

## RETHINK, REUSE, RECYCLE

### OVERVIEW

**DURATION:** 30 minutes

**TARGET AUDIENCE:** Year 6+

Currently, the UK recycles around 44% of household waste, short of the 50% target set by the EU for 2020. Many countries around the world are now looking at new ways of improving recycling facilities in order to improve efficiency and reduce costs, as a way of making economies more sustainable in their use of resources such as plastic. This activity aims to demonstrate the basic principles of recycling. It will show how magnetism is used for metal separation, and how flotation can be used to further separate plastic and glass. These are the same underlying principles that were first used in recycling facilities in order to separate different materials out of the waste stream, with some principles, such as magnetism, still in use to this day.



### EQUIPMENT

- Marbles
- Containers for the separated materials
- Fish bowls/washing up bowls x6
- Safety gloves x2
- Chess clocks/timers x2
- Horseshoe magnets x2
- Leader board
- Easel for leader board
- Marker pens
- Empty water bottles
- Gathered recycled materials  
(plastic bottle caps + metal bottle caps)
- Tray to contain each experiment x2
- Sieves x2
- Funnels x2

### METHODOLOGY

1. A large box full of mixed recycling (plastic bottle tops, metal bottle tops and glass marbles) is positioned under the table.
2. Students will be given three plastic bowls containing 10 each of plastic tops, metal tops and glass marbles as well as three empty plastic bowls, a magnet, a small sieve, a funnel and a water bottle (containing at least 1L per student).
3. Mention that in a recycling plant, different materials have to be separated before they can be recycled. Against the clock, ask them if they can separate the materials into the empty bowl without using their hands and only the tools they have been given.
4. Magnets will attract the metal bottle caps; water will make the plastic bottle caps float, which can then be sieved out; the glass marbles will sink to the bottom of the container and can then be sieved out.

5. Finally, explain that in a real recycling plant a faster separation process is important, as it will lead to an increase in the recycling capability of the plant.

To access a full equipment kit for the Rethink Reuse Recycle activity contact [info@royce.ac.uk](mailto:info@royce.ac.uk)

## BACKGROUND SCIENCE

When a unprocessed waste stream first arrives at a recycling facility, all the different materials will be mixed together. The first and most important step involves the separation of the waste into its constituent materials. This is crucial, as each material will have to undergo a different cleaning treatment in order to reuse it.

Metals contain iron can be directly separated from the mixed waste stream through the use of electromagnets and magnetic drums. In scrap yards for example, powerful electromagnets are used to remove large piece of ferrous scrap. The remaining waste stream consists of non-ferrous metals and plastics.

The most common way of separating the non-ferrous metals (e.g. aluminium and copper) is through eddy current separation. This involves the use of a high-speed magnetic rotor. As the rotor spins, an electric current is induced into the waste streams, affecting the non-ferrous metals but not the plastics. The induced electric current further produces a magnetic field, which repels the conducting metals over a pre-positioned splitter plate.

Plastics are then sorted according to their resin type. Current advanced sorting techniques makes use of automated systems involving optical sensors and spectrophotometric distribution technologies, such as UV and laser. These sensors can identify the different types of plastics and relay this information to the in-line computer. The most common method of separation then involves the use of highly pressurized air to separate the plastics by type as they are identified by the sensors.

Some plastic types are then further separated by colour using optical sensors and image recognition algorithms. Furthermore, some recycling facilities will make use of magnets to remove pollutants (e.g. ferrous wires) from the plastic waste stream.

Other plastics, such as PET plastic bottles, can be separated using flotation sorting. This technique will immerse the pre-ground plastic waste in a static liquid (usually a mixture of water and chemicals such as chlorine and calcium), which will naturally separate the PET which sinks.



## FOLLOW UP QUESTIONS

1. Would the magnets work on any kind of metal? What if the metallic tops were made out of aluminium?
2. Are there any disadvantages to the use of flotation to separate plastic and glass? Do you think every kind of plastic will float and every kind of glass will sink?

## SAFETY

When using the water take care not to spill as much as possible, as this could lead to a slip hazard. The demonstrator should ensure that any spills are cleared up as soon as possible. Any broken marbles should be disposed of immediately. Metallic tops should not pose a problem; however, any sharp tops should be disposed of immediately just in case. The demonstrator should supervise the students at all time, particularly the younger students.

