

EDUCATION ON TRACK

ENERGY AND CHANGE - MACHINES CHALLENGE



Coal Train at Tennyson Power Station,
Brisbane 1974 (State Library of Queensland)

This program has been produced and published by The Workshops Rail Museum, North Street, North Ipswich, Qld, Australia 4305.

The Museum's Vision Statement is:

to be recognised as a creative, innovative and exciting journey of discovery into Australia's rail story.

The Mission Statement is:

to harness the significance of the Workshops precinct by delivering international standard cultural and tourism related activities, education and public programs associated with the interaction of rail on people's lives.

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Unit Planner

School Name:	Unit title: Energy Change and Machines	KLA(s): Science, English	Year level(s): 8, 9, 10	Duration of unit:
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Identify curriculum	
Ways of working	Knowledge and understanding
<p>Students are able to:</p> <ul style="list-style-type: none"> • identify problems and issues, formulate scientific questions and design investigations • plan investigations guided by scientific concepts and design and carry out fair tests • research and analyse data, information and evidence • evaluate data, information and evidence to identify connections, construct arguments and link results to theory • draw conclusions that summarise and explain patterns, and that are consistent with the data and respond to the question • communicate scientific ideas, explanations, conclusions, decisions and data, using scientific argument and terminology, in appropriate formats • reflect on different perspectives and evaluate the influence of people's values and culture on the applications of science • reflect on learning, apply new understandings and justify future applications. 	<p><i>Science as a human endeavour</i> Responsible and informed decisions about real-world issues are influenced by the application of scientific knowledge.</p> <ul style="list-style-type: none"> • Responsible, ethical and informed decisions about social priorities often require the application of scientific understanding <p><i>Energy and change</i> Forces and energy are identified and analysed to help understand and develop technologies, and to make predictions about events in the world.</p> <ul style="list-style-type: none"> • An unbalanced force acting on a body results in a change in motion • Objects remain stationary or in constant motion under the influence of balanced forces • Energy can be transferred from one medium to another • Transfer of energy can vary according to the medium in which it travels • Energy is conserved when it is transferred or transformed
Context for learning	School priorities
<p>This unit explores ideas related to science as a human endeavour and explores how machines using energy change processes can create devices that are environmentally friendly and more energy efficient than those currently in use today.</p>	

Develop assessment			Make judgments	
Type of assessment	What will be assessed	When it will be assessed	Purpose of assessment	Assessable elements
<p>Presentation of Challenges and their solutions to class</p> <p>Folio of data collected and records of experiments conducted</p>	<p>Students ability to apply information gathered in experiments to solving problems</p>	<p>Throughout the unit</p>		<p>Knowledge and understanding</p> <p>Investigating</p> <p>Communicating</p> <p>Reflecting</p>

Sequence learning

Learning experiences and teaching strategies	Adjustments for needs of learners	Resources
<ol style="list-style-type: none"> 1. Previsit <ol style="list-style-type: none"> a. Break students into small groups b. Handout challenges to groups c. Students read fact sheets on the Science stations they will be looking at in the museum 2. Visit to The Workshops Rail Museum <ol style="list-style-type: none"> a. Students participate in an introductory session with Education Officer b. Students move through the museum find the Science Stations relevant to their challenge and experiment and gather data 3. Post visit <ol style="list-style-type: none"> a. Students complete the Solving your Challenge section of the worksheet b. Students present their findings to the class. c. Students use class discussion to critically reflect on the different solutions and to exchange ideas regarding the positives and negatives of each solution. 		<ul style="list-style-type: none"> • Energy Change and Machines Worksheets • Science Station Fact Sheets

