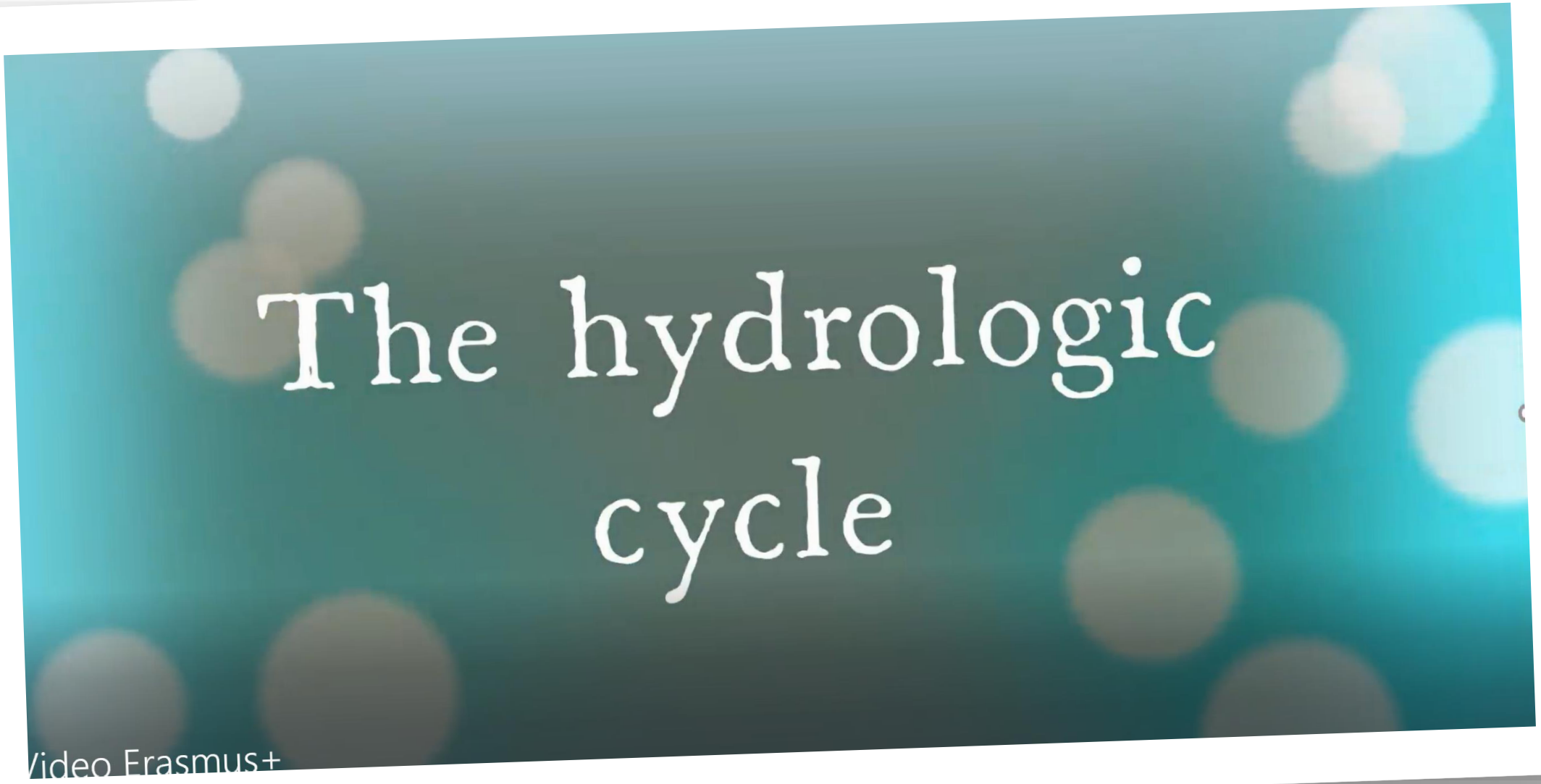
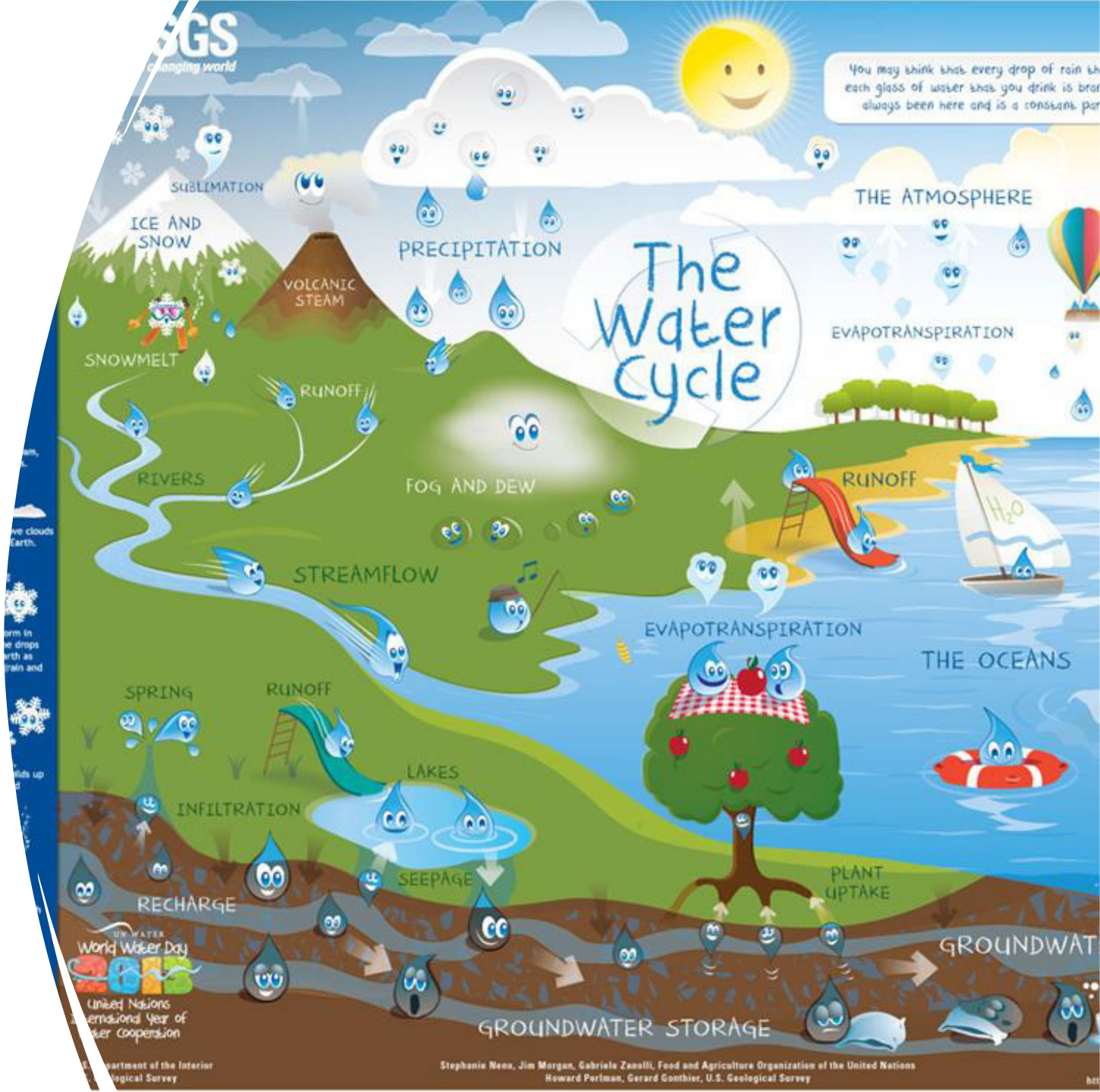

The hydrologic
cycle
Video Erasmus+

Earth has been recycling water for over **4 billion years**!

