in their environment *(ACSSU043)*

Science Inquiry Skills

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts *(ACSIS093)*

YEAR 6

Science Understanding

The growth and survival of living things are affected by the physical conditions of their environment *(ACSSU094)*

Science Inquiry Skills

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (ACSIS110)

YEAR 7

Science Understanding

Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object *(ACSSU117)*

Science Inquiry Skills

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate *(ACSIS133)*

YEAR 5 AND 6

Design and Technologies: Knowledge and Understanding

Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use *(ACTDEK023)*

Design and Technologies: Process and Production Skills

Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions *(ACTDEP024)*

Generate, develop and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques *(ACTDEP025)*

Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions *(ACTDEP026)*

Negotiate criteria for success that include sustainability to evaluate design ideas, processes and solutions *(ACTDEP027)*

Develop project plans that include consideration of resources when making designed solutions individually and collaboratively *(ACTDEP028)*

YEAR 7 AND 8

Design and Technologies: Knowledge and Understanding

Analyse ways to produce designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment *(ACTDEK034)*

Design and Technologies: Process and Production Skills

Critique needs or opportunities for designing, and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas *(ACTDEP035)*

Generate, develop, test and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies, including graphical representation techniques *(ACTDEP036)*

Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions *(ACTDEP037)*

Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability *(ACTDEP038)*

Use project management processes when working individually and collaboratively to coordinate production of designed solutions *(ACTDEP039)*

General Capabilities

Numeracy: Estimating and calculating with whole numbers; Using spatial reasoning

Critical and creative thinking: Inquiring; Generating ideas, possibilities and actions; Reflecting on thinking and processes; Analysing, synthesising and evaluating reasoning and procedures

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Flight Club Design Challenge

Design and construct a 'flying' creature with the adaptations needed to survive in and move through the challenge habitat.

In order to complete this challenge, you must:

- **Investigate** how different types of animals achieve flight. This can be powered or unpowered flight. You should also identify the features of the habitat in which your 'flying' creature must survive.
- **Design** your 'flying' creature. Draw a labelled diagram of your creature. Make sure you explain its features and adaptations and how these help the creature survive in its habitat.
- **Create** your creature from recyclable materials supplied by your teacher.
- **Test** your creature's ability to move through the challenge habitat.
- **Refine** your creature so that it moves better through the challenge habitat.
- **Collaborate** in teams of two.
- **Evaluate** continuously to construct a 'flying' creature with the adaptations needed to survive in and move through the challenge habitat.

Before starting the challenge, write down any challenge requirements below.
You could use this information to develop a project plan.

Habitat	
Type of animal	
Materials	
Budget	
Time Limit	

Draw a labelled diagram of your creature. Make sure you explain its features and adaptations and how these help the creature survive in its habitat.

Construct your creature, making sure to keep a record of the materials used and their cost.

It is important to meet the budget requirements set by your teacher!

TOTAL BUDGET	

Item	**Cost per Item**	**Number of Items**	**Total Cost**
		GRAND TOTAL	

After the challenge, construct a force-arrow diagram to record the type, size and direction of forces that acted on your creature as it moved through the habitat.

How could you increase or decrease the effects of:

Gravity	
Thrust	
Drag	
Buoyancy	

EVALUATE

Helium Balloon Investigation

Students investigate how much mass a helium balloon can lift, and then use this data to determine how many helium balloons it would take to lift them off the ground. Students use various weights to complete this task, record their observations and draw force-arrow diagrams to represent the forces acting on a helium balloon at various stages of the investigation. Students also consider the reasons for variations in collected data, and suggest changes that could be made to the investigation to increase the consistency of results.

Curriculum Links

YEAR 7

Science Understanding

Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object *(ACSSU117)*

Science Inquiry Skills

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

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed *(ACSIS125)*

Measure and control variables, select equipment appropriate to the task and collect data with accuracy *(ACSIS126)*

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

Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence *(ACSIS130)*

Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements *(ACSIS131)*

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate *(ACSIS133)*

Helium Balloon Investigation

Have you ever wondered how many helium balloons it would take to lift you off the ground?
Now is your chance to find out! Working in small groups of three or four, you will attach helium balloons, one at a time, to a weight until neutral buoyancy is achieved. Neutral buoyancy is achieved when an object neither sinks (negative buoyancy) nor rises (positive buoyancy). Instead the object will stay in place, hovering in mid-air until acted on by another force.

