PHYWE

Student and Demonstration Experiments

Sci

TESS beginner

PHYWE

Water

13234-02

TESS beginner Student and Demonstration experiments

Water

Order No. 13234-02

PHYWE series of publications
TESS beginner Student and Demonstration experiments: Water
Order No. 13234-02

Authors of experimental literature: Sabine Iwanek, Wiebke Kutzborski

1st edition

Contents

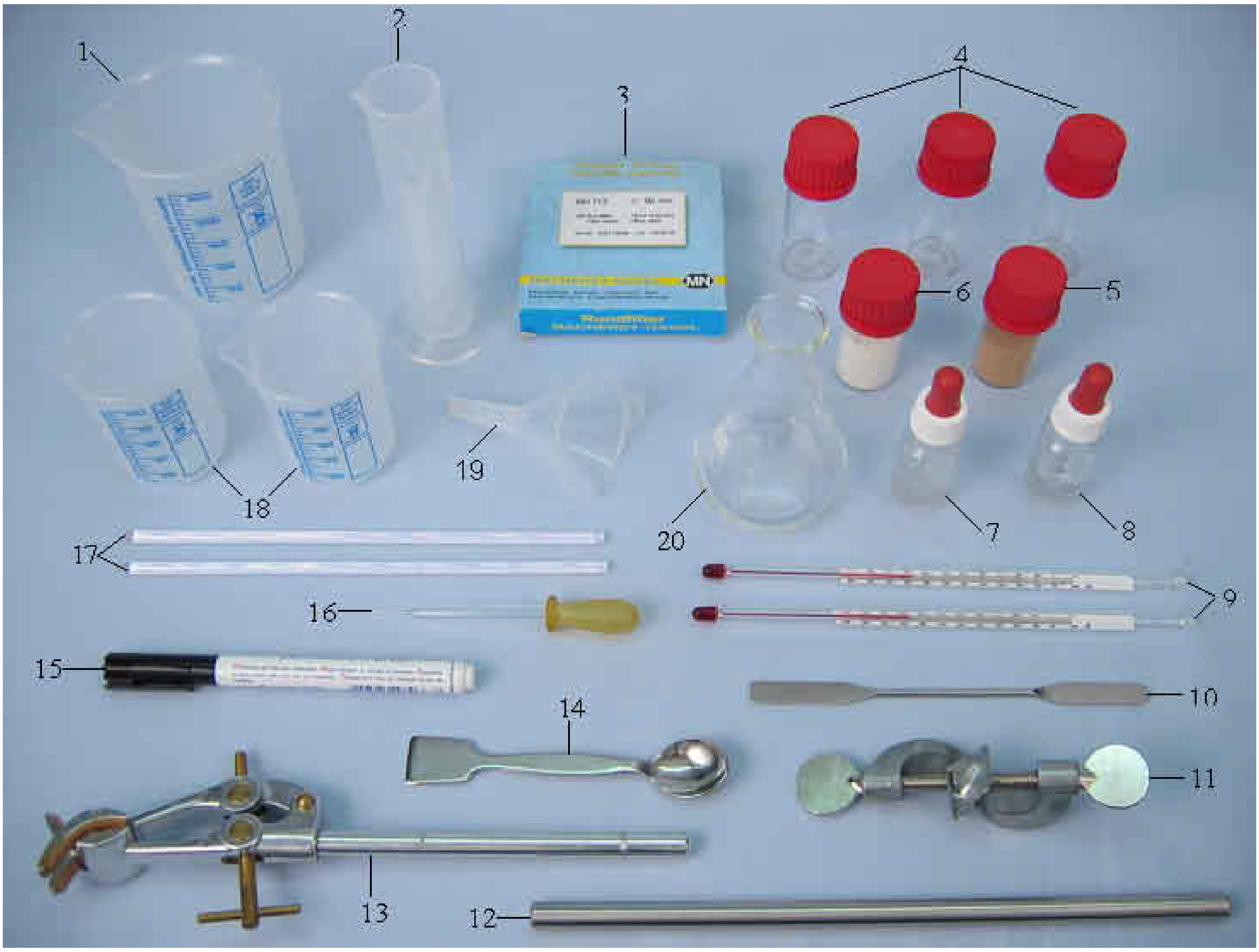
Student experiments:

Demonstration experiments:

Equipment and Storage

Student Set, Water 13233-88

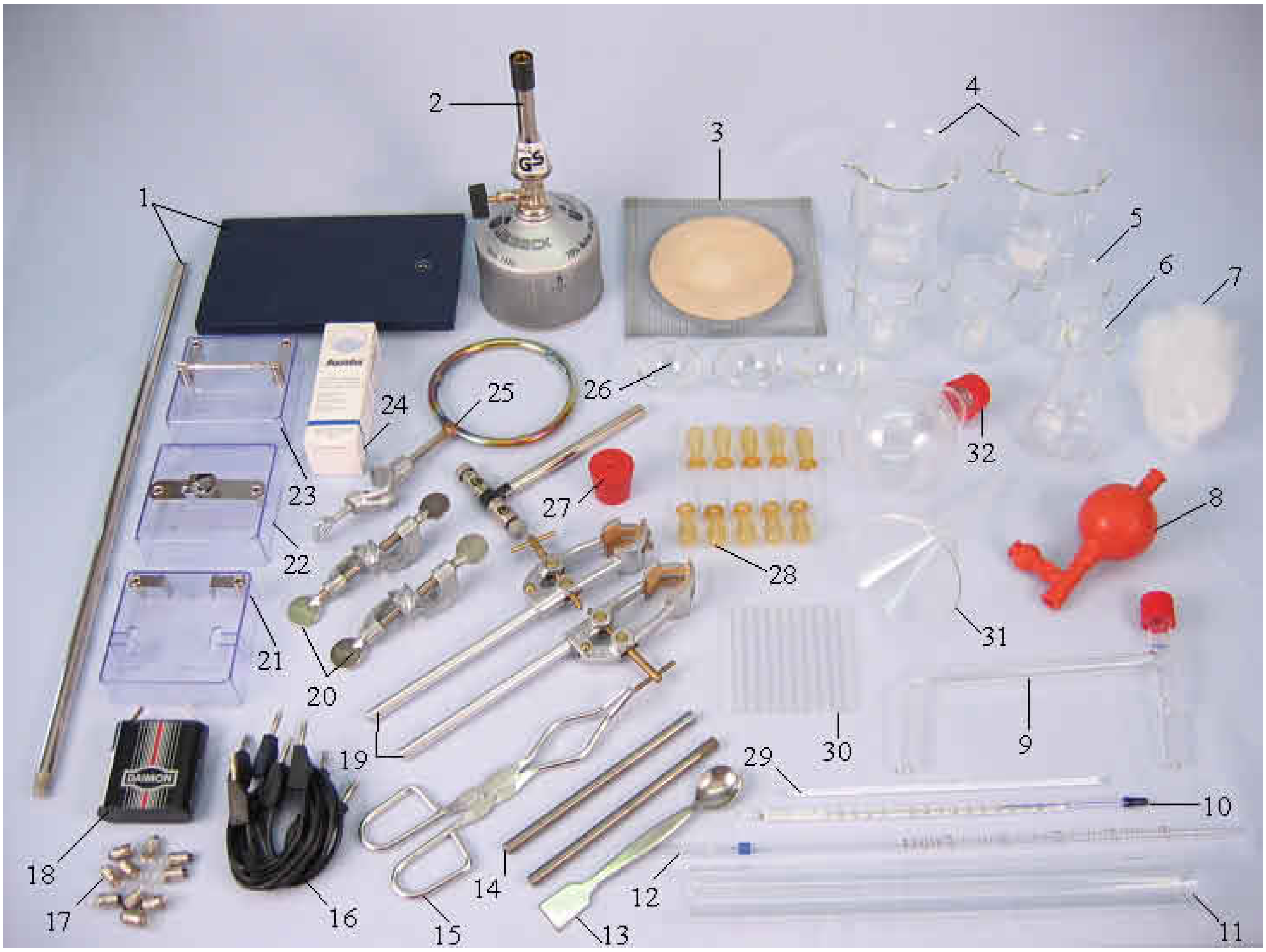
	Description	No.	Quantity
(1)	Beaker, 250 ml, low form, plastic	36013-01	1
(2)	Graduated cylinder, 50ml, plastic	36628-01	1
(3)	Circular filter,d 90 mm,100 pcs	32977-03	1
(4)	Screw cap jar, clear, 30 ml, 7 2 x 27,5 mm	46216-00	3
(5)	Cork powder 20 ml, in screw cap jar	46217-01	1
(6)	Washing powder 20 ml in screw cap jar	46217-02	1
(7)	Detergent 10 ml, in pipette bottle, round, clear	64785-01	1
(8)	Pipette bottle 10ml,brown,screw	64785-02	1
(9)	Students thermometer,-10...+110°C, l = 180 mm	38005-02	2
(10)	Spatula, double blade, 150 mm	33460-00	1
(11)	Right angle clamp	37697-00	1
(12)	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
(13)	Universal clamp	37718-00	1
(14)	Spoon + spatula, steel, l=120mm	46949-00	1
(15)	Lab. pencil, waterproof	38711-00	1
(16)	Dropping pipette with bulb	168736	1
(17)	Glass rod,boro 3.3,l=200mm, d=5mm	40485-03	2
(18)	Beaker, 100 ml, low form, plastic	36011-01	2
(19)	Funnel, plastic, dia.50mm	36890-00	1
(20)	Erlenmeyer nar.neck,boro.,100ml	46141-00	1



