

The weather – Meteorology

Age range : 5 to 7

Authors: Jointly compiled by: Ecole des Mines de Nantes and primary school teachers

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Summary: This module containing 5 sequences aims at setting up a weather station to record temperature, rain-fall and wind measurements. These three topics are approached in succession and measuring « apparatus » is built for each step.

Programme content: matter and objects: water in our daily lives, use of a thermometer in a few chosen everyday situations.

Issues approached: meteorology, water, air, temperature measurement.

As part of a scientific support programme to La Main à la Pâte, with primary schools in the Loire-Atlantique Region, the Nantes Ecoles des Mines has been working in conjunction with teachers, since school year 1996, to produce toolkits containing all of the equipment needed to perform experiments in the classroom, along with a guiding document.

For each topic covered, the document describes a range of experiments and suggests a general sequence of events, list of equipment used and list of required knowledge from the National School Board ("Inspection générale") related to the topic of study. This can be a foundation for setting up science activities, in line with the La Main à la Pâte approach. The general sequence of events is provided for guidance purposes only. Intentionally, the document does not elaborate on the pedagogical approach to be adopted, rightfully leaving it to the initiative of the teacher – the specialist.

This five-sequence module is derived from the back-up documents provided with the activity packs.

Material :

For 7 groups of 4 pupils :

14 alcohol thermometers (-20°C to 50°C)

ink or red food colouring

7 glass flasks (60 ml) with airtight stoppers

20 thin straws, clear or light-coloured

7 plastic bowls

1 measuring glass (+ 6 to be brought from home)

plastic film

1 direction compass

string

7 ping-pong balls

7 wooden sticks (w= 0.5 cm, L= 30 cm)

7 wooden supports (w= 3 cm, L= 30 cm, H= 0.5 cm)

stiff paper

20 drawing pins

14 nails (w= 1 mm, l= 5 cm)

marking tape

1 hairdryer (to be brought from home)

Sequence 1 - Initial Questioning

Initial questioning, class discussion on the subject of the weather. (1 session)

Initial questioning (session 1)

Class discussion with the teacher who notes on the board the replies put forward by pupils in answer to the questions:

What is a weather forecast? What is its purpose? Cite some phenomena of weather. What elements are involved? How are they measured? Do you know of any measuring instruments?

- the expressions put forward should include sun, rain, wind, temperature, weather forecast, etc.
- The teacher then announces that the class is to build a small weather station, to obtain information on the school's weather. The teacher asks the pupils what they will need to build this station. At the end of the session, the children are asked to bring a weather report cut out of a newspaper for their next session.

Sequence 2 - Thermometers and temperature (3 sessions)

Pupils observe different thermometers and the teacher asks questions on how they function. The pupils explain different ways to cause the liquid to rise. Building a thermometer and expansion test. The pupils calibrate the thermometer built during the previous session, using three temperature ranges: cold, warm, hot.

Session 1: Study of thermometers and introduction to the notion of expansion

Objective :

Using an everyday object such as a thermometer, to describe and understand its functioning, to use appropriate vocabulary.

To understand why the liquid rises in the thin tube; to introduce pupils to the notion of expansion..

Material :

Per group:

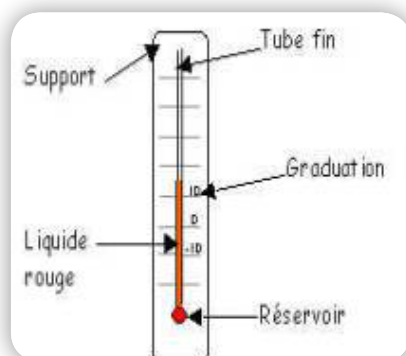
one thermometer (children will be asked to bring one from home to make comparisons – mercury thermometers must not be allowed),

hot water,

wool, etc...

For the class:

one hairdryer.



Thin tube
Holder
Graduation
red liquid
Reservoir



Procedure:

- Study of thermometers

The teacher gives a description of thermometers: what are they used for? What is the difference between them?

