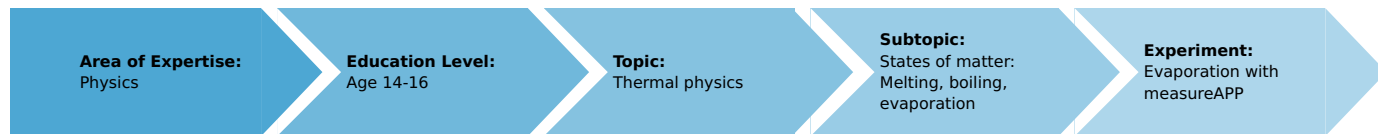


Evaporation with measureAPP (Item No.: P1045168)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- Apple iPad
- measureApp
- denatured alcohol
- absorbent paper
- pair of scissors

Experiment Variations:

Keywords:

Evaporation, Psychochrometer

Information for teachers

The evaporation of water and of alcohol, as well as the drop in temperature that occurs during this process, is observed.

Safety precautions:

Denatured alcohol (I)



R: 11

S: 7-16

Denatured alcohol it is ethanol which is made useless by denaturation for the human pleasure with a content of approx. 92-96%. Ethanol is a colourless, easily flammable liquid with a characteristic pleasant odour, that is miscible in all proportions with water and almost all organic solvents. Vapours can form explosive mixtures with air. Avoid contact with eyes and skin.

Risks: Highly flammable.

Safety precautions: Keep container tightly closed. Keep away from sources of ignition - No smoking.

First aid: Immediately rinse contaminated skin or well-opened eyes thoroughly with copious water. In case of eye injury, seek medical advice without delay. In case of accident or if you feel unwell, seek medical advice immediately. After inhalation, fresh air and free respiratory tract. On difficulty in breathing, transport to physician in half-sitting position.

Waste disposal: Collect combustible organic solvents and solutions which contain no halogens in an appropriately labelled container and properly dispose of them.

Notes on set-up and procedure:

- Alcohol is highly flammable! Ensure that there are no open flames in the vicinity of the experimental setup!
- When time must be saved, a start can be made with the temperature measurement while the drying of the patches is

being observed.

- The lowering and lifting up of the bosshead enables both thermometers with wrappings to be wetted and the thermometers to be simultaneously removed from the liquids for the start of the experiment. The beakers and Erlenmeyer flasks should be left underneath the thermometers during the experiment to catch drops of liquid.
- The evaporation process is highly “wind dependent”: Measurements near to an open window could therefore bring very different results to those obtained under “calm” conditions.
- Collect the alcohol on completion of the experiment.

Note:

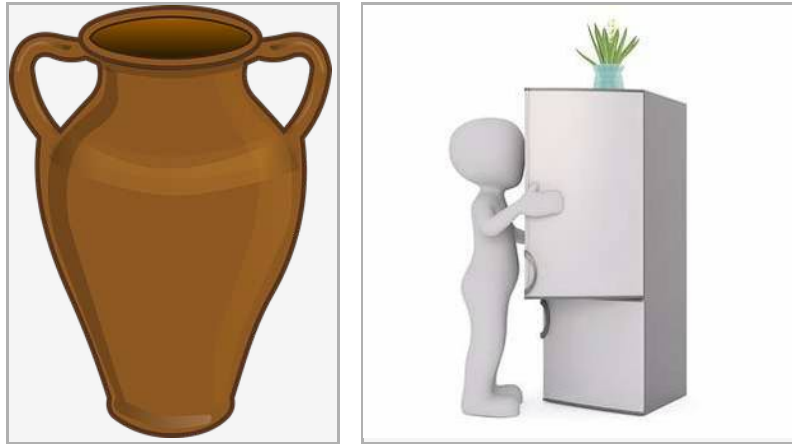
Psychrometers work according to this principle. The relative air humidity can be determined from the temperature difference between a dry and a moist thermometer.