Demo-Set, Water 13234-88

	Description	No.	Quantity		Description	No.	Quantity
(1)	Retort stand	37692-00	1	(17)	Filament lamps 1.5V	06150-03	1
(2)	Butane burner for cartridge	32180-00	1	(18)	Flat battery, 4.5 V	07496-01	1
(3)	Wire gauze, ceramic cen.	33287-01	1	(19)	Universal clamp	37715-00	1
(4)	Beaker, low, 400 ml	46055-00	2	(20)	Right angle clamp	37697-00	1
(5)	Beaker, low, 100 ml	46053-00	3	(21)	Battery case, transparent	06030-22	1
(6)	Erlenmeyer wide neck, 100ml	46151-00	1	(22)	Lamp holder E10	06170-01	1
(7)	Glass wool100g	48154-10	1	(23)	Knife switch, transparent	06034-06	1
(8)	Pipettor	47127-01	1	(24)	AQUADUR-Test sticks	47020-01	1
(9)	Distilling bridge	35902-15	1	(25)	Ring with boss head	37701-01	1
(10)	Lab thermometer	38056-00	1	(26)	Evapor. dish, spout,15ml	46250-00	3
(11)	Glass tube	64940-00	1	(27)	Rubber stopper	39258-01	1
(12)	Graduated pipette, 5 ml	36599-00	1	(28)	Dropping pipette with bulb	47131-01	1
(13)	Spoon, special steel	33398-00	1	(29)	Glass rod	40485-03	1
(14)	Iron electrode	45204-00	2	(30)	Glass tube	36701-65	1
(15)	Crucible tongs	33600-00	1	(31)	Funnel, glass	34459-00	1
(16)	Connecting cord, black	07361-05	4	(32)	Flask,round,250ml	35812-15	1

Storage tray



Why could a vessel containing water burst when the water freezes?

Task

The change in the volume of ice when it melts is to be determined and the temperatures at different positions in icy water are to be examined.

Material

1 Graduated cylinder
1 Beaker, 100 ml
1 Pipette
1 Glass rod
1 Thermometer

Ice cubes

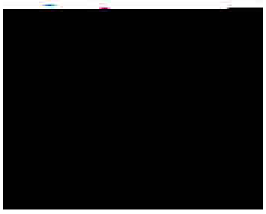



Fig. 1

Set-up and procedure

- Ice cubes are available at the teacher's table.
- Fill 25 ml of water in the measuring cylinder. Use the pipette for accurate measurement
- Record the volume of water.
- Transfer the ice cubes in the beaker to the measuring cylinder. Use the stirrer rod to dip them under the water surface, taking care that the rod dips as little as possible in the water (Fig. 1).
- Immediately read the new water level and record the value found.
- Stir the icy water for about 3 minutes.
- Use the thermometer to measure the temperatures at various positions in the cylinder (Fig. 2).
- Wait until all of the ice cubes have melted, read and record the volumes.

Fig. 2

Observations

1. Water volumes:

   Without ice cubes

   ....

   ....

   ....

   With ice cubes

   ....

   ....

   ....

   After melting

   ....

   ....

   ....

2. Temperatures in the vessel:

   Top

   ....

   Middle

   ....

   Bottom

   ....

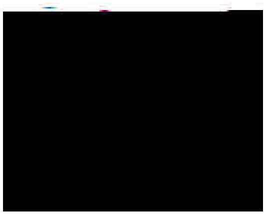
Evaluation

1. In which way does the volume of ice change on melting?

2. Explain why a container filled with water could burst because of freezing.

3. How can the temperature differences in the measuring cylinder be explained?

4. What happens in a lake in winter?



(Why could a vessel containing water burst when the water freezes?)

Material

Ice cubes

Preparation

Make sure that the ice cubes to be used fit in the 50 ml measuring cylinder.

A check should be made on how many of them can be filled into the measuring cylinder without exceeding the 50 ml volume mark prior to their distribution.

Notes on set-up and procedure

A temperature gradient of from 4 °C at the bottom to 0 °C at the ice cubes should have been formed in the vessel after stirring for 3 minutes.

Temperature deviations of about 1°C are possible here.

Observation

1. Water volumes:
   Without ice cubes: *25 ml*
   With ice cubes: *50 ml*
   After melting: *49 ml*
2. Temperatures:
   Top: *0°C*
   Middle: *2°C*
   Bottom: *4°C*

Evaluation

1. The volume decreases.
2. Water expands while it freezes and this expansion could cause the container to burst.
3. Water of 4°C temperature sinks to the bottom of the vessel, while icy water collects at the surface. An amount of water at 4°C is therefore heavier than the same amount of icy water. They have different densities. Water has its greatest density at 4°C.
4. Frost causes the formation of a layer of ice at the water surface. This ice remains there as it has a lower density than the water beneath it. “Warm” water of 4°C is at the bottom of the lake because of its highest density and this enables fish to survive under ice.

Room for notes

How much salt and sugar can you dissolve in water?

Task

Dissolve first salt, then sugar, in hot and cold water and observe what happens.

Material

2 Beakers, 100 ml
1 Beaker, 250 ml
2 Glass rods
1 Spoon spatula

Salt
Sugar

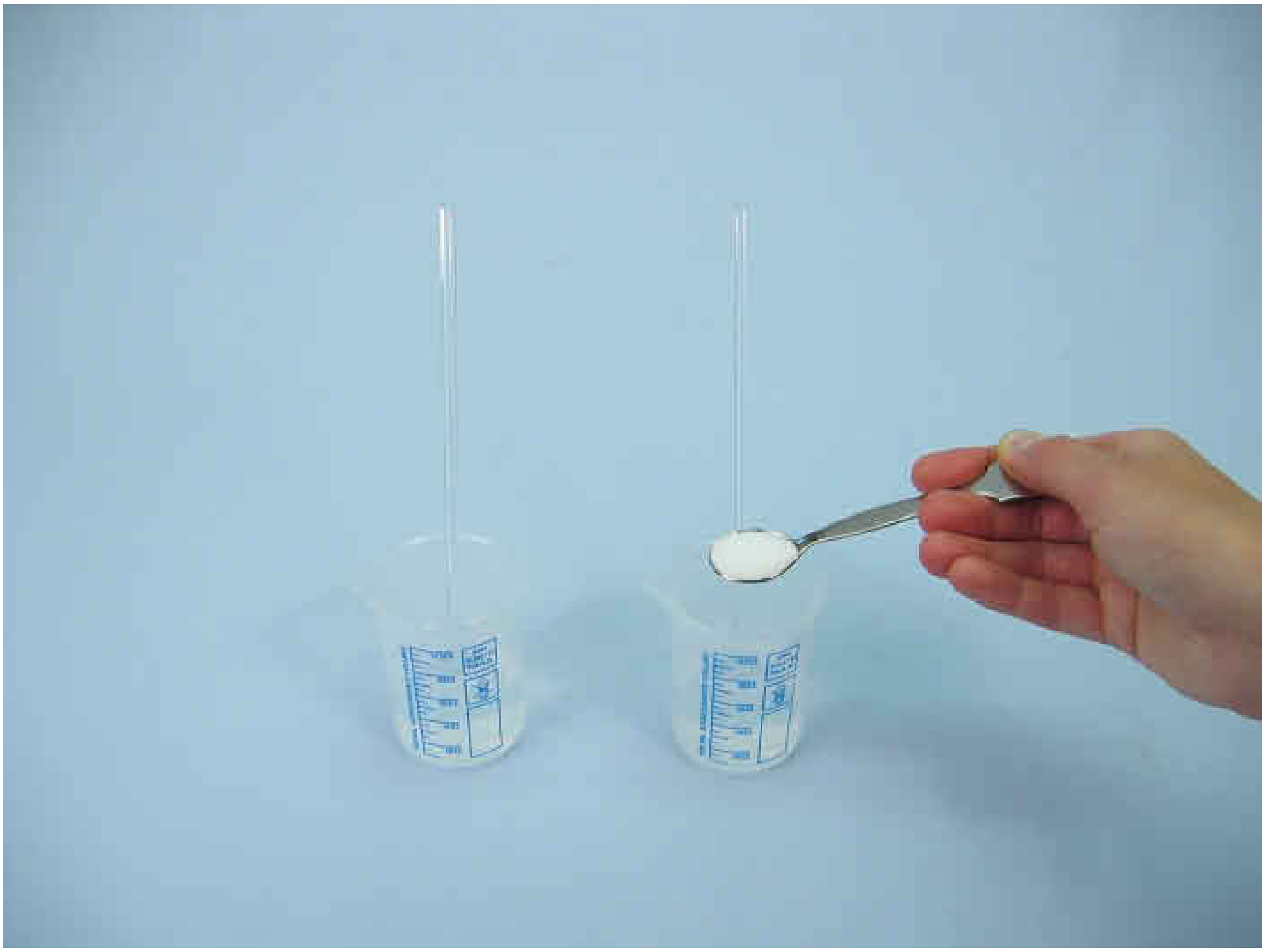


Fig. 1

Set-up and procedure

- Fill 50 ml of cold water in one beaker and 50 ml of hot water in the other one
- Add a spoonful of salt to each beaker (Fig.1).
- Stir carefully with the rods (Fig. 2).
- Observe what happens and record your observations.
- Continue adding spoonfuls of salt to the beaker containing hot water.
- After each addition, stir carefully with a rod until all of the salt has completely dissolved.
- Record the number of spoonfuls that could be brought to dissolve.
- Carry out the same procedure with sugar.

Fig. 2

Observations

1. What happens in the beakers with hot and cold water?

   With salt

   ....

   ....

   ....

   With sugar

   ....

