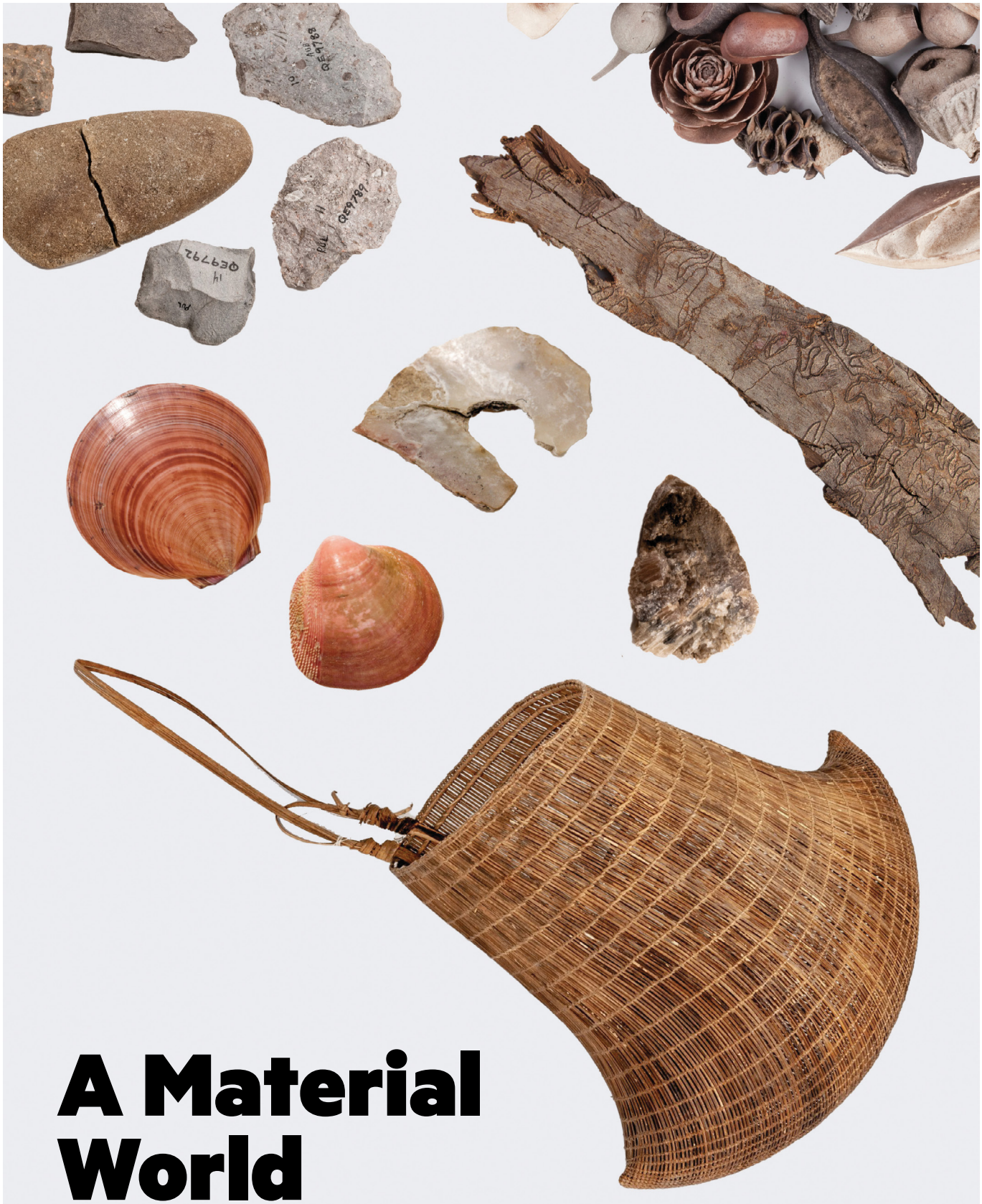

A Material World

FUTURE MAKERS TEACHER RESOURCE

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM NETWORK | Queensland Government

Future Makers

Future Makers is an innovative partnership between Queensland Museum Network 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.

Cover image: Various natural materials. Various objects from the Queensland Museum Network collection. © Queensland Museum

QUEENSLAND MUSEUM NETWORK

Queensland Government

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Workshop Overview

The natural world is full of materials that have been used for thousands of years to create innovative solutions to problems. We really are living in a material world, and the properties of these materials influence how they can be changed, combined and used.

In this hands-on workshop, you will:

- Explore how natural materials can be categorised based on their observable properties.
- Use Queensland Museum collection items and resources to investigate how Aboriginal and Torres Strait Islander Peoples use natural materials to create and produce different objects and tools.
- Analyse how natural materials are selected, changed and combined based on their properties and the purpose of the object being made.
- Explore how you can connect science and design and technologies concepts in an engaging design challenge.
- Reflect on the human use of natural and processed materials.

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

ENGAGE **EXPLORE**	**Material Sort** Examine different materials and explore how they can be described and categorised based on their observable properties.
EXPLORE **EXPLAIN**	**First Nations Scientists: Working with Materials** Learn how an Aboriginal artist from the Girringun [*girr-ig-un*] region uses their knowledge and understanding of the properties of natural materials to create string objects. Complete an object analysis to explore how Aboriginal and Torres Strait Islander Peoples use materials to create and produce different objects and tools. Analyse how materials are selected, changed and combined based on their properties and the purpose of the object being made.
ELABORATE **EVALUATE**	**Transportation Innovation: Design Challenge** Explore how natural materials can be changed and combined to solve problems (Year 2) and how we can use our understanding of the properties of natural materials to create designed solutions (Year 4) in an engaging design challenge. Design and create a tool that can be used to carry something between two places. Test out the design by transporting objects from one place to another.
ELABORATE **EVALUATE**	**Natural vs Processed: Community of Inquiry** Participate in a community of inquiry to consider and discuss the implications of using natural and processed materials.

ENGAGE – EXPLORE

Material Sort

Teacher Resource

In *Material Sort*, students examine different materials, exploring how they can be described and categorised based on their observable properties. Students work collaboratively to:

- Observe and describe different materials.
- Compare and contrast materials based on their observable properties.
- Sort and categorise materials based on their observable properties.

Detailed step-by-step instructions can be seen below. It is recommended that you use these instructions to guide your students through the activity.