Evaporation with measureAPP (Item No.: P1045168)

Introduction

How to keep things cold without power:

A fridge from early days and today



In almost every household you can find one: a fridge. But not long ago people had no fridge to keep drinks and food cold. Nevertheless, people in ancient times already had a trick at hand: They took porous earthenware vessels to store drinks and food. Part of it evaporated and thereby kept the rest relatively cool. The same effect happens on hot days, when everybody starts to sweat. You could say – we are our own fridges. But isn't evaporation usually a process that depends on heat? How the temperature is influenced by evaporation is the substance of this experiment.

Task

Wet the absorbent paper with water or alcohol.

1. Observe the wetted patch.
2. Wrap the wetted absorbent paper around the measuring tip of a thermometer and watch the behaviour of the temperature.

Material

Position No.	Material	Order No.	Quantity
1	Cobra4 Wireless/USB-Link incl. USB cable	12601-10	1
2	Cobra4 Sensor-Unit 2 x Temperature, NiCr-Ni	12641-00	1
3	Immersion probe NiCr-Ni, steel, -50...400 °C	13615-03	2
4	Support base, variable	02001-00	1
5	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
6	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
7	Boss head	02043-00	1
8	Glass tube holder with tape measure clamp	05961-00	1
9	Beaker, low form, plastic, 100 ml	36011-01	1
10	Erlenmeyer flask 100 ml, wide-neck SB 29	36428-00	1
11	Pipette with rubber bulb	64701-00	1
12	Fishing line, l. 20m	02089-00	1

Safety precautions for denatured alcohol:

Denatured alcohol is highly flammable! Keep container tightly closed. Keep away from open flames! Do not breathe or swallow.

Set-up and procedure

Set-up

Set-up the experiment as displayed in fig. 1.



Fig. 1: Experimental set-up

- Cut strips of the following sizes from the absorbent paper: two strips of 4 cm x 6 cm, two strips of 5 cm x 10 cm.
- Make a hole in each of the smaller strips (e.g. with a sharpened pencil) and draw lengths of fishing line through each of them.
- Wrap one of the larger paper strips around the lower end of one thermometer and the other one around the other thermometer. Tie a length of fishing line around each wrapping or use tape to secure it (see Fig. 2).

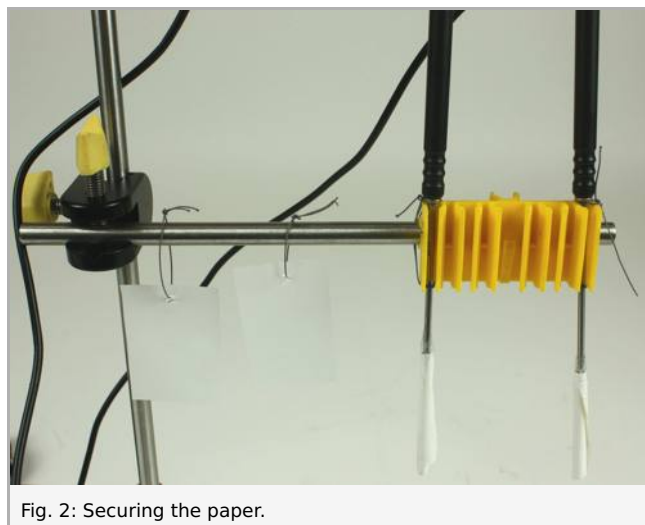


Fig. 2: Securing the paper.

- Fill 20 ml of water into the beaker.
- Fill 20 ml of alcohol into the Erlenmeyer flask.

Procedure

1. Observation of the wetted patch

- Drop 5 drops of alcohol on one of the smaller paper strips and 5 drops of water on the other.
- Hang the strips on the rod to dry.
- Note your observations in the report.

2. Temperature measurement

- Attache the Sensor-Unit 2x Temperature with the "Wireless/USB-Link" and turn it on. Plug the two prepared immersion probes into the Sensor-Unit and secure them with some fishing line in the glas tube holder as displayed in fig. 3.

