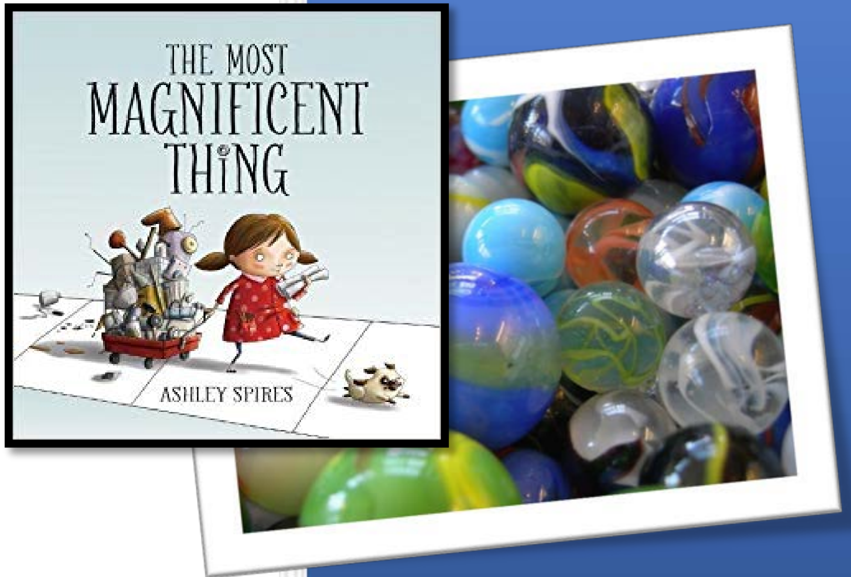
'The Most Magnificent Thing' – STEM Program

A STEM Challenge based on the picture book *'The Most Magnificent Thing'* by Ashley Spires

RIVERINA EEC
Mawang Yalbilinya



Riverina Environmental Education Centre
Stem and Storybooks 2018

The Most Magnificent Thing – STEM PROGRAM

BIG IDEAS:

- A force is an external influence that can change the motion, direction or shape of objects.
- Examples of forces include pushes, pulls, friction, gravity and magnetism.
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KEY INQUIRY QUESTIONS:

- What factors influence how a marble rolls down a marble maze? What can we change to make it go faster or slower?
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- In what ways does a design process allow us to make a better design?
- How do we measure the success of our marble maze/run?

Cross Curricular Outcomes – SCIENCE AND TECHNOLOGY

	1. Introduction – transfer of energy	2. Teacher Reading – *The Most Magnificent Thing*	3. Overview of Key Inquiry Questions and Design Brief	4. Modelled example – Rube Goldberg Machine	5. Design, Construction	6. Testing and Modification	7. iPad Documentary	8. Peer Assessment
SKILLS								
ST2-1WS-S questions, plans and conducts scientific investigations, collects and summarises data and communicates using scientific representations			✓	✓	✓	✓	✓	
ST2-2DP-T selects and uses materials, tools and equipment to develop solutions for a need or opportunity			✓	✓	✓	✓	✓	✓
ST2-3DP-T defines problems, describes and follows algorithms to develop solutions			✓		✓	✓		✓
KNOWLEDGE AND UNDERSTANDING								
ST2-9PW-ST describes how contact and non-contact forces affect an object's motion	✓			✓			✓	

<u>WORKING SCIENTIFICALLY SKILLS</u>								
Planning and Conducting Investigations • plan scientific investigations with guidance			✓	✓				
• conduct scientific investigations to find answers to questions			✓	✓	✓	✓	✓	
• use appropriate materials and equipment safely (ACSIS054, ACSIS065)					✓		✓	
• consider and apply the elements of fair tests			✓					✓
• collect and record accurate, honest observations using labelled observational drawings, basic formal measurements and digital technologies as appropriate (ACSIS055, ACSIS066)						✓	✓	✓
• participate individually and collaboratively with clear roles and goals					✓	✓	✓	✓
Processing and Analysing Data								
• compare results with predictions						✓		✓
• suggest possible reasons for findings (ACSIS215, ACSIS216)						✓	✓	✓
Communicating • represent and communicate observations, ideas and findings, using formal and informal representations (ACSIS060, ACSIS071)							✓	✓
<u>DESIGN AND PRODUCTION SKILLS</u> *Identifying and Defining*								
• critique needs or opportunities for designing solutions through evaluating products and processes			✓					✓
• consider potential resources in defining design needs and opportunities					✓			
• investigate and research materials, components, tools and techniques to produce design solutions (ACTDEP014)				✓	✓			
• define simple problems by determining and defining a process				✓				
• develop a sequence of steps and decisions (algorithms) to solve a problem (ACTDIP010)				✓	✓	✓		
Producing and Implementing								
• select appropriate tools for a specific purpose					✓	✓	✓	
• select and effectively manipulate appropriate materials for a specific purpose					✓	✓	✓	

