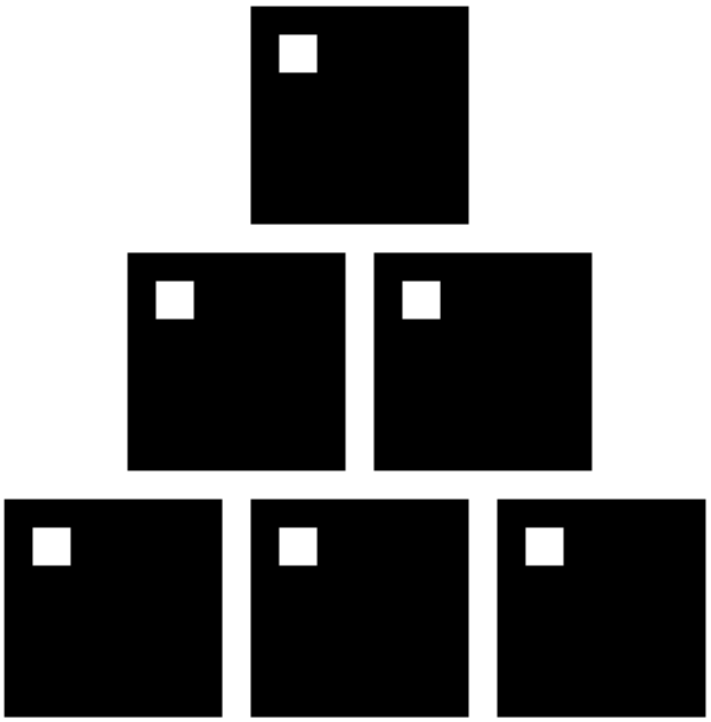
Materials



Name _____

Class _____

Teacher _____

L1 Metals and non-metals

Metals are like the superheroes of the periodic table. They are shiny, conduct electricity, and can be bent into different shapes. Think of your favourite toy car made of metal – it's strong, right? That's because metals are tough and can be hammered or stretched without breaking.

Now, non-metals are the opposite of metals. They don't shine, they don't conduct electricity, and they are usually brittle. If you've ever played with a piece of chalk, that's a non-metal. They're more like the everyday heroes, quietly doing their job.

Differences Between Metals and Non-Metals

- Appearance: Metals are shiny, while non-metals are not.
- Conductivity: Metals can conduct electricity, but non-metals cannot.
- Malleability: Metals can be bent and stretched, whereas non-metals are usually brittle.
- Density: Metals are usually denser than non-metals.
- Sound: Metals make a ringing sound when struck, while non-metals make a dull sound.
- State at room temperature: Most metals are solid at room temperature, while non-metals can be solid, liquid, or gas.
- Melting and boiling points: Metals generally have higher melting and boiling points than non-metals.

Examples of Metals and Non-Metals

Some common metals include copper (used in electrical wires), iron (used in making nails and bridges), and gold (used for making jewelry). Non-metals include oxygen (we breathe it), carbon (found in pencils), and sulfur (which smells like rotten eggs).

Why Do They Behave Differently?

The secret lies in their atomic structure. Metals have a 'sea of electrons' that can move freely, which is why they can conduct electricity and heat so well. Non-metals don't have this sea of electrons, so they can't conduct electricity.

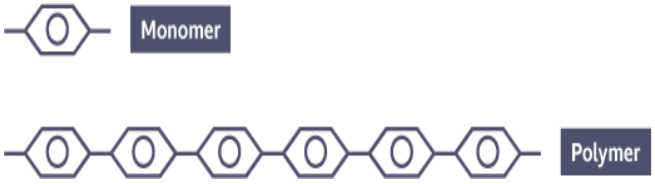
Independent practice

1. What are some properties of metals?
2. Can you give an example of a metal you use in your daily life?
3. What are non-metals like?
4. What is a common non-metal you know of?
5. **Extended writing (whole paragraph needed):** Compare metals and non-metals.
6. How does the appearance of metals differ from that of non-metals?
7. Why can metals bend without breaking?
8. Can non-metals conduct electricity? Why or why not?
9. What is the 'sea of electrons,' and why is it important for metals?
10. Which element is used to make electrical wires?
11. **Extended writing (whole paragraph needed):** Explain why we use metal to make cars.
12. What's the name of the metal often used for making jewellery?
13. Do most metals and non-metals remain solid at room temperature?
14. Why do metals make a ringing sound when struck?
15. Why does sulphur smell like rotten eggs?

L2 Polymers

Imagine you have a bunch of small, identical building blocks, like Lego pieces. Now, let's connect these pieces together to create a long chain. Each piece represents a tiny unit, and when we join them together, we get a long chain-like structure. This is like how polymers are made.

