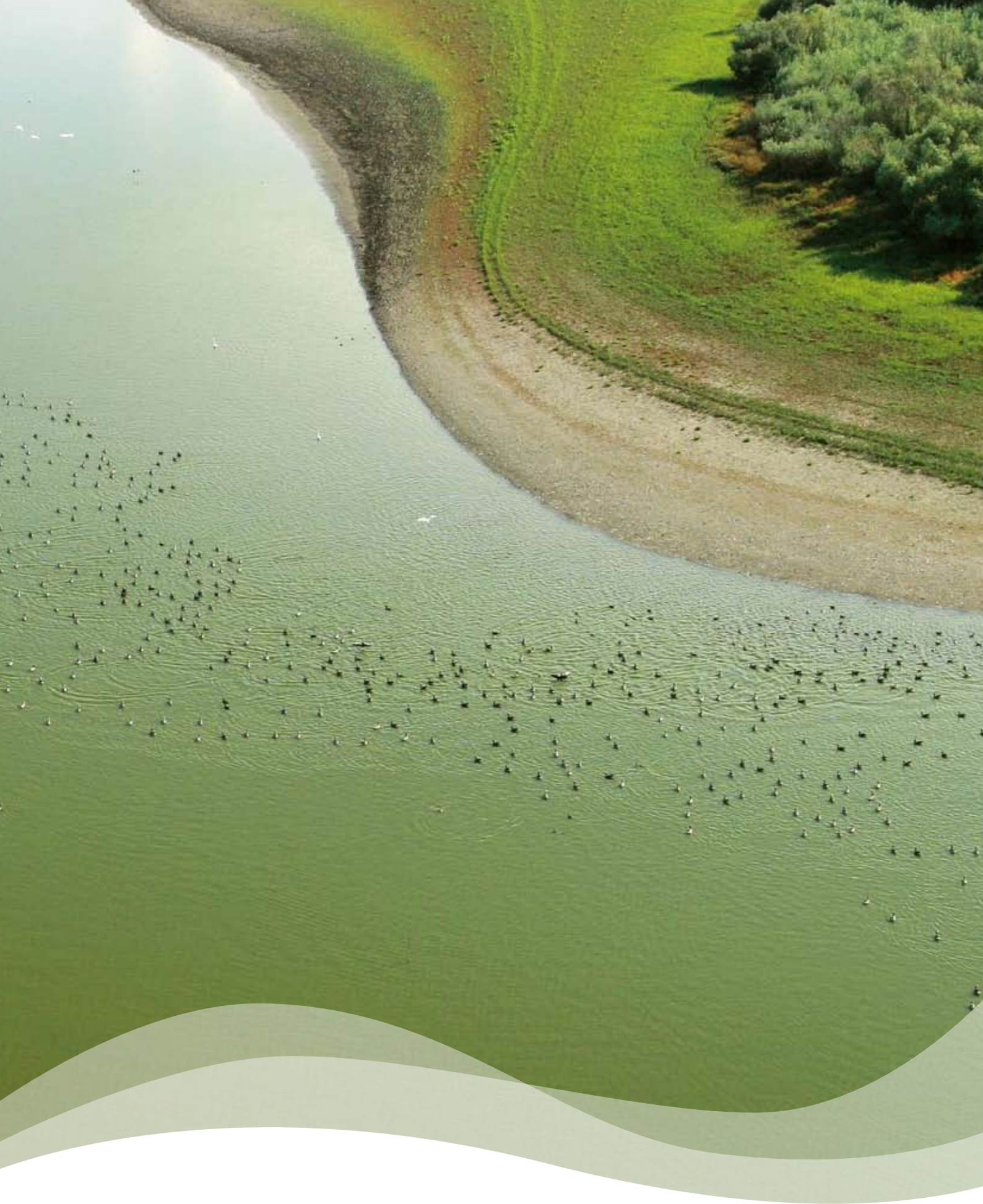


The Water Cycle

1

The global water cycle 1.1.

1.1. The global water cycle

How the sea gets into the river

A raindrop that falls to earth from a cloud has a long journey. If it falls on the ground it either evaporates immediately or it seeps into the ground. When it lands in a river, the raindrop begins its journey to the sea, where it evaporates. It returns to earth again as a raindrop. And so on in an endless cycle.

The endless route of the water moving between sky and earth is a precondition for life on our planet. Without the water cycle, there would be no clouds and no rain, no rainbows and no rivers. There would be neither freshwater nor drinking water, and therefore no trees and ... no people.

Objectives:

The children learn ...

✔ how the water cycle comes about.
✔ that the sun causes the evaporation of water and that it is the motor of the water cycle.
✔ about the central role of the sea in the water cycle.
✔ that the amount of evaporation on earth corresponds to the amount of precipitation.
✔ how the stages in the water cycle are connected to each other and consciously recognise elements of the cycle in their immediate environment.
✔ to see themselves as a stage in the water cycle.

