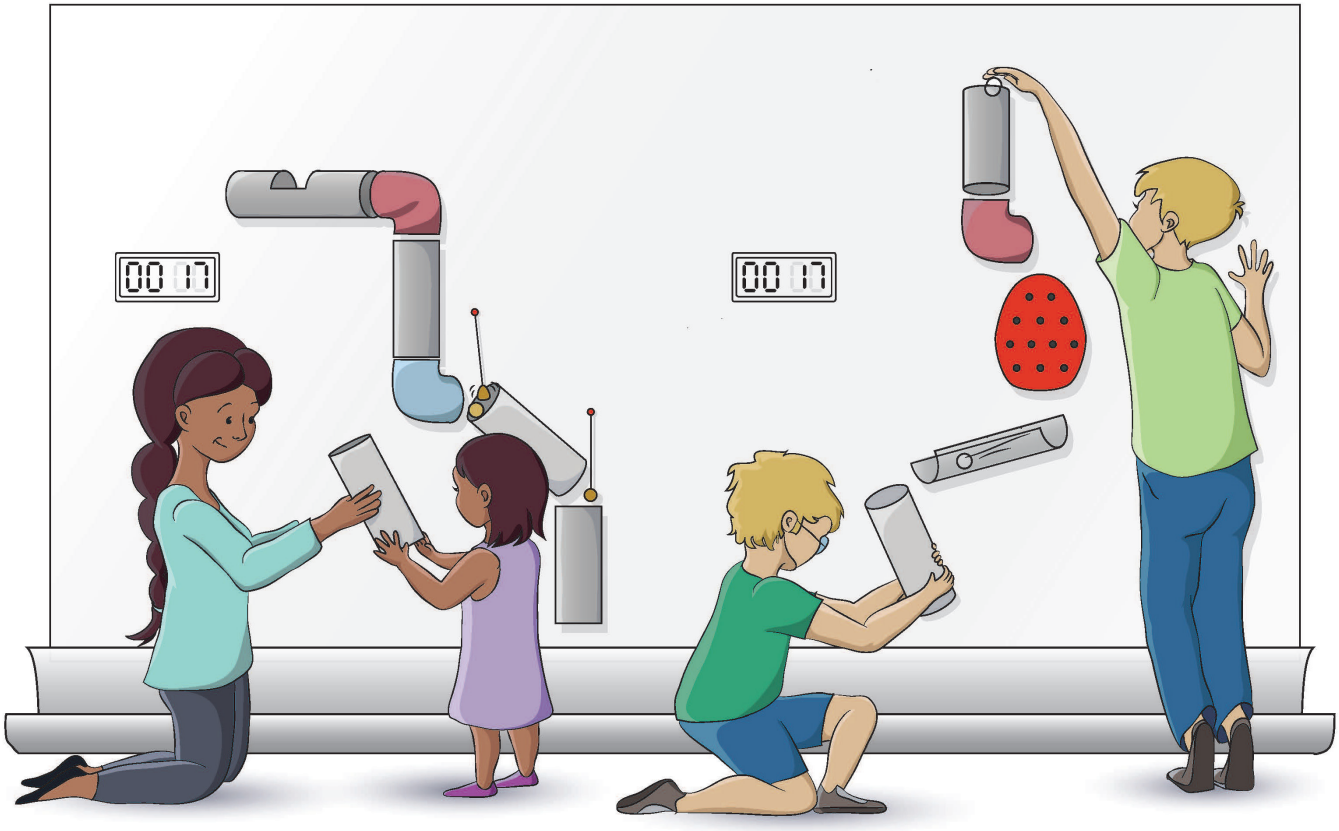


Gravity Run

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

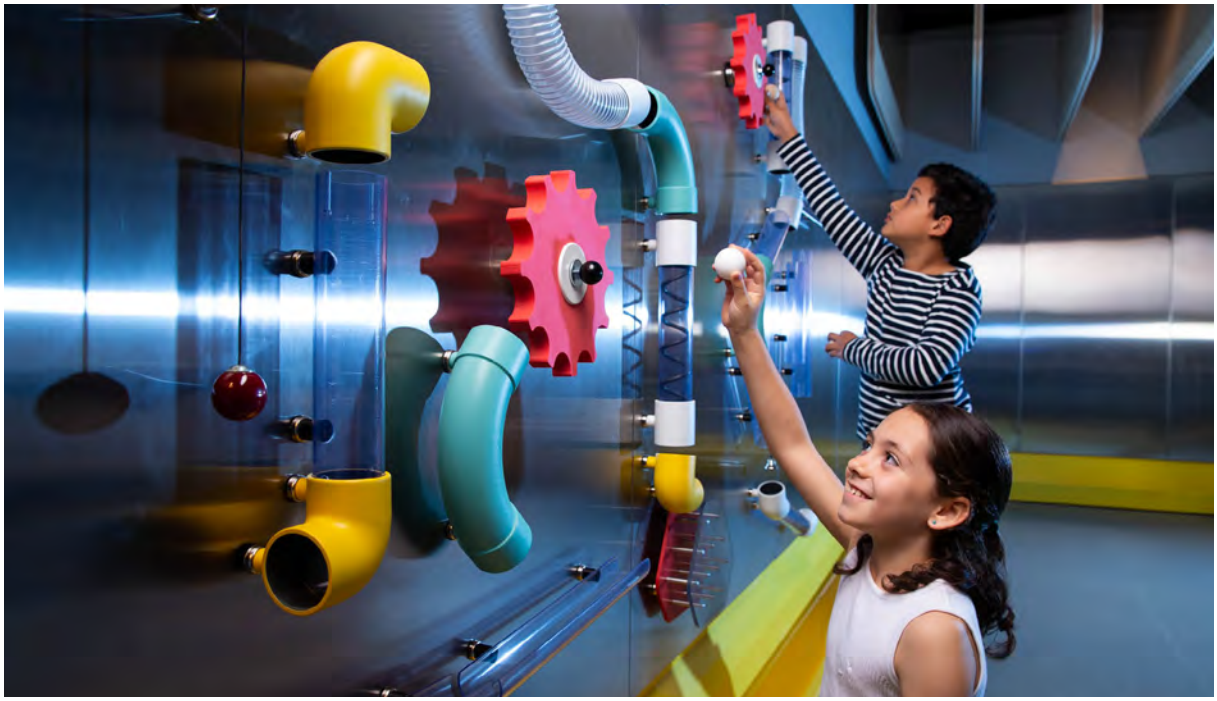
EXPLORE – EXPLAIN – ELABORATE – EVALUATE

Gravity Run

Teacher Resource

The gravity run is a collaborative, open-ended exhibit at *SparkLab, Sciencentre*. Here, visitors work together to problem-solve building a successful ball run using a series of pipes, curves, wheels, hanging bells and balls. They may also extend the challenge to create a run that fits to set criteria.

In this activity, students use a gravity run as a tool to explore different forms of energy, including electrical energy, as well as energy transfers and transformations. They work in groups of two or three to improve the gravity run by designing a new part for the run that incorporates electrical energy (Year 6) and/or other forms of energy that are not already present in the system (Year 8). Please note, this activity assumes Year 6 students have developed knowledge and understanding of electrical systems and components, and Year 8 students have developed knowledge and understanding of energy, energy transfers and transformations.



Children building and testing the gravity run at SparkLab, Sciencentre. Image: John Nguyen.

Before engaging with this activity, you may like to view the gravity run in action at *SparkLab, Sciencentre*. You could view a video of the gravity run challenge or visit *SparkLab, Sciencentre* to build and test your own gravity run. Registered teachers are invited to a free preview of *SparkLab, Sciencentre*. Contact the Queensland Museum Bookings Officer via phone (07) 3153 4401 or email education@qm.qld.gov.au to arrange your free entry.

Detailed step-by-step instructions for this activity can be seen below. It is recommended that you use these instructions to guide your students through the activity.

