TOAST BITE

A wheel is a circular object that revolves on an axle. The axle is a cylindrical rod through the centre of the wheel. The wheel and axle are a type of simple machine that has been used for thousands of years. Technically it is actually just a lever formed in a circle! As with all simple machines, its purpose is to make a task easier for the user. This is called providing a mechanical advantage.

In EPISODE 1 - CRUMBS - we see Jiwi too interested in planning his rocket launcher to be bothered feeding himself breakfast. His toast is delivered to his mouth by a wheel and axle set in motion by another series of simple machines! The Toast Bite clip shows us some of Jiwi’s thinking as he went about perfecting his “toast delivery system”. This clip can help develop understanding of wheels and axles and also of investigating in science.

WHY WHEELS AND AXLES ARE USEFUL
The purpose of the wheel and axle (and all simple machines) is to make work easier. The purpose of a steering wheel on a car is to turn the wheels so the car can drive and take you where you want to go. The steering wheel is connected to a smaller rod or axle called the steering column. The steering column is connected to the car’s road tyres and axles by a series of cogs and connectors. It takes a lot of force to turn the car’s wheels left or right. You couldn’t do it on your own!
As you gently turn the steering wheel, the steering column turns with much more force, allowing the heavy tyres to be turned.

**THE WHEEL AND AXLE:** A circular object with a rod or shaft through its centre.

**BRAINSTORM:** Name some wheels and axles that you know. Record these.

**ACTIVITY 1:**
**WHEEL AND AXLE HUNT**  
(10 – 20 minutes + discussion time)

**DID YOU KNOW?**
- A door knob is an example of a wheel and axle. When the knob is turned an axle releases the door clasp.
- A screwdriver is another example of a wheel and axle. The handle rotates like a wheel and the shaft is the axle.

**CRITIQUE EVIDENCE**
- How sure are you of your method and results? How did you get the data? What were the possible short comings of this method? How many times was the experiment repeated? Would these results always be true?

**JIWI WONDERS**
- What other variables affect this machine?
- Are there other investigations that would perfect how this machine works? Try them.
- Wheels are revisited in EPISODE 3: THE WHEEL & AXLE.

**INVESTIGATION:**
**WHAT IS THE BEST BALL TO USE TO ACTIVATE THE TOAST DELIVERY MACHINE?**  
(1 hour)

**BIG SCIENCE IDEA:** A wheel turns around an axle and can be used to make work easier.

Can you recreate Jiwi’s toast delivery machine? Use some wrapping paper tubing, a paper cup, some pegs, masking tape, wire, a range of balls with different weights (eg: table tennis ball, squash ball, golf ball) and an upside down bicycle. There is a certain amount of trial and error necessary to get the toast delivery machine to balance and perform. It is not hard. Groups of two to four children should be able to make their own depending on their age.

Having created the toast delivery machine, now the investigation into the effect of a variety of balls can begin. What balls would you like to test? Why? What do you think will happen?

**Wrapping paper tube cut in half lengthways**
**Peg held open with a rubber band and wired to the wheel at the top**
**Cup masking taped to wheel**
**Peg taped to stop the toast hitting the ground**
**Screwdriver (or any object) as a weight to balance the cup in position at the top**
ACTIVITY 2: MAKE A WATER WHEEL
(20 minutes to 1 hour)

Using plastic plates, plastic cups, a round pencil and tape, make a water wheel to test outside.

The cups need to be taped to the plates in a relatively evenly-spaced way. If children are able, they can calculate and draw 5 equally spaced marks on each outer edge of each plate. \((360° \div 5 = 72°)\). This can be where the cup base is sellotaped. Here the base of each cup has been taped in position about half in and half out of the plates and the top of the cup is about 1/3 in, 2/3s out.

This water wheel was tested outside using a slowly running garden hose. You could equally well use a watering can, drink bottle or classroom tap to test this water wheel.

WARNING: water splashes far and wide! Would you like to test? Why? What do you think will happen?

JIWI WONDERS

💡 What other ways could a wheel & axle be made to turn without a person pushing it?

💡 What ways have people used a wheel & axle throughout history?

INVESTIGATION:

The steering wheel provides us with a MECHANICAL ADVANTAGE. Mechanical advantage means how much the machine multiplies the force you put into it. Have you ever had to try and open a door using just the axle when the doorknob has been taken off? It is very hard to do and requires a lot of force to turn. By putting the doorknob back on we increase the diameter of the wheel compared to its axle. It provides mechanical advantage and turns more easily. You can calculate the mechanical advantage by dividing the length of the effort arm (the part you turn) by the length of the axle. In most cases this means dividing the radius of the wheel by the radius of the axle.

In this door handle the axle radius is 1cm and the handle itself has a radius of 4cm. \(MA = \text{radius of handle} / \text{radius of axle} = 4 / 1 = 4\)

The door handle gives us a mechanical advantage of 4.

This is a ratio and has no units. The larger the wheel is compared to the axle, the greater the mechanical advantage it provides. Relate this to a car steering wheel and compare to the size of a yacht’s steering wheel / helm.

In reality there will always be some loss to this advantage due to friction.
### NZ CURRICULUM PLANNING SUMMARY

<table>
<thead>
<tr>
<th>Contextual Achievement Objective:</th>
<th>Nature of Science Achievement Objective:</th>
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<tbody>
<tr>
<td>PHYSICAL WORLD: Explore and investigate physical phenomena in everyday situations.</td>
<td>INVESTIGATING IN SCIENCE: Carry out science investigations using a variety of approaches: exploring, making things, pattern seeking and fair testing.</td>
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<tr>
<th>Big Science Idea:</th>
<th>Big Nature of Science Idea:</th>
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<tr>
<td>A wheel turns around an axle and can be used to make work easier.</td>
<td>In science, to get useful results, investigations need to be “fair”.</td>
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<th>Weblinks:</th>
<th>Capability focus:</th>
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### MATHS ACTIVITY 1

**Investigation**

- Wrapping paper tubes
- Paper cup
- Spring peg
- Masking tape
- Wire
- Counterweight (e.g., screwdriver)
- Range of balls

**MATERIALS**

- Pen
- Paper

### MATHS ACTIVITY 2

**Investigation**

- Plastic plates
- Plastic cups
- Tape (e.g., cellotape)
- Round pencil
t- Source of water

**MATERIALS**

- Plastic plates
- Plastic cups
- Tape (e.g., cellotape)
- Round pencil