Aim

To identify how much mass a helium balloon can lift.

Materials

- Helium tank, operated by your teacher only
- Helium balloons (30 centimetre diameter)
- String or ribbon, one per helium balloon (60 centimetres long)
- 2 gram weight
- 5 gram weight
- 10 gram weight
- 20 gram weight

OR

- Various materials of different masses
- Scales, kitchen and bathroom

Method

1. Your teacher will inflate a helium balloon for your group. After the helium balloon is inflated, tie a knot in the balloon. Then tie a 60 centimetre length of string or ribbon to the balloon.
2. Attach a 2 gram weight to the string or ribbon. What happened? Record any observations. Alternatively, you could use a scale to identify material/s with a total mass of 2 grams. Attach material/s to the string or ribbon and record any observations.
3. Attach a 5 gram weight to the string or ribbon. What happened? Record any observations. Alternatively, you could use a scale to identify material/s with a total mass of 5 grams. Attach material/s to the string or ribbon and record any observations.
4. Predict how many balloons it will take to achieve neutral buoyancy. Record your prediction.
5. Continue to attach helium balloons to the 5 gram weight until neutral buoyancy is achieved. Record how many balloons were required to achieve neutral buoyancy.
6. Attach a 10 gram weight to the string or ribbon. What happened? Record any observations. Alternatively, you could use a scale to identify material/s with a total mass of 10 grams. Attach material/s to the string or ribbon and record any observations.
7. Predict how many balloons it will take to achieve neutral buoyancy. Record your prediction.
8. Continue to attach helium balloons to the 10 gram weight until neutral buoyancy is achieved. Record how many balloons were required to achieve neutral buoyancy.
9. Attach a 20 gram weight to the string or ribbon. What happened? Record any observations. Alternatively, you could use a scale to identify material/s with a total mass of 20 grams. Attach material/s to the string or ribbon and record any observations.
10. Predict how many balloons it will take to achieve neutral buoyancy. Record your prediction.
11. Continue to attach helium balloons to the 20 gram weight until neutral buoyancy is achieved. Record how many balloons were required to achieve neutral buoyancy.

Questions

1. Record your observations and results.

Mass	Number of Balloons	Observations
2 grams		
5 grams Prediction:		
10 grams Prediction:		
20 grams Prediction:		

2. Draw a force-arrow diagram to represent the forces acting on a helium balloon in each of the following situations.

Neutral buoyancy	**Negative buoyancy**
Positive buoyancy	**A gust of wind**

3. Use the data you have collected to calculate how many helium balloons it would take to lift you off the ground. If needed, weigh yourself first then record your working out in the space below.

4. Share your results with your class. Explore any variations in data. Why might these variations exist? How could the investigation be altered to gather more consistent data?

EVALUATE

Who Should Get the Helium?

Students consider the ethical implications of helium use as a non-renewable resource across various industries.

Students may either participate in a community of inquiry or a jigsaw activity to investigate:

- How helium is used by various industries
- The helium shortages have been and/or are currently experienced by industry
- Why there is a helium shortage
- If it is possible to resolve this problem, and, if so in what ways

Both activities are described in further detail on the following pages.

Curriculum Links

YEAR 7

Science as a Human Endeavour

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures *(ACSHE223)*

Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations *(ACSHE120)*

General Capabilities

Literacy: Comprehending texts through listening, reading and viewing; Composing texts through speaking, writing and creating; Word knowledge

ICT: investigating with ICT; Managing and operating ICT

Critical and Creative Thinking: Inquiring; Reflecting on thinking and processes; Analysing, synthesising and evaluating reasoning and procedures

Who Should Get the Helium? Community of Inquiry

Research questions to consider prior to conducting the whole-class community of inquiry:

- What helium shortages have been and/or are currently experienced by industry?
- Why is there a shortage?
- Can the problem be resolved? In what ways?

