

Humidity – the story for teachers

As we have learned earlier, water may exist as a gas (water vapour). Even in the driest desert there is some water vapour in the air. Water vapour is the most important gas as far as weather is concerned, and humidity is the measure of the amount of water vapour in the air at a given temperature. High humidity means there is a great deal of water vapour in the air; low humidity means there is very little water vapour in the air. In conditions of high humidity, people will often talk about it being 'close' or 'sticky'.

In tropical countries, at certain times of the year, humidity levels can be very high. Warm air feels even warmer as humidity increases. When our bodies heat up, we depend on evaporation of moisture from the surface of our skin to cool us down, but, as humidity increases, the speed at which water evaporates decreases. High humidity slows down our natural cooling system. Visitors in particular find this quite unpleasant.

Humidity is measured as a percentage called relative humidity (RH). When it is 100% the air is said to be saturated. Another way of thinking about this is to imagine two cubes of air. One is filled with water vapour until it can hold no more (it is saturated). The other is the normal air of the classroom. If the temperature of the air in each cube is the same, RH is the amount of moisture in the cube of classroom air expressed as a percentage of the moisture in the saturated cube.

The amount of water vapour that air can hold is dependent on the temperature of the air. The hotter the air, the more moisture it can hold, so that when the air is warm the air can hold more water vapour. Cold air is more dense than warm air and cannot hold as much water vapour.

At sea level:

Air at 30°C can hold 28 grams of water vapour per cubic metre of air.

Air at 10°C can hold 8 grams of water vapour per cubic metre of air.

If you measured the air temperature and it was 30°C, and then you measured the water vapour content and it was 8 grams per cubic metre, what would happen if this air was cooled to 10°C? As it cools to 10°C, the air becomes saturated, for that is all the moisture it can hold at that temperature. If we cool the air even a little more, then water vapour will condense to form clouds, fog or dew, depending on the height above the ground.

In Britain, the direction of the wind often determines the amount of water vapour in our air. Winds blowing from the west will have crossed the Atlantic Ocean and the air will be quite humid; air coming from the south and having crossed Europe will be dry and less humid.

New words

Saturation of air – where the amount of water vapour in the air is the maximum possible at the existing temperature (and pressure). When the air is saturated, washing hung out to dry will remain wet, since there is no evaporation.

Relative humidity – the amount of water vapour in the air divided by the amount of water vapour the air can hold (expressed as a percentage).

Humidity – upper primary

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

Pupil Learning Outcomes

- Humidity is a measure of the amount of moisture (water vapour) in the air.
- You cannot see, smell or feel water vapour.
- Warm air can hold more water vapour than cold air.
- The amount of water vapour in the air can be measured by working out its relative humidity.
- Air with no water vapour has 0% relative humidity.
- Air fully saturated with water vapour has 100% relative humidity.

Scotland: 5–14 Environmental Studies

People and place: the physical environment

- Level C: describe some main types of weather and climate in the world and ways in which people adapt to them.
- Level D: describe how extremes of weather and climate can disastrously affect people and places.
- Level E: describe and explain simply the main weather and climate patterns in Britain and the wider world, including extremes, and explain the effects on ways of life.

People and place: using maps

- Level D: describe the main features of a range of maps at different scales, e.g. climate maps.

Earth and space: materials from earth

- Level C: describe the differences between solids, liquids and gases.

Skills in social subjects – enquiry

- Level D: select and use known enquiry methods and/or equipment to access, select and record relevant information from a variety of straightforward sources.
- Level D: select techniques to process/classify information in a variety of ways.

Skills in science – investigating

- Level C: select and use appropriate measurement devices or make appropriate observations.

England and Wales National Curriculum

Geography

Key Stage 2

- 1b: collect and record evidence
- 2a: use appropriate geographical vocabulary
- 2b: use appropriate fieldwork techniques
- 2c: use atlases and globes, and maps and plans at a range of scales
- 2d: use secondary sources of information
- 3a: identify and describe what places are like
- 3d: explain why places are like they are
- 7b: study a range of places and environments in different parts of the world

WALT

We are learning to ...

Understand what humidity is and how we can measure it.

Phase 1 Overview

Establish the children's prior knowledge:

- What is water vapour?
- Where does it come from?
- What is humidity?

Phase 2 Input

Revise the water cycle. Explain humidity to the children, using the material from 'The story for teachers'. Perhaps the children can talk about places they have been to on holiday and describe their own experiences of humid climates. Tell the children that a hygrometer is used to measure air humidity. You can show them the photographs of hygrometers from the resources sheet (resources download)

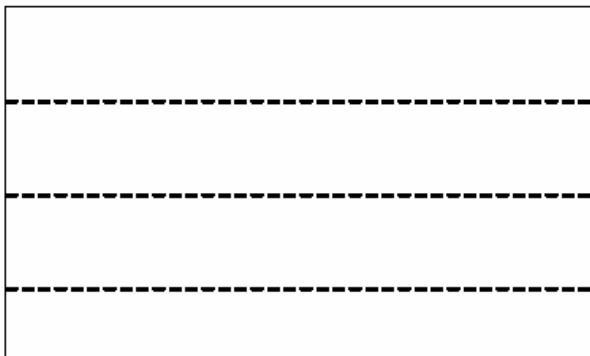
Phase 3 Process

Make a wet and dry bulb hygrometer

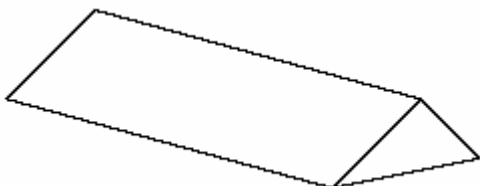
What you need:

- an A4 piece of card
- two thermometers
- water
- a small piece of muslin (cotton bandages also work well)
- a cup
- sticky tape
- a pile of textbooks

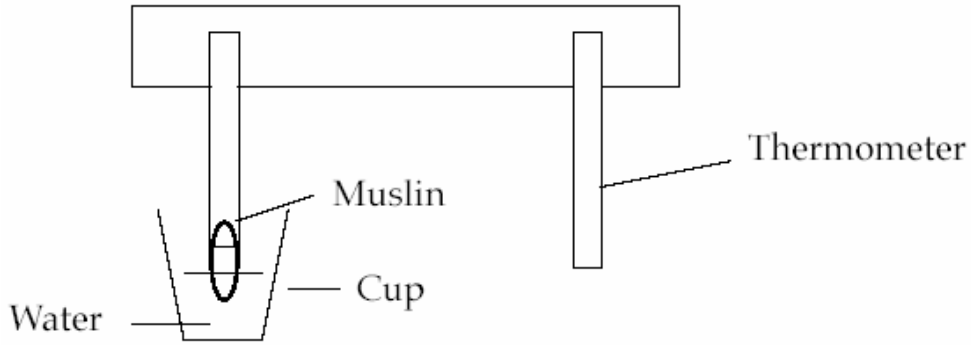
Fold the card as shown below:



Now fold it into a triangular prism and fasten it with sticky tape.



Now attach the two thermometers to one of the sloping sides of the prism, one at each end of the prism.



Put the prism on a stack of textbooks so that one of the thermometers can be placed inside the upper part of a cup. Half-fill the cup with water and position it beneath one of the thermometers. Wrap the muslin around the bulb of the thermometer and have the rest dangling in the water. After 10 minutes, take the readings of both thermometers and use this table to work out the relative humidity.

Dry bulb Current temp	Wet bulb 1 degree less	Wet bulb 2 degrees less	Wet bulb 3 degrees less	Wet bulb 4 degrees less	Wet bulb 5 degrees less
0.0°C	82%	65%	47%	31%	15%
2.5°C	84%	68%	53%	38%	24%
5.0°C	86%	71%	58%	45%	32%
7.5°C	87%	74%	62%	50%	38%
10.0°C	88%	76%	65%	54%	44%
12.5°C	89%	78%	68%	58%	48%
15.0°C	90%	80%	70%	61%	52%
17.5°C	90%	81%	72%	64%	55%
20.0°C	91%	82%	74%	66%	58%
22.5°C	92%	83%	76%	68%	61%
25.0°C	92%	84%	77%	70%	63%
27.5°C	92%	85%	78%	71%	65%
30.0°C	93%	86%	79%	73%	67%
32.5°C	93%	86%	80%	74%	68%
35.0°C	93%	87%	81%	75%	69%
37.5°C	94%	87%	82%	76%	70%
40.0°C	94%	88%	82%	77%	72%

Make a hair hygrometer

Hair changes length depending on whether it is wet or dry. Therefore, it is affected by humidity. On more humid days, hair will lengthen.

Take a straight strand of hair. Pinch the hair between your thumbnail and the fleshy part of your forefinger. Pull the hair gently through. The hair should become curly. Demonstrate to the children that by wetting it again it will become straight.

What you need:

- a long strand of hair (30 cm)
- a ruler
- sticky tape

Attach the hair to the end of the ruler using some sticky tape. Position it so that the tip of the hair is at 0 mm. Measure the length of the hair to the nearest mm. Place the hair hygrometer next to the wet and dry bulb hygrometer and measure them at the same each day.

Water vapour cooler

When water vapour is cooled it turns into water droplets. The following experiment shows how to make water vapour condense into droplets.

What you need:

- a refrigerated can of juice
- a bowl of ice
- paper towels
- a fan
- water

Place the can of juice in the bowl of ice for at least 15 minutes. Remove it and dry it thoroughly. Leave it on a table in the room. Watch as beads of condensation form on the side of the can.

Ask the pupils:

- What has happened?
- Where is the water coming from?
- Why?

Explain to the children that the water on the outside of the can came from the water vapour in the surrounding air being cooled by the contents of the can.

The experiment can be repeated using a fan to blow air past the can.

Ask the pupils:

- Do they expect more or less condensation to occur?
- Why?

There should be less condensation on the can as the air is moving, which makes it harder for the air to cool down enough for it to condense.

Seaweed

Seaweed can be used as a humidity tester, as it absorbs the water in the air and can change from moist to crispy depending on the humidity. It is a better tester in a more humid climate such as Thailand, but it is worth mentioning to the children.

Humidity facts

The humidity facts (resources download) are in large print and can be printed out on to coloured paper or card to display in the classroom. Here they are for reference:

- Woodlice (slaters) can absorb water vapour directly through their exoskeleton surface in periods of high humidity. If they remain in these conditions for too long they appear to become waterlogged!
- The Dew Beetle lives in the Namib desert in southern Africa. On some nights, fog drifts inland from the sea. When this occurs the beetles climb on to the top of the sand dunes in a line and raise their bottoms with their backs facing the sea. The water droplets collect on their backs where it runs down into their mouth and this allows them to have a drink!
- When humidity levels drop, some wooden instruments, such as guitars, can become dried out. The wood starts to shrink and can cause tuning problems as well as potential cracking. This is the main reason pianos need to be tuned each year!
- A sign of lower humidity levels inside your house can be an increase in static electricity!

Phase 4 Review

Through discussion the following questions can be asked:

- What is humidity?
- How is it measured?
- Why do we measure it?