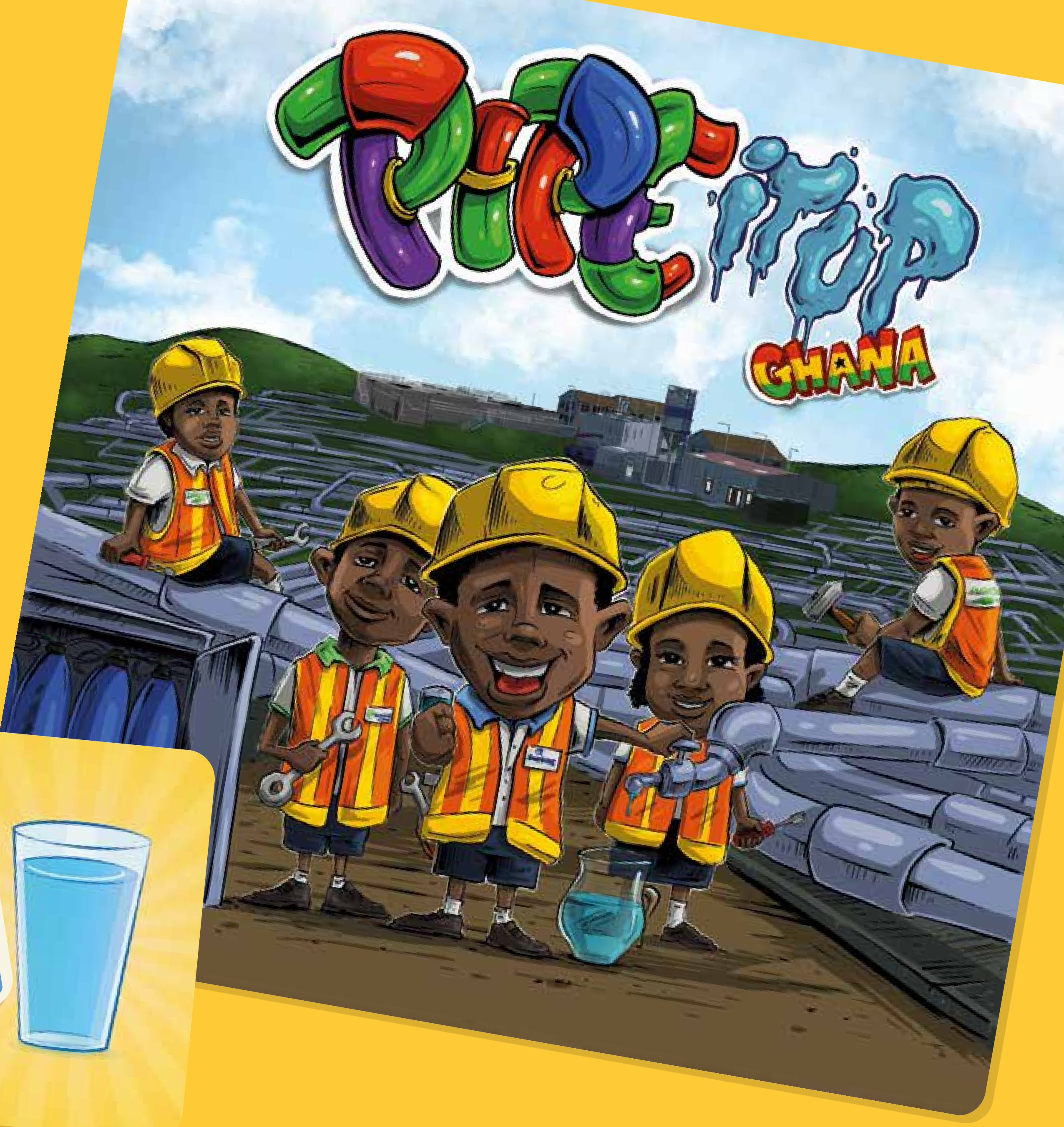
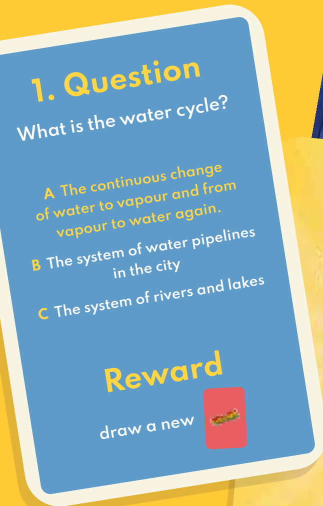
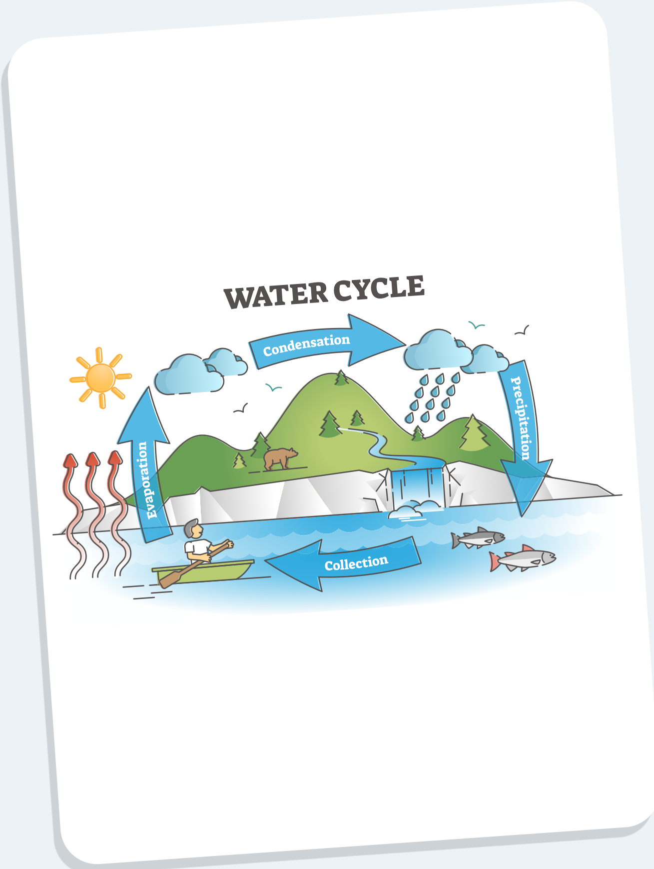


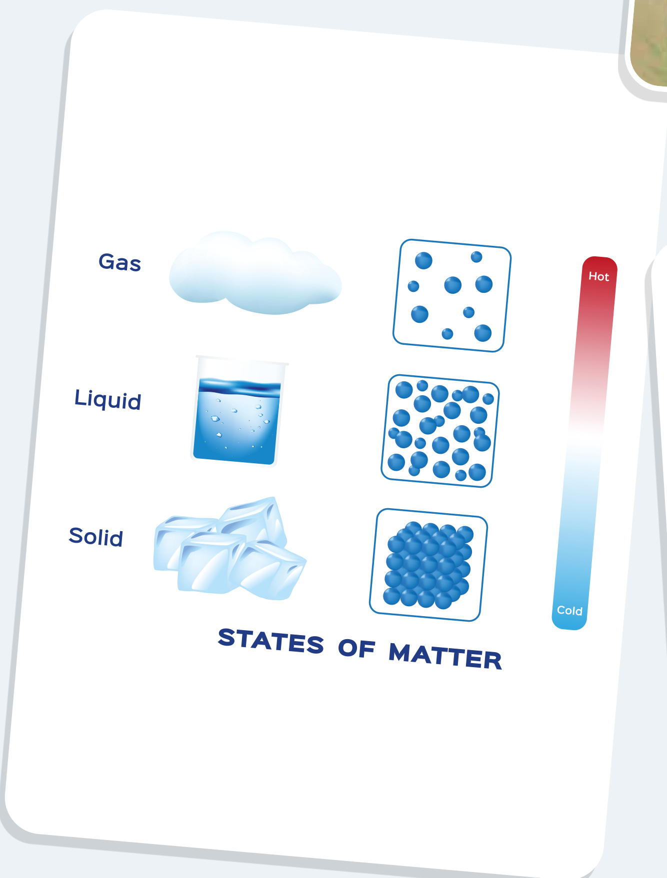


PLAYBOOK

TO PIPE IT UP GHANA QUIZ QUESTIONS

Train your brain - Drink healthy tapwater for good marks!


WATER CYCLE
Condensation
Precipitation
Evaporation
Collection


Gas
Liquid
Solid
Hot
Cold
STATES OF MATTER


SEWAGE TREATMENT PLANT
Your Home
Pump Station
Screens
Biosolids
Grit Removal
Digester
Sedimentation Tank
Trickling Filter
Trash and Sand
Collection System
To the Landfill
Aeration Tank
Clarifier
Ultraviolet Disinfection
Treated Wastewater


Water is life.

It nourishes us.

It cleans us and sustains us.

Simply put, we are all made of water!
Be a water specialist and show others
the value of water!

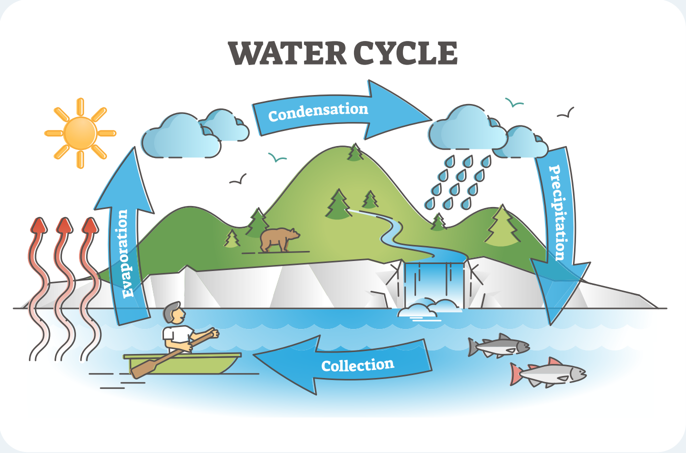
Learn about proper water usage,
the importance of clean drinking water
and the water cycle.

Here you can find a complete explanation
to the questions on the Question Cards.

Dive into the details to be a water
professional!

