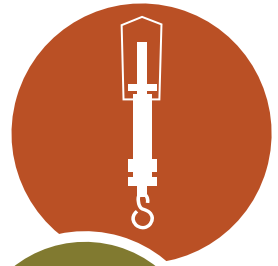
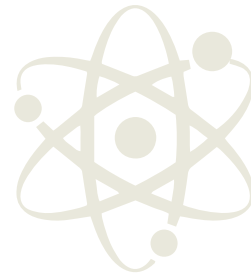




making physics matter



Age
9-11
years

Phizzi practical

Investigating gears

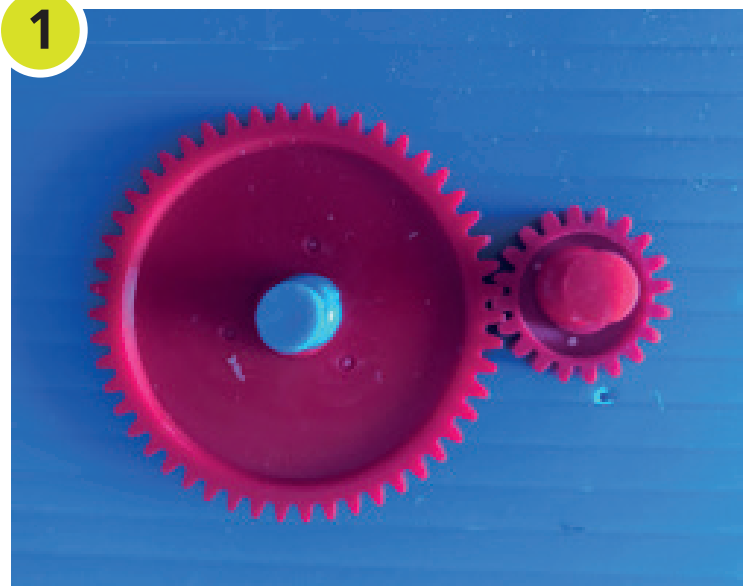
Introduction

Machines are devices that change the direction or size of a force. There are six types of simple machines: wheels, ramps, wedges, levers, screws and pulleys. Most simple machines reduce the force you need to apply to lift or move a heavy object by making the distance over which you apply the force larger than the distance the object moves. Gears are an example of a wheel and axle. Each wheel has teeth that can interlock with the teeth on another wheel to create a gear that turns on an axle. Gears are simple machines that can transmit forces from one place to another and increase the size of a force.

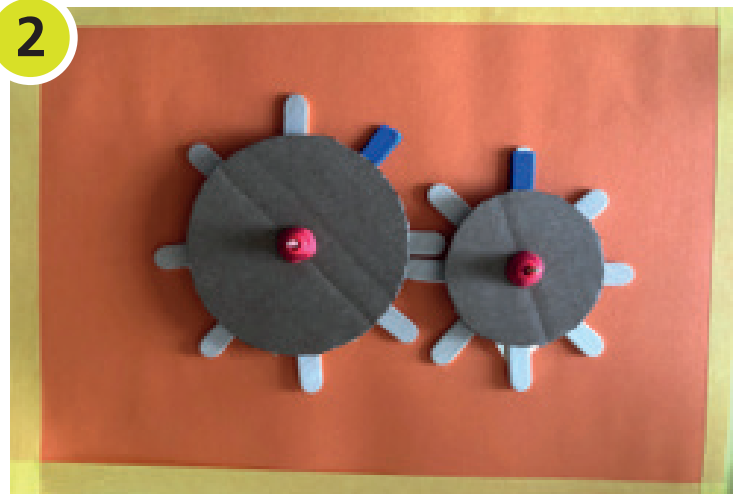
Scientific explanation

Gears come in different sizes and can have different numbers of teeth. The teeth on the gears mesh together so that the teeth of one gear lock into the teeth of another, preventing them from slipping. As one gear is turned, it transmits a force to the gear it is locked to, causing it to turn in the opposite direction. If two connected gears are of different sizes, they can increase the size of the turning force. A smaller gear will turn rapidly with less force, whereas a larger gear will turn more slowly with a greater force. For example, if a child applies a turning force to a gear with 20 teeth which is connected to a gear with 10 teeth, the second, smaller gear will make two complete revolutions for every revolution that the larger gear makes.

1



2



Equipment needed

- Stiff cardboard (recycled boxes)
- Lolly sticks
- Scissors or craft knife
- Sellotape or PVA glue
- Compass and pencil
- Protractor
- Ruler
- Paper
- Cocktail sticks (one end blunted for safety)
- Plasticine
- Beads

Method

1. Children use a compass to draw two circles of different sizes on to the stiff cardboard and then cut them out with scissors or a craft knife (adult supervision required). A cocktail stick can be pushed through the centre to create a hole for the axle.
2. Next, they draw and cut out two paper circles of identical size.
3. With adult assistance, the children cut 16 lengths of wooden lolly stick at 4cm each.
4. The children use PVA glue to stick the lolly stick lengths around the circle (image 3). These will be the teeth on the gear. They need to be evenly spaced and in line with each other.
5. The paper circle is stuck over the top of the lolly stick lengths to help hold them securely in place. The glue is left to dry.
6. The children can colour one of the teeth on each gear with pens or tape – this will help with counting the number of rotations once they start investigating.
7. The children should then cover a large rectangle of cardboard with coloured paper to form the base that the gears will be pinned to.
8. The gears can then be pinned to the base with cocktail sticks (one end blunted for safety); a small piece of plasticine and a bead can help secure the gears in place while still allowing them to rotate (image 2).
9. The children can make a number of gears of different sizes and with different numbers of teeth, they can then investigate how changing variables affect the way in which the gears move. They can even look for patterns when they have different numbers of gears working together.



Alternative methods

Children could also use corrugated cardboard cut into narrow strips to create teeth around the outside of their gear wheels. Adding arrows pointed at one of the teeth will help children to count the number of complete revolutions (image 5).

Alternatively, pre-made plastic gears can be purchased at fairly low cost; these could be pinned to a corrugated plastic, cork or cardboard base for investigation. These gears often have many teeth so colouring one of the gears with a contrasting nail polish will help children count the number of revolutions when they start investigating (image 1).