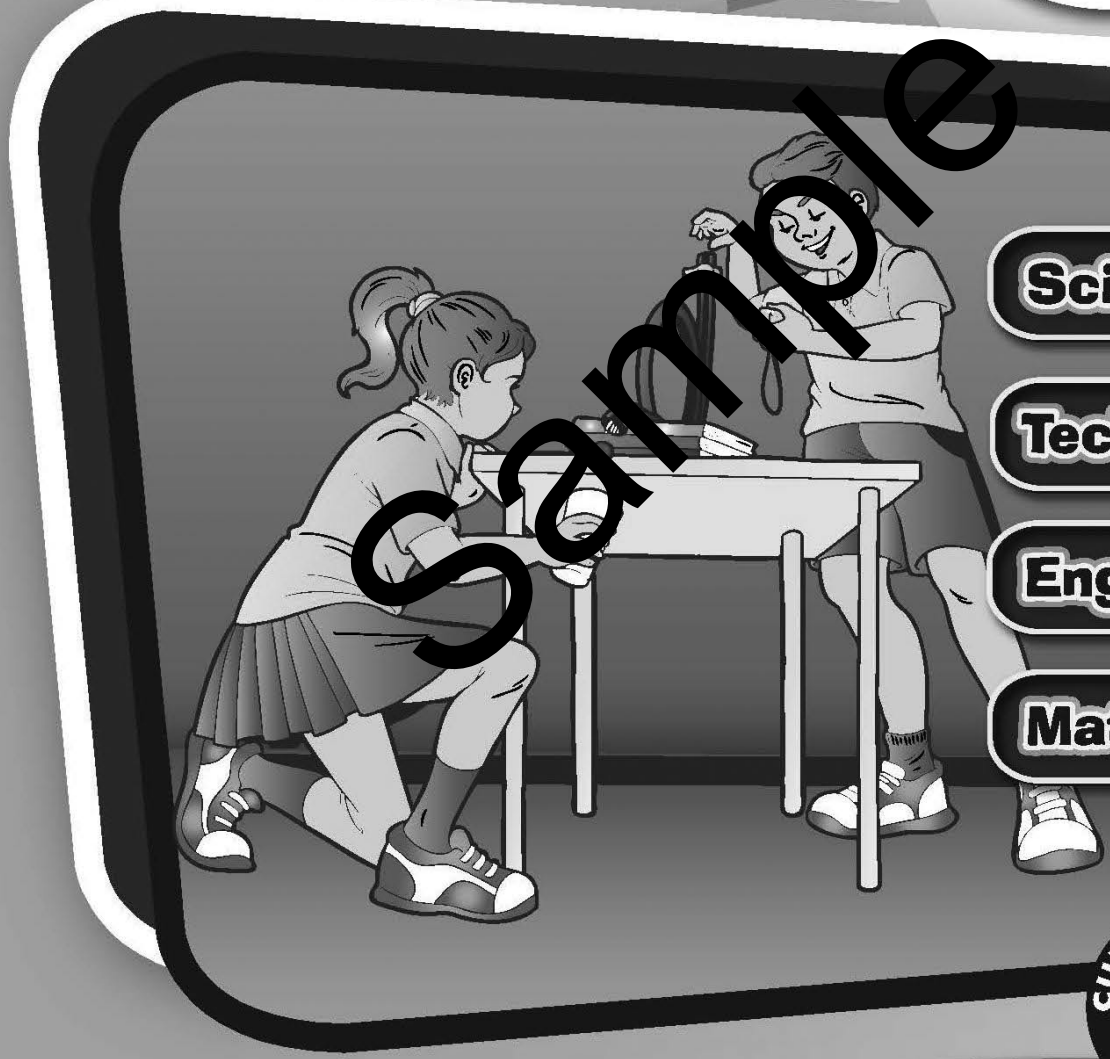
Ready-Ed Publications

PRIMARY LEVELS
Year 4 - Year 5

PHOTOCOPY MASTERS

STEM

Book 1



- Science
- Technology
- Engineering
- Maths

CURRICULUM LINKED

By Leonie Westenberg

Contents

Teachers' Notes

The Australian government's initiative to foster STEM education in schools is aimed at 'ensuring [that] Australia's young adults are equipped with the necessary skills for the economy of the future' (Australian Government, Department of Education and Training, December 2015). Programmes targeted by the STEM initiative include inquiry-based learning and teaching in mathematics education and the introduction of coding activities in ICT across all year levels of Australian schools (DET, 2015).

