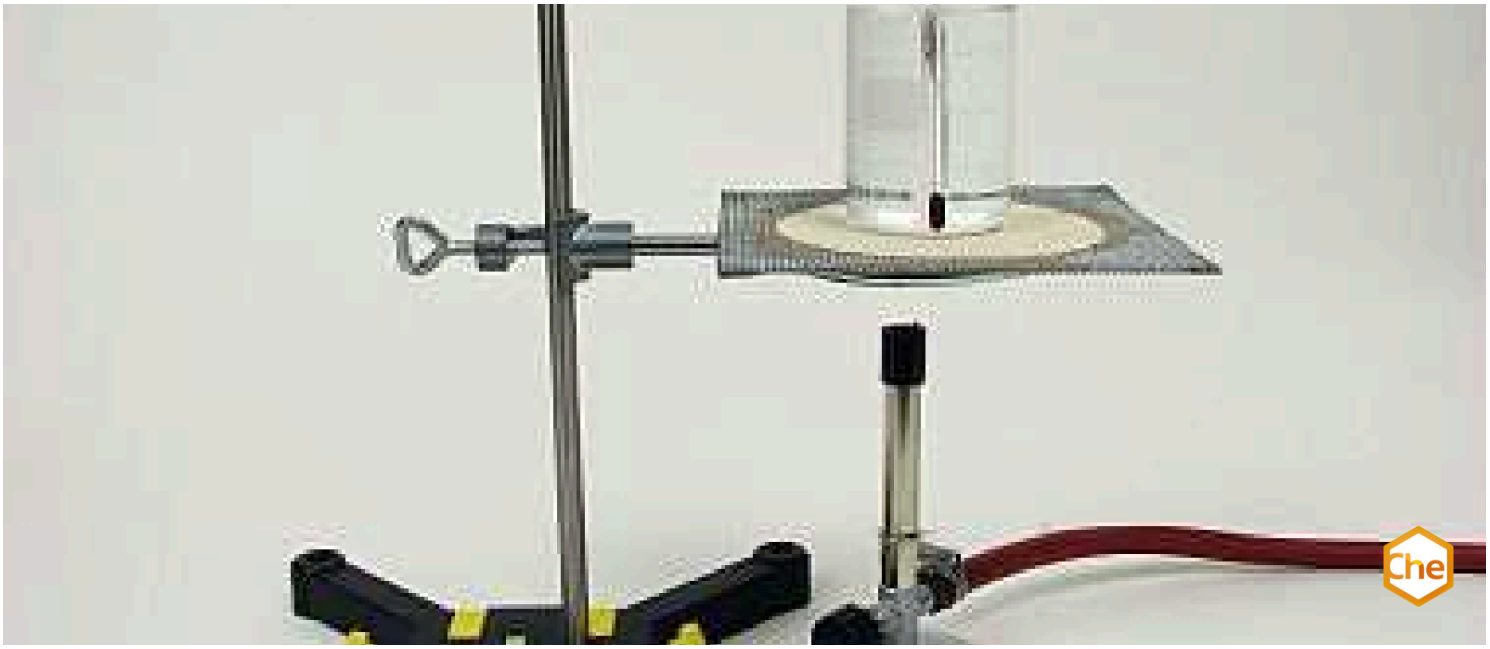
Solubility of salts in water - comparison with the solubili-ty of gases in water



This experiment confirms that, unlike gases, salts dissolve better in water the higher the temperature of the water. By supercooling, metastable supersaturated solutions can be produced that have a higher salt concentration than corresponds to the thermodynamic equilibrium variable at a given temperature.

Chemistry > Inorganic chemistry > Water

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/633b4a20bdf6080003a9430b

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Teacher information

Application

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Experimental setup

In this experiment, the students observe the effects of temperature on the solubility of salts in water.

They find that more salt can be dissolved in water as the temperature rises, in contrast to the solubility of gases in water.

They also learn that metastable supersaturated solutions can be produced by supercooling, which have a higher salt concentration than corresponds to the thermodynamic equilibrium variable at a given temperature (SEK II).

