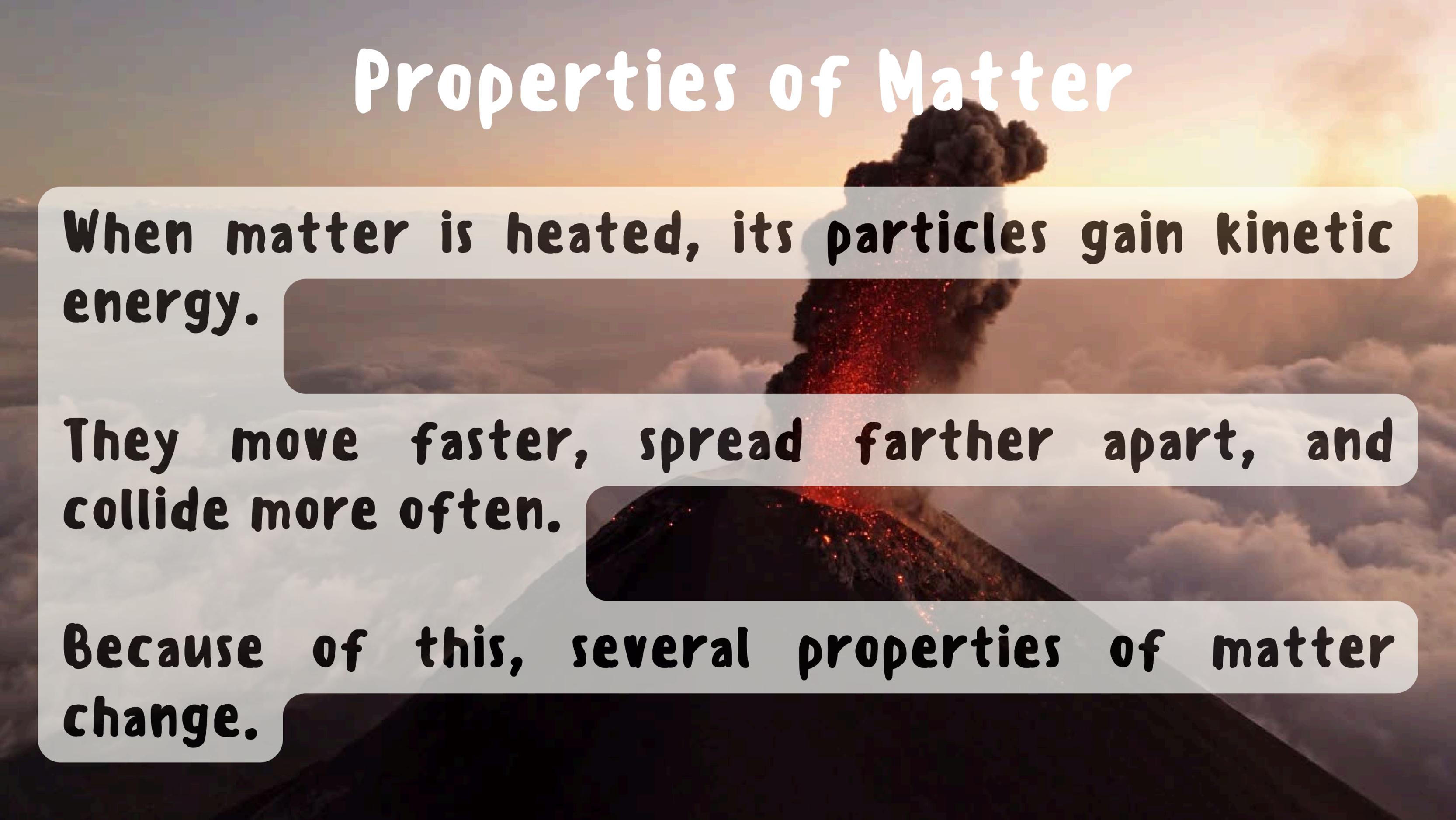


Properties of Matter



Properties of Matter



When matter is heated, its particles gain kinetic energy.

They move faster, spread farther apart, and collide more often.

Because of this, several properties of matter change.

Properties of Matter

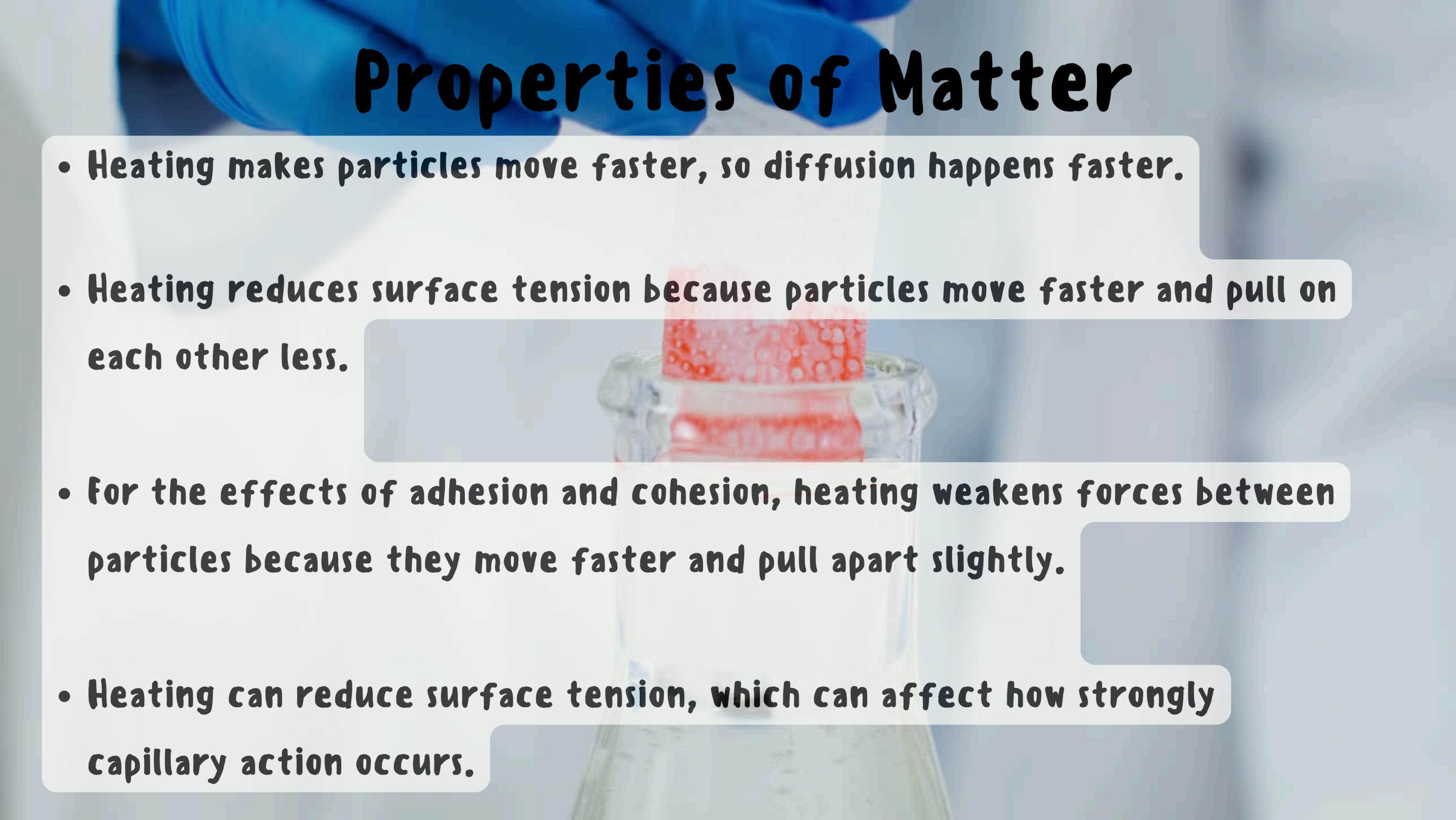
A close-up photograph of a hand being washed with water. The hand is positioned on the right side of the frame, with water splashing over it. The background is a soft, out-of-focus green, suggesting an outdoor setting. The water droplets are captured in motion, creating a sense of freshness and cleanliness.

