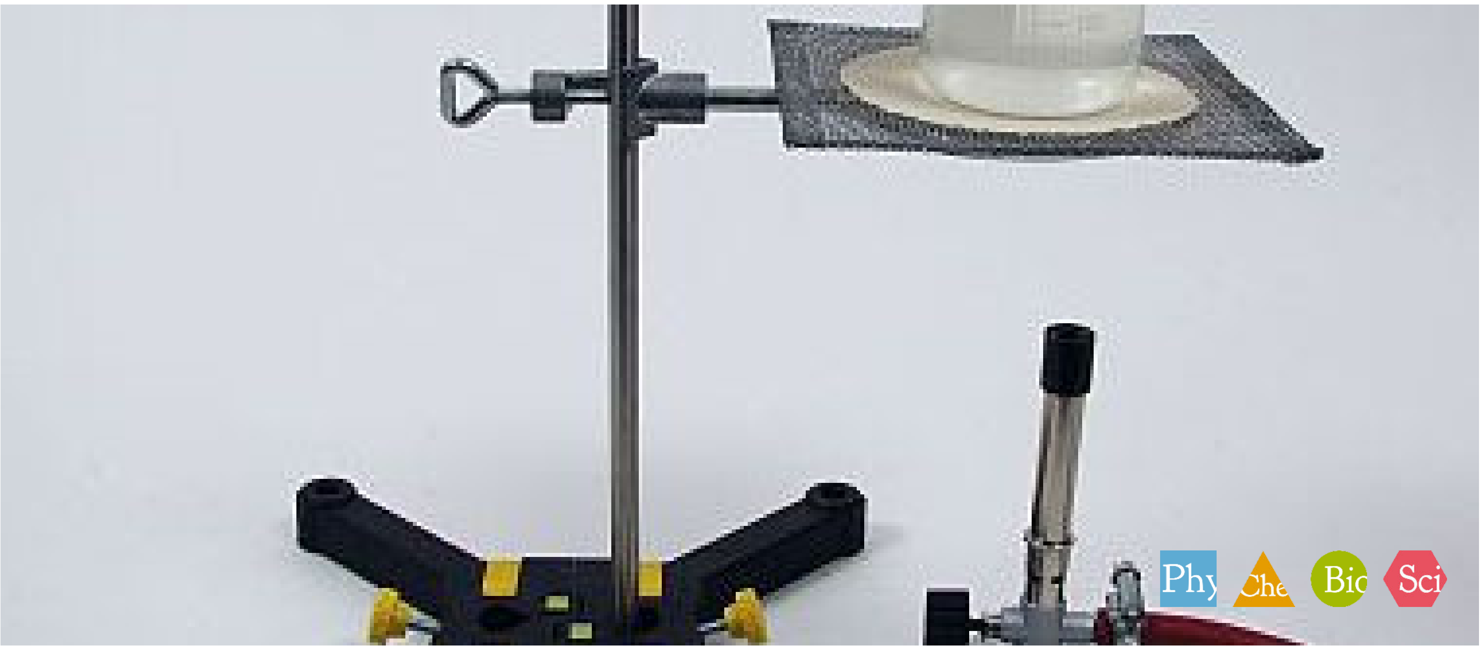
# Hardness of water




Chemistry > Inorganic chemistry > Water

Nature & technology > Substances in everyday use

| Difficulty level | Group size | Preparation time | Execution time |
|---|---|---|---|
| easy | 2 | 10 minutes | 10 minutes |

# Teacher information

## Application

Water for body cleansing

Water is not only a necessary foodstuff (drinking water), but also plays in everyday life a special position. (Drinking) water forms the basis of almost all beverages. We also use water to wash and clean ourselves and objects. Water is also used as a solvent in many technical processes. In some of these processes (e.g. in the washing machine), the "quality" of the water plays an essential role. This can be seen in everyday life by the calcification of dishes or kettles. The degree of calcification is directly linked to the so-called water hardness. In principle, the higher the water hardness of the water, the more calcified it is, the quicker it calcifies machines or everyday products such as tableware.

# Other teacher information (1/2)

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**Prior knowledge**

Students should be familiar with the principle or concept of solubility (and what factors influence solubility). They should be able to judge which substances are poorly and easily soluble.

**Scientific principle**

This experiment shows how to determine the water hardness of water experimentally. In this experiment the students apply methods to reduce the hardness of water in different ways. By adding soap solution to water with high water hardness, it can be shown that this reduces the formation of foam or the washing effect.

# Other teacher information (2/2)

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**Learning objective**

In this experiment, the students learn that water can be calcium and magnesium salts into hard und soft water to divide. Hard water in turn has negative properties, such as the reduction of the washing effect. Further falls from hard water precipitates when heated, it is lime (boilertein).

**Tasks**

In this student experiment, the influence of water hardness is investigated, for which soap solution is added to various water samples and the foam formation is observed. By adding water softener the lime soap produced is dissolved again.



