Queensland Museum Toy Factory

YEAR 6 AND 8
PHYSICAL SCIENCES
DESIGN AND TECHNOLOGIES

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.

QUEENSLAND MUSEUM NETWORK

Queensland Government

ENGAGE – EXPLORE – EXPLAIN

Queensland Museum Toy Factory

Teacher Resource

In this activity, students are engineers tasked with developing an innovative toy for babies. Year 6 students investigate how they can use electrical energy in a toy to help a baby recognise colours or learn about cause and effect. Year 8 students investigate how they can use motion, force and energy in a toy to help a baby learn how to walk. Students work in pairs to complete this activity.

Aspects of this activity assume Year 6 students understand electrical systems and components, and Year 8 students understand energy, energy transfers and transformations. However, it is possible to deliver this activity at the start of a unit of work about energy (electrical or otherwise). In this instance, we recommend students respond to concept specific questions (i.e. draw a circuit diagram of the toy; draw a flow diagram to represent the energy transfers and transformations that occur in the toy) after they have developed sufficient knowledge about these concepts.

During the initial design phase, students may gain inspiration for their toy design from Queensland Museum collections. Visit Queensland Museum's Online Collections webpage and search 'toy' to explore the collection. Further prompts and questions that you can use to guide students through this activity are provided on the following pages.

A toy from Queensland Museum's collection. This clockwork toy canary is operated by a winding key (seen in the image on the left). This example demonstrates one way kinetic energy can be incorporated into a toy's design. QM, Peter Waddington.

After students have designed their toy, they create an advertisement that persuades an adult to purchase the toy for a child. Students could produce a print, television, radio or digital advert.

Maker Space

Maker Spaces are 'creative spaces where people gather to tinker, create, invent, and learn.'[1] They promote the development of problem-solving skills, critical and creative thinking, inquiry capabilities, design thinking skills, the ability to work collaboratively and autonomously, scientific understanding, technological capabilities, communication skills, reflective thinking and resilience.[2]

1 Hughes, J. (2017). *Meaningful Making: Establishing a Makerspace in Your School or Classroom.* Ontario Ministry of Education. https://brocku.ca/supporting-coaches/wp-content/uploads/sites/247/Hughes-J.-2017-April-Meaningful-Making-Establishing-a-Makerspace-in-Your-School-or-Classroom.pdf

2 Bower et al. (2018). *Makerspaces in Primary School Settings: Advancing 21st Century and STEM Capabilities using 3D Design and 3D Printing.* Macquarie University. https://primarymakers.com/

The Maker Space at *SparkLab, Sciencentre* encourages visitors to get hands on and design and create solutions to challenging questions. User-centred design is a key aspect of *SparkLab's* Maker Space. Here, children design a solution for a specific user – whether that be a person who needs to travel down a zip line or take a seat on a chair.

In a Maker Space, children firstly think of some possible solutions for their user. They then select a solution, make a prototype of the solution, test it out, improve on their design and then test their design again to explore the effects of any modifications. You can learn more about *SparkLab's* Maker Space by watching the *SparkLab*: Design Process video.

A variety of materials from which children can construct a prototype should be provided in a Maker Space. There should be enough materials to allow for a range of different solutions, but not too many materials so that choices become overwhelming. Suggested materials for the *Queensland Museum Toy Factory: Maker Space* activity are listed on the following pages.

The Shake It Up Maker Space in action at SparkLab, Sciencentre. QM, Peter Waddington.

Curriculum Links

Science

YEAR 6

Science Understanding

Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources (ACSSU097)

Science as a Human Endeavour

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

Science Inquiry Skills

Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks (ACSIS103)

Compare data with predictions and use as evidence in developing explanations (ACSIS221)

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

YEAR 8

Science Understanding

Energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems (ACSSU155)

Science as a Human Endeavour

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

Science Inquiry Skills

Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS139)

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS140)

Communicate ideas, findings and evidence-based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS148)

Design and Technologies

YEAR 5 AND 6

Design and Technologies Knowledge and Understanding

Investigate how electrical energy can control movement, sound or light in a designed product or system (ACTDEK020)

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 Processes 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)

YEAR 7 AND 8

Design and Technologies Knowledge and Understanding

Analyse how motion, force and energy are used to manipulate and control electromechanical systems when designing simple, engineered solutions (ACTDEK031)

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

Design and Technologies Processes 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)

English

YEAR 6

Language

Investigate how vocabulary choices, including evaluative language can express shades of meaning, feeling and opinion (ACELA1525)

Literacy

Plan, draft and publish imaginative, informative and persuasive texts, choosing and experimenting with text structures, language features, images and digital resources appropriate to purpose and audience (ACELY1714)