- Did you know that the water you drink is the same water that wooly mammoths, King Tutankhamun and the first humans drank?

- That's because Earth has been recycling water for over **4 billion years**!

- The world's water moves between lakes, rivers, oceans, the atmosphere and the land in an ongoing cycle called the **water cycle**. As it goes through this continuous system, it can be a liquid (water), a gas (vapour) or a solid (ice).



"Vapour"

Evaporation

- Energy from the sun heats up the surface of the Earth, causing the temperature of the water in our rivers, lakes and oceans to rise. When this happens, some of the water "evaporates" into the air, turning into a gas called "**vapour**". Plants and trees also lose water to the atmosphere through their leaves. This process is known as "**transpiration**.

Video Erasmus+

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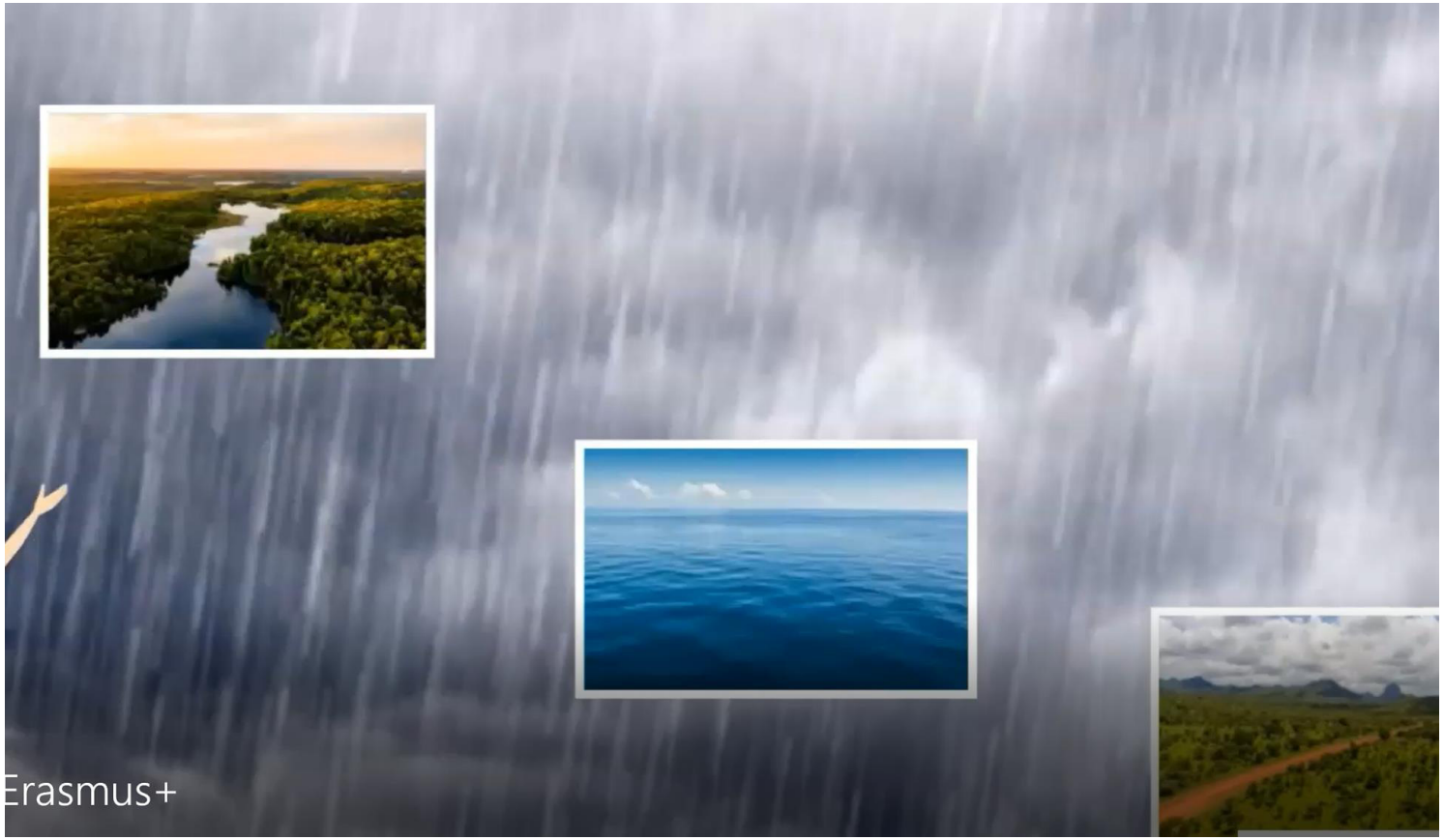
Erasmus
Enriching lives, opening min

