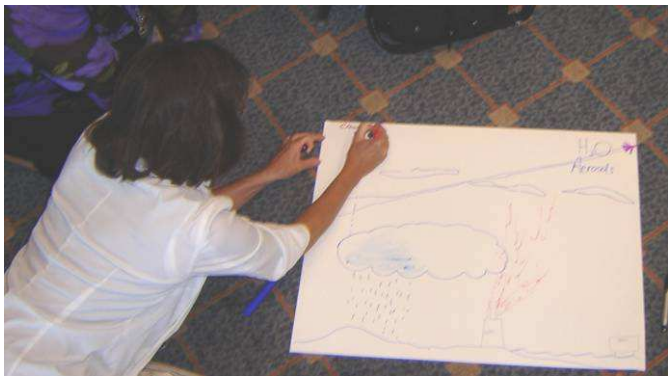
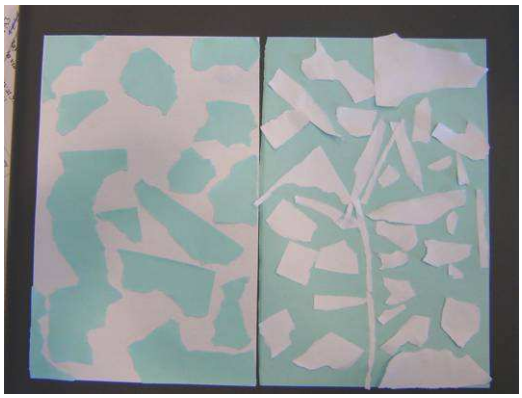
Clouds and how they form

Here we attempt to describe how clouds form and the influence of aerosols on their formation.

Discovering clouds and cloud cover

As an introductory activity, students can be asked to draw clouds on a poster. There can then be a discussion between the different groups about how they chose to illustrate their clouds.





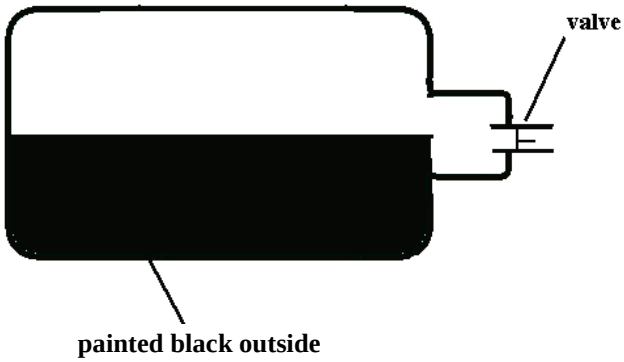
A short exercise to make students aware of the difficulty of estimating cloud cover:
Two A4 sheets of paper are needed (one white, one blue). One group folds the white sheet into ten (into five and then in half), then decides on a percentage to be cut out and stuck onto the blue sheet. The other groups must then guess the percentage!

Experiments for simulating cloud formation

One simple experiment involves taking sparkling water and adding salt: bubbles form which to a first approximation represent clouds. The salt granules are the equivalent of the condensation nuclei necessary for water droplets to form.

One of the major scientific questions of the *Calisph'air* programme is to learn more about the role of aerosols in the formation of water droplets.

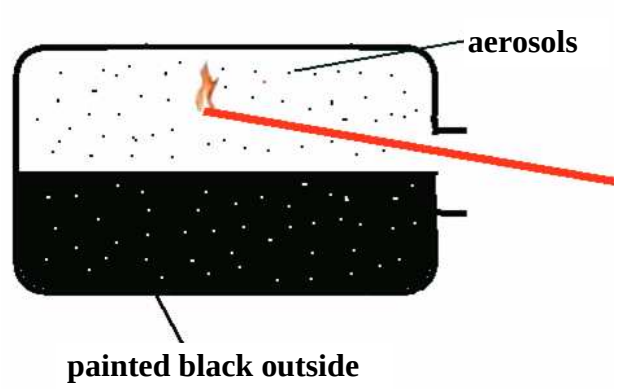
With a slightly more sophisticated experiment we can actually create a cloud. Once again, the equipment required is relatively simple. We need only a transparent plastic bottle (SMOOTH if possible), one side of which is painted black on the outside to improve the contrast (see diagram), with a valve such as one from a bicycle inner tube fitted to the cap to make it as airtight as possible.

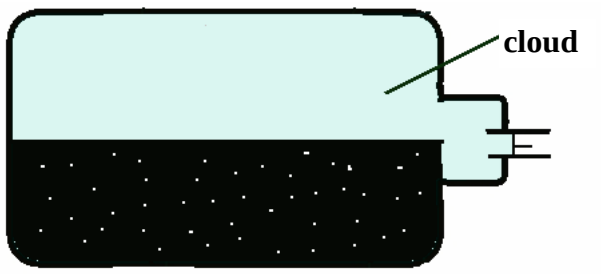


Paul Adams and Jean-Noël Puig at work

A little water is added to the bottle, the cap is closed and the bottle is shaken vigorously so that some of the water changes to water vapour; air is then pumped in and let out again rapidly (by removing the cap). This is the control, showing that in these conditions no clouds are formed.

In the second version, after adding the water a long match is held burning inside the bottle (a barbecue-lighting match is a good choice) so that smoke is produced (= aerosols).





Close the bottle, pump it up and let out the pressure rapidly: the cloud appears!

The conditions needed for the cloud to appear are: the presence of condensation nuclei (the smoke) to initiate the reaction allowing the cloud to form from the water vapour enclosed in the bottle, and the cooling obtained by lowering the pressure.

An experiment showing how hot air rises: the Montgolfier balloon

For this experiment a balloon is built using very thin paper whose seams are glued together (see photo) and the inside of the balloon is heated, e.g. with a hair-dryer.
This is the principle on which the Montgolfier or hot-air balloon is based:
http://en.wikipedia.org/wiki/Hot_air_balloon

You can find explanations about why a hot-air balloon rises here:
http://en.wikipedia.org/wiki/Buoyancy

or here:
http://imagine.gsfc.nasa.gov/docs/ask_astro/answers/970106a.html

Cloud formation and relative humidity

Water vapour condenses at the ‘dew point’, which depends heavily on temperature.
Using a hygrometer and a thermometer inside an airtight box saturated with water vapour, we can show that relative humidity rises as temperature decreases.

Therefore, when relative humidity increases, this encourages the formation of clouds.
You can find the Mollier Diagram (absolute humidity/temperature) at the following address:

https://ecourses.ou.edu/...mollier...thermotables

and more detailed explanations at:

http://www.natmus.dk/cons/tp/mollier/moll1.htm