• use safe work practices				✓	✓	✓	✓	
• consider sustainability and constraints when choosing resources and managing time in the production of designed solutions (ACTDEP016)			✓		✓			
• organise and perform strategic roles within a group to solve a problem					✓	✓	✓	✓
• collect, access and present data, using software to present and communicate information and solve problems (ACTDIP009)							✓	✓
Testing and Evaluating								
• develop a set of criteria for success with guidance, based on defined needs and opportunities			✓					✓
• develop criteria to evaluate the environmental impact of a design with guidance			✓					✓
• devise a fair process to test a designed solution with guidance						✓	✓	
• evaluate design ideas, processes and solutions, based on criteria for success (ACTDEP017)			✓				✓	✓
THINKING SKILLS **Design thinking – DesT** Design thinking is a process where a need or opportunity is identified and a design solution is developed. The consideration of economic, environmental and social impacts that result from designed solutions are core to design thinking. Design thinking methods can be used when trying to understand a problem, generate ideas and refine a design based on evaluation and testing.			✓	✓	✓	✓	✓	
Scientific thinking – SciT Scientific thinking is purposeful thinking that has the objective to enhance knowledge. A scientific thinker raises questions and problems, observes and gathers data, draws conclusions based on evidence, tests conclusions, thinks with an open mind and communicates research findings appropriately.	✓	✓	✓	✓	✓	✓	✓	✓

Cross Curricular Outcomes – MATHEMATICS

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MA2-1WM uses appropriate terminology to describe, and symbols to represent mathematical ideas			✓	✓	✓	✓	✓	✓
MA2-3WM checks the accuracy of a statement and explains the reasoning used			✓		✓	✓	✓	✓
MA2-9MG measures, records, compares and estimates lengths, distances and perimeters in metres, centimetres and millimetres, and measures, compares and records temperatures *Measure, order and compare objects using familiar metric units of length* (ACMMG061) *Use scaled instruments to measure and compare lengths* (ACMMG084) • record lengths and distances using metres and centimetres, eg 1 m 25 cm					✓	✓		
• estimate lengths and distances using metres and centimetres and check by measuring					✓	✓		
• estimate lengths to the nearest millimetre and check by measuring					✓	✓		

• select and use an appropriate device to measure lengths and distances (Problem Solving)					✓	✓		
• select and use an appropriate unit to estimate, measure and compare lengths and distances					✓	✓		
MA2-14MG makes, compares, sketches and names three-dimensional objects, including prisms, pyramids, cylinders, cones and spheres and describes their features *Make models of three-dimensional objects and describe key features (ACMMG063)* • recognise and describe the use of three-dimensional objects in a variety of contexts, eg buildings, packaging (Communicating)				✓	✓	✓	✓	✓
• describe and compare curved surfaces and flat surfaces of cylinders, cones and spheres, and faces, edges and vertices of prisms (including cubes) and pyramids				✓	✓	✓		
• describe similarities and differences between prisms (including cubes), pyramids, cylinders, cones and spheres (Communicating)				✓	✓	✓		
• deconstruct everyday packages that are prisms (including cubes) to create nets, eg cut up tissue boxes				✓	✓	✓		
• recognise that a net requires each face to be connected to at least one other face (Reasoning)				✓	✓	✓		
• Investigate and represent three-dimensional objects using drawings					✓			
• investigate types of three-dimensional objects used in commercial packaging and give reasons for some being more commonly used (Communicating, Reasoning)				✓	✓	✓		
• sketch prisms (including cubes), pyramids, cylinders and cones, attempting to show depth					✓			
• compare their own drawings of three-dimensional objects with other drawings and photographs of three-dimensional objects (Reasoning)					✓	✓	✓	✓

CRITICAL AND CREATIVE THINKING LEARNING CONTINUUM (ACARA)

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Inquiring – identifying, exploring and organising information and ideas element								
• pose questions to expand their knowledge about the world	✓	✓	✓	✓				✓
• identify main ideas and select and clarify information from a range of sources	✓	✓	✓	✓	✓	✓	✓	✓
• collect, compare and categorise facts and opinions found in a widening range of sources			✓	✓	✓	✓	✓	✓
Generating ideas, possibilities and actions element								
• expand on known ideas to create new and imaginative combinations		✓			✓			
• explore situations using creative thinking strategies to propose a range of alternatives				✓	✓	✓	✓	
• experiment with a range of options when seeking solutions and putting ideas into action				✓	✓	✓		
Reflecting on thinking and processes element								
• reflect on, explain and check the processes used to come to conclusions			✓	✓	✓	✓	✓	✓
• identify pertinent information in an investigation and separate into smaller parts or ideas			✓	✓	✓	✓	✓	✓
• transfer and apply information in one setting to enrich another	✓	✓	✓	✓	✓	✓	✓	✓
Analysing, synthesising and evaluating reasoning and procedures element								
• identify and apply appropriate reasoning and thinking strategies for particular outcomes			✓		✓		✓	
• draw on prior knowledge use evidence when choosing a course of action or drawing a conclusion	✓		✓	✓	✓		✓	✓
• explain and justify ideas and outcomes	✓		✓		✓	✓	✓	✓