1. Consider where you would like to create the gravity run at school. Is there a free wall in the classroom, or will you need to use wall space outside?
2. Consider how you will stick materials like cardboard or plastic to this surface. Could you use masking tape, gaff tape, thumbtacks, velcro or magnets?
3. Gather the following materials prior to delivering the activity in the classroom. You may choose to substitute some materials for others or provide additional materials that are not listed below. Some materials will be saved for later, when students are required to improve the gravity run.

Pre-Selected Materials

- Track materials, such as cardboard, cardboard tubes, flexible plastic, PVC pipes etc.
- Balls, such as golf balls or ping pong balls
- Adhesive materials, such as masking tape, gaff tape, thumbtacks, velcro, magnets etc. These materials can be used to construct the tracks and to stick the track materials to the wall. Which adhesives you work with will depend on your chosen wall surface.
- Start sign
- Finish sign

Improvement Materials

- Scissors
- Additional adhesive materials
- Additional track materials
- Cardboard, paper, fabric etc.
- String
- Rubber bands
- Paddle pop sticks
- Bells
- Electrical wire
- Electrical tape
- Batteries
- Battery snaps and/or holders
- Electric buzzers
- LED lights or bulbs
- Switches (toggle, contact, slide, paper clips)
- Thumbtacks
- Aluminium foil

4. When you are ready to deliver the activity, gather students around the wall. Stick the Start and Finish signs to the wall. Ensure the Start sign is higher and further along the wall than the Finish sign. Ensure the pre-selected materials are with you too. (Alternatively, your students could develop a free-standing gravity run, or use everyday materials to create a platform for their gravity run such as books stacked at different heights.)