Materials:

Activity 1: 1 glass of water
Activity 2: 1 narrow drinking glass, 1 wide, flat plate
Activity 3: warm water, 1 plastic bottle, matches, 2 small, transparent plastic bags, 1 fridge
Activity 4: a balloon for each child
Activity 5: 1 kettle filled with water, 1 Bunsen burner, matches, 2 pans, cold water and possibly ice cubes
Activity 6: paper, pens

Organisational points:

Duration: 2 teaching units
Location: classroom, occasionally outdoors

Activity 1: Game

The sun keeps water permanently on the move

As an introduction, the children are offered a glass of water. A volunteer drinks it. Everyone guesses how old the water is and the answers are written on the blackboard.

Then the children are told that the water is so old that even dinosaurs will have swum in it. The children learn that water is almost as old as the world and that it has been part of a cycle in which it constantly renews itself, for approximately 4.5 billion years. The water is 4,500,000,000 years old and this figure can be written on the blackboard as a figure with eight zeros.

The children learn about the importance of the sun for the water cycle and what happens when water evaporates.

The children are told that they can feel the evaporation on their own bodies in the open air. When there is an opportunity for them to go outside they are encouraged to make the following experiment.

Lick a clean index finger and hold it up in the air. After a short time the side of the finger that is in the wind begins to cool down. Thus, the children can feel on their own fingers that the wind causes the liquid to evaporate especially quickly and that warmth is extracted in the process. In this way it is possible to work out the direction the wind is coming from.

Learning outcomes: water exists in a cycle in which it has been renewing itself since time immemorial. Water depends on wind, air temperature and humidity to evaporate. It can be felt on one's own body.

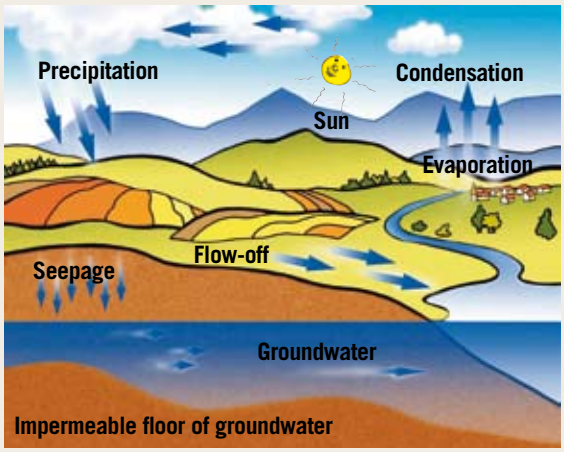
How does the water cycle work?

The motor of the water cycle is the sun, whose energy causes water to pass from a liquid to a gaseous state and to become water vapour.

A third of the sun's energy that reaches the earth – that is, every "third ray of sunlight" – is used up just to evaporate water. Later, this energy is released again in the condensation of water vapour and the production of rain.

Huge amounts of energy are tied up in evaporation and are extracted from the place where it happens. This leads to cooling. This can be experienced on one's own body after swimming in the open air. Wind allows the water to evaporate more quickly. The stronger the wind, the stronger the evaporation and the feeling of coldness.

The warmer and drier the air, the more water it can absorb and transport in the form of water vapour, and the faster the water evaporates. If the air is already damp and cold, however, it can absorb only a little water. In this case, the water only evaporates slowly. This is why washing dries much more slowly in rainy weather than it does in fine, dry weather.



Sun as motor: our water is in a permanent cycle.

Background information

Activity 2: Experiment
Seawater goes up in the air

The children are made aware of where particularly large amounts of water evaporate and why. In class, water is poured into a narrow drinking glass and the same amount of water is poured into a large, shallow plate. The drinking glass and the plate are placed next to each other in the classroom. The children observe what happens over the next few days.

The following questions are then discussed: What natural water bodies do the plate and drinking glass correspond to? How will the evaporation differ? Why?

The central role of the sea in the water cycle is discussed and explained. To illustrate the point, it is described that a 1.3-m-deep layer of seawater evaporates from the Black Sea every year. The immense weight of the water evaporating annually from the Black Sea is pointed out. The children learn that a 1.3-m-deep layer of water weighs about 1,300 kg per square metre (a 1 mm layer of water corresponds to approximately 1 litre of water per square metre). >>>

The blue planet

71% of the earth's surface is covered by seas. This enormous area of water results in the evaporation of great quantities of water. For example, a 1-m-deep layer of seawater evaporates from the Mediterranean Sea every year. In areas of the Red Sea, further south, the sunshine is even stronger. The more strongly the sun shines, the more water evaporates. A 3.5-m-deep layer of water evaporates from the Red Sea every year as gaseous water vapour.

