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KS2: Science of Materials

Lesson Objective:

To find out the different properties of a range of materials and relate those properties to ways of separating them in mixed recycling.

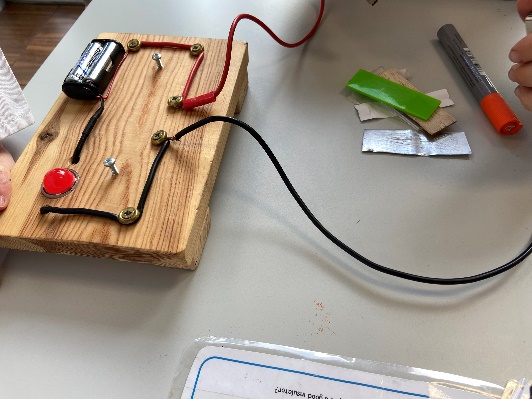
Science National Curriculum Links:

**Y4 Science: Electricity** – Recognise some common conductors and insulators, and associate metals with being good conductors.

**Upper KS2 Science: Working scientifically** – Recording data and results in a table; reporting findings.

**Y5 Science: Properties and changes of materials** – compare and group together everyday materials on the basis of their properties including hardness, transparency, conductivity and response to magnets; give reasons based on evidence from comparative and fair tests for the uses of everyday materials.

Resources:

* Magnet
* Torch (ideally wind-up/solar)
* Simple circuit board with crocodile clips for testing conductivity
* Cup/beaker, tray and pipette
* Round object for bending materials around
* Nail or screw
* Recording sheets plus pens or tablet devices
* A set of white coats
* Set of 6 pieces approx. 2cm x 8cm of the following materials
  + - Glass
    - Plastic
    - Steel
    - Aluminium
    - Cotton
    - Paper
    - Wood



Time required: 45 minutes - 1 hour

Introduction to Activity:

Introduce the idea that it is important to know what materials something is made from so it can be recycled properly. Recycling requires pure streams of different materials.

Revise the words used in the experiments: Rigid, Flexible, Waterproof, Absorbent, Conductor, Insulator, Opaque, Translucent, Transparent, Hard, Soft, Magnetic

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**DID YOU KNOW?**

Material Recovery Facilities or MRFs are places where recycling is separated via a series of belts and machines, according to the properties of different materials, such as weight, response to a magnet and transparency. This happens mostly in urban areas, such as Exeter and Plymouth, where recycling is collected all together in a large wheelie bin.

Main Activity:

Set up 6 different tables with the following experiments:

1. Waterproof Test – fill the beaker with water, put in a small tray along with a pipette.
2. Magnetism Test – place a magnet on the table.
3. Electrical Conductivity Test – place the circuit board on the table.
4. Flexibility Test – provide a round/cylindrical object for bending the materials over.
5. Hardness Test – provide a nail.
6. Transparency Test – put a torch on the table.

Now place samples of each of the 7 materials on the table, add the laminated cards with the instructions, plus the laminated sheets with the recording tables and pens or tablets with them if doing this electronically.

Ask your students to work in pairs or small groups (depending on your class size). Put the white coats on to be “Super Scientists”.

Students should read the experiment instructions before starting the different tests, and teachers should provide recording sheets, either as laminated paper copies (if repeating the experiment with another group) or digitally on a tablet.

The students should be able to complete the experiment and recording of results in 2 minutes. This can be run as a kind of “speed experiment round robin” if time is limited. All students should complete all the experiments.

Discussion:

Discuss what they discovered in the set of experiments. Students should have found out that aluminium does not stick to a magnet while steel does, while both metals conduct electricity. In material recovery facilities or MRFs magnets and optical sorters are often used to separate materials to be recycled as clean streams of different types of materials are needed for the best recycling to take place.

Extension Activity:

Each experiment has a set of extension questions. These can be done if students finish before others. The questions could also be used as Homework after the activity.

Extra Resources:

For further information about material recovery facilities see our Youtube playlist: <https://youtube.com/playlist?list=PLHby835r5GWWKC7K5bBLi6bbGqk1Q-RWV>

**Electrical conductivity test**

Use the circuit to test all 7 samples of the materials. Attach a crocodile clip to each end of the strip of material. Watch what happens to the light. Record your findings in the table provided.

