

# The Future of Rail: A Design Challenge

PHYSICS - ELECTRICAL ENERGY



**QGC**

**FUTUREMAKERS**



QUEENSLAND  
MUSEUM NETWORK



Queensland  
Government

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# Glossary



Writing exercise



Need to know information



Presenting exercise



Group activity



Hands on exercise

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Future Makers is an innovative partnership between Queensland Museum Network and Shell’s QGC project 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.

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# Australian Curriculum Links

While this resource has been developed to support the delivery of the Year 6 Science Curriculum, it is possible to connect learning with other year levels. You are encouraged to adapt the resource to meet your individual needs and learning context.

Year 6 Curriculum focus

## **Science Understanding (SU)**

### **Physical Sciences**

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

(ACSSU097)

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## **Science as Human Endeavour (SHE)**

Scientific knowledge is used to solve problems and inform personal and community decisions.

(ACSHE100)

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## **Science Inquiry Skills (SIS)**

### **Communicating**

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

(ACSIS110)

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# Introduction

This learning resource has been designed to explore the past, present and future of electrical energy, including its generation and ability to power movement around our vast state. The Workshops Rail Museum has been used to contextualise learning due to the site's strong historical connections with the generation and use of electricity.

Primary and secondary sources of information from The Workshops Rail Museum are used throughout the resource to stimulate inquiry into, and facilitate discussion about, topics and concepts associated with electrical energy.

**As this resource has been designed to complement classroom-based teaching and learning experiences, students are assumed to have developed knowledge about the following concepts:**

- Energy is the capacity to do work and can exist in a variety of forms.
- Electrical energy can be transferred to objects and transformed into different energy forms.
- Electrical energy can be generated from a range of sources. A number of these sources use kinetic energy to drive the movement of a turbine within a power station. The turbine rotates a generator which is used to generate electricity.
- A generator is a device that spins a magnet between coils of wire to create a steady flow of electrons. This movement generates an electric current that can be used to power varied objects.

*The completion of this learning resource requires engagement with [The Workshops Rail Museum](#). While a visit to The Workshops Rail Museum is strongly encouraged, the activities described below can also be completed with reference to selected museum learning resources and online research.*

Please contact The Workshops Rail Museum to make a [group booking](#) and refer to the [Teacher Guide](#) for additional information about the museum.

*It is recommended that students complete the following activities independently or in groups of four.*

***Generating Electricity: Past and Present*** may also be used to complement learning experiences explored within this resource.

# Design Challenge

Your class has been selected by the Queensland Museum Network to design and develop a 'clean' train and rail system. Your system will use electrical energy to transport valuable collection items between metropolitan and regional museums across the state.

This design challenge is divided into four parts, which include:

- **Part 1** Develop Background Understandings
- **Part 2** Design Your Train
- **Part 3** Plan Your Network
- **Part 4** Report Outcomes

You will work independently or in small groups to complete the challenge.

## Part 1: Develop Background Understandings



### Museum Perspectives

Rail has been an integral industry in the development of Queensland and especially in Ipswich. The construction of the original Ipswich Railway Workshops began in 1864 at a site adjacent to the Bremer River in North Ipswich. As the railways expanded, a much larger site was needed, so the Workshops moved to its current location between 1884 and 1888. For decades, the site was the centre of rail construction, maintenance and technology for Queensland's burgeoning rail industry.



You will explore how electrical energy is used to power the movement of diesel-electric, electric and maglev trains. This research will help you determine how your train will operate across the rail network.



You will use exhibits located at The Workshops Rail Museum and conduct online research to complete this task. If visiting The Workshops Rail Museum, you might like to examine the diesel-electric locomotive or explore how train travel changed the lives of Queenslanders by analysing objects and stories of the past. Record information gathered from these sources on the following pages.

# Electrical Energy and Trains



If visiting The Workshops Rail Museum, make sure you explore Zones 4, 8 and 13. These locations will help you find some of the answers you seek!