In this part of the lesson:

- **diffusion,**
- **surface tension,**
- **adhesion and cohesion**
- **capillary action and**
- **the mechanical properties of matter**

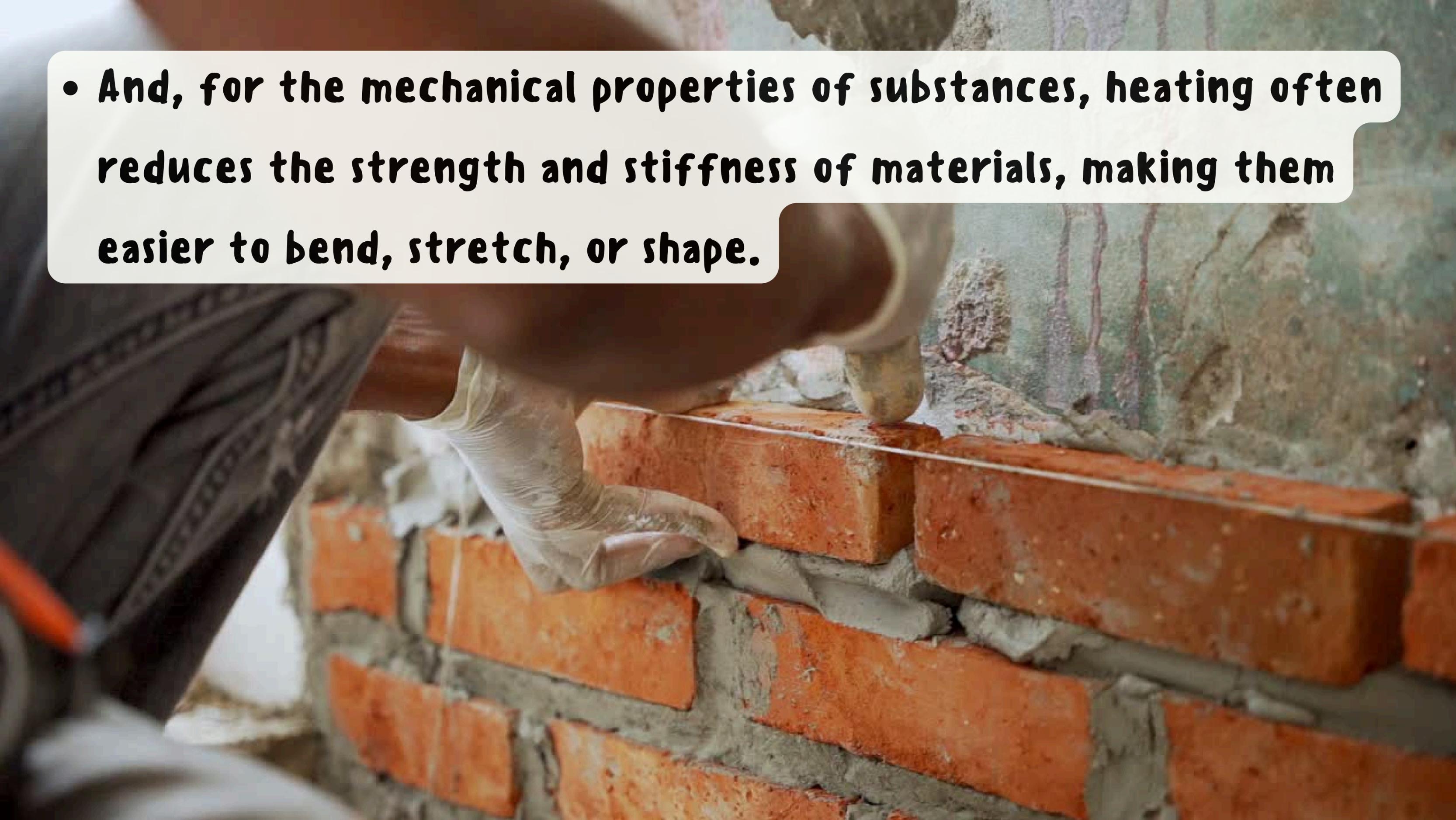
will be explored.

Properties of Matter

A hand wearing a blue nitrile glove is pouring a red liquid from a beaker into a glass flask. The background is a blurred laboratory setting.

- Heating makes particles move faster, so diffusion happens faster.
- Heating reduces surface tension because particles move faster and pull on each other less.
- For the effects of adhesion and cohesion, heating weakens forces between particles because they move faster and pull apart slightly.
- Heating can reduce surface tension, which can affect how strongly capillary action occurs.