Polymers are materials made up of many small units linked together in a repeating pattern, just like our Lego chain. The word "polymer" comes from two Greek words: "poly," which means many, and "mer," which means part. So, polymers are materials with many parts!



Types of Polymers

- There are lots of different types of polymers around us. Some common ones include:
- Plastics: You've probably heard of plastic bags, bottles, and toys. They are all made of polymers.
- Rubber: Ever stretched a rubber band? That's also a polymer in action.
- Nylon: This is used in things like stockings and sports gear.
- Polyester: You might have clothes made of polyester.
- DNA: Yes, even the stuff that carries our genetic information is a type of polymer!

What Makes Polymers Special?

- Polymers have some unique properties that make them different from other materials, like metals:
- Flexibility: Polymers are usually flexible and can bend or stretch, like rubber bands.
- Lightweight: They are often lightweight, which is why plastic is used for things like packaging.
- Insulators: Polymers can be good insulators, meaning they don't conduct electricity well. That's why they're used to cover wires.
- Colourful: You can find polymers in all sorts of colours, making them great for making bright toys and colourful clothing.
- Malleable: When heated, many polymers become soft and can be moulded into different shapes, like when you melt plastic to create a new toy.

Polymers vs. Metals

Now, let's see how polymers are different from metals:

- Composition: Polymers are made up of long chains of repeating units, while metals are made of closely packed atoms in a lattice structure.
- Conductivity: Metals are usually good conductors of electricity, while most polymers are insulators.
- Flexibility: Polymers are flexible and can be easily bent, while metals are often rigid and less flexible.
- Weight: Metals are generally heavier than polymers, making polymers a good choice for lightweight products.

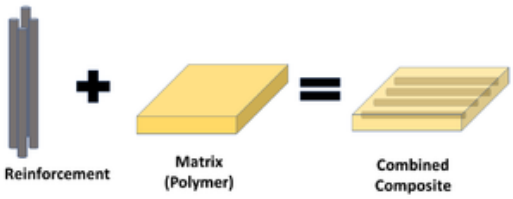
Polymers are amazing materials that come in many forms, from plastic toys to rubber bands and even DNA! They have special properties that make them different from metals, like flexibility and lightweight. Next time you see a plastic bottle or stretch a rubber band, you'll know you're dealing with polymers!

Independent practice

1. What are polymers made of?
2. What does the word "polymer" mean?
3. Name three common types of polymers.
4. Why are polymers like plastic used for packaging?
5. **Extended writing (paragraph needed):** Compare polymers and metals.
6. Can you think of a polymer that is stretchy and flexible?
7. What property of polymers makes them useful for covering electrical wires?
8. What happens to many polymers when you heat them?
9. How are the structures of polymers and metals different?
10. Do metals conduct electricity well? What about most polymers?
11. **Extended writing (paragraph needed):** Explain why we make lots of kids toys out of polymers.
12. Which is usually heavier, metals or polymers?
13. Give an example of a product made of metal.
14. What makes polymers colourful and suitable for making toys and clothes?
15. Can you name a natural polymer found in our bodies?
16. Can you think of an everyday use of a polymer that we didn't mention in the article?

L3 Composite materials

What Are Composite Materials?



Let's start with the basics. Composite materials are made by combining two or more different substances to create a new material with unique properties. Think of it like making a delicious sandwich: you combine bread, lettuce, cheese, and maybe some ham to create something tastier and more satisfying than each ingredient on its own.

Composites are used in all sorts of things around us, from the bicycle you ride to school to the tennis racket you play with. Why? Because they have some pretty cool benefits:

- Strength: Composites can be super strong. They often combine materials that are strong in different ways, making the final product even stronger.
- Lightweight: Many composites are lightweight, which is crucial for things like airplanes and sports equipment.
- Durability: They can resist wear and tear better than single materials.
- Customization: You can mix and match different materials to get the exact properties you need.
- Flexibility: Composites can be tailored to be flexible or rigid as required.
- Identifying Composite Materials

Now, let's learn how to identify whether something is a composite material. Look around you; you'll find composites everywhere! To check if a material is a composite, ask yourself these questions:

- Is it made of more than one kind of material?
- Does it have properties (like strength, flexibility, or lightness) that seem unusual for its main material?
- Can you see different layers or parts in it?

If you answer "yes" to these questions, you're likely dealing with a composite material.

Choosing the Right Composite

Imagine you're designing a skateboard. You'd want it to be strong but not too heavy. To do that, you might choose a composite material like fiberglass, which combines glass fibres with plastic. The glass fibres make it strong, while the plastic keeps it light. This is how engineers and designers pick the perfect composite for their projects.

