2 Uses of metals

KEY QUESTIONS

- How can we use the special properties of metals (magnetism, electrical conductivity and thermal conductivity) to our advantage?
- Which additional properties of metals make them so suitable for use in items such as jewelry, coins, buildings, vehicles, furniture and utensils?

New Words

- conduct
- magnetic
- rust
- corrosion
- tarnish

We have learnt that whenever we wish to make something new, we first have to decide what the purpose of that product will be. Since we are learning about *Matter and Materials*, let us assume that the product will be a tool or any other kind of object that will be doing a job for us. Once we have decided what the purpose of the object will be, we can choose a material with the right properties for the job.

2.1 Special properties of metals

In this chapter we will learn about some of the uses of metals. The properties of metals make them suitable materials for many different objects. We will soon investigate some special properties of metals that we have not thought about yet.

Metals and magnets

Have you ever played with magnets? Did you notice how magnets attract other magnets, and also certain metal objects?

ACTIVITY: Learning about magnetism

MATERIALS:

- Metal objects: coins, spoon, metal pencil sharpener, nail or screw, paper clip, thumb tack, pin, steel wool etc.
- Non-metal objects: paper or cardboard, cotton wool, fabric, plastic spoon, cork, sponge, piece of chalk, small glass
- Magnet

INSTRUCTIONS:

1. Sort the objects in front of you into two groups: metals on one side and non-metals on the other.
2. Write the names of all the metal objects in the column named "Metal objects" in the table below.
3. Write the names of all the non-metal objects in the column named "Non-metal objects" in the table below.
4. Hold each object close to the magnet to see if it is attracted to the magnet or not?
5. Write your observations in the table below.

Metal objects	Is the object attracted to the magnet? Answer YES or NO	Non-metal objects	Is the object attracted to the magnet? Answer YES or NO

QUESTIONS:

1. Use the information in your table to say decide whether the following statements are True or False. If the statement is true, you should draw a cross (X) in the 'TRUE' column; if the statement is false, you should draw a cross (X) in the 'FALSE' column.

Statement	TRUE	FALSE
All the metal objects are attracted to the magnet.		
Some of the metal objects are attracted to the magnet.		
Some of the metal objects are not attracted to the magnet.		
Some of the non-metal objects are attracted to the magnet.		
None of the non-metal objects are attracted to the magnet.		

1. One of the Thunderbolt Kids on the front cover for Matter and Materials for this term is holding a magnet. Who is it and what is stuck on the magnet? What must these objects be made from to be attracted to the magnet?

_____

_____

2. Complete the following sentence by filling in words from the box below:
   _____ of the metal objects are attracted to the magnet, but _____ of the non-metal objects are attracted to the magnet.

Word box
- all
- some
- none

Magnetism is a very interesting property and playing with magnets and materials is fun! Were all the metals that you tested attracted to the magnet?

In the next activity we are going to test the magnetic properties of different metals. There is also a problem that Tom needs to help solve. After you have completed the activity you may be able to give him some advice on how to use magnetism to solve the problem!

ACTIVITY: Using magnetism to solve a problem

MATERIALS:

- Metal pieces: iron, aluminium, and copper
- Magnet

The problem:

Tom likes to visit the junkyard to look for bits and pieces of rubbish to use in his inventions. Uncle owns the junkyard. He buys all kinds of scrap metal, which he then sells to a recycling company. The recycling company pays more if the metal is sorted by type. Uncle has a problem. He does not know how to sort the metal. One day, he is talking to Tom about his problem.

Uncle: "Tom, I need your advice. I know you are clever with inventions, and that you like a challenge."

Tom: "That is true, Uncle. I love a challenge! What is your problem? Maybe I can help you solve it with science!"

Uncle: "I have a huge pile of metal scrap that I need to sort. I know there is iron, aluminium and copper in the pile of metal scrap. But I have no idea how to do this! Iron and aluminium are both metals, and look very similar. Can you think of a way to help me sort them?"

What do you think Tom's advice to Uncle will be?