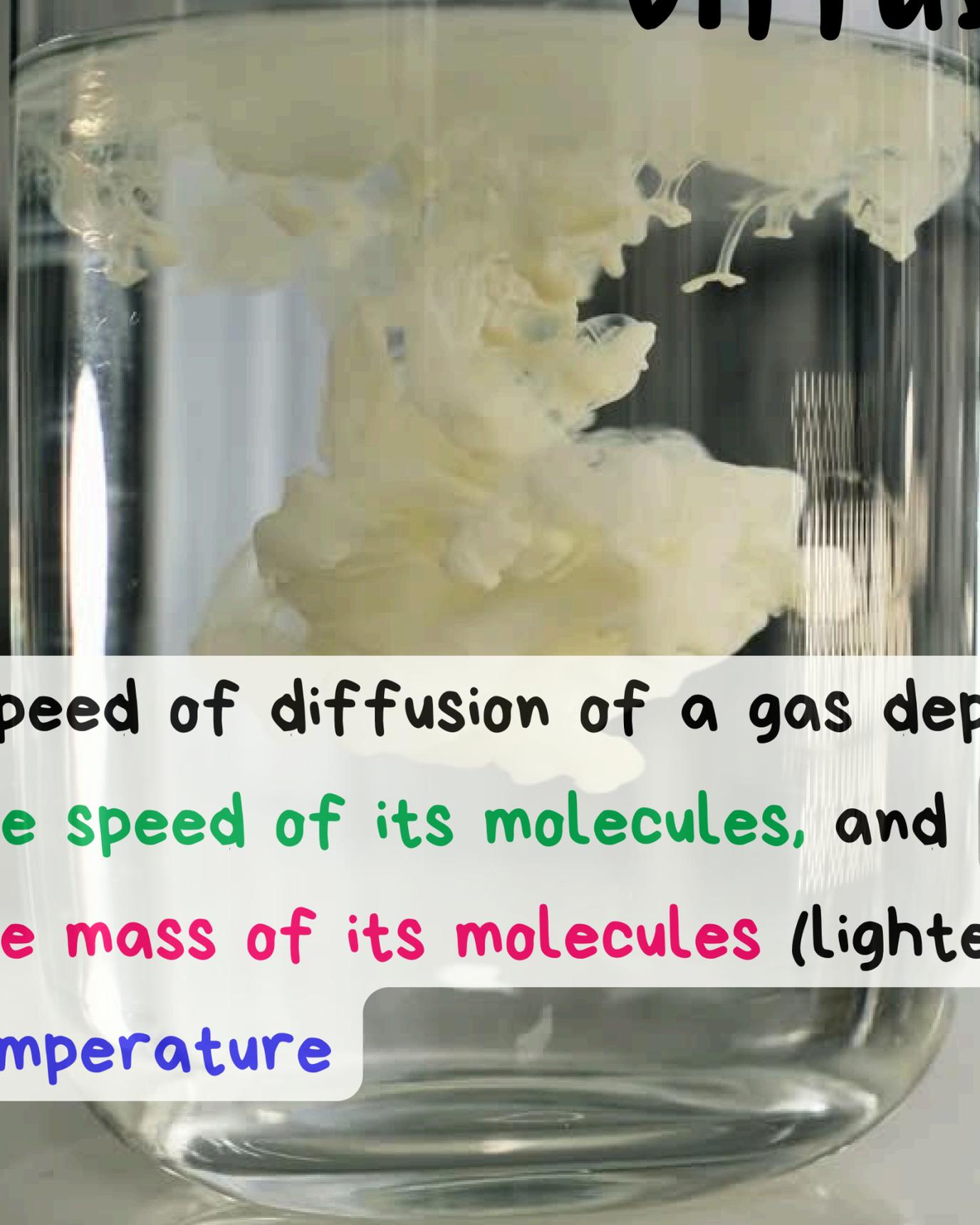
- **And, for the mechanical properties of substances, heating often reduces the strength and stiffness of materials, making them easier to bend, stretch, or shape.**



Diffusion

- Diffusion is the movement of particles from an area of high concentration to an area of lower concentration.
- Some examples of diffusion are:
 - a. perfume spreading
 - b. food colour spreading in water
 - c. gas exchange in lungs
 - d. tea spreading in hot water
 - e. sugar dissolving in water

Diffusion



- The speed of diffusion of a gas depends on:
 - a. the speed of its molecules, and
 - b. the mass of its molecules (lighter molecules travel faster)
 - c. temperature

Surface Tension

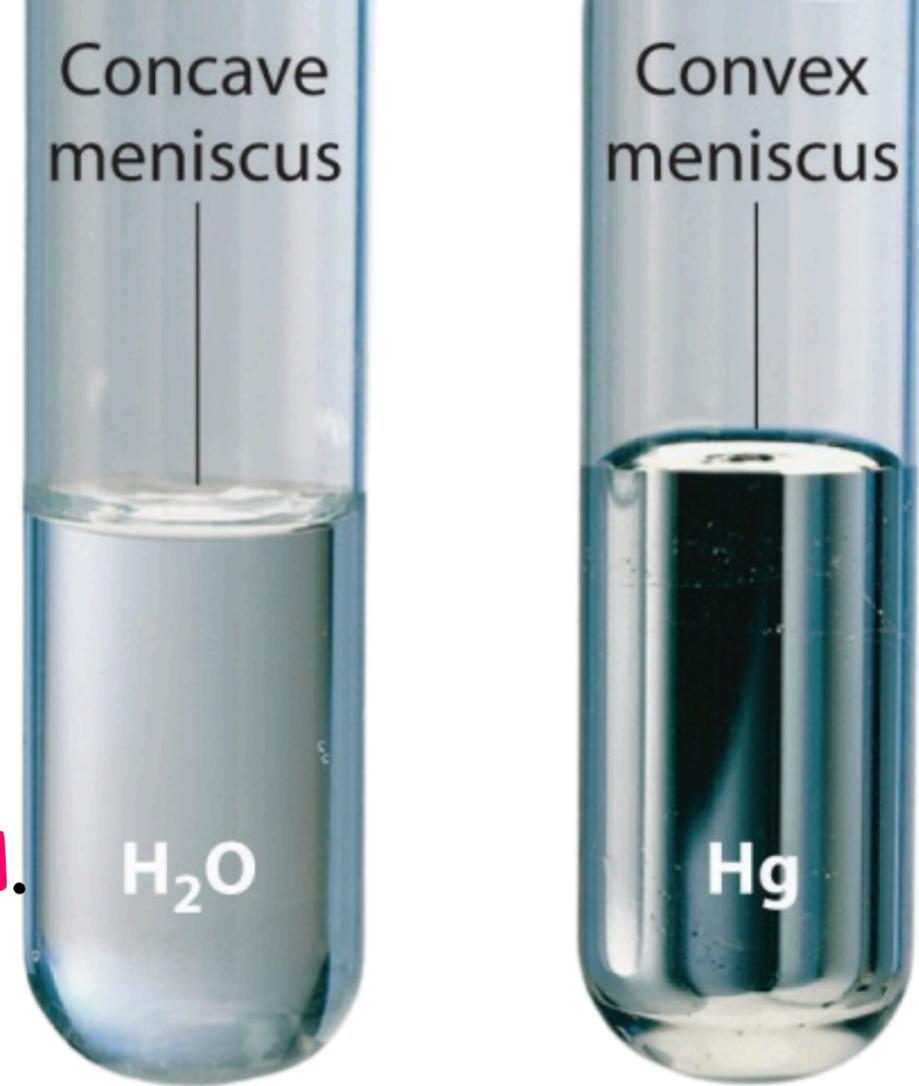
- The surface of a liquid behaves as if it were covered with an elastic skin that is trying to shrink.
- This effect is called **surface tension**.
- It is due to the molecules in a liquid surface being slightly farther apart than normal, like those in a stretched wire.
- Surface Tension can be reduced by heating and adding detergent.