YEAR 8

Language

Understand how rhetorical devices are used to persuade and how different layers of meaning are developed through the use of metaphor, irony and parody (ACELA1542)

Literacy

Create imaginative, informative and persuasive texts that raise issues, report events and advance opinions, using deliberate language and textual choices, and including digital elements as appropriate (ACELY1736)

Experiment with text structures and language features to refine and clarify ideas to improve the effectiveness of students' own texts (ACELY1810)

General Capabilities

Literacy

Comprehending texts through listening, reading and viewing

Composing texts through speaking, writing and creating

Text knowledge

Grammar knowledge

Information and Communication Technologies

Investigating with ICT

Managing and operating ICT

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

Queensland Museum Toy Factory

Teacher Resource

Prompts and Questions

The following prompts and questions can be used to guide students through this activity. Students are expected to cycle through this process, and between the test and refine stages, multiple times.

Consider the Challenge

- What are the requirements of the design challenge?
- How could you measure success?

Think of Some Solutions

- What are some real-world examples of baby toys that meet your design brief?
- What materials and components are used in the toy design?
- What equipment and processes are needed to make the toy?
- What ideas do you have for a design?

Make a Prototype

- What materials could you use in your design?
- How will the properties of different materials affect what you use?
- What components could you use in your design? What will these components do?
- Create a labelled diagram of your design. Explain and justify your ideas in the diagram.
- How will you work safely?
- Now that you are making your design, how suitable are the materials and components? What changes might you need to make to the design of the toy?

Test It Out

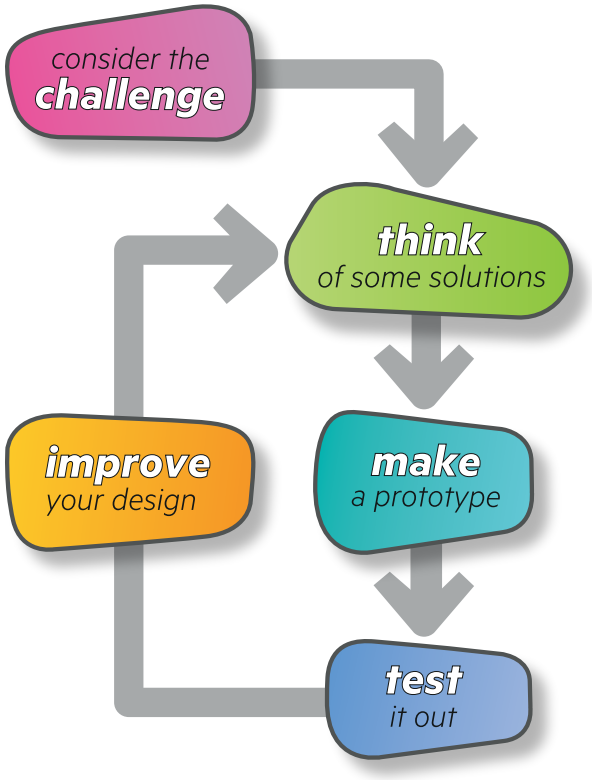
- Test out your design. What did you notice?
- Does the toy meet the needs of the user?
- Did the toy operate as you intended?
- What part of your design worked really well?

Improve Your Design

- What changes will you make to improve your design?
- How could you modify the toy to better meet the needs of the user?
- What ideas could you incorporate from someone else's design?
- Continue to test and refine until you are satisfied with your design.

Evaluate Your Design

- What aspects of your toy are you very satisfied with, and why?
- Describe any further changes you could make to improve the toy.
- What were the main challenges you experienced during the design process? How did you overcome these challenges?
- If you started again, what would you do differently?
- What have you learnt about science or design from this activity?
- Did the design meet your idea of success?



Queensland Museum Toy Factory

Teacher Resource

Material Suggestions

We recommend the following materials for your classroom's Maker Space. You can substitute some materials for others or provide additional materials that are not listed below. Ensure students know how to work safely with electrical components before they create their designed solutions.

Materials for the Surface of the Toy

- Paper
- Fabric
- Cellophane
- Patty papers
- Milk bottle lids or similar
- Paper clips

Connectors

- Straws
- Paddle pop sticks
- Skewers
- Pipe cleaners
- Rubber bands
- String
- Thumbtacks
- Split pins

Joiners

- Masking tape

Electrical Components

- Electrical wire or alligator clips with lead wire
- Aluminium foil
- Electrical tape
- Electric buzzers
- LED lights
- Motors
- Switches (toggle, contact, slide or paperclips, thumbtacks, split pins)
- Batteries
- Battery snaps and/or holders

