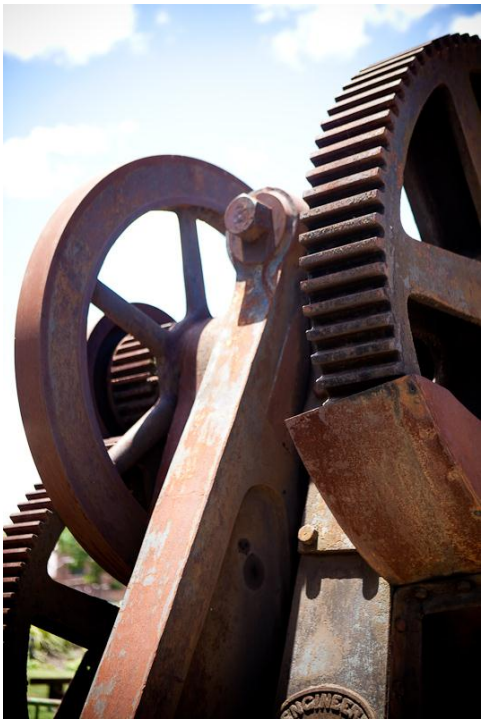
THE WORKSHOPS RAIL MUSEUM
IPSWICH

EDUCATION

ENERGY AND CHANGE

SCIENCE TRAIL

Years 8 to 10



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(except Good Friday, ANZAC Day & Christmas Day)

QUEENSLAND MUSEUM NETWORK
Queensland Government

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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Purpose and Overview

The following questions and activities are based on the Science Stations and other exhibits at The Workshops Rail Museum. They are aimed at helping students to develop an understanding of energy and change and how they can be used in real life contexts.

These activities are aligned with the Australian Curriculum: Science content strands of *Science Understanding*, *Science as a Human Endeavour*, and *Science Enquiry Skills* for Years 8, 9 and 10.

Students will further develop and apply their knowledge and understanding of the following areas:

- Science Understanding – Physical sciences
- Science as Human Endeavour – Use and influence of science
- Science Enquiry Skills – Questioning and predicting; Planning and conducting; Processing and analysing data and information; Evaluating; and Communicating

Context for learning

This worksheet 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.

Title: Energy and Change: Machines Challenge	**KLA(s):** Science (English)	**Year level(s):** 8, 9, 10

CURRICULUM LINKS

SCIENCE UNDERSTANDING

Physical Sciences

YEAR 8

Energy appears in different forms including movement (kinetic energy), heat and potential energy, and causes change within systems **(ACSSU155)**

Elaboration:

- investigating different forms of energy in terms of the effects they cause, such as gravitational potential causing objects to fall and heat energy transferred between materials that have a different temperature

YEAR 9

Energy transfer through different mediums can be explained using wave and particle models **(ACSSU182)**

Elaboration:

- exploring how and why the movement of energy varies according to the medium through which it is transferred

YEAR 10

The motion of objects can be described and predicted using the laws of physics **(ACSSU229)**

Elaboration:

- gathering data to analyse everyday motions produced by forces, such as measurements of distance and time, speed, force, mass and acceleration

SCIENCE AS HUMAN ENDEAVOUR

Use and Influence of Science

YEAR 8

Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations **(ACSHE135)**

Elaborations:

- investigating requirements and the design of systems for collecting and recycling household waste
- investigating how energy efficiency can reduce energy consumption
- investigating the development of vehicles over time, including the application of science to contemporary designs of solar-powered vehicles

YEAR 9

The values and needs of contemporary society can influence the focus of scientific research **(ACSHE228)**

Elaborations:

- investigating how energy efficiency can reduce energy consumption
- investigating the development of vehicles over time, including the application of science to contemporary designs of solar-powered vehicles

YEAR 10

The values and needs of contemporary society can influence the focus of scientific research **(ACSHE230)**

Elaboration*:*

- considering innovative energy transfer devices, including those used in transport and communication