Initial pooling of observations: how many different parts have you noticed? The teacher draws a simple thermometer on the board, only showing the important parts, and writes a key: holder, thin tube, red liquid (coloured alcohol), reservoir, graduation.

This diagram is copied by pupils.

Introduction to the notion of expansion

The purpose of this section is find out how to cause the liquid to rise inside the thermometer. Class challenge: «think up an experiment to make the liquid rise in the thermometer ». Each pupil writes down his/her idea which is then tested within the group.

Various suggestions:

- place it in the sun
- heat it in one's hands (without specifying which part)
- use hot water
- blow on it (with a hairdryer)
- wrap it in wool, etc.

Pooling of suggestions: Which idea worked ? which did not ? What is the connection between temperature variation and the supply of heat ? It will be simply observed that when the thermometer is placed next to a warm object, the temperature rises and conversely, when the thermometer is placed next to a cold object, the temperature drops.

Make pupils specify: which is the part that is heated? Does it make any difference if the source of heat (glass of hot water) is placed level with the reservoir? next to the thin tube ? or at the top of the tube ?

Pupils repeat their experiments to determine whether thermometer reaction is related to the part which is heated.

Conclusion, after testing for 10 min: the thermometer does not react in the same manner for each part that is heated. It is the reservoir which must be heated, that is to say the liquid.

Then at the end of the session, collect all the questions raised by children subsequent to their observations of the thermometer: For example:

What happens to the thermometer when the level of liquid cannot fall any lower?

What makes the liquid rise or fall?

How does it know whether it is cold or hot?

What does "°C" mean?

What is this red liquid, in general?

The most recurrent question is definitely the second one: «what makes it move upwards or downwards? » it is therefore decided to work on this question. The class agrees on which type of thermometer to use.

Session 2: Notion of expansion; building a thermometer

Objective: Demonstrate the expansion of liquids when they are heated.

Material:

- Per group:
- one thermometer,
- red ink,
- 60 ml glass flask with airtight stopper,
- a thin straw, clear or light-coloured,
- plastic bowl.

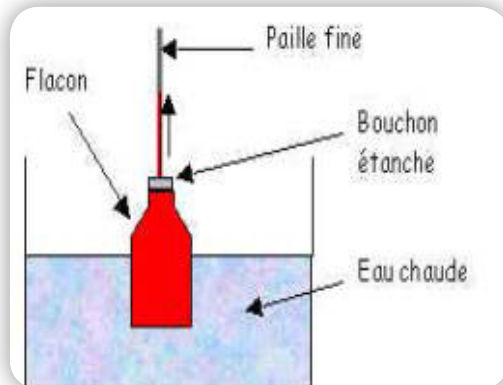


Procedure:

- First recall the conclusion previously reached: the liquid rises in the thermometer when the reservoir is heated. The thermometer makes use of a property of liquids when they are heated: what happens? If the liquid rises, is it because there is more liquid? If it is recognized that there has been no exchange of matter (the liquid being in a «closed container »), the reply is No. But then, why?

- Liquids take up more room when they are heated, they are said to expand. The teacher asks pupils to suggest an experiment to prove this.

Suggestion: the flask filled with coloured water and with a straw plunged through the stopper is placed in a bowl of very hot water. The level of water in the straw at room temperature is previously recorded. The water rises inside the straw within a few minutes. Our thermometer works !



Thin straw
Flask
Airtight stopper
hot water

What is missing in this thermometer ? Graduations, so that we can read the temperature.

The problem which remains therefore concerns its calibration. The pupils are asked to find out at home how this thermometer can be graduated.

Going further:

The session can be extended by showing that with a source of cold (ice cubes) the liquid falls.

Session 3: Calibrating the thermometer

Objective: Understanding the notion of graduation, finding the connection between temperature and the level of liquid in the thin tube.

Material - Per group:

- one control thermometer,
- the thermometer previously made,
- some ice,
- hot water

Procedure:

Has anyone found a way of graduating the thermometer ?

If so, test it.