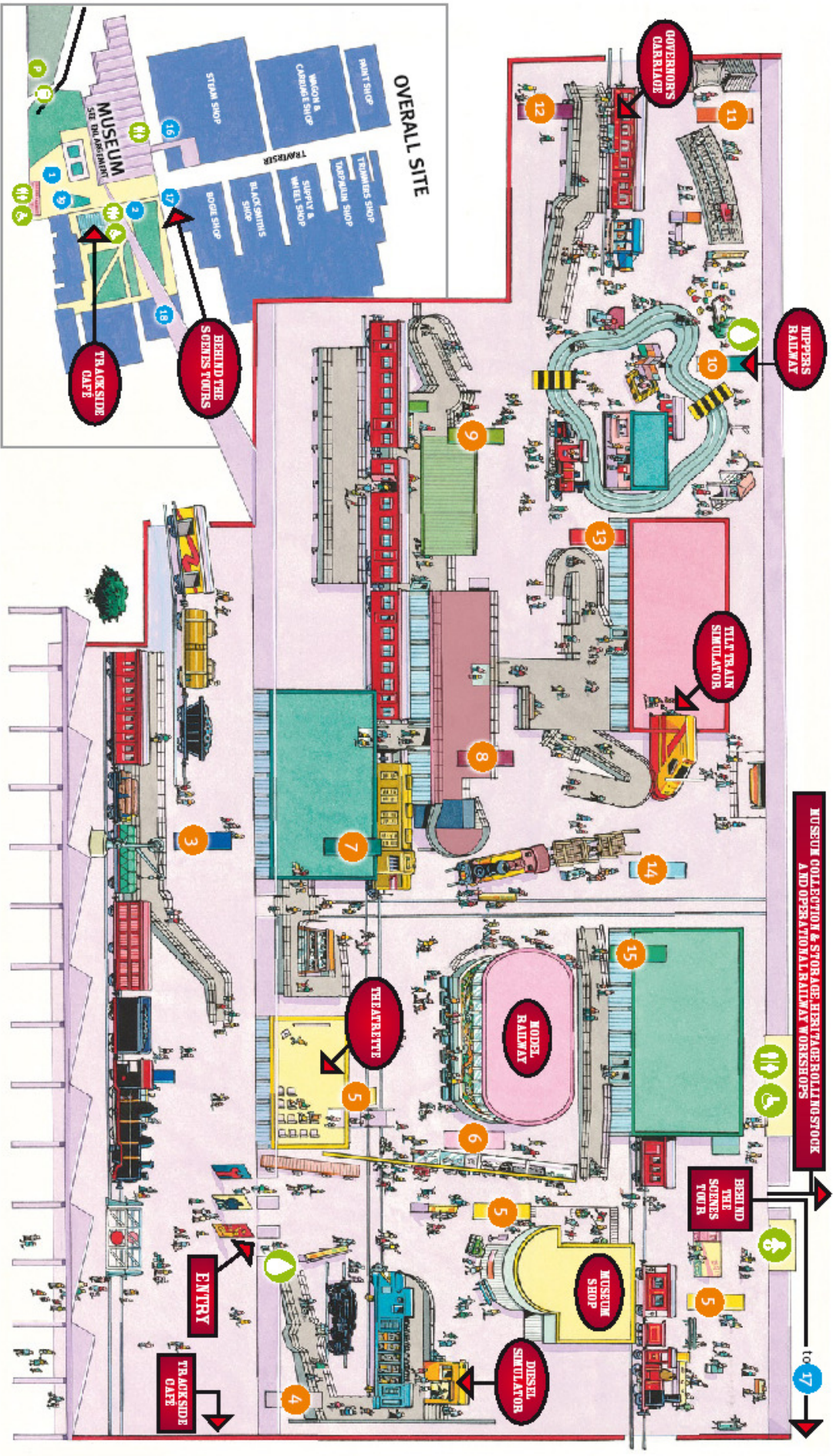
Use feedback

Ways to monitor learning and assessment

- Presentation
- Observation
- Completion of class activities

Science Station Challenges: Energy and change

Challenge	Key ideas	Stations & Exhibitions
1. Energy efficient device to separate out paper, glass and metal rubbish collected from trains.	<ul style="list-style-type: none"> • Magnetic materials • Forces on objects • Floating objects in air 	<ul style="list-style-type: none"> • Magnetism from electricity • Jumping disc • Floating magnets • Air blast • Fluid coupler • Electric motor
2. Energy device that could harness some of nature's "free" energy for use by the train system. ...	<ul style="list-style-type: none"> • Electromagnetism • Energy converters • High voltage electricity • Magnetic forces 	<ul style="list-style-type: none"> • Magnetic shuttle • Jumping disc • Flywheels • Rising arc • Magnetism from electricity • Electric motor • <i>Diesel revolution</i> • <i>Rail into the future</i>
3. A simple machine to lift a 200kg wool bale into the back of a rail wagon	<ul style="list-style-type: none"> • Simple machines • Levers and gears • Power driven machines • Mechanical advantage 	<ul style="list-style-type: none"> • Levers • Gears • Electric motor • <i>Moving goods: Crane</i>
4. A train that uses magnetic attraction / repulsion for propulsion as well as for direction.	<ul style="list-style-type: none"> • Magnetic attraction • Magnetic repulsion • Electromagnetism • Magnetic levitation 	<ul style="list-style-type: none"> • Magnetic shuttle • Floating magnets • Magnetic field • Magnetism from electricity • <i>Rail into the future</i>
5. A theme park ride that does not require constant propulsion by an engine.	<ul style="list-style-type: none"> • Energy converters • Energy sources • Magnetic repulsion • Forces on tracks 	<ul style="list-style-type: none"> • Train wheels • The flywheel • Air blast • Jumping disc • Catenary arch • <i>Might and muscle</i>
6. A faster and more energy efficient train: consider methods of propulsion as well as track design.	<ul style="list-style-type: none"> • Magnetic forces • Electromagnetism • Energy storage • Energy converters • Balancing forces 	<ul style="list-style-type: none"> • Magnetic shuttle • Floating magnets • Magnetism from electricity • Flywheels • Electric motor • <i>Rail into the future</i>



- 11 Toilets
- 12 Baby change room
- 13 Disabled toilet
- 14 Water fountain
- 15 Parking
- 16 Special event station

- 1 Trackkeepers Building and Grounds
- 2 Trackside Café
- 3 Museum Collection and Storage
- 4 Behind the Scenes Tours
- 5 Powerhouse
- 6 War Memorial

- 7 Moving Goods
- 8 Diesel Revolution
- 9 Diesel Simulator