   ....

   ....

2. What do you observe when you keep adding salt and sugar?

   With salt

   ....

   ....

   ....

   With sugar

   ....

   ....

   ....

Evaluation

1. What is the reason for the sediment in the beaker?

   ....

   ....

   ....

   ....

   ....

Room for notes

(How much salt and sugar can you dissolve in water?)

Material

Salt

Sugar

Preparation

Each group of students needs 10 spoonfuls of salt in their 250 ml beaker for the first part of the experiment and 20 spoonfuls of sugar in it for the second part.

Notes on set-up and procedure

The process of dissolving in hot and cold water must be simultaneously carried out for the time difference to be clearly noticeable.

After each addition of a spoonful of salt or sugar, stirring must be carried out until all of the added substance has dissolved.

About 7 spoonfuls of salt and 18 spoonfuls of sugar are required before an insoluble deposit is seen.

Observation

1. Salt dissolves faster in hot water than in cold water.
   Sugar also dissolves faster in hot water than in cold water.
2. Salt no longer dissolves when 7 spoonfuls have been added.
   Sugar no longer dissolves when 18 spoonfuls have been added.

Evaluation

1. Water can only dissolve a certain amount of a substance. As long as water can still dissolve a substance, the solution is unsaturated. When a sediment results, then the solution is saturated. The amounts of different substances which are required for them to form saturated solutions are different

Room for notes

Can an egg swim?

Task

Put an egg in water and keep a watch on it while you stepwise add salt.

Material

1 Beaker, 100 ml
1 Beaker, 250 ml
1 Spoon spatula
1 Glass rod

Egg
Salt

Fig. 1

Set-up and procedure

- Place an egg in a beaker and fill the beaker up to the 250 ml mark with water.
- Record the position of the egg.
- Add in salt from the 100 ml beaker spoonful by spoonful.
- Carefully stir with the rod after adding each spoonful to bring the salt to dissolve (Fig. 1).
- Take care not to break the egg while stirring.
- Keep a watch on the position of the egg and record changes in it.

Observations

1. Where was the egg at the start of the experiment?

....

....

....

2. How did the position of the egg change?

....

....

....

Evaluation

1. Why does the egg rise up in salt water?

....

....

....

2. Do you know of a similar phenomenon which occurs in nature?

....

....

....

....

....

(Can an egg swim?)

Material

Eggs

Salt

Preparation

Each student group needs an egg and approx. 15 spoonfuls of salt, which is to be given out in the 100 ml beaker.

Notes on set-up and procedure

Stirring is to be carried out after each addition of a spoonful of salt until the added salt has completely dissolved. The egg begins to become suspended when 10-12 spoonfuls have been added. It begins to float after further 1 or 2 spoonfuls have been added.

Observation

1. The egg was lying at the bottom of the beaker.
2. The egg first started to become suspended until it finally floated.

Evaluation

1. The addition of salt increases the density of the water. As soon as the salt water has the same density as the egg, the egg begins to become suspended. When the density of the egg is exceeded, it floats at the surface.
2. The salt content of the Dead Sea is so high that one can float on it and be washed along without having to swim.

Room for notes

How does the temperature of water change when salt is dissolved in it?

Task

Dissolve salt in water while measuring the temperature.

Material

2 Screw cap jars
1 Beaker, 100 ml
1 Funnel
1 Thermomether
1 Spoon spatula

Salt

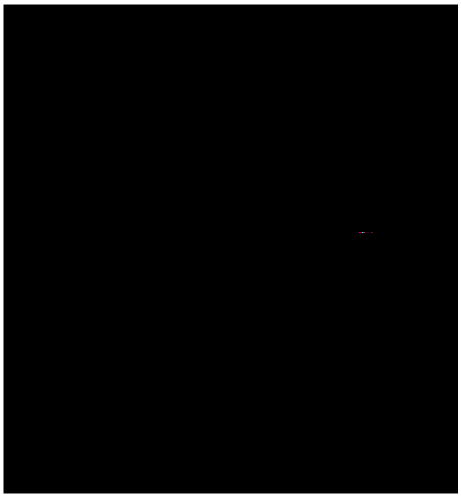


Fig. 1

Fig. 2

Set-up and procedure

- Half-fill a screw-cap bottle with water.
- Tip a spoonful of salt from the 100 ml beaker into the bottle through the funnel. Close the bottle with the screw-cap (Fig. 1)
- Hold the bottle in a closed hand and shake it vigorously until the salt has dissolved (Fig. 2).
- Record what happened.
- Now also fill the second screw-cap bottle half-full with water.
- Use a thermometer to measure the temperature of the water and record the value (Fig.3).
- Add a spoonful of salt into the bottle through the funnel and close the bottle.
- Hold this bottle between thumb and forefinger and shake it until the salt has dissolved (Fig. 4).
- Hold the bottle at the upper rim and again measure the temperature. Compare the temperature values obtained.

Fig. 3

Fig. 4

Observations

1. What did your hand feel as you shook the bottle?

....

....

....

....

....

2. Water temperature without salt:

....

....

3. Water temperature with salt:

....

....

Evaluation

4. What can you derive from your observations?

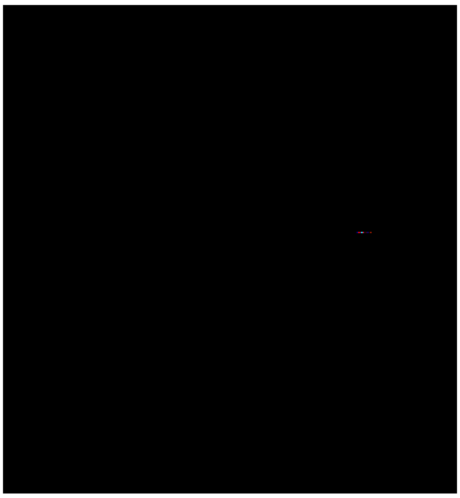
....

....

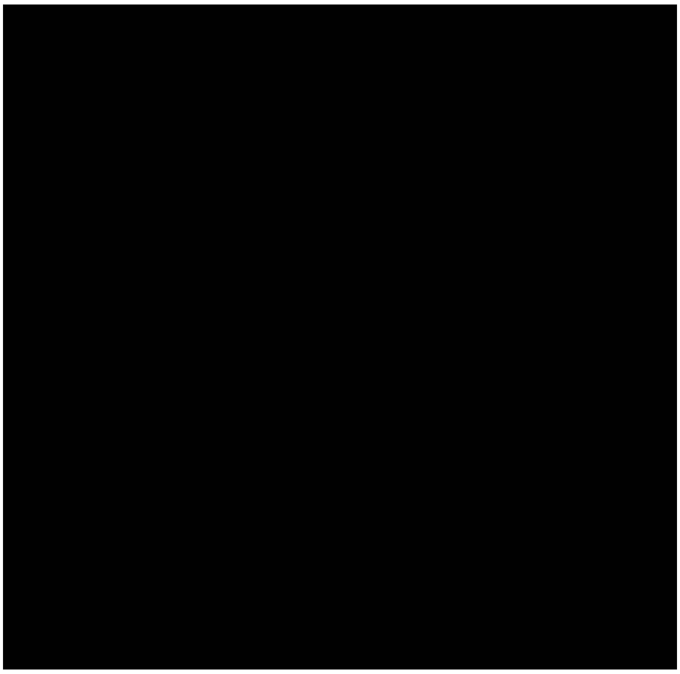
....

....

....



Room for notes



(How does the temperature of water change when salt is dissolved in it?)

Material
Salt

Preparation
Each student group needs two spoonfuls of salt which are to be given out in the 100 ml beaker.

Notes on set-up and procedure
The students must begin shaking very quickly after the addition of salt to be able to feel the temperature effect. The change in temperature is very small and can only be felt for a very short time.

Observation
1. The bottle cooled a little.
2. 24°C
3. 23°C

Evaluation
1. Water cools while salt dissolves.

Room for notes

Colder than ice

How can one combat unwanted ice?

Task

Measure the temperature of melting ice cubes.

Use ice and salt to prepare a refrigerant mixture.

Material

2 Beakers, 100 ml
1 Beaker, 250 ml
2 Thermometers
1 Spoon spatula

Salt
Ice cubes
Crushed ice

Fig. 1

Set-up and procedure

- Fill 20 ml of one of the water samples in a screw-cap bottle (Fig. 1).
- Dip an indicator strip in the water for 1 second and shake it a little when you take it out to remove excess water (Fig. 2).
- Use a water-resistant pen to mark the test strip so that you can recognise to which water sample it belongs (Fig. 3).
- Carry out the same procedure with the other water samples.
- Compare the test strips with the colour scale which your teacher will give you (Fig. 4).
- Enter your observations in the Table below.

Fig. 2

Observations

1. What did you observe as the two ice cubes melted?

....

....

....

....

....

2. Temperature in the beaker without salt:

....

3. Temperature in the beaker with salt:

....

4. Temperature of the refrigerant mixture:

....

Evaluation

1. Why is salt sprayed on icy roads?

....

....

....

....

....

2. What is the effect of a mixture of ice and salt?

....

....

....

....

....

Room for notes

(How can one combat unwanted ice?)

Material

Salt

Ice cubes

Crushed ice

1 Hammer

1 Towel

Preparation

Each student group requires two ice cubes and two spoonfuls of crushed ice for the first part of the experiment.

They require crushed ice for the second part of the experiment. A convenient way to make this is to wrap ice cubes in a towel and hit them with a hammer. The amount made must be sufficient for each student group to receive a 250ml beaker half-filled with crushed ice.