1. What is the water cycle?

It all begins with the Sun. We take it so natural that it shines that we almost forget how much we owe to it. We cannot just think about the light and warmth which are essential for the plants but can be unbearable for us, for humans sometimes. **The Sun is an awfully big driving force, the engine of our environment.**

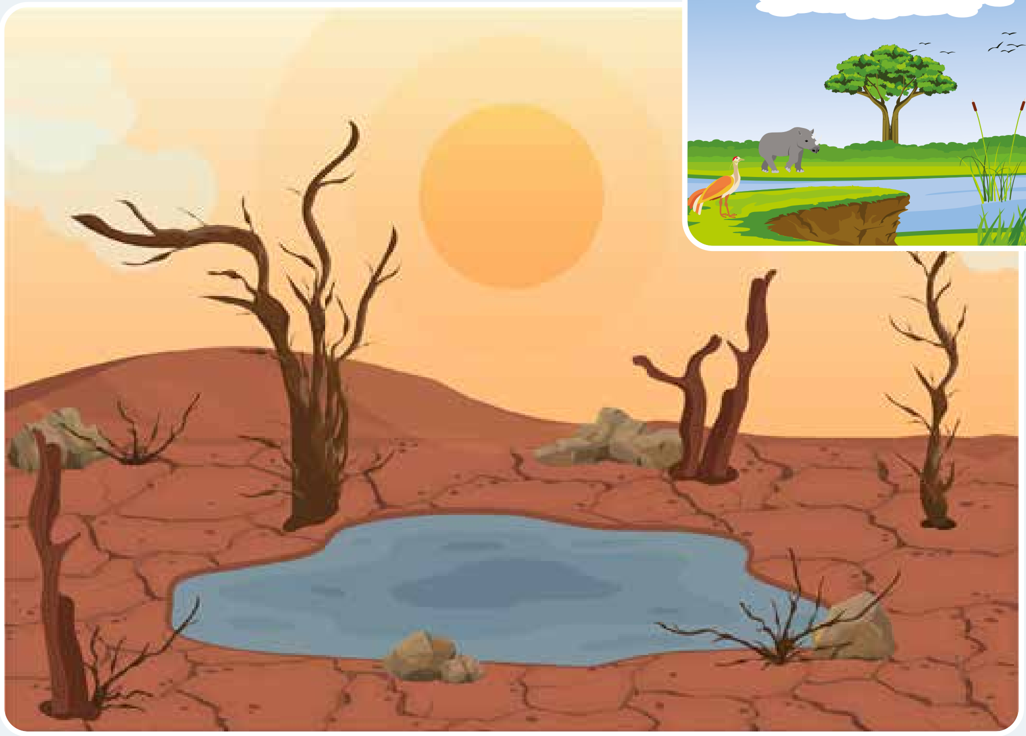


We know that the oceans make up a significant portion of the Earth's surface. The Sun's rays heat this huge body of water, causing the water to evaporate (change from liquid phase to gas phase). When the hot water vapor rises high enough, it condenses due to the cooler air (changes back to liquid phase). This is how clouds form. From the clouds, it precipitates to the earth and flows back to the oceans. The plants are also forcing the water to evaporate, we call it transpiration.

It is very important to note that everything is interconnected and it can take lots of years for the cycle to go around. Local elements of the environment can influence this process. For example, too much irrigation in the upper section of a river can sharply reduce the amount of water in the lower section, and (in extreme situations) no water can travel into the ocean.

In other words, you can see beautiful green heaven in one place…

…while it causes a dry hell a few miles away.



2. What does sunbeam do to water?

The Sun's rays heat the body of water such as oceans, seas, lakes and other water surfaces, causing the water to evaporate (change from liquid phase to gas phase). Check the water-cycle illustration above.

3. What is a cloud?

A visible mass of condensed water vapour floating in the atmosphere, typically high above the general level of the ground.

How are clouds formed? When the hot water vapor rises high enough, it condenses due to the cooler air (changes back to liquid phase). This is how clouds form. From the clouds, it precipitates to the earth and flows back to the oceans.

4. Is it possible to increase the amount of water on Earth?

Important fact about water: No new water is formed on earth. For thousands and millions of years, we use the same water over and over again! This is a wonderful consequence of the huge water cycle.

5. Was there a waterworld without continents?

In recent times, we have been living on the Earth with continents and water. More than 70% is covered by water. What did Earth look like 3.2 billion years ago? New evidence suggests the planet was covered by a vast ocean and had no continents at all.

Continents appeared later, as plate tectonics thrust enormous, rocky land masses upward to breach the sea surfaces as scientists recently reported. They found clues about this ancient "waterworld" preserved in a chunk of ancient seafloor, now located in the outback of northwestern Australia.

6. What percentage of all the water on Earth is drinking water?

Water is a finite resource. There are about 1400 million km^3 on earth circulating through the hydrological cycle. Only 0.5 % of the world's water is readily available for human use. This would be enough to meet humanity's needs - if it were evenly distributed.

7. How many people do not have access to healthy drinking water in the world?

Water scarcity can mean the limited availability of water due to: physical shortage; scarcity in access due to the failure of institutions to ensure a regular supply and; a lack of adequate infrastructure. Water scarcity already affects every continent. Water use has been growing globally at more than twice the rate of population increase in the last century. Therefore, an increasing number of regions are reaching the point where water services can be sustainably delivered, especially in arid regions. Water scarcity will be exacerbated as rapidly growing urban areas place heavy pressure on neighbouring water resources. Climate change and bio-energy demands are also expected to amplify the already complex relationship between world development and water demand.

3.2 billion people live in agricultural areas with high to very high water shortages or scarcity, of whom 1.2 billion people – roughly one-sixth of the world's population – live in severely water-constrained agricultural areas. Over 2 billion people live in countries experiencing high water stress. It is estimated that by 2040, one in four of the world's children under 18 – some 600 million in all – will be living in areas of extremely high water stress. 700 million people worldwide could be displaced by intense water scarcity by 2030.

Water is complex because it is linked to almost everything in the world. But complexity should not hinder understanding: Water is a precondition for human existence and for the sustainability of the planet. Over 2 billion people live in countries experiencing high water stress.

8. What happens to us if we drink polluted water?

Why do we drink water from bottles, not from tap? Why can't we drink from the rivers or lakes like our ancestors did?

Unfortunately, the answer is that if we drink this water directly, we will contract several types of diseases and illnesses, we might even die. Our waters are polluted, and the sad reality is that it is mainly humanity, who did this.

9. What is wastewater?

The most typical pollutants in our waters come from households, industry, agriculture and from almost every human activity. There are visible ones such as garbage and all the floating junk but also invisible ones such as:

suspended solids, organic matter, chemicals, fats, nutrients like nitrogen and phosphorus, drugs, heavy metals, etc.

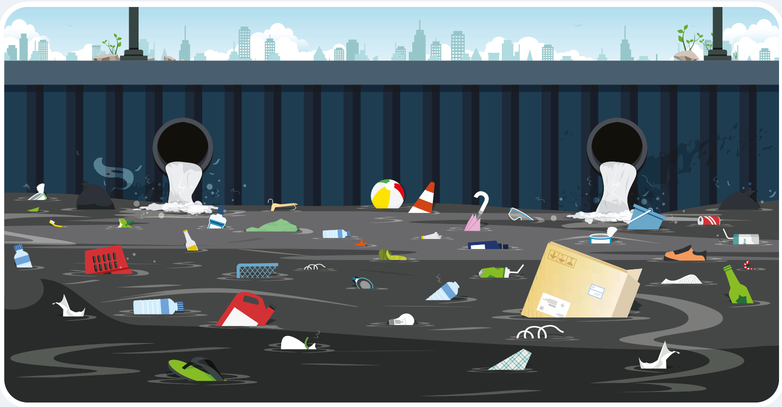
10. Where should the wastewater go from your home?

Globally, it is likely that **over 80% of wastewater** is released to the environment without adequate treatment (UN WWDR, 2017).

The availability of safe and sufficient water supplies is inextricably linked to how wastewater is managed. Increased amounts of untreated sewage, combined with agricultural runoff and industrial discharge, have degraded water quality and contaminated water resources around the world. Globally, 80% of wastewater flows back into the ecosystem without being treated or reused, contributing to a situation where around 1.8 billion people use a source of drinking water contaminated with faeces, putting them at risk of contracting cholera, dysentery, typhoid and polio. Far from being something to discard or ignore, wastewater will play a major role in meeting the growing water demand in rapidly expanding cities, enhancing energy production and industrial development, and supporting sustainable agriculture.

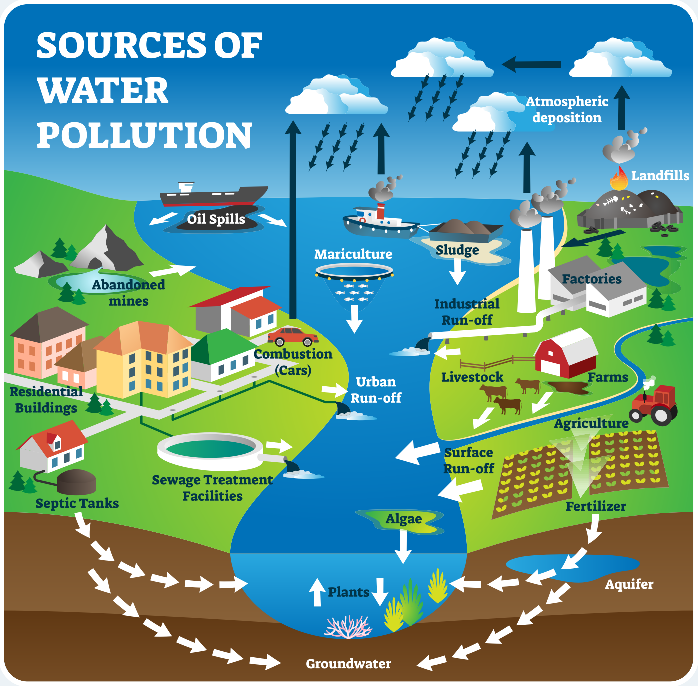
Mainly in low-income areas of cities and towns within developing countries, a large proportion of wastewater is discharged directly into the closest surface water drain or informal drainage channel, sometime without or with very little treatment. In addition to household effluent and human waste, urban-based hospitals and industries such as small-scale mining and motor garages, often dump highly toxic chemicals and medical waste into the wastewater system.

Even in cities where wastewater is collected and treated, the efficiency of treatment may vary according to the system used. However, water used by a municipal authority for irrigating green spaces or cleaning streets does not need to be treated to a potable standard. Treating wastewater to a water quality standard appropriate to its intended use increases the potential for cost recovery. The growth of urban demand for water will require new approaches to wastewater collection and management. Indeed, reused wastewater may help address other challenges including food production and industrial development.



