Crossing the water

Strand	Organiser	Level						
		1	2	3	4	5	6	B6
Technology Practice	Investigation	■	▒					
	Ideation	■	▒					
	Production	■	▒					
	Evaluation	■	▒					
Information	Nature							
	Techniques							
Materials	Nature	■	▒					
	Techniques	■	▒					
Systems	Nature							
	Techniques							

Purpose

The activities in this module are planned to provide students with opportunities to design and develop a model of a bridge or other device for crossing an expanse of water. As a class, they identify the needs and wants of a character in a story and work technologically to meet a design challenge.

Overview

The following table shows the activities in this module and the way in which these are organised into orientating, enhancing and synthesising phases.

Orientating	Enhancing	Synthesising
Read the story The Lighthouse Keeper's Lunch. Discuss the problems associated with crossing expanses of water. Discuss a range of solutions. Discuss the needs and wants of the community when investigating the design of different solutions. Visit local waterways to gather information about methods of crossing the water. Discuss and record their findings. Display books/charts about bridges, ferries, flying foxes, tunnels and other devices.	Identify and describe the design challenge to the students. Generate design ideas and plans that show basic features. Discuss the appropriateness of the designs. Test suitability of materials. Produce a model using their design ideas and following production procedures. Discuss safety issues related to the use of equipment and manipulation of materials.	Use large equipment in the sandpit to make devices that reflect their models. Evaluate their own and others' models. Record their processes and opinions. Display their models and initial design ideas. Invite peers and parents to view their models. Reflect on learning.

Core learning outcomes

This module focuses on the following core learning outcomes from the *Years 1 to 10 Technology Syllabus*:

Technology Practice

TP 1.1 Students gather knowledge, ideas and data from familiar environments and consider how they will use this information to meet design challenges.

TP 1.2 Students generate design ideas and communicate these through experimentation, play and pictures.

TP1.3 Students make products that are meaningful to them and describe their production procedures.

TP 1.4 Students express thoughts and opinions to evaluate their own and others' design ideas and products.

Materials

MAT 1.1 Students identify characteristics of materials and explain how materials are used in everyday products.

MAT 1.2 Students explore equipment and techniques when joining and combining materials for meaningful purposes.

Core content

The core learning outcomes are the focus for planning learning activities and assessment tasks. Students will engage with core content (see pp. 37-40 of the syllabus) when they are provided with opportunities to demonstrate core learning outcomes. While the content is listed in strands for organisational convenience, no one part of that content is to be viewed as discretely associated with a single strand.

The organisation of content within a strand should not be considered hierarchical. Any of the content can be addressed at any appropriate level; not all of the content need be addressed at every level. Core content should be selected to suit students' needs, interests and abilities and to take account of their prior knowledge and experiences.

The core content should be studied in a range of contexts. These could include personal and global contexts, as well as contexts of agriculture, business, communities, home and family, industry, leisure and recreation, and school.

Using this module

The activities in this module are designed to provide opportunities for students to demonstrate Level 1 core learning outcomes. These activities can also provide opportunities for students to develop and demonstrate the related learning outcomes at other levels. In order to do this, teachers will need to prepare additional sets of anticipated evidence derived from the related learning outcomes at different levels. They may also need to modify aspects of the activities.

This module includes a variety of sequenced activities requiring varying amounts of time. Teachers can modify the design brief and related activities depending on the local contexts, particular needs and prior knowledge of students and the availability of materials and resources.

Advice to teachers

Students may respond in a variety of ways when investigating and generating ideas about crossing a body of water.

The concept of appropriateness can be introduced in broad terms and the different types of appropriateness introduced over a period of time.

The module could be modified to enable students to explore other types of constructions in the local area, such as houses or roads. Others books could be used to introduce the students to a problem.

Students may need to be encouraged to label their designs and list the materials they intend to use so that they can reflect back on their initial designs when they evaluate their finished product. Design ideas and information should be kept in a Technology project folio.

Resources

Students' creativity in demonstrating core learning outcomes in this module should not be limited by the range and scope of resources and equipment provided by the teacher. A variety of resources should be collected over time and should be safely stored and made available to students as required.