INSTRUCTIONS:

1. A few metal pieces have been placed in front of you. Find the label on each piece and read the name out loud. Give everyone in your group a chance to say the names of the metals.
2. Write the name of each metal in the table below.
3. Look at each metal carefully. Do they look the same, or are they different? Can you describe the colour of each metal? Write the colour of each metal in the table below.
4. Hold each metal near the magnet. If the metal is attracted to the magnet, draw a cross (X) in the column "Magnetic". If the metal is not attracted to the magnet, draw a cross (X) in the column "Not magnetic".

Metal	Colour of the metal	Magnetic	Not magnetic

Write what Uncle should do in the space below. (It would help Uncle if you gave him step by step instructions on how to sort the metals.)

Not all metals are magnetic. We've seen how metals can be sorted according to their magnetic properties.

Metals and heat

We will now investigate another special property of metals. But first, a question: How do we cook food on the stove? We put the food inside a metal pot, and then we heat the outside of the pot. This makes the food cook on the inside! How does the heat get inside the pot? The next activity will help us answer this question.

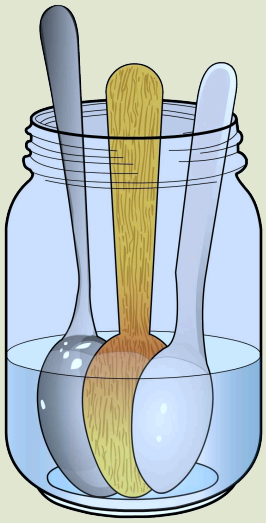
ACTIVITY: Learning about heat flow (thermal conductivity)

MATERIALS:

- Container (1 liter yoghurt tub, bottle or a 2 liter ice cream container)
- Warm water (not boiling)
- Ice cold water
- Metal spoon
- Plastic spoon
- Wooden spoon (a pencil or a stick will also do)

INSTRUCTIONS:

1. Fill the container with the warm water.
2. Place the spoons in the hot water so that their handles are above the surface of the water as in the image.



The three spoons in a container with warm water.

3. Leave them in the water for about 15 counts.

4. a) Feel the handles of each of the spoons in turn. Which spoon feels the warmest? Write your answer below.

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5. Empty the container and rinse the spoons under the cold tap.

6. Fill the container with the ice cold water.
7. Place the spoons in the ice cold water so that their handles are above the surface of the water.
8. Leave them in the water for about 15 counts.

9. Feel the handles of each of the spoons in turn. Which spoon feels the coldest? Write your answer below.

QUESTIONS:

1. Did the metal spoon feel warm after it had been standing in the warm water?

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2. Where did the heat (that you felt with your fingers) come from?

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3. How did the heat reach your fingers?

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4. Complete the sentence. Write the sentence out in full.
The spoon feels hot because heat flows from _____ to _____.

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5. Did the metal spoon feel cold after it had been standing in the ice cold water?

6. Where did the cold (that you felt with your fingers) come from?

7. How did the cold reach your fingers?

8. Complete the sentence. Write the sentence out in full.
The spoon feels cold because heat flows from_____ to _____.

9. Which material (metal, plastic or wood) is the best conductor of heat?

Metals and corrosion

Have you ever noticed how some metal objects are shiny when they are new, but over time the shine disappears and they become dull and blotchy? The car in the picture was once shiny and new, but look at it now! It is covered in rust from standing out in the rain for so long.

An old car covered in rust. [1]

Rust has a reddish-brown colour and a rough texture. Rust is very common; it is the product that forms when iron corrodes. During corrosion, iron reacts with oxygen in the air or in water to form iron oxide (the chemical name for rust). Rust is a type of corrosion, but it is not the only type.

Other types of corrosion include:

- Tarnish (found on silver teapots, trays, trophies and jewellery)
- Patina (the green coating that we sometimes see on copper objects)
- Black spots that appear on brass.
- Aluminium oxide (grey-white coating that forms on aluminium)

Can you see how this old cutlery is dull and tarnished?

Can you see the green coating forming on this copper statue?

