What is a physical property?

A physical property is a trait of a substance which can be measured or observed without changing the identity of a substance. When a substance undergoes a physical change, it is usually reversible

In science, a **property** is often used to describe the different characteristics of a substance. These various qualities may refer to the state of matter, mass, density, oxidation, conductivity, color, bonding, etc. It is important to recognize the unique properties each substance holds, as it helps to better understand how the substance behaves in different situations. It should be noted that there are two kinds of properties in science: chemical and physical.

Physical properties: required to evaluate the condition of the material without any external force acting on it. These are,

- Shape, size
- Density, porosity
- Water absorption, permeability
- Fire resistance
- Frost resistance
- Weathering resistance
- Hygroscopicity
- Durability

Shape, Size

- **Shape**: The form or outline of an object, which can be described in terms of dimensions and geometry. For materials, shape can influence how they fit into assemblies or their overall structural performance.
- **Size**: The physical dimensions of an object, typically measured in units of length (such as meters, centimeters, inches). Size can refer to the height, width, depth, or any other dimension that defines the extent of the material.

Density, Porosity

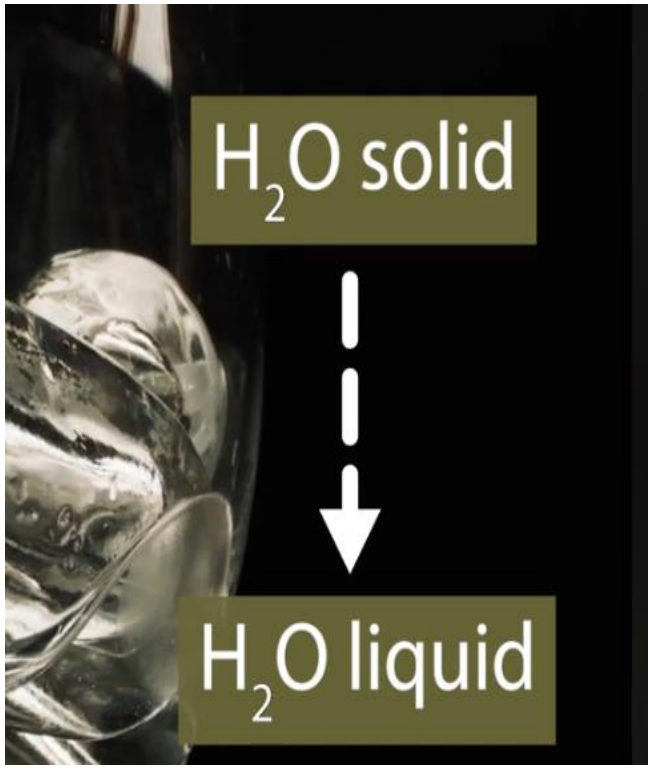
- **Density**: The mass per unit volume of a material, often expressed in kilograms per cubic meter (kg/m^3) or grams per cubic centimeter (g/cm^3). It is a measure of how compact the material is.
- **Porosity**: The measure of void spaces in a material, usually expressed as a percentage of the total volume. High porosity indicates more voids, which can affect the material's strength and insulation properties.

