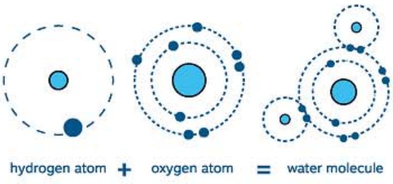
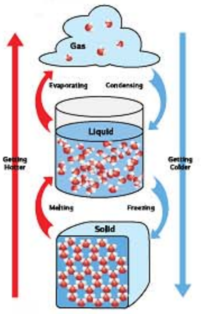
WATER – THE MOST NOTABLE COMPOUND

Water (H_2O)

is a colourless, tasteless and odourless liquid. It consists of two elements – **oxygen and hydrogen**, or, more precisely, of a mixture of their isotopes **^{1}H, ^{2}H (D – deuterium)** and **^{3}H (T – tritium)**, and **^{14}O, ^{15}O, ^{16}O, ^{17}O, ^{18}O** and **^{19}O**.

The **$^{1}H_2{}^{16}O$** molecule completely predominates in nature. **Heavy water $D_2{}^{16}O$** comprises only about 0.015% and **super heavy water $T_2{}^{16}O$** is radio-active (T is β emitter). Heavy water is 10.6% denser than ordinary water, hence its name.





Water, although it is the most common compound on the Earth, has a number of surprising physical properties, some of which are quite unique and certainly have made life on the Earth possible.

To name at least some of them:

1. The water molecules creates **clusters** (by **hydrogen bonds**), which are the main cause of the **anomalous properties of water**.
2. The water molecule, though it seems electroneutral, has a **dipole character** (positive and negative charge in the molecule is not evenly distributed).
3. Water has a **high specific heat capacity** (large thermal inertia), and is thus able to **"hold" the thermal energy**. This not only allows efficient transport of heat (warm ocean currents, central heating, etc.), but also has a major influence on the Earth's climate.
4. **The density of water varies with temperature and pressure.** The maximum value 999.973 kg.m^{-3} (and minimum volume) is achieved at the temperature of **3.98 °C** and pressure of 101.325 kPa. **Ice** has a density of only **917 kg.m^{-3}** and therefore floats on water. The volume of ice, however, is about 9% greater than the volume of liquid water.
5. **The viscosity of water** (liquid resistance against motion) **decreases with increasing pressure** (at temperatures < 30 °C). The opposite is true for other liquids – as the pressure increases, their viscosity increases (molecules are pushed closer to each other and they "interfere" more when they move).
6. **Water has a high surface tension** (the effort of the liquid to minimize its surface at a given volume) – therefore, raindrops have a "spherical" shape.

Water attributes

seawater × freshwater
flowing × still
drinking × utility × waste
natural × modified
distilled × mineral
tap × bottled
rain × surface × underground
soft × hard
clear × turbid
pure × contaminated
dangerous × useful
boiling × icy

Does water have memory?

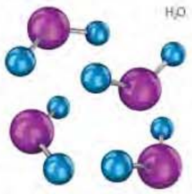
Structures of water molecules (clusters) are being formed and destroyed very dynamically, on a trillionth of a second timescale. So if water "remembers" being forced into some structure, it is really a very short memory. Long-term memory of water, often emphasized by homeopaths and some "charlatans", is not possible, because the hydrogen bonds between water molecules are just very weak interactions.

Why do ponds, lakes and the sea freeze from the top?

When the water cools down, its density increases and thus the cold water first moves to the bottom, until it reaches a temperature of 4 °C. However, when the water temperature drops below 4 °C, the density of water begins to decrease. Thus, the water at 4 °C remains "trapped" at the bottom and water starts to freeze from the surface. This anomaly is crucial to the biosphere and probably allowed the preservation of life on the Earth 650 million years ago, when (according to the hypothesis called "snowball Earth") the entire planet Earth froze.

What is the Mpemba effect?

This is a seemingly paradoxical fact that hot water freezes (changes from liquid to solid) faster than cold water. The causes of Mpemba's phenomenon have not yet been satisfactorily clarified. There are a number of theories. Most of them try to describe this phenomenon by convection or molecular structures of water.



Clusters of water molecules

At how many degrees does water boil?

Boiling of water depends on atmospheric pressure. At normal pressure (101.3 kPa) water boils at 100 °C, but high in the mountains, like in the Himalayas, where the pressure is much lower, water boils at a much lower temperature.

VODA