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## Safety instructions

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

For H- and P-types please consult the safety data sheet of the respective chemical.

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# Student Information



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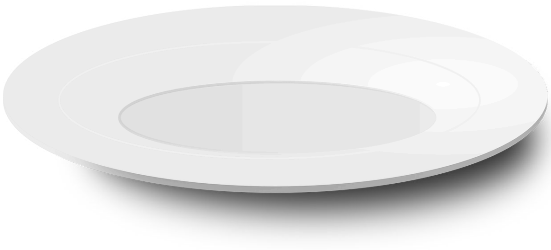
## Motivation



Lime free tableware

Water is not equal to water, so we divide water into hard and soft water. The water hardness is determined by magnesium and calcium ions in Water. Basically: The higher the concentration of these metal salts, the harder the water. The negative consequences of a high water hardnessärte we know from everyday life. High water hardness is responsible for the fact that appliances and dishes calcify. In addition, a high water hardness reduces the washing effect of detergents. In order to give a more scientific definition of water hardness, the water hardness was defined in a temporary and permanent Hardness classified. The temporary hardness refers to sich only refers to the proportion of carbonate ions in Water.

## Tasks

1. In this experiment you examine different water samples for their (different) water hardness and how the water changes according to the proportion of (above all) calcium and magnesium salts into hard und soft water to divide.
2. Experimentally prove that lime (scale) precipitates when hard water is heated.
3. Check whether the so-called lime soap (which has precipitated out of the solution) can be dissolved by adding water softener.



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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 | Beaker, Borosilicate, low form, 250 ml | 46054-00 | 1 |
| 5 | Beaker, Borosilicate, tall form, 250 ml | 46027-00 | 1 |
| 6 | Ring with boss head, i. d. = 10 cm | 37701-01 | 1 |
| 7 | Protecting glasses, clear glass | 39316-00 | 1 |
| 8 | Glass rod, boro 3.3, l=200mm, d=5mm | 40485-03 | 1 |
| 9 | Spatula, powder, steel, l=150mm | 47560-00 | 1 |
| 10 | Butane burner with cartridge, 220 g | 32180-00 | 1 |
| 11 | Soap solu.(Boutron-Boudet) 250 ml | 30221-25 | 1 |


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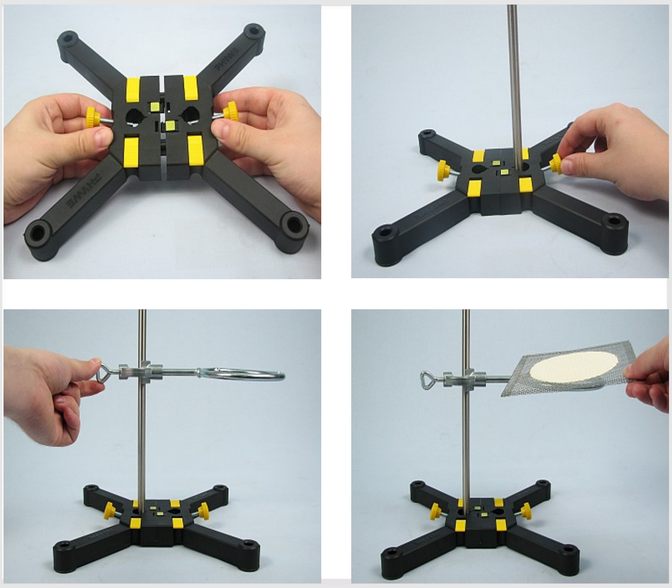
## Additional equipment

| Position | Equipment | Quantity |
|---|---|---|
| 1 | Water samples | 1 |
| 2 | Water softener | 1 |

## Set-up (1/2)

- Assemble the tripod from the tripod base and the tripod rod. Note the two upper pictures in the illustration on the right
- Attach the tripod ring to the tripod rod and place the wire netting on it. Please note the lower two illustrations in the picture on the right.





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## Set-up (2/2)

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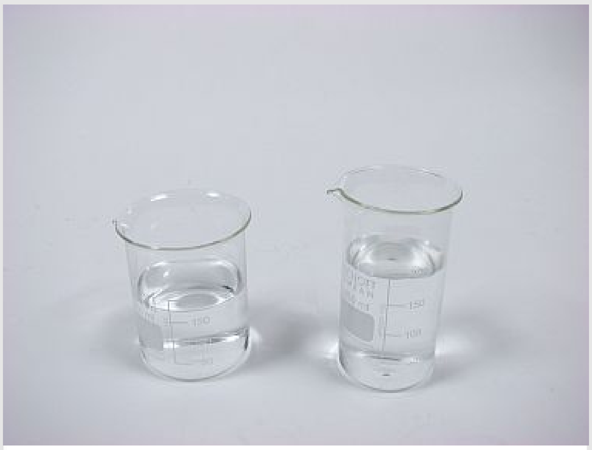
- Take two beakers and label them with 1 and 2.
- Fill one beaker 1 two-thirds full with tap water, the other two-thirds full with distilled water (as shown in the figure on the right)