Advantages and Disadvantages

Not all composites are the same, and they each have their own pros and cons. Let's look at an example:

Composite: Carbon Fiber Reinforced Plastic (CFRP)

Advantages:

- Exceptionally strong.
- Lightweight.
- Resistant to corrosion.
- Used in high-performance sports cars and aircraft.

Disadvantages:

- Expensive to produce.
- Difficult to recycle.
- Can be brittle.

Independent practice

1. What are composite materials, and how are they made?
2. Can you give an example of a composite material from everyday life?
3. Why are composite materials used in bicycles and tennis rackets?
4. **Extended writing (paragraph needed): Evaluate the use of carbon fibre reenforced plastic to make a skateboard.**
5. What are some benefits of using composite materials in various products?
6. How can composites be both strong and lightweight at the same time?
7. Why is durability an important characteristic of composite materials?
8. How can you customize the properties of composite materials?
9. In what situations would you want a composite material to be flexible, and when would you want it to be rigid?
10. What questions can you ask yourself to determine if something is a composite material?
11. **Extended writing (paragraph needed):** Compare composite materials and polymers
12. Can you think of an example where you've encountered a composite material in your daily life?
13. How do engineers and designers choose the right composite material for their projects?
14. What are some advantages of Carbon Fiber Reinforced Plastic (CFRP) as a composite material?
15. Why might CFRP be used in high-performance sports cars and aircraft?
16. What are the disadvantages of CFRP as a composite material, and why might it be challenging to use in certain applications?

L4 Ceramics

Ceramics are a type of material that has been used by humans for thousands of years. They are made from clay, which is a natural substance found in the Earth's crust. Clay is special because it can be moulded into different shapes and then hardened to make a variety of useful items.

Making Ceramics

Clay Collection: To make ceramics, the first step is to collect clay from the ground. This clay is usually mixed with water to create a workable paste.

Shaping: Once the clay is ready, it can be shaped into different forms. Potters use their hands or tools to create pots, plates, cups, and sculptures.

Drying: After shaping, the clay needs to dry. It becomes harder as the water in it evaporates. This stage can take several days.

Firing: The dried clay objects are then placed in a special oven called a kiln. The kiln is heated to very high temperatures, around 1000°C (1832°F) or even hotter. This process is called firing, and it turns the clay into ceramics by making it hard and durable.

Different Types of Ceramics

Ceramics come in various forms, each with its unique properties:

Earthenware: It's the most porous and least durable type of ceramics. It's often used for decorative items and pottery that won't be exposed to high heat.

Stoneware: Stronger than earthenware, stoneware is often used for dinnerware and baking dishes. It can withstand higher temperatures.

Porcelain: Porcelain is very strong and delicate at the same time. It's used for fine China, bathroom fixtures, and decorative art pieces.

Why Are Ceramics Important?

Ceramics are all around us, and they play crucial roles in our daily lives:

Cooking and Eating: Plates, bowls, and cups are often made from ceramics. They can handle the high temperatures of an oven or microwave.

Building Materials: Tiles, bricks, and pipes used in construction are made from ceramics because they are strong and resistant to weather.

Electronics: Ceramics are used in making insulators for electrical wiring and even in the tiny parts inside your smartphone.

Art and Decoration: Many artists use ceramics to create beautiful sculptures and pottery. It's a way to express creativity and culture.

Chemistry of Ceramics

Now, let's explore the chemistry behind ceramics:

Clay Composition: Clay is made up of tiny particles called minerals. The most important mineral in clay is kaolin, which contains aluminium, silicon, and oxygen.

Firing Process: When clay is fired in the kiln, chemical reactions occur. The heat causes the minerals in the clay to transform, creating a hard and stable structure.

Glazes: Many ceramics are coated with glazes, which are special mixtures of minerals that create a glassy, protective surface when fired. Glazes add colour and texture to ceramics.

Independent practice

1. What is clay, and where can it be found? A natural substance found in the Earth's crust
2. Name three types of ceramics and explain their uses. Earthenware: pottery, Stoneware (dinnerware), porcelain (china, bathroom fixtures)
3. **Extended writing (paragraph needed):** Describe how ceramics are produced.
   - Collect clay from ground and mix with water, mould and shape, evaporate the water
   - place clay into a kiln at high temperature
4. How does firing clay turn it into ceramics? The high temperature creates ceramics
5. Which type of ceramics is used for fine China? Porcelain
6. What are some everyday items made from ceramics?
7. How does the composition of clay relate to its properties?
8. What happens to clay minerals during the firing process?
9. What is a kiln, and why is it used in making ceramics?
10. How do glazes enhance ceramics?
11. **Extended writing (paragraph needed):** Explain how chemical processes give ceramics their properties.
12. Can ceramics withstand high temperatures? Give an example.
13. Name an electronic device that contains ceramics.
14. Why is pottery considered an art form?