If not, the teacher sets pupils on the right track: all that is needed is to compare with a real thermometer and to mark on our own the three ranges of cold, warm and hot. To determine these ranges, the pupils must successively dip the flask in water at different temperatures (for example, cold: 0°C to 12°C, warm: 12°C to 25°C, hot: 25°C to 35°C) and mark the corresponding level of liquid

Sequence 3 - Rain – Building a rain gauge

Summary: Building a device to collect rainwater followed by experimental stage. Discussion on the choice of rain gauge. (1 session)

Objective

Devise and use of an instrument to measure rainfall.

Material :

Per group of 4:

one plastic bottle,

plastic film,

one measuring glass,

a rubber band.

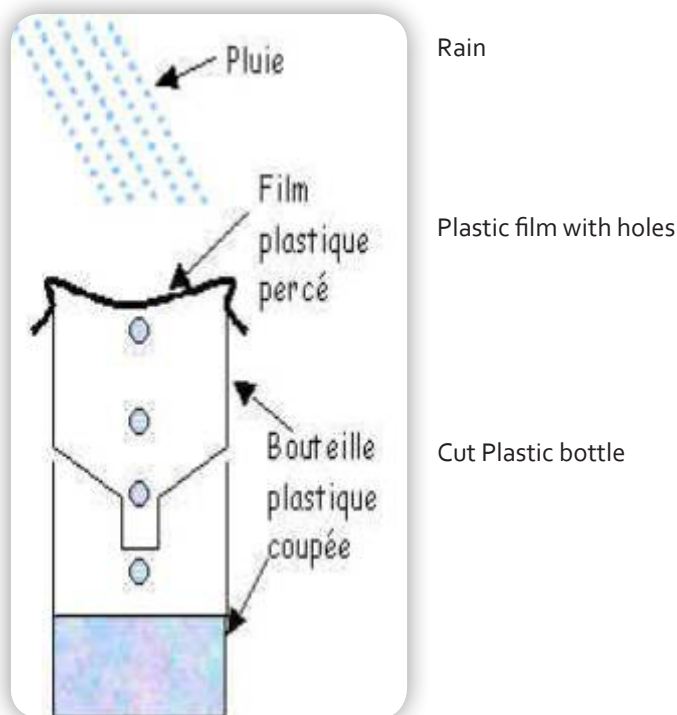
Procedure

- Recall of the different states of water: in general how do we call what falls from the sky ? Give examples: rain, snow, hail, etc. They are called precipitations.

What happens to snow when it has fallen to the ground? It melts and turns to water. The same thing happens to hail.

How does one set about measuring the quantity of water which falls from the sky? With a measuring instrument called a rain gauge.

Then challenge the class: how can we make a rain gauge using a bottle?



It can be suggested to cover the bottle (top part sectioned) or container with a plastic film pierced with a hole and held in place with a rubber band. The volume of water collected is quantified using a measuring glass.





sequence 4 - The wind

Summary: The wind - observations and definition. Study on the direction of the wind using a windsock. Characterizing the action of the wind. Building a weathervane and an anemometer (3 sessions).

Session 1: Description of the wind; observation of the effects caused by the wind; wind direction

1) Description of the wind

Objective

To describe and define the wind; on the basis of observations made, to determine which parameters can be used to characterize the wind.

Material :

Per group of 4:

various plastic bags,
paper (light material).

For the class:

hairdryer or fan.

Procedure

- Class discussion:

What is the wind ? Group together all the representations made by pupils.

How can we create wind ? By blowing, with a hairdryer, etc.

What are the effects of the wind (if possible choose a windy day !)? Otherwise conduct tests in classes using plastic bags, paper...

- A joint effort is then made to find a definition. In their exercise books each pupil must continue the sentence : "The wind is... ". Followed by the class definition: «It is air in movement ».

- Then ask how we could characterize the day's wind. What makes it different from yesterday's wind ? Firstly, its force or its speed (both are connected), . Secondly, its direction. The class will endeavour to measure these two parameters.

2) Wind direction

Objective

To devise and use an instrument which determines the direction of the wind.