5. Ask students: ***How could we design a track for a ball to travel from the start to the finish?*** Provide students with time to explore the pre-selected materials and to discuss their ideas in small groups. Student groups may like to sketch their ideas using paper or a digital medium.

6. Use student ideas to construct a gravity run as a class or in groups. Test the gravity run. Ask students to make predictions about how the ball may travel through the run, recording observations for each test (see *Student Activity: Constructing a Gravity Run*). Year 8 students could also record the speed at which each ball travels through the run.

7. **YEAR 6**

   Ask students: ***How could we introduce electrical energy into the system? What could we do with the electrical energy?*** As an example, students could suggest incorporating a switch into the system, and when a ball rolls over the switch, a bulb might light up or a buzzer might sound.

   Share the challenge with students: ***Improve the gravity run so that it incorporates electrical energy.*** Students work in groups of three to complete the challenge. Students should firstly examine the existing gravity run and consider where and how they could introduce electrical energy into the system. Students then create a diagram (sketched or digital) to represent their ideas. Following this, students may construct their modified part and test it within the existing system. Students can use supplied modification materials or source their own materials to complete the task. Students evaluate their modified part, and then share it with the class.

   YEAR 8

   Revise the concept of energy and different forms of energy with students. Ask students to identify the different forms of energy present within the system, as well as the energy transfers and transformations that occur in the system. Ask students: ***What forms of energy are not present in this system?*** Discuss responses as a class group.

   Share the challenge with students: ***Improve the gravity run so that it incorporates at least two 'new' forms of energy.*** Students work in groups of three to complete the challenge. Students should firstly examine the existing gravity run and consider where and how they could introduce different forms of energy into the system. Students then create a diagram (sketched or digital) to represent their ideas. Following this, students may construct their modified part and test it within the existing system. Students can use supplied modification materials or source their own materials to complete the task. Students evaluate their modified part, and then share it with the class.

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

Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions (ACSHE098)

Science Inquiry Skills

With guidance, pose clarifying questions and make predictions about scientific investigations (ACSIS232)

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)

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 Inquiry Skills

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

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)

General Capabilities

Literacy

Composing texts through speaking, writing and creating

Critical and Creative Thinking

Generating ideas, possibilities and actions

Reflecting on thinking and processes

Analysing, synthesising and evaluating reasoning and procedures

Personal and Social Capability

Social management

Gravity Run

Student Activity

Constructing a Gravity Run

Construct a gravity run with your class or in groups. You may choose to attach the gravity run to a wall, design a free standing gravity run, or use everyday materials to create a platform for your gravity run. Test the gravity run, and record observations about how the ball travels through the run below.

Test Number	Prediction	Observations

Gravity Run

Student Activity

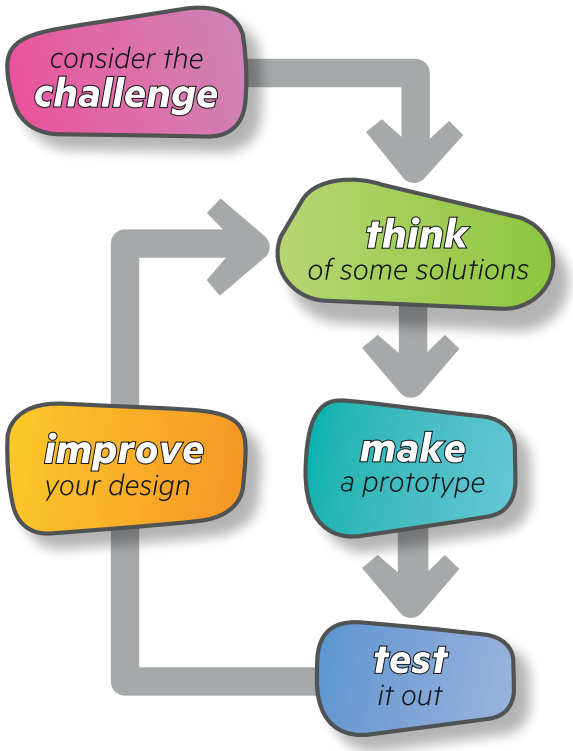
Year 6 Design Challenge

Task:

Improve the gravity run so that it incorporates electrical energy.