Notes on set-up and procedure

In the first part of the experiment, the temperature of the meltwater must be measured directly at the ice cubes for a clearly recognisable temperature difference.

The temperature of the refrigerant mixture sinks the most when about two spoonfuls of salt are layered on each ice layer and three of four layers are made in this way.

Observation

1. The ice cube with salt melted quicker than the one without it.
2. 0°C
3. -3°C
4. -13°C

Evaluation

1. Salt causes the ice to melt at temperatures below 0°C.
2. With ice and salt one can prepare a refrigerant mixture in which the temperature is distinctly below the freezing point of water.

Room for notes

How can one measure the hardness of water?

Task

Determine the hardness of different types of water.

Material

3 Screw cap jars
1 Measuring cylinder

Water-resistant pen
Samples of different types of water
Indicator strips

Fig. 1

Set-up and procedure

- Fill 20 ml of one of the water samples in a screw-cap bottle (Fig. 1).
- Dip an indicator strip in the water for 1 second and shake it a little when you take it out to remove excess water (Fig. 2).
- Use a water-resistant pen to mark the test strip so that you can recognise to which water sample it belongs (Fig. 3).
- Carry out the same procedure with the other water samples.
- Compare the test strips with the colour scale which your teacher will give you (Fig. 4).
- Enter your observations in the Table below.

Fig. 2

Observations

1.

Water sample	Colour of the indicator strip	Water hardness / °e (or ppm)

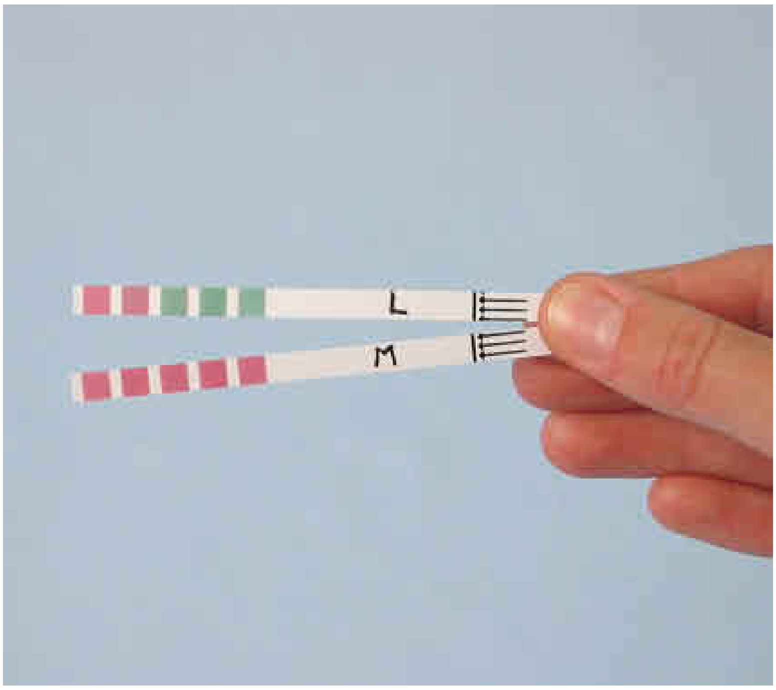


Fig. 3

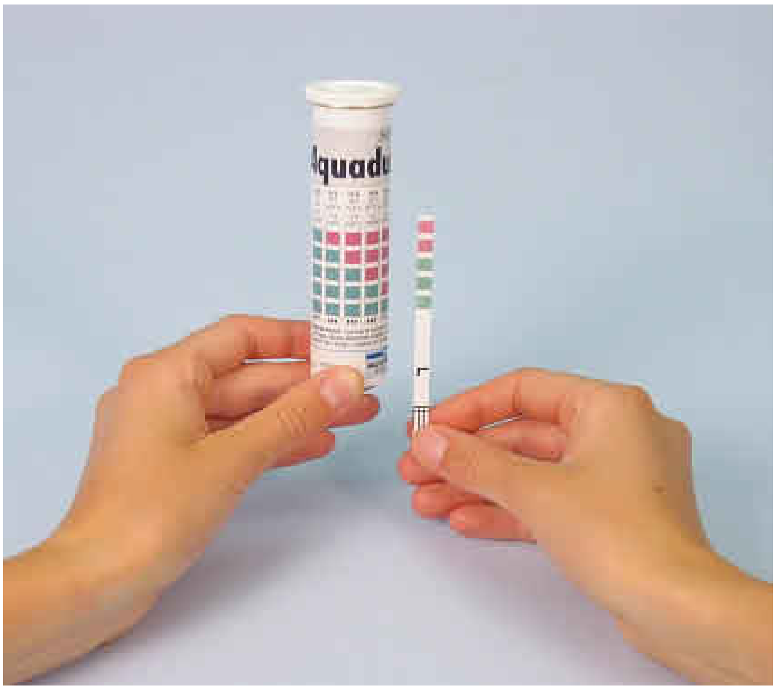


Fig. 4

Evaluation

1. Write in the names of the water samples in the succession of their hardness.

 ....

 ....

 ....

 ....

 ....

2. Where can hard water cause damage?

 ....

 ....

 ....

 ....

 ....

3. For what is hard water useful?

 ....

 ....

 ....

 ....

 ....

(How can one measure the hardness of water?)

Material

Indicator strips

Various types of water Crushed ice

Preparation

Samples of different types of water, each having a different hardness, are required here.

Rainwater and distilled water have a low hardness, tap water has a medium hardness and mineral water is particularly hard.

Each student group needs the same number of test strips as the number of water samples.

Notes on set-up and procedure

The colour scale can be explained when all students have finished carrying out the tests.

Subsequent to this, they can compare the results they have obtained from the colour scale.

Observation

1.

Water sample	Colour of the indicator strip	Water hardness / °e (or ppm)
Rainwater	5 times green	0
Tap water	3 times green, 2 times red	10
Mineral water	5 times red	25

* 1°e (= 14.3 mg CaCO3 per 1000 ml of water) = 14.3 ppm (= 1 mg CaCO3 per 1000 ml of water)

Evaluation

1. Rainwater, tap water, mineral water
2. Hard water can cause scaling in water pipes, dishwashers and coffee machines.
3. The substances which cause scaling in pipes and appliances are important minerals for us. Mineral water has a particularly large content of important minerals.

Room for notes

How does soap behave in hard and soft water?

Task

Determine the action of soap (washing powder) in various types of water.

Material

2 Screw cap jars
1 Measuring cylinder, 50 ml
1 Spatula, double blade
1 Screw cap jar containing washing powder
Still mineral water
Distilled water or rainwater

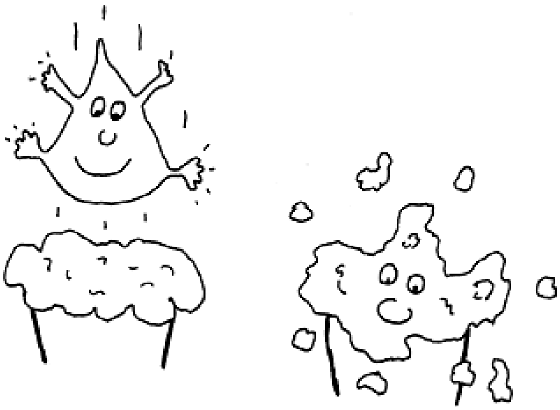


Fig. 1

Fig. 2

Set-up and procedure

- Use the measuring cylinder to fill 10 ml of each water sample into a separate screw-cap bottle (Fig. 1).
- Drop one grain of washing powder in each bottle (Fig. 2).
- Take hold of the bottles, one in each hand, and shake them in unison. (Fig. 3)
- Compare the formation of suds in each bottle and record your observations (Fig. 4).

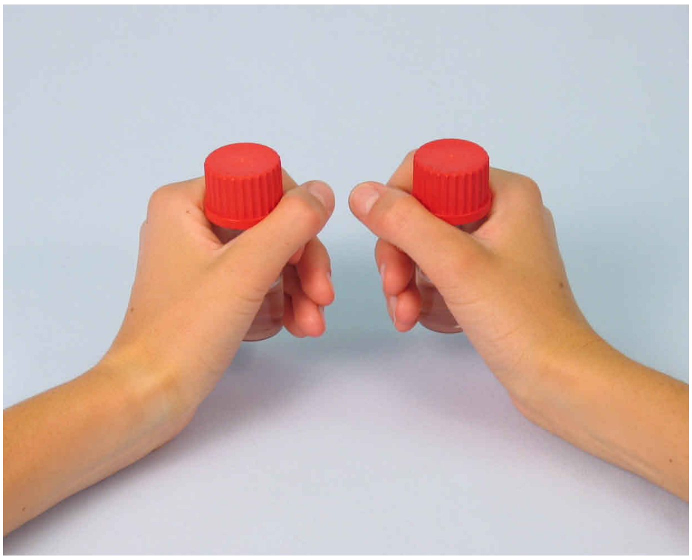


Fig. 3

Fig. 4

Observations

1. Is there any difference to be seen in the bottles after shaking them?

....

....

....

....

....

Evaluation

1. Explain the different behaviour in the two bottles?

....

....

....

....

(How does soap behave in hard and soft water?)

Material

Still mineral water

Distilled water or rainwater

Preparation

Rainwater has about the same softness as distilled water and can so be used as alternative.

Notes on set-up and procedure

It is necessary here that more suds can be seen with the soft water sample. For this to occur, the two water samples must have a sufficient difference in their hardness. In addition, it is important that the soap concentration is not too high so that the amount of washing powder added must be as according to the instructions.