This book provides classroom teachers with the means to approach both the targets of inquiry-based mathematics learning and the introduction of coding, alongside science inquiry skills and content, use of engineering processes, and design and digital technologies. The activity sheets also emphasise literacy skills, given that the Australian curriculum defines literacy as one of the General Capabilities across all curriculum areas, noting that, 'Success in any learning area depends on being able to use the significant, identifiable and distinctive literacy that is important for learning and representative of the content of that learning area' (AC, v. 8.3, Literacy, Introduction).

Section 1: How Roller-Coasters Work includes activities that enhance students' knowledge in the physical sciences with inquiries that facilitate problem solving skills and the production of text, diagrams, and designs. Students predict, question, analyse and evaluate results to design experiments and test hypotheses concerning energy, gravity and friction. The activity sheets encourage collaborative work with partners or in small groups, facilitating deep learning and knowledge (ACARA, 'The shape of the Australian curriculum', May 2013). Photocopiable sheets provide guided progressive questions to develop skills in mathematical problem solving, digital technologies, and design capabilities, within an interdisciplinary approach that also incorporates Arts and English (known as STEAM). Students are asked to present their work in a variety of forms, using technology, literacy and numeracy skills and art and design. Communication literacies are encouraged through reports, persuasive speech, video presentations and blogging or vlogging.

Section 2: Design And Make Your Own Roller-Coaster focuses on group work in design technologies. Students are guided through the process of applying scientific, mathematical and technological skills to create a model of a roller-coaster. While this section furthers independent work in small groups, formative assessment tasks are provided to allow for peer and teacher evaluation throughout the learning project. A summative assessment task during the project has provision for self, peer and teacher feedback.

Section 3: Virtual Roller-Coasters And Coding introduces students to programming and coding. Students make use of online technologies to design and advertise roller-coaster and amusement park rides. Activity sheets present an introduction to computer programming and ASCII. These inquiry-based activity pages introduce students to traditional, contemporary and emerging technologies (Australian Curriculum, Technologies, v 8.3).

Section 4: The History Of Amusement Parks encourages students to use skills in English and in Technologies to understand the intersection of technologies and innovation in the past, in the present, and in the future. Students are asked to research, prepare and present a speech. In addition, students explore emerging technologies and create animations of their own, building skills in innovative and critical thinking and in design and digital technologies.

Parts Of A Roller-Coaster – Page 12

Suggested Extra Activity

Students can find online examples of amusement park rides from across the world. They should select three to four images of rides they would like to have a go on. Students could prepare a PowerPoint presentation using these images. The PowerPoint might explain where the rides are located, how they think the rides move, and what the different parts of the rides are called. Students to share the presentation with a small group or the whole class.

Curriculum Focus

ENGLISH

Clarify understanding of content as it unfolds in formal and informal situations, connecting ideas to students' own experiences and present and justify a point of view (Year 5: ACELY1699)

SCIENCE

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (Year 5: ACSIS093)

- Elaboration: using labelled diagrams, including cross-sectional representations, to communicate ideas

Potential And Kinetic Energy 1 - Page 13

Suggested Answers

3. Potential energy: A rock on a cliff; a person sitting at the top of a slide; two batteries inside a torch or digital clock; the food we eat; the spring of a catapult.
Kinetic energy: a moving aeroplane in the air; a car travelling down a hill; a skateboard going down a ramp; a ball travelling through the air or rolling on the ground.

4.a. The greatest potential energy would be at the top of the first and highest hill.
b. Kinetic energy would be most available in the hills and down the slopes.