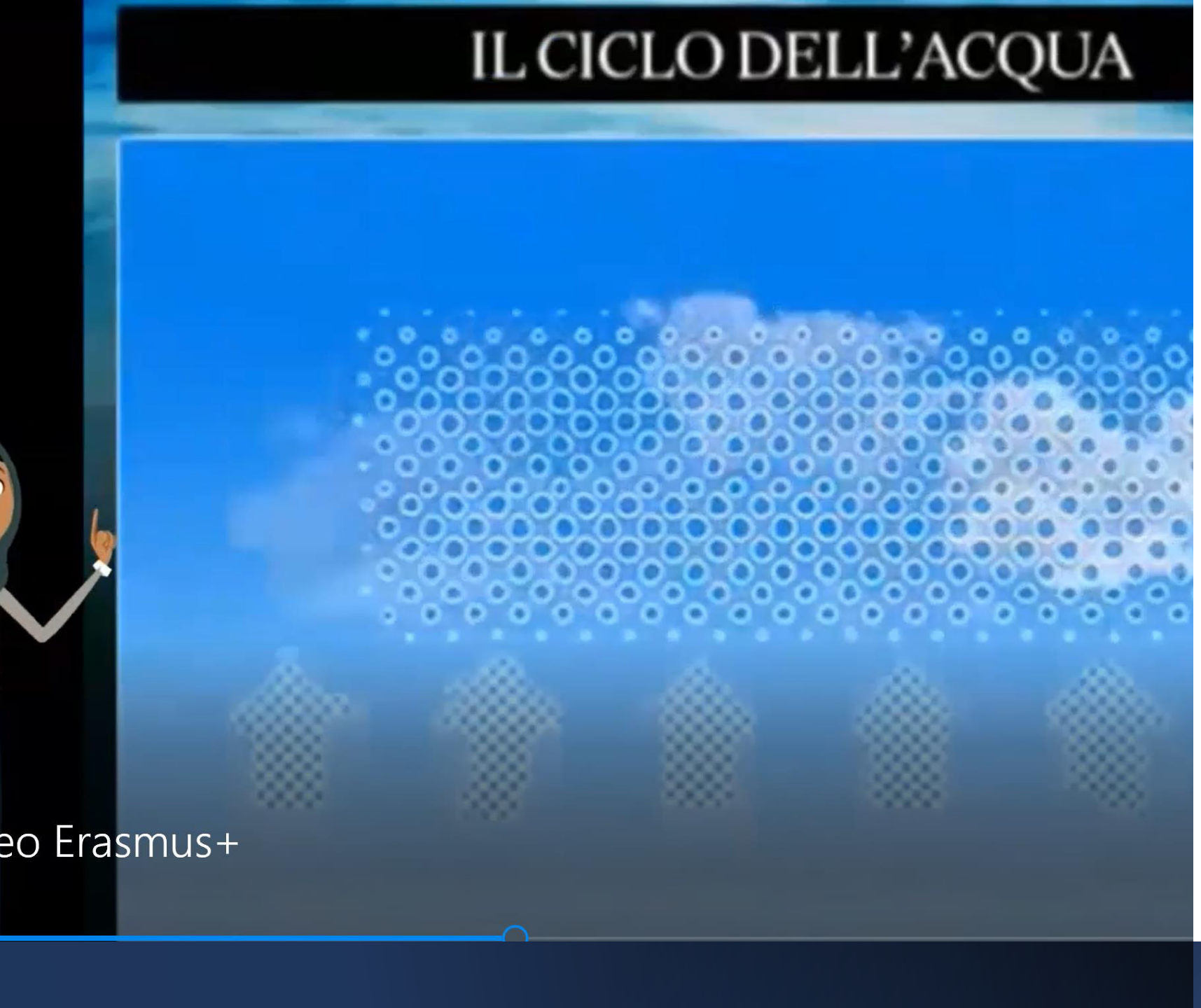
Condensation

As water vapour rises up high into the sky, it cools and turns back into a liquid, forming clouds. This process is called "**condensation**". Currents high up in the air move these clouds around the globe.



Collection

- The fallen precipitation is then “collected” in rivers, lakes and oceans from where it will evaporate back into the air, beginning the cycle all over again. *How* it is collected, depends on where it lands…
  - Some will fall directly into lakes, rivers or the sea, from where it will evaporate and begin the cycle all over again.
  - If the water falls on vegetation, it may evaporate from leaves back into the air. Some of this water may then be taken up by the plant roots in the earth.
  - In cold climates, the precipitation may build up on land as snow, ice or glaciers. If temperatures rise, the ice will melt to liquid water and then soak into the ground, or flow into rivers or the ocean.
- Water that reaches land directly may flow across the ground and collect in the oceans, rivers or lakes. This water is called “**surface run-off**“. Some of the precipitation will instead soak (or “infiltrate”) into the soil, from where it will slowly move through the ground until eventually reaching a river or the ocean.

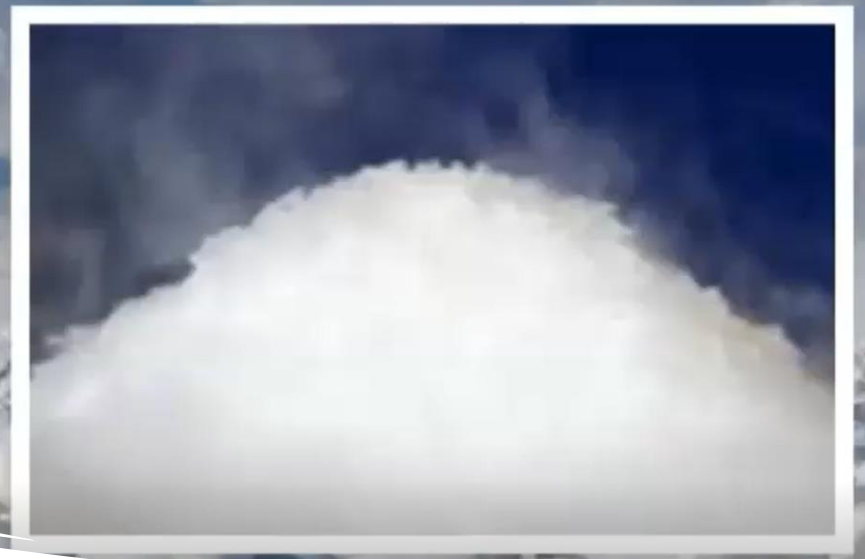


Precipitation

When too much water has condensed, the water droplets in the clouds become too big and heavy for the air to hold them. And so they fall back down to Earth as rain, snow, hail or sleet, a process known as "**precipitation**".

Water that reaches land directly may flow across the ground and collect in the oceans, rivers or lakes. This water is called “**surface run-off**“. Some of the precipitation will instead soak (or “infiltrate”) into the soil, from where it will slowly move through the ground until eventually reaching a river or the ocean.

"Sublimation"



sublimation

- **Water can change from a solid to a gas, without becoming a liquid first. Through this process of "*sublimation*" our planet's ice can evaporate directly into the air without melting!**

NO WASTE!