You must:

- **Consider the challenge.** What are the requirements of the design challenge?
- **Think of some solutions.** How you could introduce electrical energy into the gravity run? 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.** Test the new part in the gravity run. What did you notice? Did the new part operate as you intended?
- **Improve your design.** 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?



Consider the Challenge

What are the requirements of the design challenge? Identify and record these requirements, and the criteria for success, below.

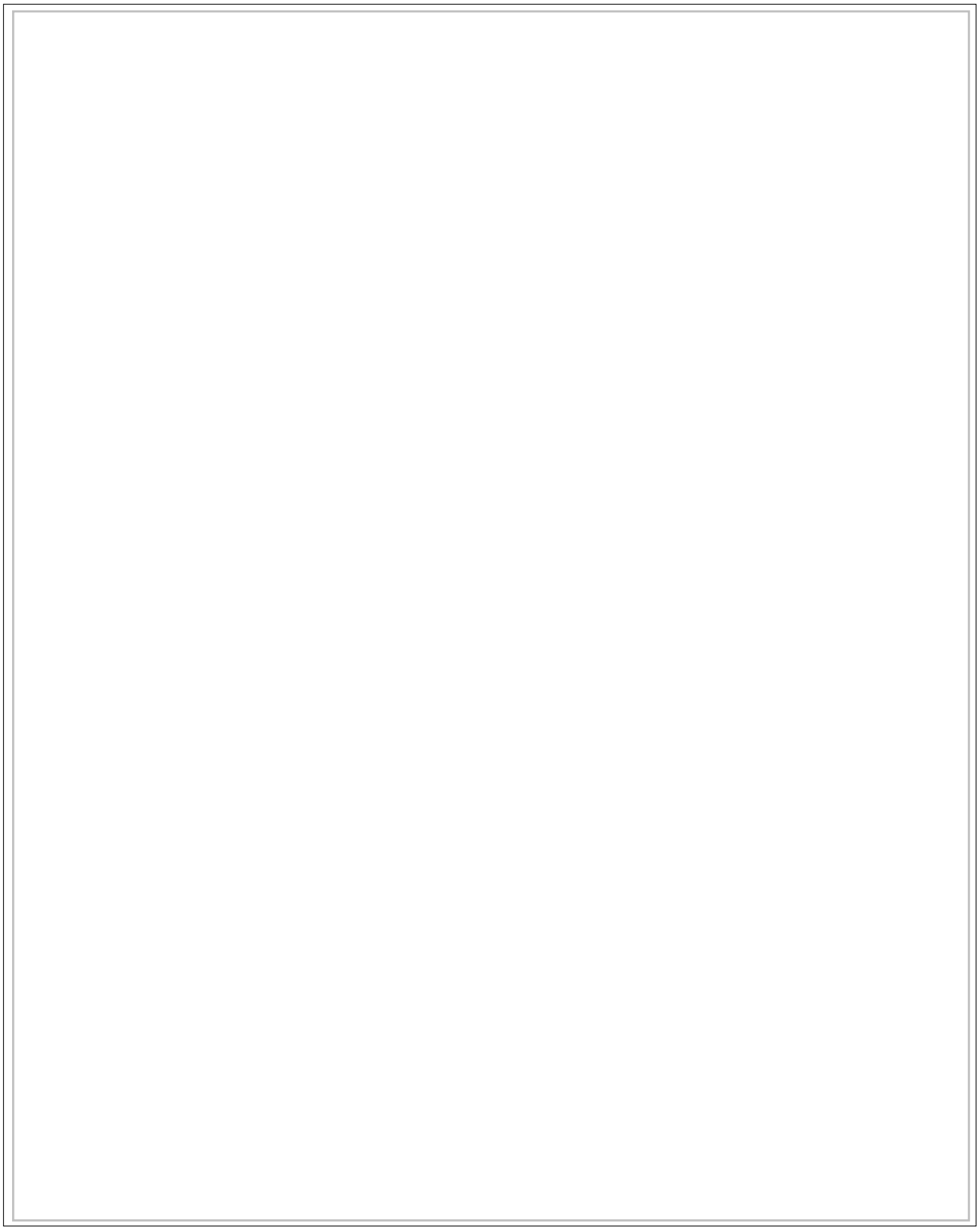
Think of Some Solutions

Examine the gravity run. How could you introduce electrical energy into this system? Brainstorm ideas with your group. Record your ideas below.