Adhesion & Cohesion

- The force of attraction between molecules of the **SAME** substance is known as **COHESION**.

For example, the attraction between two water molecules.



Adhesion & Cohesion

- The force of attraction between molecules of **DIFFERENT** substances is known as **ADHESION**.

For example, the attraction between water molecules and glass molecules.

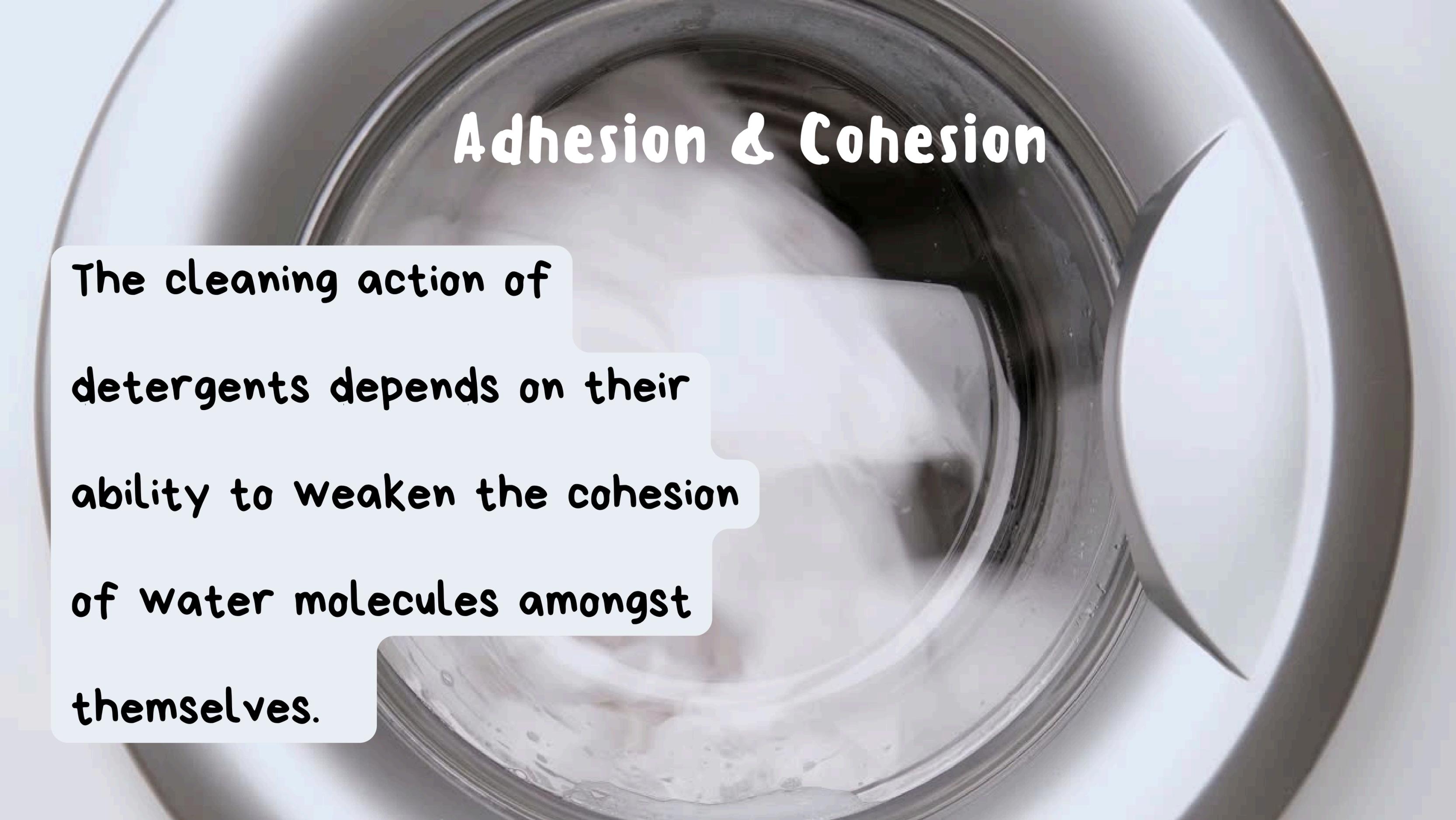
Adhesion & Cohesion

- The **ADHESION** of water to glass is greater than the **COHESION** of water molecules with itself. This is why water is able to wet and clean glass by spreading a thin film upon it.

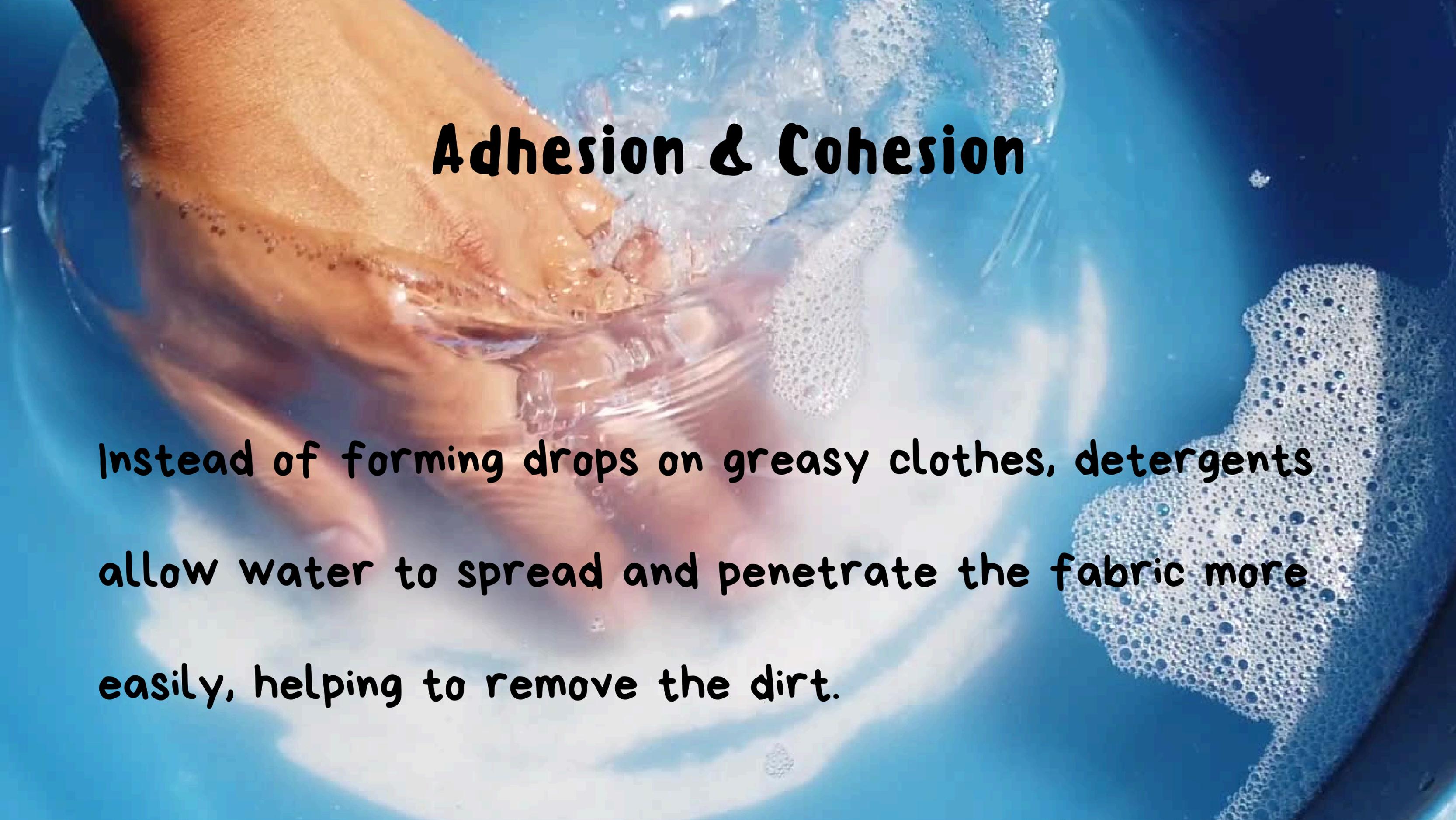
In contrast, mercury on glass forms small spherical drops or large flattened ones if applied to glass, why is this so?