Stimulus

“Helium supplies are tightening up. Hiccups in global helium supply lines, along with increasing demand in a growing economy, are leading to shortages of the noble gas.

According to the industrial gas firm Linde, helium supply interruptions in the Middle East and allocations of helium from the U.S. Bureau of Land Management’s Texas helium reserves have restricted the company’s ability to supply customers with this gas. Linde says it is now allocating helium in 'a fair and reasonable way.'

There is not enough helium to go around. As representatives of Linde, how will you define ‘fair and reasonable’?”

Uses of helium

- Filling balloons (balloon rides, party balloons, blimps, meteorological research)
- Gas-cooled nuclear reactors
- Some neon lights
- MRI machines (can be replaced by hydrogen)
- In diving apparatus
- Breathing mixtures
- Pressurising agent (rockets)
- Purge systems of unwanted gas
- Leak detection
- Shielding gas for arc welding
- Inert atmosphere in welding
- Food preservation
- Cryogenics
- Protective gas when growing silicon
- Semi-conductors – fibre optics
- Gas for supersonic wind tunnels

How would you define fair and reasonable allocation of helium in times of a global shortage?

Consider the previous list of helium uses. You will need to prioritise these uses in order of most to least fair and reasonable allocation of helium. To do this, you would firstly need to consider the following questions in a community of inquiry:

Questions to consider and discuss with your class:

(It is important to provide reasons for your thoughts/ideas as this allows all participants to better understand your thinking):

- Is it possible to solve the problem of the helium shortage by fair and reasonable allocation of helium?
- Are there alternatives to helium that could be considered for some of the listed uses (e.g. MRI and hydrogen)?
- Should these uses still be considered for helium allocation? Why/Why not?
- In what ways could the problem of helium shortage be solved fairly and reasonably?
- Fair and reasonable for whom? Who will the allocation benefit?
- Are these benefits widespread (a wide range of people/communities)? How do you know that?
- What flow-on benefits might the allocation have? In what ways are the flow-on benefits significant?
- If allocations are considered to be fair and reasonable, does that mean they are also ethical? Why/Why not?
- How could an ethical approach to helium allocation be achieved or maintained?
- Should global need be prioritised over local need when considering helium allocation? Why do you think that?
- Are there some helium uses that would be considered less ethical/less important than others? Why do you think that? (environmental pollution, leisure vs research/medicine etc.)
- How would the amount of helium allocated to each group/use be decided upon?
- Who should have the right to make decisions regarding the allocation of helium? Why do you think that?

In small groups (three participants), prioritise the list of helium uses in order of **most to least fair and reasonable** allocation of helium. Make sure you provide **well-considered, logical and ethical justification** for the priority position of each use. You could record your decisions here, or on a larger piece of poster paper.

Note: Complete only the first two columns at this point (Helium Use and Justification).

Priority	Helium Use	Justification	Disagreement
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Return to the whole-class community of inquiry (seated in a circle) and place your poster in the centre of the circle so that it is visible to all members of the community.

Explore and consider each of the priority lists. Do you disagree with any of the chosen priorities? Clearly share your reasons for disagreement with the community. Your teacher will record disagreements and reasons for disagreements as they are voiced.

Applying your new understandings, now consider: How would the amount of helium allocated to each group be decided upon?

Reflection

- On consideration of the shared disagreement/s, should we change our priority order?
- Were the reasons we put forward ethically and logically considered?
- What have we taken away from this activity that will remain with us in future? Why do we consider this important?
- What action could we take as individuals or as a community to make a difference?