Identifying and Selecting Materials

Firstly, identify and select the materials that students will observe and sort during this activity. When selecting materials for this activity you should consider:

- Including a variety of natural and processed materials with a range of observable properties.
- Supplying enough materials to allow for a range of different sorts, but not too many materials so that choices become overwhelming. It is suggested that you use 10-15 materials during the sort, however you should modify this based on your class context, student abilities and year level.

Suggested materials for this activity are listed below. You may choose to add to this list or substitute various materials with other materials.

- Paper
- Al-foil
- Plastics, including various types with different properties (e.g. hard plastics such as milk bottles, soft drink bottles, plastic cutlery and soft plastics such as plastic bags, bubble wrap, plastic film/wrapping)
- Rubber (e.g. samples from rubber gloves, swimming caps etc.)
- Foam (e.g. samples from packaging, sponges, Styrofoam craft materials etc.)
- Cardboard, including various types with different properties (e.g. corrugated, tube, sheets)
- Cotton balls
- String
- Grasses or raffia
- Palm leaves
- Balsawood
- Bark
- Seed pods
- Sticks
- Shells
- Rocks

Introducing the Material Sort

1. Divide students into groups of four or five. Provide each group of students with a set of materials. Inform students that they are going to be examining these different materials and exploring how they are similar and different.

   Allow time for students to briefly explore their sets of materials. You may wish to prompt students by asking questions such as: ***What do you notice?, How are these materials similar or different? and What do all of these things have in common?***

2. Explain to students that all of the items are materials. Introduce students to subject-specific terminology (e.g. objects, materials and properties):
   - All objects are made of materials. Some objects are made from a single material while others are made from a combination of materials.
   - Materials are what objects are made from (e.g. glass, wood, plastic, metal, fabrics etc.).
   - Properties of materials are the things about a material that they can see, feel or measure.

3. Ask students to select and focus on one of their materials. Ask students to work in their groups to brainstorm words to describe the materials and its properties. You may wish to model this process before students complete the task in their groups. You could also provide students with a word bank to complete this task, using the information below as a guide. The word bank could also be displayed in the classroom, and students could add additional words over time.

Properties	**Words to describe properties**
Absorbency	Absorbent, waterproof
Strength	Strong, weak, brittle
Flexibility	Flexible, inflexible, bendy, rigid, stiff
Hardness	Hard, soft
Texture	Rough, smooth, bumpy
Density	Heavy, light
Transparency	Transparent, opaque

   Students then share their observations and discuss as a class.

4. Introduce students to the activity, explaining that they will be completing a material sort where they will sort their sets of materials into groups based on their properties. These groups could be based on what the materials look like or feel like or how the materials can be changed or used.

   Provide students with the following information:

   - The material sort will be split into a number of rounds (minimum of three rounds).
   - Each round will have a time limit (it is suggested you provide students with 2-3 minutes to complete each round, however this should be adjusted based on class context and student abilities).
   - Students will sort the items into a different number of groups each round.
   - The categories are up to the groups to decide, however they must work as a team and agree on their decisions by the end of the round.

- Students must group materials using different properties each round (cannot repeat same groups) and they should be encouraged to justify the reasoning behind their sorts.

You may like to use *Sorting Dice* (page 7) to assist students in completing this activity or as a differentiation strategy.

Facilitating the Material Sort

5. Complete the first round of the material sort. At the end of the round, instruct students to label the groups they have created. Students can use labels or sticky notes to identify how they sorted the materials. Students could then use digital technologies to take a photograph of their first sort.
6. After the sort, facilitate a class discussion with students. Possible discussion prompts include:
   - What categories did you decide on? What words would you use to describe each group?
   - Did you create your groups based on one property or multiple properties?
   - How does your sort compare to the sort of another group? What are the similarities? What are the differences?
   - Was the process of creating these groups easy or challenging? Why?
7. Repeat this process for a number of rounds.

   You may like to reduce the time limit after each round or provide students with a set number of groups to sort the materials (while still basing groups on observable properties). These adaptations maintain student engagement and offer additional challenges towards the end of the activity.
8. **YEAR 2**

   Ask students: ***How could we change these materials? Can they all be changed in the same ways?***

   Work with students to brainstorm ideas on how they could change the materials using 'I can' statements, for example: I can bend, I can fold, I can twist, I can stretch, I can snap. You may wish to discuss and act out what these actions look like, sound like or feel like. Students could then work in groups or as a class to create groups based on these actions.

   YEAR 4

   Ask students: **Which materials do you think are natural? Which do you think are processed?**

   Ask students to work in groups to sort materials based on whether they believe they are natural or processed. Student groups then take turns to share their decisions with the class group. Students should provide reasons to justify their decisions.

   The ability for materials to change categories (i.e. natural or processed) throughout the sharing process should be emphasised to the class. Students may change their minds about various materials during the discussion, and this is acceptable. Students should still be able to justify reasons for any changes.

   Provide definitions of natural and processed materials with the class and ask them if there are any materials they would move. Again, encourage students to justify their responses.

   You may also wish to extend students by asking them to sort the materials along a continuum from materials that are the most natural to the most processed.

Curriculum Links

Science

YEAR 2

Science Understanding

Different materials can be combined for a particular purpose (ACSSU031)

Science as a Human Endeavour

Science involves observing, asking questions about, and describing changes in, objects and events (ACSHE034)

Science Inquiry Skills

Participate in guided investigations to explore and answer questions (ACSIS038)

Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions (ACSIS040)

Compare observations with those of others (ACSIS041)

Represent and communicate observations and ideas in a variety of ways (ACSIS042)

YEAR 4

Science Understanding

Natural and processed materials have a range of physical properties that can influence their use (ACSSU074)

Science Inquiry Skills

Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS068)

Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

Design and Technologies

YEAR 2

Design and Technologies: Knowledge and Understanding

Explore the characteristics and properties of materials and components that are used to produce designed solutions (ACTDEK004)

YEAR 4

Design and Technologies: Knowledge and Understanding

Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (ACTDEK013)

Design and Technologies: Processes and Production Skills

Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to produce designed solutions (ACTDEP014)

General Capabilities

Critical and Creative Thinking

Inquiring – identifying, exploring and organising information and ideas

Generating ideas, possibilities and actions

Literacy

Word Knowledge

Composing texts through speaking, writing and creating

Material Sort

Teacher Resource

Sorting Dice

Smooth	**Flexible**	**Strong**
Transparent	**Soft**	**Can be bent or folded**
Can be stretched	**Can be broken into smaller pieces**	**Absorbent**
Natural Materials	**Wildcard!**	

EXPLORE – EXPLAIN

First Nations Scientists: Working with Materials

Teacher Resource

Aboriginal and Torres Strait Islander Peoples deep scientific knowledge and understanding of the properties of natural materials has informed, and continues to inform, the selection, use and modification of materials for specific purposes.