Adhesion & Cohesion



The cleaning action of detergents depends on their ability to weaken the cohesion of water molecules amongst themselves.

A close-up photograph of a hand washing a white cloth in a blue basin filled with soapy water. The water is bubbly and white with detergent. The hand is visible, and the cloth is being moved through the water. The background is a solid blue color.

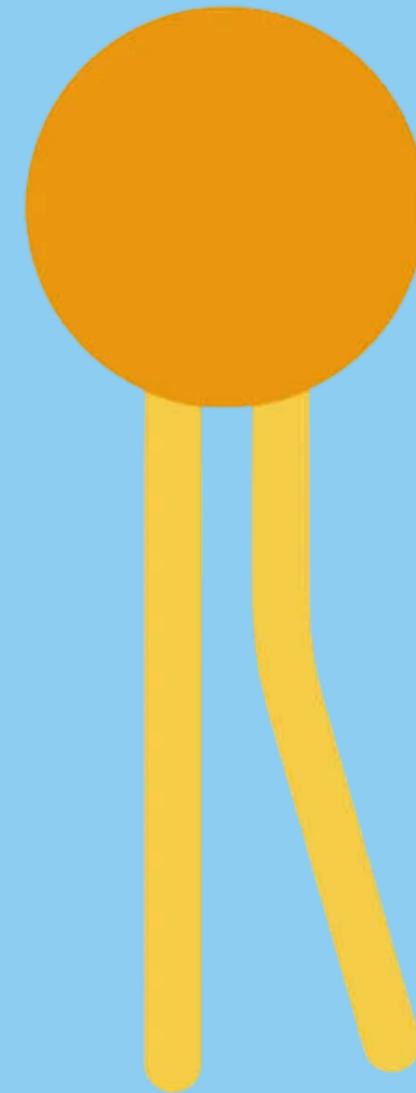
Adhesion & Cohesion

Instead of forming drops on greasy clothes, detergents allow water to spread and penetrate the fabric more easily, helping to remove the dirt.

Adhesion & Cohesion

A detergent molecule has a hydrophilic (water-loving) head and a hydrophobic (water-repelling) tail.

This allows it to interact with both water and oil/dirt.



Hydrophilic
Head

Hydrophobic
Tail

Adhesion & Cohesion

In water filled with soiled clothing, the detergent molecules form a micelle (a small spherical structure) around the dirt or oil.



Adhesion & Cohesion

The oil or dirt is removed because the hydrophilic heads interact with water, while the hydrophobic tails attach to the dirt or oil.



Adhesion & Cohesion

- Detergent molecules have a polar part and a non-polar part.
- Water is polar while dirt and oil are non-polar substances.
- This is why water alone can not remove dirt.



Adhesion & Cohesion

Non-polar substances only interact with other non-polar substances and likewise for polar substances.



Capillarity

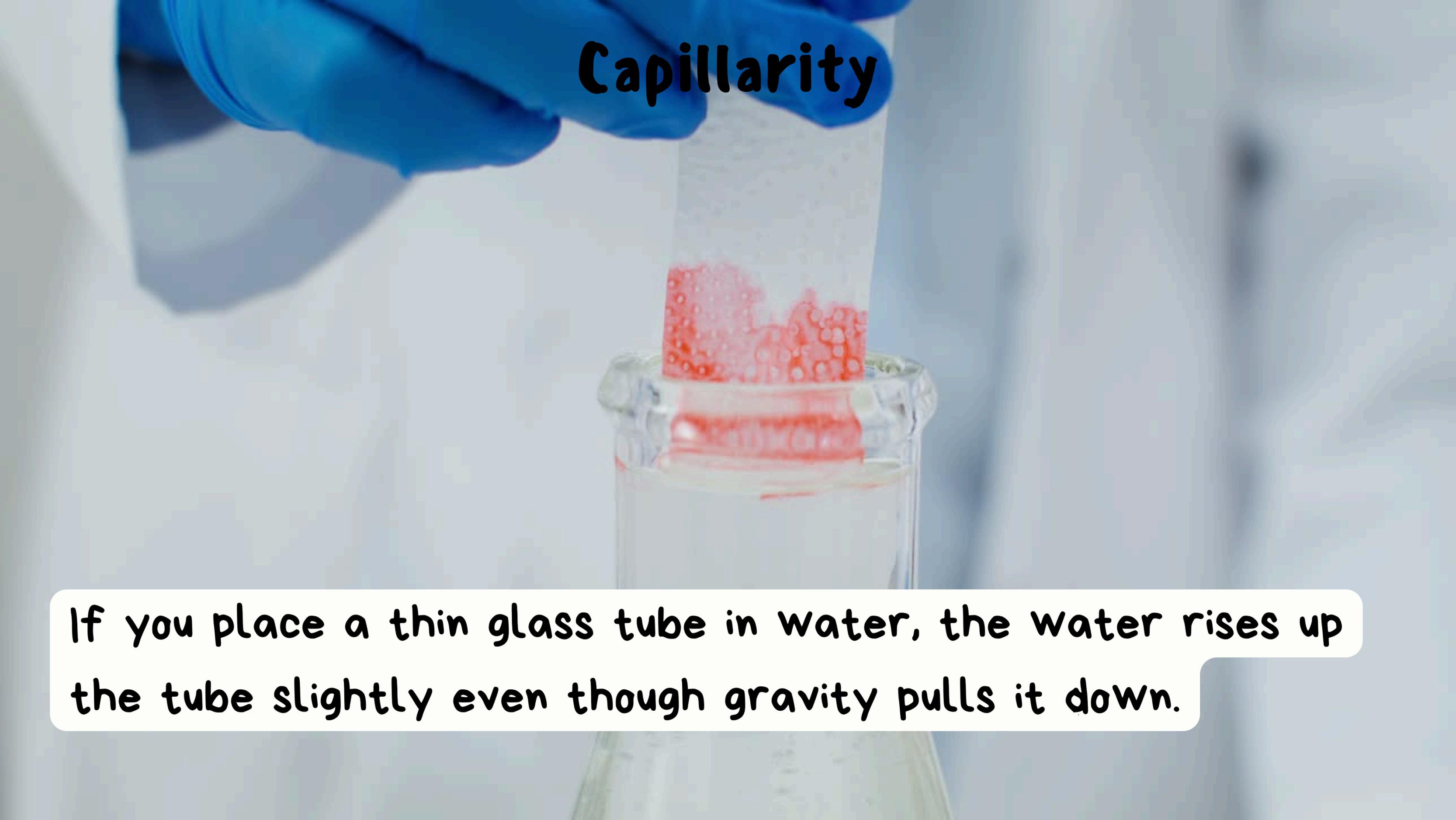
A hand wearing a blue nitrile glove holds a thin, clear glass tube vertically. The tube is partially submerged in a beaker containing a red liquid. The liquid level inside the tube is significantly higher than the level in the beaker, illustrating the phenomenon of capillarity. The background is a plain, light-colored surface.