Wastewater and industry

Societal and environmental pressures over recent years have led to a growing movement for industry to reduce its wastewater and to treat it before discharge. Wastewater is now seen as a potential resource and its use, or recycling after suitable treatment, can provide economic and financial benefits.



Wastewater can be used within the business itself or between several businesses through 'industrial symbioses. Industrial water consumption is responsible for 22% of global water use. In 2009 in Europe and North America, water consumption by industries was 50% as compared to 4-12% in developing countries. It is expected that in rapidly industrialising countries, this proportion could increase by a factor of five in the next 10-20 years. Therefore, there is a strong incentive to use wastewater in-house and locally, based on cost savings alone.

Businesses can directly use some wastewater, providing it is fit for purpose. For instance, using process water for cooling or heating, or rainwater from roof collection or concrete aprons for toilet flushing, irrigation or vehicle washing.

Wastewater in agriculture

To help maximise yields to meet demand, usage of chemical fertilizers and pesticides has increased in recent years both in industrial and small farming, making agriculture a potential source of environmental pollution. Farmers are increasingly looking into non-conventional water resources, mainly wastewater, whether due to its high nutrient content or lack of conventional water resources.

Pollution of groundwater and surface water by agricultural use of untreated or inadequately treated wastewater is a major issue in many developing countries where such irrigation is practised. Improved wastewater management can improve the health of workers, especially in agriculture, by reducing the risk of pathogen exposure.

If applied safely, wastewater is a valuable source of both water and nutrients, contributing to water and food security and livelihood improvements.

11. What is a wastewater treatment plant?

If we decided to clean the water we polluted, **the first thing is we must do is to collect the polluted wastewater** in order to prevent it from entering the environment and polluting it further. In Western countries, this is done by building a pipeline everywhere so that sewage can leave the site of pollution (everybody uses flushing toilets in their houses, the aim is to get rid of polluted wastewater as soon as possible). The pipelines then collect the water and lead it to a central location where there is a relatively large amount of contaminated water in one place. The treatment facility can be installed into this place. Elsewhere – where there are no flushing toilets, no pipelines in the houses – it is not that simple. A practice, similar to what is used in the collection and transport of solid waste, has become widespread. **The Zoomlion Company does the same in Ghana too.** The septic trucks empty domestic water closet toilets, latrines where people go to do their "thing" every day. In this case, the trucks, not the pipes transport the sewage to a central place where it can be collected and treated.

The treatment facility we build to clean the wastewater is called **wastewater treatment plant**. It has several machines and pools. Some of them are made for the **physical treatment** of wastewater: they catch larger contaminants floating in the water and remove them: it is the first phase of the treatment. Since the water itself is polluted too, **we need some chemistry and biology too** to clean it as much as possible. Treating wastewater is a complex science. It is good to know that nature can also do it and it does so, but it takes much longer time for it (it can take years or more than a 100 years, see the big oil tankers' accidents!). What we do is to speed it up in an artificial "environment".

12. Do you know the name of relatively clean wastewater?

We call the relatively clean wastewater coming from baths, sinks, washing machines, and other kitchen appliances grey water. It is generated in households or office buildings except for the wastewater coming from the toilets.

13. What happens if sewage water is not treated?

Globally, it is likely that over 80% of wastewater is released to the environment without adequate treatment.The availability of safe and sufficient water supplies is inextricably linked to how wastewater is managed. Increased amounts of untreated sewage, combined with agricultural runoff and industrial discharge, have degraded water quality and contaminated water resources around the world. Globally, 80% of wastewater flows back into the ecosystem without being treated or reused, contributing to a situation where around

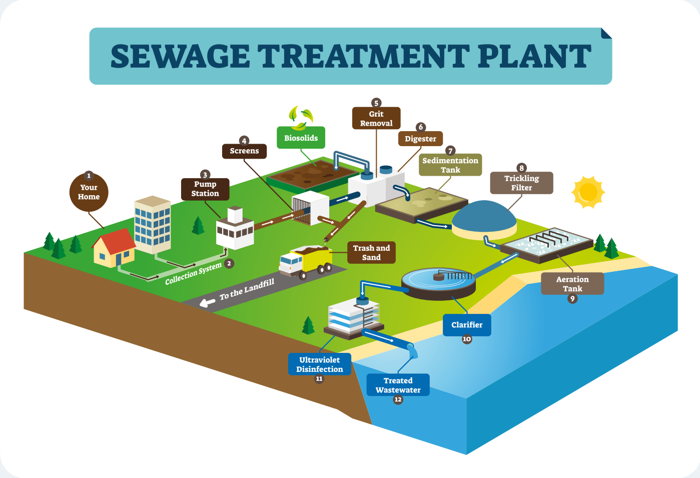
1.8 billion people use a source of drinking water contaminated with faeces, putting them at risk of contracting cholera, dysentery, typhoid and polio. Far from being something to discard or ignore, wastewater will play a major role in meeting the growing water demand in rapidly expanding cities, enhancing energy production and industrial development, and supporting sustainable agriculture.

14. Do you know the name of wastewater derived from pure urine?

In the conventional wastewater treatment systems, instead of utilising the **yellow water** for plant nutrition, it is wasted. In modern municipal wastewater treatment plants, **nitrogen** compounds (most of them originating from **yellow water**) is removed with the costly nitrification and denitrification process. Separate collection of yellow water is possible with **sorting toilet**. Among the flows of wastewater, **yellow water** contains most of the nutrients.

15. What types of treatments are usually applied at the WWTPs?

The screening and primary phase: physical and chemical treatment



We remove the large floating waste, sand, fat, oil and grease, or even rocks, and smaller suspended solids from the wastewater first. We have easy work to do with larger particles: they cannot pass the filters or can be sedimented by gravity. In case of smaller suspended solids, we add some chemicals which react with the contaminants. As a result, we get larger particles and we can sediment them also. Sand particles are sedimented by gravity. Fats and oil particles should be removed also, they float on the surface of the water, so we can skim them easily. How do you think fat and oil get into wastewater? Answer: washing dishes.

The secondary treatment: biological treatment

After our wastewater is free from floating and suspended contaminants, we remove the dissolved contaminants. **What are these materials? For example, organic material or nutrients, like nitrogen or phosphorus**. Why should we remove them? The **organic materials require a lot of oxygen during their decomposition by nature** (millions of microorganisms work on that). Remember, nature can also treat wastewater! Oxygen is a vital element for living creatures, like fish. If untreated wastewater gets into a river, many fish can die because decomposition processes take away the oxygen from them.

16. How can we reuse stormwater?

Beneficial uses of stormwater include any use of water to meet individual or societal water needs, including but not limited to: irrigation, drinking, washing, bathing, cooling, and flushing. The use of stormwater pose different levels of human health risk based on whether public access is “restricted” or “unrestricted”. Usage is restricted if public access can be controlled, such as irrigation of golf courses, cemeteries, and highway medians. Usage is unrestricted if public access cannot be controlled, such as irrigation of parks, toilet flushing, firefighting, or water feature uses. Unrestricted use of stormwater have more stringent water quality regulations that limit public health risk and exposure to pollutants and microorganisms than the restricted use of stormwater.

Green Infrastructure: stormwater and rainwater harvesting use systems that improve or maintain watershed hydrology, reduce pollutant loading to receiving waters, increase water conservation, reduce stress on existing infrastructure, and reduce energy consumption.

17. What is the unit for water measurement?

The water meter records how much water you use in cubic metres (m^3). One cubic metre equal 1000 litres - that’s enough for either 13 baths, 14 washing machine loads, 28 showers, 33 dishwasher loads or 111 toilet flushes!

The cubic metre (in Commonwealth English and international spelling as used by the International Bureau of Weights and Measures) or cubic meter (in American English) is the SI derived unit of volume. Its SI symbol is m^3. It is the volume of a cube with edges one metre in length.

18. Mention three ways water is polluted

What is water pollution?

Water pollution happens when toxic substances enter water bodies such as lakes, rivers, oceans and so on, getting dissolved in them, lying suspended in the water or depositing on the bed. This degrades the quality of water.

Not only does this spell disaster for aquatic ecosystems, but the pollutants also seep through and reach the groundwater, which might end up in our households as contaminated water.

Sources and effects of water pollution.

Water pollution can be caused in a number of ways, through city sewage and industrial waste discharge. Indirect sources of water pollution include contaminants that enter the water supply from soils or groundwater systems and from the atmosphere via rain.

Soils and groundwaters contain the residue of human agricultural practices and also improperly disposed industrial wastes.

Types of water pollutants can be: organic, inorganic, radioactive and so on. In fact, the list of possible water contaminants is just too vast.

19. What happens during chemical treatment in a WWTP?

Chemical wastewater treatment causes contaminants that are dissolved in wastewater to separate more easily through the targeted addition of specific substances. During precipitation, a previously dissolved substance is turned into an insoluble substance that can be filtered from the liquid.

20. What happens during biological treatment in a WWTP?

Biological wastewater treatment harnesses the action of bacteria and other microorganisms to clean water. Wastewater typically contains a buffet of organic matter, such as garbage, wastes, and partially digested foods. It also may contain pathogenic organisms, heavy metals, and toxins.

Biological wastewater treatment is a process that seems simple on the surface since it uses natural processes to help with the decomposition of organic substances, but in fact, it's a complex, not completely understood process at the intersection of biology and biochemistry.

Biological treatments rely on bacteria, nematodes, or other small organisms to break down organic wastes using normal cellular processes.

The goal of biological wastewater treatment is to create a system in which the results of decomposition are easily collected for proper disposal. Biological treatment is used worldwide because it's effective and more economical than many mechanical or chemical processes.