In this activity, students firstly explore how an Aboriginal artist from the Girringun [*girr-ig-un*] region uses their knowledge and understanding of the properties of natural materials to create objects, specifically objects made from string.

Students then use objects from Queensland Museum Network's Cultures and Histories collection to explore how Aboriginal and Torres Strait Island Peoples use natural materials to produce different objects and tools. Students in Year 2 explore how Aboriginal and Torres Strait Islander Peoples physically change and combine natural materials to make them useful for particular purposes, while Year 4 students consider how Aboriginal and Torres Strait Islander Peoples use natural and processed materials for different purposes based on their properties.

Queensland Museum Network's Cultures and Histories collection is comprised of objects that are significant to the people of Queensland, including the material culture of Aboriginal Peoples and Torres Strait Islander Peoples. You can view objects from these collections online and in person at exhibitions on display across the Queensland Museum Network.

Video Resource

Students explore how an Aboriginal artist from the Girringun [*girr-ig-un*] region uses their knowledge and understanding of the properties of natural materials, specifically string, to create objects. Join the artist as they describe:

- Why string is a useful material to work with based on its properties.
- How string is made and how materials are changed during this process.
- How string is used to make objects.
- How work with string has changed over time.

This video resource is available at the Queensland Museum Network Learning Resources site.

Object Analysis

Students use objects from Queensland Museum Network's Cultures and Histories collection to explore how Aboriginal and Torres Strait Island Peoples use natural and processed materials to create and produce different objects and tools. Students will use images of these collection items to complete an object analysis. During the object analysis, students will:

- Identify and describe the features and characteristics of each object.
- Examine the materials used to construct each object.
- Explore how materials have been changed in the construction of the objects.
- Investigate how materials have been combined to construct the objects.
- Consider how the properties of materials have influenced their use and the design of the objects.

Detailed step-by-step instructions can be seen below. It is recommended that you use these instructions to guide your students through the activity.

1. Divide students into groups of two or three. Distribute one object image to each group. Ask students to analyse the object using the See-Scan-Analyse strategy:

   See: Describe what you see.
   What materials is the object made from?
   What colour is the object?
   What shape is the object?
   What size is the object?

   Scan: Look closely at the object.
   What extra details do you notice now that you didn't before?
   How are the different materials combined?
   How are the different parts of the object combined?
   How do you think the materials used in the object have been changed?

   Analyse: What do you think the object was used for? Why?
   Who do you think used this object? Why?
   Why do you think these materials were used to create this object?

   You may wish for students to record their observations and ideas on the provided *Object Analysis Template* (page 26).

2. Student groups then share their objects and responses to the See-Scan-Analyse questions with the class. Alternatively, you may wish for students to repeat this process with a number of different objects, before sharing their observations and responses.

   During the class discussion, you may wish to prompt students to focus on year-level specific content when discussing their responses. For instance, Year 2 students can be prompted to further consider how materials have been changed and combined. Year 4 students can be prompted to consider how the properties of the various materials affect their use.

3. After students have shared their responses, explore the *Object Profile Cards* (page 19) with students to learn more about each object, including the materials the objects were made from and how they were used.

4. Students research other objects which have been created by Aboriginal and Torres Strait Islander Peoples. During this research task, students could analyse the materials used to create these objects, how the materials were changed and combined, and how the properties of the materials influenced how they were used. An *Object Analysis Template* is provided on the following pages to guide students' responses to the task (page 26).

   Additional research may be conducted through a visit to Queensland Museum's Discovery Centre to view the *First Scientists* display. You can see examples of other First Nations objects in the Queensland Museum collection by searching 'Aboriginal and Torres Strait Islander' on the Queensland Museum Learning Resources platform and selecting 'collection items'.

The video resource and object analysis featured within this activity can also be used as a starting point from which you can explore:

- How different geographical regions encompassing a community's Country or Place produce different resources and how the availability of resources influences and impacts the production of objects.
- How Aboriginal and Torres Strait Islander Peoples have long used science to inform the sustainable harvest of environmental resources to meet their needs.
- How Aboriginal and Torres Strait Islander Peoples' cultural practices have continued and changed over time.

When discussing Aboriginal and Torres Strait Islander practices, it is important to highlight that these cultural practices are strong and continue to be practised today by First Nations Peoples.

You may also wish to invite local Aboriginal and/or Torres Strait Islander community members into your school as you complete this activity to build relationships and facilitate the sharing of knowledge and perspectives.

Curriculum Links

Science

YEAR 2

Science Understanding

Different materials can be combined for a particular purpose (ACSSU031)

Science as a Human Endeavour

Science involves observing, asking questions about, and describing changes in, objects and events (ACSHE034)

People use science in their daily lives, including when caring for their environment and living things (ACSHE035)

Science Inquiry Skills

Pose and respond to questions, and make predictions about familiar objects and events (ACSIS037)

Participate in guided investigations to explore and answer questions (ACSIS038)

Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions (ACSIS040)

Compare observations with those of others (ACSIS041)

Represent and communicate observations and ideas in a variety of ways (ACSIS042)

YEAR 4

Science Understanding

Natural and processed materials have a range of physical properties that can influence their use (ACSSU074)

Science as a Human Endeavour

Science knowledge helps people to understand the effect of their actions (ACSHE062)

Science Inquiry Skills

Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

Design and Technologies

YEAR 2

Design and Technologies: Knowledge and Understanding

Identify how people design and produce familiar products, services and environments and consider sustainability to meet personal and local community needs (ACTDEK001)

Explore the characteristics and properties of materials and components that are used to produce designed solutions (ACTDEK004)

YEAR 4

Design and Technologies: Knowledge and Understanding

Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (ACTDEK013)

General Capabilities

Critical and Creative Thinking

Inquiring – identifying, exploring and organising information and ideas

Generating ideas, possibilities and actions

Analysing, synthesising and evaluating reasoning and procedures

Literacy

Word Knowledge

Composing texts through speaking, writing and creating

Intercultural Understanding

Recognising culture and developing respect

Cross-curriculum Priorities

Aboriginal and Torres Strait Islander Histories and Cultures

Australia has two distinct Indigenous groups: Aboriginal Peoples and Torres Strait Islander Peoples, and within those groups there is significant diversity (OI.1)

Aboriginal and Torres Strait Islander communities maintain a special connection to and responsibility for Country/Place (OI.2)