Curriculum Focus

SCIENCE

Forces can be exerted by one object on another through direct contact or from a distance (Year 4: ACSSU076)

- Elaborations: Observing qualitatively how speed is affected by the size of a force; Exploring how non-contact forces are similar to contact forces in terms of objects pushing and pulling another object; Comparing and contrasting the effect of friction on different surfaces, such as tyres and shoes on a range of surfaces; Investigating the effect of forces on the behaviour of an object through actions such as throwing, dropping, bouncing and rolling

Compare results with predictions, suggesting possible reasons for findings (Year 4: ACSIS216)

- Elaborations: Discussing how well predictions matched results from an investigation and proposing reasons for findings; Comparing, in small groups, proposed reasons for findings and explaining their reasoning

MATHS

Use simple scales, legends and directions to interpret information contained in basic maps (Year 4: ACMMG090)

- Elaborations: Identifying the scale used on maps and describing the difference; Using directions to find features on a map

Potential And Kinetic Energy 2 - Page 14

Suggested Answers

Which part of the process represents potential energy? Step 7
Which part of the process represents kinetic energy? Step 8

Parts Of A Roller-Coaster

ACTIVITY

Have you ever been to an amusement park? Maybe you have been to Movie World; Wet and Wild; Sea World; the Royal Agricultural Show or to a local fair or fete. At amusement parks there are usually a lot of rides that members of the public can pay to go on. These rides might include: a Ferris wheel, merry-go-round, carousel or roller-coaster.

1. Write in the space below what rides you have been on. If you haven't been on any, write down rides that you have seen or know.

2. Study the picture of the roller-coaster below. A roller-coaster is a popular amusement park ride. You may have been on one. Have a go at labelling this roller-coaster using the words provided. Use a pencil and ruler to do this. Draw arrows to show the direction in which you think the ride moves.

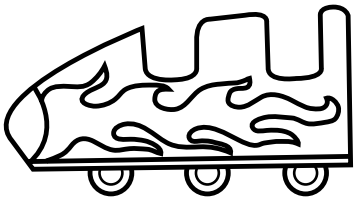
- cars
- track
- starting point
- end point
- highest point
- lowest point
- ramp
- downward slope
- upward slope
- rider
- fastest part of the ride
- slowest part of the ride
- brakes

3. Pair-up. Compare and discuss your labelled diagrams. Use an eraser to make any changes.

Potential And Kinetic Energy 1

ACTIVITY

Have you ever thought about how amusement park rides actually move? Or do you just climb aboard and enjoy the ride? Let's consider movement in a bit more detail.



1. Read the information about potential and kinetic energy.

> Potential energy is stored energy, like the energy in the elastic when you pull back on an elastic band. Kinetic energy is moving energy, like the energy that moves the band forward when you let go of the elastic.

2. In pairs use an elastic band to demonstrate potential and kinetic energy.

3. Can you think of any other everyday objects that you can use to demonstrate these two different energy types? Brainstorm your ideas in groups and jot down your thoughts below.

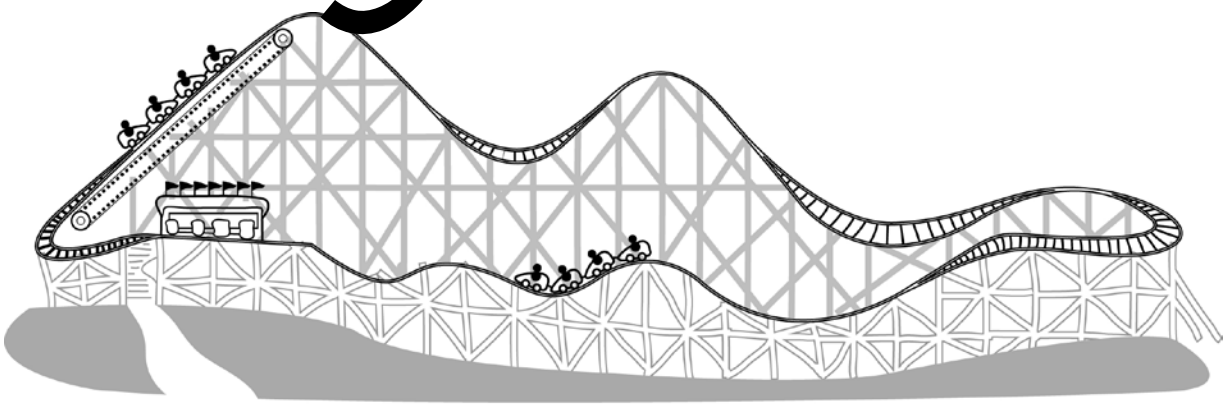
KINETIC ENERGY	POTENTIAL ENERGY
	

4. Mark and label the roller-coaster diagram below:

a. where you think the **greatest amount of potential energy** would be;

b. where you think this potential energy would be **converted into kinetic energy**.

