SparkLab, Sciencentre

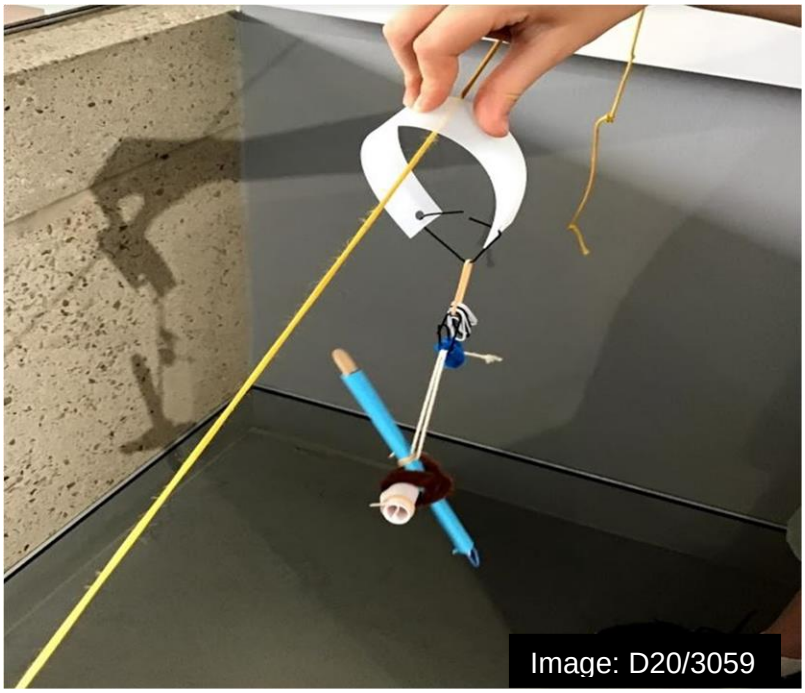
Maker Space: *Zip to it*

The Challenge

Make a device to safely transport a person or object, across tricky terrain, along a zip line. Test your design on a variety of zip lines of varying lengths, angles and materials.

Learning Outcomes

- Explore and build experimental understanding of forces such as gravity, friction, drag and momentum and how these forces affect the movement of your device down the zip line.
- Develop an understanding of the ways in which the physical properties of materials can effect the way an object behaves and how it can be used for design.
- Consider different real world scenarios in which the basic principles of a zip line could be applied. Who might need to use a zip line?
- Increase participant's understanding and confidence of the design and testing process; making a simple working prototype, observing areas of the design that need improvement, posing a new design solution, making a change and observing the impact of that change.
- Feel and recognise success in implementing creative solutions to real world challenges. Apply this approach in their everyday life.
- Express enjoyment in engaging in the design challenge and sharing ideas and understandings.
- Appreciate the importance of structural design and engineering in everyday life, with particular relevance to the safety and efficacy of a zip line transport system.
- Increased confidence in design skills, using creativity to overcome obstacles and ability to make a simple working prototype.



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Equipment

- Zip lines: smooth or rough, thick or thin cord/string
- Cargo items: variety of light-weight household items to use as pay loads i.e. dinosaur figurine, ping pong balls, toy cars, dolls.
- Scissors
- Staplers
- Hole punches

Design Materials

- Paper and thin card
- Re-purposed materials e.g.
  - Thin, flexible plastics i.e. vinyl, folder dividers
  - Small, hard plastics i.e. bottle lids, receipt tubes
- Paddle pop sticks
- String, rubber bands
- Pipe cleaners
- Masking tape
- Bulldog clips

Set-up steps

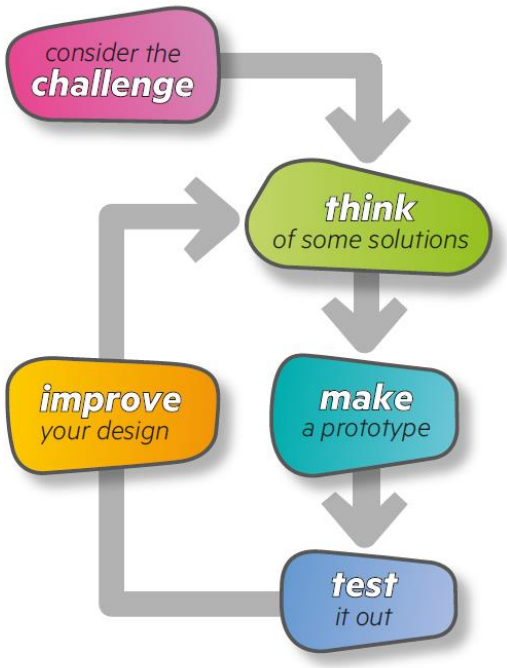
Create your zip line by securing the ends of the cord or string to two points at different heights. The zip line should be stretched tight.

Consider:

- safe and clear access routes
- strong and secure anchor points
- easily reached by all participants

Design Process

This activity follows a design process. Below are some of the questions that may help provide prompts at each stage of the process.



Think of some solutions

- What would you like to transport along a zip line?
- What size and shape is the item you will transport?
- What features will your prototype need to have?
- How will you keep your item safe?
- What are some real world examples that you have seen before?
- What ideas do you have for a design?

Make a prototype

- What materials will you use to attach your carrier to the zip line?
- How can you use the different properties of the materials in your own design?
- How will your carrier move along the zip line?
- What part of your design are you finding tricky to build?

Test it out

- Test out your design. For an added challenge try changing the angle of the zip line or using lines made from different materials.
- What did you observe during testing?
- Did your prototype move the way you expected? Did anything unexpected happen?
- How safely did your cargo travel?
- What part of your design worked really well?

Improve your design

- How could you improve on your design?
- What ideas could you incorporate from someone else's design? Talk to a friend or search online.
- What changes can you make?
- If you started again, what would you do differently? What would you do the same? Create a record of your design to guide future projects.

Background Science

Forces push or pull objects. There are lot of forces that we can notice when testing our zip line carriages! Gravity is the downward force which pulls our carriages towards the centre of the Earth. Friction between surfaces and drag from the air are forces that act in the opposite direction that an object is moving. The normal force is the force on the object from the surface it is sitting or travelling on and always acts in the direction perpendicular to the surface.

When the zip line carriage is stationary, or moving at a constant speed, all the forces acting on it are balanced. The push and pull of gravity, the normal force, friction and drag are even and so the carriage does not change speed. When the forces become unbalanced, such as when the angle of the zip line is increased, there is a greater force pushing the carried down the line and so it accelerates forward. Friction and drag forces oppose the forward motion, and when they become greater than the forces pushing the carrier forward it will decelerate and eventually stop. Changing the carrier design, total weight, and even zip line surface can change the amount of force required to get the carrier to move down the zip line.

Key Search Terms: Gravity: Frictional Force: Drag Force: Normal Force: Balance and Unbalanced forces.

Appendix

Links to Australian Curriculum

Science	F	1	2	3	4	5	6	7	8
Science Understanding Chemical Sciences		✓			✓				
Science Understanding Physical Sciences	✓		✓						✓
Science Understanding Earth and Space Sciences									
Science Understanding Biological Sciences									
Science as a Human Endeavour	✓	✓	✓	✓	✓	✓	✓	✓	✓
Science Enquiry Skills	✓	✓	✓	✓	✓	✓	✓	✓	✓

Design and Technologies	F	1	2	3	4	5	6	7	8
Knowledge and Understanding	✓	✓	✓	✓	✓	✓	✓	✓	✓
Processes and Production Skills	✓	✓	✓	✓	✓	✓	✓	✓	✓