Aboriginal and Torres Strait Islander societies have many Language Groups (OI.4)

Aboriginal and Torres Strait Islander Peoples' ways of life are uniquely expressed through ways of being, knowing, thinking and doing (OI.5)

First Nations Scientists: Working with Materials

Teacher Resource

Object Images

Object A

QM, Jeff Wright

Object B

QM, Jeff Wright

Object C

QM, Peter Waddington

Object D

QM, Peter Waddington

Object E

QM, Peter Waddington

Object F

QM, Jeff Wright

Object G

QM, Peter Waddington

First Nations Scientists: Working with Materials

Teacher Resource

Object Profile Cards

Object A	*Weres* (fish scoop) from Mer Island, Torres Strait
Materials used to construct the tool/object?	Bamboo, plant fibres (from palm leaves)
What properties of the materials make them a good choice for this tool/object?	Bamboo: lightweight, flexible, strong Plant fibres: flexible, strong, durable
How were the materials changed/modified for use in this object?	Bamboo was soaked in sea water and bent into shape. Fibres prepared through processes that may involve a combination of steaming, soaking, splitting, scraping, chewing, stripping, washing, pounding and drying. Once the string was prepared it was physically changed through twisting, twining, plaiting or knotting.
What was/is the purpose of the object? **How was/is it used?**	*Weres* were used to catch sardines, which are found close to the shore of the eastern islands of the Torres Strait. The fish would be 'scooped' after being driven into shallow waters. Larger scoops could also be set between the gaps of stone fish traps. Some Torres Strait Islander Peoples use *weres* in art and dance to tell stories. *Weres* and fish traps made of natural materials are still used by some Aboriginal and Torres Strait Islander Peoples today. However, modern nylon nets have become the marine technology of choice for most Aboriginal and Torres Strait Islander Peoples. The same weaving techniques can be used for both natural fibres and synthetic materials to make and mend nets.

Object B	Palm spathe container from Erub Island, Torres Strait
Materials used to construct the tool/object?	Palm spathe (part of leaf) Grass stem (culm)
What properties of the materials make them a good choice for this tool/object?	Palm spathe: flexible, strong, waterproof Grass culm: flexible, strong, durable
How were the materials changed/modified for use in this object?	This object was made from a single palm spathe which was folded and tied to create a container. The grass culm was plaited together to improve strength and durability.
What was/is the purpose of the object? **How was/is it used?**	Palm containers were primarily used to transport water, however they are a multi-purpose tool used for a number of functions. These containers are impermeable and easily transported. Some other uses for palm containers include: carrying infants, foods and other materials.

Object C	*Coolamon*
Materials used to construct the tool/object?	Hardwood
What properties of the materials make them a good choice for this tool/object?	Wood: strong, durable, mouldable, waterproof (when treated)
How were the materials changed/modified for use in this object?	The wood used to create this object was moulded to its desired shape. There are a number of techniques used by Aboriginal and Torres Strait Islander Peoples to bend and shape wood. These include: • Stone tools were used to cut and strip away wood to shape the object. • Steam bending: heat and moisture are applied to wood or bark to enable the material to be moulded • Using flexible, green timber • Soaking wood in water • Burying wood in hot, dry sand • Bending and fastening wood in place with twine or sinew *Coolamons* were treated using resin to make them waterproof. To help preserve and protect *coolamon* they were regularly rubbed with animal fat to keep the wood in good condition.
What was/is the purpose of the object? **How was/is it used?**	*Coolamons* were traditionally used by Aboriginal women to carry water, fruits, nuts and to cradle babies. They were also used for winnowing grains in the traditional bread-making process and as a general heating and cooking vessel. *Coolamons* were often carried on the head when traveling or under the arm as a cradle.

Object D	Turtle shell fish hooks from Badu Island, Torres Strait
Materials used to construct the tool/object?	Turtle shell
What properties of the materials make them a good choice for this tool/object?	Turtle shell: hard, strong, mouldable, dense, durable
How were the materials changed/modified for use in this object?	These fish hooks were manufactured from turtle shell by cutting or scraping the shell. Heat was then applied to soften the shell, allowing it to be bent into shape. The heat was then removed from the shell. As the shell cools it hardens and sets in the desired shape/form.
What was/is the purpose of the object? **How was/is it used?**	Fishing forms part of the deep cultural and spiritual connection many Aboriginal and Torres Strait Islander communities have with their oceans or inland waterways that form part of their Country. Today, Aboriginal and Torres Strait Islander Peoples primarily use fishing lines with metal hooks, rather than those made from turtle shells or animal bones. Although new technologies have changed Aboriginal and Torres Strait Islander Peoples' means of fishing, the traditional knowledge of how, where and when to gather marine food resources (such as fish and shellfish) hasn't changed.

Object E	Dilly Bag
Materials used to construct the tool/object?	A variety of natural resources are used to prepare fibre for string. These differ according to each geographical region and the desired purpose of the finished product. Different groups throughout Queensland use different resources due to the region's very diverse plant life and geographical variation.
What properties of the materials make them a good choice for this tool/object?	Plant fibres: flexibility, strength, durability
How were the materials changed/modified for use in this object?	Fibres were prepared through processes that may involve a combination of steaming, soaking, splitting, scraping, chewing, stripping, washing, pounding and drying. These processes are carried out to improve the flexibility, strength and durability of the fibre. Once the string is prepared it can then be physically changed through twisting, twining, plaiting or knotting to manufacture items for a desired purpose.
What was/is the purpose of the object? **How was/is it used?**	Bags and baskets have been used across all Indigenous Australian communities for a variety of purposes. Dilly bags are traditional bags used for gathering food and could be hung around the neck in order to leave the hands free. In recent times, the production of Dilly bags has become a centrepiece for weaving artistry. Artists have created Dilly bags with new designs, colours and forms, while still using traditional weaving techniques.

Object F	*Jawun* (Bicornual basket)
Materials used to construct the tool/object?	Lawyer cane
What properties of the materials make them a good choice for this tool/object?	Lawyer cane: flexibility, strength, durability
How were the materials changed/modified for use in this object?	Lawyer cane is physically changed in the construction of *Jawun*. The prickly outer casing of the plant is removed, and the fibre is split. A frame is made by bending several lengths of stripped lawyer cane over a fire. Fine fibre is then twined across this frame. To strengthen the basket, rings of bent cane are added to the inside. Handles are added by attaching bent strips of lawyer cane to the mouth of the basket.
What was/is the purpose of the object? **How was/is it used?**	*Jawun* were used for collecting and processing food and at times for carrying young infants. *Jawun* were used for collecting and carrying foods, such as nuts and seeds. A long handle was sometime included on Jawun. This would allow the user to loop this strap around their forehead, allowing the basket to be worn hanging down their back. This would keep the user's hands free. *Jawun* were also used in the process of leaching toxic substances from certain plant foods, to render them safe to eat. The baskets were placed in running streams with the top facing upstream. The hornlike projections were wedged among rocks to keep the basket in place. The *Jawun* were left at times for several days. This allowed people to eat a much wider variety of foods, that would otherwise have been poisonous.