INVESTIGATION: INVESTIGATION: Learning about corrosion (rust)

AIM: To find out how rust occurs

MATERIALS:

- 30 identical iron nails
- 3 small clean, dry containers (yogurt tubs or polystyrene cups)
- tap water
- salt water (made by dissolving 10 teaspoons of salt in a liter of tap water)
- plastic wrap to cover the containers

METHOD:

1. Mark the containers by writing A on one of them, B on the second one and C on the last one.
2. Place 10 iron nails in each of the containers.
3. Pour enough tap water on the nails in container A to cover completely.
4. Pour enough salt water on the nails in container B to cover them completely.
5. Do not pour anything on the nails in container C.
6. Cover containers A and B with plastic wrap.
7. Place the containers next to each other in a safe spot where they can be left undisturbed for a few days.
8. Check the nails in the containers every day. Every day (preferably at the same time each day) count the number of nails that have rust on them. Make sure to return the same nails to the same container after you have examined them. Continue to do this over a period of 10 days.
9. Write your results in the table below.

RESULTS:

Day	Number of rusty nails in the cup containing water only (A)	Number of rusty nails in the cup containing salt water (B)	Number of rusty nails in the cup containing no water (C)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Use the space below to draw a line graph of how many nails had rust on them after each day.

QUESTIONS:

1. In which cup did the nails start rusting first?

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1. Complete the following sentences. You may use the words in the box below, or any other words that will make the statement true for you.
   a) Iron rusts when it comes into contact with _____.
   b) Iron will rust more quickly in _____ than in _____.

Word box:
- air
- water
- salt water

1. Can you think of ways to protect iron against rust? (Hint: Look at the following picture for a clue.)

These people are painting the iron poles and fences. [2]

We have seen that iron rusts. Other metals also change when they are not protected. Have you noticed what coins look like when they are new? New coins are bright and shiny. Old coins are dull and they look dirty. That is because they have a dark layer of tarnish on them. In the next activity we will see how the layer of tarnish can be removed to make coins bright and shiny again.

ACTIVITY: How can dirty copper coins be cleaned?

MATERIALS:

- 20 dull, dirty copper coins
- 1/4 cup white vinegar
- 1 teaspoon salt
- A clear, shallow bowl (not metal)
- Paper towels, tissues or sheets of paper

INSTRUCTIONS:

1. Put the salt and vinegar in the bowl. Stir until the salt dissolves.
2. Dip one coin halfway into the liquid. Hold it there for about 10 seconds, then pull it out. What do you see?

3. Place all the coins into the liquid. You can watch them change for the first few seconds. After that you won't see anything happen.
4. After 5 minutes, take half of the coins out of the liquid. Put them on a paper towel but do not rinse them or dry them.

5. Take the rest of the coins out of the liquid. Rinse them really well under running water, and put them on a paper towel to dry. Write "rinsed" on the second paper towel.

6. After about an hour, look at the coins on the paper towels. Write your observations in the table below.

DID YOU KNOW?

Many plastics can be made strong enough to replace metals, glass and other materials. Some cars can be made from these plastics! The plastic weighs much less than metal, and this means the car needs less energy to move around.

Item	What does it look like?
Coins before you put them in the vinegar-and-salt mixture	
Unrinsed coins after one hour	
Rinsed coins after one hour	
Paper under the **unrinsed** coins	
Paper under the **rinsed** coins	

QUESTIONS:

1. Why did the coins look dirty before you put them in the vinegar-and-salt mixture?

2. What happened to the coins in the vinegar-and-salt mixture? Why do you think this happened?

3. Taste a few drops of the clean vinegar. What does it taste like?

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4. Can you think of another liquid that could be used instead of the vinegar? (Hint: What other liquids taste sour?)

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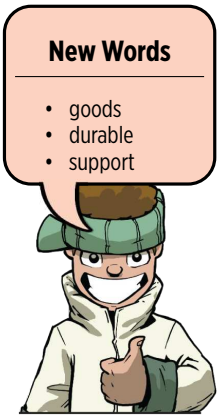
5. What happened to the unrinsed coins? Did they also become clean and shiny?

Next, we are going to learn more interesting things about metals and what they are used for.

2.2 Uses of metals



Metals have thousands of uses. We use metals every day, sometimes even without knowing!

Metals are ductile and good conductors of electricity. This is why metal is used to make the wire inside electrical cables. Without electrical cables we would not have electricity in our homes or schools; we would not have lights or television, or telephones. (Next term we will look more at electricity!)

Metals are extremely strong and can be turned into thin sheets. These sheets can be used to make the bodies of the cars, trucks, trains and aeroplanes that are used to transport people and goods from one place to another.