Make a Prototype

Design a new part for the gravity run that incorporates electrical energy. Consider the electrical components and materials you will need to build the new part, as well as the properties of these components and materials.

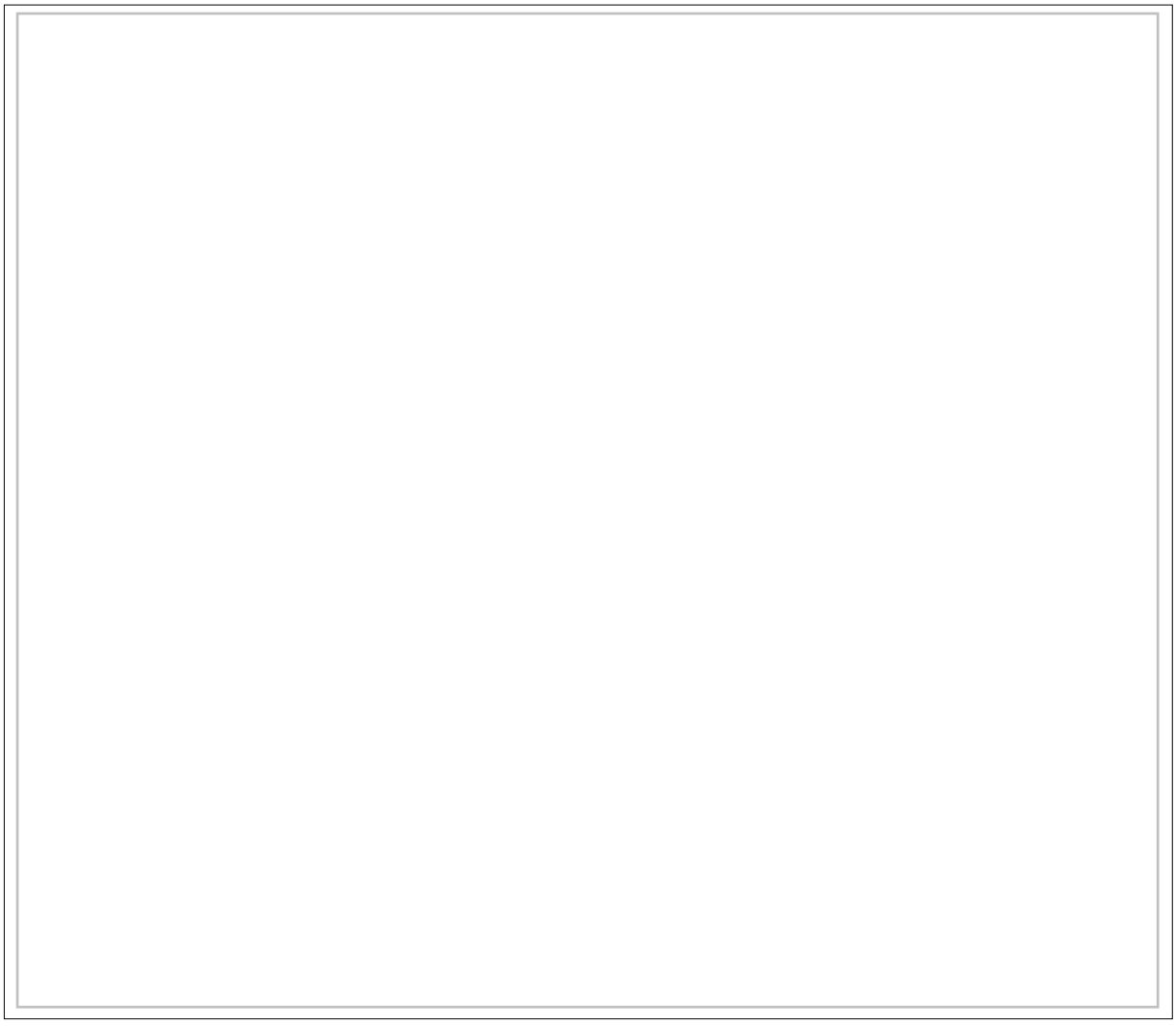
Create a labelled diagram of your design. Make sure you identify and justify the electrical components and materials you will use in your design.



Construct your prototype.

Explain any changes that were made to the design as you created the prototype.

Draw a circuit diagram of the new part of your gravity run.



Test It Out

Test the new part in the gravity run. Record your observations below.

