Water: Water quality experiments

These four subexperiments on water quality based on Experimento | 10+ are designed to encourage learning through research in science class in the lower grades. The materials are editable and can be adapted individually to the learning group or supplemented with other interesting content from the media portal of the Siemens Stiftung (https://medienportal.siemens-stiftung.org).

The subexperiments are:

1. Do all substances dissolve in water?
2. We clean water
3. Detect invisible substances in water (1)
4. Detect invisible substances in water (2)

1 Relevance to the curriculum

Topics related to water (quality, pollution, purification) are found in nearly all curricula worldwide. These experiments deal with the following topics:

- Water as the basis for life
- Forms and properties of water, water as a solvent
- Water quality
- Testing of some water samples without explanation of how the indicators work, for example, by measuring the pH value
- Water pollution, purification and treatment of water

2 General information

2.1 Structure of the worksheets

The experiments supplement the lesson, but are not sufficient on their own for working through the learning content. Each experiment has a worksheet that includes a list of the required apparatus and materials, illustrated instructions for preparing and conducting the experiment, and various assignments that can be completed.
The assignments are suggestions that can always be scaled down or expanded as needed.
Note that in the list of apparatus and materials, items printed in *italics* must be provided separately. These items are not included in the photo. When students use water-soluble markers, advise them that the markers can smear.

2.2 Safety information

Observe hazard labeling and the information on safety and disposal, which are found in the teacher instructions for Experimento | 10+.
You can always use newspaper as a work surface. However, this is not necessary if the tables can be wiped. If need be, hand out plastic bowls for the two experiments with acids and alkalis. The students can place used materials, such as pH test strips, in these bowls.
If the materials are used as described in the teacher instructions and the experimentation instructions, they pose no hazards.

2.3 Cleaning information

Liquids are simply poured down the sink. Residues in test tubes or cups, for example, silica sand or cooking oil, must be removed with a brush. The marker can be wiped off with a damp towel. Remember to wash and dry all dirty materials.

3 Information on the subexperiments

3.1 Subexperiment 1: Do all substances dissolve in water?

3.1.1 Information for teachers

In this experiment, students test the solubility of substances in water. The question of why substances do or do not dissolve in water is not to be answered in this age group.

3.1.2 Skills

The students will …

- know that substances dissolve in water, sink, or remain at the water's surface.
- be able to name substances that dissolve or do not dissolve in water.

3.1.3 Variation, additional tasks

- Check other substances to see if they dissolve in water.
- Regarding assignment 5: Complete phrases can be removed for fast learners.

3.1.4 Answer

Assignment 1
Examine the test tubes for two minutes. What do you see?
Note the key points of your observations.

Substance	Observation
1 clay	partially dissolves in water, makes the water “dirty,” settles on the bottom
2 salt	dissolves, partially dissolves, must be shaken well, disappears
3 silica sand	does not dissolve, remains on the bottom, makes the water cloudy
4 dish detergent	dissolves, colors the water, makes foam
5 cooking oil	remains on the water’s surface, does not dissolve, becomes foamy

Assignment 3
Mark the correct answer with an X.

Substance	Observation
1 clay	☐ Dissolves completely in water. ☒ Changes the color of the water. A residue remains at the bottom. ☐ Collects on the surface of the water.
2 salt	☒ Dissolves completely in water. ☐ Colors the water blue. ☐ Remains at the bottom of the test tube.
3 silica sand	☐ Dissolves completely in water. ☒ Settles on the bottom; the water becomes somewhat cloudy. ☐ Reacts with the water to form a slippery substance.
4 dish detergent	☒ Dissolves completely in water and changes the color. ☐ Does not dissolve; it remains on the bottom of the test tube. ☐ Dissolves in the water and produces foam with a pungent odor.
5 cooking oil	☐ Dissolves completely in water. ☐ Forms sediment that does not mix with the water. ☒ Forms a layer above the water that does not mix with the water.

3.2 Subexperiment 2: We clean water

3.2.1 Information for teachers

The purification and treatment of water is an important teaching topic. The experiment allows comparisons to be made to the functioning of a sewage plant. Experiments B3 and B4 from Experimento | 10+ lend themselves to this topic as well. The worksheets for subject teaching in English can also be used here.
The physical variable density (g/cm³) is explained in simple terms. The decimal numbers may present a difficulty. If necessary, have the density values first shown on a number line.
During the filtering process, the water runs very slowly through the filter paper. However, a small amount of clear water is sufficient for gaining knowledge.

3.2.2 Skills

The students will …

- know the meaning of the term “density.”
- know that density can be used to separate substances.
- be able to correctly use the terms skim off, decant, and filter.

3.2.3 Variation, additional tasks

- After decanting the dirty water, allow it to stand again for 15 minutes (until the end of the class). Note your observation.
- Make a sand and plastic film mixture. How can you separate the substances again (the fastest way)? (Note: When water is added, the different densities of the substances result in separation.)
- Make dirty water yourself. Then clean it.
- How does a sewage plant work?
  The media package “Waste water and sewage plant” related to the topic of sewage plants is available on the media portal of the Siemens Stiftung. In addition to numerous photos, graphics, and information sheets, it contains a questionnaire that guides the students in exploring a sewage plant on a field trip.