SCIENCE INQUIRY SKILLS

Questioning and Predicting

YEAR 8

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

Elaborations:

- considering whether investigation using available resources is possible when identifying questions or problems to investigate

YEAR 9

Formulate questions or hypotheses that can be investigated scientifically **(ACSIS164)**

Elaborations:

- revising and refining research questions to target specific information and data collection or finding a solution to the specific problem identified
- developing ideas from students own or others' investigations and experiences to investigate further

YEAR 10

Formulate questions or hypotheses that can be investigated scientifically **(ACSIS198)**

Elaborations:

- developing ideas from students own or others' investigations and experiences to investigate further
- evaluating information from secondary sources as part of the research process

Planning and Conducting

YEAR 8

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

Elaboration:

- working collaboratively to decide how to best approach an investigation

YEAR 9

Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods **(ACSIS165)**

Elaboration:

- combining research using primary and secondary sources with students' own experimental investigation

YEAR 10

Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods **(ACSIS199)**

Elaborations:

- combining research using primary and secondary sources with a student's own experimental investigation
- using modelling and simulations, including using digital technology, to investigate situations and events

Processing and Analysing Data and Information

YEAR 8

Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate **(ACSIS144)**

Elaboration:

- explaining the strengths and limitations of representations such as physical models, diagrams and simulations in terms of the attributes of systems included or not included

YEAR 9

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence **(ACSIS170)**

Elaboration:

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate

YEAR 10

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence **(ACSIS204)**

Elaboration:

- constructing a scientific argument showing how their evidence supports their claim

Evaluating

YEAR 8	YEAR 9	YEAR 10
Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method **(ACSIS146)**	Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data **(ACSIS171)**	Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data **(ACSIS205)**
Elaboration: • discussing investigation methods with others to share ideas about the quality of the inquiry process	***Elaborations:*** • identifying gaps or weaknesses in conclusions (their own or those of others) • identifying alternative explanations that are also consistent with the evidence	***Elaborations:*** • evaluating the strength of a conclusion that can be inferred from a particular data set • identifying alternative explanations that are also consistent with the evidence

Communicating

YEAR 8	YEAR 9	YEAR 10
Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate **(ACSIS148)**	Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations **(ACSIS174)**	Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations **(ACSIS208)**
Elaboration: • selecting and using appropriate language and representations to communicate science ideas within a specified text type and for a specified audience	***Elaboration:*** • presenting results and ideas using formal experimental reports, oral presentations, slide shows, poster presentations and contributing to group discussions	***Elaboration:*** • presenting results and ideas using formal experimental reports, oral presentations, slide shows, poster presentations and contributing to group discussions

General capabilities

- **Literacy:** Students communicate scientific ideas, explanations, conclusions, decisions and data, using scientific argument and terminology, in appropriate formats
- **Critical and creative thinking:** Students evaluate data, information and evidence to identify connections, construct arguments and link results to theory and draw conclusions that summarise and explain patterns, and that are consistent with the data and respond to the question
- **Sustainability:** Students use science to predict possible effects of human and other activity, and to develop management plans or alternative technologies that minimise these effects in their machine challenges
- **Numeracy:** Students use spatial reasoning through visualising 2D shapes and 3D objects, and record and analyse data
- **Personal and social capability:** Students reflect on different perspectives and evaluate the influence of people's values and culture on the applications of science
- **Intercultural understanding**: Students consider and develop multiple perspectives
- **Personal and social capability:** Students demonstrate collaboration skills, decision making and self-management
- **Ethical understanding:** Students reason and make ethical decisions and consider consequences

Develop assessment			Make judgments	
Type of assessment	**What will be assessed**	**When it will be assessed**	**Purpose of assessment**	**Assessable elements**
Presentation of Challenges and their solutions to class Folio of data collected and records of experiments conducted	Students ability to apply information gathered in experiments to solving problems	Ongoing and at presentation of Challenges	To demonstrate students' knowledge, understanding and application of the relevant scientific concepts	Knowledge and understanding Investigating Communicating Reflecting