**What is the main period of use for this train?**

**Diesel-Electric**

**Electric**

**Maglev**



**Describe how electrical energy is used to power this train.**

**Diesel-Electric**

**Electric**

**Maglev**



**How has this train impacted society?**

**Consider both the benefits and costs of its use.**

**Diesel-Electric**

**Electric**

**Maglev**





**Use this information to rate the sustainability of these trains as low, moderate or high.**

**Consider the impacts on people, the environment and economy.  
Be prepared to justify your response.**

### **Diesel-Electric**

### **Electric**

### **Maglev**

# Part 2:

## Design Your Train



1. Select one of the three trains studied in the previous activity.

Explore the structure, function and operation of your selected train.  
Consider how electrical energy is generated and used to control its movement.



2. Redesign the train to make it a 'cleaner' option for transporting collection items across the state.



What features can you keep, improve or remove to enhance its:

- Structure
- Function
- Operation
- Sustainability

Sketch your design in the space below or on a sheet of A3 paper. After developing your design, you may choose to construct a model of your new train using available materials.

3. You will pitch your 'clean' train to members of the Queensland Museum Network (your class and teacher) in *Part 4: Report Outcomes*. Discuss and record your responses to the following questions to prepare for this presentation.

You could add your responses in note form to your A3 sheet of paper and use this information during your presentation.

**How will your train access the electrical energy it needs to operate?  
Will your train access power from the grid or an alternative energy source?**

**Why is this method of operation a 'clean' option for the Queensland Museum Network?**

**What are the benefits, impacts or limitations of use associated with your redesigned train?**

# Part 3:

## Plan Your Network



1. Closely examine the map on page 13 which depicts Queensland's railway systems and branch lines at 1907, before planning your own rail network.

As you examine the map you may choose to:

- Calculate the distance covered by individual branch lines
- Conduct online research to identify a present-day rail network map. Explore how the state's rail network has changed over time by comparing the present-day map to the 1907 map.



2. Select three museums serviced by your 'clean' rail system.

These must include:

- 1 x Museum in the Queensland Museum Network:
  - Queensland Museum & Sciencentre
  - The Workshops Rail Museum
  - Cobb + Co
  - Museum of Tropical Queensland
- 2 x Queensland regional museums