Observation

1. There are different amounts of suds (foam) in the bottles.

Evaluation

1. The foam in the soft water sample is distinctly higher than that in the other water sample. Hard water restricts the formation of foam and also the washing effect of soap. The height of the foam is a pointer to the degree of hardness of a water sample.

Room for notes

How can you mix water and oil?

Task

Make a mixture of water and oil.

Material

2 Beakers, 100 ml
2 Glass rods
Dropping bottle containing oil
Dropping bottle containing washing-up liquid

Fig. 1

Set-up and procedure

- Half-fill each beaker with water (Fig. 1).
- Use the dropping bottle to add 5 drops of oil to each beaker.
- Mix the two liquids with stirrer rods (Fig. 2).
- Keep a watch on the surfaces.
- Use the second dropping bottle to add five drops of washing-up liquid to the water in one of the beakers (Fig. 3).
- Stir again.
- Take care not to cause too much foam in the beaker in which foam is formed.
- Compare the two surfaces of the liquids and record your observations.

Fig. 2

Fig. 3

Observations

1. Surface without washing-up liquid:

   ....

   ....

   ....

2. Surface with washing-up liquid:

   ....

   ....

   ....

Evaluation

1. Can you explain why the two surfaces are different?

 ....

 ....

 ....

 ....

 ....

2. What is the effect of washing-up liquid when dishes are washed-up?

 ....

 ....

 ....

 ....

 ....

 ....

Room for notes

(How can you mix water and oil?)

Observation

1. Oil swims at the surface in large drops.
2. Oil is finely distributed at the surface and in the water. The water is turbid.

Evaluation

1. Water and oil do not mix. As oil is lighter than water, it swims at the surface. Mixing of oil and water is made possible by the addition of washing-up liquid.
2. Washing-up liquid enables fatty residues to be taken up by water and rinsed away with it.

Room for notes

What happens when you slip coins into a beaker full of water?

Task

Fill a beaker to the brim with water and add coins one after the other.

Material

2 Beakers, 100 ml
1 Glass rod
1 Dropping bottle containing washing-up liquid

Coins

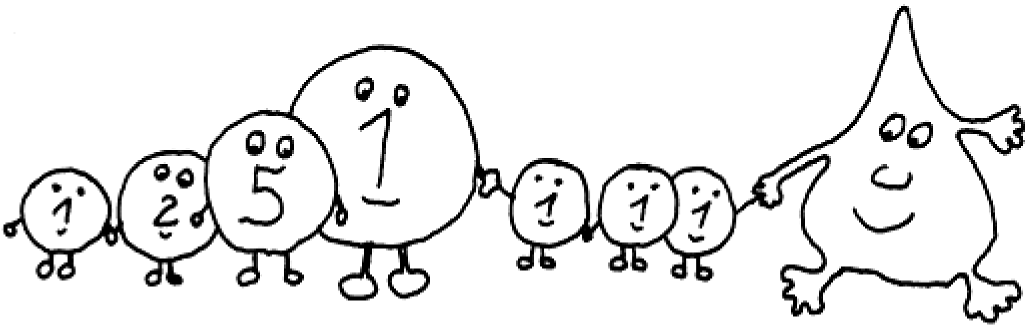


Fig. 1

Set-up and procedure

- Fill a beaker brimful with water.
- While doing this, take care not to wet the rim of the beaker.
- Take some coins and let them slide into the beaker one after the other without causing the water to overflow while doing this (Fig. 1).
- Keep a watch on the water surface from the side. What do you observe?
- Record how many coins you could slide in the beaker.
- Fill the second beaker with water, add one drop of washing-up liquid and stir briefly.
- Repeat the coin adding procedure. What happens?

Observations

1. How many coins could you put in the beaker?

   ....

2. What could you see from the side?

   ....

   ....

   ....

3. What happened after you added washing-up liquid?

   ....

   ....

   ....

Evaluation

1. Why could you put more coins in the beaker although it was already brimful?

   ....

   ....

   ....

   ....

2. What is the effect of the washing-up liquid?

   ....

   ....

   ....

   ....

(What happens when you slip coins into a beaker full of water?)

Material

Coins

Preparation

Each student group needs about five coins. The number can vary according to the size of the beaker and the filling-height.

Notes on set-up and procedure

The meniscus of the water in the beaker should not be above the rim before coins are added. Wetting of the rim of the beaker must be avoided.

Observation

1. A total of 5 coins of between 1 and 50 cents were put in.
2. A wall of water forms above the rim of the beaker.
3. Water overflows after only a few coins have been added.

Evaluation

1. Further coins could be added because the water arches up so that the water level is higher than the brim. Water particles are highly cohesive. This cohesion is called surface tension.
2. Washing-up liquid prevents a wall of water. Washing-up liquid particles occupy the water surface and disrupt water particle cohesion there. The surface tension is hereby reduced.

Room for notes

Can a paper clip float?

Task

Fill a beaker with water and try to make a paper clip float.

Material

1 Beaker, 100 ml
1 Dropping bottle containing washing-up liquid
1 Pipette

Paper clips

Fig. 1

Set-up and procedure

- Fill the beaker to the 100 ml mark with water.
- Pick up a paper clip and bring it to lie on the surface of the water (Fig. 1).
- Use a pipette to carefully drop a few drops of water in the water without wetting the paper clip.
- Record what you observe?
- Now add a drop of washing-up liquid to the water (Fig. 2).
- What happens?

Fig. 2

Observations

1. What did you observe when a few drops of water were added?

....

....

....

....

....

....

2. What happened when a drop of washing-up liquid was added?

....

....

....

....

....

....

Evaluation

1. Can you think of any similar behaviour in nature?

....

....

....

....

....

Room for notes

(Can a paper clip float?)

Material

Paper clips

Preparation

Each student group needs just one paper clip which is not to be bent.

Notes on set-up and procedure

A steady hand is necessary to be able to position the paper clip on the water surface. It only floats when the whole of the underside simultaneously touches the water.

Observation

1. The water surface moved but the paper clip did not sink.
2. The paper clip sank immediately.

Evaluation

1. Pond skaters make use of the surface tension of water. The resistance of the surface is sufficient to carry the weight of such an insect.

Room for notes

How can a paper boat be brought to move without you giving it a push?

Task

Fold a paper boat and fit it out with a soap drive.

Material

Storage box cover

Quadratic piece of paper
Scissors
Adhesive tape
Soap

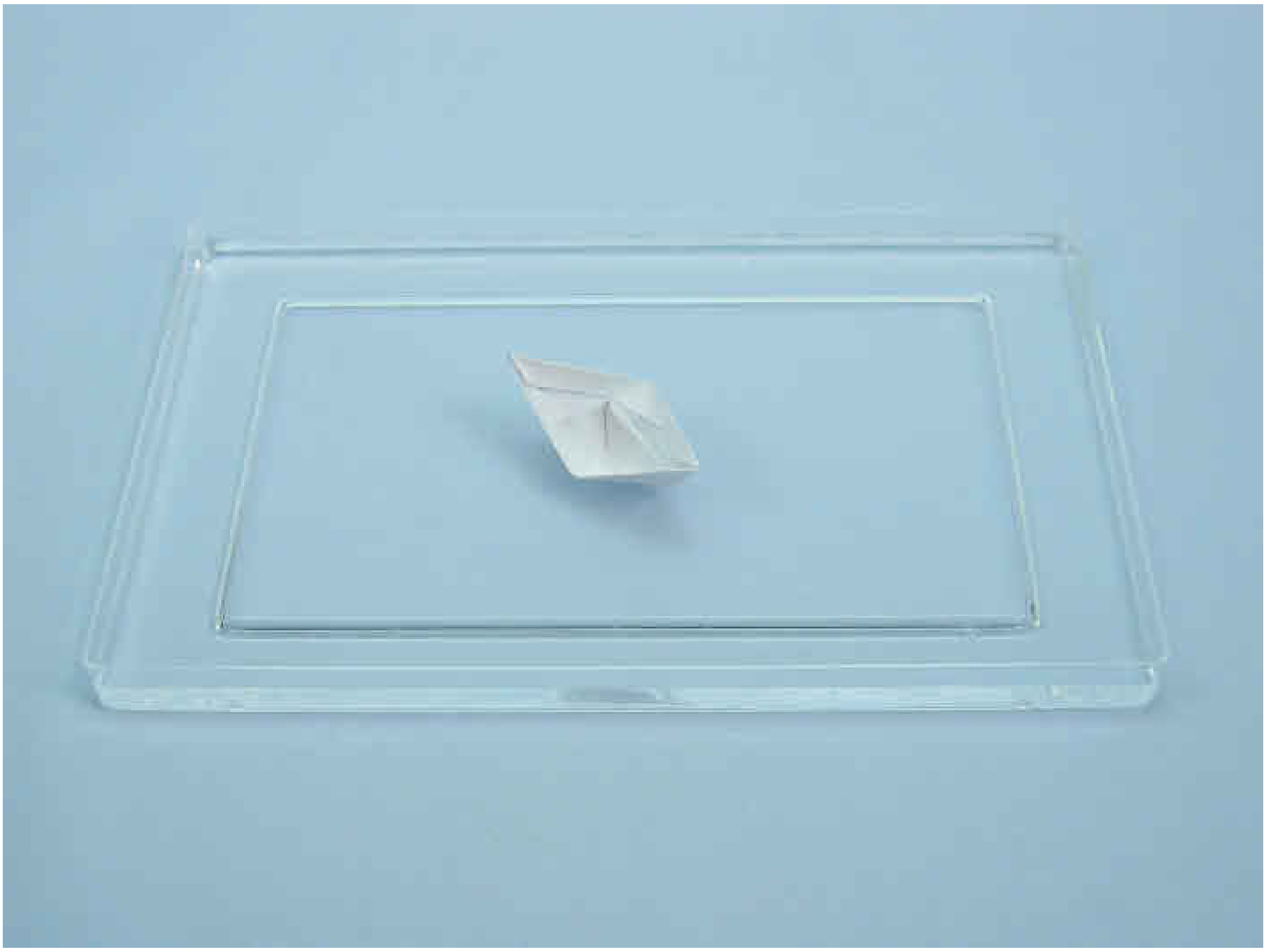


Fig. 1

Set-up and procedure

- Make a boat from an 8 cm x 10 cm sheet of paper.
- Insert a small piece of soap in a side slit at the bottom of the boat and fix it there with a piece of adhesive tape.
- Fill the storage box cover with water.
- Carefully place the boat on the surface of the water and keep a watch on it.