Learning Sequence	
Learning experiences and teaching strategies	**Resources**
1. Pre-visit 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 (TWRM) a. Students participate in an introductory session with the Learning, Events and Activities Officer - optional b. Students move through the Museum find the Science Stations and other exhibit zones relevant to their challenge and experiment and gather data 3. Post visit 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.	• Energy Change and Machines Worksheet • Science Station Fact Sheets (contact the Learning, Events and Activities Officer at info@theworkshops.qm.qld.gov.au)

Use feedback
Ways to monitor learning and assessment
• Presentation • Observation • Completion of class activities

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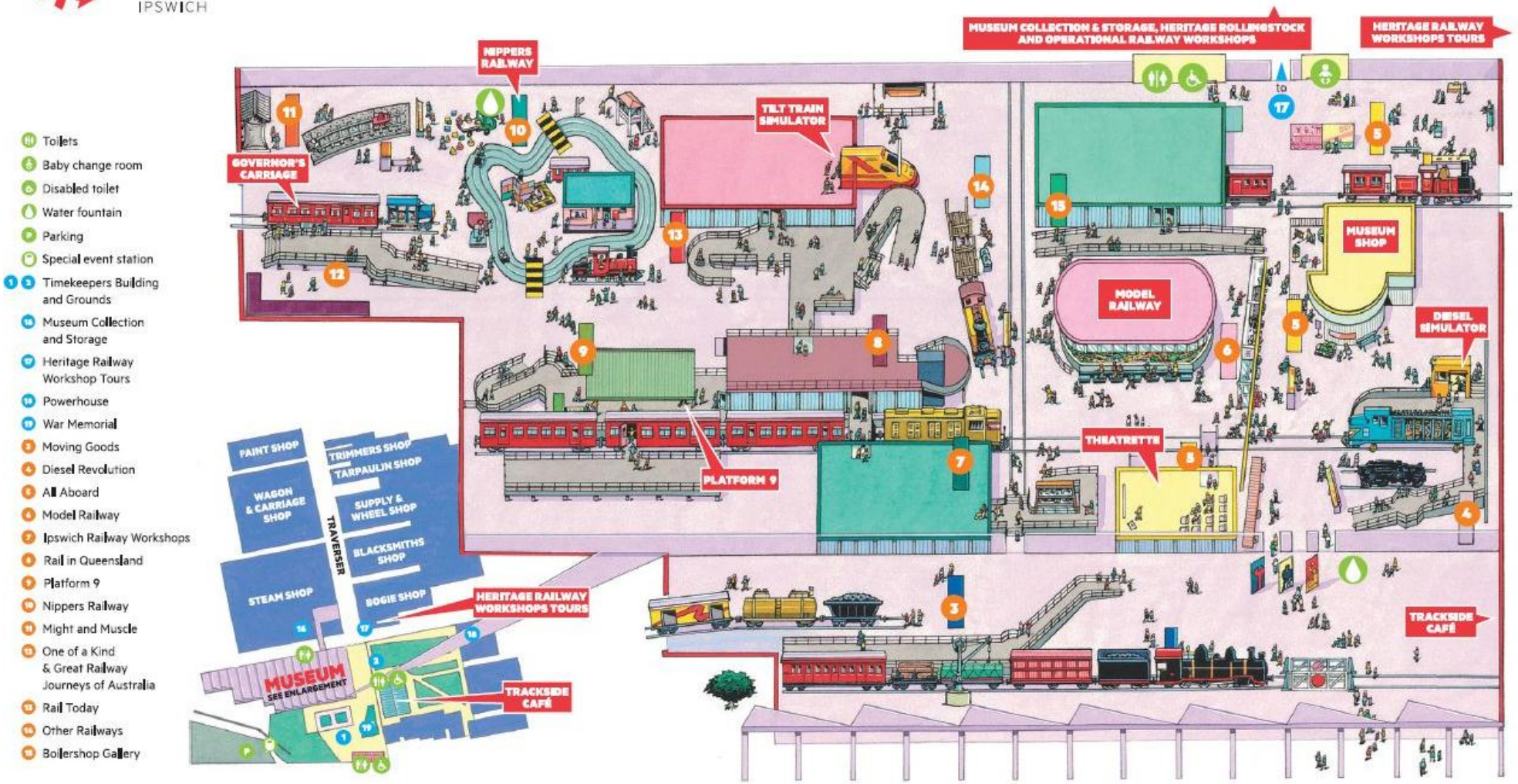
MUSEUM MAP