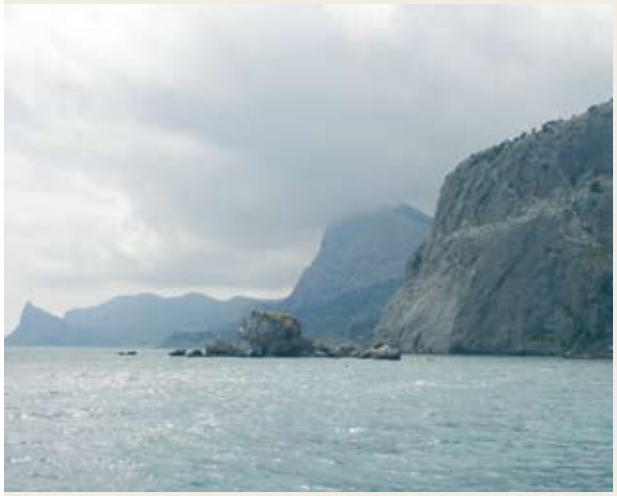


photo: DRP/ Marylise Vigneau

Black Sea: A 1.3-m-deep layer of seawater evaporates every year. It is replaced by water from rivers and by rain.

World-wide, 500,000 cu km of water evaporate per year. This corresponds to a cube filled with water with sides 79.37 km long. Or, put differently: this quantity would produce a 623.86-m-high layer of water over the whole catchment area of the Danube – 801,463 sq km.

This enormous quantity of water returns into water vapour and covers huge distances in the form of clouds. All the previously evaporated water returns to earth as precipitation. 80% of global rainfall falls over the sea. Only one in five raindrops fall on solid earth. In the earth's water cycle, the quantity of precipitation corresponds to the quantity of evaporation.

Owing to the power of gravitation, the water vapour in the water cycle is not lost into space. It remains in the earth's atmosphere and returns to it in its totality. The total quantity of water on earth does not change and always remains the same.

Background information

The average weight of the children in the class is worked out and it is calculated how many children together would weigh approximately 1,300 kg.

The results give an idea of the quantity of water that evaporates into the air, is carried in the air and later falls to the earth as precipitation.

The children consider why, despite evaporation, the seas do not dry out. They are told that the 1.3-m-deep layer of seawater from the Black Sea is replaced by water from rivers such as the Danube and by rain every year. This underlines the fact that all the evaporated water from the sea falls back to earth as rain and comes back into the sea.

Learning outcomes: the larger an expanse of water, the larger the amount of water that evaporates from it. Therefore more water evaporates from seas than from rivers or lakes. The quantity of water that evaporates from seas is enormous. Evaporated water returns to the sea through rain and rivers.

Activity 3: Experiment
Clouds form

The children see how gaseous clouds of water vapour form after evaporation. Clouds are made in the classroom.

Some warm water is poured into a plastic bottle and the bottle is laid on its side. A match is struck. After three seconds, the match is blown out and it is held so that the smoke enters the bottle. Then the bottle is closed and shaken so that water flows down on all the sides. The bottle is held against a light window or a lamp and squeezed for a moment. >>>

How clouds form

If a lot of water evaporates and the now humid and relatively warm air rises, then the water cools down. In the process the water vapour condenses onto particles of dust, pollen or salt, and drops of water or ice crystals are formed, because cold air cannot hold as much water as warm air. Billions of particles coated in water form a cloud.

The formation of clouds is comparable to the condensation of water vapour onto a cold glass of water on a hot summer's day. Breathing out on cold days also condenses water vapour and clouds of tiny water droplets form in front of our mouths: a cloud of breath.

Warm air is lighter than cold air and therefore rises. This can be observed in a heated room in winter. The warm air rises; the cooler air is heavier and stays on the floor. It is therefore warmer just under the ceiling than it is near the floor.

Because of the processes of cloud formation, described above, in the Danube basin we have high precipitation in the mountains and rivers with plentiful water. The Danube receives particularly large quantities of water from the Inn from the Alps, from the Tisza from the Carpathians and from the Sava, which it brings from the Alps and the Dinarian Mountains. In the mountains, precipitation is very high, because masses of air with a high moisture content piles up against the high mountains. The mountains represent a barrier that leads to the damp air rising and thereby cooling. Clouds form. Further cooling results in rain.

Read more about this in Chapter 5.2. "The Catchment Area of the Danube".

Background information

This causes the air pressure to rise; when the bottle is suddenly allowed to expand again, the pressure falls. The smoke represents the dust particles that water vapour condenses onto. Through the reduction in air pressure, the water vapour condenses onto the dust particles. Clouds form.