Material :

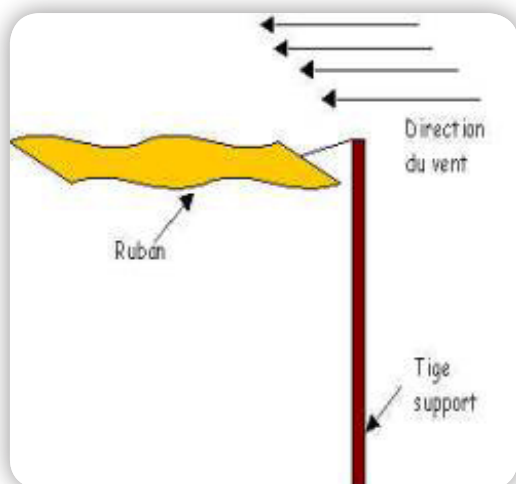
Per group of 4:

tape, approximately 30 cm in length,
string and a stake measuring 30 cm,
one drawing pin.

Procedure

After fixing the tape to a stake, (which can be compared with a windsock) the children are asked to show from which direction the wind is blowing.





Direction of the wind

Tape

Stake

This activity is conducted outdoors and the children can move around if there is not enough wind. The direction of the wind is identified using surrounding school landmarks (or using a compass).

Session 2 : The action of the wind

Objective

To characterize the action of the wind (or its force) and to find a means of measuring the wind.

Material :

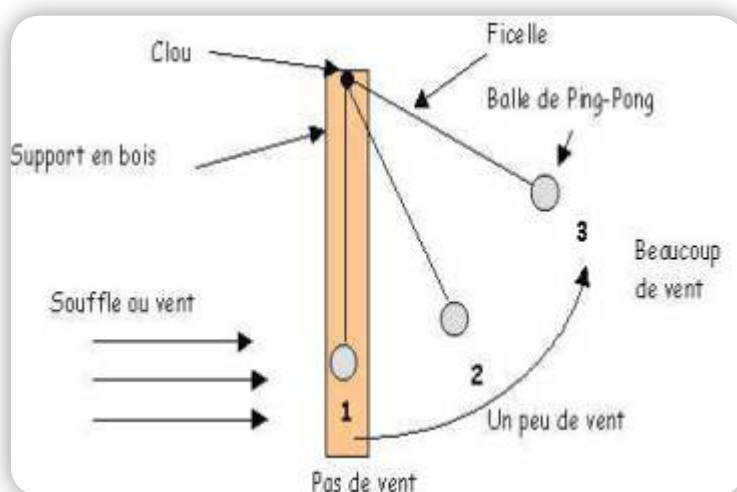
- Per group of 4:
- some string (30 cm),
- a ping-pong ball,
- a wooden stake,
- nails.

Procedure

Discuss the action of the wind on the basis of daily observations: what happens when there is a great deal of wind? (doors bang, hats fly away, etc.)

Ask pupils if they know of a simple way to measure the action or the speed of the wind.

Depending upon their suggestions, the teacher distributes the necessary material and asks the pupils to show the effects of the wind using the model described below for example. The following is then observed:



String

Nail

Ping-Pong ball

Wooden stake

Very windy

Direction

in which wind
is blowing

Some wind

No wind





The session is completed by specifying that this principle will be used to measure the action of the wind.

Going further:

Use of the Beaufort scale to measure the action (or force) of the wind. The wind is also used as energy: windmills, sailing boats, wind turbines, etc.

Session 3 : Building a weathervane and an anemometer

- cf. La science by J. HANN, éditions SEUIL

Sequence 5 – Observations and measurements – Setting up a weather station

List of instruments available for taking weather measurements.

On the completion of this module, draw up a list of instruments which we now have available to take weather measurements:

- a thermometer to measure the temperature
- a rain gauge to measure the quantity of rainfall
- a windsock or a weathervane to determine the direction of the wind
- an anemometer to measure the speed of the wind

There are other, more complex, parameters which pupils may have read in weather forecasts: air pressure in particular which is measured with a barometer

A class rotation system now needs to be set up to record this data regularly throughout the year, graphs may be plotted and conclusions drawn.

Books to consult:

- MEGA EXPERIENCES (Nathan)
- LA SCIENCE by J.HANN (Seuil)
- 100 expériences faciles à réaliser (Nathan)