Remember to use a ruler and a pencil to do this.



5. Pair-up. Compare and discuss your labelled diagrams. Use an eraser to make any changes.

Design Your Own Ride 1 - Page 30

Suggested Answers

1. a) The top of the hill has the highest potential energy so the roller-coaster can go faster down the other side of the hill, using kinetic energy.
1. b) When the roller-coaster climbs hills it has friction but when it goes down hills, it uses its stored energy to work with gravity. The top of the hill has the most stored energy, the bottom of the hill has used gravity and kinetic energy to move fast.

2. accelerate: to move more quickly
decelerate: to reduce speed or slow down
gravity: the natural force that causes things to fall towards THE EARTH
force: the strength or energy of physical movement or action
potential energy: the energy stored in an object
kinetic energy: moving energy or the energy of a moving object
speed: the pace at which something moves
friction: the resistance when two or more objects meet or connect

Curriculum Focus

TECHNOLOGIES

Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques (Year 4: ACTDEP01)

Investigate how forces and the properties of materials affect the behaviour of a product or system (Year 4: ACTDEK011)

- Elaborations: Conducting investigations to understand the characteristics and properties of materials and forces that may affect the behaviour and performance of a product or system; Deconstructing a product or system to identify how motion and forces affect behaviour; Identifying and exploring properties and construction relationships of an engineered product or system, for example a structure that floats, a bridge to carry a load; Experimenting with available local materials, tools and equipment to solve problems requiring forces

SCIENCE

Forces can be exerted by one object on another through direct contact or from a distance (Year 4: ACSSU076)

- Elaborations: Observing qualitatively how speed is affected by the size of a force; Comparing and contrasting the effect of friction on different surfaces; Investigating the effect of forces on the behaviour of an object

Design Your Own Ride 2 & 3 - Pages 31 and 32

Curriculum Focus

TECHNOLOGIES

Recognise the role of people in design and technologies occupations and explore factors, including sustainability that impact on the design of products, services and environments to meet community needs (Year 4: ACTDEK010)

- Elaboration: Investigating materials, components, tools and equipment, including by using digital technologies, to discover their characteristics and properties

Investigate how forces and the properties of materials affect the behaviour of a product or system (Year 4: ACTDEK011)

- Elaborations: Conducting investigations to understand the characteristics and properties of materials and forces that may affect the behaviour and performance of a product or system; Deconstructing a product or system to identify how motion and forces affect behaviour; Identifying and exploring properties and construction relationships of an engineered product or system, for example a structure that floats, a bridge to carry a load; Experimenting with available local materials, tools and equipment to solve problems requiring forces

Design Your Own Ride 1

ACTIVITY

Your group is going to design a roller-coaster. Later, you will make a model of your group's design.

1. When designing your roller-coaster, think about the physics' principles you have covered so far.

a. Remember: The top of your first hill must be the highest point on the roller coaster. Why?

_____

_____

b. Your cars will move fastest at the bottom of hills and the slowest at the tops of hills. Why?

_____

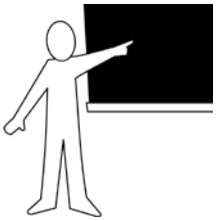
_____

2. Complete this physics' glossary by writing a definition for each term. Use an online dictionary or encyclopaedia to help you.

accelerate:	
decelerate:	
gravity:	
force:	
potential energy:	
kinetic energy:	
speed:	
friction:	

Extra Activity

Make an infograph or infochart explaining and illustrating some of the terms above. Share these with the class or share on a class blog. Use a free online tool such as Piktochart, Vengage or Google Chart Developer (or something similar) to create your information graphic.



Program Writing 1 – Page 41

Suggested Extra Activity

Students should try to draw a more complicated maze, adding a diagonal line or a curve. They may have to use different words and symbols for their instructions, e.g. Move across 3 squares until you hit a wall.