The following questions are discussed with the children: What can be observed in the bottle? (It should be possible to see smoke.) Does smoke form every time the bottle is squeezed and allowed to expand? Why?

In a further experiment, the influence of air temperature on the formation of clouds can be shown by carrying out this experiment. Two small plastic bags are blown up (by mouth) and sealed. Now they have warm, damp air in them. One bag is put into the fridge, the other remains outside. After 15 minutes the plastic bag is taken out of the fridge. The children compare the two bags and attempt to answer the following questions: Which plastic bag contains condensed water vapour? Why?

The two bags are left at room temperature for half an hour. The children observe what happens to the condensed water vapour. The class discusses how the air temperature influences the formation of clouds.

Learning outcomes: the ability of air to "hold" water increases with air temperature. If warm, damp air cools down, the gaseous water vapour condenses and clouds form. Clouds disperse as soon as the temperature rises and the air can absorb moisture again.

Activity 4: Experiment
Gone with the wind

The children learn how wind is generated! Each child blows up a balloon and takes care that the air does not escape. The class is told that there are many compressed breaths in the balloon and therefore the air pressure inside the balloon is greater than it is outside. If the air is let out, the pressure in the balloon equalises with the pressure outside it and this creates a strong draught. The children learn that wind generally rises according to this principle. >>>

The origin of the wind

Wind drives the clouds from the sea over the mainland and equalises pressure differences in the air. The formation of different air pressures comes about through the varying intensity of sunshine over different surfaces, such as sea or mainland. Therefore the wind, too, owes its existence to the sun.

The air is warmed by the heating of the earth. It expands and rises. Colder, heavier air flows in to take the place of the air that has risen. The air flows from areas of higher pressure into areas of lower pressure.

The greater the pressure difference between two areas, the stronger is the wind.

Background information

Learning outcomes: wind is formed through the equalisation of pressure differences. Air flows from an area of higher air pressure to an area with lower air pressure. The greater the pressure difference between two areas, the stronger the wind. If the air pressure is equal, there is no wind; it is calm.

Activity 5: Game, experiment
Home-made rain

Part 1: "Rainmakers"

The children sit on the ground with their eyes shut in a "rain circle" and imitate the sound of rain. The game leader slowly and quietly starts to snap their fingers.

The child to the left of the game leader takes up the sound and also starts to snap his fingers. Then the next child starts – and so on. This sounds like light rain that becomes ever heavier. When the sound has gone round the circle and everyone is snapping their fingers, a new sound comes in.

The game leader starts to rub the palms of his hands together. Again the children gradually join in until all of them are rubbing their hands together. This sounds like drizzle.

In the next round, the game leader starts clapping his hands together. When everyone is doing this it sounds like a downpour.

Then the game leader claps his hands on his thighs. The children gradually join in as before. In a further round, starting from the game leader, they slap their thighs and at the same time stamp their feet. A storm with thunder!

The high-point has been reached and the thunderstorm begins to die down. In the next round the thunder stops.

Everyone slaps their thighs. One child after another stops until the sound can no longer be heard. Then they all clap hands quietly. One child after another stops clapping. In the next round they all rub their hands together. Again, it becomes quieter. At the end everyone snaps their fingers. One child after another stops. At the end it is quiet again. The storm rain is over.

Part 2: The class makes rain together

Water is heated in a kettle. When it is boiling a pan of cold water, if possible with ice cubes in it, is held right over the rising, hot steam. A second pan is held below the ice pan (take care that no one burns themselves in the hot steam). The children watch the base of the pan, where droplets of water form there. When they are big enough they fall as rain. It's raining.

Together, the following questions are discussed: To what extent is the rain model comparable to the water cycle? What does the kettle of boiling water represent? Where are the clouds? How can you get it to rain more quickly? Can the size of the raindrops be influenced? >>>

If salt water is evaporated in a kettle it can be shown that the salt remains in the kettle – or the sea. The same is true of pollutants that come down the Danube into the Black Sea. They accumulate in the sea. The water that evaporates from the sea comes back to earth as freshwater.

The children are told how raindrops are formed and how this can be observed in everyday life. They are encouraged to let it rain on the way to school according to the following pattern.

The air in the school bus is warm and humid. If it is cold outside the windows are cool. Water vapour condenses on them and they steam up. This is similar to the way that clouds form. If you draw on the window, your finger pushes a track through the moisture and water drops begin to run down the window. This corresponds to rain.

Learning experiences: in the experiment, the kettle represents the sea, from which water evaporates. Warm and humid air rises, cools down, condenses in the process and forms clouds. If the water droplets combine to form bigger droplets, as soon as they reach a particular size they can no longer be "held". It starts raining. The faster the water droplets combine to form bigger droplets, the faster it rains.

It can be seen that water can take different forms; the total quantity of water in the cycle, corresponding to the water cycle on earth, does not change, however.