Who Should Get the Helium?
Research Jigsaw Activity

Introduction

1. Select stimulus for students to view in relation to the worldwide helium shortage. Stimulus could include the following:

   - We Need Helium More Than Ever (And We're Running Out)
     The Good Stuff. YouTube. 30 June, 2017.
   - Huge Helium Gas Find in East Africa Averts Medical Shortage
     Ian Sample. The Guardian. 29 June, 2016.
   - Uses of helium:
     Filling balloons (balloon rides, party balloons, blimps, meteorological research)
     Gas-cooled nuclear reactors
     Some neon lights
     MRI machines (can be replaced by hydrogen)
     In diving apparatus
     Breathing mixtures
     Pressurising agent (rockets)
     Purge systems of unwanted gas
     Leak detection
     Shielding gas for arc welding
     Inert atmosphere in welding
     Food preservation
     Cryogenics
     Protective gas when growing silicon
     Semi-conductors – fibre optics
     Gas for supersonic wind tunnels

2. After viewing the stimulus material, ask students:

   - What did the introduction material tell us about the following questions?
   - What helium shortages have been and/or are currently experienced by industry?
   - Why is there a shortage?
   - Can the problem be resolved? In what ways?

Class Investigation (Jigsaw Strategy)

3. Set up a jigsaw activity. Roles are designated for groups to research. Alternatively, groups could use relevant media articles to derive answers from their role's perspective.

Each group will use their research findings to create five main points of view to communicate as ‘experts’ in the next jigsaw configuration, with all responding to the same question:

Why is helium important to ‘me’?