Evaluation of a unit of work

After completion of a unit of work developed from this module, teachers collect information and make judgments about:

- teaching strategies and activities planned or selected to allow students to demonstrate the core learning outcomes
- future learning opportunities for students who have not yet demonstrated the core learning outcomes and to challenge and extend those students who have already demonstrated the core learning outcomes
- the extent to which activities matched needs of particular groups of students and reflected equity considerations
- the appropriateness of time allocations for particular activities
- the appropriateness of resources used.

Information from this evaluation process can be used to plan subsequent units of work so that they build on, and support, student learning. The evaluated units of work may also be adapted prior to their reuse. For further information, refer to the 'Curriculum evaluation' section of the sourcebook guidelines.

Links

Links to other key learning areas

Activities from this module can be used as part of an integrated unit that makes links to other key learning areas. When incorporating this module into an integrated unit of work, teachers can select activities that provide opportunities for students to demonstrate learning outcomes from other key learning areas and identify anticipated evidence of students' demonstrations of these learning outcomes. It is important, however, that the integrity of the processes and concepts within key learning areas is maintained.

This module could link to the following key learning areas

- The Arts
- English
- Mathematics
- Science
- Studies of Society and Environment.

Contributions to the cross-curricular priorities

This module contributes to students' development of the cross-curricular priorities:

- **literacy** as students interpret, critically appraise, and communicate information in different forms; as they meet design challenges, students express ideas — in written, spoken and visual forms — about the appropriateness of processes and products of technology
- **numeracy** as students apply numerical terms and concepts in practical situations, identify and use patterns and employ spatial concepts
- **lifeskills** as students interpersonal skills in cooperative learning situations they are encouraged to experiment, to take reasonable risks and to view options and opportunities in imaginative and enterprising ways
- **a futures perspective** as students consider the effects of technological development on individuals, communities and environments.

The valued attributes of a lifelong learner

The overall learning outcomes of the Queensland Years 1 to 10 curriculum contain elements common to all key learning areas and collectively describe the valued attributes of a lifelong learner.

The following points indicate how various activities in this module might contribute towards the development of these attributes.

Knowledgeable person with deep understanding

- gains knowledge and conceptual understanding about technology practice and materials as they design their models
- draws together knowledge to develop creative solutions to a design challenge

Complex thinker

- participates in problem-solving activities related to the construction of the models
- makes decisions and justify choices in realising their designs

Active investigator

- explores aesthetic, culture, economic, environmental, ethical, functional and social implications
- tests the suitability of materials for specific purposes and experiment with techniques for manipulating and processing materials.

Responsive creator

- uses imagination, originality, intuition, enterprise and aesthetic judgment when meeting design challenges
- identifies and conceptualise new ways to solve problems.

Effective communicator

- uses a variety of methods to communicate design ideas effectively to a range of audiences.

Participant in an interdependent world

- works individually and collaboratively on their design challenge
- negotiates with others and resolve conflict in appropriate ways as they work towards common goals and share equipment and resources.

Reflective and self-directed learner

- displays self-motivation and perseverance in seeing projects through to completion.

Assessment strategies

The assessment opportunities outlined are examples of how to assess students' demonstrations of the identified learning outcomes. As often as possible, negotiate assessment with students and support a variety of ways of demonstrating the learning outcomes. Reflect with students on evidence gathered when making judgments about their demonstrations of learning outcomes. Some students may require more time and/or other contexts in which to demonstrate these learning outcomes. Other modules may provide such time and/or contexts

Suggestions for gathering information about student learning are provided in the activities section of this module. The table below provides descriptions of anticipated evidence that teachers might gather to support their judgments about students' demonstrations of learning outcomes and suggests sources of evidence. The table is neither exhaustive nor mandatory. Once sufficient evidence has been collected, judgments can be made about students' demonstrations of learning outcomes.

