

Water is one of the strangest substances on Earth!

Life on Earth depends on the strange properties of water:

Water's solid form is lighter than the liquid, being the densest (the heaviest) at 4° C.

The H₂O molecules form bridges between each other due to their polar nature, the more positive H atoms lie close to the more negative O atoms of nearby molecules (see tutorial p.14-15). You can test some of these properties in the following experiments.

Experiments with water

1. The density of solid (ice) and liquid water at different temperatures

1.a. Watch ice melt in liquid water.

See what happens when ice melts in water: place a coloured ice cube (frozen coloured water) in a long glass of still warm water.

- Record the result (photo or video); describe what happens to the coloured water as it melts!

- This property is important for the layers of water in lakes in different seasons! Explain this connection using the terms "stratification" and "thermocline".

https://upload.wikimedia.org/wikipedia/commons/thumb/a/a8/LSE_Stratification.png/600px-LSE_Stratification.png

1.b. How much bigger is a piece of ice compared to its liquid volume? (tutorial p.9 and p.15)

- How much of a floating ice cube is above the water level? This is partly why the size of icebergs are tricky for ships and difficult to judge!

- How could you find out how much water expands when it becomes ice? (Use a small tube to show the change more clearly.)

2. "Sticky water"

The strong bonds between the H₂O molecules are described in the tutorial "Matter" (p.14-15).

http://www.exploratorium.edu/ronh/bubbles/sticky_water.html

2.a. The overfull glass: Fill a glass (standing on the table) very carefully with water from another cup or glass until it is "overfull" with a bulging surface. Explain how this is possible!

2.b. Walking on water Some water organisms make use of the "surface tension" [Oberflächenspannung] of water to prevent them from sinking in. They spread their weight with several thin legs on the surface (see above link). -> Test how well the little "animals" made of aluminum foil can stand on the water; you can also make your own "creatures".

Water's high surface tension makes a water drop's form as tight as possible, i.e. it's round. This insect is *inside* the "tight" water drop!

http://phenomena.nationalgeographic.com/2016/01/20/help-im-trapped-in-a-drop-of-water/?utm_source=NatGeocom&utm_medium=Email&utm_content=wild_science_20160209&utm_campaign=Content&utm_rd=2115465544

- Add a drop of detergent [Waschmittel] to the water with the "creatures" on it. Explain what happens.

Explanation: <http://www.middleschoolchemistry.com/multimedia/chapter5/lesson2>

3. Cool, man!

3.a. Water stores heat well; this means a lot of energy is needed to raise the temperature of water. Water thus takes relatively long to evaporate compared to other similar substances, such as alcohol, which vaporize much more readily at room temperature. It takes more energy to break all the hydrogen bonds to release the H_2O molecules into the air than is needed for the alcohol molecule.

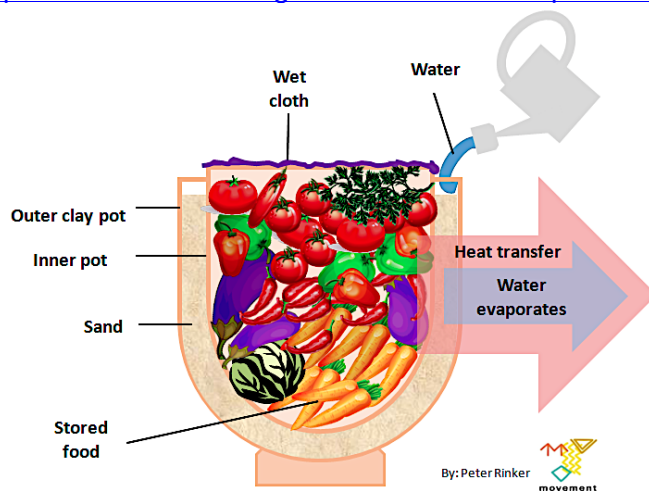
- Put a drop of water and a drop of alcohol on the back of your hand. Compare the result.

3.b. Cool, man! A lot of heat is needed for water to evaporate. Evaporating water takes (extracts) the heat from the surroundings, especially the air, which is needed for the H_2O molecules to break up their hydrogen bonds and escape from the liquid.

- Test whether butter wrapped in a damp cloth in a warm room stays solid (hard).

People in hot climates make use of this property of water to keep things fresh:

<http://www.resilience.org/stories/2006-11-22/passive-cooling>



- Explain how the “desert cooler” (also called “swamp cooler”) works.

https://probaway.files.wordpress.com/2009/01/swamp_cooler.gif?w=529

4. Water as a solvent (Lösungsmittel)

Mix and mix? Water is one of the most important solvents [Lösungsmittel] in nature (“Matter“p.16).

- Try to mix the following substances with water:

table salt, sugar, oil, starch or flour [Stärke oder Mehl].

Mix them vigorously: either in a test tube [Reagenzglas, Röhrchen], holding your thumb over the opening, or in a glass using a spoon.

- Describe your observations.

Explain the results using your knowledge from the tutorial and the link below.

<http://www.ck12.org/user:cwake4433/book/Mr.-Wake's-Physical-Science/section/3.46/>

- Does adding salt to water (dissolving the salt completely) raise the water level? Find an explanation!

Dissolve as much salt as possible in a little water until some of the salt remains at the bottom of the glass. Would adding more salt raise the level of the water in the glass?

<http://www.ck12.org/book/CK-12-Chemistry-Concepts-Intermediate/section/16.3/>