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Other teacher information (1/2)

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Prior knowledge

The students have basic knowledge about material properties and states of aggregation.

You can independently and safely handle experimental set-ups that include a burner.

Principle

The students experiment independently on the experimental set-up and test the influence of temperature on the solubility of salts in water by heating. It is helpful if they already know the experiment on the solubility of gases in water.

Other teacher information (2/2)

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Learning objective

Salts dissolve better in water the higher the temperature of the water.

By supercooling, salt solutions with higher concentrations than normally possible can be produced.

Tasks

- Students prepare saturated salt solutions at different temperatures by heating with a burner and compare the amounts of salt needed.
- You produce a supersaturated solution by cooling down a saturated solution

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Safety instructions

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Sodium thiosulphate is harmful to health. Do not swallow!

There is a risk of splashing when heating the water. Wear protective goggles!

The general instructions for safe experimentation in science lessons apply to this experiment.

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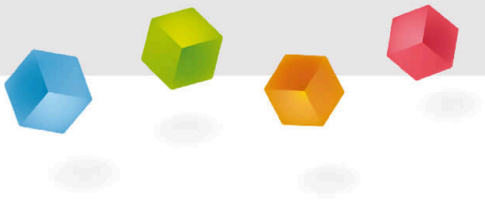

Student information

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Motivation

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Salt production

Perhaps you have been to the sea and noticed that when salty seawater evaporates over time, salt is left behind.

This phenomenon has something to do with the fact that solutions become saturated at some point. A liquid can then no longer absorb salt and it precipitates. This effect is used, for example, in the extraction of salt from seawater.

In this experiment we want to find out how much salt you can dissolve in a liquid and how this amount depends on the temperature of the water.

Tasks

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When can you dissolve more salt in water?

When the water is cold.

When the water is warm.

What does the solubility of a substance in water depend on?

- Prepare saturated salt solutions at different water temperatures and compare the amounts of salt required.
- Make a supersaturated solution by cooling down a saturated solution

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Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
4	Wash bottle, 250 ml, plastic	33930-00	1
5	Watch glass, dia.60 mm	34570-00	3
6	Beaker, Borosilicate, tall form, 250 ml	46027-00	1
7	Beaker, Borosilicate, low form, 250 ml	46054-00	1
8	Beaker, 250 ml, plastic (PP)	36013-01	1
9	Graduated cylinder, 10 ml, plastic	36636-00	1
10	Test tube, 180x18 mm,100pcs	37658-10	1
11	Test tube rack f. 6 tubes, wood	37685-10	1
12	Ring with boss head, i. d. = 10 cm	37701-01	1
13	Students thermometer,-10...+110°C, l = 180 mm	38005-02	1
14	Laboratory pen, waterproof, black	38711-00	1
15	Test tube brush w. wool tip,d20mm	38762-00	1
16	Test tube holder, up to d 22mm	38823-00	1
17	Rubber stopper, d=22/17 mm, without hole	39255-00	3
18	Protecting glasses, clear glass	39316-00	1
19	Spatula, powder, steel, l=150mm	47560-00	1
20	Potassium aluminium sulphate 250g	30018-25	1
21	Potassium nitrate 250 g	30106-25	1
22	Butane burner with cartridge, 220 g	32180-00	1
23	Sodium thiosulphate pentahydrate, 500 g	30169-50	1

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Set-up (1/5)

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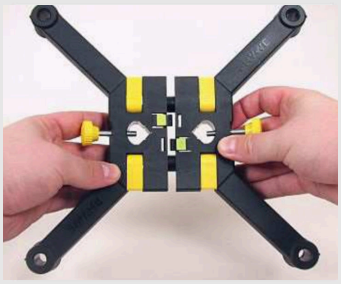
First set up the support as shown above left.

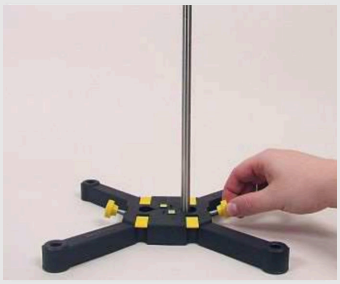
To do this, put the two halves of the support together.