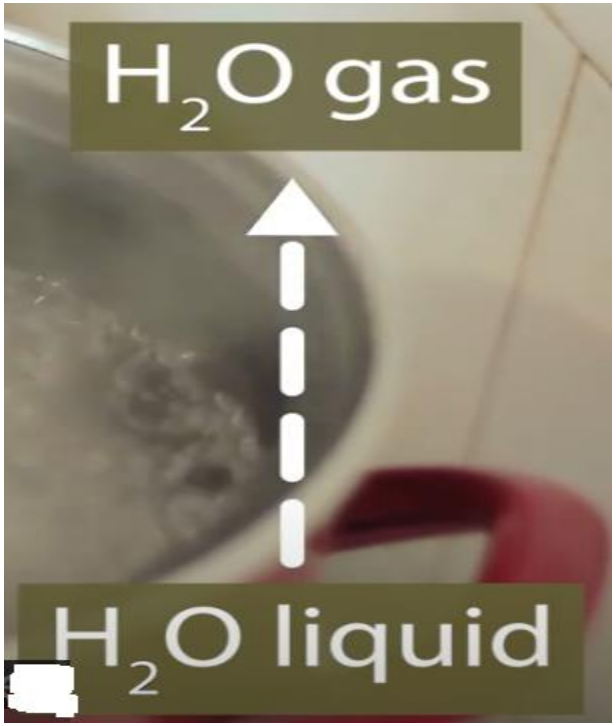
Water absorption, permeability

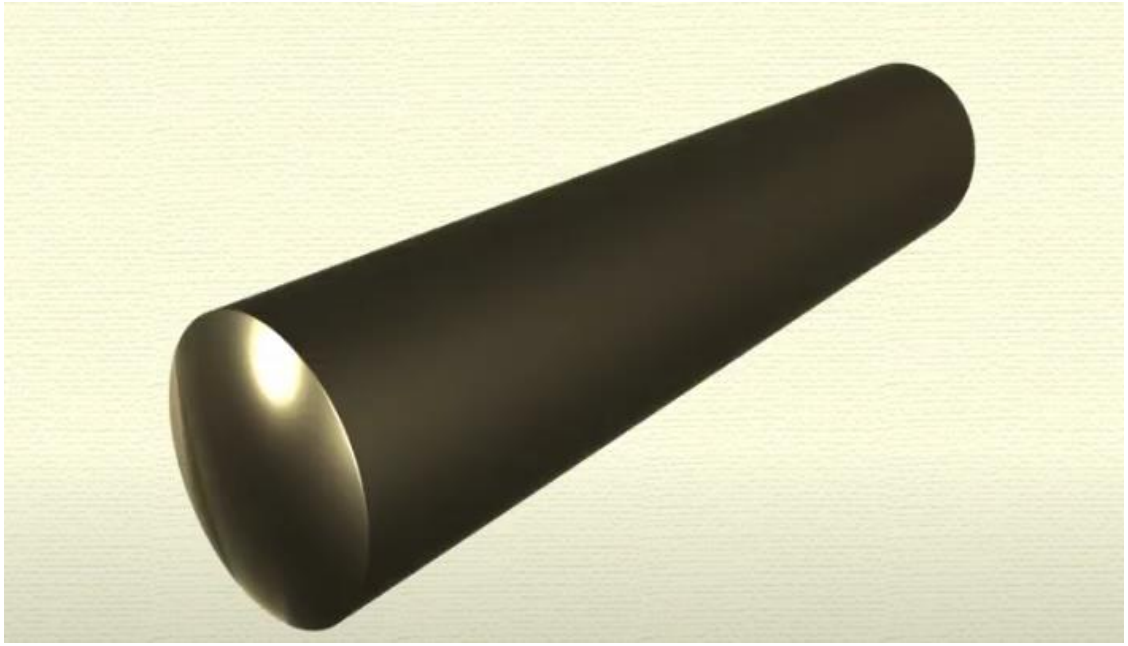
- **Water Absorption**: The ability of a material to take in water when it is exposed to it. It is typically measured as the percentage increase in weight due to water absorption over a specific period.
- **Permeability**: The ability of a material to allow fluids (usually water or air) to pass through it. It is often quantified by the rate at which a fluid can flow through a material's pores or interconnected voids.