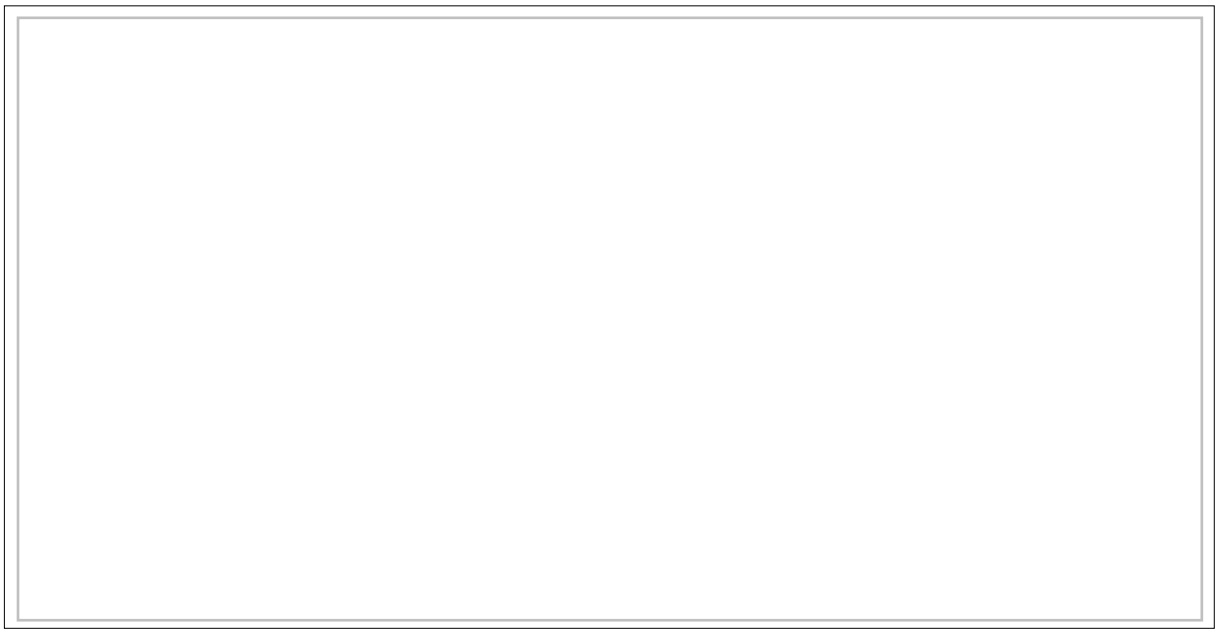
Explain your observations. Consider what you already know about electrical energy and the properties of different materials. Make sure you include scientific language in your explanation.

Improve Your Design

Explain how you could improve your design.

Make these improvements and then re-test your design. Explain and evaluate the effect of these modifications.

Draw a revised circuit diagram to show these modifications.



Keep testing and refining until you are satisfied with your design.

Evaluate Your Design

Reflect on your actions with your team or class after you have completed the design challenge. You might like to think about the following questions to assist with your reflection:

- Explain how your knowledge of science helped you to make decisions about your design.
- Evaluate your final design. Which aspects are you most satisfied with? Which aspects would you further improve on? How would you make these improvements?
- Describe the main challenges you experienced during the design process. Explain how you overcame these challenges.
- Explain what you have learnt about electrical energy and/or the design process from this activity.

Explore More!

- What is the longest gravity run you can make?
- What happens when you change the angles of the run?
- Can you make the ball jump at one point of the run?
- Can you make the ball roll up a slope?
- How can you make a run that takes exactly 10 or 20 or 30 seconds to complete?

Gravity Run

Student Activity

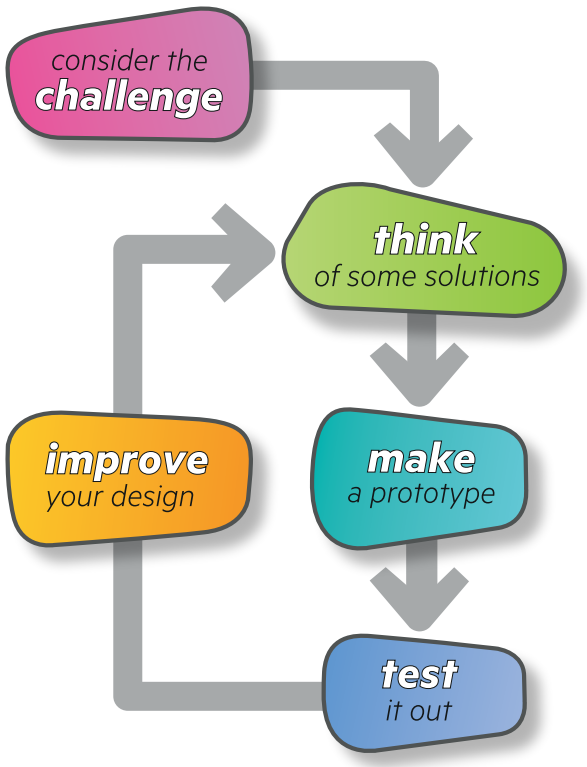
Year 8 Design Challenge

Task:

Improve the gravity run so that it incorporates at least two 'new' forms of energy.