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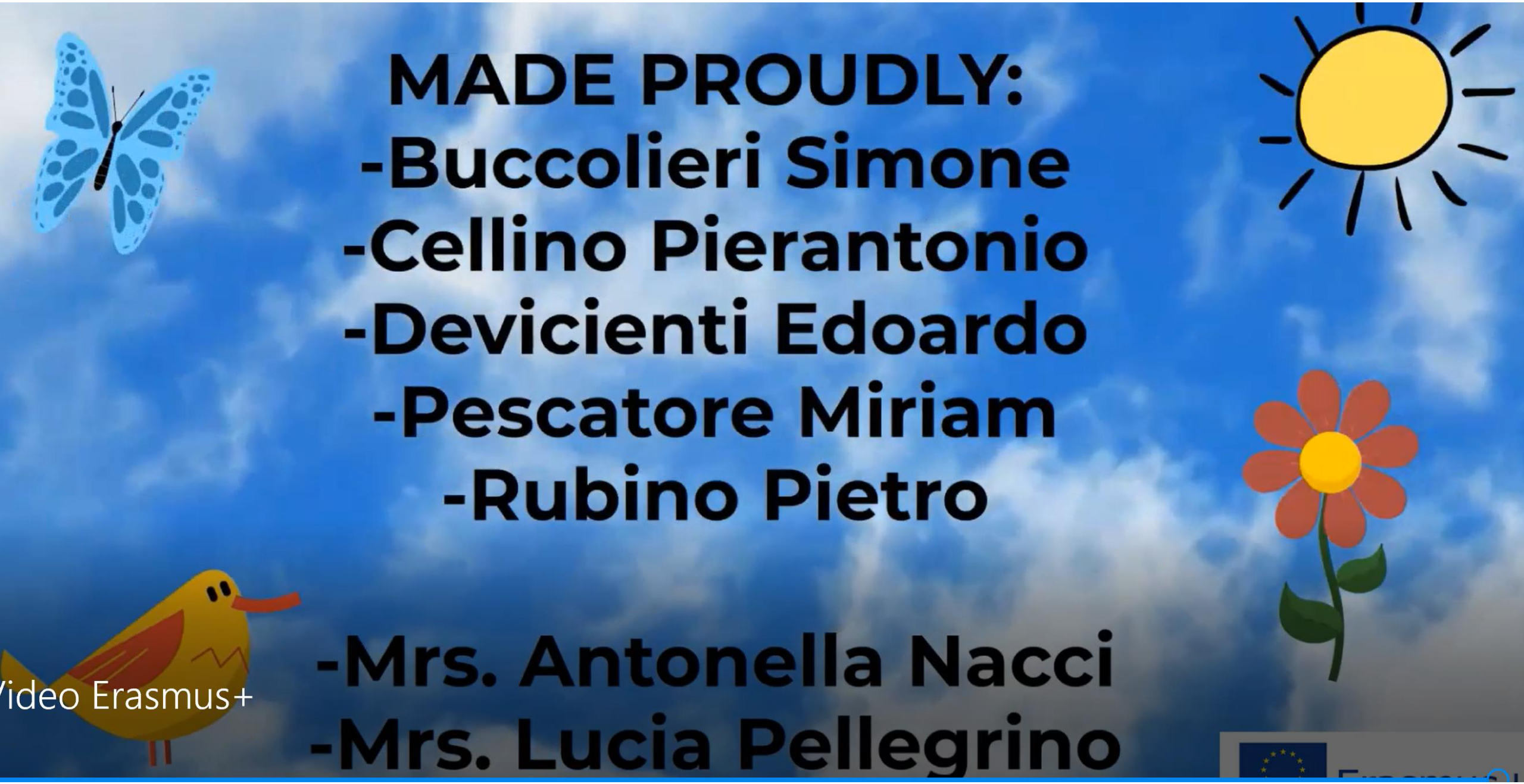

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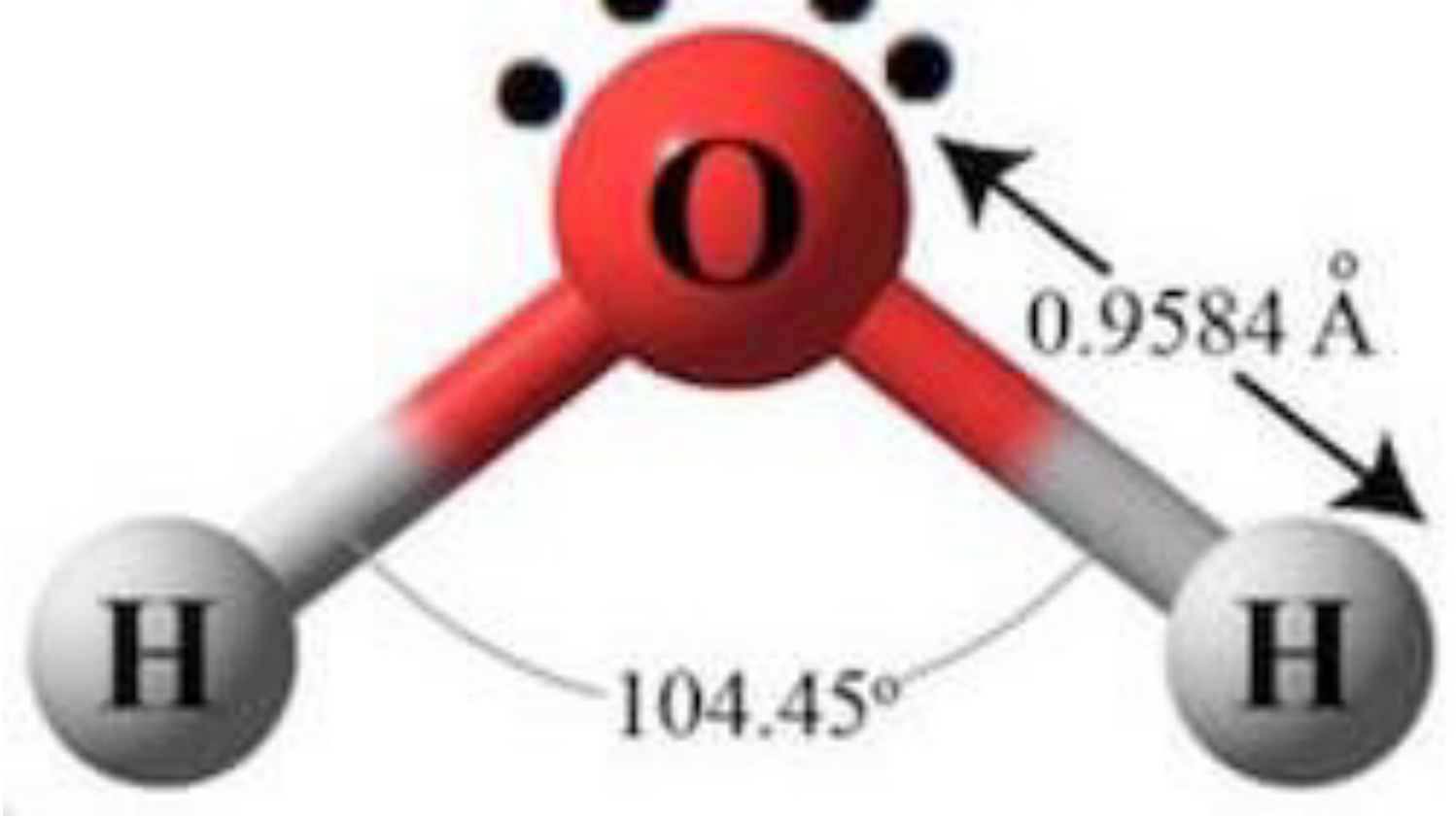

CHEMICAL CHARACTERISTICS OF WATER

Water, H^20, is a molecule made up of one oxygen atom and two of hydrogen tied to each other from a bond angle of 104.5. Being the oxygen atom more electronegative than hydrogen, it exerts a greater attractive force on the electronegative cloud and generates a polar molecule.