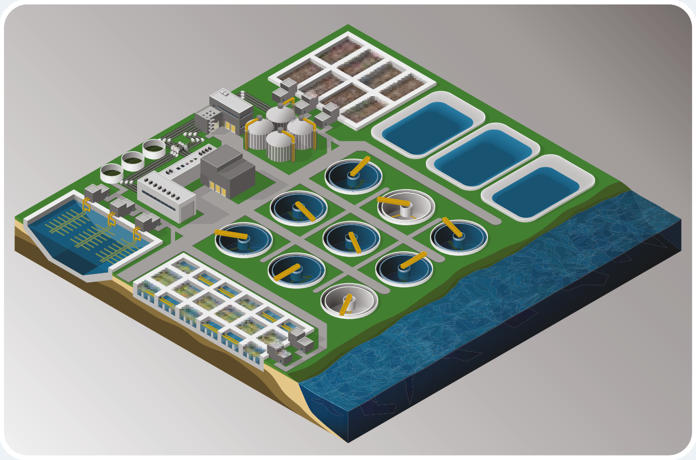
Biological treatment usually is divided into aerobic and anaerobic processes. "Aerobic" refers to a process in which oxygen is present, while "anaerobic" describes a biological process in which oxygen is absent. Scientists have been able to control and refine both aerobic and anaerobic biological processes to achieve the optimal removal of organic substances from wastewater.

Biological wastewater treatment often is used as a secondary treatment process to remove material remaining after primary treatment with processes including dissolved air flotation (DAF). In the primary water treatment process, sediments and substances such as oil are removed from the wastewater.

21. What is happens during the physical treatment in a WWTP?

Screens and strainers remove solid contaminants from wastewater. These mechanical processes separate solid pollutants such as diapers, hair, and wet wipes from the wastewater stream. Before the treatment of industrial wastewaters, strainer separate textile fibers, paper labels, plastic residuals, and production residues such as potato peels and other scraps and wastes.

Depending on the area of application, coarse or fine screens are used. They clean the wastewater by means of parallel rods. Strainer feature grits, screens, perforations and meshes of varying sizes.
Coarse strainer (> 20 mm) to micro (<0.05 mm) separate solid substances as large as human waste to as small as sand and tiny sludge particles from the wastewater stream.



The mechanical preliminary cleaning in the treatment of sanitary wastewaters is extremely important. Fibers suspended in the wastewater pose a particular challenge, especially the extremely tear-resistant textile fibers of wet wipes and non-woven materials. They tend to build up, potentially creating blockages and enormous damage to pumps and mixers.

22. Do you know the name of the wastewater that comes from your toilet, kitchen sink and dishwasher?

Black water definition: wastewater and sewage from toilets. It cannot be reused without purification.

23. What percentage of the Earth's surface is covered in water?

A whopping 96.5 percent of water on Earth is in our oceans, covering 71 percent of the surface of our planet. And at any given time, about 0.001 percent is floating above us in the atmosphere. If all of that water fell as rain at once, the whole planet would get about 1 inch of rain.

24. What percentage of the world's water is fresh?

Of all the water that exists on our planet, roughly 97% is saltwater and less than 3% is freshwater. Most of Earth's freshwater is frozen in glaciers, ice caps, or is deep underground in aquifers. Less than 1% of Earth's water is freshwater that is easily accessible to us to meet our needs, and most of that water is replenished by precipitation—a vital component of the water cycle, affecting every living thing on Earth.

25. How much of all the freshwater in the world flows through rivers, seas or lakes?

Of all the water on Earth, more than 99 percent of Earth's water is unusable by humans and many other living things. Only about 0.3 percent of our fresh water is found in the surface water of lakes, rivers and swamps.

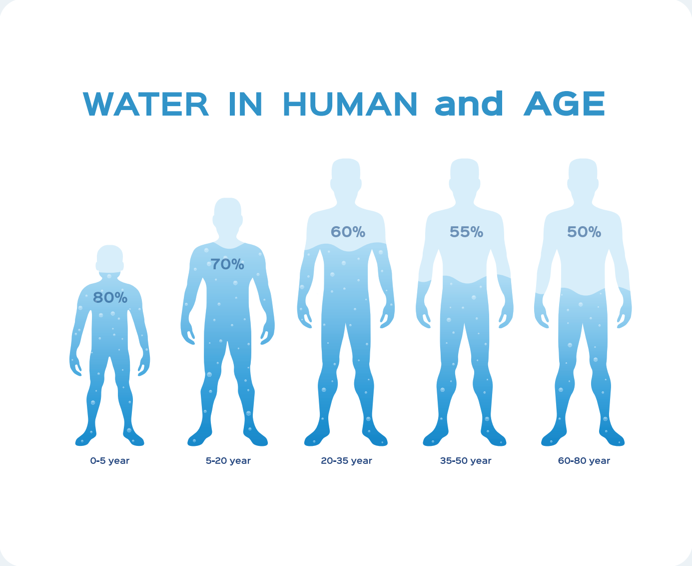
26. How much water is the body made up of?

Most of the human body is water, with an average of roughly 60%. The amount of water in the body changes slightly with age, sex, and hydration level. While the average percentage of water in a person's body is around 60%, the percentage can vary from roughly 45–75%.For example, babies have a high percentage of water in their bodies, which decreases with age. Also, fatty tissue contains less water than muscle, so the percentage of water can vary with body type. Water is essential for health and is necessary for numerous bodily functions. These include: temperature regulation, cellular function, waste removal.

People can maintain the balance of water in their bodies by drinking fluids throughout the day. They may need to drink more water after exercise and in hot weather. We discuss the percentage of water in the human body, why it varies, and why it is important.

Body water percentage chart

A person's age, sex, and hydration levels may affect the percentage of water in their body. The percentage of water in the body varies slightly, depending on factors such as age and sex, but is usually within the 45–75% range. There is more water in lean muscle than there is in fatty tissue. Typically, a female body contains a lower percentage of water than a male one. This is due to females having a higher percentage of fat. This water distribution means that people with a higher percentage of body fat are likely to have a lower percentage of water in their bodies.



The percentage of water in the body changes with age. Babies have a very high percentage of water in their bodies, while older adults have less. The following tables give the average percentages and ranges of water in the body, according to sex and age:

	Age 12–18 years	Age 19–50 years	Age 51 years and older
Male	Average: 59% Range: 52–66%	Average: 59% Range: 43–73%	Average: 56% Range: 47–67%
Female	Average: 56% Range: 49–63%	Average: 50% Range: 41–60%	Average: 47% Range: 39–57%
	Birth to 6 months	**6 months to 1 year**	**1–12 years**
Infants and children	Average: 74% Range: 64–84%	Average: 60% Range: 57–64%	Average: 60% Range: 49–75%

Body size, shape, and balance of muscle and fat can all affect the percentage of water in a person's body.

27. How much water should you drink a day to keep your body fit and hydrated?

The Institute of Medicine says children and teenagers should consume about two to three quarts of water a day (1.7 to 3.3 liters), depending on age, size and sex. Adolescent boys generally need to drink more water than girls do, research suggests.

28. When the dinosaurs ruled the world, how much water was there?

One more important fact about water: did you know that no new water is formed on Earth? For thousands and millions of years we use the same water over and over again! It is just the wonderful consequence of the water cycle.

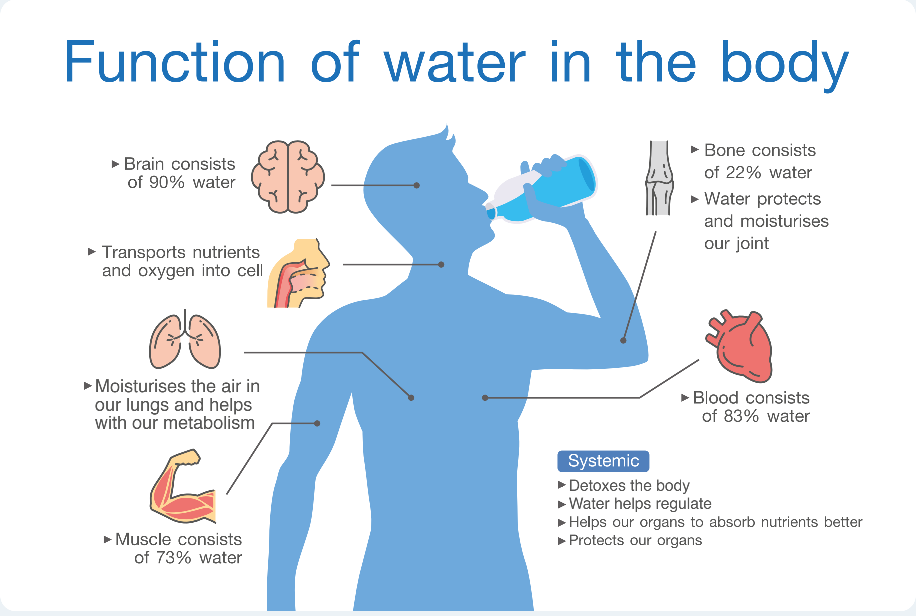
29. A river basin is ....?

The area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta.

A river drainage basin is an area drained by a river and all of its tributaries. A river basin is made up of many different watersheds. A watershed is a small version of a river basin. Every stream and tributary has its own watershed, which drains to a larger stream or wetland. These streams, ponds, wetlands, and lakes are part of a river basin. Every river is part of a network of watersheds that make up a river system's entire drainage basin. All the water in the drainage basin flows downhill toward bigger rivers.

30. Which of these contains the most water?

Regardless of water content, all parts of the body need water to work properly.



31. What takes most water to make?

Water is used in many stages of the industrial production process. From maintaining facilities, to conducting manufacturing processes, and even to grow elements used to make products. When you look at an industrial product, the water usage is typically hidden – you're not thinking of the water used to make your car, for example, because the end product doesn't have visible water.

Cars

To make the average passenger car, around 147971 litres of water is required. To make a single tire, an average of 1960 litres of water is used.

Clothing

To create a pair of blue jeans, about 6813 litres of water is needed just to grow enough cotton for one pair. To grow enough cotton to create one T-shirt, 1514 litres of water is consumed. These totals are just for growing the cotton – creating cotton fabric, constructing the clothing, and other factors are not accounted for, but do add to the water footprint of each clothing item.

It takes about 8543 litres of water to make one pair of shoes. To make a pound of synthetic rubber, used for shoe soles, 208 litres of water is needed.

Construction Materials

One board of lumber takes about 20,4 litres of water to grow – not included is water consumed during logging, cutting, and processing. A 220m² home requires approximately 3000 m² of lumber and other wood products. To make one gallon of paint, it takes 49 litres of water. A ton of steel requires 234695 litres of water.

Bottled Water

The bottle of water you're drinking – it takes 3 litres just to make the bottle! 9 litres of drinking water is needed to produce one litre of bottled water.

32. True or false? Sound travels faster through water than air?

Sound travels faster in water than it travels in air. Its speed is around 1500 m/s at around 25 °C whereas in air its speed is approximately 350 m/s at 25 °C temperature. This is because the particles of a liquid are much tightly packed than that of gases. So the sound energy gets transferred easily to the next particle.

