

THE SUBSTANCE OF THE UNIVERSE



The passage you are going to read starts by saying, "Everything that has mass and takes up space is matter; however, there are some things that do not consist of matter". In groups, decide whether the following things are 'matter' or 'non-matter'.

Write M for matter and NM for non-matter in the boxes below.

air	☐
clouds	☐
energy	☐
gravity	☐
heat	☐
iron	☐
love	☐
Mars	☐
microwaves	☐
a person	☐
rainbow	☐
reflections	☐
a rock	☐
sound	☐
a spider	☐
the Sun	☐
sunlight	☐
time	☐
a tree	☐
water	☐

Everything that has mass and **takes up** space is **matter**; however, there are some things that do not consist of matter. All substances consist of matter but any type of energy or any abstract concept is something that is not matter.

The basic chemical **building blocks** of matter are **elements**. A chemical element is a material which cannot be **broken down** or changed into another substance using chemical **means**.

Four states of matter can be observed in everyday life: solid, liquid, gas and plasma. Each of these states is also known as a phase. The different states of matter have different physical properties.

A **solid** has a rigid shape and a **fixed** volume. The particles of a solid cannot move and are already so **tightly packed together** that **increasing** pressure will not compress the solid to a smaller volume.

A **liquid** has a fixed volume but no rigid shape and it takes the shape of its container. Its particles are close together and can move. Liquids, like solids, cannot be compressed. They diffuse quite easily but not as easily as a gas. Another property common to liquids is surface tension, a force of attraction that keeps molecules together causing tension.

A **gas** is a form of matter that has no definite volume or shape. Its volume is very sensitive to temperature and pressure. Gases have low density and diffuse easily. If unconfined, the particles of a gas will **spread out** indefinitely; if confined, the gas will expand to fill its container.

The characteristics of **plasmas** are significantly different from those of ordinary gases, so that plasmas are considered a distinct fourth state of matter. Plasma consists of highly charged particles with extremely high **kinetic** energy.

While plasma is not a common state of matter on Earth (but may be the most common state of matter in the universe), **man-made** plasmas are everywhere.

Many other states of matter are known to exist only in extreme environments – such as BEC (Bose-Einstein Condensates), **referred to as** 'the fifth state of matter' – and scientists will probably discover more states as they continue to explore the Universe.

When specific physical conditions – such as temperature, pressure, and other physical forces – change, matter can move from one phase to another:

- solids may melt into liquids (fusion / melting)
- solids may sublime into gases (sublimation)
- liquids may vaporise into gases (vaporisation / boiling)
- liquids may freeze into solids (freezing)
- gases may condense into liquids (condensation)
- gases may deposit into solids (deposition).



1 **Choose the suitable subject to complete the phrases below, then join them together and give a short oral report of the reading passage.**

Chemical elements • Each phase of matter • Gases • Heating or cooling • Liquids • Matter • Natural plasmas • Solids • The phases of matter

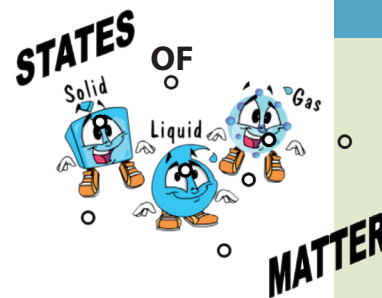
- is everything that you can touch, see, feel or smell.
- make up all matter.
- has its own chemical and physical properties.
- are solids, liquids, gases, and plasmas.
- have a definite shape and volume. They maintain their shape.
- have a definite volume, but no defined shape. They take the shape of any container they are in.
- do not have a definite shape or volume.
- are not found very often.

2 **Underline the correct alternative.**

- A solid has a a) *definite* b) *indefinite* shape and volume.
- A liquid has a definite volume, but a) *can* b) *cannot* change shape.
- The shape and volume of a gas a) *can* b) *cannot* change.
- Depending on temperature and pressure, matter a) *can* b) *cannot* transit from one state to another.
- Melting occurs when a substance changes from a a) *liquid* b) *solid* to a a) *liquid* b) *solid*.
- Boiling happens when a substance changes from a a) *gas* b) *liquid* to a a) *gas* b) *liquid*.
- Condensation takes place when a gas changes to a a) *solid* b) *liquid*.
- Freezing occurs when a liquid changes to a a) *solid* b) *liquid*.

3 **Which phase of matter are these substances? Write them in the appropriate column then compare your choices with your partner's.**

air • auroras • blood • butter • comet tails • dry ice • gasoline • gold • helium • lightening • milk • oil • oxygen • ozone • sand • stars • the Sun • water vapour • wine • wood



to break (broke-broken)
down: *to separate*
building block:
constituent
fixed: *definite*
increasing: *growing*
kinetic: *dynamic*
man-made: *synthetic*
mean: *method, manner*
packed together: *compact*
referred to as: *called*
to spread (spread-spread)
out: *to extend*
to take (took-taken) up:
to occupy
tightly: *closely, strongly*



Did you know?

- You have all three states of **matter** inside of you.
- You can drink any liquid.
- Anything you eat is **matter**.
- The molecules of a gas work in the same way hot liquid does.
- The molecules of a solid work in the same way cold water does.

SOLIDS	LIQUIDS	GASES	PLASMAS