surface tension

- Water is the best natural solvent for many substances including salts, but also gaseous substances. When an ionic or polar compound is dissolved in water, it is surrounded by the water molecules themselves.
- Water has a high surface tension which can be observed on spherical geometry of the water drops and from some objects like a needle or the insects that manage to lay on the surface of water without sinking or breaking it.
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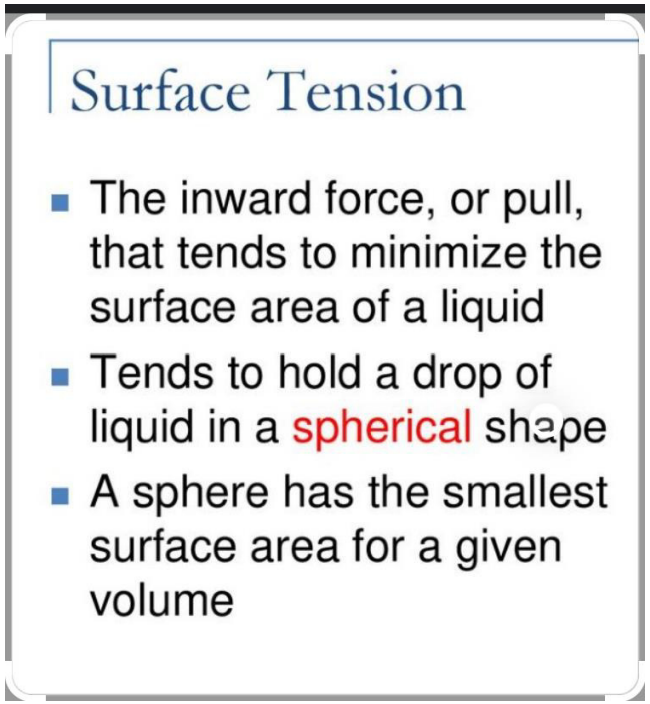


capillarity

- Another consequence of the surface tension is the capillarity. It consists of the ability of water to rise (obviously for short distances) in very thin cracks and pipes. The thinner the crack is, the more the rising up above. The surface tension plays a vital role in the function of many living organisms. An example is a transport of water in the xylem of stems of plants; the surface tension keeps the water column together and adhesive forces keep water tight to the xylem. The capillarity is the set of phenomena thanks to which water arrives from the roots to the leaves of a plant.

POLARITY

polarity of the water molecule

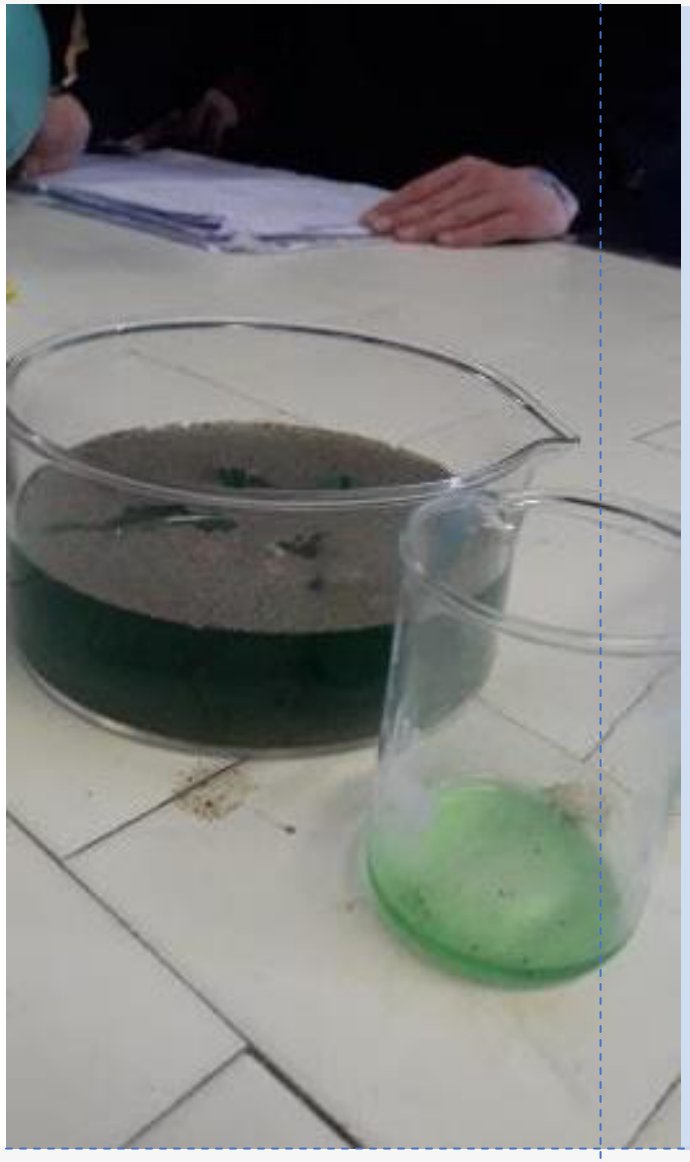
We verify the polarity of the water molecule. We pour some water in a becher and add some blue coloring. Then we transfer the coloured water in the burette. After this, we inflate a balloon and rub it on a pullover. We let the water flow and put the balloon close to it. We notice that the balloon diverts the water. This is because it feels the electric field generated by the rubbing. Since the polar molecule has a less uniform charge distribution, the water is a polar solvent.

Water is the best solvent for a lot of substances, but not for all of them.

- We can demonstrate this with a simple experiment.
- We take three beakers and pour some water in two of them and some alcohol in the other one. We add some sugar in one of the beakers filled with water and after some minutes it melts. In the other water-filled beaker we put some iodine and can see that it does not melt. Then we put the iodine in the alcohol-filled beaker and it melts a bit. This happens because, in chemistry, polar substances are only melted by other polar substances. So, consequently, the sugar melts because it’s polar like the water, on the other hand, the iodine does not melt in the water, because it isn’t polar. It melts a bit in the alcohol because they are both partially polar. If we had put the iodine in the chloroform, it would have melted because they aren’t polar.

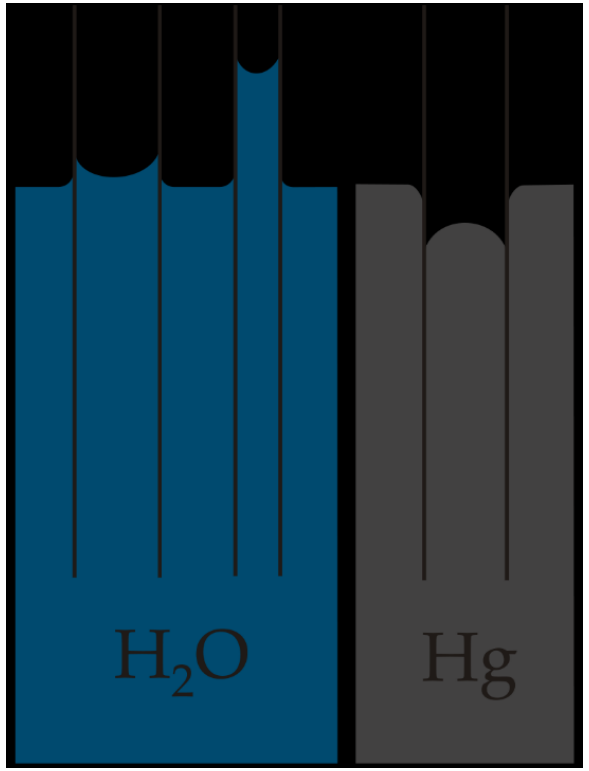
surface tension

The water also has a characteristic called, that is a thin film that the water forms thanks to some strong links between its molecules. To verify this, we pour some water in a beaker and add some pepper. It floats, of course. We touch the water with a finger with some soap on it and we notice that the pepper expands, creating some little holes. On the contrary, when we touch it without the soap, the pepper sticks on the finger. This happens because the soap is a surfactant, a substance that breaks the surface tension.