- 10 All Aboard
- 11 Theatre
- 12 Museum Shop
- 13 Model Railway
- 14 Ipswich Railway Workshops
- 15 Rail in Queensland
- 16 Platform 9
- 17 Nippers Railway
- 18 Might and Muscle
- 19 One of a Kind
- 20 Governor's Carriage
- 21 Rail Today
- 22 Tilt Train Simulator
- 23 Other Railways
- 24 Boilershop Gallery



To solve your challenge you will need to look closely at the:

- Objects
- Hands-on experiments; and
- Information panels at the Energy change and machines Science Stations.

You will need to use the scientific ideas from the hands-on experiments, not the devices themselves to help solve your challenge.

Key ideas:

- Magnetic materials
- Forces on objects
- Floating objects in air

The Workshops Rail Museum

Energy change and machines

Student Challenge #1

Design an energy efficient device that can be used to sort these recyclable materials – steel cans, plastic containers, glass bottles, newspapers, cardboard, and milk and fruit juice cartons.

This device must not have a motor that relies on the use of fossil fuels.

Investigate these hands-on stations

- Magnetism from electricity
- Jumping disc
- Floating magnets
- Air blast
- Fluid coupler
- Electric motor

Suggestions for investigating the hands-on experiments

Follow the instructions on the device and record what happens.

What we tried	What happened

- Why did that happen?
- What type of energy is being used?

Solving your Challenge

- Brainstorm with your group for ideas.
- Base your ideas on what you have found out about your hands-on science stations.
- You may draw diagrams or write an explanation of the device you have designed to solve your challenge.



To solve your challenge you will need to look closely at the:

- Objects
- Hands-on experiments; and
- Information panels at the Energy change and machines Science Stations.

You will need to use the scientific ideas from the hands-on experiments, not the devices themselves to help solve your challenge.

Key ideas:

- Electromagnetism
- Energy converters
- High voltage electricity
- Magnetic forces

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Energy change and machines

Student Challenge #2

Design an energy device that could harness some of nature's "free" energy for use by the train system.

You must first decide what function your device will perform and what "free" energy you will use.

Investigate these hands-on stations

- Magnetic shuttle
- Jumping disc
- Flywheels
- Rising arc
- Magnetism from electricity
- Electric motor

Suggestions for investigating the hands-on experiments

Follow the instructions on the device and record what happens.

What we tried	What happened

- Why did that happen?
- What type of energy is being used?