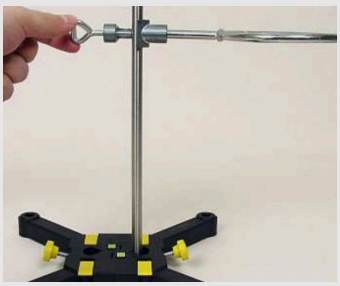
Position a support rod in the support base.

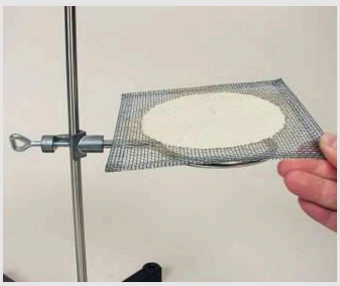
Then attach the support ring to the support rod

Place the wire net on the suppoort ring (see picture below left).









Set-up (2/5)

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Open the scale (fig. left) and switch it on (fig. centre).

Place a watch glass bowl on the scale (fig. right).

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Set-up (3/5)

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Tare it to 0 (left fig.) and add 0.5 g alum with the spatula. Mark the filling quantity of the spatula for 0.5 g alum and then fill the watch glass bowl with 3 g alum (centre illustration). Then proceed in the same way with 5 g potassium nitrate, also memorise the filling quantity for 0.5 g (right illustration).

Set-up (4/5)

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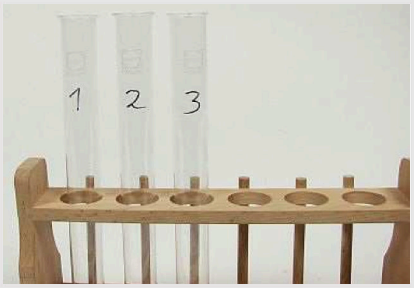
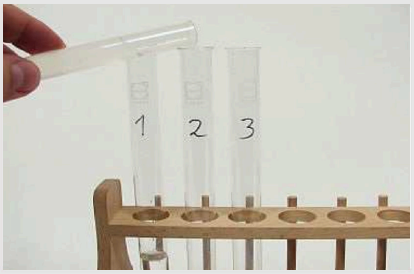
Take three test tubes.

Number the test tubes from 1 to 3.

Place the test tubes in the test tube rack as shown in the picture above.

Add 10 ml of distilled water to each of the test tubes 1 and 2 (bottom illustration).





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Set-up (5/5)

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Fill the three cups 2/3 full each with tap water (fig. top left).

Determine the room temperature of the water (Fig. top right).

On the wire mesh, heat the water of one beaker to 30 °C and that of the second to 40 °C, as shown in the two illustrations below.

The water of the plastic laboratory beaker remains at room temperature. Never use the plastic laboratory beaker to heat water with the Bunsen burner!

Procedure (1/4)

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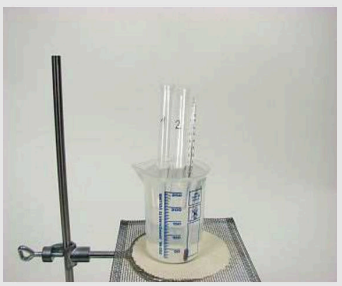
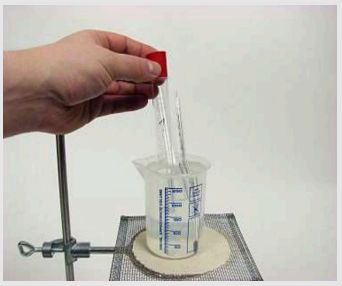
Place test tube 1 and 2 in the laboratory beaker at room temperature (fig. top left).

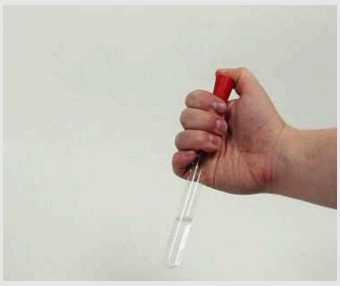
Add 0.5 g alum to the first test tube.