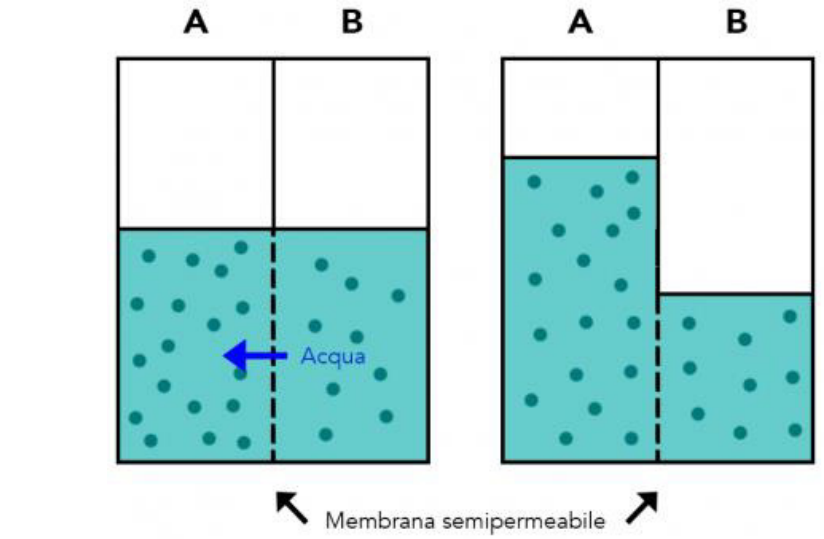
capillarity

A consequence of the surface tension is the capillarity, the ability of the water of going up in some little tubes. To understand this process, we can take some celery and cut the bottom part. We put it in a glass filled with red coloured water and leave it there for some hours. So, after this time, we can see that the celery is red. This happens because the celery contains some little tubes and so the water goes up.

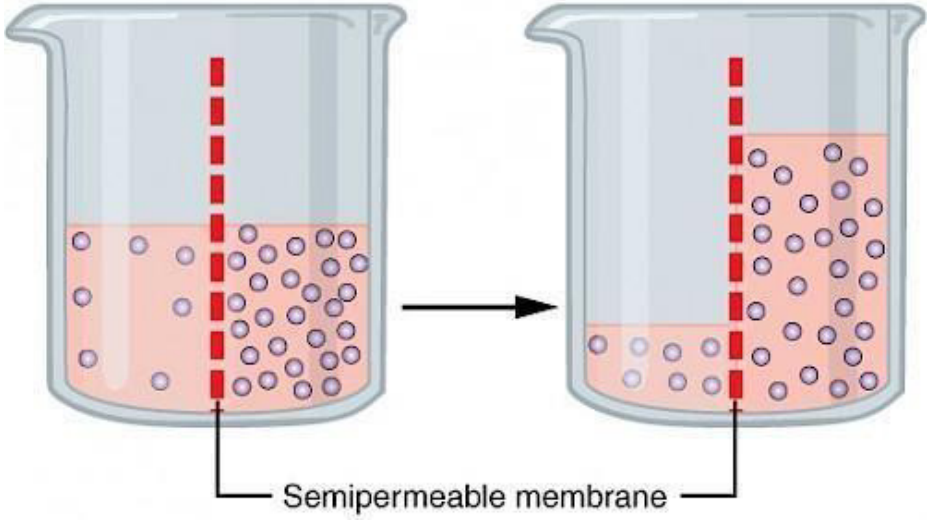



Erasmus 2021
OSMOSIS

OSMOSIS: a spontaneous passage of a solvent from the solution where the solutes are more dissolved to the solution where they are closer to each other.

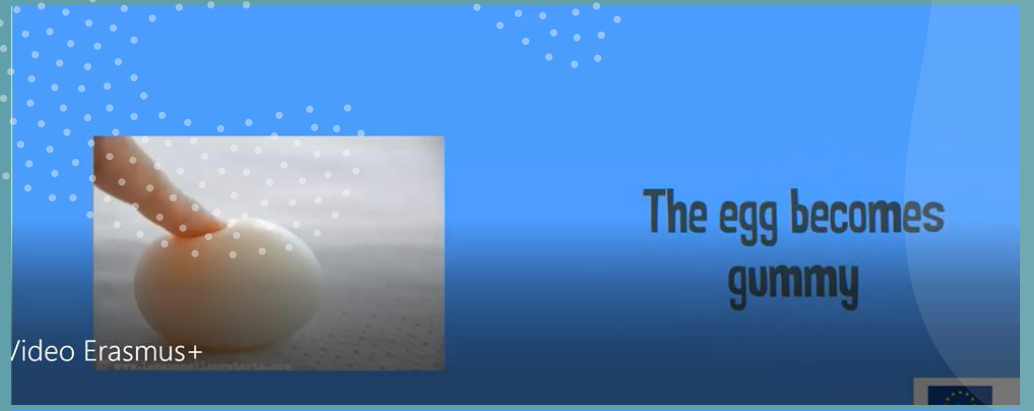


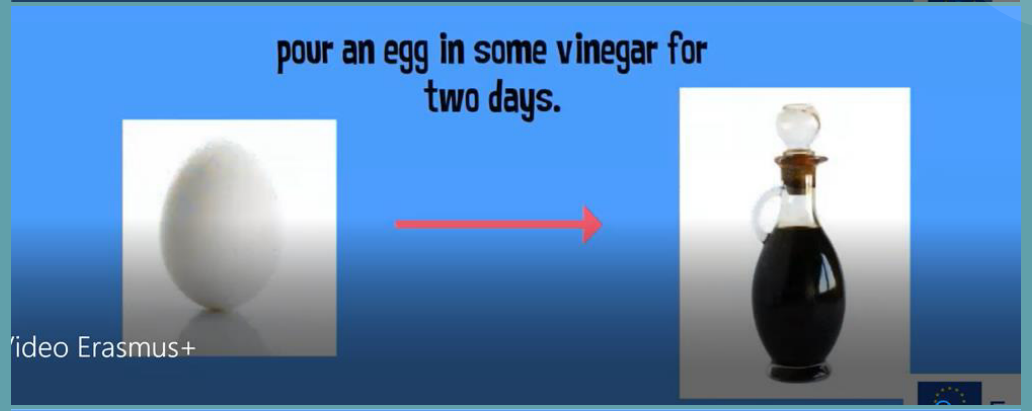
- Another property of the water is osmosis. It is a spontaneous passage of a solvent from the solution where the solutes are more dissolved to the solution where they are closer to each other.

