

## Matter and energy

### 1. Matter and its properties

- All things are made of **matter**: our bodies, a notebook, a pen, a flower, the air, water, etc. A pen and water are different because they are different types of matter. Each type of matter is called a **substance**.
- An object's **mass** is how much matter it has. For example, a notebook has more mass than a pen. To find an object's mass, we have to weigh it. Mass is expressed in various units, such as in **grams** (g) and **kilograms** (kg).
- An object's **volume** is how much space it takes up. For example, a football has more volume than a tennis ball. The volume of liquid that a container can hold is its **capacity**. For example, a bottle has more capacity than a syringe. Volume is expressed in liquid units of litre (L), centilitre (cl), millilitre (ml), etc.
- Objects can have the same volume, a different mass. This is because their **density** is different. To calculate an object's density, we divide its mass by its volume.
- If we put the objects in water, we see that the iron object sinks, but the objects made of wood and cork float. An object floats or sinks in a liquid because of **buoyancy**. If the density of the object is less than that of the liquid, it floats. If its density is greater, it sinks.

---

### 2. Changes in matter

- Matter exists in three states: **solid**, **liquid** and **gas**.
  - The volume of **solids** does not change. However, if we can change the shape of a solid, we say that it is malleable, like plasticine, or elastic, like rubber.
  - The volume of **liquids** does not change, but they change shape easily. Liquids take the shape of the container they are in.
  - The volume and shape of **gases** are always changing. Gases take the shape of the container they are in and fill its entire volume.
- Matter can change its state when we apply a force such as increasing the temperature (heating) or reducing the temperature (cooling).
- The main changes of state are:
  - **Fusion** (melting), the change from solid to liquid through heating.
  - **Solidification** (freezing), the change from liquid to solid through cooling.
  - **Evaporation**, the change from liquid to gas through heating.
  - **Condensation**, the change from gas to liquid through cooling.
- Examples of common **chemical** changes:
  - **oxidation** – when oxygen changes a substance into something else, as with the apple.
  - **combustion** – when a combustible substance reacts with oxygen and produces gases (smoke), ash, light and heat.

---

### 3. Materials

- A substance used to make objects is called a **material**. Materials can be either: natural, obtained directly from nature, such as wood, wool, coal and cotton or **artificial** (man-made), made from other materials: paper, glass, plastic, steel, ceramic.
- Different materials have different **properties**. This means that materials for making an object need to have properties suitable for the object's function.
- Progress often occurs because of the discovery or invention of artificial materials with new properties.

---

### 4. Energy

- **Energy** causes matter to change, and it allows us to carry out work.
- Energy is produced by **energy sources**. Sources of energy enable machines to do things. The main source of energy on Earth is the Sun, which gives us light and heat. The Earth has many other energy sources like: coal, oil, natural gas, uranium, water, wind and the sea.
- Some energy sources, such as oil or coal, are used up as they are consumed. These are **non-renewable energy sources**. Others, such as wind or the Sun, do not run out and are called **renewable energy sources**.
- Energy has many different forms:
  - **Electrical energy**. This produces electricity.
  - **Thermal energy**. This energy is generated from heat.
  - **Kinetic energy**. This type of energy moves objects.
  - **Chemical energy**. This energy is stored in food, fuel, batteries, etc.
  - **Light energy**. This energy is in light, like the Sun's, which is used for solar power.
  - **Nuclear energy**. Substances like uranium are used in nuclear power plants to produce electricity.
- Energy can be transformed from one form into another. For example, the chemical energy in batteries is transformed into electrical energy, for example, in a mobile phone.

---

## 5. Discover sustainable energy

- Most of our electricity comes from power plants that are run using non-renewable energy sources such as coal, gas and oil. The use of this type of energy source presents many problems:
  - **Toxic gases** from burning coal or oil pollute the environment.
  - These gases combine with water vapour in the air to produce **acid rain**.
  - The energy produced by coal and oil cause more pollution than natural gas, which is now a more popular energy source.
  - Nuclear **power plants** produce radioactive waste, which is harmful to all living things, and accidents can be very dangerous.
- We can contribute to and encourage the production and use of sustainable energy by doing the following things:
  - using renewable energy, such as wind or solar.
  - being responsible with our energy consumption at home.
  - travelling on public transport, such as on buses and the metro, or walking and cycling around the city. We save on fuel by travelling less by car.

## 6. Energy forces

- **Energy** is the power that causes change in things. It is also what we need to carry out work. Energy can be transferred from one object to another when we apply a **force**.
- A **force** is an interaction that can produce changes in motion between two bodies. Forces **produce** or **modify motion**.
- A force can also **change the shape** of an object.
- **Structures** must be:
  - **stable** in order to prevent other forces from moving the structure.
  - **resistant** to prevent them from breaking because of the effects of forces on them.Structures are often constructed using resistant materials, such as reinforced concrete or steel.