Solving your Challenge

- Brainstorm with your group for ideas.
- Base your ideas on what you have found out about your hands-on science stations.
- You may draw diagrams or write an explanation of the device you have designed to solve your challenge.



To solve your challenge you will need to look closely at the:

- Objects
- Hands-on experiments; and
- Information panels at the Energy change and machines Science Stations.

You will need to use the scientific ideas from the hands-on experiments, not the devices themselves to help solve your challenge.

Key ideas:

- Simple machines
- Levers and gears
- Power driven machines
- Mechanical advantage

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Energy change and machines

Student Challenge #3

Design a simple machine to lift a 200kg wool bale into the back of a rail wagon.

You must first investigate different types of simple machines that might be useful for lifting.

Investigate these hands-on stations

- Lift and lever
- Gears
- Electric motor
- *Moving goods: Crane*

Suggestions for investigating the hands-on experiments

Follow the instructions on the device and record what happens.

What we tried	What happened

- Why did that happen?
- What type of energy is being used?

Solving your Challenge

- Brainstorm with your group for ideas.
- Base your ideas on what you have found out about your hands-on science stations.
- You may draw diagrams or write an explanation of the device you have designed to solve your challenge.



To solve your challenge you will need to look closely at the:

- Objects
- Hands-on experiments; and
- Information panels at the Energy change and machines Science Stations.

You will need to use the scientific ideas from the hands-on experiments, not the devices themselves to help solve your challenge.

Key Ideas:

- Magnetic attraction
- Magnetic repulsion
- Electromagnetism
- Magnetic levitation

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Energy change and machines

Student Challenge #4

Design a train that uses magnetic attraction and repulsion for propulsion as well as for direction changes.

You should first find out about how magnets work and can be switched on and off.

Investigate these hands-on stations

- Magnetic shuttle
- Floating magnets
- Magnetic field
- Magnetism from electricity
- *Rail into the future*

Suggestions for investigating the hands-on experiments

Follow the instructions on the device and record what happens.

What we tried	What happened

- Why did that happen?
- What type of energy is being used?

Solving your Challenge

- Brainstorm with your group for ideas.
- Base your ideas on what you have found out about your hands-on science stations.
- You may draw diagrams or write an explanation of the device you have designed to solve your challenge.



To solve your challenge you will need to look closely at the:

- Objects
- Hands-on experiments; and
- Information panels at the Energy change and machines Science Stations.

You will need to use the scientific ideas from the hands-on experiments, not the devices themselves to help solve your challenge.

Key ideas:

- Energy converters
- Energy sources
- Magnetic repulsion
- Forces on tracks

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Energy change and machines

Student Challenge #5

Design a theme park ride that does not require constant propulsion by an engine.

You should first investigate how the ride can stay on tracks and be able to start and stop.

Investigate these hands-on stations

- Train wheels
- Flywheels
- Air blast
- Jumping disc
- Catenary arch
- *Might and muscle*

Suggestions for investigating the hands-on experiments

Follow the instructions on the device and record what happens.

What we tried	What happened

- Why did that happen?
- What type of energy is being used?

Solving your Challenge

- Brainstorm with your group for ideas.
- Base your ideas on what you have found out about your hands-on science stations.
- You may draw diagrams or write an explanation of the device you have designed to solve your challenge.



To solve your challenge you will need to look closely at the:

- Objects
- Hands-on experiments; and
- Information panels at the Energy change and machines Science Stations.

You will need to use the scientific ideas from the hands-on experiments, not the devices themselves to help solve your challenge.

Key ideas:

- Magnetic forces
- Electromagnetism
- Energy storage
- Energy converters
- Balancing forces

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Energy change and machines

Student Challenge #6

A faster and more energy efficient train: consider methods of propulsion as well as track design.

You should first investigate the use of magnets for propulsion and reducing friction.

Investigate these hands-on stations:

- Magnetic shuttle
- Floating magnets
- Magnetism from electricity
- Flywheels
- Electric motor
- *Rail into the future*

Suggestions for investigating the hands-on experiments

Follow the instructions on the device and record what happens.

What we tried	What happened

- Why did that happen?
- What type of energy is being used?

Solving your Challenge

- Brainstorm with your group for ideas.
- Base your ideas on what you have found out about your hands-on science stations.
- You may draw diagrams or write an explanation of the device you have designed to solve your challenge.