Clouds – the story for teachers

Naming clouds

The system for naming clouds was introduced in 1802 by Luke Howard, a chemist and amateur meteorologist. He gave the clouds Latin names because Latin was the international language used for classifications of the natural world (plants, animals, etc). There are ten main cloud groups. You don't need to teach them all, but it is a good idea to start with:

Cirrus – very high clouds (usually 6–12 km above the ground). They are made of tiny ice crystals and are usually seen as thin wispy fibres like the tail of a white horse.

Cumulus – White fluffy dome-shaped heaps, usually with a flat base and cauliflower top. They are generally found between 300 and 1500 metres above the ground.

Stratus – Blanket clouds in a layer that can cover the whole sky (making it 'overcast'). They are found between the ground and 1000 metres. Sometimes they produce long periods of drizzle. There are words for days like this that vary from region to region. In Scotland, we use the word dreich. The name stratus is often linked with other clouds – hence cirrostratus (layers of cirrus clouds) and stratocumulus (layers of cumulus clouds).

Two more special clouds that are linked to bad weather and rainy days are:

Nimbostratus – From 'nimbus', the Latin for 'rain cloud' – hence, 'layers of rain clouds'. They are found between the surface and 3 km. Expect moderate to heavy prolonged rain or snow.

Cumulonimbus – These are huge towering clouds in the shape of a blacksmith's anvil. Thunderstorms are large cumulonimbus clouds and bring heavy showers or hail in winter. They can stretch upwards from 600 m to 8 km. This means that in the top of the anvil water droplets become tiny ice crystals.

How are different types of cloud formed?

Clouds occur when air is cooled to its saturation temperature. This usually happens when air is forced to rise (see below). As air rises, it cools at 10°C per kilometre of ascent. On reaching the height where it is saturated, condensation occurs. On the same day and in the same area, the moisture in warm rising air will all condense at roughly the same height. This is called the condensation level and can be seen in the flat base of cumulus clouds.

Air can rise in a number of ways:

- Hills and mountains force air to rise. Clouds form if the ascent is sufficient for the water vapour to condense.
- Low pressure weather systems (depressions) cause air to rise as if on a conveyor belt and produce clouds at different heights.
- Severe convection (warm air rising) during hot summer days can lead to pronounced vertical uplift. This causes cumulonimbus clouds to grow to heights of several kilometres in 20 to 30 minutes.

What's happening in the bottle in 'Making a cloud'?

To understand this, we need to know a little about water. Water is H_20, two atoms of hydrogen joined to one atom of oxygen, making a molecule of water. The atoms are attracted to each other by invisible electrical forces.

The molecules of water are also attracted to each other. The positive parts of one molecule are attracted to the negative parts of another one. Whole raindrops contain millions and millions of tiny water molecules. The process of forming raindrops is called condensation.

This science story is in three parts:

Part 1

The bottle starts with damp moist air inside. Smoke is added to create 'dust' particles (called hygroscopic nuclei) which the water molecules can cling to in order to help trigger the formation of droplets. To form clouds we need to decrease the temperature and pressure inside the bottle.

Part 2

The bottle is then squeezed and released a few times. Squeezing increases the temperature and pressure inside the bottle. Releasing it again decreases the temperature inside the bottle. When the bottle is released, the molecules rush away from one another using energy (in this case heat). As they do this, they slow down causing the temperature and pressure to become lower.

Part 3

When a gas cools down and decreases in pressure, the molecules inside it move more slowly, so condensation takes place. In this case, the molecules cling to the dust particles from the smoke. This is how the cloud is formed within the bottle. The children should be informed that the cloud they see is not smoke but a collection of tiny water droplets..

What are the differences/similarities with the real atmosphere?

Difference:

One important process is missing within the bottle. Warm air can also cool by mixing with colder air.

Similarity:

Hygroscopic nuclei are found in real life as dust, pollution particles or tiny salt crystals.