Capillary action is the ability of a liquid to rise or fall in a thin tube because of attractive forces between the liquid and the surface.

Capillarity

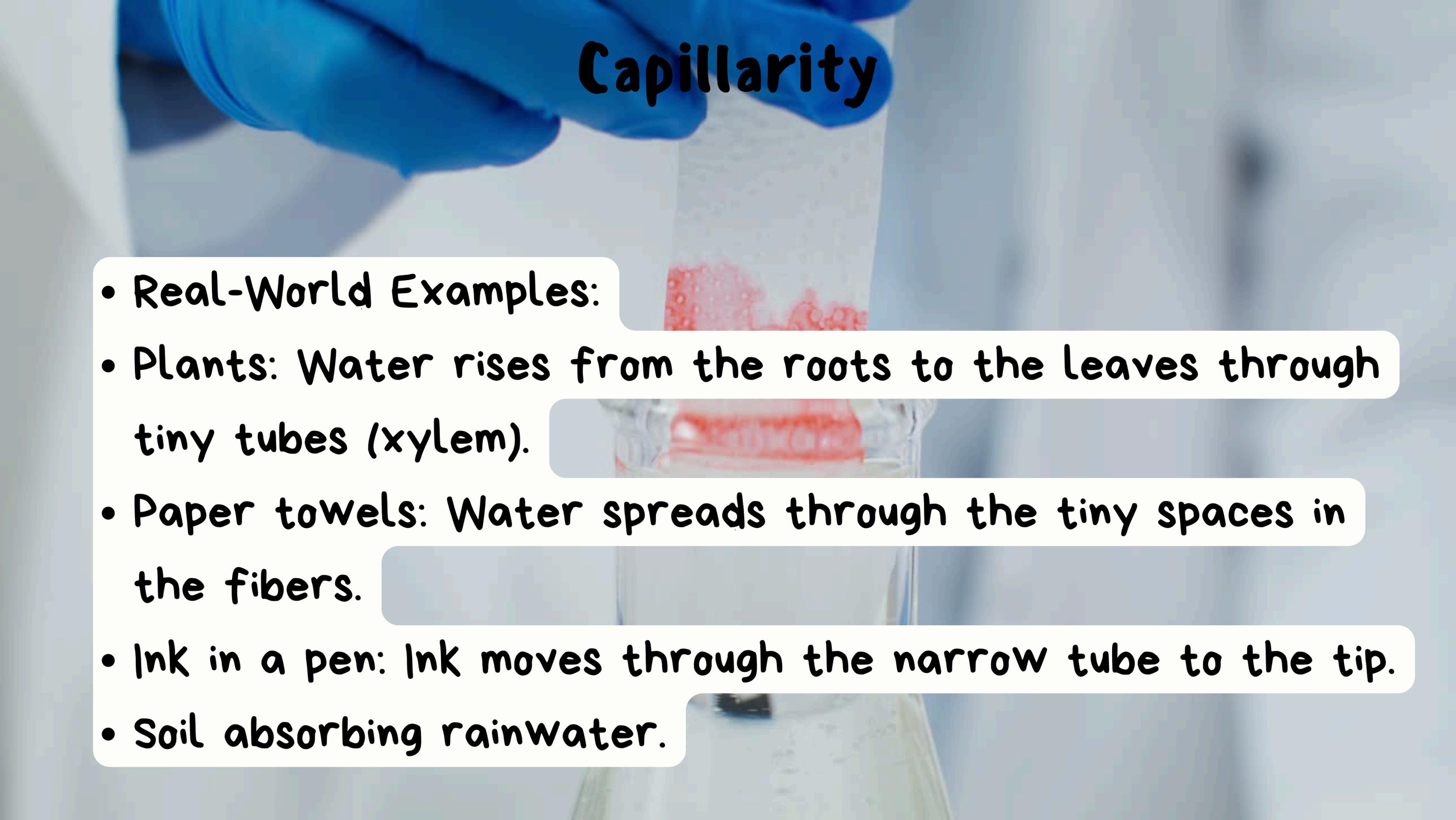
- Capillary action occurs because of two forces:
- Adhesion – attraction between the liquid and the surface of the tube (or material). 
- Cohesion – attraction between the molecules of the liquid itself. 
- When adhesion is stronger than cohesion, the liquid climbs up the surface.

Capillarity

A hand wearing a blue nitrile glove holds a thin, clear glass tube vertically. The tube is partially submerged in a beaker of water. The water level inside the tube is noticeably higher than the water level in the beaker. The background is a plain, light-colored surface.