Object G	Woven basket from Erub Island, Torres Strait
Materials used to construct the tool/object?	Plastic tape The practice of using plastic packaging tape is becoming more widespread, particularly in mainland communities where raw materials are hard to obtain.
What properties of the materials make them a good choice for this tool/object?	Plastic: flexible, durable, colourful, reused
How were the materials changed/modified for use in this object?	The plastic packaging tape was woven together to create this object using traditional skills and techniques.
What was/is the purpose of the object? **How was/is it used?**	Basketry and weaving are central to Torres Strait Islander lifestyle. The objects are used in a practical sense (for transporting items), although decorative pieces are also produced. The weaving of baskets are significant skills that have become symbols of identity for contemporary Torres Strait Islander women. Women learn from their mothers or aunties and their expertise helps link the generations together.

First Nations Scientists: Working with Materials

Student Activity

OBJECT		
SEE	**Look at the object. Describe what you can see.**	
	What materials is the object made from?	
	What colour is the object?	
	What shape is the object?	
	What size is the object?	
SCAN	**Look closely at the object. What extra details do you notice?**	
	How can you describe the object in more detail?	
	How are the different materials/parts of the object combined?	
	How do you think the materials used in the object have been changed?	
ANALYSE	**Analyse the object to answer the following questions. Explain your responses.**	
	What do you think this object was used for? Why?	
	Why do you think these materials were used to create this object?	

ELABORATE – EVALUATE

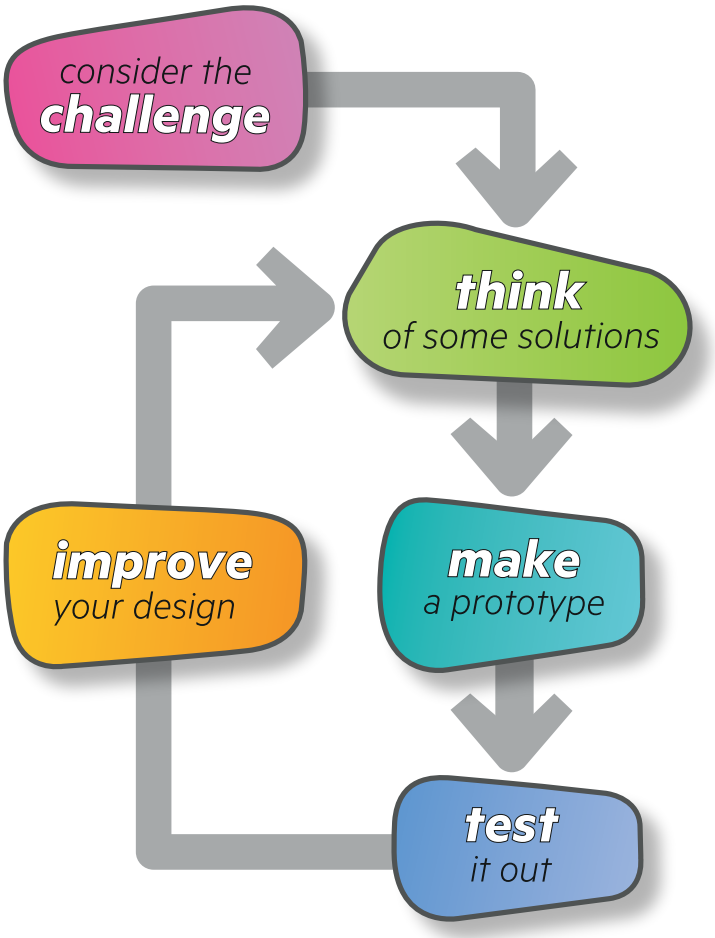
Transportation Innovation: Design Challenge

Teacher Resource

In this activity, students participate in a design challenge, during which they use natural materials to design and create a tool that can be used to transport an object between two places. *Transportation Innovation* provides students with an opportunity to:

- Explore how natural materials can be changed and combined to solve problems (Year 2).
- Use their understanding of the physical properties of natural materials to create designed solutions (Year 4).

Students follow a design process (see below) to complete this activity. Further prompts and questions you can use to guide students through this activity are provided on the following pages.



The design process students will follow to complete this design challenge.

Incorporating Natural Materials in Transportation Innovation

There are a number of ways you could incorporate and explore natural materials in this design challenge. You may wish to:

- Encourage students to consider what natural material/s they would use in their design. You could provide students with a requirement to incorporate a certain number of natural materials in their designs.
- Ask students to collect natural materials from home, school and/or their local community.

  If using plant material in this design challenge, be mindful of the types of plants that are used, especially if students are collecting plant material themselves, as some may contain toxins that are harmful to humans if touched or ingested. As a result, you may like to familiarise yourself with the common toxic plants found in Queensland and provide students with pre-selected non-toxic plant material they can use to construct their designs.
- If suitable natural materials are not available or cannot be collected, students could identify and use a different material that has similar properties.

Consider the Challenge

1. Introduce students to the design challenge. Explain to students that they will be exploring how natural materials can be changed and combined to solve problems (Year 2) or how they can use their understanding of the properties of natural materials to create designed solutions (Year 4).

   Explain to students that their challenge is to: ***Use natural materials to design and create a tool that can be used to transport something between two places.***

2. Divide students into groups. Ask student groups to consider and discuss the following questions:
   - What makes a material 'natural'?
   - What are natural materials?
   - What is the difference between natural and processed materials?
   - What are examples of natural materials?

   You may wish to complete the Material Sort activity (page 7) to explore these questions. Ask students to share their ideas and responses as part of a class discussion.

3. Ask students to then consider the question: ***Why do people need or use tools and devices to transport different objects?***

   Prompt students to discuss this question in their groups before sharing their responses with the class.

   You may wish to provide students with stimulus material to help them respond to this question, such as images of tools or devices used for transporting different objects or materials, or objects and materials which may require tools or devices to transport. Students can also consider the tools and devices they use to transport objects in their everyday life.