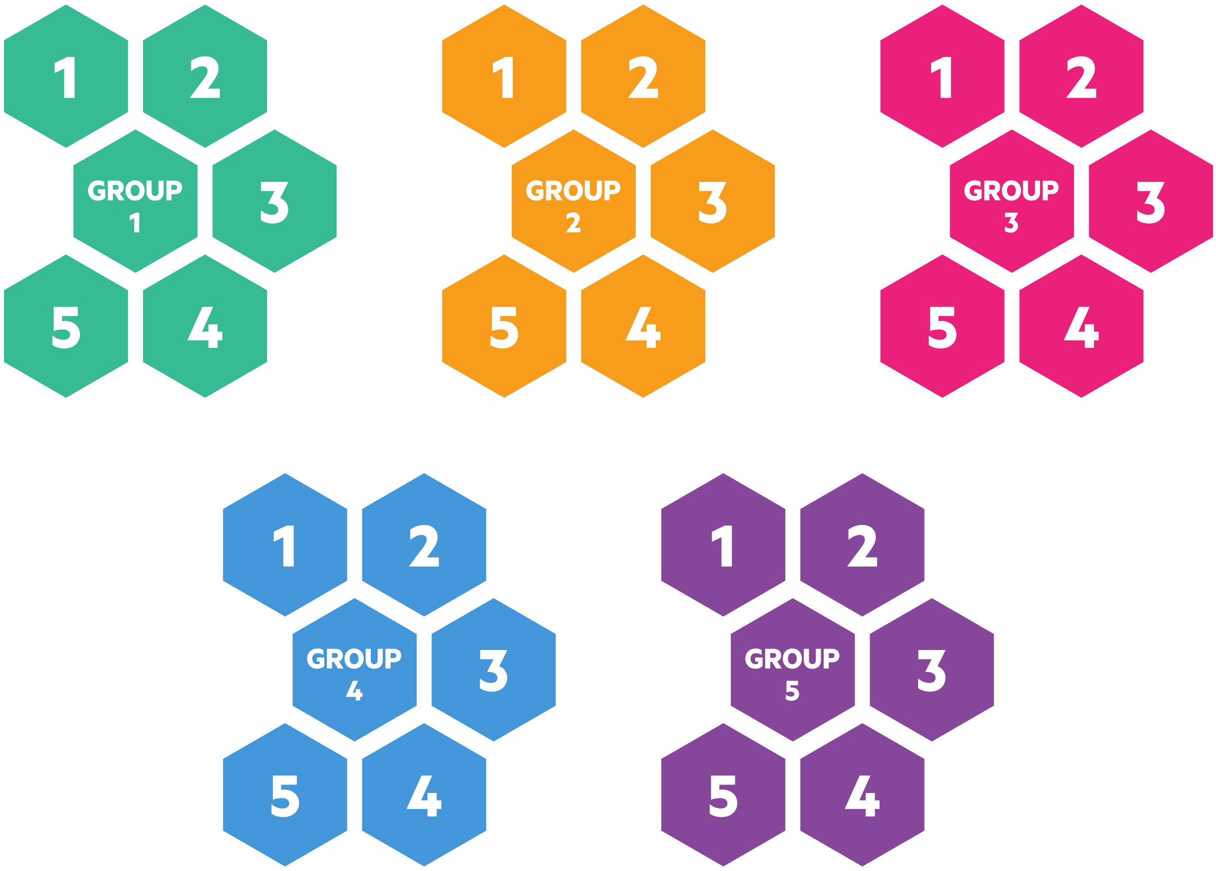
Group 1 Meteorologists

Group 2 Sustainable chemists

Group 3 Party suppliers

Group 4 NASA representatives

Group 5 Technical scuba divers



Meteorologists

—

ROLE 1

FOLD FOLD

As a meteorologist, you work closely with the data that weather balloons collect.

Weather balloons filled with helium take off twice a day in over 200 places around the globe to measure current weather conditions and collect data.

This data, collected by the attached instrument called a sonde, is transmitted back via radio signal for analysis and shared internationally. You understand the vital importance of weather balloons as the most effective data collection method for weather pattern analysis and extreme storm warnings.

Annual usage in weather balloons around the world (2010):
140 million cubic feet of helium (~4 million cubic meters)

CUT OUT THIS TABLE TOP CARD

Sustainable Chemists

—

ROLE 2

FOLD FOLD

As a chemist who specialises in sustainability, you are concerned that the helium used in life-saving medical equipment such as MRIs is being used for trivial purposes such as filling party balloons.

Each MRI needs around 10,000L to function. The gas is the second most abundant element in the observable universe, but Earth has lost its initial helium as it is lighter than air, it just floats into space.

What is available today is produced inside rocks through radioactive decay of uranium and other elements, and it is difficult to locate where the gas builds up into useful reserves. You understand that helium is a precious non-renewable resource.

Annual usage by MRIs around the world (2016):
1.2 billion cubic feet of helium (34 million cubic meters)

CUT OUT THIS TABLE TOP CARD

Party Suppliers

ROLE 3

FOLD

FOLD

As a small business owner, you know how hard it is to cover costs and make a living, only making a couple of dollars per helium balloon that you sell.

The price of helium has increased around 10% per year since you started the business and customers are unhappy when you put up prices, which also affects your sales. Sometimes your helium supplier does not provide your regular order because they have a limited helium supply.

Annual usage for latex and foil balloons around the world (2012):
360 million cubic feet of helium (~10 million cubic meters)

CUT OUT THIS TABLE TOP CARD

NASA Representatives

ROLE 4

FOLD

FOLD

NASA can use up to 100 million cubic feet of helium per year, costing millions of dollars. Helium is used throughout NASA as a cryogenic agent for cooling various materials, in precision welding applications, as well as lab use.

Helium is also used as an inert (unreactive) purge gas for hydrogen systems and as a pressurising agent for ground and flight fluid systems of space vehicles. As a representative of NASA, you are aware of the huge volume and vital role that helium plays in your agency.

NASA's Annual usage of helium (2015):
100 million cubic feet (~2.8 million cubic meters)