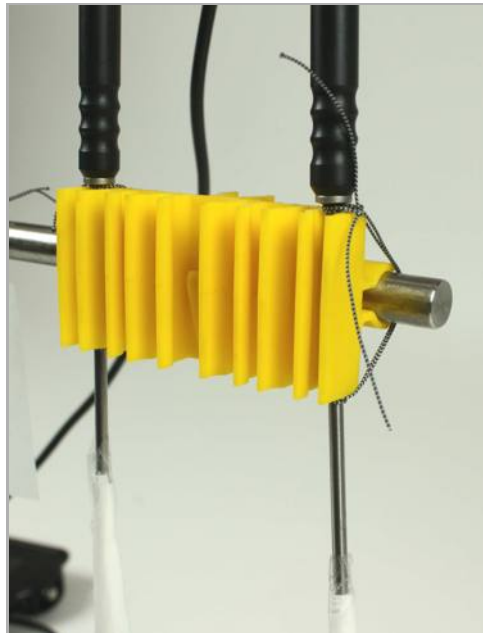


Fig. 3: Securing the immerion probe in the glas tube holder.

- Connect your tablet with the "Wireless/USB-Link". Start the app called "measure" and select the hooked up sensor. The experiment is conducted with default settings.
- Lower the bosshead so that the temperature probes dip into the water and alcohol respectively. Wait until the two rolled paper strips have become completely soaked.
- Lift the bosshead up so that the temperature probes are approx. 20 - 30 cm above the rims of the vessels. Start the measurement recording with the app.
- Stop the measurement, when the temperatures have reached almost constant values which should have happend after about 8 to 10 minutes. Save the measurement.

Evaluation

You can evaluate the experiment in the report.

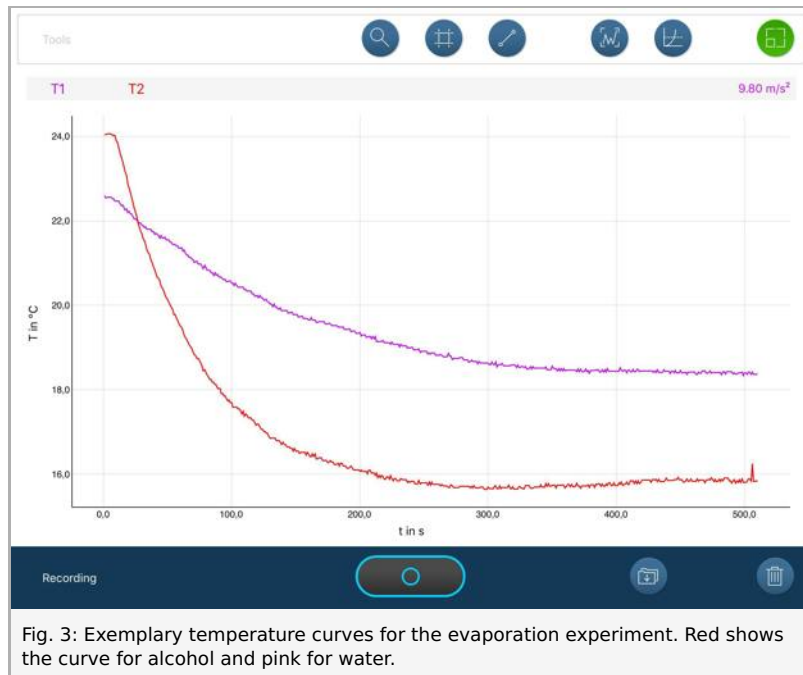


Fig. 3: Exemplary temperature curves for the evaporation experiment. Red shows the curve for alcohol and pink for water.

Report: Evaporation with measureAPP

Evaluation - Question 2

When are the patches dry?

Alcohol:

Water:

Which patch dries first?

The dries first.

Evaluation - Question 2

The drying process is called

Evaluation - Question 3

Can you say how drying can be speeded up from your own experience?

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Evaluation - Question 4

Describe and compare the measured course of temperature for water and for alcohol.

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Evaluation - Question 5

Why do the temperatures shown by the thermometer drop?

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Evaluation - Question 6

The boiling points of the two liquids are:
Water: 100 °C
Alcohol: 78°C.

Formulate a connection between the boiling points and the final temperatures that are reached in the experiment.

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