Possible responses could include:

- Objects could be difficult to transport without using a tool/device
- People may want to transport a number of objects
- People may want to transport objects that they don't want to touch

4. Share or negotiate any specific challenge requirements. These may include:
   - Size of student groups (recommended two to three students per group)
   - Student roles
   - Available materials and equipment
   - Time limits students have to complete the challenge

5. Prompt students to think about the tool that they are going to design and construct. Ask students to consider the purpose of their tool, develop success criteria and determine how they could test the effectiveness of their design. Refer to the student activity resources for questions you can use to guide students through this process (page 26).

   Alternatively, you may wish to further scaffold this activity by asking all students to respond to a specific challenge, such as:

   - Design a tool that can transport a specific object/s from one place to another. Students could test whether their devices are successful in transporting objects between different locations or measure the distance that they are able to transport the objects.
   - Design a multi-purpose device that can transport a number of different objects. Students could test their devices on objects that are different sizes, or objects that have different characteristics or properties.
   - Design a tool that can move multiple objects at one time. Students record how many objects they can transport from one location to another. An opportunity for extension could be to place a time limit on transporting objects. How many objects can you transport in a certain period of time?
   - Design a tool that can be used to transport objects to or from hard to reach places. Can you design a device to reach up high or down low? Can your device overcome different obstacles?

Think of Some Solutions

Provide students with time to brainstorm ideas for their designs. Students create diagrams of possible designs, consider the different parts of their designs and identify materials they could use to construct them.

When developing possible solutions, students could:

- Explore and investigate examples of tools made from natural materials that are used to transport objects and materials. Students could observe and analyse Aboriginal and Torres Strait Islander objects from QMN's Cultures and Histories collections (see online or First Nations Scientists: Working with Materials, page 8).
- Consider tools that they use to transport objects in their everyday life, and then think about how they could use natural materials to construct similar tools.
- Explore and test different natural materials. Prompt students to think about how they could change and combine materials to make them more useful.

If natural materials are not available or cannot be collected, students could brainstorm other materials that share similar properties and could therefore be used as substitute materials when creating their prototypes.

Make a Prototype

1. Ask students to discuss their initial ideas and select a design they would like to develop further.

2. Students create a labelled diagram of their design and identify the materials required to construct their prototype. Students consider the properties of these materials and justify their selections.

3. Students then work collaboratively to construct a prototype of their design. Materials required to complete the design challenge will vary depending on students' designs. Suggested materials for the *Transportation Innovation* design challenge are listed on page 33.

   The following questions and prompts may be useful in guiding your students through this stage of the design process:

   - What materials could you use in your design?
   - How will the properties of different materials affect what you use?
   - How will you work safely?
   - Now that you are making your design, how suitable are the materials? What changes might you need to make to your tool's design?

Test It Out

After constructing their prototype, students test the effectiveness of their designed solution. The methods for testing student designs will vary depending on the specific requirements of the challenge and the purpose of student's tools.

When planning and conducting their tests, students should consider:

- The object/s or material/s they will use to test their prototypes; these should be based on the purpose of their tool.
- How they will collect data and measure the effectiveness of their prototype. Students could measure the distance they are able to transport an object or material, the number of objects they are able to move in a specified time, the number of different objects their design is able to transport or the success rate of their prototype.

Improve Your Design

Students reflect on their testing process and evaluate the effectiveness of their designed solution. Students suggest how they could improve their design.

If time allows, students could modify their prototype and repeat the testing process to determine the impacts of any changes.

Evaluate and Reflect

Encourage students to reflect on their experiences (either within their teams or as a class group) after they have completed the design challenge. Students may like to think about the following questions to assist with their reflection:

- Tell other groups about your tool! What is it designed to do?
- What features does your design have?
- What is your favourite thing about your design?
- What inspired your design? How did you come up with your idea?
- How did your knowledge and understanding about materials help you complete this challenge?
- If you had more time, what would you do next?
- Was there anything that you found difficult in the design challenge? How did you overcome these challenges?
- What have you learnt about science or design from this activity?
- Is there anything that you would like to keep exploring or find out more about?

Curriculum Links

Science

YEAR 2

Science Understanding

Different materials can be combined for a particular purpose (ACSSU031)

Science Inquiry Skills

Pose and respond to questions, and make predictions about familiar objects and events (ACSIS037)

Participate in guided investigations to explore and answer questions (ACSIS038)

Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions (ACSIS040)

Compare observations with those of others (ACSIS041)

Represent and communicate observations and ideas in a variety of ways (ACSIS042)

YEAR 4

Science Understanding

Natural and processed materials have a range of physical properties that can influence their use (ACSSU074)

Science Inquiry Skills

Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

Design and Technologies

YEAR 2

Design and Technologies: Knowledge and Understanding

Explore the characteristics and properties of materials and components that are used to produce designed solutions (ACTDEK004)

Design and Technologies: Processes and Production Skills

Explore needs or opportunities for designing, and the technologies needed to realise designed solutions (ACTDEP005)

Generate, develop and record design ideas through describing, drawing and modelling (ACTDEP006)

Use materials, components, tools, equipment and techniques to safely make designed solutions (ACTDEP007)

Use personal preferences to evaluate the success of design ideas, processes and solutions including their care for environment (ACTDEP008)

YEAR 4

Design and Technologies: Knowledge and Understanding

Investigate how forces and the properties of materials affect the behaviour of a product or system (ACTDEK011)

Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (ACTDEK013)

Design and Technologies: Processes and Production Skills

Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to produce designed solutions (ACTDEP014)

Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques (ACTDEP015)

Select and use materials, components, tools, equipment and techniques and use safe work practices to make designed solutions (ACTDEP016)

Evaluate design ideas, processes and solutions based on criteria for success developed with guidance and including care for the environment (ACTDEP017)

Plan a sequence of production steps when making designed solutions individually and collaboratively (ACTDEP018)

General Capabilities

Literacy

Word knowledge

Critical and Creative Thinking

Inquiring – identifying, exploring and organising ideas

Generating ideas, possibilities and actions

Reflecting on thinking and processes

Analysing, synthesising and evaluating reasoning and procedures

Personal and Social Capability

Social management

Transportation Innovation: Design Challenge

Teacher Resource

Material Suggestions

We recommend the following materials for use when facilitating this design challenge in your classroom. You can substitute some materials for others or provide additional materials that are not listed below.