How precipitation forms

When humid air masses cool this leads to condensation, because cold air cannot absorb and "hold" water so much as warm air. Billions of water droplets of a cloud now combine and form ever larger droplets. If the air currents can no longer hold the bigger water droplets, they fall to earth under the force of gravity. The result is rain. Alternatively a cloud rises into higher air strata and the water droplets become ice crystals. Whether rain, snow, hail or sleet reaches the earth's surface depends on the temperature near the ground.

Background information

Activity 6: Group work / discussion
Humans in the water cycle

The children work in small groups and consider how human beings are involved in the water cycle. The individual answers are written down on pieces of paper.

The children pursue the following questions:
Is it possible to live without water? How long can a person survive without water? How do people come into contact with water? Is all the water available on earth useable for drinking? How does water come into the school? Where and how does water get back into the cycle after it has been used in school?

The results are discussed in class.

Learning experiences: Nobody can live without water. Clean water is only available in a limited way. It is precious. We should keep water as clean as possible.

Human beings in the water cycle

Human beings are part of the water cycle. A person drinks approximately 2.5 l of water a day and loses 2.5 l of water in sweat, breath and urine. A person can only survive a few days without drinking water. Water is essential for the human metabolism. Metabolic products are excreted and removed and materials important to live, such as protein, mineral salts and trace elements, are made available to the body again. Water plays a further important role in regulating body temperature.

Humans use water to cook, shower, wash clothes and to clean. We use water in agriculture to produce food and in industrial production. And we need water to produce electrical energy. We take water from streams, rivers, lakes and springs, or out of the ground as groundwater. Humans need clean water, and waste water should be allowed to return to the water cycle once it is purified.

There is not an unlimited supply of water for us to use. Only a small amount of the water on earth is useable by people. The reason is that the amounts of salt water and fresh water on earth are very unequal. 97.4% of the water on our planet is salt water. Only 2.6% is freshwater. The amount of drinking water that is available is so small because 22.4% of freshwater is trapped in groundwater and 77.2% in glaciers and polar ice. This leaves just 0.4% of freshwater that is in the immediate cycle and therefore available.

Comparison: for every full bathtub of salt water there is just 1 litre of fresh water and 1 schnapps glass of available drinking water in the world.

Clean water is a rare commodity. It should therefore be used consciously (and sparingly) and protected against pollution.

Background information

The water cycle at a glance

The earth's water is constantly changing into gaseous, solid or liquid form between air, land, rivers, lakes and the sea. In the process it makes up a cycle.

The sun causes the evaporation of water from water bodies and the earth's seas. When a lot of water has evaporated and the now humid and relatively warm air rises, it cools down. In the process, clouds form. The wind drives the clouds from the sea over dry land.

When clouds drift into cooler areas they cool down and condense. The innumerable small water droplets in the clouds clump together and form ever larger droplets, which fall to the ground as rain. If precipitation reaches the earth as rain, part of it evaporates immediately and goes back into the air as water vapour. Some of the rainwater flows into lakes, or streams and rivers and then into the sea.

A large amount of the rainwater seeps into the ground and is absorbed by plants and evaporated through the leaves. Plants thus represent an important stop-over on the journey of water coming from the sea and going back into it. Because of their enormous leaf surface, plants evaporate incredibly high quantities of water. This explains why of all the water that is evaporated on earth, 45% comes from plants, 41% from the sea, 13% directly from the soil and only 1% from lakes and rivers.

A further amount of the rainwater seeps into the ground and remains under the earth's surface as groundwater, where it forms our drinking water reserves. This water may be withdrawn from the cycle for a long time. It can come to the surface again in the form of springs, however.

In the polar region, precipitation falls as snow, and because of the low temperatures it does not melt right away. In this way, 1,000-m-thick layers of ice have formed. Thousands of years can pass until the ice melts and returns to the sea. The same is true of snow that ended up on glaciers.

No drop of water can completely escape the water cycle. Sooner or later all of them evaporate and then return to the earth as raindrops.

Background information

Danube tales

The Danube: border or connection? Hungary's fateful place on the Danube

The small town of Mohács lies on the bank of the Danube, shortly before the river leaves Hungary and flows into Croatia and Serbia. Mohács has twice played a tragic role in Hungarian history. In 1526 the Hungarian King Lajos (Louis) II stood here with 25,000 soldiers facing a superior Ottoman force of 100,000 warriors under Sultan Suleiman I, who had conquered Belgrade five years before (in 1521). A further 10,000 well-armed allies of Lajos, led by the Voyvodinian sovereign Johannes Zápolya, were in the area of Szeged.