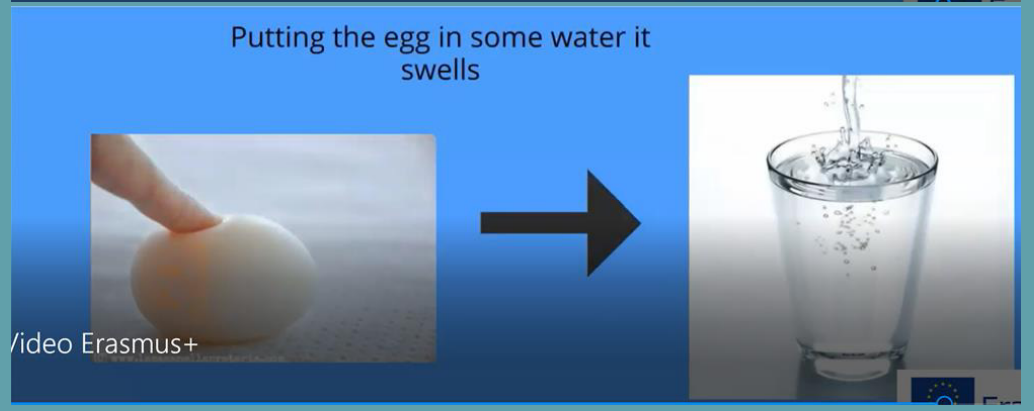


DEMONSTRATION

- An easy way to test this is using an egg, putting it in some vinegar for two days. The shell dissolves and the egg becomes gummy. After that, putting the egg in some distilled water, the egg swells.







this confirms the osmosis.

If we put it in a solution made with water and salt, it loses water and this confirms the osmosis.

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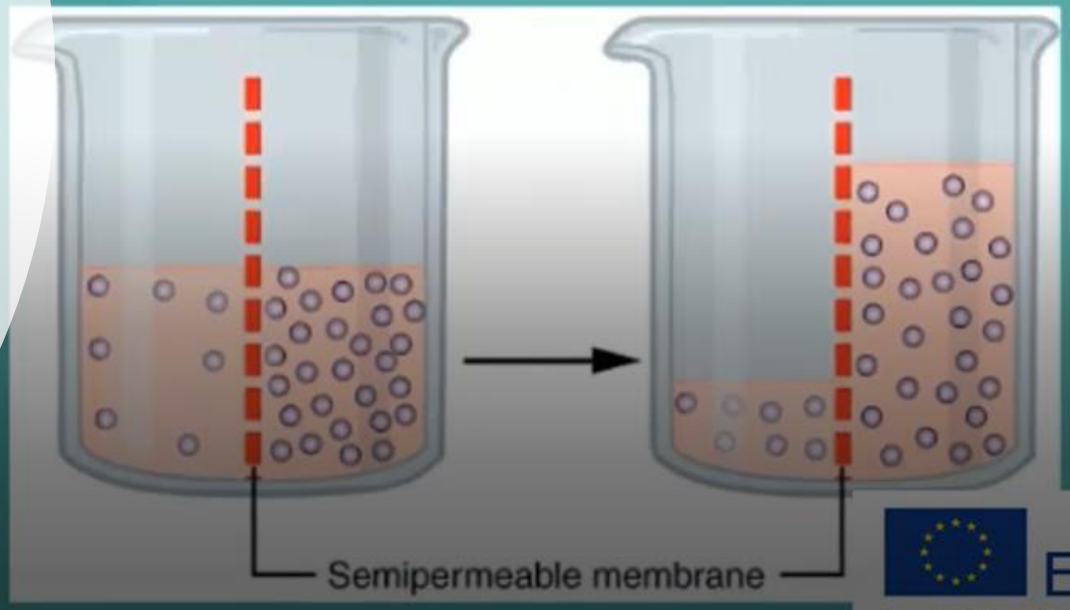
Trying to put the egg in a solution made with water and salt, it loses water and this confirms the osmosis.