Natural Materials:

- Grasses
- Raffia
- Leaves
- Palm leaves
- Feathers
- Bark
- Seed pods
- Sticks
- Shells
- Rocks
- Shells

Alternative Processed Materials:

- Fabric
- Aluminium foil
- Cellophane
- Milk bottle lids or similar
- Assorted plastics
- Cardboard
- Paper
- Foam
- Table tennis balls
- Netting or mesh
- Paddlepop sticks
- Straws
- Skewers
- Marbles
- Lego or Meccano
- Balsawood
- Pipe cleaners
- Rubber bands
- String
- Masking tape
- Blu-Tack

Transportation Innovation: Design Challenge

Student Activity: Year 2 Challenge

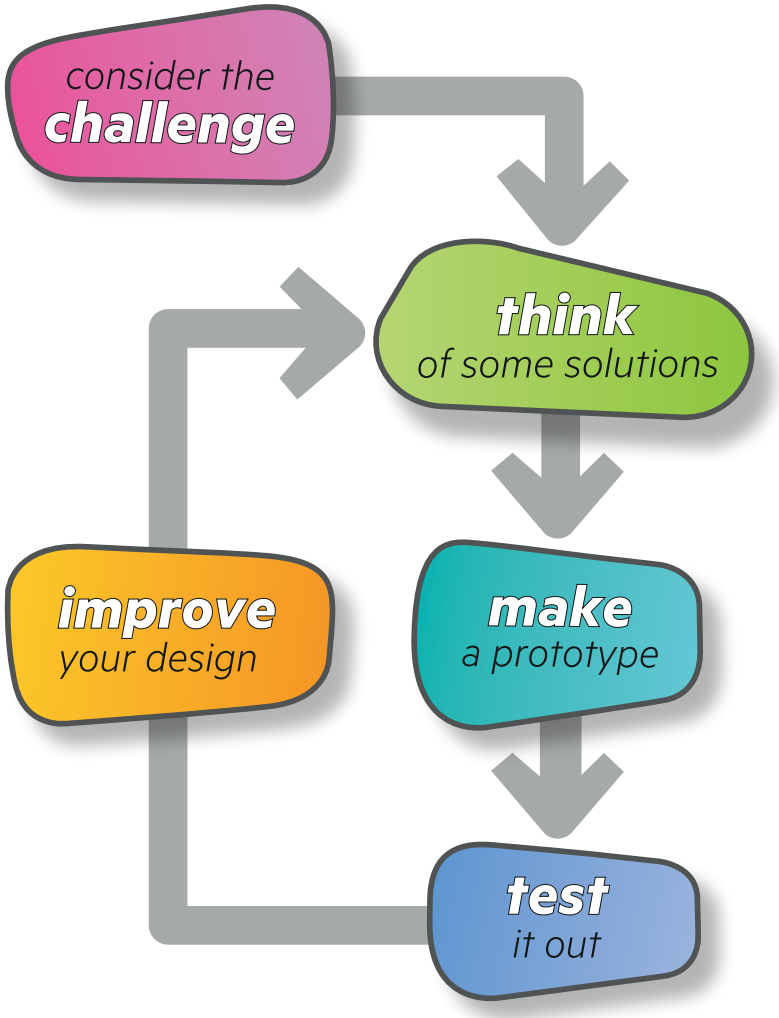
Task:

How can natural materials be changed and combined to solve problems?

Use natural materials to design and create a tool that can be used to carry something between two places.

Test out your design by transporting objects from one place to another.

In this challenge you will:



Consider the Challenge

In this challenge I am going to design a tool that can be used to transport...

To be effective at its job, my design will need to be...

I am going to be creating my design out of natural materials. Some natural materials I think will be useful are...

What ideas do you have for your design? Use this page to brainstorm different possibilities.

Make a Prototype

1. Select a design that you would like to construct. **You are now going to create a prototype!**
2. Draw a diagram of your prototype.

   Label your diagram to show the materials you have used and the different parts of your design.

3. What materials have you used in your design? Why did you use these materials? How did you change this material?

Material	**I chose this material because...**	**I changed the material by...**

Test It Out

Test your prototype. How effective is it at transporting your chosen object or material?

Make sure you test your device a number of times! Record your results.

Improve Your Design

How could you improve your design? What changes would you make?

Reflect

Reflect on the design challenge as a class group. You might like to think about the following questions:

- Tell other groups about your tool! What is it designed to do?
- What is your favourite thing about your design? What features does it have?
- What inspired your design? How did you come up with your idea?
- How did what we have been learning about materials help you?
- If you had more time... what would you do next?
- Was there anything that you found difficult in the design challenge? How did you overcome these challenges?
- What have you learnt about science or design from this activity?
- Is there anything that you would like to keep exploring or find out more about?

Transportation Innovation: Design Challenge

Student Activity: Year 4 Challenge

Task:

How can we use our understanding of the properties of natural materials to create designed solutions and solve problems?

Design and create a tool that can be used to carry something between two places. Test out your design by transporting objects from one place to another.

You will:

- **Consider the challenge:**

  Reflect on why people require or use tools to transport different objects.

  Identify what your tool will be used for and who will use it.

  Determine how you could test your design. How will you know if it is effective?

- **Think of some solutions:**

  Investigate real-world examples of tools, objects or devices that are used for a similar purpose. Explore how these work and what materials are used in their designs.

  Brainstorm possible ideas for your device.

- **Make a prototype:**

  Select a design and create a prototype.

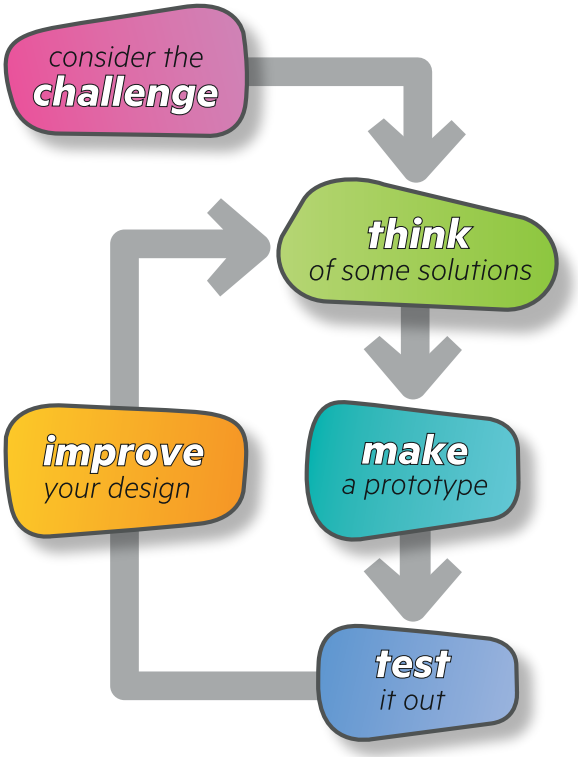
  Consider what materials you will use in your design. How do their physical properties influence their use?