In view of the extremely small Hungarian army, the Ottomans believed in a stratagem, but after four hours the battle on 29 August was over. As he fled, King Lajos drowned in the floodwaters of the Csele stream. Hungary of the Middle Ages was over, and the country broke into three parts. Three years later, in 1529, the Ottomans had reached Vienna, which they besieged in vain. Another battle against the Ottomans raged near Mohács 158 years later. The Austrian general Prince Eugen was victorious. And Austrian emperors ruled Hungary for the next 200 years.

Sagas from the source to the mouth

Nymphs of the source of the Danube, Danube maidens ("Donauweibchen"), ferrymen who were dragged into the water, robber barons and kings and treacherous millers ... around inexplicable phenomena, deadly river passages or historical personalities, legendary tales have grown up everywhere around the Danube. The heroes and heroines who fought poverty, sickness and death are called János, Bogdan, Matúš, Ilja, Lau or Agnes. From the source to the mouth the Danube flows through ten countries, and one can follow it on a mythical journey as if on a ship.

A selection of the Danube sagas can be found at "Additional information for teachers".

Suggestion 1: Read or recount sagas from the countries and regions of the Danube. Or let each child choose a story that they read and then recount to the others. The children can paint a picture illustrating the story they have heard or make a portrait of the heroes. They stick the pictures onto the Danube poster in the appropriate place. You can take a saga journey on the map with your finger.

Another possibility would be to paint together a big poster with the Danube and its tributaries and place the picture on it.

Suggestion 2: Play one or more stories as theatre pieces. It is particularly effective when the performance takes place on the "original site", when it takes place on the bank of the Danube or another water body and is incorporated into the surroundings.

Stages in the water cycle

1.2.

1.2. Stages in the water cycle

Start source; destination sea

Water that falls to the earth as precipitation can take various paths. If it rains in a woodland, a quarter of the rain evaporates straight away from the surface of the trees. A fifth flows directly into streams and rivers. The rest seeps into the ground. If rain falls on a treeless area, double the amount goes directly into flowing water. That means that wooded areas have a great capacity to retain water.

When water seeps into the ground it is filtered and enriched with minerals. If it builds up on a layer that is impermeable to water then it can come to the surface again through springs. Or it remains underground as groundwater. The final destination for water of all rivers and streams in the Danube basin is the Black Sea. The water quality of the sea is consequently in our hands.

Objectives:

The children learn …

✔ that woods are water reservoirs and can reduce the danger of floods.

✔ what happens when water seeps into the ground and how a spring develops.

✔ how much the water quality of the Black Sea is influenced by everybody living in the Danube basin.

Materials:

Activity 1: drawing paper, pencils

Activity 2: sand, loam or clay, gravel, earth, a small aquarium or transparent plastic tub, water in a watering pot

Activity 3: 1 basin, 1 heavy bowl, food-colouring water, transparent plastic foil, small stones

Organisational points:

Duration: 1–2 teaching units

Location: classroom

Activity 1: Creative design
Woods store rainwater

The children think of a wood with big trees. Each child draws their wood in the rain, and also the roots of trees, on a piece of paper. Together the children consider what happens to the raindrops that fall onto the trees. With support, the children find out what different paths the drops of water take.

The children learn what amounts of rainwater go where. They draw the respective number of raindrops in their drawing and show where they flow to with arrows.

The class discusses together what has changed for the raindrops if they fall on a woodland slope that has been cleared. It is explained that now no more water evaporates from the trees and through the trees. As a result the flow-off rises.

Learning experiences: that rainwater takes various paths on the earth's surface. When it rains in a woodland, only half as much of the water flows directly into streams and rivers as it does if the rain falls in an unwooded area. People can have an influence on the severity of floods by using the land in different ways.

The rainwater's journey through the wood

Rainwater that falls over a wood takes five different routes. Almost before it arrives, some of the water evaporates from the surface of the tree trunks, branches and leaves. One-quarter of raindrops thus go straight back into the air. One-fifth of raindrops remain on the ground surface and run directly into streams or rivers. Just over half of the raindrops seep into the woodland floor. There, some of the rainwater is absorbed by the tree roots, transported to the leaves and is then released into the air as water vapour. The rest of the rainwater collects under the earth as groundwater or some of it comes back to the surface through springs.

If there is no layer of trees, rainwater cannot evaporate from the surface of the trees. If there are no trees, no water is absorbed by tree roots and evaporated through the leaves. More water seeps into the earth and the groundwater level rises.

Without woods, the run-off on the surface of the soil is also heavier. The amount of rain that runs into streams and rivers is double when there are no woods. Treeless areas, like deforested areas, or arable farm land in the catchment areas of rivers, result in a higher water table and heavier floods in rivers.