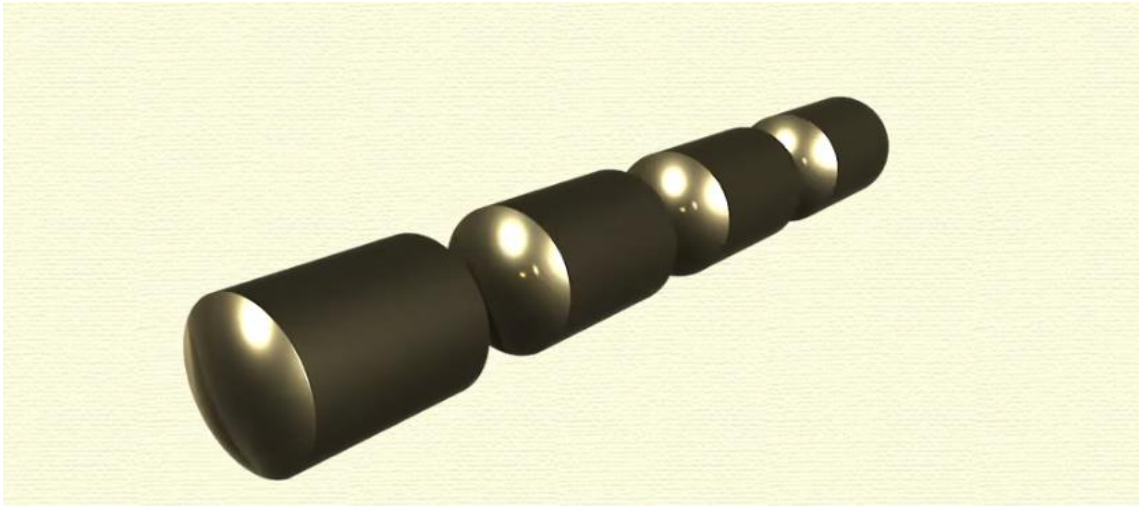
- **Fire Resistance**: The ability of a material to withstand fire or to resist burning. Fire resistance is often measured by the duration a material can endure exposure to fire while maintaining its structural integrity.
- **Frost Resistance**: The ability of a material to resist damage caused by freezing and thawing cycles. This property is crucial for materials used in environments where temperatures fluctuate below and above the freezing point of water.

- **Weathering Resistance**: The ability of a material to withstand exposure to atmospheric conditions (such as sunlight, rain, wind) without significant degradation. This property ensures longevity and durability in outdoor applications.
- **Hygroscopicity**: The ability of a material to absorb moisture from the air. Materials with high hygroscopicity tend to draw in and retain water vapor, which can influence their weight, dimensions, and performance.
- **Durability**: The capacity of a material to withstand wear, pressure, or damage over time. It reflects the material's long-term performance and resistance to various forms of deterioration, including mechanical wear, chemical exposure, and environmental effects.