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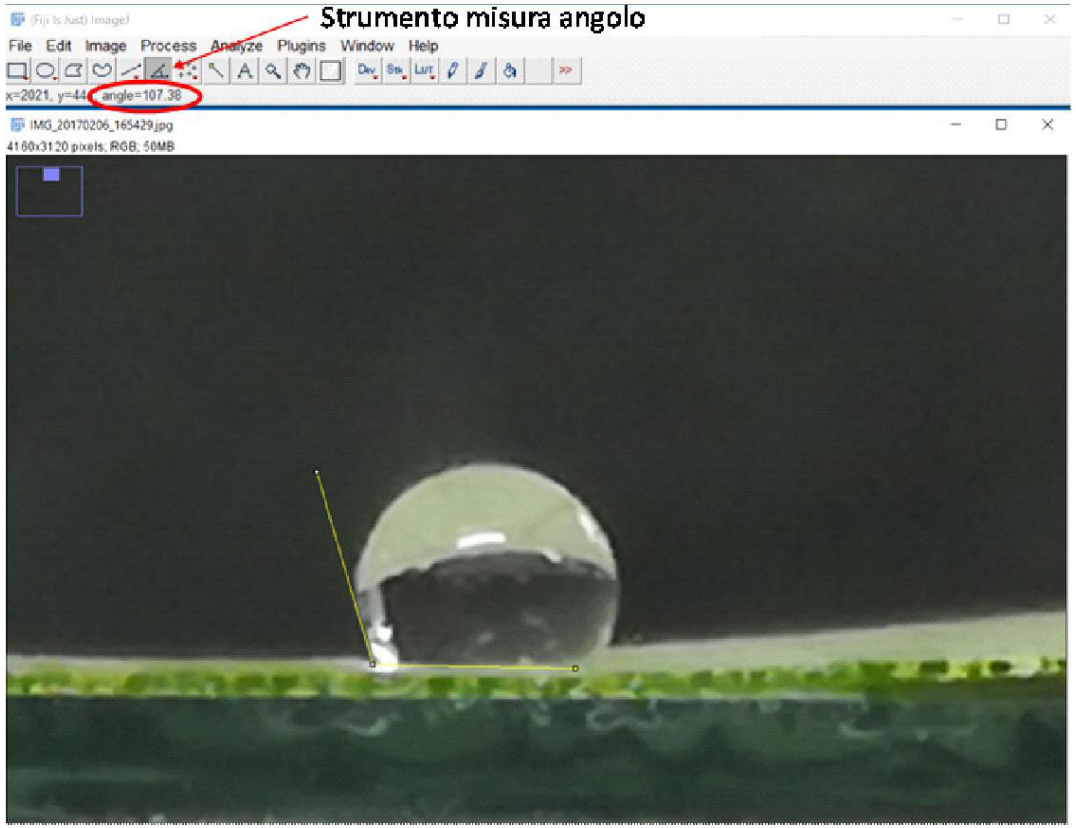
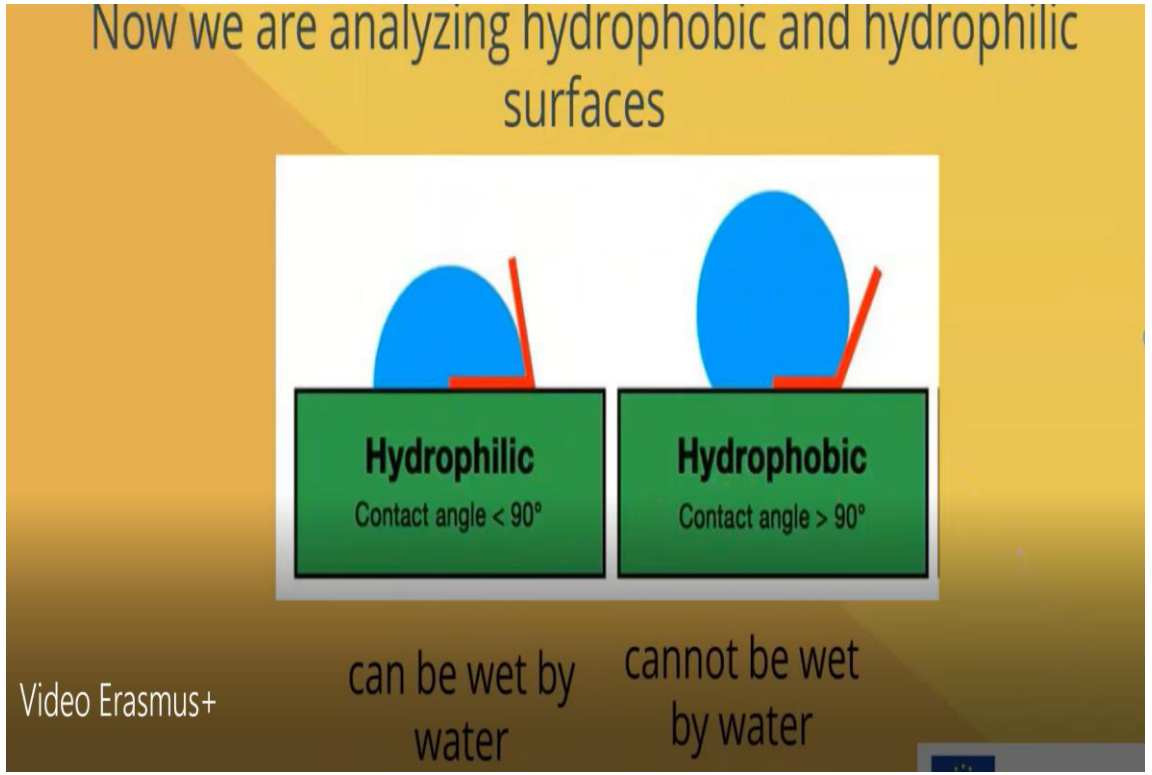
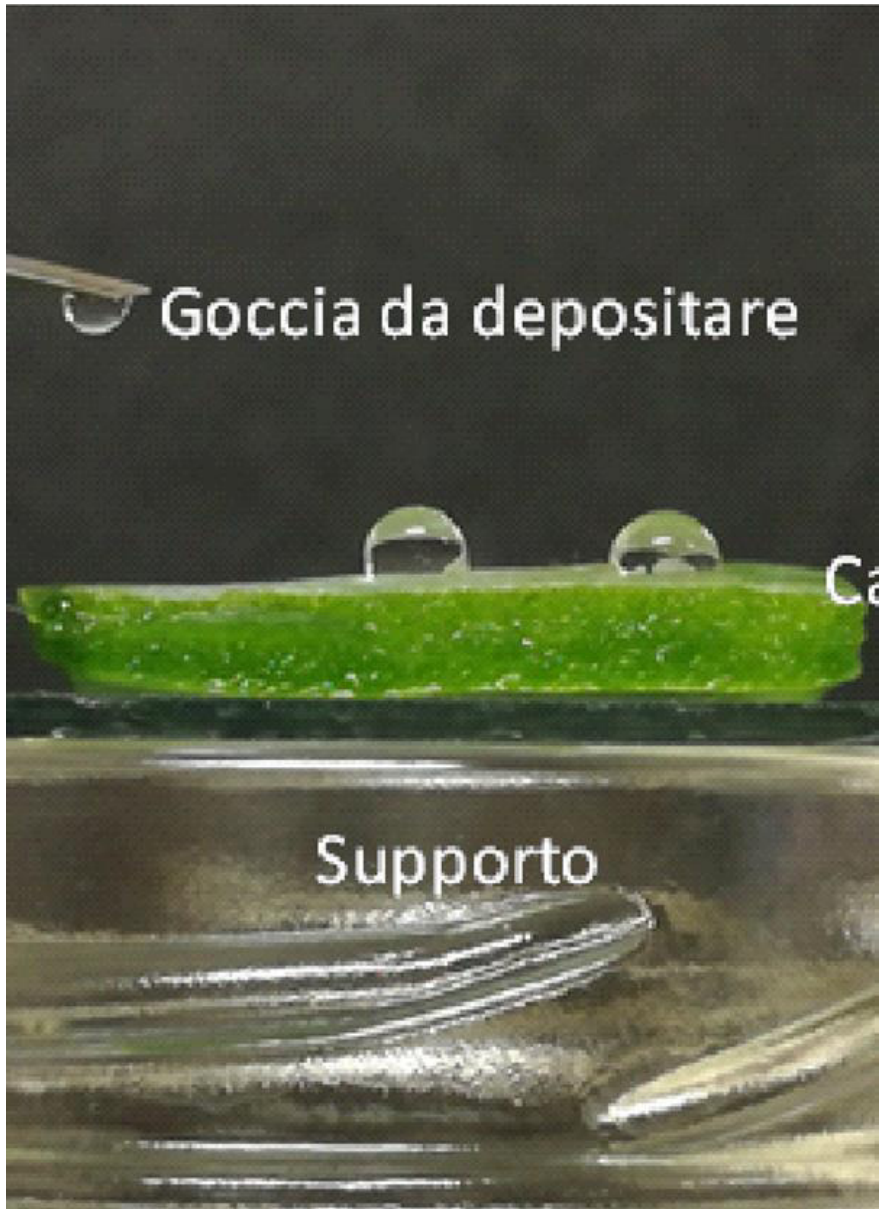




HYDROPHILLIC – HDROPHOBIC SURFACES

hydrophilic and hydrophobic surfaces

- All these experiments are useful to see the difference between hydrophilic and hydrophobic surfaces. When a liquid touches a solid, we can notice two forces:
- The cohesive forces
- The adhesion forces



COHESIVE/ADHESIVE FORCES

- The cohesive forces, that connect the molecules of the liquid to each other and give to the drop a spherical shape,
- The adhesion forces, that connect the molecules of the liquid to the solid ones and flatten the drops.
- If the cohesive forces prevail, the solid material is hydrophobic and it cannot be wet by water.
- If the adhesion forces prevail, the material is hydrophilic and it can be wet.