You must:

- **Consider the challenge.** What are the requirements of the design challenge?
- **Think of some solutions.** Which forms of energy are not present in the gravity run? How you could incorporate at least two of these forms of energy into the system?
- **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.** Test the new part in the gravity run. What did you notice? Did the new part operate as you intended?
- **Improve your design.** 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?



Consider the Challenge

What are the requirements of the design challenge? Identify and record these requirements, and the criteria for success, below.

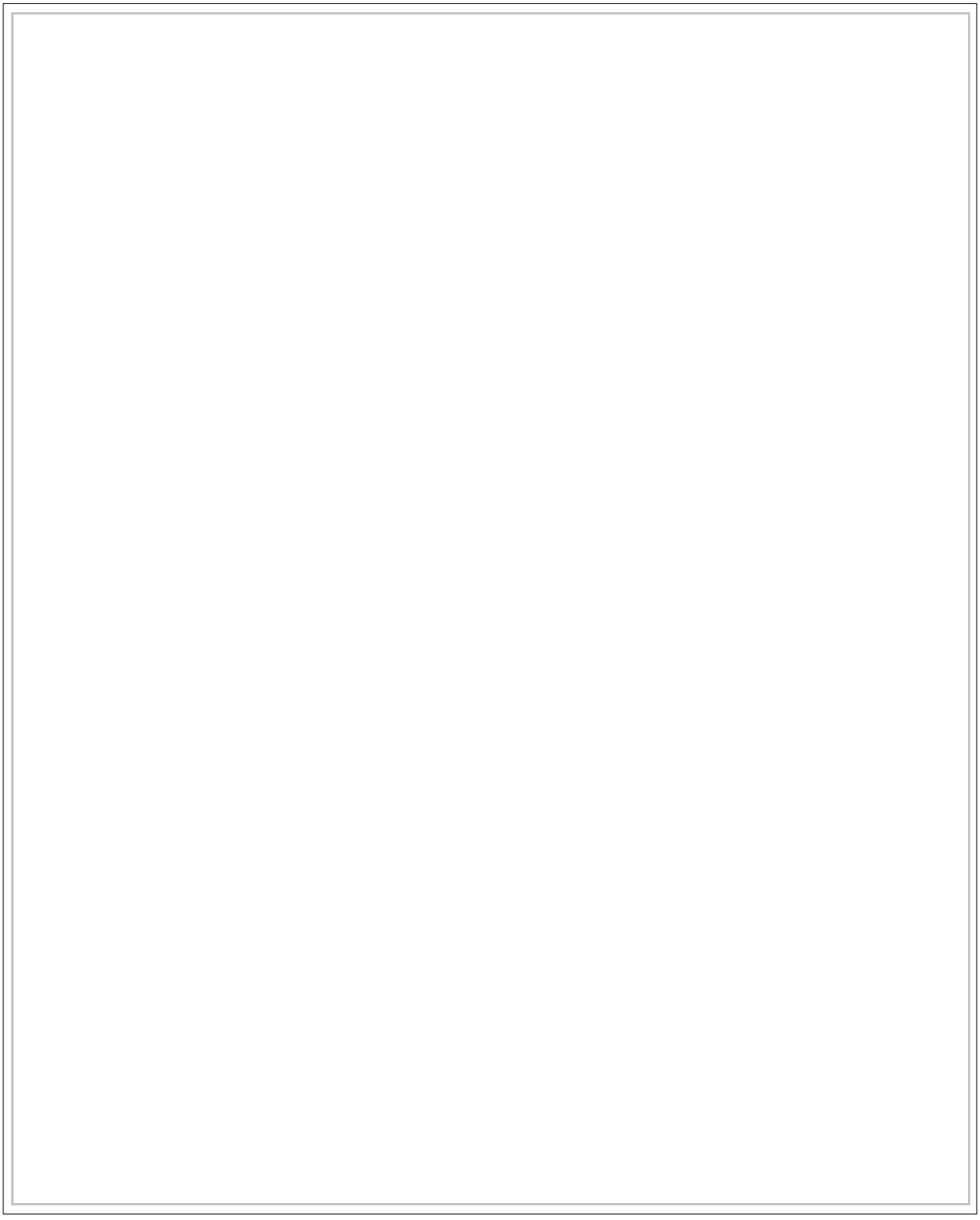
Think of Some Solutions

Examine the gravity run. How could you introduce at least two 'new' forms of energy into this system? Brainstorm ideas with your group. Record your ideas below.