REEC Incursion – Program Outline

The Most Magnificent Thing – STEM and Story books

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Suggested Learning Experiences	Suggested Website Links for Learning	Language focus and resource list for collection	Suggested Teacher Resources
Setting the Scene • Discuss concept of STEM learning. What does STEM stand for? Why are schools focussing on activities that incorporate STEM key learning areas? ***Teacher Reading*** • Read 'The Most Magnificent Thing', by Ashley Spires. • Record the following headings on the smartboard / chart paper: Goal, Barrier, Strategy. As a class, record the main character's goal, barriers faced and strategies used to overcome them.	Rube Goldberg Machine ultimate example https://www.youtube.com/watch?v=QmOxqhEuBUM	centimetre, communicate, compare, design, direct contact force, direction, distance, engineer, error, evaluate, experiment, feedback, flat, force, friction, gravity, inquiry question, kinetic energy, horizontal, hypothesis, invention, length, magnetism, magnitude, measure, metre, millimetre, modify, non-contact force, observe, perimeter, plan, potential energy, predict, process, prototype, pull, push, ramp, recycle, refine, resourcing, 'Rube Goldberg machine',	***The Most Magnificent Thing***, by Ashley Spires 

Modelled Example – Rube Goldberg Machine

- Look at ‘Rube Goldberg Machine’ (YouTube link at right) that has obviously involved a great many man-hours in design, planning, and modification and testing. What was the goal, perceived barriers faced, and possible strategies that the inventor employed to make a successful ‘magnificent thing?’ Write these on the chart under the headings already created – Goal/Barrier/Strategy. Discuss the following questions in regards to this video:

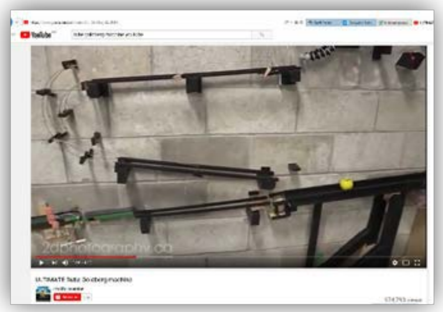
    - Which elements of the machine were the most impressive?
    - What parts of the machine would be a challenge to make?
    - What kinds of materials were used? Where could you find some of these resources?

- Can someone like you make a Rube Goldberg machine? Look at a student example (8th grade student video reference to right). Identify goal/barrier/strategies for this example.

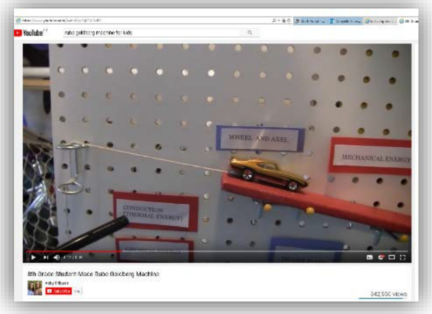
Transfer of Energy

- Discuss ‘transfer of energy’. Energy is needed to do ‘work’. In the first Rube Goldberg machine, we see examples of sound energy, heat energy, light energy, chemical energy and kinetic energy. (Kinetic energy is a more scientific name for movement energy). There are many different ways we see energy change its form. Use graphic posters to illustrate this.

- Complete ‘algorithms’ showing energy transformations; eg chemical energy stored in battery converts to electrical energy to power a torch, which transforms this to light and heat energy.



8th grade student made Rube Goldberg Machine
https://www.youtube.com/watch?v=3rjLPX-LcB8



scientist, technology, test, trial, unit, vertical

Resources from REEC

REEC will provide the following items for student use:

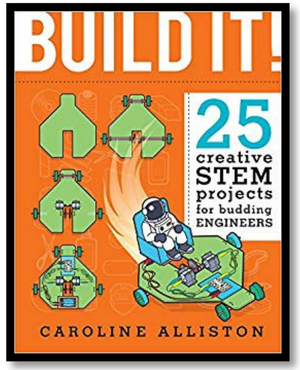
- ‘The Most Magnificent Thing’, (by Ashley Spires)
- Pegboard
- Alternative Energy kits
- Metal pegs
- Conduit and elbow joins
- Garden ties