Background information

Activity 2: Experiment
A spring is born

In small groups the children build a model that illustrates the way that springs emerge. In a small aquarium or a transparent plastic tub, layers of soil are laid down in the following order, from bottom to top, covering the whole area: sand, loam or clay, gravel, sand, earth. The loam or clay layer is shaped with channels in it. To do this, draw three 1-cm-deep channels in the loam or clay layer with a finger.

The children let water rain onto the model. The water seeps through the soil and collects in the channels of the loam or clay that is impermeable to water. The model is slowly and slightly tilted. As a result three springs emerge.

The children are invited to talk about springs that they have already visited. Together there is a discussion about how one can safeguard a spring to keep the water pure.

Learning experiences: a spring emerges where rainwater that has seeped into the ground accumulates on an impermeable layer. The water quality of a spring depends on the activities in its surroundings.

Find more at "Additional information for teachers":
Woods for protecting springs

Groundwater

Whether it is rain, snow or hail, what is left is drops of water. These seep into and run past layers of earth and stone. The water can remain as groundwater deep under the earth's surface.

Groundwater is water that has seeped into the earth without being absorbed by plants or having evaporated out of the soil. Seeping water can take from a few days to weeks to penetrate strata of stone and earth and reach a groundwater horizon. A layer of loam or clay is the precondition for the formation of a body of subterranean water. The seepage water gathers above such a layer and fills up all the underground cavities, for example, in grits and gravel. The movement of groundwater is only effected through gravity. It can flow from a few centimetres to metres per day. There may be other groundwater horizons under the first layer of groundwater, separated by watertight layers. This very deep groundwater can be thousands of years old. For an indeterminate length of time it has not been part of the water cycle. Groundwater is formed not only through rain but also from flowing water through the seepage of river water.

photo: Austria tourism / Liebing R.

Spring: groundwater emerges to the surface from springs.

Background information

Activity 3: Experiment
Destination sea

A basin is filled with water and coloured with a drop of food colouring. An empty bowl is put in the middle of the basin of water and a foil is stretched over the basin. This must be well sealed. A small stone is placed on the foil exactly over the bowl.

The basin is put in the sun for a few hours. The children observe clear water that drips into the bowl.

In the discussion it is pointed out that the same thing happens in lakes and ponds, in particular when they have no outflow of water.

Learning experiences: there is a direct connection between the water purity of the Danube and its tributaries and that of the Black Sea. The sea is the destination for all the material that is transported in the river. The children see that it is important that the rivers are not polluted.

photo: DRP/M.Vigneau

Black Sea: the destination of all rivers of the Danube basin.

Find more at "Additional information for teachers": Black Sea

Destination: Black Sea

In the arrangement of the experiment the water basin corresponds to the Black Sea. As a result of the sun's rays, water will evaporate, condense on the foil and collect under the stone. From there, the condensed and clear water will drip into the bowl. As a result of the continuing evaporation, the water quantity in the basin will constantly fall. More and more water will collect in the bowl. In the same way as the food colouring remains behind in the experiment with the water basin, in the Black Sea, salt and occasional pollutants are left behind. The water that escapes from the water basin or the Black Sea is clear, fresh water.

The Black Sea is like an inland sea. It only has a connection with the Mediterranean Sea through the Bosporus straits. Every year a 1.3-m-deep layer of seawater disappears through evaporation. The water vapour consists of pure fresh water as it moves into the air. The salt and the materials that people have put into the sea remain behind, as do materials that can pollute the sea.

Pollutants also get into the Black Sea through rivers such as the Danube. For these the Black Sea is the final destination. The pollutants gather in the seawater and affect the water quality. Thus the quality of the Black Sea depends on the human activity in the whole Danube basin. The cleaner the water in the Danube, the better, too, is the water quality in the Black Sea.

Background information

Danube tales

Stones testify to the past: castles, palaces and monasteries on the Danube

Anyone who tours the Danube today notices the innumerable castles, palaces and monasteries that there are on the Danube.

The practice of knighthood was at its strongest in the period of the High Middle Ages (10th to 13th century). Noble residential and defensive buildings that can be seen enthroned on mountain heights and rocks are reminders of the knightly society of the High Middle Ages.

The rocky high banks above the Danube offered ideal conditions for castle building, to which numerous ruins still testify. From here, water routes and roads could be surveyed, one could exact tolls and demonstrate the will to rule.

Some "Danube castles"

One can visit the castle Wildenstein in Germany, the castle ruins Aggstein in Austria or the castle ruins in Esztergom and other royal palaces and cathedrals as well as Oberburg in Visegrad in Hungary, built in 1263 in order to ward off a possible Mongolian attack. The crown of Stephan, an important symbol of Hungarian identity, was treasured here.

Or one can discover the Peterwardein and the Kalemegdan fortresses, to which only the remains of walls bear witness today, in Belgrade on the mouth of the Sava, one of the most fought-over sites on the whole Danube.