Make a Prototype

Design a new part for the gravity run that incorporates two ‘new’ forms of energy. Consider the materials and components you will need to build the new part, as well as the properties of these components and materials.

Create a labelled diagram of your design. Make sure you identify and justify the materials and components you will use in your design.



Construct your prototype.

Explain any changes that were made to the design as you created the prototype.

Test It Out

Test the new part in the gravity run. Record your observations below.

Explain your observations. Consider how motion, force and energy are used to manipulate and/or control parts within the system. Make sure you include scientific language in your explanation.

Draw a flow diagram to represent the energy transfers and transformations that occur in the gravity run, including the forms of energy added by your new design.

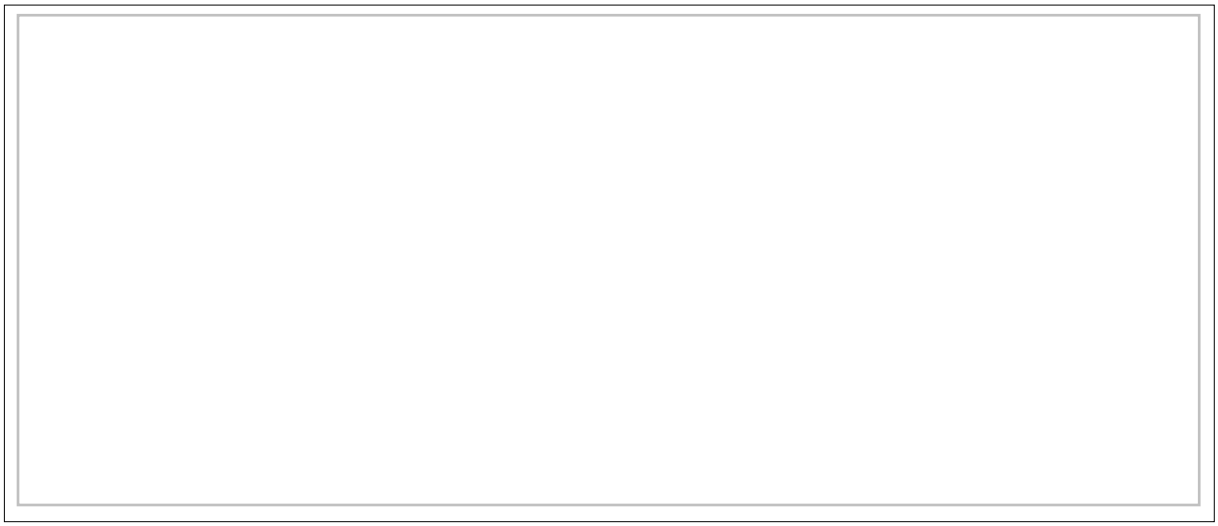
Calculate the speed at which the ball travels through the improved system. Compare this to the speed at which the ball travelled in the original system. Provide an explanation for any differences.

Improve Your Design

Explain how you could improve your design.

Make these improvements then re-test your design. Explain and evaluate the effect of these modifications.

Draw a revised flow diagram to show the effect of these modifications.



Continue testing and refining until you are satisfied with your design.

Evaluate Your Design

Reflect on your actions with your team or class after you have completed the design challenge. You might like to think about the following questions to assist with your reflection:

- Explain how your knowledge of science helped you to make decisions about your design.
- Evaluate your final design. Which aspects are you most satisfied with? Which aspects would you further improve on? How would you make these improvements?
- Describe the main challenges you experienced during the design process. Explain how you overcame these challenges.
- Explain the limitations of the system. Which forms of energy were you unable to include in the system, and why?
- Explain what you have learnt about electrical energy and/or the design process from this activity.

Explore More!

- What is the longest gravity run you can make?
- What happens when you change the angles of the run?
- Can you make the ball jump at one point of the run?
- Can you make the ball roll up a slope?
- How can you make a run that takes exactly 10 or 20 or 30 seconds to complete?