Core learning outcomes	Anticipated evidence	Sources of evidence
TP 1.1 Students gather knowledge, ideas and data from familiar environments and consider how they will use this information to meet design challenges.	Gather information about different devices that will be useful when designing their own model. Record this information in their Technology project folios.	Work samples/Technology project folios.
TP 1.2 Students generate design ideas and communicate these through experimentation, play and pictures.	Brainstorm design ideas in groups. Record design ideas in different ways — for example, modelling, making, building, drawing.	Observation of students as they participate in planned activities.
TP 1.3 Students make products that are meaningful to them, and describe their production procedures.	Use construction materials to create models that represent their design ideas.	Consultation with students to verify the evidence gathered. Work samples.
TP 1.4 Students express thoughts and opinions to evaluate their own and others' design ideas and products.	Evaluate the models by expressing thoughts and opinions about the appropriateness of their designs. Explain how the bridge meets needs and wants.	Observation of students as they participate in planned activities.
MAT 1.1 Students identify characteristics of materials and explain how materials are used in everyday products.	Describe the characteristics of a variety of materials. Explain why certain materials were selected for use in the production of their products.	Observation of students as they participate in planned activities. Consultation with students to verify the evidence gathered.
MAT 1.2 Students explore equipment and techniques when joining and combining materials for meaningful purposes.	Experiment and play with a range of objects as they explore the use of equipment and techniques to make their models.	Observation of students as they participate in planned activities. Work samples/Technology project folios.

In gathering evidence to make judgments about students' demonstrations of core learning outcomes, it may be necessary to look at Level 2. The following table indicates evidence of Level 2. Students may be demonstrating core learning outcomes at another level.

Core learning outcomes	Anticipated evidence	Sources of evidence
TP 2.1 Students organise knowledge ideas and data about how needs and wants might be met and use this information when meeting design challenges.	Make lists of needs and wants and how they may be met. Store knowledge, ideas and data to disk, make a booklet, keep a Technology project folio.	Observation of students as they participate in planned activities. Consultation with students to verify the evidence gathered.
TP 2.2 Students generate design ideas, acknowledge the design ideas of others and communicate their design ideas using annotated drawings that identify basic design features.	Generate ideas by participating in group brainstorming activities. Question others about their design ideas and discuss ideas with others. Draw pictures of their design ideas and label the major features and their purposes. Use sketches and simple annotated diagrams to represent and communicate their ideas clearly so that others can understand their meaning.	Observation of students as they participate in planned activities. Consultation with students to verify the evidence gathered. Work samples/Technology project folios.
TP 2.3 Students identify, sequence and follow production procedures needed to make products of their own design.	Select production steps needed to complete tasks and record them in a design proposal. Follow sequenced production procedures to make a bridge.	Observation of students as they participate in planned activities. Consultation with students to verify the evidence gathered. Work samples/Technology project folio.
TP 2.4 Students compare initial design ideas with final products and give reasons for similarities and differences.	Record similarities and differences between their initial design ideas and the final model of a bridge in their Technology project folio.	Observation of students as they participate in planned activities. Work samples/Technology project folios.
MAT 2.1 Students match the characteristics of materials to design requirements.	Test materials for different characteristics that make them suitable for use in their designs.	Observation of students as they participate in planned activities. Work samples/Technology project folios.
MAT 2.2 Students select and use suitable equipment and techniques for manipulating and processing materials.	Select and use available equipment such as hammers and scissors. Manipulate materials and use techniques that demonstrate development in fine and gross motor control.	Observation of students as they participate in planned activities. Work samples/Technology project folios.

Background information

Terminology

In this module students have opportunities to become familiar with and use the following terminology:

appropriateness	engineer	product
design	evaluate	production procedures
design brief	ideate	side view
design challenge	information	structure
designer	model	front view

School authority policies

Teachers need to be aware of and observe school authority policies that may be relevant to this module.

Safety policies will be of particular relevance to some of the activities that follow. It is essential that teacher demonstrations and student activities are conducted according to procedures developed through appropriate risk assessments at the school.

In this module, teachers may need to consider safety issues relating to excursions and use of equipment in the sandpit.

Equity considerations

This module provides opportunities for students to increase their understanding and appreciation of equity and diversity within a supportive environment. It includes activities that encourage students to:

- be involved
- work individually or in groups
- value diversity of ability, opinion and experience
- value diversity of language and cultural beliefs
- support one another in their efforts
- become empowered to communicate freely
- negotiate
- accept change.

Some students with disabilities may need assistance with some activities. Advice should be sought from their support teachers. It is important that these equity considerations inform decision making about teaching strategies, classroom organisation and assessment.

Activities

Orientating activities

Focus

TP 1.1 Students gather knowledge, ideas and data from familiar environments and consider how they will use this information to meet design challenges.