CUT OUT THIS TABLE TOP CARD

Technical Scuba Divers

ROLE 5

FOLD

FOLD

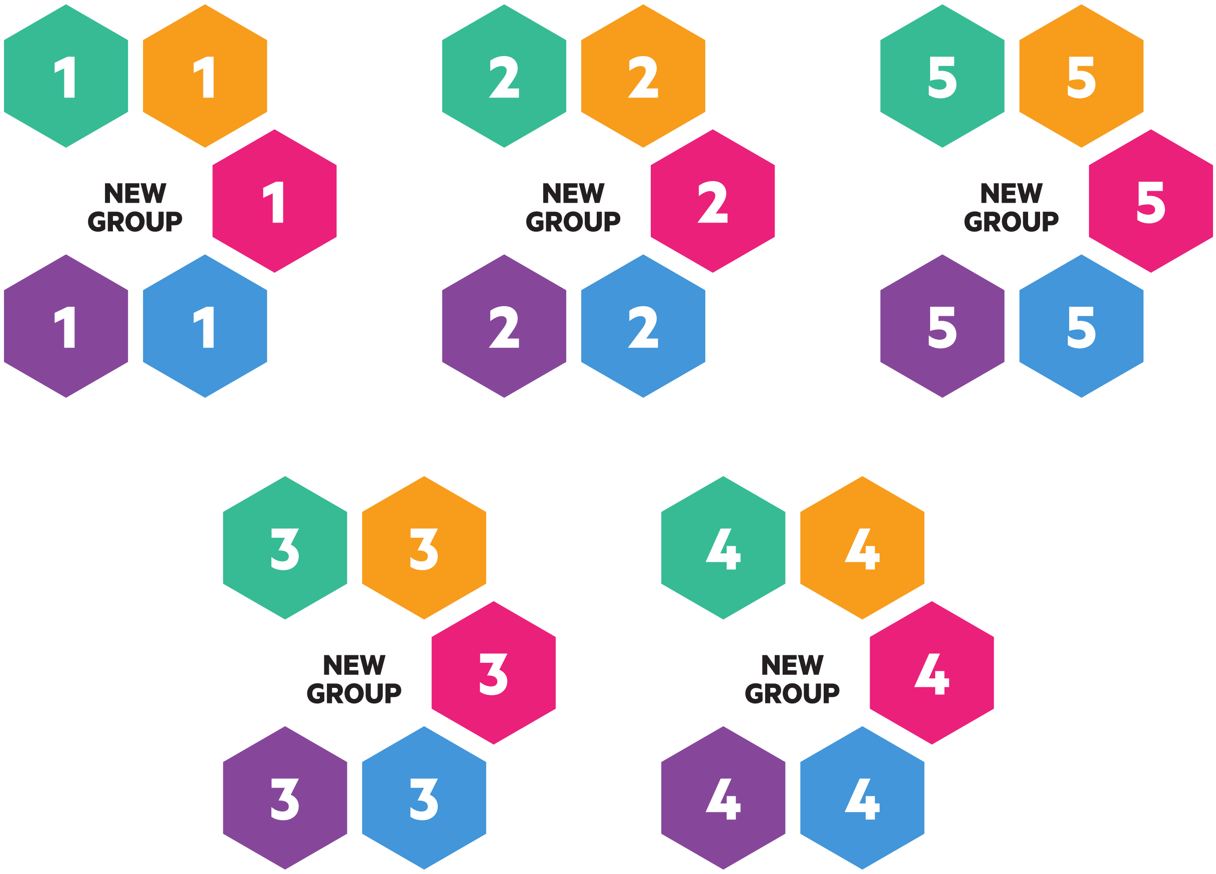
You are a technical diver that is part of a research team investigating ongoing changes in the Great Barrier Reef. Helium is an inert (unreactive) gas that is used instead of nitrogen in oxygen tanks because it does not induce narcosis.

There are predictions in Diver Magazine (2011) that your usual tank cost of US$65 could increase to US$1300. That's about US$25 per minute of diving. With funding only just covering the costs of the research you support, you are concerned that you will no longer have a job in research or in the diving industry in the future.

Annual usage of helium for scuba diving around the world (2016):
360 million cubic feet (~10 million cubic meters)

CUT OUT THIS TABLE TOP CARD

4. Students move into 'shared knowledge groups' where each 'expert' shares why helium is important to them.



Fair and Reasonable Allocation of Helium: Who Should Get the Helium?

5. Students remain in 'shared knowledge groups' as expert representatives of their role. A scenario is given to each group for evaluation:

   Helium supplies are tightening up. Hiccups in global helium supply lines, along with increasing demand in a growing economy, are leading to shortages of the noble gas.

   According to the industrial gas firm Linde, helium supply interruptions in the Middle East and allocations of helium from the U.S. Bureau of Land Management's Texas helium reserves have restricted the company's ability to supply customers with this gas. Linde says it is now allocating helium in 'a fair and reasonable way.