3.2.4 Answer

Assignment 2
Observe the dirty water for two minutes.
Note your observations.

The clay dissolved in the water and colored it.
The plastic snippets float on the water.
The oil is above, the water below.
The clay settles on the bottom of the cup.

Assignment 4

True or false? Mark the correct answer with an X.

	True	False
a) The plastic snippets have a lower density than water. They float on water.	X	
b) Silica sand has a higher density than water and therefore floats on water.		X
c) Materials with a density of less than 1 g/cm³ are lighter than water. They float on water.	X	
d) Clay has a density of 3.95 g/cm³. Clay is heavier than water and sinks to the bottom.	X	

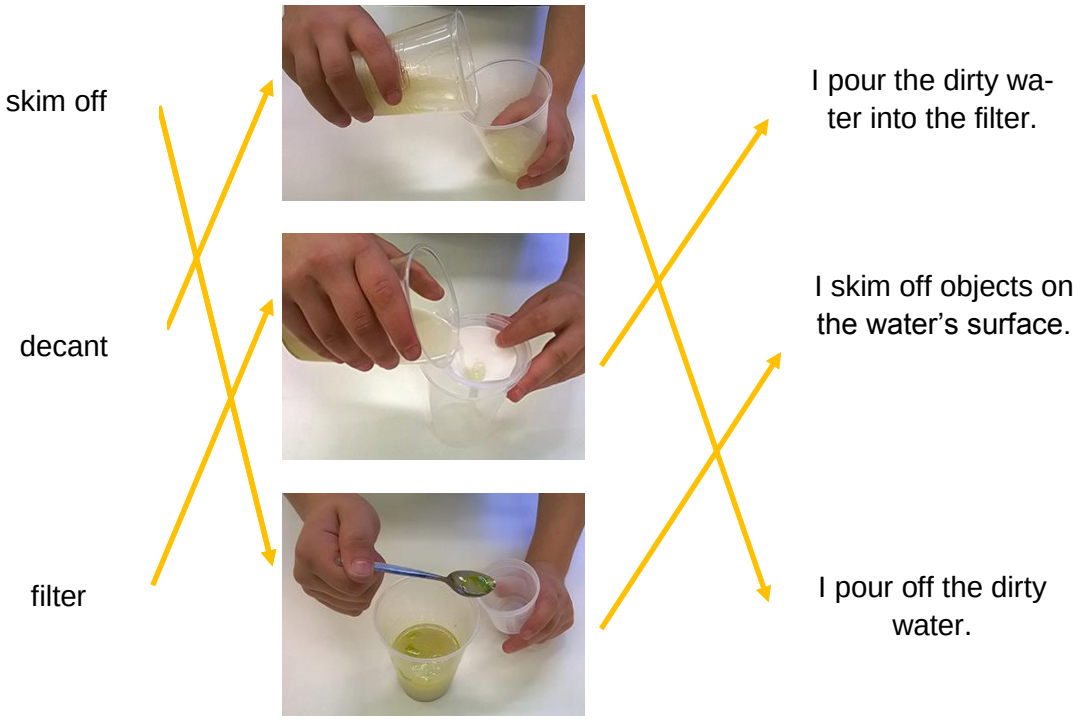
Assignment 6

Describe the experiment based on the pictures. Form sentences using the language aids.

First I skim off the plastic snippets with a spoon.
Then I skim off the oil.
Next I pour the dirty water into a cup.
Finally, I filter the dirty water with filter paper.

Assignment 7

Draw arrows to correctly match the term, picture, and explanation.



3.3 Subexperiment 3: Detect invisible substances in water (1)

3.3.1 Information for teachers

The experiment illustrates that a clear liquid is not necessarily pure water, but may also contain other, perhaps even dangerous, substances. The pH value can provide information. Make sure you point out the safety instructions for handling acids and alkalis to the students. You can hand out safety goggles. Experiments B4 from Experimento | 10+ and B2 from Experimento | 8+ lend themselves to this topic as well. The worksheets for subject teaching in English can also be used here.

Attention: Before the students handle the materials in this experiment, point out how they should safely handle acids and alkalis (safety instructions).

3.3.2 Skills

The students will …

- know what the pH value of a liquid indicates.
- know how to determine and differentiate acids, alkalis, and neutral substances.
- be able to correctly use the terms pH value, acid, and alkali.