TP 1.2 Students generate design ideas and communicate these through experimentation, play and pictures.

Teaching considerations

These activities provide opportunities for students to investigate the needs and wants of individuals, to generate design ideas and to communicate them through drawings.

Consider recording students' ideas directly onto the computer screen using a large font. The students can then work individually or in pairs to print their ideas out, paste them into a class big book and clarify them with a drawing.

Either read the whole of *The Lighthouse Keeper's Lunch* stopping once the problem has been identified.

Consider organising an excursion that would allow students to look at a real waterways Refer to school policies for safety procedures and policies relating to excursions.

Different resources and books can be used instead.

Resources

Materials for recording ideas; Technology project folios; Materials for making a big book — large pieces of paper, crayons; *The Lighthouse Keeper's Lunch* by Ronda Armitage or other books; Books and posters.

[This table spreads over two pages]

Teacher	Students
Students may come up with ideas other than bridges. Students will also explore these ideas.	*Read the story* The Lighthouse Keeper's Lunch. *Read the first part of the story and stop to identify the problem.* • Brainstorm how to get the lunch to the lighthouse keeper and list the suggestions on a chart.
Assist students to identify and list solutions. • What are some of the problems of getting across the water? • How could we solve this problem? • What could we design?	*Discuss the problems associated with crossing expanses of water.* • Draw ideas on large pieces of paper and display the illustrations around the classroom or make them into a big book. • Record ideas in Technology project folios.
Assist students to identify the features of a device and to label and display pictures of suspension bridges, arch bridges and span bridges, flying foxes, ferries, tunnels etc (refer to Teachers' information in Support materials and references).	*Discuss the different designs.* • Use the Internet, books and other sources to research different devices. • Work in groups to discuss materials used for building. models. • Identify and discuss different types of devices.

[table continued]

Teacher	Students
	Discuss the needs and wants of the community that should be considered when investigating the design of different products. • In groups, discuss and record the various uses of bridges, and other devices in the local area. • Discuss the economic, functional aesthetic, social cultural and environmental factors that need to be consider.
Make explicit what the students will be looking for during the excursion (optional activity). • What different types of devices might we see? e.g. bridges, • What are the devices made from? • Who uses the devices?	*Visit local waterways to gather information about bridge design.* • Go for a walk in the local school environment and identify different types of products, such as the suspension bridge in the adventure playground, wooden bridges over ponds, footbridges over creeks and railway bridges. Flying foxes, tunnels. • Take photos of the different products.
Assist students to discuss their findings and to display the books, charts, photos and information they have gathered.	*Discuss and record their findings.* *Display books/charts about different products.*

Assessment

Sources of evidence could include:

- contributions to brainstorming and creation of a chart
- suggestions about the different ways of solving the problem
- drawings and designs
- contributions to discussions and participation in activities.

Enhancing activities

Design challenge

Design a model of a device that would get people from one side of the river to the other. Your model needs to transport a toy car and be made from available materials.

Focus

TP 1.2 Students generate design ideas and communicate these through experimentation, play and pictures.

TP 1.3 Students make products that are meaningful to them, and describe their production procedures.

MAT 1.1 Students identify characteristics of materials and explain how materials are used in everyday products.

MAT 1.2 Students explore equipment and techniques when joining and combining materials for meaningful purposes.

Resources

The *Lighthouse Keeper's Lunch.*

Kid Pix (computer software).

Materials to record design ideas, including paper, paints and coloured pencils .

Construction materials such as paper, newspaper, real bricks, wood and nail, straws, cardboard boxes, polygon shapes, woodblocks, cards and commercial materials.

Joining materials such as glue, masking tape, sticky tape, rubber bands, split pins, wool, staples and paperclips.