   There is not enough helium to go around; you only have 80% of your usual stock. As representatives of Linde, how will you define 'fair and reasonable' allocation of helium in times of a global shortage?

In order to answer this question, groups should consider the following questions:

- Is it possible to solve the problem of the helium shortage by fair and reasonable allocation of helium?
- Are there alternatives to helium that could be considered for some of the listed uses (e.g. MRI and hydrogen)? Should these uses still be considered for helium allocation? Why/Why not?
- In what ways could the problem of helium shortage be solved fairly and reasonably?
- Fair and reasonable for whom? Who will the allocation benefit?
- Are these benefits widespread (a wide range of people/communities)? How do you know that?
- What flow-on benefits might the allocation have? In what ways are the flow-on benefits significant?
- If allocations are considered to be fair and reasonable, does that mean they are also ethical? Why/Why not?
- How could an ethical approach to helium allocation be achieved or maintained?
- Should global need be prioritised over local need when considering helium allocation? Why do you think that?
- Are there some helium uses that would be considered less ethical/less important than others? Why do you think that? (environmental pollution, leisure vs research/medicine etc.)
- How would the amount of helium allocated to each group/use be decided upon?
- Who should have the right to make decisions regarding the allocation of helium? Why do you think that?

6. Students move back to their original 'expert' groups to share how Linde's various decisions will affect their roles.

EVALUATE

Inspired by Nature

Students examine developments in science and technology by selecting an innovation or object whose design has been inspired by nature. They explore why the innovation or object was developed, its design and function, then determine how the item has impacted society. The Question Answer Relationship (QAR) strategy may be used to guide this process.

Students then work to improve the selected innovation or object in some way. They identify the features that they would keep, improve or remove to enhance the item, and then begin the redesign process by identifying a new user, establishing a refined set of user needs and explaining the final design solution.

Inspired By Nature Curriculum Links

YEAR 5

Science as a Human Endeavour

Scientific knowledge is used to solve problems and inform personal and community decisions *(ACSHE083)*

YEAR 6

Science as a Human Endeavour

Scientific knowledge is used to solve problems and inform personal and community decisions *(ACSHE100)*

YEAR 7

Science as a Human Endeavour

Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations *(ACSHE120)*

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity *(ACSHE121)*

YEAR 8

Science as a Human Endeavour

Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations *(ACSHE135)*

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity *(ACSHE136)*

YEAR 9

Science as a Human Endeavour

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities *(ACSHE160)*

YEAR 5 AND 6

Design and Technologies: Knowledge and Understanding

Examine how people in design and technologies occupations address competing considerations, including sustainability in the design of products, services, and environments for current and future use *(ACTDEK019)*

YEAR 7 AND 8

Design and Technologies: Knowledge and Understanding

Investigate the ways in which products, services and environments evolve locally, regionally and globally and how competing factors including social, ethical and sustainability considerations are prioritised in the development of technologies and designed solutions for preferred futures *(ACTDEK029)*

YEAR 9 AND 10

Design and Technologies: Knowledge and Understanding

Investigate and make judgments, within a range of technologies specialisations, on how technologies can be combined to create designed solutions *(ACTDEK047)*

Inspired by Nature

YEAR 5 AND 6

Select an innovation or object whose development has been inspired by nature, then use your selection to answer the following questions.

My Selection:	
In The Resource	**In My Head**
Right There	**Author and You**
What does the object do?	What solutions does this object offer?
Who was involved in the design and production of the object?	How did people in different occupations work together to develop this object?
Think and Search	**On My Own**
What has inspired the development of this object?	What sustainability issues may arise as a result of using this object? Explain your answer.
	How could these issues be resolved?

Inspired by Nature

YEAR 7 AND 8

Select an innovation or object whose development has been inspired by nature, then use your selection to answer the following questions.

