3. Crush the can

2 hours

Children investigate the force of up thrust in different liquids and link it to a recycling process where materials are sorted in flotation tanks containing liquids of various densities.

OBJECTIVES

- To understand that different shapes affect the strength of an object
- To devise and carry out an investigation to test the most efficient way of crushing a can
- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs

RESOURCES

(Per group of 4 children unless otherwise stated)

- Activity sheets 5 , 10 and 11
- Three empty fizzy drinks cans for the whole class
- Wooden board
- 3 cardboard tubes (made from 3 pieces of A4 strong enough to support 40g.
- 0-20 Newton Push-meter (available from TTS) or 10 x 100g weights.)

INTRODUCING THE ACTIVITY

Look back at the e-mail (Activity sheet 5) and explain that once sorted, the waste needs to be crushed and baled ready to be transported to the recycling plant. The aim of this activity is to find an efficient way to crush cans. Ask the children to discuss what might affect the efficiency of crushing cans (e.g. the amount of force on the can, or the position and direction of the force used).

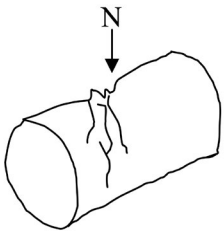
In this activity the children will test the strength of the cylindrical shape using card.

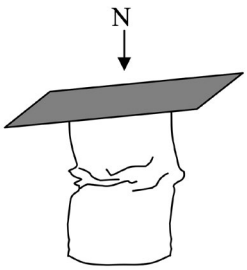
MAIN ACTIVITY

Ask the children to create three identical open-ended cylinders out of A4 card (to represent the cans). Alternatively, they could use the cardboard cylinders from the inside of kitchen rolls.

Each group begins by thinking about the question they are trying to answer. Examples of this could be:

- Is it easier to crush a can from the top or from the sides?
- Does applying a force in two places cause the can to crush more easily?
- Do we need more force to crush the cylinder from the sides or from the top?





The chosen question is then added to Activity sheet 10 and the process of planning the investigation is recorded so that the children think carefully about what they are going to do and why. Any diagrams required can be drawn on the reverse of the sheet.

A prediction is made before the investigation is carried out. The children suggest the most likely answer to the question that they have posed and give reasons to support their claims.

Each group investigates the force needed to crush the cylinder from the top by standing it upright, placing a piece of card on the top and applying a force using the push-meter, or by adding 100g weights one at a time. Each 100g weight applies a force of 1N. The force needed to crush the cylinder can be read just before the cylinder collapses. (One child reading the values out loud until the collapse point will enable the correct reading to be identified.) The children record their results in the table on Activity sheet 11.

They repeat the investigation on the side of the cylinder and record their results.

They could repeat the investigation a final time, but this time applying a force on the top and the sides simultaneously. One child could place the weights on top while the other pushes in at the sides using the push meter.

Collect each group's results in a table on the board and find the mean average. Discuss the fact that collecting repeated results makes the investigation more reliable.

The children could draw a series of force diagrams to show the direction of forces they applied to the cylinders, representing the magnitude by the size of the arrows.

Safety note

Care should be taken that the weights do not fall onto children's hands.

PLENARY

Discuss the findings. Ask questions such as:

- Which direction of force will crush the shape best?
- Where would you apply the force to crush cans or plastic bottles?

Demonstrate an experiment which applies their findings. Use three empty fizzy drinks cans. Place a wooden board on top of each can in turn (balanced or propped up by a volunteer) and begin to add weights. Find out the direction of the force which crushes the can most easily (vertical, horizontal and vertical with additional force on the sides).

Ask:

- Does it match the results of the cardboard cylinder experiment?
- What difference does having top and bottom ends to the can make?

Compare empty fizzy drinks cans with empty food cans: fizzy drinks cans are thinner and more flexible/crushable, whereas food cans are more rigid and stronger. You may want to discuss the reasons for the differences, their comparable costs, their implications for recycling and the forces needed to crush the cans. Food cans are often made of steel and use more material , which will affect cost of production, but also the force needed to crush them. They are more rigid than drinks cans and therefore can be stacked for storage.

Drinks cans can also be stacked for storage.

Ask the children:

- Where do the drinks cans get their added strength from?

The gas inside pushes outwards, making the cans more rigid.

You could ask the children to draw force diagrams showing the forces in a pile of drinks cans and a pile of food cans. Explain the dangers of testing the strengths of full fizzy cans. The pressure of carbon dioxide gas being exerted on the can from the inside could cause an explosion if the can was put under external pressure.

Safety note

Cans containing fizzy drinks are pressurised and may explode.

EXTENSION ACTIVITIES

The children could visit the Novelis Alcan website (https://thinkcans.net/) to explore the next part of the process: shredding and purification. They could visit the SCRIB website (http://www.scrib.org.uk/) to find out about the recycling of steel cans.