33. Water is made up of what two elements?

A water molecule is made up of two hydrogen atoms and one oxygen atom.

34. Are tsunami and tidal wave the same?

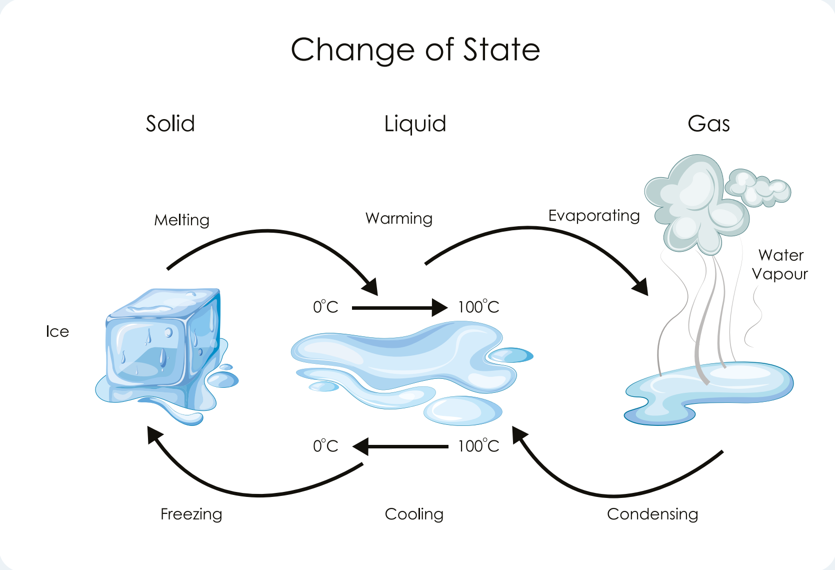
A tidal wave is a regularly reoccurring shallow water wave caused by effects of the gravitational interactions between the Sun, Moon, and Earth on the ocean. The term "tidal wave" is often used to refer to tsunamis; however, this reference is incorrect as tsunamis have nothing to do with tides. Tsunami is a series of water waves caused by the displacement of large bodies of water. They generally have low amplitude but a high (a few hundred km long) wavelength.

35. True or false? The Indian Ocean is the biggest ocean on Earth

Covering approximately 63 million square miles and containing more than half of the free water on Earth, the Pacific is by far the largest of the world's ocean basins. The Atlantic basin is the second largest basin, followed by the Indian Ocean basin, the Southern Ocean, and finally the Arctic Ocean basin.

36. The solid state of water is known as what?

There are three states of water: solid, liquid, gas. Water is known to exist in three different states; as a solid, liquid or gas. Clouds, snow, and rain are all made up of some form of water. A cloud is comprised of tiny water droplets and/or ice crystals, a snowflake is an aggregate of many ice crystals, and rain is just liquid water.



Water existing as a gas is called water vapor. When referring to the amount of moisture in the air, we are actually referring to the amount of water vapor. If the air is described as "moist", that means the air contains large amounts of water vapor. Moisture is a necessary ingredient for the production of clouds and precipitation.

37. How long can the average human survive without water?

The body needs lots of water to carry out many essential functions, such as balancing the internal temperature and keeping cells alive. As a general rule of thumb, a person can survive without water for about 3 days. However, some factors, such as how much water an individual body needs, and how it uses water, can affect this.

Factors that may change how much water a person needs include:

- age
- activity levels
- overall health
- bodily factors, such as height and weight
- sex

What a person eats may also affect the amount of water they need to drink. For example, a person who eats water-rich foods, such as fruits, juices, or vegetables, may not need to drink as much water as someone who has been eating grains, bread, and other dry foods.
The environmental conditions a person is in will also affect how much water their body uses. A person living in a very hot climate will sweat, causing them to lose more water. A person in a climate-controlled environment will not sweat so they will not use as much water. If a person who has diarrhoea or is vomiting has no access to water, they will lose water much faster than someone without these issues.

Effects of having no water

Humans can only survive a short amount of time without water because the body needs it for almost every process, including:

- regulating body temperature through sweating and breathing
- aiding in digestion by forming saliva and breaking down food
- moistening mucous membranes
- helping to balance the pH of the body
- lubricating joints and the spinal cord
- helping the brain make and use certain hormones
- helping transport toxins out of the cells
- eliminating waste through the urine and breath
- delivering oxygen throughout the body

Without water, the body is unable to function correctly and will begin to stop working. The effects of dehydration come on quickly, especially in extremely hot conditions when a person sweat. The body uses water to produce sweat, which evaporates and lowers a person's body temperature. Without water, the body cannot produce sweat. This can lead to a dangerous increase in body temperature and put pressure on the fluid in the body, including the blood. If this leads to a drop in blood volume, less blood circulates in the body, causing a severe drop in blood pressure. This itself can lead to unconsciousness or death. At the same time, the mouth dries, and the digestive system slows down. Water helps the body remove the toxins from cells and excrete them through the urine and breath. Without water, the body cannot do this efficiently, causing toxins to build up. A toxic buildup harms the kidneys, which process the removal of the toxins from the body. If the kidneys fail, the toxins build up even further, causing widespread organ failure and death.

38. True or false? Pure water is tasteless.

See under question 39

39. True or false? Pure water is odourless.

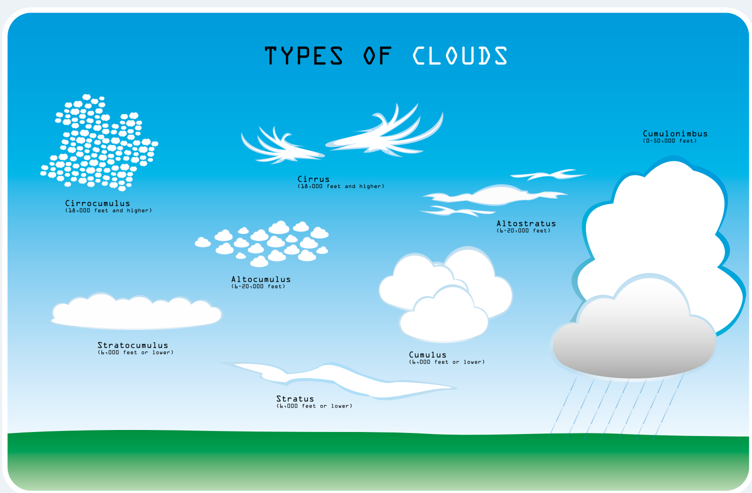
Looking at water, you might think that it's the simplest thing around. Pure water is practically colorless, odorless, and tasteless. But it is not at all simple and plain and it is vital for all life on Earth. Where there is water there is life, and where water is scarce, life must struggle or just "throw in the towel." Continue to learn about dozens of water properties.

40. Nimbus, cumulus and stratus are types of what?

Clouds are made up of very light water droplets or ice crystals. These particles can float in the air. When warm air rises, swells and cools, it forms clouds. Many water droplets formed together scatter reflect sunlight. This allows you to see a white cloud, but with a dark or gray cloud, the sunlight is scattered in all directions instead of reflected. The different types of clouds are cumulus, cirrus, stratus and nimbus.

Cirrus Clouds

Cirrus clouds are the thin, wispy clouds seen high in the sky. They look as if someone took a cloud, stretched it, pulled pieces off, like a cotton ball when it is pulled apart. They are thin because they are made of ice crystals instead of water droplets. A blue sky and a few cirrus clouds high in the sky, usually means it is going to be a nice day.



Cumulus Clouds

Cumulus clouds are the puffy clouds that are usually scattered throughout the sky. In Latin, the word cumulus means pile. Just like when we say "accumulate," it means things pile up. This type of cloud is formed when warm air rises carrying water vapor with it by evaporation. Cumulus clouds can be white or gray. White fluffy clouds mean no rain, but when they form into dark or gray clouds, it is going to rain.

Stratus Clouds

Stratus clouds look like a huge thick blanket covering the sky. These clouds are a sure sign of rain if it is warm and snow if it is cold. If stratus clouds are near the ground, they form fog. These clouds form when the weather has been cold and warmer moist air blows in. The amount of moisture in the air and the difference between warm and cold air determine how thick the cloud or fog is.

Nimbus Clouds

The word nimbus means a cloud that already has rain or snow falling from it. These clouds are dark and seen during a thunderstorm along with thunder and lightning. They can be a combination of two clouds, like a cumulonimbus, which means a puffy black cloud with rain falling out of it, or a stratonimbus, which is a dark blanket with rain falling out of it.

41. True or false? Water is an example of a chemical element.

Elements are the building blocks of nature. Water, for example, is a compound composed of two ingredients: hydrogen and oxygen elements. Each element is a pure substance that cannot be split up into any simpler pure substance.

Both are molecules, because 2 or more atoms are joined together. But, in these examples, only oxygen, whether it is made of 2 oxygens joined together in a molecule or only 1 oxygen is an element because it is made of only one type of atom - oxygen! H_2O is not an element because it is made of 2 types of atoms - H and O.

42. Does water cover more or less than 50% of the Earth's surface?

Most water in Earth's atmosphere and crust comes from the World Ocean's saline seawater. The area of Earth reflect blue light, Earth appears blue from space, and is often referred to as the blue planet and the Pale Blue Dot.

Fresh water is defined as water with a salinity of less than 1 percent that of the oceans- i.e. around 0.35‰. Water with a salinity between this level and 1‰ is typically referred to as marginal water because it is marginal for many uses by humans and animals. The ratio of salt water to fresh water on Earth is around 50 to 1.

The planet's fresh water is also very unevenly distributed. Of the liquid surface fresh water, 87% is contained in lakes, 11% in swamps, and only 2% in rivers. Small quantities of water also exist in the atmosphere and in living beings. Of these sources, only river water is generally valuable.

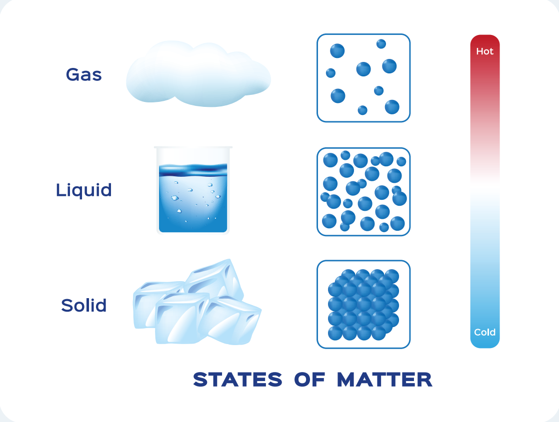
However, fresh groundwater is of great value, especially in arid countries.