[Table spreads over two pages]

Teacher	Students
Identify and describe the design challenge to the students. • What is the purpose of this device? • Where could these devices be built? • What can these devices be built out of? Discuss the aspects of appropriateness with the students.	*Generate design ideas for the models.* • Reflect on the walk around the local area and focus on the different structures that were identified. • Work in groups to generate design ideas for their models. *Record plans and designs that show basic features.* • Work in pairs or individually to draw a design for a bridge. • Use the computer to generate designs using Kid Pix or similar drawing programs. *Discuss the appropriateness of the design*s.
Demonstrate a few ways of testing the strength of materials (refer to Student resource 1) and then allow students to investigate for themselves. Discuss the characteristics that make materials appropriate for particular purposes. How materials are shaped and joined How different combination of materials can be used. Interact with the students by asking them questions such as: • What can you do to the card to make it stronger? • Could we strengthen the paper by using glue?	*Test materials for suitability*. • Paint sheets of newspaper with pva or flour paste glue. Let the paper dry over night and then test for strength. • Try using supports under the bridge to give it added strength. • Try rolling the newspaper and taping it together. • Explore the nature of the materials and decide which is the strongest (refer to Student resource 1).

[table continued]

Teachers	***Students***
	Produce a model of a bridge using their design ideas and following production procedures. • Use a variety of materials to experiment and make a model of a bridge that includes basic design features. • Record their ideas (Student resource 2). • Test their models using a toy car. *Discuss safety issues related to the use of equipment and manipulation of materials.*

Assessment

Sources of evidence could include:

- designs and drawings of models
- manipulation of materials
- selection of materials.

Synthesising activities

Focus

TP 1.4 Students express thoughts and opinions to evaluate their own and others' design ideas or products.

MAT 1.2 Students explore equipment and techniques when joining and combining materials for meaningful purposes.

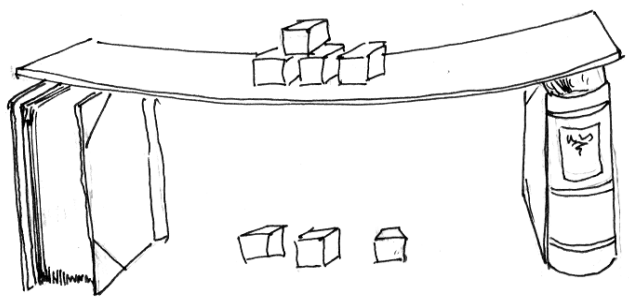
Teacher	Students
Discuss any problems the students had in making their models. Celebrate the success of their designs, and use the knowledge gained in further construction activities.	*Use large equipment in the sandpit to make devices that reflect their models.* • Use large play equipment such as balance beams, drama boxes and supports to construct a bridge in the sandpit. *Evaluate their own and others' models.* • Consider their choice of materials, considering the aspects of appropriateness as well as meeting the design challenge. • Discuss what they liked about their designs. – What worked best? – What didn't work very well? – What could you do to make your models better? • Record their evaluations in their Technology project folios. • Label their models and display them for others to evaluate.
	Record their processes and opinions. • Keep a technology project folio of all the work in progress and completed.
	Display their models and initial design ideas. Invite peers and parents to view their models. • Create a display that can be viewed by others. Include diagrams, models and other work samples.
Discuss safety issues with the students and make sure they are aware of any risks associated with large equipment.	

Assessment

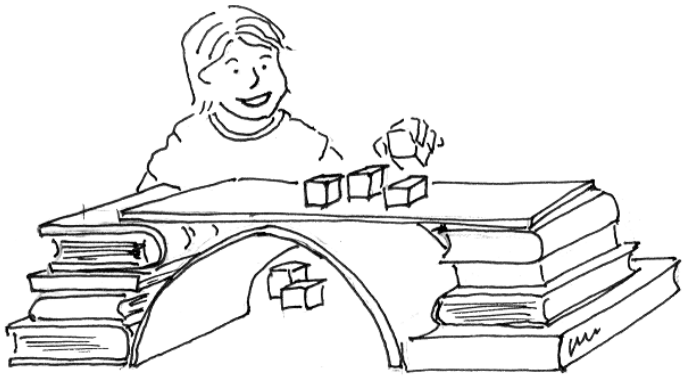
Sources of evidence could include:
- participation in activities
- work samples/models/journals.