A **conductor** will allow electricity to pass through it and complete the electrical circuit which will make the light turn on. An **insulator** will not complete the circuit so the light won’t turn on.

**Hardness test**

Scratch a sample of the 7 materials with a nail. Can you see the scratch?

A hard material cannot be scratched, while a soft material can be scratched with a nail.

Record the results in the table provided.

Repeat the test with your fingernail. Are the results different or the same?

**Magnetism test**

Test which materials stick to the magnet. Record the results in the table provided.

**Transparency test**

Test all the materials to see which ones are transparent (let all the light through so you can see through them), which ones are translucent (let some light through) or opaque (let no light through). Record the answers in the table provided.

**Waterproof test**

Using the pipette drop water onto each of the materials. Record whether the material is waterproof or absorbent.

**Flexibility test**

Bend the materials around the round object. Take care doing this as some might break. Record if the materials are flexible or rigid. Can you work out which materials would be brittle?

**Electrical conductivity test**

Extension questions:

1. How do you think that conductivity of different materials could be used for separating recycling?
2. What materials could be separated?
3. Do you conduct electricity, or are you a good insulator?

**Hardness test**

Extension questions:

1. How do you think you could use hardness of materials as a way of sorting materials for recycling?
2. What is the hardest substance you know?
3. Can you think up a way of changing the hardness of something?

**Magnetism test**

Extension questions:

1. How could magnetic properties of a material be used in the recycling process?
2. What could you separate?
3. Make up a name of a superhero who uses magnetic forces.

**Transparency test**

Extension questions:

1. Transparency is used in separating different materials for recycling – how could this work?
2. What could be separated out?
3. Think up a good name for a machine that separates out different materials by using transparency.

**Waterproof test**

Extension questions:

1. What are you wearing that is waterproof?
2. How could you use the waterproof test to separate out materials for recycling?
3. How could you make cardboard waterproof? Would this cause problems with recycling it?

**Flexibility test**

Extension questions:

1. Can you think of a way to use the flexibility test in your everyday life to separate your recycling at home?
2. Can you think of a type of flexible plastic packaging?
3. Think of a name for a very flexible superhero…

Results Tables

Electrical Conductivity Test

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **Conductor** | **Insulator** |  |
| Example: Card | **No** | **Yes** |  |
| Paper |  |  |  |
| Cotton |  |  |  |
| Steel |  |  |  |
| Aluminium |  |  |  |
| Glass |  |  |  |
| Wood |  |  |  |
| Plastic |  |  |  |

Flexibility Test

|  |  |  |
| --- | --- | --- |
| **Material** | **Flexible** | **Rigid** |
| Example: Card | **Yes** | **No** |
| Paper |  |  |
| Cotton |  |  |
| Steel |  |  |
| Aluminium |  |  |
| Glass |  |  |
| Wood |  |  |
| Plastic |  |  |

Hardness Test

|  |  |  |
| --- | --- | --- |
|  | **Can you see a:** | |
| **Material** | **Fingernail scratch** | **Nail scratch** |
| Example: Card | **Yes** | **Yes** |
| Paper |  |  |
| Cotton |  |  |
| Steel |  |  |
| Aluminium |  |  |
| Glass |  |  |
| Wood |  |  |
| Plastic |  |  |

Magnetism Test

|  |  |
| --- | --- |
| **Material** | **Attracted to a magnet?** |
| **Yes / No** |
| Example: Card | **No** |
| Paper |  |
| Cotton |  |
| Steel |  |
| Aluminium |  |
| Glass |  |
| Wood |  |
| Plastic |  |

Transparency Test

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **Transparent** | **Translucent** | **Opaque** |
| Example: Card |  |  | **Yes** |
| Paper |  |  |  |
| Cotton |  |  |  |
| Steel |  |  |  |
| Aluminium |  |  |  |
| Glass |  |  |  |
| Wood |  |  |  |
| Plastic |  |  |  |

Waterproof Test

|  |  |  |
| --- | --- | --- |
| **Material** | **Waterproof** | **Absorbent** |
| Example: Card | **No** | **Yes** |
| Paper |  |  |
| Cotton |  |  |
| Steel |  |  |
| Aluminium |  |  |
| Glass |  |  |
| Wood |  |  |
| Plastic |  |  |