My Selection:	
In The Resource	**In My Head**
Right There	**Author and You**
What does the object do?	What solutions does this object offer?
Who was involved in the design and production of the object?	How did people in different occupations work together to develop this object?
Think and Search	**On My Own**
What has inspired the development of this object?	What ethical issues may arise as a result of this object? Explain your answer
	How could these issues be resolved?

Inspired by Nature

YEAR 9 AND 10

Select an innovation or object whose development has been inspired by nature, then use your selection to answer the following questions.

My Selection:	
In The Resource	**In My Head**
Right There	**Author and You**
What does the object do?	What solutions does this object offer?
Who was involved in the design and production of the object?	How did people in different occupations work together to develop this object?
Think and Search	**On My Own**
What has inspired the development of this object?	What ethical issues may arise as a result of this object? Explain your answer
	How could these issues be resolved?

Queensland Museum Learning Resources

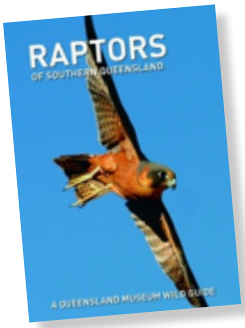
Online Resources

Specific resources relevant to Flight Club and/or animal adaptations can be found online at Queensland Museum Learning Resources, including:

- Year 5 Biology, Flight Adaptations, Dr Paul Oliver
  Explore the various adaptations that allow animals, particularly birds, to fly. This video is presented by Dr Paul Oliver, Senior Curator of Vertebrates at Queensland Museum and features specimens from the Museum's Mammals and Birds Collection.
- On the Wing: Exploring Aspect Ratio
  Calculate the aspect ratio of various wings from Queensland Museum's Mammals and Birds collection, then explore how aspect ratio influences the flight of birds and increases their chances of survival within their environment.
- *Wild State* Teacher Resource
  Contains an overview of the *Wild State* exhibition space, key teaching points for each habitat, a glossary, and curriculum links.
- Adaptations Teaching Unit
  Explore the structural and behavioural adaptations that allow organisms to survive within their environments. The resource includes lesson plans, student worksheets, and assessment instruments.
- Bird Beaks and Feet
  Investigate how the form of bird beaks and feet perform specific functions and assist survival in various environments.
- Skulls Kit – Teacher and Student Notes
  This resource includes teacher notes and suggested activities for student investigations designed to complement the Skulls Kits which can be borrowed from Queensland Museum Loans.
- Museum Expert Videos
  Watch documentaries in which our experts talk about a specimen, artefact, or process from their area of research and learn about what our scientists and curators do.

Resources, including industry professional videos, are available online at Future Makers Teacher Resources. You can also view Collections Online, Animals of Queensland and Queensland Museum Google Arts and Culture webpages. All sites contain information about biological specimens contained in Museum collections.

Queensland Museum Publications



Raptors of Southern Queensland
Contains information about almost 50 species of raptor living in Southern Queensland.

Apps

Queensland Museum Field Guide to Queensland Fauna

This app holds descriptions of over 560 species encompassing birds, fishes, frogs, lizards, snakes, mammals, turtles, freshwater, marine and terrestrial invertebrates, spiders and insects.

Detailed descriptions of animals, maps of distribution and endangered species status combine with images to provide a valuable reference that can be used in urban, bush and coastal environments. Our scientists will continue to add new species and refine this app over time.

Queensland Museum Loans

Borrow kits and sets of museum specimens and artefacts from Queensland Museum Loans to engage learners in your classroom.

You can also borrow QM Loans learning resource kits from a Regional Loans depot. Regional Loans are free and generally for a loan period of two weeks. Borrowers are responsible for costs of and for transporting kits. Check our Regional Loans annual schedules and then contact a Regional Loans depot to book and borrow kits.

To find other loans kits, enter your search terms into the "Catalogue Search" bar at the bottom of the QM Loans webpage. Examples of loans kits relevant to adaptations include:

- Animals in Flight: Explore features of Australian animals in flight.
- Animals in Disguise: Explore features of Australian animals that help them to hide in their environment.
- Rainforest Camouflage (right): Investigate how camouflage helps living things survive in Queensland's wet tropics.