Curriculum Focus

TECHNOLOGIES

Define simple problems, and describe and follow a sequence of steps and decisions (algorithms) needed to solve them (Year 4: ACTDIP010)

- Elaborations: Describing, using drawings, pictures and text, the sequence of steps and decisions in a solution, for example to show the order of events in a game and the decisions that a player must make; Experimenting with different ways of describing a set of instructions, for example writing two versions of the same simple set of instructions for a programmable robotic device; Explaining to others how to follow technical instructions

Explain how student solutions and existing information systems meet common personal, school or community needs (Year 4: ACTDIP012)

- Elaborations: Investigating how information systems are used in communities and explaining what needs are being met; Testing the adequacy of student solutions

Plan, create and communicate ideas and information independently and with others (Year 4: ACTDIP013)

Program Writing 2 – Page 42

Suggested Extra Activity

Swap programs with another group. Can your group follow another group's program without crashing? Can the other group follow your program without crashing?

Curriculum Focus

TECHNOLOGIES

Define simple problems, and describe and follow a sequence of steps and decisions (algorithms) needed to solve them (Year 4: ACTDIP010)

- Elaborations: Describing, using drawings, pictures and text, the sequence of steps and decisions in a solution, for example to show the order of events in a game and the decisions that a player must make; Experimenting with different ways of describing a set of instructions, for example writing two versions of the same simple set of instructions for a programmable robotic device; Explaining to others how to follow technical instructions

Explain how student solutions and existing information systems meet common personal, school or community needs (Year 4: ACTDIP012)

- Elaborations: Investigating how information systems are used in communities and explaining what needs are being met; Testing the adequacy of student solutions

Plan, create and communicate ideas and information independently and with others (Year 4: ACTDIP013)

Coding: Binary Code and ASCII 1 & 2– Pages 43-44

Extra Activity

Choose different coloured beads - one colour to represent 0, another colour to represent 1, a different colour for the delimiter. Try coding your surname or the name of your favourite sports team.

Curriculum Focus

TECHNOLOGIES

Define simple problems, and describe and follow a sequence of steps and decisions (algorithms)

Program Writing 2

ACTIVITY

Now you have tried writing a program for a maze, your small group will write a program for the path of a roller-coaster.

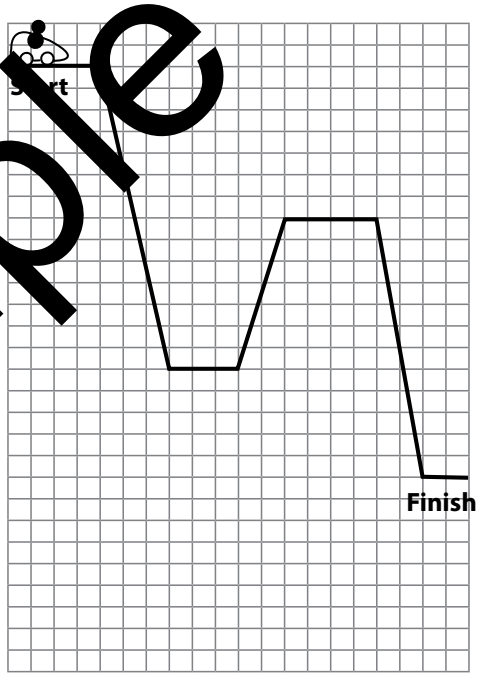
You will repeat the activity from the previous page but this time:

- you will work in a small group;
- the diagram on the graph paper will follow the path of a roller-coaster.

You will need:

- graph paper
- ruler
- pencil
- eraser

Steps



1. Using your ruler if needed, draw the path of a roller coaster on the graph paper.
2. Copy your roller-coaster plan onto the grid on the paper. See the example to help you.
3. Mark a START and FINISH point.
4. Write instructions (a program) on how to go from the START to the FINISH, e.g. Move in a diagonal line up to the 4th square. Move across 4 squares. Move diagonally across 3 squares and down 14 squares. You can use arrows as well as words. Instead of saying move up 4 squares write: ↑4.
   Or instead of saying go forward 1 square write: →1. At the end write: Stop.
5. Try to follow the instructions (program) to move along the path of your roller-coaster. Did you crash?
6. Did you have any bugs? Rub out any mistakes and re-do this part of the program. This is called *re-writing your program*.
7. When you have finished debugging the program, retry the path.

Questions

i. Did you crash?

_____

ii. Did you have any bugs?

_____