New words

atmosphere – the envelope of gases surrounding the earth or another planet

atom – the smallest particle of a chemical element, which consists of a positively charged nucleus surrounded by negatively charged electrons

convection – transference of mass or heat within a fluid

hygroscopic – tending to absorb moisture from the air

meteorologist – a specialist who studies processes in the earth's atmosphere that cause weather

molecule – a group of atoms chemically bound together

okta grid – an eight-sectioned grid used for measuring cloud cover.
Link – octagon with eight sides, octave with eight notes, octopus with eight legs

nucleus – the positively charged central core of an atom, containing nearly all its mass

saturation point – the stage beyond which no more can be absorbed or accepted

Clouds – middle primary

By using a range of materials and activities, we aim to focus on these outcomes and targets:

Pupil Learning Outcomes

- Cloud cover can be measured using okta grids.
- Identification of common cloud types.
- Clouds exist at different heights.
- Water exists in the air as a gas called water vapour.
- Water vapour is invisible.
- Water vapour collects around dust particles in the air to form clouds.

Scotland: 5–14 Environmental Studies

People and place: The physical environment

- Level B: describe main weather elements and some effects on people's everyday lives.
- Level C: describe some main types of weather and climate in the world and ways in which people adapt to them.

People and place: using maps

- Level C: describe the main features, e.g. compass direction.

Earth and space: materials from earth

- Level C: give some everyday uses of solids, liquids and gases.

Earth and space: changing materials

- Level B: describe how everyday materials can be changed by heating or cooling.
- Level C: describe in simple terms the changes that occur when water is heated or cooled.

Skills in science – investigating

- Level B: use simple equipment and techniques to make observations and measurements.
- Level C: select and use appropriate measurement devices or make appropriate observations.

Skills in social subjects – enquiry

- Level B: process/classify simple information in a variety of ways.
- Level C: select simple techniques to process/classify straightforward information in a variety of ways.

England and Wales National Curriculum

Geography

Key Stage 1

- 1b: observe and record
- 2a: use geographical vocabulary
- 2b: use fieldwork skills
- 7a: study at a local scale
- 7b: carry out fieldwork investigations outside the classroom

Key Stage 2

- 1b: collect and record evidence
- 1c: analyse evidence and draw conclusions
- 2a: use appropriate geographical vocabulary
- 2b: use appropriate fieldwork techniques
- 3a: identify and describe what places are like
- 3d: explain why places are like they are
- 7c: carry out fieldwork investigations outside the classroom

Science – materials and their properties

Key Stage 1

- 2b: explore and describe the way some everyday materials change when they are heated or cooled

Key Stage 2

- 2a: describe changes that occur when materials are mixed
- 2b: describe changes that occur when materials are heated or cooled
- 2c: know that temperature is a measure of how hot or cold things are
- 2d: know about reversible changes including dissolving, melting, boiling, condensing, freezing and evaporating
- 2e: know about the part played by evaporation and condensation in the water cycle

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WALT

We are learning to …

Recognise cloud types and measure cloud cover.

Understand how clouds are formed.

Phase 1 Overview

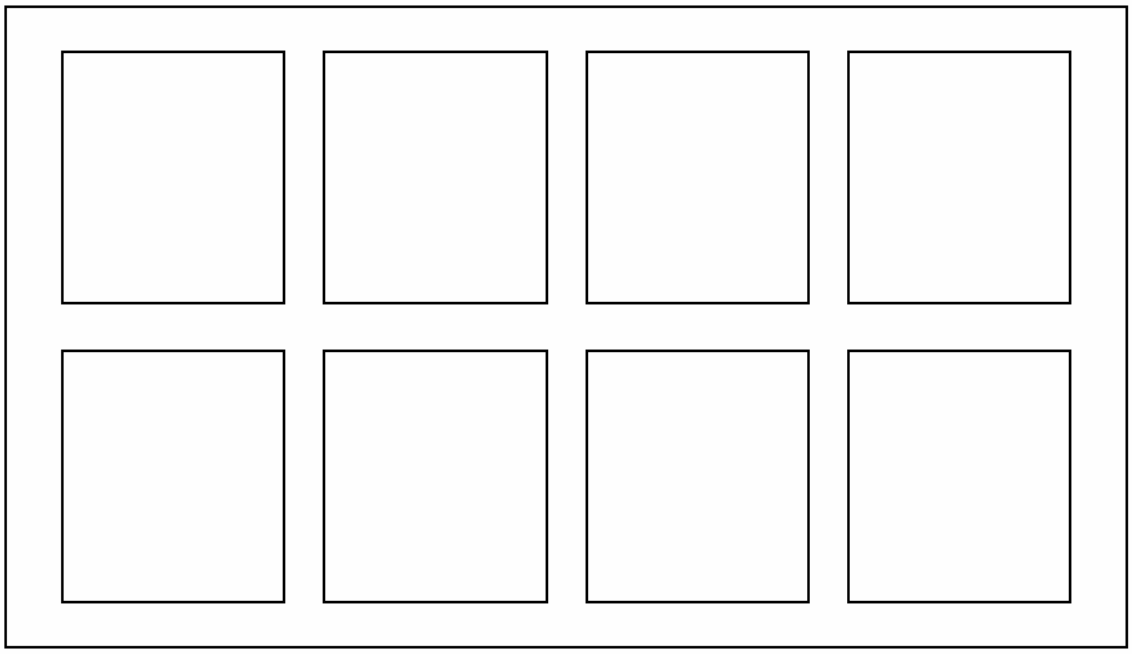
Establish the children's prior knowledge:

- What are clouds?
- Where do we find them?
- What are they made of?
- Where do they come from?

Phase 2 Input

Introduce the children to types of cloud using photographs from the resources download or cloud identification charts (available from the Royal Meteorological Society). Discuss the different types of clouds. Ask the children to think of a way to measure the amount of cloud cover. Talk about why we would need to know this (aircraft control, weather forecasts, visibility, etc).

Now introduce the children to okta grids. These can be made by making a 'window' with eight identical rectangular 'panes' from a bit of cardboard, and sticking a piece of clear acetate over it. There should be four holes above and four below, and the bits between the panes should be as thin as practicable (see diagram). Ask the children to think of a way of using them to measure cloud cover. Explain what they are going to do. Give the children some A4 photos of cloud cover and ask them to try using their okta grids over them.



Phase 3 Process

Measuring and identifying clouds

What you need for each pair:

- okta grid
- cloud chart/photos of types of cloud
- clipboard
- Cloud cover worksheet (resources download)
- Cloud identification worksheet (resources download)
- compass

Take the children out into the playground. Split them into pairs. Ask each pair to draw a compass rose on the ground with a piece of chalk. Now demonstrate to the children how to measure the cloud cover: tell them to stand in the middle of the compass rose facing north and holding their okta grid up to the sky, then count how many sections are covered in cloud and record their results on the cloud cover worksheet. Tell them to repeat for the other seven directions on the compass rose.

Encourage the children to use their cloud charts or photos to identify the different clouds present (if any!). Return indoors, and ask the children to complete the rest of the cloud cover worksheet and the cloud identification worksheet.

Making a cloud

What you need:

- a two-litre bottle filled with about 200 ml of water (for each group)
- a box of matches (for teacher use only)
- making a cloud worksheet (resources download)

Ask the children to shake the bottles to dampen the air. Now light a match at the end of each open bottle and blow it out, blowing the smoke inside the bottle. Replace the lid on each bottle.

Now ask the children to squeeze their bottles and release. Watch what happens inside. A cloud should appear when the bottle is released and should disappear when the bottle is squeezed. This happens because the water vapour clings to the dust particles (smoke) and forms a cloud.

The cloud only appears when the bottle is released. This happens because the air is under a lower pressure and at a lower temperature when the bottle is released. When the bottle is squeezed, the air pressure and temperature are high and the cloud disappears. Clouds form under low pressure/temperature air conditions. The point at which a cloud forms is called the condensation level.

A useful prior experiment is to try and make a cloud in a bottle without any smoke in it. The purpose of this experiment is to show that smoke is essential for cloud formation in the bottle.

Ask the children to complete the worksheet.

Phase 4 Review

The following discussion questions can be explored:

Observation questions

- What happened when you squeezed the bottle?
- What happened when you released the bottle?
- Did the cloud form in the whole bottle or just in one area?

Explanation questions

- How do you think the cloud forms?
- Why do you think a cloud forms when you release the bottle?
- Why do you think the cloud disappears when you squeeze the bottle?

Relevance questions

- At what point do you think a cloud forms in the sky?
- Why do you think that some clouds are higher than other clouds?