43. True or false? Water boils at 100 degrees Celsius (212 degrees Fahrenheit).

Water boils at 100 ˚C or 212 ˚F at one atmosphere of pressure. Liquids boil when the pressure of the atmosphere is equal to the pressure of the liquid. When the pressure of the atmosphere is reduced, a liquid boils at a lower temperature. This is what happens when you climb a mountain. When a pressure cooker is used, steam is trapped in the pot and it increases the pressure above the water. This causes the water to boil at a temperature more than 100 ˚C. When you pull back on the plunger, the pressure in the syringe is reduced and the liquid boils at a lower temperature. You can boil water at about 50 ˚C in this system.

44. When water is frozen, does it contract or expand?

Most liquids have a quite simple behaviour when they are cooled (at a fixed pressure): they shrink. The liquid contracts as it is cooled; because the molecules are moving slower, they are less able to overcome the attractive intermolecular forces drawing them closer to each other. Then the freezing temperature is reached, and the substance solidifies, which causes it to contract some more because crystalline solids are usually tightly packed.



Water is one of the few exceptions to this behaviour. When liquid water is cooled, it contracts like one would expect until a temperature of approximately 4 degrees Celsius is reached. After that, it expands slightly until it reaches the freezing point, and then when it freezes it expands by approximately 9%.

This unusual behaviour has its origin in the structure of the water molecule. There is a strong tendency to form a network of hydrogen bonds, where each hydrogen atom is in a line between two oxygen atoms. This hydrogen bonding tendency gets stronger as the temperature gets lower (because there is less thermal energy to shake the hydrogen bonds out of position). The ice structure is completely hydrogen bonded, and these bonds force the crystalline structure to be very "open.

45. Water freezes at what temperature?

Interesting to know that the answer is far more complicated than it first appears—We've all been taught that water freezes at 0 ˚C. That's not always the case, though. Scientists have found liquid water as cold as -40 ˚C in clouds and even cooled water down to -41 ˚C in the lab. This supercooling of water is possible because water needs a small nucleus or seed of ice for the molecules to form crystals and in very pure water, it crystallizes into ice too quickly for scientists to measure the temperature of the liquid. So Emily Moore and Valeria Molinero of the University of Utah developed a sophisticated computer simulation of 32,768 water molecules (fewer molecules than can be found in a raindrop) that let them see what happened to the water's heat capacity, density and compressibility as it supercooled and determine what happened as 4,000 of those molecules froze. Their results appear in the journal Nature.

As the temperature of the water approaches -55 degrees F, the water molecules form tetrahedrons, with each molecule loosely bonding to four other molecules. The density of the water decreases, its heat capacity increases and its compressibility increases. "The change in structure of water controls the rate at which ice forms," Molinero says. "We show both the thermodynamics of water and the crystallization rate are controlled by the change in structure of liquid water that approaches the structure of ice." Below -48 °C , tiny bits of liquid water may still exist, but it would do so only for an incredibly short time, Molinero says.

This supercooling of water is possible because water needs a small nucleus or seed of ice for the molecules to form crystals and in very pure water "the only way you can form a nucleus is by spontaneously changing the structure of the liquid," Molinero says. Those nuclei won't form or grow large enough until the structure of the liquid water molecules approaches that of solid ice, which doesn't happen until the water gets so incredibly cold.

46. True or false? Water is easy to compress.

Water is the only common substance that is naturally found as a solid, liquid or gas. Solids, liquids and gases are known as states of matter. Before we look at why things are called solids, liquids or gases, we need to know more about matter. Matter can be a confusing word because it has several meanings.

We often hear phrases like "What is the matter?" or "It doesn't matter". Scientists have a different meaning for matter – matter is anything that occupies space and has mass.

Matter is made up of tiny particles. These can be atoms or groups of atoms called molecules. Atoms are like individual LEGO blocks. They are the smallest unit that anything can be broken down into without doing something extreme. If atoms are like LEGO blocks, molecules are the structures you build with them. The physical characteristics of atoms and molecules decide the form or state the matter is in.

Water: solid, liquid and gas

Water has three forms: solid, liquid and gas. The water molecules stay the same, but they behave differently as they change from one form to another.

Solid

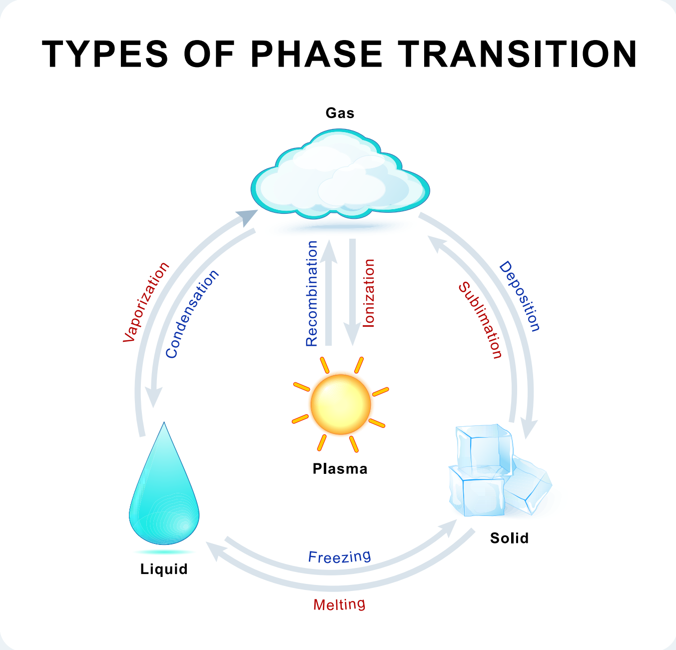
Right now, you are probably sitting on a chair, using a mouse or a keyboard that is resting on a desk – all these things are solids. Something is usually described as a solid if it can hold its own shape and is hard to compress (squash). The particles in most solids are closely packed together. Even though the particles are locked into place and cannot move or slide past each other, they still vibrate a tiny bit.

Ice is water in its solid form or state. Ice keeps its shape when frozen, even if it is removed from its container. However, ice is different from most solids: its molecules are less densely packed than in liquid water. This is why ice floats.

Liquid

The simplest way to determine if something is a liquid is to ask this question: If I try and move it from one container to another (i.e. by pouring), will it conform to (take on the shape of) the new container? Water is a liquid. We can pour liquid water from one container into another. Liquid water takes on the shape of its container.

If you have a glass of water and pour it into another glass, it clearly conforms – it takes on the shape of the glass. If you spill the water, it will go everywhere. Because it isn't in a container, it conforms to the shape of the floor, making a big puddle!



In most liquids, the particles are less densely packed, giving them the ability to move around and slide past each other. While a liquid is easier to compress than a solid, it is still quite difficult – imagine trying to compress water in a confined container! Water is an example of a liquid, and so are milk, juice and lemonade.

Gas

The atoms and molecules in gases are much more spread out than in solids or liquids. They vibrate and move freely at high speeds. A gas will fill any container, but if the container is not sealed, the gas will escape. Gas can be compressed much more easily than a liquid or solid. Right now, you are breathing in air – a mixture of gases containing many elements such as oxygen and nitrogen.

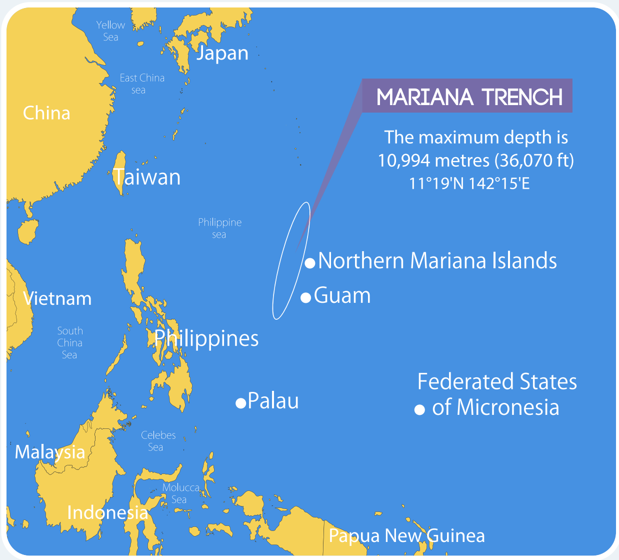
Water vapour is the gaseous form or state of water. Unlike ice or water, water vapour is invisible. We exhale water vapour whenever we breathe out. We cannot see the water vapour as we exhale, but if we hold our eyeglasses or smartphone to our mouths, we can see the water vapour condensing (becoming liquid) on these objects.

47. What is the chemical formula of water?

Water is an inorganic, transparent, tasteless, odourless, and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms (in which it acts as a solvent). It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H_2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms, connected by covalent bonds. Two hydrogen atoms are attached to one oxygen atom.

48. What's the name of the deepest natural point in all of the world's oceans?

The Mariana Trench or Marianas Trench is located in the western Pacific Ocean about 200 kilometres east of the Mariana Islands; it is the deepest oceanic trench on Earth. It is crescent-shaped and measures about 2,550 km in length and 69 km in width. The maximum known depth is 10,984 metres at the southern end of a small slot-shaped valley in its floor known as the Challenger Deep. However, some unrepeated measurements place the deepest portion at 11,034 metres.
If Mount Everest were placed into the trench at this point, its peak would still be under water by more than two kilometres.



At the bottom of the trench, the water column above exerts a pressure of 1,086 bars (15,750psi), more than 1,071 times the standard atmospheric pressure at sea level. At this pressure, the density of water is increased by 4.96%. The temperature at the bottom is 1 to 4°C. In 2009, the Marianas Trench was established as a US National Monument. Monothalamea have been found in the trench by Scripps Institution of Oceanography researchers at a record depth of 10.6 kilometres below the sea surface. Data has also suggested that microbial life forms thrive within the trench.

49. True or false? The consumption of bottled water has risen significantly over the last few decades.

Sales and consumption of bottled water have skyrocketed in recent years. For example in 2020, for the fifth year in a row, bottled water ranked as the largest beverage category by volume in the U.S. Bottled water sales worldwide are continuing to increase annually far faster than almost any other category of commercial beverage. As of 2013, more than 50% of Americans drank bottled water occasionally or as their major source of drinking water – an astounding fact given the high quality and low cost of U.S. tap water.