Observations

1. How does the paper boat behave?

....

....

....

....

Evaluation

1. What makes the boat move?

....

....

....

....

The soap boat

(How can a paper boat be brought to move without you giving it a push?)

Material

Paper
Scissors
Knife
Soap
Adhesive tape

Preparation

Quadratic sheets of paper of size 8 cm x 10 cm are needed for the boats. To prpare these pieces from an A4 sheet, fold the sheet three times and then cut it along the folds to give eight rectangles.

The knife is required for cutting a piece of soap to pea-size pieces.

The cover of the storage box should be filled to just under the brim with water.

Each student group needs an approx. 2 cm length of adhesive tape for fixing the pea-size pieces of soap in position.

Notes on set-up and procedure

The small piece of soap must be so fixed to the boat that it protrudes into the water.

Observation

1. The boat began to move.

Evaluation

1. Soap dissolves in water. The resulting soap particles press the water particles apart and this causes a movement of the water which then drives the boat.

Room for notes

How can you tear a dusty surface apart?

Task

Examine how washing-up liquid acts on a dusty water surface.

Material

1 Beaker, 250 ml
1 Screw cap jar containing cork dust

Dropping bottle containing washing-up liquid

Fig. 1

Set-up and procedure

- Fill the beaker up to the 250 ml mark with water.
- Carefully sprinkle a thin layer of cork dust on the water surface (Fig. 1).
- Add a drop of washing-up liquid at the middle of the water surface (Fig. 2).
- Watch and record what happens.

Fig. 2

Observations

1. What happens to the cork dust layer?

....

....

....

Evaluation

1. Which effect does washing-up liquid have on the water surface?

....

....

....

....

(How can you tear a dusty surface apart?)

Notes on set-up and procedure

The cork dust is to be sprinkled as evenly as possible over the water surface otherwise it could possibly sink down before the washing-up liquid is added. The “tearing apart” effect would then not be as impressive as when it first sinks after washing-up liquid is added.

Observation

1. The cork dust layer is torn apart when the drop of washing-up liquid is added. The cork dust collects at the wetted edge of the beaker and slowly sinks.0°C

Evaluation

1. The washing-up liquid particles distribute themselves over the water surface and force the cork dust against the side of the beaker. The surface tension of the water has now been broken down so that cork dust can no longer be held at the water surface and slowly sinks down.

Room for notes

A drop of water

How does a drop of water behave on cloth?

Task

Examine how washing powder acts on a drop of water.

Material

2 Beakers, 100 ml
1 Beaker, 250 ml
1 Pipette
1 Glass rod
1 Spatula, double blade
Screw top jar containing washing powder

Piece of cloth
Elastic band

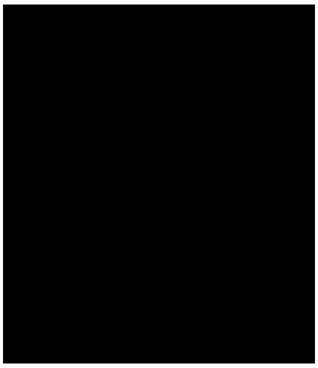


Fig. 1

Set-up and procedure

- Use an elastic band to hold the piece of cloth over the mouth of the 250 ml beaker (Fig. 1).
- Half-fill each of the 100 ml beakers with water.
- Add a spatula tip of washing powder to one of the beakers and stir with the rod.
- Use the pipette to drop one drop of the water without washing powder on the cloth (Fig. 2).
- Describe the shape of the drop.
- Pick the beaker up and hold it at an angle. What happens to the water drop?
- Now use the pipette to drop a little of the “washing powder water” on the cloth.
- What happens to this drop?

Fig. 2

Observations

1. How does the drop of water look?

....

....

....

....

....

2. What happens to the drop of water when the beaker is held inclined?

....

....

....

....

....

3. What happens to the “washing powder drop”?

....

....

....

....

....

Evaluation

1. Explain the difference in the behaviours of the drops of water.

....

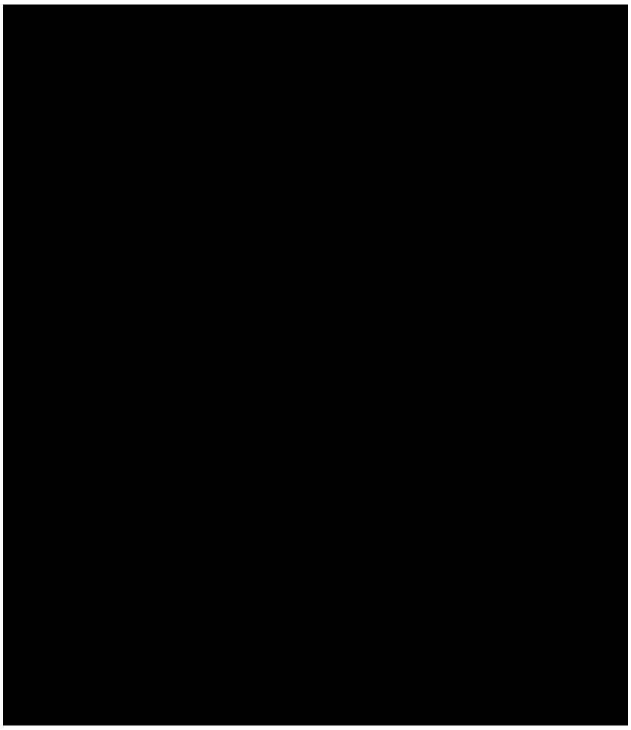
....

....

....

....

Room for notes



(How does a drop of water behave on cloth?)

Material

Cloth

Elastic bands

Preparation

Each student group needs a 10 cm x 10 cm large piece of cloth and an elastic band.

The cloth should be slightly non-wetting but not waterproof. A piece of fine-mesh tights is most suitable.

Notes on set-up and procedure

A steady hand is necessary to be able to position the paper clip on the water surface. It only floats when the whole of the underside simultaneously touches the water.

Observation

1. The drop of water has a half-round shape which arches upwards.
2. The drop runs off of the cloth.
3. The washing powder immediately passes into the cloth.

Evaluation

1. The arched form of the drop of water is caused by the surface tension of water. The running off behaviour can also be explained by this, as it causes a surface to form which is resistant to not only to the ambient air but also against the cloth. Washing powder lowers the surface tension so that the drop can no longer keep its shape and the soapy water can penetrate in the fabric and reach any dirt particles which are there.

Room for notes

How can water be cleaned?

Task

Use different separation techniques to clean water.

Material

2 Beakers, 100 ml
1 Beaker, 250 ml
1 Spoon spatula
1 Glass rod
1 Right angle clamp
1 Erlenmeyer nar. neck
1 Funnel
1 Filter paper
1 Support rod, 250 mm
1 Universal clamp

Storage box cover
Sand
Garden mould

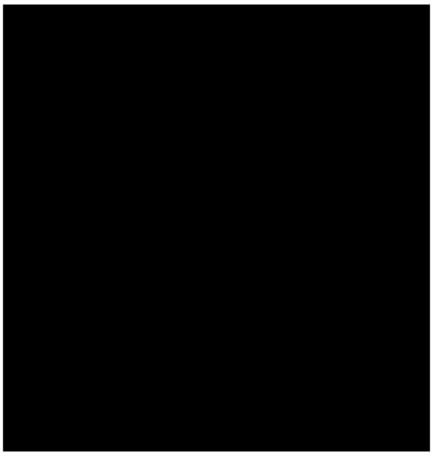


Fig. 1

Set-up and procedure

- Set up the filter stand as shown in Fig. 1.
- Pick up the cover of the storage box, turn it over and place it back on the box in the reverse position so that it can act as a tray.
- Stand the Erlenmeyer flask directly under the clamp of the filter stand.
- Fold the filter paper as shown in the Figure and insert it in the funnel (Fig. 2)
- Now make dirty water. To do this, put a spoonful of sand and a spoonful of garden mould in the 100 ml beaker, then fill up to 80 ml mark with water and briefly stir.
- For the next 5 minutes, observe what happens in the beaker from the side.
- Use the spatula to scoop off all parts which are floating on the surface and transfer them to the 250 ml beaker.
- Pour off the water which is above the sediment on the bottom in the second 100 ml beaker. This process is called “decanting“.
- Describe the contents of the three beakers.
- Pour the decanted water into the filter funnel little by little.
- Hold the Erlenmeyer flask containing the filtrate against the light and describe what you see.