The fortress triangle of Smederevo on the confluence of the Jezava with the Danube, built by the Serbs in 1428 as a defence against the Ottomans, was conquered by the Ottomans, but only destroyed in the first and second world wars.

Golubac Castle (now in ruins), in the gap through the southern Carpathians, was built by the Hungarians from a former Roman castle in the second half of the 13th century. Later it was in Ottoman hands for 260 years. One of the Ottoman pashas is supposed to have abandoned one of his wives who fell in love with a Hungarian reeve on a rock in the middle of the Danube. Whether her noble knight saved her from this unfortunate situation or whether she went lamenting to her end is not clear. In any case, the rock in the Iron Gate is still named after the Pasha's wife Babakaji.

Other examples are the ruins of the Serbian Kladovo fortress opposite Turunu Severin; Baba Vidin fortress in Bulgaria; and the Kaleto fortress in the holy rocks of Belogradčik, which goes back to the Romans and was supplemented by the Ottomans with an outer defensive ring.

There were also numerous castles that were later converted into palaces, for example Werenwag palace, the symbol of the Danube gap through the Swabian Alb, and the Sigmaringen palace in Germany.

The High Middle Ages was an important period of monastery foundations, to spread and care for Christian belief of the West ("bearers of occidental culture"). Monasteries were built above all in the upper and middle course of the Danube; some of them were rebuilt in the baroque style and testify today to the one-time power and influence of the church. The oldest monastery on the Danube is Weltenburg. It was founded in 617 in Bavaria. Some other examples are Melk and Göttweig in the Wachau valley and Klosterneuburg in Austria; Krušedol monastery in Serbia, founded in 1509, was long the seat of the Serbian patriarchs and thus the centre of the religious life of the Serbs.

Suggestion: The students mark the places of the "stone witnesses" on the Danube poster and see the connection between breakthrough gaps and castle building. Why were these places chosen to build castles?

"On the beautiful blue Danube": Danube art

"Brown for 11 days and for 46 clay grey; for 59 days dirty green, for 45 pale green, for 5 grass green, for 69 days steel green, for 46 days emerald green and for 64 days dark green." That, in the early 20th century, was the hydrographical summary of Anton Bruszaky, who in Mautern, to the north of Vienna, recorded the water colour through the year and sent his record to the hydrographical headquarters in Vienna. Only if the sun is favourable, the sky is blue and the attitude and expectation of the observer is right can the Danube acquire a blue sheen.

In search of the origin of the "blue Danube" one thus has to abandon reality and go to the Johann Strauss waltz "The Blue Danube", which was a world-wide hit in 1867. The Danube Waltz succeeded in establishing an image of the blue Danube in people's heads.

But it was not only Strauss who was inspired by the Danube. Even earlier, the Danube had enchanted numerous artists and inspired the most diverse works. Whether made by sculptors, painters, composers or writers, everywhere there are tributes to this European river. In the baroque "four rivers fountain" on the Piazza Navona in Rome, the powerful Danubius represents Europe, alongside the African Nile, the American La Plata and the Indian Ganges.

Today, too, large rivers speak to people´s feelings and call for artistic interpretation.

Land art is the term used to describe an artistic movement that grew up in the 1970s in which people's surrounding landscape, for example fields, woods, mountains, desert, water, etc, become the object and field of work of an artist. The artist intervenes with the space in various ways, for instance arranging findings of vegetation, laying down and piling up slabs and stones, or in bulldozer work. These markings in the landscape are usually transient. Weathering by rain, sun, wind or frost changes the work of the artist momentarily or for the long term, and ultimately destroys it. Photography or film is thus essential to the preservation of these art works. Two well-known exponents of land art are Andy Goldsworthy and Richard Long.

Suggestion: The children can make their own work of river art. If possible, find a place on the bank of your Danube tributary or the Danube itself. There the children can make a work of art together in the middle of and with the natural world. Leaves, flowers, branches, feathers, stones, sand, earth and other natural material can be formed into a natural work of art. Ranging from a simple mosaic or mandala to big sculptures and installations – there are no limits to the imagination.

The school class can also participate in the international competition "Become a Danube Art Master", which takes place annually in the context of celebrations on "Danube Day". School classes as well as interested children and adults from all the Danube countries are invited to participate in the Danube Art Master competition or in one of the many other activities around Danube Day initiated by the International Commission for the Protection of the Danube River (ICPDR) and thereby to express their appreciation for our waters. The first Danube Day celebration took place on 29 June 2004, on the 10th anniversary of the signing of the Danube River Protection Convention. Since then, at the end of June each year, ministries, schools, NGOs and many other organisations have been celebrating the Danube on Danube Day with colourful activities. Information on how to participate and other activities can be found at www.danubeday.org.