What is the reason for this? Bottled water typically costs a thousand times more per litre than high-quality municipal tap water. Are consumers willing to pay this price because they believe that bottled water is safer than tap water? Do they have a real taste preference for bottled water? Or is the convenience of the portable plastic bottle the major factor? Are they taken in by the images portrayed in commercials and on the bottles?

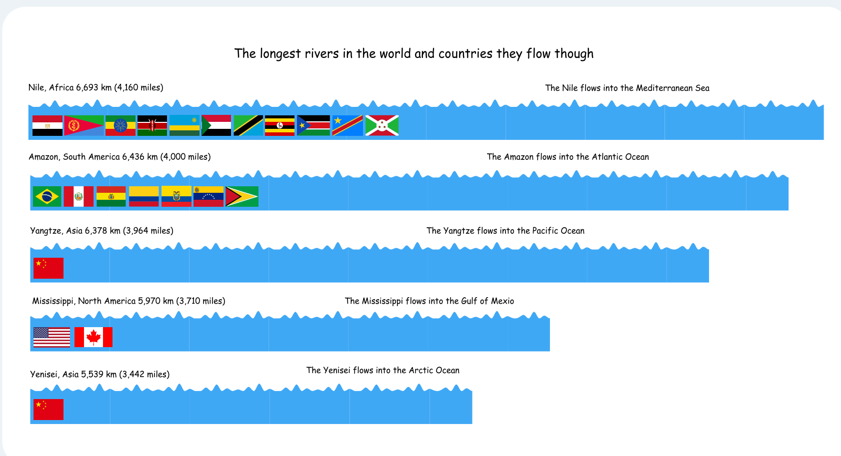
Despite its cost, users should not assume that the quality of bottled water is adequately protected, regulated, or monitored. Ultimately, the provision of clean water to all will not come from sales of bottled water but from effective actions of communities, governments, and municipal providers to provide a safe and reliable domestic water supply.

50. Pure water has a pH level of around what number?

In general, a water with a $pH < 7$ is considered acidic and with a $pH > 7$ is considered basic. The normal range for pH in surface water systems is 6.5 to 8.5 and for groundwater systems 6 to 8.5. Alkalinity is a measure of the capacity of the water to resist a change in pH that would tend to make the water more acidic. The measurement of alkalinity and pH is needed to determine the corrosivity of the water.

51. What is the longest river on Earth?

The Nile is credited as the longest river in the world. Its main source is Lake Victoria in east central Africa. From its farthest stream in Burundi, it extends 6,695 km in length. The two longest rivers in the world are the Nile, flowing into the Mediterranean, and the Amazon, flowing into the South Atlantic. Which is the longer is more a matter of definition than simple measurement. Not until 1971 was the true source of the Amazon discovered, by Loren McIntyre (USA) in the snow-covered Andes of southern Peru. The Amazon begins with snowbound lakes and brooks-the actual source has been named Laguna McIntyre-which converge to form the Apurimac. This joins other streams to become the Ene, the Tambo and then the Ucayali. From the confluence of the Ucayali and the Marañón the river is called the Amazon for the final 3,700 km as it flows through Brazil into the Atlantic Ocean. The Amazon has several mouths, which widen towards the sea, so that the exact point where the river ends is uncertain. If the Par estuary (the most distant mouth) is counted, its length is approximately 6,750 km.



52. True or false? Ice sinks in water

Whenever you put ice cubes into your glass of water, do you ever wonder what makes them float, instead of sinking to the bottom of your glass? This doesn't just occur with small ice cubes - giant icebergs float atop oceans and lakes.

Sinking Vs. Floating

The density of an object is what determines whether that object will sink or float. If an object or substance is less dense (having less weight) than other components in a mixture, it will float. When an object floats, it displaces a weight of fluid equal to its own weight. Let's try a bucket of water and some rocks to explain this concept: When tossing rocks into a bucket of water, the rocks will sink. This is because the rocks are denser than the water, so they displace the water - or push it out of the way.

Why does ice float?

Since it's known that solid objects are denser and have more weight than liquids - and ice is a solid - one would automatically think that ice would sink in water. But it doesn't! What's so special about ice that causes it to float? Believe it or not, ice is actually about 9% less dense than water. Since the water is heavier, it displaces the lighter ice, causing the ice to float to the top.

How is ice less dense than water?

When a liquid is cooled, more molecules are brought closer together and need to be accommodated in a smaller area. This results in most solids having a greater density than liquids. Not so with ice. Water consists of positively-charged hydrogen atoms and negatively-charged oxygen atoms. When water cools, the hydrogen bonds adjust to hold the negatively-charged oxygen atoms apart, which prevents the ice from becoming any denser. So for water, the density actually decreases along with a decrease in temperature - causing ice to be less dense than water!

A gift to nature

When looking at this concept in nature, we see how important it is: Lakes and rivers freeze from top to bottom, enabling fish to survive even after the surface of the body of water they live in has frozen over. This winter season, when you're out in nature walking, sledding, or ice skating, if there's a river or lake nearby, take some time to closely observe it. Has the top frozen over? If so, look through the frozen layer and see if you can spy any fish happily swimming around.

53. Where does the drinking water come from?

Drinking water, also known as **potable water**, is water that is safe to drink or use for food preparation. The amount of drinking water required to maintain good health varies, and depends on physical activity level, age, health-related issues, and environmental conditions. For those who work in a hot climate, up to 16 litres a day may be required.

Typically in developed countries, tap water meets drinking water quality standards, even though only a small proportion is actually consumed or used in food preparation. Other typical uses include washing, toilets, and irrigation. Greywater may also be used for toilets or irrigation. Its use for irrigation however may be associated with risks. Water may also be unacceptable due to levels of toxins or suspended solids.

Potable water is available in almost all populated areas of the Earth, although it may be expensive and the supply may not always be sustainable. Sources where water may be obtained include:

- Ground sources such as groundwater, springs
- Precipitation which includes rain, hail, snow, fog, etc.
- Surface water such as rivers, streams, glaciers
- Biological sources such as plants
- Desalinated seawater
- Water supply network
- Atmospheric water generator

Springs are often used as sources for bottled waters. Tap water, delivered by domestic water systems refers to water piped to homes and delivered to a tap or spigot. For these water sources to be consumed safely, they must receive adequate treatment and meet drinking water regulations.

The most efficient and convenient way to transport and deliver potable water is through pipes. Plumbing can require significant capital investment. Some systems suffer high operating costs. The cost to replace the deteriorating water and sanitation infrastructure of industrialized countries may be as high as $200 billion a year. Leakage of untreated and treated water from pipes reduces access to water. Leakage rates of 50% are not uncommon in urban systems.

Because of the high initial investments, many less wealthy nations cannot afford to develop or sustain appropriate infrastructure, and as a consequence people in these areas may spend a correspondingly higher fraction of their income on water. In El Salvador for example, reports show that the poorest 20% of households spend more than 10% of their total income on water. In the United Kingdom, authorities define spending of more than 3% of one's income on water as a hardship.

54. What percentage of people in the Sub-Saharan region has no access to safe drinking water?

Globally, by 2015, 89% of people had access to water from a source that is suitable for drinking – called improved water source. In Sub-Saharan Africa, access to potable water ranged from 40% to 80% of the population. Nearly 4.2 billion people worldwide had access to tap water, while another 2.4 billion had access to wells or public taps. The World Health Organization considers access to safe drinking-water a basic human right. About 1 to 2 billion people lack safe drinking water, a problem that causes 30,000 deaths each week. More people die from unsafe water than from war, U.N. Secretary-General Ban Ki-Moon said in 2010.

55. Which do you think are the reasons for unsafe drinking water?

Common sources of drinking water contaminants include:

Industry and agriculture. Organic solvents, petroleum products, and heavy metals from disposal sites or storage facilities can migrate into aquifers. Pesticides and fertilizers can be carried into lakes and streams by rainfall runoff or snowmelt can percolate into aquifers.

Human and animal waste. Human wastes from sewage and septic systems can carry harmful microbes into drinking water sources, as can wastes from animal feedlots and wildlife. Major contaminants include Giardia, Cryptosporidium, and E. coli.

Treatment and distribution. While treatment can remove many contaminants, it can also leave behind byproducts (such as trihalomethanes) that may be harmful. Water can also become contaminated after it enters the distribution system, from a breach in the piping system or from corrosion of plumbing materials made from lead or copper.

Natural sources. Some ground water is unsuitable for drinking because the local underground conditions include high levels of certain contaminants. For example, as ground water travels through rock and soil, it can pick up naturally occurring arsenic, other heavy metals, or radionuclides.

Water that's safe to drink should ideally be clear with no odor or funny taste. One way to tell if water is contaminated is to look for turbidity, or cloudiness. While cloudy water isn't necessarily dangerous to your health, it could signal the presence of unsafe pathogens or chemicals.

You can also take preventive measures such as replacing old or rusty pipes and/or faucets in your home, or purchasing a water filter or other water treatment system, or requesting a water test.

Effects on Human Health. If drinking water contains unsafe levels of contaminants, it can cause health effects, such as gastrointestinal illnesses, nervous system or reproductive effects, and chronic diseases such as cancer. Factors that can influence whether a contaminant will lead to health effects include the type of contaminant, its concentration in the water, individual susceptibility, the amount of water consumed, and the duration of exposure.

Health effects of chemical exposure. Chemical exposure through drinking water can lead to a variety of short- and long-term health effects. Exposure to high doses of chemicals can lead to skin discoloration or more severe problems such as nervous system or organ damage and developmental or reproductive effects. Exposure to lower doses over long periods of time can lead to chronic, longer-term conditions such as cancer. The effects of some drinking water contaminants are not yet well understood.

Health effects of consuming water with disease-causing microbes. Most life-threatening waterborne diseases caused by microbes (such as typhoid fever or cholera) are rare in the United States today. The more common illnesses caused by viruses, bacteria, and parasites can result in stomach pain, vomiting, diarrhoea, headache, fever, and kidney failure. Infectious diseases such as hepatitis can also occur. Hepatitis may be severe in people with weakened immune systems (e.g., infants and the elderly) and sometimes fatal in people with severely compromised immune systems (e.g., cancer and AIDS patients).

56. How many litres of water does it take to produce a litre of bottled water?

In fact, plastic bottles take about three times as much water to produce than they can actually hold. This means that three litres of water is needed to make a water bottle that only holds one litre.