Sample tests for strength

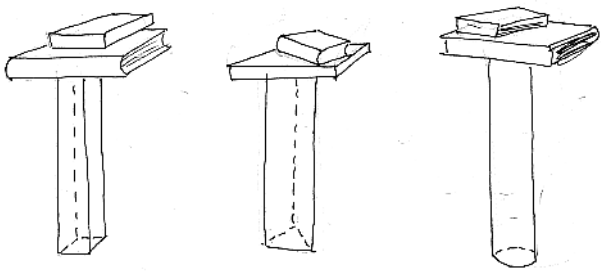
Student resource 1



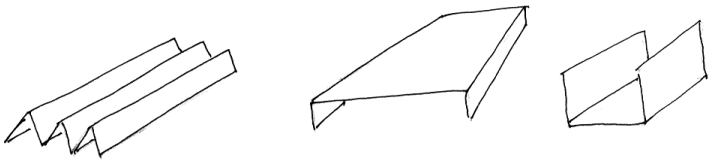
1. Stand two books on end and place a piece of paper on top of them. See how many small blocks will stay on the paper before it falls in.



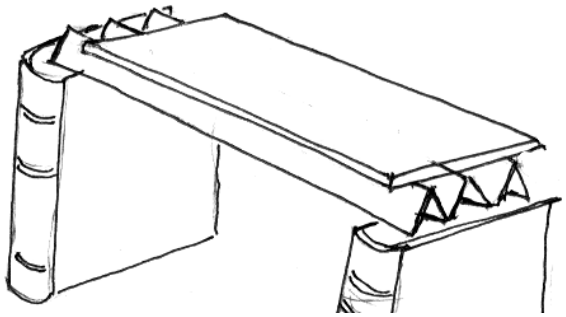
2. Place a pile of books at either end of a sheet of paper and make an arched strip to go underneath. See how many blocks it can now support.



3. Fold sheets of paper into square, triangular and cylinder-shaped columns. Balance books on the top of each column. Which shape holds the most books before collapsing?



4. Fold paper in different ways and test them for strength across the books. Which piece of paper is the strongest?



5. Test different folded sheets for strength.

Design proposal

Student resource 2

Use this sheet to plan your design

My design ideas Draw and write	
What I need Materials and tools	
What I will do Describe my steps	1. 2. 3.

Support materials

Teachers' information

In an **arch** bridge, compression pushes the weight away from the arch and against the sidewalls and the stones of the arch itself. The Romans were the first to build arch bridges and some of their bridges and aqueducts still stand today.

Span bridges consist of beams and/or trusses that rest on supports or piers. A *truss* system is often used if the *span* length would require a very large or heavy beam to support it. Since a truss is composed of triangles (the strongest polygons because their shapes cannot be distorted), a truss bridge can support heavy loads with its relatively small weight.

A **suspension** bridge hangs from cables firmly anchored at each end. It is also supported by towers positioned at regular intervals along the span. The main elements of suspension bridges, the cables, are in tension. The trusses hang from the cables and support the deck. Trusses in these bridges provide stiffness to their *decks*. Suspension bridges are generally used for long spans.

References

Armitage, R. 1977, *The Lighthouse Keeper's Lunch,* Hutchinson Group (Australia), Ultimo, NSW.

Bridges and Tunnels 1972, Macdonald and Co., London.

Kaner, E. 1994, *Bridges,* Kids Can Press, Toronto.

Kerrod, R. 1971, *A First Look at Bridges,* Franklin Watts, London.

Kerrod, R. 1971, *Bridges,* Franklin Watts, London.

Turnbull, M. 1970, *Big Bridges and Little Bridges,* Hulton Educational, Amersham, Buckinghamshire.

Shoesmith, K. 1975, *Do You Know About — Bridges?* Burke, London.

Websites

(All websites listed were accessed in March 2002)

Askjeeves for Kids
www.ajkids.com
Useful search engine for students.

Building Big
www.pbs.org/wgbh/buildingbig
Useful information about bridges and building techniques.

Newton's Apple
www.ktca.org/newtons/12/bridges.html
Includes information about bridges and tunnels, useful vocabulary and activities.

Super Bridge
www.pbs.org/wgbh/nova/bridge
Includes an online build-a-bridge activity.

Yahooligans! The Web Guide for Kids
www.yahooligans.com
Internet search engine for students.

This sourcebook module should be read in conjunction with the following Queensland Studies Authority materials:

Years 1 to 10 Technology Syllabus

Years 1 to 10 Technology Sourcebook Guidelines

Technology Initial In-service Materials

Technology CD-ROM

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