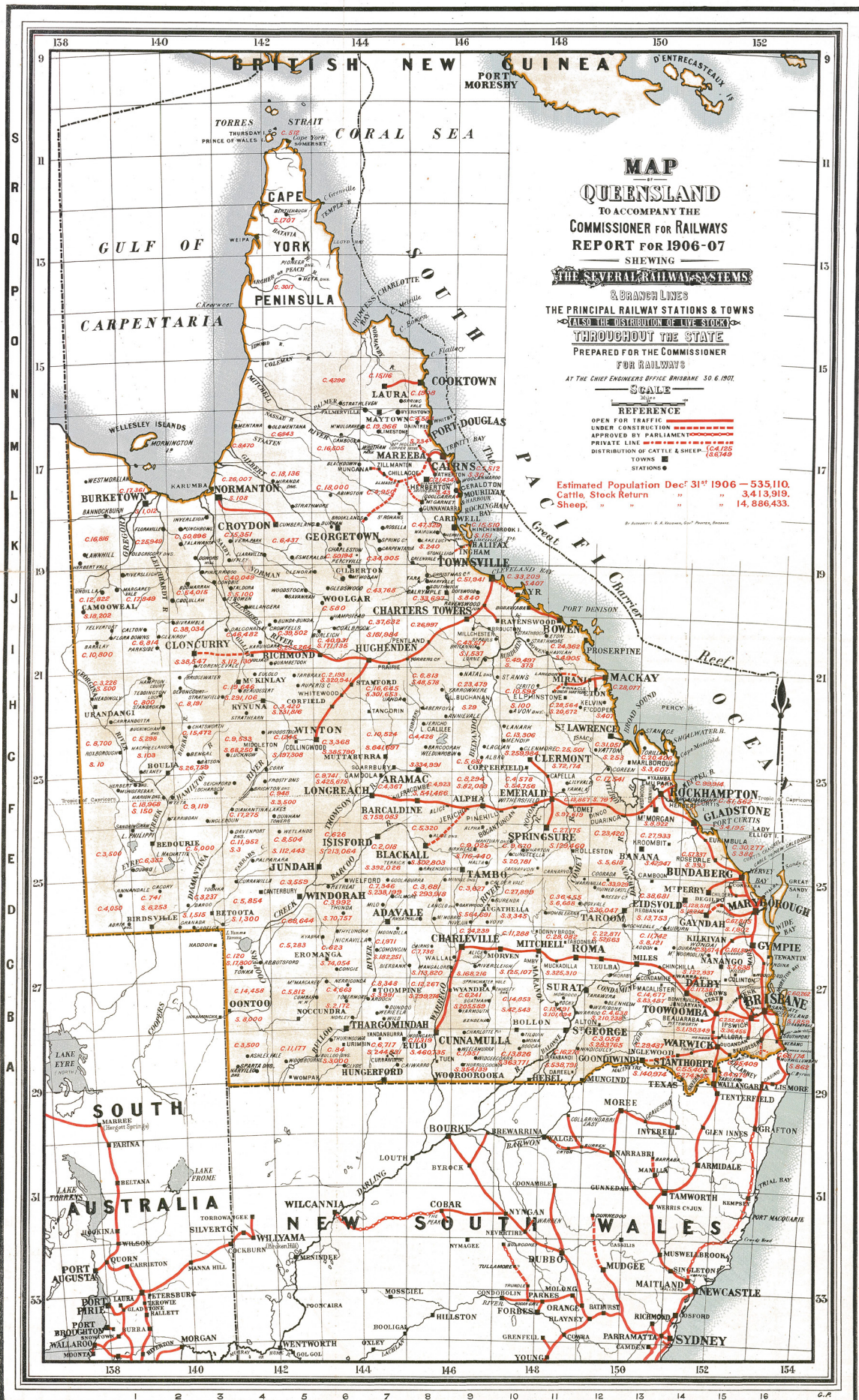
Determine the route your rail system will take between selected museums. Will you use or make extensions to existing rail networks? Alternatively, will you construct a brand new rail network? How will landscapes or landforms influence your rail network's route?

**Your teacher may introduce project constraints and requirements, which could include:**

- Monetary and/or resource constraints, including total budget, total length of track available for use, price per kilometer of track
- Geographical constraints, including how to negotiate varied environments and landforms and the production of a network map
- Time requirements, including calculation of average speed, time taken to reach each destination, and the development of a timetable for service

Make sure you record and justify any decision-making processes during this stage.





**MAP**  
**QUEENSLAND**  
 TO ACCOMPANY THE  
**COMMISSIONER FOR RAILWAYS**  
**REPORT FOR 1906-07**  
 SHEWING  
**THE SEVERAL RAILWAY SYSTEMS**  
 & BRANCHED LINES  
 THE PRINCIPAL RAILWAY STATIONS & TOWNS  
 THROUGHOUT THE STATE  
 PREPARED FOR THE COMMISSIONER  
 FOR RAILWAYS  
 AT THE CHIEF ENGINEERS OFFICE BRISBANE 30.6.1907

**SCALE**  
 REFERENCE  
 OPEN FOR TRAFFIC  
 UNDER CONSTRUCTION  
 APPROVED BY PARLIAMENT  
 PRIVATE LINE  
 DISTRIBUTION OF CATTLE & SHEEP  
 TOWNS  
 STATIONS

Estimated Population Dec<sup>r</sup> 31<sup>st</sup> 1906 — 535,110.  
 Cattle, Stock Return " " 3,413,919.  
 Sheep, " " " 14,886,433.

# Part 4:

## Report Outcomes



Your group will present and pitch their 'clean' train and rail system to members of the Queensland Museum Network (your class and teacher).

You should include the following information in your presentation:



- The type of train selected, including:
  - How the train operates
  - Benefits, impacts or limitations of use
  - Why this method of operation is considered a 'clean' option



- The rail system, including:
  - The three museums serviced by the system
  - Rail routes
  - Why these routes were selected, including benefits, impacts or limitations

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