H_2O solid
H_2O liquid


H_2O gas
H_2O liquid



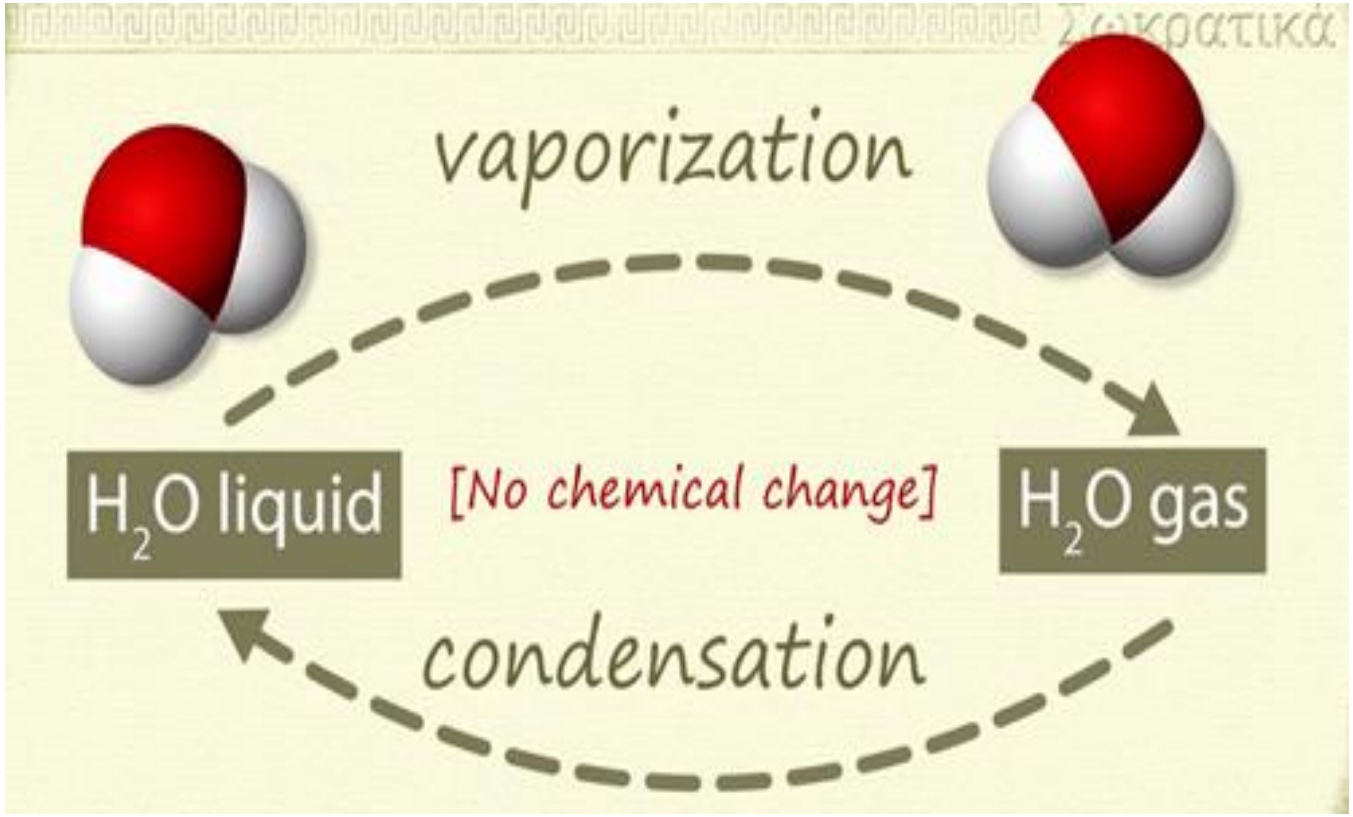


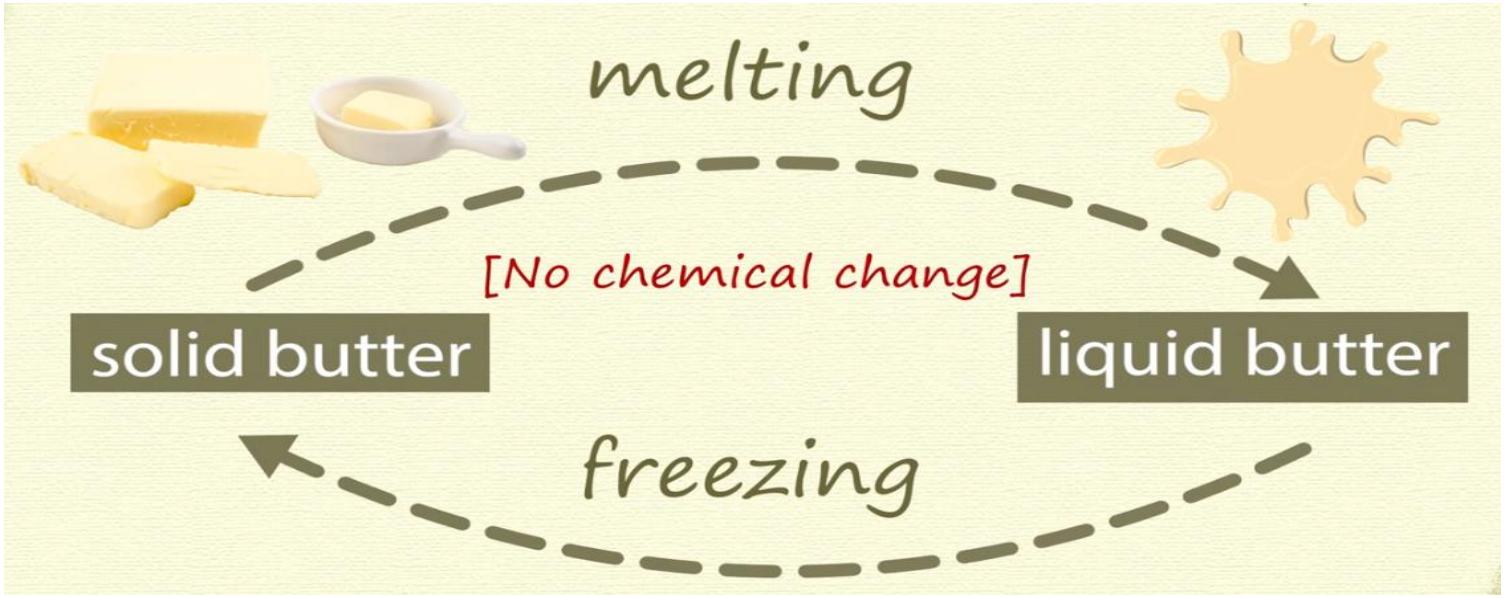
Name PHYSICAL disruptions of matter

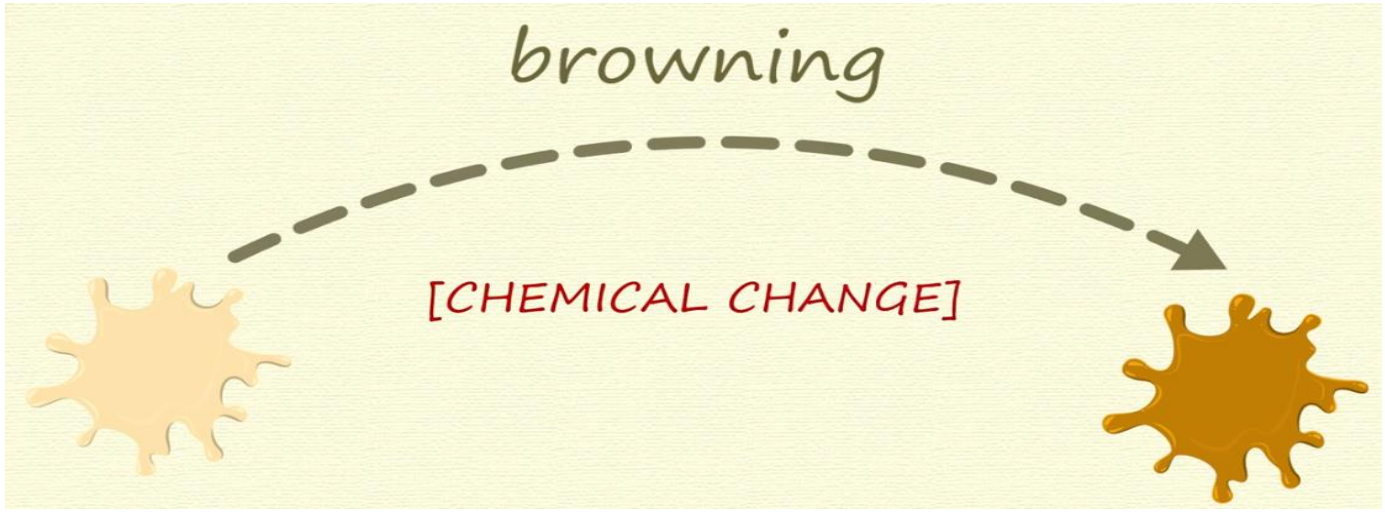


- Break
- Cut
- Crumble
- Chop (chopping onion)
- Crack (egg)
- Grind
- Mix
- Fracture
- Pour
- Split
- Shatter
- Tear
- For Water (melt, freeze, evaporate, boil, condense)




vaporization
H2O liquid
[No chemical change]
H2O gas
condensation


melting
[No chemical change]
solid butter
liquid butter
freezing


browning
[CHEMICAL CHANGE]