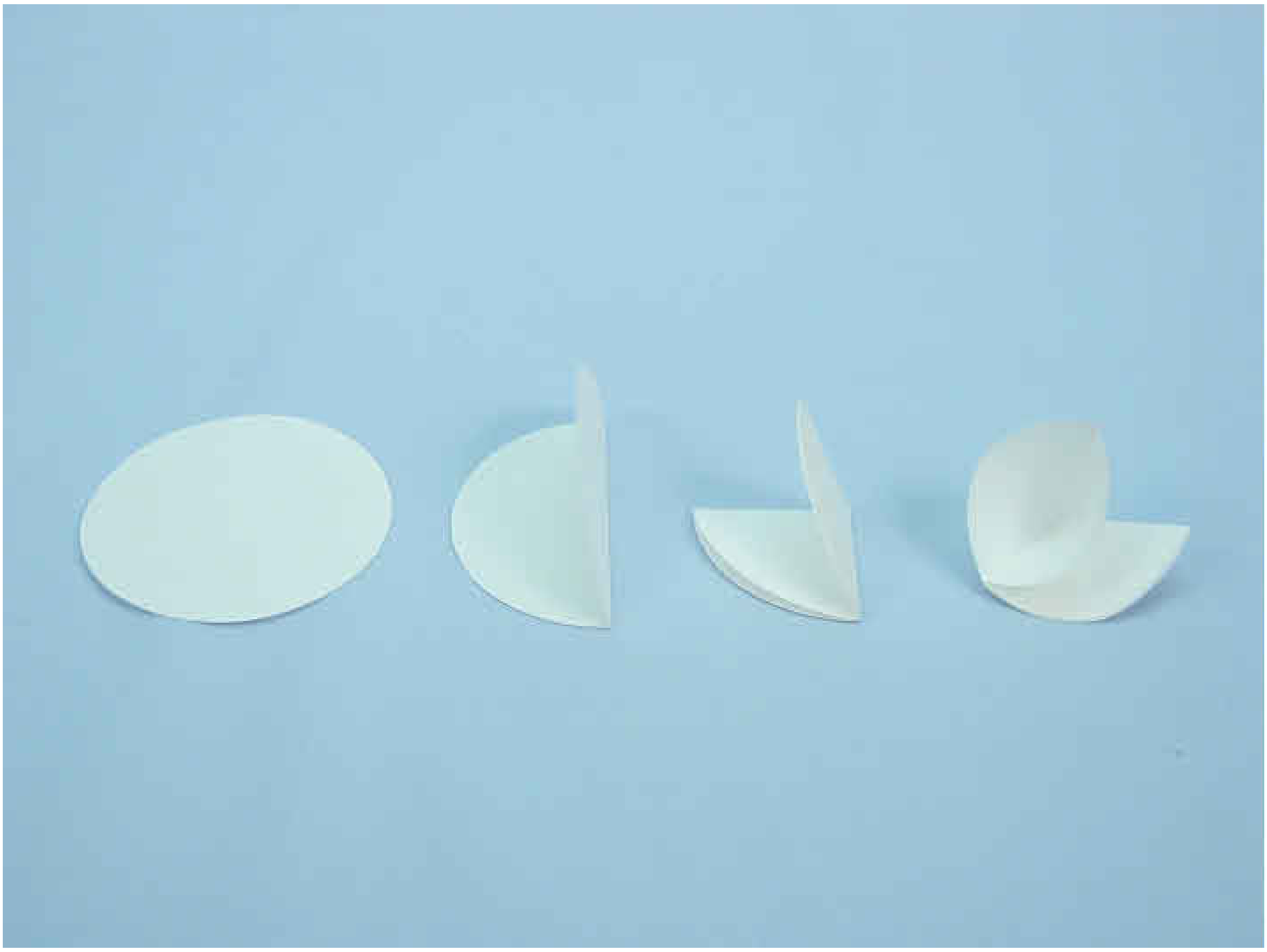


Fig. 2

Observations

1. What did you observe as you briefly stirred the contents in the beaker?

   ....

   ....

   ....

   ....

   ....

2. What do the contents of the three beakers look like?

   ....

   ....

   ....

   ....

   ....

3. Describe the residue in the filter and the filtrate in the Erlenmeyer flask.

   ....

   ....

   ....

   ....

   ....

Evaluation

1. Do you know the names given to the various separating processes?

   ....

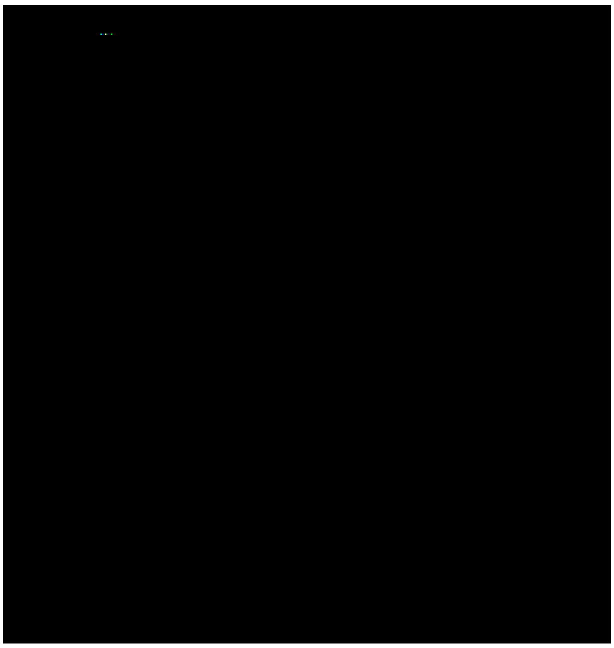
   ....

   ....

   ....

   ....

2. Why does a sewage works have different tanks?



(How can water be cleaned?)

Material

Sand

Garden earth

Preparation

Each student group needs a spoonful of sand and a spoonful of garden mould.

Observation

1. When the water stopped moving, some substances were deposited at the bottom of the beaker, others were suspended and the rest were floating on the surface of the water.
2. The lightest part of the garden mould is in the 250 ml beaker. The 100 ml beaker with the sediment from the bottom contains sand and heavy parts of the garden mould. The suspended particles are in the beaker containing the decanted water.
3. The filter contains fine suspended substances which could not pass through the pores of the filter. The filtrate is slightly turbid.

Evaluation

1. Sedimentation: Settling
   Decanting: Pouring off
   Filtration: Pour through a filter
2. The cleaning of water requires several successive steps in which contaminants are removed, for example, by size and weight. There are additionally tanks in which contaminants are degraded by bacteria and chemicals.

Room for notes

In this experiment the three states of aggregation of water are to be demonstrated and related to the temperature.

Material

2	Beakers, low, 400 ml	46055-00
1	Retort stand	37692-00
1	Ring with boss head	37701-01
1	Wire gauze, ceramic cen.	33287-01
1	Butane burner for cartridge	32180-00
1	Right angle clamp	37697-00
1	Universal clamp	37715-00
1	Lab thermometer	38056-00
1	Dropping pipette with bulb	47131-01
	Ice cubes	

Additional material

Boiling chips, 200 g	36937-20

Fig. 1

Set up and procedure

Determination of the boiling point

- Set up the experiment as shown in Fig. 1.
- Half-fill the 400 ml beaker with water, add a few boiling stones and dip the thermometer into the water.
- Use the butane burner to heat the water.
- Measure the water temperature during the whole heating process.

Solid, liquid, gaseous

- Drop an ice cube in a 400 ml beaker.
- Measure the temperature directly at the ice cube.
- Now use the pipette to drop hot water from the first part of the experiment onto the ice cube.

Observations

The water temperature increased up to 100°C, but did not go above this. Small bubbles were formed at the boiling stones shortly before this temperature was reached. At 100°C, many bubbles ascended in the water, the water surface started to move and steam was given off. A bubbling sound was to be heard.

When the hot water met the ice cube, steam was immediately formed and the ice melted.

Evaluation

Water is liquid from 0°C to 100°C. It is solid below the freezing point of 0°C. It is a gas above the boiling point of 100°C.

When water is brought to boil, bubbles of gaseous water rise up from the bottom of the beaker where the boiling point has already been reached. The rising of the gas through the liquid causes the bubbling sound.

All three of the states of aggregation of water - solid, liquid and gaseous - can be simultaneously observed when hot water is dropped on an ice cube.

Water hardness

In this experiment the hardness of water samples which were differently treated is to be examined by separately evaporating them to dryness and comparing their residues.

Material

3	Evapor. dish, spout,15ml	46250-00
3	Beakers, low, 100 ml	46053-00
1	Crucible tongs	33600-00
1	Butane burner for cartridge	32180-00
1	Graduated pipette, 5 ml	36599-00
1	Pipettor	47127-01
	Rainwater or distilled water	
	Tap water	
	Still mineral water	

Additional material

Protecting glasses, clear glass	39316-00

Fig. 1

Set up and procedure

- Fill each water sample into a separate 100 ml beaker.
- Successively pipette 5 ml of the water samples into separate evaporating dishes but, before pipetting the next water sample, allow the remaining water in the pipette to empty out and dry the pipette with absorbent paper.
- Light the butane burner.
- Use the tongs to grip the edge of one of the evaporating dishes and swivel the dish around a little in the flame until all water has evaporated. As hot water could spurt out of the dish should delayed boiling occur, wear protective eyewear and ensure that the students keep at a safe distance when this is being carried out.
- Carry out the same procedure with the other two dishes.
- Finally stand the dishes alongside each other and compare the residues.

Observations

White coatings are to be observed in every dish. Mineral water left the most coating, rainwater or distilled water left the least and the tap water coating is in between.

Evaluation

Mineral water and tap water contain sodium, potassium, calcium and magnesium salts. These do not evaporate when the water is boiled but remain in the dish as a residue. Rain water and distilled water have only a low salt content.