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.	• Magnetic materials • Forces on objects • Floating objects in air	• 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.	• Electromagnetism • Energy converters • High voltage electricity • Magnetic forces	• Magnetic shuttle • Jumping disc • Flywheels • Rising arc • Magnetism from electricity • Electric motor • *Diesel revolution* • *Rail into the future*
3. A simple machine to lift a 200kg wool bale into the back of a rail wagon.	• Simple machines • Levers and gears • Power driven machines • Mechanical advantage	• Levers • Gears • Electric motor • *Moving goods: Crane*
4. A train that uses magnetic attraction / repulsion for propulsion as well as for direction.	• Magnetic attraction • Magnetic repulsion • Electromagnetism • Magnetic levitation	• Magnetic shuttle • Floating magnets • Magnetic field • Magnetism from electricity • *Rail into the future*
5. A theme park ride that does not require constant propulsion by an engine.	• Energy converters • Energy sources • Magnetic repulsion • Forces on tracks	• Train wheels • The flywheel • Air blast • Jumping disc • Catenary arch • *Might and muscle*
6. A faster and more energy efficient train: consider methods of propulsion as well as track design.	• Magnetic forces • Electromagnetism • Energy storage • Energy converters • Balancing forces	• Magnetic shuttle • Floating magnets • Magnetism from electricity • Flywheels • Electric motor • *Rail into the future*

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, 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:

- Air blast (in *Zone 4: Diesel Revolution*)
- Magnetism from electricity
- Jumping disc
- Floating magnets
- Fluid coupler
- Electric motor

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

- Objects
- Hands-on experiments
- 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

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.

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 (in *Zone 13: Rail Today*)
- Jumping disc (in *Zone 13: Rail Today*)
- Flywheels
- Rising arc
- Magnetism from electricity
- Electric motor

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

- Objects
- Hands-on experiments
- 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

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.

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

- *Zone 3: Moving goods* - Crane
- Levers
- Gears
- Electric motor

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

- Objects
- Hands-on experiments
- 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

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.

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 (in *Zone 13: Rail Today*)
- Rail into the future (in *Zone 13: Rail Today*)
- Magnetism from electricity
- Floating magnets
- Magnetic field

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

- Objects
- Hands-on experiments
- 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

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.

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 (in *Zone 11: Might & Muscle*)
- Air blast (in *Zone 4: Diesel Revolution*)
- Jumping disc (in *Zone 13: Rail Today*)
- Zone 11: Might & Muscle
- Catenary arch
- Flywheels

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

- Objects
- Hands-on experiments
- 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:

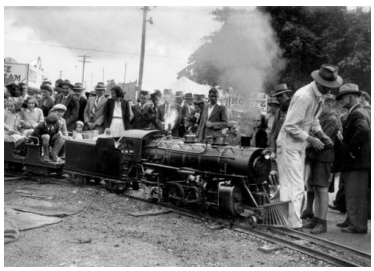
- Energy converters
- Energy sources
- Magnetic repulsion
- Forces on tracks

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.

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 (in *Zone 13: Rail Today*)
- Floating magnets
- Magnetism from electricity
- Flywheels
- Electric motor
- Rail into the future (in *Zone 13: Rail Today*)

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

- Objects
- Hands-on experiments
- 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

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.