Add 1 g potassium nitrate to the second test tube (fig. top right).

Close the test tubes with the stoppers and shake them vigorously until all the salt has dissolved in both test tubes, as shown in the two figures below.







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Procedure (2/4)

Now add salt in portions (0.5 g each), shake again each time and check whether more salt dissolves. Note down the amounts of salt used in a table as soon as a permanent soil body forms.

Now place the test tubes in the water that has been heated to 30 °C and wait some time until the water in the test tube has also warmed up. In the meantime, check the temperature of the water in the beaker and heat it again if necessary. Make sure that the experimental temperature is not exceeded. Take out the test tubes after they have been heated and shake them. Check whether the bottom body dissolves.

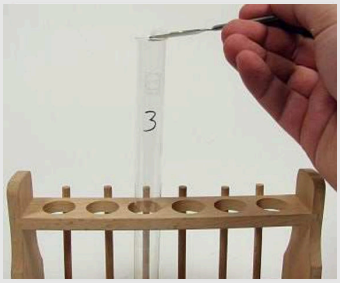
Now continue to add salt in portions as described above until a soil body forms again. Note down the amounts of salt used. Then proceed in the same way at the test temperature of 40 °C.

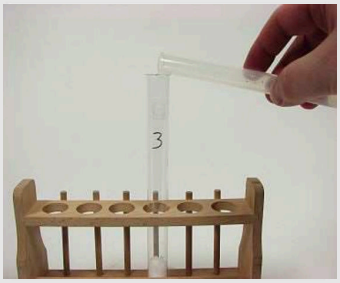
Procedure (3/4)

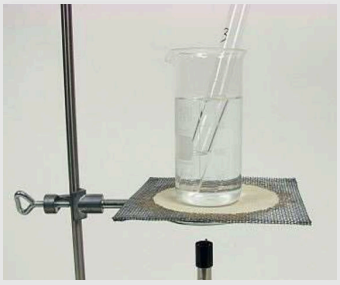
Weigh 6 g sodium thiosulphate on another watch glass dish and put this into test tube 3 (fig. top left).

Add 2 ml of water (fig. top right) and place the test tube in the beaker with the warm water as shown in the figure below left.

Heat this until all the sodium thiosulphate has dissolved (fig. below right).







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Procedure (4/4)

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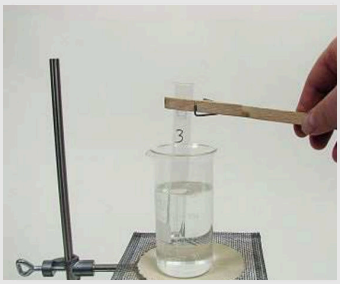
Now remove the test tube with the test tube clamp.

Place it carefully and without shaking in a beaker with water that is as cold as possible, as shown in the top two pictures.

After 5 minutes, add a small sodium thiosulphate crystal to the salt solution with the spatula:

Tap briefly on the test tube, as in the two illustrations below.



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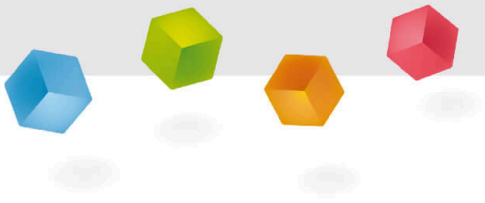

Report

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Task 1

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At a fixed temperature, ... of salt dissolves in water.

only a certain amount

any amount

Task 2

PHYWE

Summarise what you have learned in this experiment.

In this experiment you investigated the effects of temperature on the _____ of salts in water.
The _____ the water, the more salt you can dissolve in it. The _____ the water, the less salt you can dissolve in water.
If a solution is _____, the water cannot take up any more salt. If you cool a saturated solution and then create a _____, the dissolved salt suddenly precipitates.

disturbance
warmer
saturated
colder
solubility

Check

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Slide	Score / Total
Slide 8: Dissolving salts	0/1
Slide 20: Temperature influence	0/4
Slide 21: Summary of the experiment	0/5

Total 0 / 10

Solutions Repeat

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