Beakers with different water samples

## Procedure (1/2)

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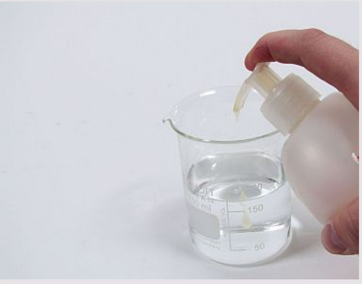

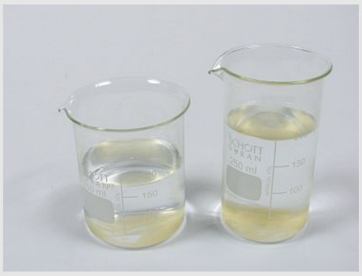

- Pour about 5 ml of soap solution into both beakers (see illustration top left).
- Stir with the glass stick.
- Leave the beakers to stand still for a short time after stirring.
- Note down what was observed during stirring.



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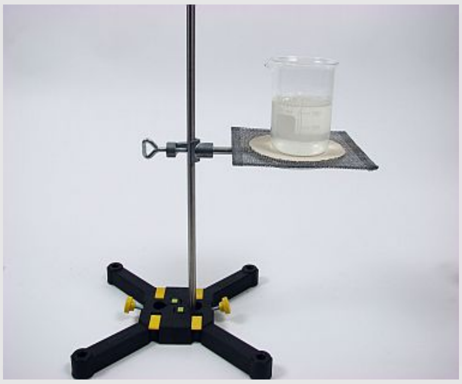
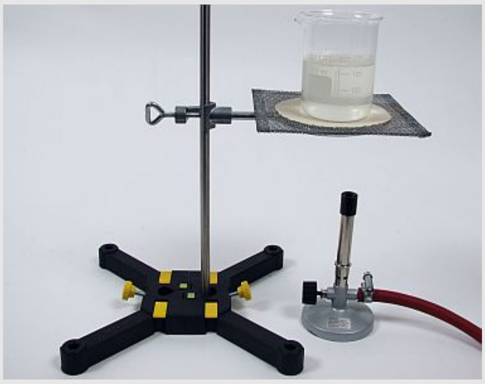
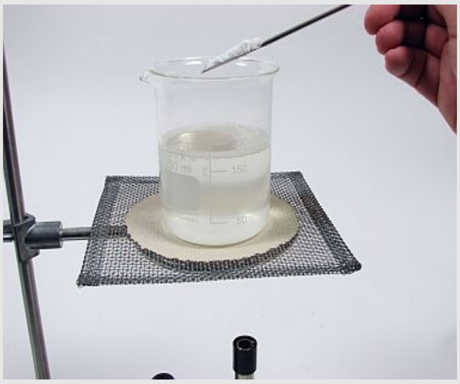
## Procedure (2/2)

Place the beaker with the tap water on the wire netting (bottom left figure) and heat it to boiling point (bottom middle figure). Adjust the burner flame so that the water just boils. Add half a spoonful of water softener to the boiling water (bottom right illustration)







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# Report



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## Task 1

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Describe your observations

When stirring after adding soap solution, foam is produced in both beakers. However, the foam formation is much stronger when using ________ than with ________. In the beaker containing tap water, ________ are formed after a certain time and settle. After adding the ________ these flakes dissolve again and the water stops boiling.

- water softener
- insoluble flakes
- line water
- distilled water

Check

## Task 2

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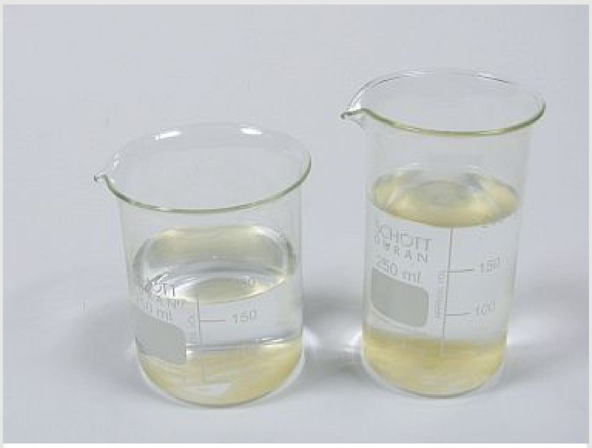
Since tap water does not foam as much as distilled water, the former must contain dissolved substances that react with the soap. How can this be seen?

- The tap water starts boiling
- At the formation of the precipitate (lime soap)
- Soap foams equally in both solutions

Check



Water samples in comparison



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| Slide | Score / Total |
|---|---|
| Slide 16: Water hardness | **0/4** |
| Slide 17: Water samples in comparison | **0/1** |

**Total amount** 0/5

Solutions Repeat



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