57. What percentage of people in Sub-Saharan Africa are not part of the pipe water network?

About 9% of the world does not have access to an improved water source. Access to improved water sources is increasing across the world, rising from 76% of the global population in 1990 to 91% in 2015. This means 9% – nearly one-in-ten – do not have access to an improved water source.

The definition of an improved drinking water source includes "piped water on premises (piped household water connection located inside the user's dwelling, plot or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection)." In 2015, most nations had improved water access in greater than 90% of households. This marks significant progress since 1990 where most countries across Latin America, East and South Asia, and Sub-Saharan Africa were often well below 90%. Access remains lowest in Sub-Saharan Africa where rates typically range from 40 to 80% of households.

58. On average, how far do women in developing countries walk to get water?

Every day, women and girls spend 200 million hours walking to collect water for their families. That's 8.3 million days. More than 22,800 years. It's hard to get your head around numbers that large, so start instead with 6km. A little more than 3.7 miles, is the average distance round trip women and children in the developing world walk for water — water that is often contaminated with life-threatening diseases. It is 15 laps around a football field. It is five times the number of steps to climb the Empire State Building.

You could do that, right? Well, maybe not the climbing part; that would be hard. You could probably walk 6 km in an hour and 15 minutes. If you're a runner, you could cover the distance in half that time.

Walking for water in Africa

But that's not how it's done in sub-Saharan Africa. There, people don't have access to an improved water source. Moms and daughters walk their 6 km barefoot or in rubber sandals to collect water from polluted rivers and ponds. More than 3 million children and nearly 14 million women walk more than 30 minutes to collect water. And they often make that trip more than once a day! Maybe they climb up steep hills or over rocks, slide down a steep gully, or circle around thorn trees. There may be snakes and bees or people who want to rob them— or worse — lying in wait along the way.

On the way home from the water source, it's even harder.

You know what it's like to carry a litre of milk from the car to the kitchen counter? Try a bottle in each hand at 4,5 litres each, and the total weight is less than half the 21 litres an African woman carries on her head in a 20-liter jerrycan. You see, carrying water is not just difficult, it's a lifelong pain in the neck or back that sometimes causes serious health problems.

But would that 20-liter jerrycan be enough water for your family to drink, cook, bathe, and wash for a day? No way. Fifteen liters a day is considered a bare minimum water supply for only one person. You might have to walk to the waterhole many times a day for more than that. Knowing that puts those 200 million hours in perspective, doesn't it?

59. Where is most of the Earth's freshwater located?

Earth's Freshwater

Most people have heard Earth referred to as "the water planet." With that name comes the rightful image of a world with plentiful water. In photographs taken from space, we can see that our planet has more water than land. However, of all the water on Earth, more than 99 percent of Earth's water is unusable by humans and many other living things - only about 0.3 percent of our fresh water is found in the surface water of lakes, rivers and swamps.

Earth Science

In photographs taken from space, we can see that our planet has more water than land. It is unexpected and somewhat inconceivable that less than three percent of Earth's water is fresh water. According to the U.S. Geological Survey, most of that three percent is inaccessible. Over 68 percent of the fresh water on Earth is found in icecaps and glaciers, and just over 30 percent is found in ground water. Only about 0.3 percent of our fresh water is found in the surface water of lakes, rivers, and swamps. Of all the water on Earth, more than 99 percent of Earth's water is unusable by humans and many other living things! It seems extraordinary that the water that supports all terrestrial, as well as aquatic, life on our planet is actually so scarce. With this stunning realization comes a recognition that we have to utilize this resource very wisely. An important first step is to educate ourselves and future generations of citizens.

60. How is Earth's water supply being continuously renewed?

Water helps define the physical makeup of the Earth – considering it covers more than 70 percent of our planet's surface – and is essential to all its life forms.

Water, after all, composes the bulk of the mass of most living things – about 65 percent of human beings, for example – and provides the medium by which nutrients are transported through the body and within which they're transformed into energy or life-sustaining biological structures.

The water cycle, also known as the **hydrologic cycle**, describes the routes and processes by which this critical substance travels between land, ocean and atmosphere. The oceans and seas account for about 97 percent of all the water on the planet, fed primarily by terrestrial runoff and precipitation.

Several key water cycle steps – evaporation, condensation and precipitation – help ensure the proportionately scanty amount of moisture contained in freshwater is continually renewed.

As it was written in Answer No.1 the **water cycle** can be thought of as the movement of water in its solid, liquid and gaseous states between different global reservoirs. Less than one percent of the Earth's water is actually actively moving through the water cycle at any given time.

Most is temporarily locked in "storage." That refers to water residing in deep ocean waters, glacial ice, subterranean aquifers and other long-term reservoirs, which in some cases may hold water molecules for thousands or tens of thousands of years.

Only a tiny fraction of water exists outside of the oceanic system, and roughly three-quarters of that freshwater is frozen as glaciers and ice caps. About half a percent of Earth's freshwater makes up **groundwater**, which is water within rock layers. Only about a quarter of a percent of freshwater is contained within lakes, rivers, the atmosphere and organisms.

Priming the Atmosphere with Water

Though there's a minuscule amount transferred by storm surges and sea spray, evaporation is the main way by which ocean water is moved onto land to help replenish freshwater reservoirs. Evaporation is the transformation of liquid water into the gaseous form of water vapor.

Because they account for the majority of surface waters on the planet and because they dominate the warmer latitudes where high temperatures encourage high evaporation, oceans contribute more than 80 percent of the Earth's total evaporated moisture.

The land, of course, accounts for the rest of the water vapor added to the atmosphere: not just via evaporation off surface waters, but also via transpiration, the water vapor given off by plants.

Transpiration from forests can increase rainfall by supplying significant quantities of water vapor to the local atmosphere. This is an example – given trees require a certain minimum level of precipitation to grow – of a positive feedback loop.

The term **evapotranspiration** captures the combined effects of evaporation and transpiration. Much smaller amounts of water vapor are also contributed by other processes such as the respiration of animals and volcanic eruptions.

From Atmosphere to Land

Water evaporated or transpired into the atmosphere generally doesn't stick around there very long: often merely hours or days. But needless to say its atmospheric residency is incredibly important from the standpoint of refueling the land-based portion of the water cycle.

Water vapor condenses into liquid droplets or sublimes to ice particles to form clouds when the airmass containing it cools sufficiently.

That can happen when the airmass rises: from the buoyancy created through solar heating (convection), for example, or when it's shoved upwards by terrain or another airmass (along a frontal boundary). Humid maritime air masses laden with moisture evaporated off the oceans reach land by advection, the horizontal movement of air.

Water as Precipitation

When the droplets and ice particles in a cloud grow large and heavy enough, they fall as precipitation: rain, snow, freezing rain, hail, graupel, sleet and the like. This provides an input of water into the terrestrial system. Precipitation is delivered very unequally around the Earth's surface, which helps determine the layout of different ecosystems: deserts and semi-deserts one end of the moisture spectrum, rainforests and monsoon forests on the other. The atmosphere doesn't even need to generate precipitation to supply water to the land, either. Trees, for example, wring moisture from low-hanging or ground-hugging clouds by providing a surface for water condensation.

This **fog drip** can supply significant amounts of moisture to the soil. Air at ground level that cools overnight can also condense water on vegetation and other surfaces in the form of **dew**.

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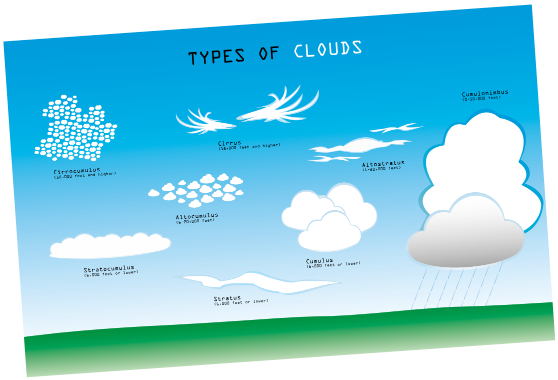

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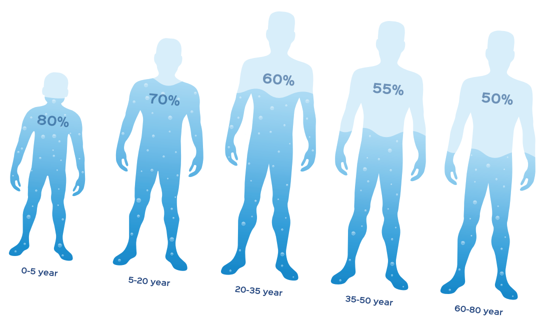

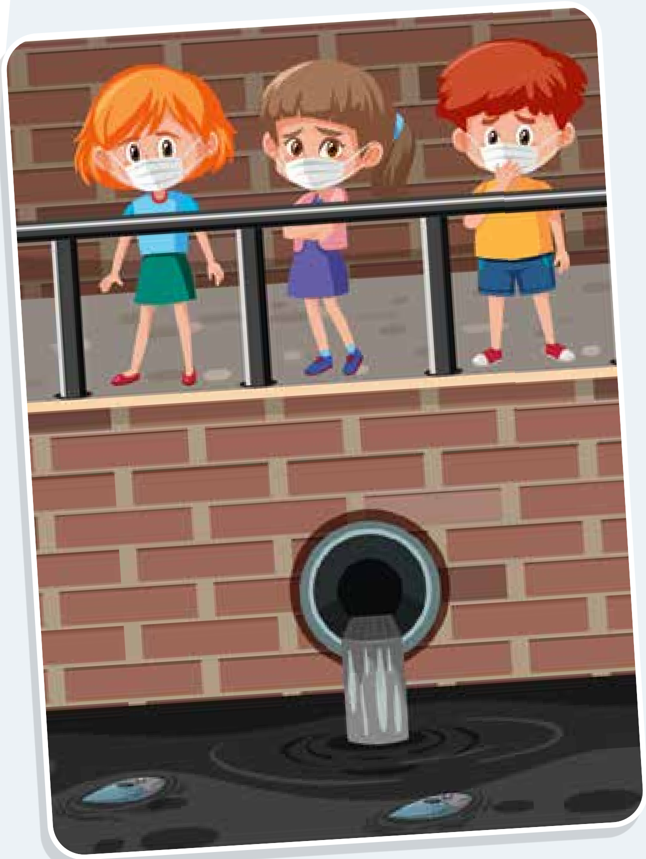

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