Tools

- Scissors

Queensland Museum Toy Factory

Student Activity

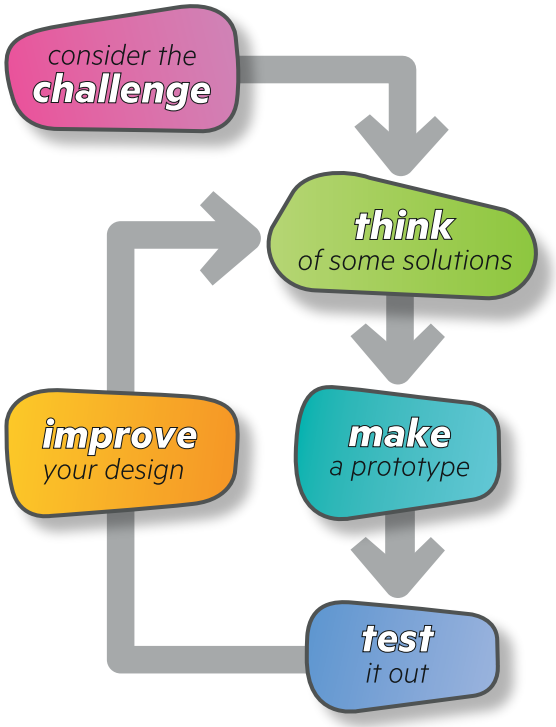
Year 6

Task:

Design and create a toy that will help a baby recognise different colours or learn about cause and effect.

You must:

- **Consider the challenge.** What are the requirements of the design challenge?
- **Think of some solutions.** Investigate real-world examples of baby toys. How do these toys help a baby recognise different colours or learn about cause and effect? What ideas do you have for a design?
- **Make a prototype.** What materials and components will you use? How will you work safely? Create a labelled diagram of your design, and then construct your prototype.
- **Test it out.** What did you notice? Does the toy achieve the design prompt? Does the toy meet the needs of a baby?
- **Improve your design.** How can you make your toy better achieve the design prompt and meet the needs of a baby? Keep testing and refining until you are satisfied with your design.
- **Evaluate your design.** What aspects of your design are you very satisfied with, and why? What challenges did you experience during the design process, and how did you overcome them?



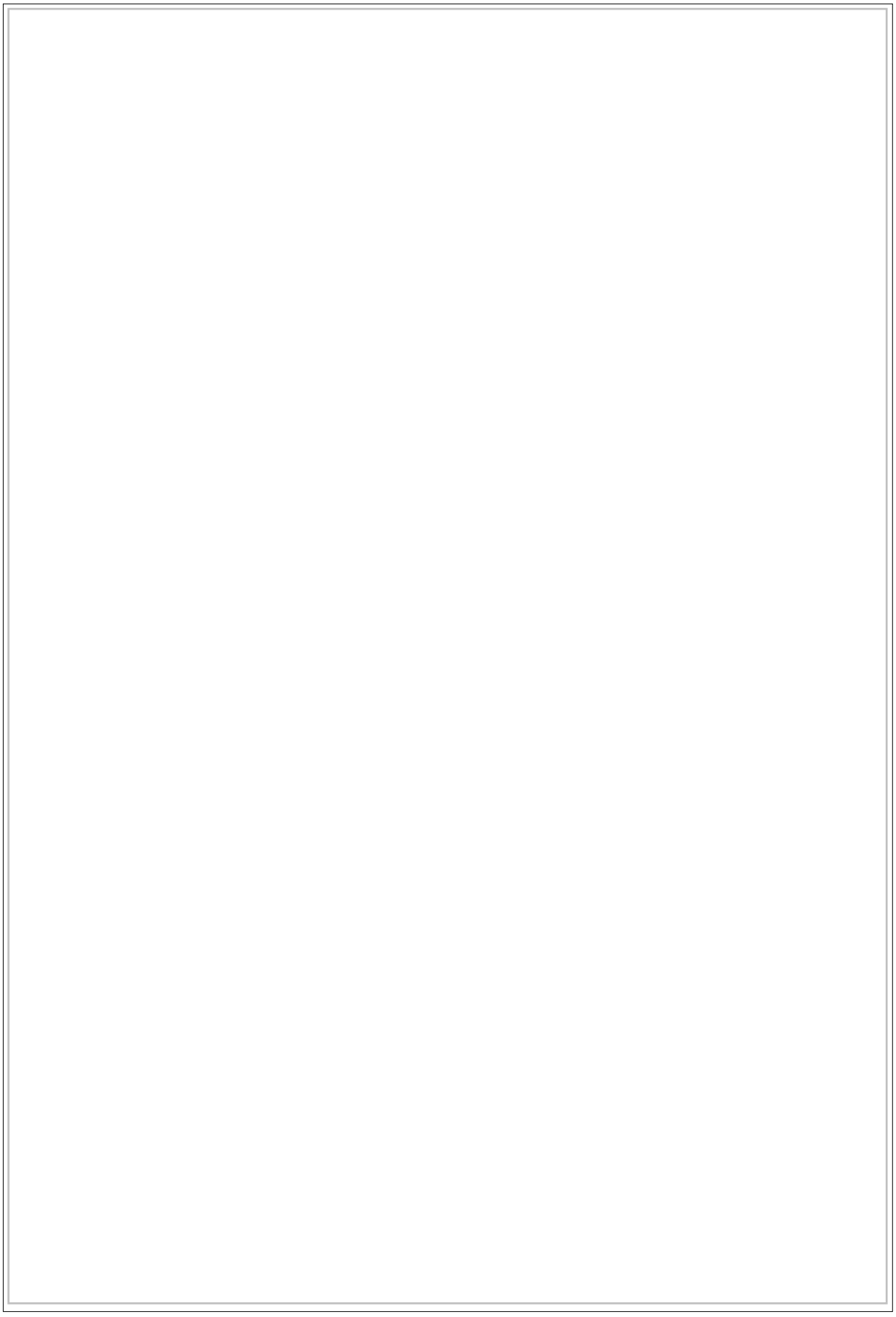
Respond to the following questions after you have designed your toy.