Recycled and repurposed items to collect – (examples):

Bottles, cardboard, boxes of varying sizes, tape, glue, paperclips, paper cups, plastic utensils, scissors, bulldog clips, CDs, pencils, corks, balloons, straws, pipecleaners, polypipe, milk bottle lids, rulers, **marbles**, elastic bands, popsticks, paper bags, string, styrofoam meat trays, alfoil, cable ties, milk cartons, wooden skewers, cotton reels, cupcake liners, cotton tips, toothpicks, egg cartons, cores from alfoil/clingwrap/baking paper/paper towel, coffee filters, coffee pods (empty and clean), old toothbrushes,

Toys and games to collect – (examples):

dominoes, cards, matchbox cars, lego blocks and lego people, magnets, fidget spinners, broken toys, wheels,



Build It! 25 Creative STEM Projects for Budding Engineers, By Caroline Alliston

- P22-25 ‘Marble Run’.

Overview of Key Inquiry Questions and Design Brief

Discuss with students the **agreed parameters** of designing a marble run (their own 'magnificent thing'). When deciding these, teachers can ask questions to guide the discussion. Some examples might be:

- How many changes of direction will you need to include?
- How many different recycled/repurposed items will you need to use in your design?
- Will you need to include an extra 'obstacle' that the marble must pass through? Eg loop the loop, a corrugated surface, a 'jump', cogwheel, etc.
- A set time that the marble must exceed over its journey?

Once the agreed parameters are recorded for all to see, students can be introduced to the **'key inquiry questions'** for their project. These are:

- What factors influence how a marble rolls down a marble maze? What can we change to make it go faster or slower?
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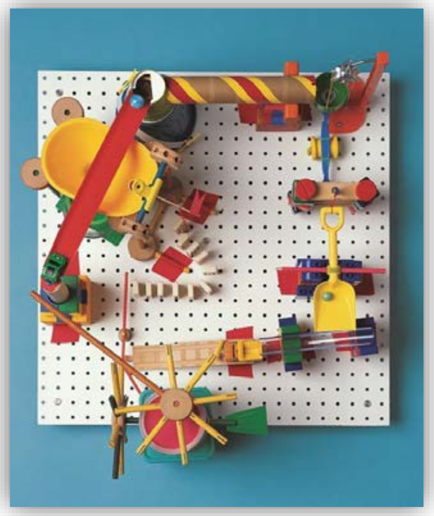
How do we measure the success of our marble maze/run?

Students are advised that they do not have to come up with the answers to these questions immediately. Rather, they should keep them in mind while they are in the planning and designing phase of their project. These questions will be revisited at the conclusion of the project when they have had



Peg board example

playdoh or plasticine, small dolls or action figures, train/car tracks, torches (+ batteries), cogs, party whistles, 'snap' wristbands, McDonald's toys, bouncy balls, loom bands, broken electronics, springs, old dollhouse furniture, old blocks

opportunity to plan, observe, modify, test and retest their marble run machine.

Planning phase

Students are offered a ‘bank’ of collected resources. These might include conduit tubes, paper rolls, elastic bands, paperclips, broken toys, plastics, playdoh or blutack, CDs, skewers, cable ties, etc... *(see list of collectable items on previous page)*

Students will need to break into 5 small groups. Each group will be given a piece of ‘pegboard’. This will act as the base for the marble run. All components added to the pegboard will need to be connected in some way so that a marble can ‘run’ from top to bottom whilst using abiding by the agreed parameters.

Once they are familiar with the resources available, they now need to show design planning before they embark on the building phase. Isometric dot paper and square dot paper is then made available to the students. They should be encouraged to use this to plan where the components should be placed on their pegboard. Make it clear that the design plan should be discussed with all group members, and the plan completed on paper before building takes place. All components used in the design should be clearly labelled.

Build it!

Using the plans drawn, students will create their own marble run. Following the building phase, students will be required to take an iPad and record a video of the processes used to create the marble run (including the plans drawn). This narration should also include

details of the desired path that the marble will take on its journey down the marble run. Only then, should the actual marble run be filmed.

A student reflection should be included at the end of the video. Students can verbalise which aspects of the project they found most challenging, which part of the project was most enjoyable and what roles each member of the group played. At the end of the video, students should review the key inquiry questions (again below), with their responses to each question:

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Evaluate it! Peer evaluation

Each of the iPad videos are viewed on the smartboard. Classmates should discuss whether the video viewed presented the following:

1. Use of drawn plan (and any modifications of marble run that differ from the original plan recorded)
2. Annotation of processes and resources used to create the marble run
3. Narration of preferred path taken for marble down marble run
4. Filming of marble run
5. Reflection of challenges faced, teamwork, roles played by individual team members
6. Responding to key inquiry questions
7. Marble run used agreed parameters