Calcium and magnesium salts are responsible for the hardness of water. The amount of residue is a pointer to the degree of hardness of the water sample.

River bank filtration

Filtration is a process which can separate solid substances from liquids.

This process also occurs in nature. River bank filtration is an example of this: The various ground layers of river banks act as filters of different pore size and so exert a cleaning effect.

Material

1	Glass tube	64940-00
1	Rubber stopper	39258-01
1	Glass tube	36701-65
1	Retort stand	37692-00
1	Right angle clamp	37697-00
1	Universal clamp	37715-00
2	Beakers, low, 400 ml	46055-00
1	Spoon, special steel	33398-00
1	Dropping pipette with bulb	47131-01
1	Glass wool100g	48154-10

Gravel
Sand
Garden mould
Sawdust
Coffee powder
Clay
Cooking oil

Additional material

Glycerol	30084-10

Fig. 1

Set up and procedure

- Prepare a dirty water sample by filling water into a 400 ml beaker and dirtying the water with clay, sawdust, coffee powder and a few drops of cooking oil.
- Set up the experiment as shown in Fig.1.
- Insert the smaller glass tube in the hole at the wider side of the stopper until the lower end of the tube is flush with the edge of the other side of the stopper. To simplify this, first lubricate the lower outside part of the tube with a drop of glycerol.
- Fit the stopper in the lower opening of the larger glass tube.
- Now push a ball of glass wool into the larger tube.
- Add layers of garden mould, sand and gravel in this succession.
- Pour dirty water into the tube and place the second 400 ml beaker under the tube to collect the filtrate.

Observations

Clean water drops out from the tube.

Evaluation

The contaminants have been removed by the various layers in the tube.

Rivers and lakes have a similar ground layering which is typically humus, sand, gravel and stones. There is a water impermeable layer under the stones.

Filtration is a process which can separate solid substances from liquids.

This process also occurs in nature. River bank filtration is an example of this: The various ground layers of river banks act as filters of different pore size and so exert a cleaning effect.

Material

1	Distilling bridge	35902-15	1	Ring with boss head	37701-01
1	Flask,round,250ml	35812-15	1	Wire gauze, ceramic cen.	33287-01
1	Erlenmeyer wide neck, 100ml	46151-00	1	Butane burner for cartridge	32180-00
1	Lab thermometer	38056-00	1	Beaker, low, 400 ml	46055-00
1	Retort stand	37692-00	1	Funnel, glass	34459-00
2	Right angle clamp	37697-00	1	Spoon, special steel	33398-00
2	Universal clamp	37715-00	1	Glass rod	40485-03

Additional material

Boiling chips, 200 g	36937-20
Patent Blue V (sodium salt), 25 g	48376-04
Microspoon, steel	33393-00

Fig. 1

Set up and procedure

- Set up the apparatus as shown in Fig.1.
- Fill approx. 100 ml of water in the 400 ml beaker.
- Use the micro spatula to add a small amount of patent blue and dissolve it by stirring with the stirrer rod. The food colouring has a very intensive colour so that only a few crystals are required. Patent blue is a water soluble food colouring dye which is completely excreted after ingestion and so is not harmful to health.
- First insert a few boiling stones in the 250 ml round-bottomed flask and then fill the blue solution into the flask through a funnel.
- Use the butane burner to heat the solution.
- Continue the distillation until an easily visible amount of colourless water has collected in the conical Erlenmeyer flask. Do not allow the solution in the round-bottomed flask to evaporate to dryness.

Observations

The solution began to boil at 100°C. Small drops formed at the wall of the distilling bridge. A colourless liquid dropped into the conical flask and the solution in the round-bottomed flask remained coloured.

Evaluation

Water has a boiling point of 100°C and steam is evolved when this temperature is reached steam. Patent blue dye has a far higher boiling point and so does not evaporate with the steam. The steam cools at the distillation bridge wall, condenses and runs down into the conical flask, which is called the receiver, as colourless water.

This experiment introduces both an important separation process and also the terms “boiling” and “condensing”. It additionally clarifies the meaning of the term “distilled water”.

This experiment demonstrates that water conducts electricity. In connection with this, reference can be made to the possible risks which arise when electrical appliances are used in a bathroom.

Material

1	Lamp holder E10	06170-01
1	Filament lamps 1.5V	06150-03
1	Knife switch, transparent	06034-06
1	Battery case, transparent	06030-22
1	Flat battery, 4.5 V	07496-01
4	Connecting cord, black	07361-05
	Bath salts	
2	Iron electrode	45204-00
1	Holder for two electrodes	45284-01
1	Retort stand	37692-00
1	Right angle clamp	37697-00
1	Beaker, low, 400 ml	46055-00
1	Spoon, special steel	33398-00
1	Glass rod	40485-03

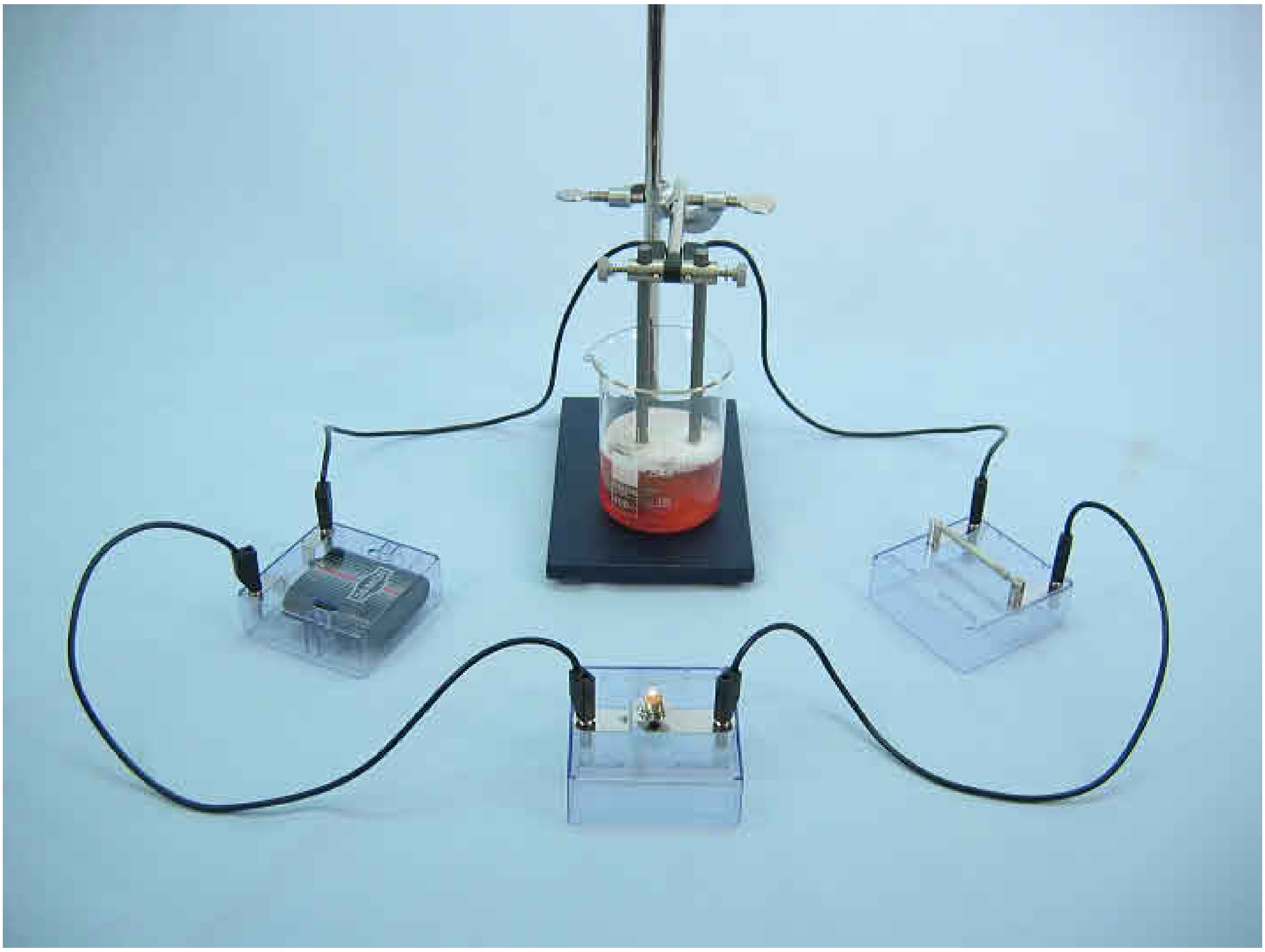


Fig. 1

Set up and procedure

- Set up the apparatus as shown in Fig.1. The switch must be at the “off” position.
- Fill approx. 200 ml of water into a 400 ml beaker.
- Use the spatula to add three spoonfuls of bath salts. Stir with the rod to dissolve them.
- Position the beaker under the electrodes and lower the electrode holder so that the electrodes dip a few centimetres into the solution.
- Now close the circuit by operating the switch.

Observations

The lamp lights up.

Evaluation

Water conducts electric current because it contains ions as charge carriers. The conductivity of water would not be sufficient to bring the lamp to light up in this experimental set-up, however. Bath salts are therefore used to increase the number of ions and so also the conductivity. The use of bath salts here can first be explained as being to simulate bath water. A discussion can later be held on the real life situation of 230 V from a socket (compared to 4.5 V from a flat cell battery) which is sufficient to cause a bad accident even for water without bath salts, e.g. should a hair dryer or radio fall in it by accident.

The small bubbles which arise from electrolysis can hardly be explained to classes 5 and 6.

It would be sufficient to say here that electric current can decompose water.