1. Identify the electrical components used to make the toy. Draw the electrical symbol for these components, and then describe the purpose of the components.

Electrical Component	Symbol	Purpose

2. Explain how electrical energy was used to control movement, sound or light in your toy.

3. Draw a circuit diagram of the toy.



Queensland Museum Toy Factory

Student Activity

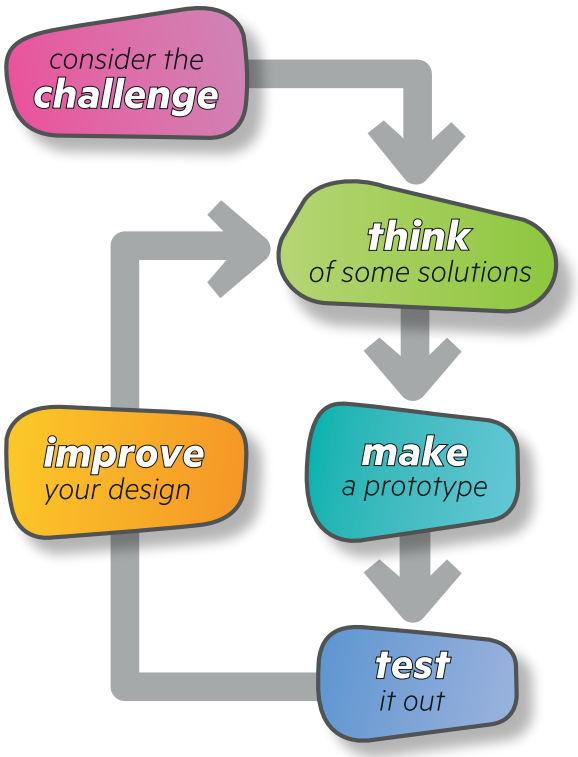
Year 8

Task:

Design and create a toy that will help a baby learn how to walk.

You must:

- **Consider the challenge.** What are the requirements of the design challenge?
- **Think of some solutions.** Investigate real-world examples of baby toys. How do these toys use motion, force and energy to help a baby learn how to walk? What ideas do you have for a design?
- **Make a prototype.** What materials and components will you use? How will you work safely? Create a labelled diagram of your design, and then construct your prototype.
- **Test it out.** What did you notice? Does the toy achieve the design prompt? Does the toy meet the needs of a baby?
- **Improve your design.** How can you make your toy better achieve the design prompt and meet the needs of a baby? Keep testing and refining until you are satisfied with your design.
- **Evaluate your design.** What aspects of your design are you very satisfied with, and why? What challenges did you experience during the design process, and how did you overcome them?



Respond to the following questions after you have designed your toy.

1. Identify the forms of energy used by the toy.

2. Describe any energy transfers and/or transformations that occur in the toy.

3. Draw a flow diagram to represent the energy transformations that occur in the toy.

Queensland Museum Toy Factory

Student Activity

Make Me Want That Toy!

You have designed your toy, and now it is time to sell your toy! Create an advertisement that persuades adults to purchase your toy for their child. Consider the following:

- How you will advertise your toy? Will you produce a print, television, radio or digital advert?
- What persuasive language will make your toy a 'must have' item?
- What visual effects will you use? Think carefully about images, fonts and colours.
- How will you appeal to emotion, logic and reason, or credibility and character?

Describe or draw your advertisement in the space below.