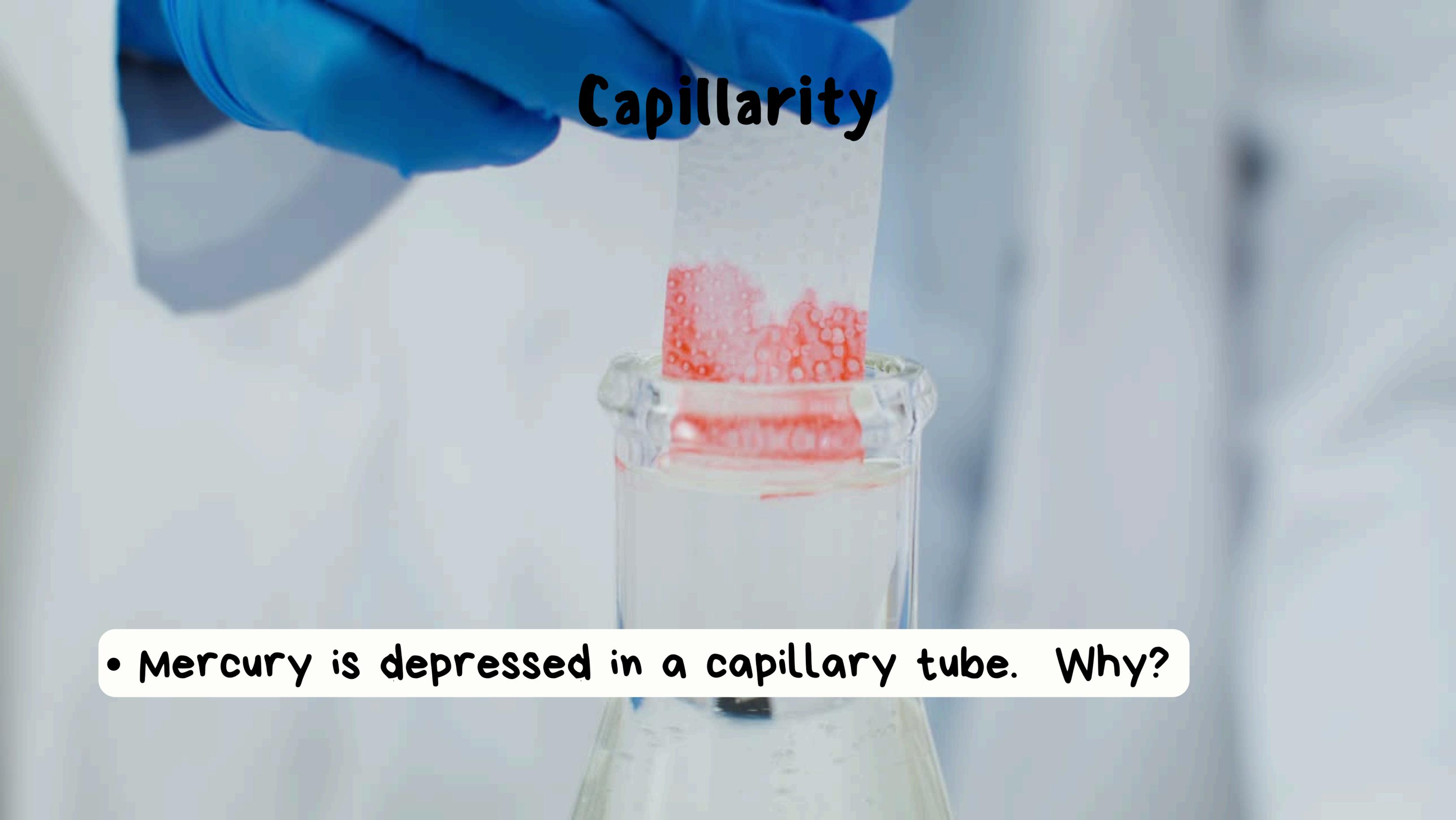
If you place a thin glass tube in water, the water rises up the tube slightly even though gravity pulls it down.

Capillarity



- Real-World Examples:
- Plants: Water rises from the roots to the leaves through tiny tubes (xylem).
- Paper towels: Water spreads through the tiny spaces in the fibers.
- Ink in a pen: Ink moves through the narrow tube to the tip.
- Soil absorbing rainwater.

Capillarity

A hand wearing a blue nitrile glove holds a clear glass tube vertically. The tube is partially submerged in a beaker containing a clear liquid. The liquid level inside the tube is noticeably lower than the liquid level in the beaker, illustrating the concept of capillarity. The background is a plain, light-colored surface.

- Mercury is depressed in a capillary tube. Why?

Mechanical Properties of Materials

The background of the slide shows a construction site. In the foreground, there are several large stacks of light-colored wooden planks. To the right, a wooden structure is under construction, with some planks leaning against it. The ground is reddish-brown soil. The title 'Mechanical Properties of Materials' is written in a large, white, sans-serif font at the top of the image.

- When selecting a material for a particular job we need to know how it behaves when forces act on it.

Hence we need to know what a material's mechanical properties are.

Mechanical Properties of Materials

- Mechanical properties include:

1. Strength:

The strength of some materials depends on how the force is applied.

2. Stiffness:

A stiff material resists forces which try to change its shape or size or both.

3. Elasticity:

An elastic material such as rubber recovers its original shape and size after the force deforming it has been removed.

4. Ductility:

Materials which can be rolled into sheets, drawn into wires or worked into other useful shapes without breaking are ductile.

