

SparkLab, Sciencentre

Maker Space: *Slow it down*

The Challenge

Your cart is racing down a steep slope... how can you stop it from crashing? Design a cart that can slow down and stop before it reaches the end of the track. Test it by setting the cart at the top of a ramp and letting it go. Watch it move, and see how far from the end you can make it stop.

Learning Outcomes

- Gain an understanding that forces exerted on an object will change its speed and can speed it up or slow it down.
- Gain an understanding that there are different types of forces acting on us and the objects around us all the time, e.g. friction, drag, gravitational force, normal force and tension.
- Gain an understanding that the size, mass, shape, and other properties of an object will affect the way it moves.
- Build skills in manipulating different materials for a particular purpose, e.g. cutting, bending, threading, re-shaping, and attaching.
- Use skills of observation during testing to consider ways of improving design.
- Increase participant's understanding and confidence of the testing and design process; 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.
- Enjoy using creativity to build unique, personal cart designs.
- Express enjoyment in engaging in the challenge and sharing ideas and understandings.



Equipment

- Ramp or flat board (min 60cm long).
- Cushion
- Toy cars/carts with free-moving wheels
- Scissors
- Hole puncher
- Ruler or tape measure

Design Materials

- Paper and card
- Fabric
- Tissue paper
- Paper straws
- Paddle pop sticks
- Rubber bands
- Pipe cleaners
- String
- Masking tape
- Patty pans

Optional materials

Consider adding 'wildcard' items to your materials. These could include:

- Door stops
- Foam offcuts
- Additional weights
- Odds and ends

Set-up steps

1. Find an area for your testing track – this needs to be long and straight.
2. Secure your board or ramp at the end of the track at a 45° angle. Place the pillow at the other end of your track as a buffer.
3. Design and build your cart.
4. Get testing! Use the tape measure to find out how far from the end of the track your cart stopped.

Design process

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

Think of some solutions

- How does the cart move along the track?
- What sort of things might be slowing it down already?
- What do you notice about the surface of the track?
- What materials are available to you? How do they feel and what can they do?
- 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 slow your cart down?
- How and where will you attach your design to your cart?
- How can you use the different properties of the materials in your own design?
- What part of your design are you finding tricky to build?

Test it out

- Test your cart out by rolling it down the ramp. What did you observe?
- Did your cart stop before it reached the end of the track? How far did it travel?
- Did your cart do what you wanted it to do?
- Did anything unexpected happen when you tested your cart?
- What part of your design worked really well?

Improve your design

- How could you improve on your design?
- What would happen if you used different materials or added a new part?
- What would happen if you used a different base for your cart?
- What ideas could you incorporate from someone else's design? Talk to a friend or search online.
- What changes can you make? Test out your modified design.
- 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.
- Change the challenge by changing the surface of the track (carpet, artificial grass, vinyl) or by changing the angle of the ramp (30° or 60° angle). How will you modify your design to respond to these changes?

Background science

There are lots of different push and pull forces acting on objects all the time. When these forces are unbalanced, they cause changes in the object's movement.

When the cart is on the ramp, gravitational forces act on the cart and it accelerates towards the bottom of the ramp. As it moves along the track, other forces acting on the cart slow it down. These can include:

- **Friction:** Occurs between two surfaces sliding past each other. It opposes the direction of movement.
- **Drag/Air resistance:** A frictional force which occurs when an object moves through a fluid (air or liquid).
- **Tension:** A pull force along a cord, cable, or rope. Tension force acts along a line parallel to the rope.

Key Search Terms: Forces, inclined planes, air resistance, friction, tension force, gravity