- **Test it out:**

  Test your prototype. How effective is your design at performing its purpose?

- **Improve your design:**

  Identify opportunities to improve your design. How can you make it more effective?



Consider the Challenge

1. Discuss why people use tools or devices to transport different objects.

Think about the device that you are going to design and construct.

2. What is the purpose of your device? What will it be used for?

   Consider what it will be used to transport and how it will make performing a task easier.

3. Develop success criteria by thinking about the requirements of the challenge, the purpose of your device and how you will test your prototype.

4. How will you know if your device is effective? Develop a method for testing your design.

   Think about what you will use to test your device and how you will test it.

Think of Some Solutions

1. Investigate real-world examples of tools that are used to transport different objects. Research these tools and respond to the following prompts.

Example A	
	Identify what objects or materials this tool was designed to transport.
	What materials is this tool constructed from? Why are these materials used in constructing this tool? How do the properties of these materials affect how they are used?
	What are materials which share similar properties? What materials could be used as alternatives?

Example B	
	Identify what objects or materials this tool was designed to transport.
	What materials is this tool constructed from? Why are these materials used in constructing this tool? How do the properties of these materials affect how they are used?
	What are materials which share similar properties? What materials could be used as alternatives?

2. What ideas do you have for a design? Use this page to brainstorm different possibilities.

Make a Prototype

1. Select a design that you would like to create. This may be one of your ideas from the previous page or a combination of different designs.

   Create a diagram of your chosen design. Label the different parts of your tool and the materials you could use to construct them.

Now, create a prototype of your design!

2. What materials have you used in your design? Why did you use these materials? How did you change this material?

Material	**Properties of Material**	**How are the properties of the material useful? Why did you use these materials in your design?**

Test It Out

Test your prototype. How effective is your tool at transporting objects? Record the results of your tests in the space below.

Make sure you test your prototype a number of times. You may wish to create a table or graph to help present your results.

Improve Your Design

How could you change your design to improve your tool and make it even more effective?

Draw a diagram of your new and improved design. Label any of your changes, explaining how they improve your device.

Reflect

Reflect on the design challenge as a class group. You might like to think about the following questions:

- Tell other groups about your device! What is it designed to do?
- What is your favourite thing about your device? What features does it have?
- What inspired your design? How did you come up with your idea?
- How did what you have learned about materials help you create your device?
- If you had more time... what would you do next?
- How could your device be used in the real-world? What changes would you make to your prototype in the final device?
- Was there anything that you found difficult in the design challenge? How did you overcome these challenges?
- What have you learnt about science or design from this activity?
- Is there anything that you would like to keep exploring or find out more about?

ELABORATE – EVALUATE

Natural vs Processed: Community of Inquiry

Teacher Resource

In the following activity, students participate in a community of inquiry (COI) to discuss the implications of natural and processed materials. This process gives students an opportunity to come to a full, shared understanding of the concepts and issues surrounding the use of these materials.

The COI is a process of discussion where participants pose open-ended questions, listen to the viewpoints of others and share their own ideas. Disputed or contestable issues and concepts are considered collaboratively within a supportive and respectful classroom environment. It is important that all participants reflect on their own thinking throughout a COI.

The following ways of working are used during a COI. These should be put up on a wall for all students to refer to throughout the COI:

- Listen attentively to others
- Build upon and connect ideas
- Respect yourself and others
- Disagree respectfully and reasonably
- Many responses and opinions may be considered correct

Detailed instructions for this activity are below.

1. Engage students in a Think-Pair-Share about the current unit of work. Ask students to reflect on what they have learnt so far, what they have found most interesting, what they have found most challenging and what has been most surprising.
2. Ask students to independently consider the overarching question: ***As a community, are we better off using natural or processed materials?***

   Provide students with two minutes of thinking time before they share their thoughts and ideas with a partner. Remind students to support their thinking with reasons.
3. Before inviting students to share their responses with the class, share the ways of working for a COI (see above). You may like to talk through what each of these ways of working looks like, sounds like and feels like with students. Remind students that only one person may speak at a time during the class discussion; you may wish to use a 'talking stick' or a small soft toy to indicate who is able to talk at any one time.
4. Invite students to share their responses with the class, while you record their thoughts and ideas on the whiteboard or butchers paper. Again, remind students to support their thinking with reasons.

You could use a PMI Chart to record students' responses. If it is not clear where a response fits, ask the students if they consider the response to be an advantage or a disadvantage. If students are uncertain, record the response in the *Interesting* column.

During the COI, you may like to pose additional questions to further prompt student thinking. Such questions could include:

- Can we use one in place of the other?
- Should we use one in place of the other?
- Why should we care about this topic?
- What do we need to think about when using natural materials?
- What do we need to think about when using processed materials?
- What rights do we have and/or need to consider when using these materials?
- What responsibilities do we have and/or need to consider when using these materials?

5. At the end of the discussion, ask students if there are any questions they are wondering about, and record these in the Interesting column (if using a PMI Chart).

   Display students' responses in the classroom for future reference. You may wish to pose these questions again at the end of the unit, as students may share new and/or different responses based on new information or understandings.

Curriculum Links

Science

YEAR 2

Science Understanding

Different materials can be combined for a particular purpose (ACSSU031)

Science as a Human Endeavour

Science involves observing, asking questions about, and describing changes in, objects and events (ACSHE034)

People use science in their daily lives, including when caring for their environment and living things (ACSHE035)

Science Inquiry Skills

Pose and respond to questions, and make predictions about familiar objects and events (ACSIS037)

Represent and communicate observations and ideas in a variety of ways (ACSIS042)

YEAR 4

Science Understanding

Natural and processed materials have a range of physical properties that can influence their use (ACSSU074)

Science as a Human Endeavour

Science knowledge helps people to understand the effect of their actions (ACSHE06)

Science Inquiry Skills

Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

General Capabilities

Literacy

Composing texts through speaking, writing and creating

Critical and Creative Thinking

Inquiring: Identifying, exploring and organising information and ideas

Reflecting on thinking and processes

Ethical Understanding

Reasoning in decision making and actions

Cross-Curriculum Priorities

Sustainability

Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments (OI.7)

Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgements based on projected future economic, social and environmental impacts (OI.8)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