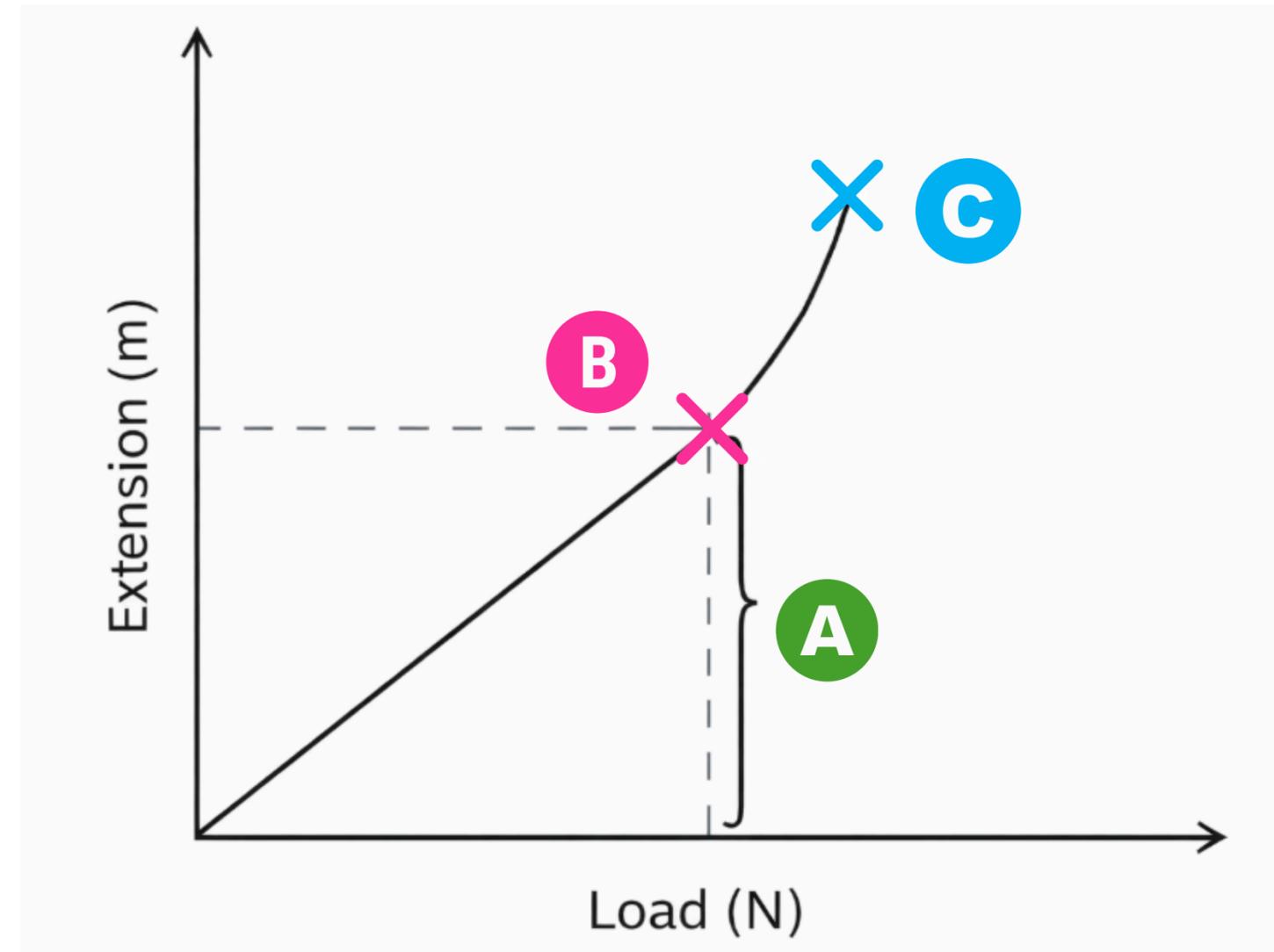
5. Brittleness:

A brittle material is fragile and breaks suddenly.

Stretching a Wire

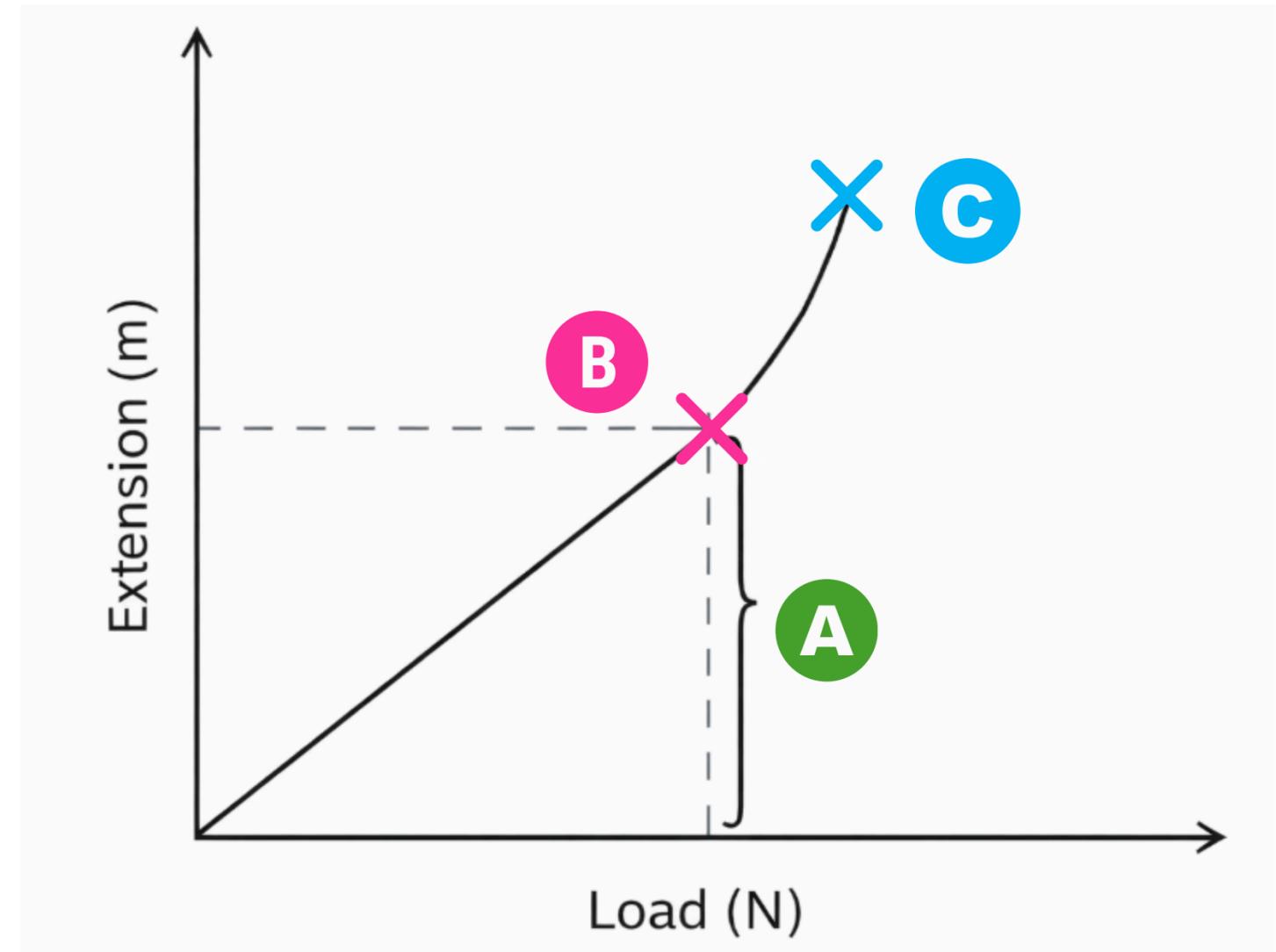
- Useful information about mechanical properties is obtained from stretching a long wire of material by gradually loading it with a weight.

The graph obtained by plotting extension against load is similar to that for stretching a spring.



Stretching a Wire

Where the graph is straight/linear, **A**, the material's extension is directly proportional to the load added.



Stretching a Wire

At the limit of proportionality, **B**, molecules are pulled apart, and can return to their original length when the load is removed.

However, beyond the limit of proportionality, the material's extension will not be proportional to its Load.