3.3.3 Variation, additional tasks

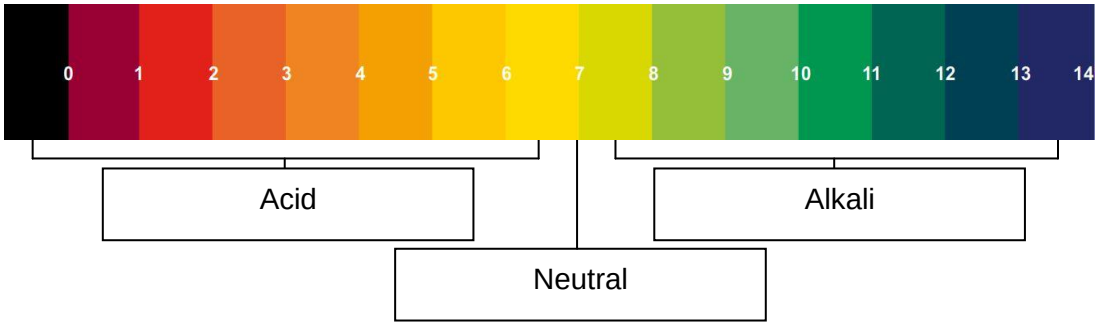
- Dissolve other substances in water. Measure the pH value. Enter the determined values on the pH value scale.
- Add a spoonful of citric acid to 100 ml of water. Measure the pH value. Add a second spoonful. Measure the pH value again. What do you notice?

3.3.4 Answer

Assignment 2
Fill in the table.

Cup no.	1	2	3
Liquid	Water	Water + citric acid	Water + washing soda
pH value	7	2 – 4	9 – 10

Assignment 4
Fill in the terms acid, alkali, and neutral on the pH value scale.



Assignment 5
Fill in the missing words.

The pH value indicates whether a liquid is an acid or an alkali.
The liquid with citric acid has a pH value of 2 – 4.
It is an acid.
Water has a pH value of 7. Water is neutral.
The liquid with washing soda has a pH value of 9 – 10.
It is an alkali.
Another designation for “alkali” is “base.”
Invisible substances in water can be detected by measuring the pH value.

3.4 Subexperiment 4: Detect invisible substances in water (2)

3.4.1 Information for teachers

In the previous experiment, substances were detected in water by measuring the pH value. Another possibility is to check the conductivity of electricity.

Attention: Before the students handle the materials in this experiment, point out how they should safely handle acids and alkalis (safety instructions).

3.4.2 Skills

The students will …

- know that conductivity indicates the presence of invisible substances in water.
- make and use an electrical circuit to measure the conductivity.
- be able to correctly use the terms conductivity and electrical circuit.

3.4.3 Variation, additional tasks

- What substances in water also conduct electricity?

3.4.4 Answer

Assignment 2
What do you observe when you dip the iron nails into the cups?

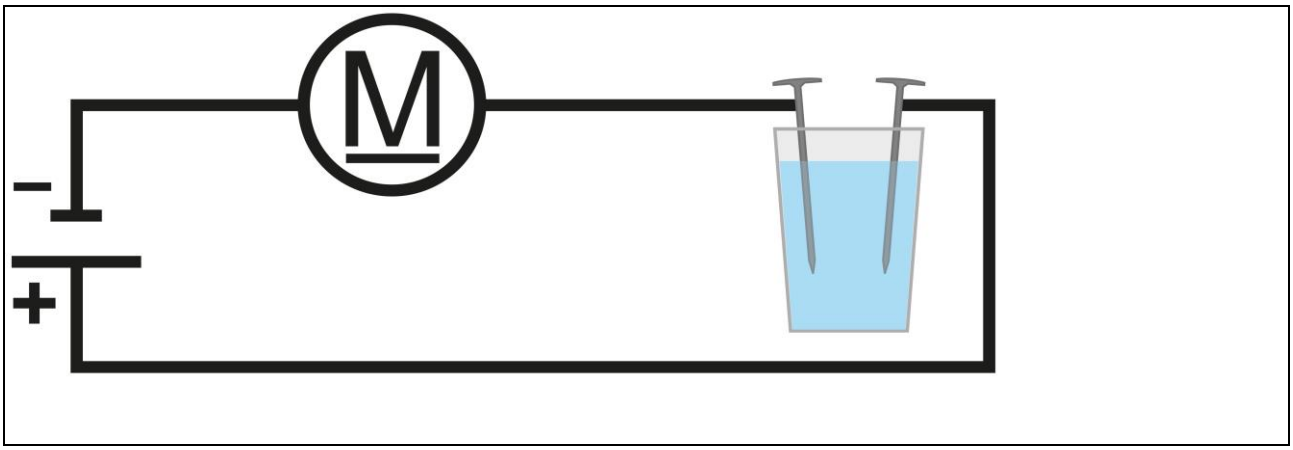
	Observation
1 Water	The propeller does not rotate. Current is not flowing.
2 Water + citric acid	The propeller rotates. Current is flowing.
3 Water + washing soda	The propeller rotates. Current is flowing.

3.5 Assignment 3

Fill in the missing words using the following terms:
electricity, substance, water, conductive, invisible

Water conducts electricity if a substance, e.g., citric acid, is added. The citric acid dissolves. As a result, the water becomes conductive. Electricity flows and the propeller rotates. Invisible substances in water can be detected by testing conductivity.

Assignment 4
Draw the experiment setup using a pencil. Use the graphic symbols.



Assignment 5
Connect the arrows in the correct sequence.