Chemical properties are observed in the course of a chemical interaction or change

Chemical stability
Flammability
Heat of Combustion
Oxidation State
Charge
Electronegativity
PH
There is a huge variety of chemical changes that can take place

Signs of a Chemical Reaction

Energy change: heat, light
Gas produced: bubbling, smell
Colour change
Precipitate formed

IMPORTANT NOTE

Chemical Reactions can only be reversed by another chemical reaction

Physical or Chemical?

- Shredding paper
- Chopping wood
- Burning wood
- Melting ice
- Fireworks
- Rotting food
- Rusting metal
- Breaking glass
- Dissolving sugar
- Dissolving salt

TYPES OF REACTIONS

- Synthesis
- Decomposition
- Single-displacement
- Double-displacement
- Combustion

GOALS:

- To classify reactions
- To predict products of reactions

METHOD:

- Learn general forms
- Learn sample reactions

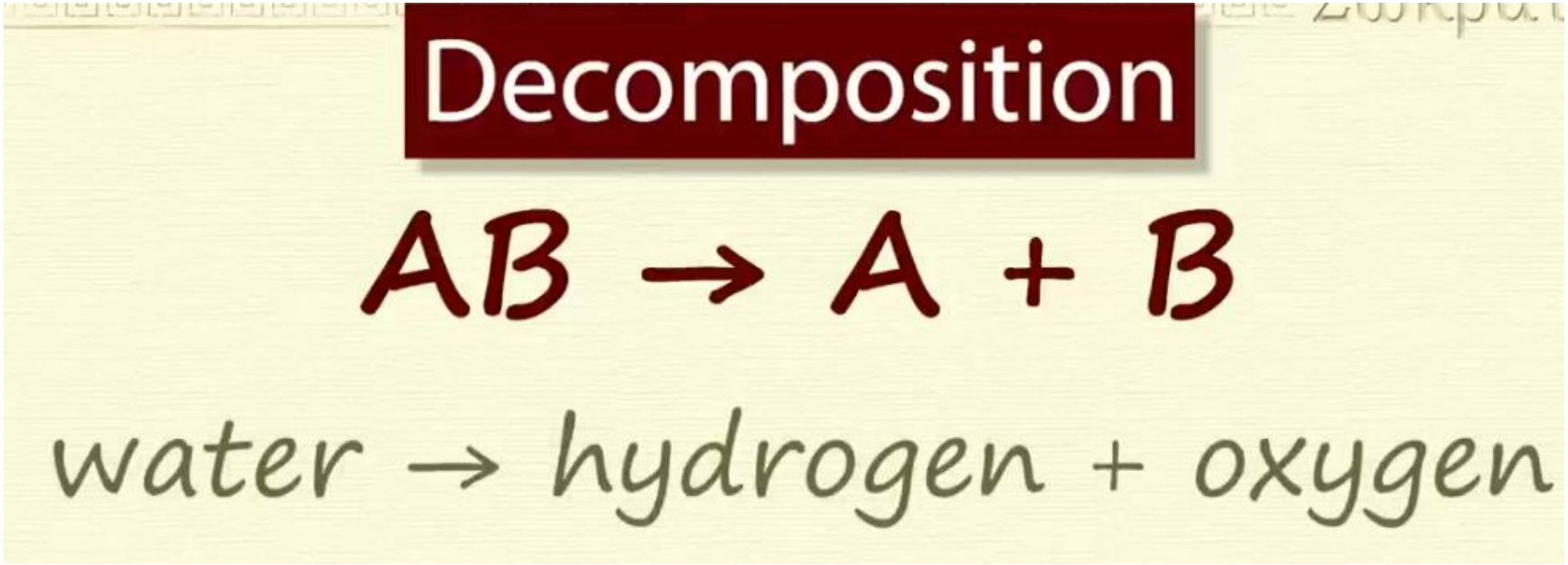
Synthesis

$$A + B \rightarrow AB$$

iron + oxygen → iron (III) oxide

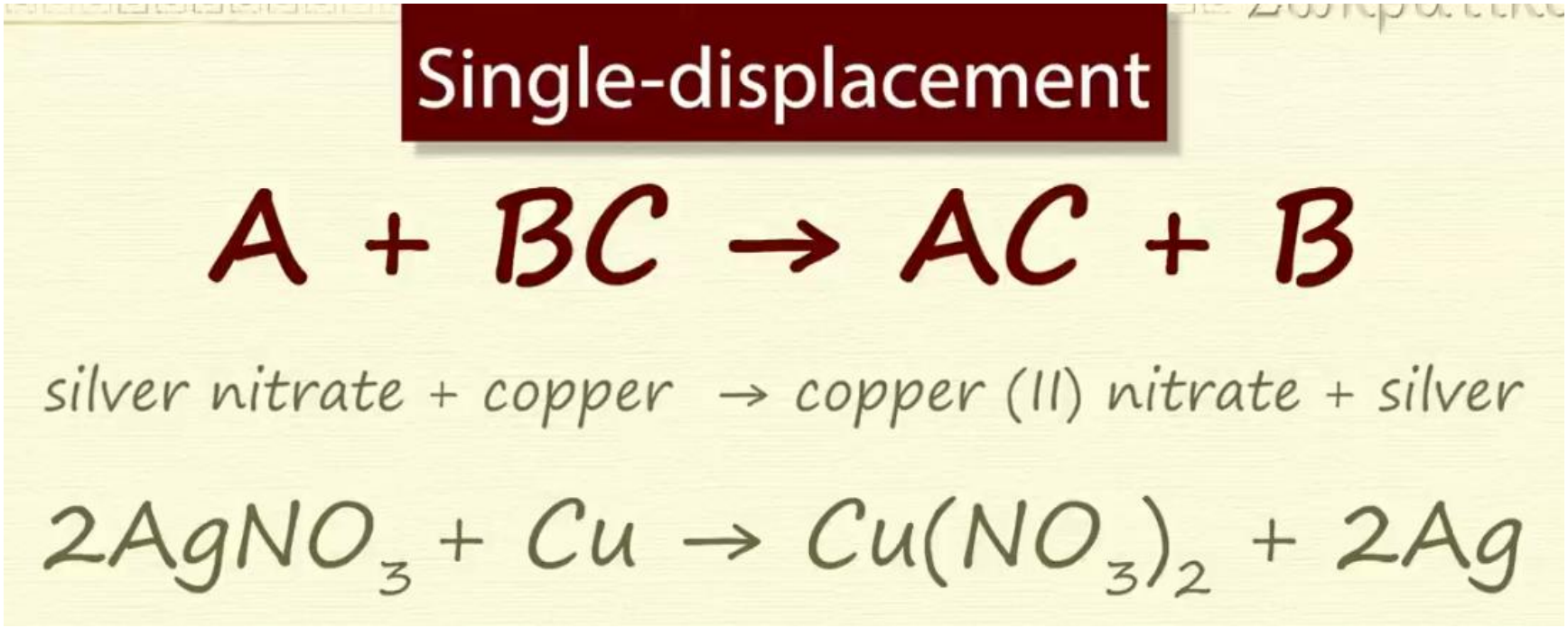
$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

Decomposition: A compound is broken into smaller pieces

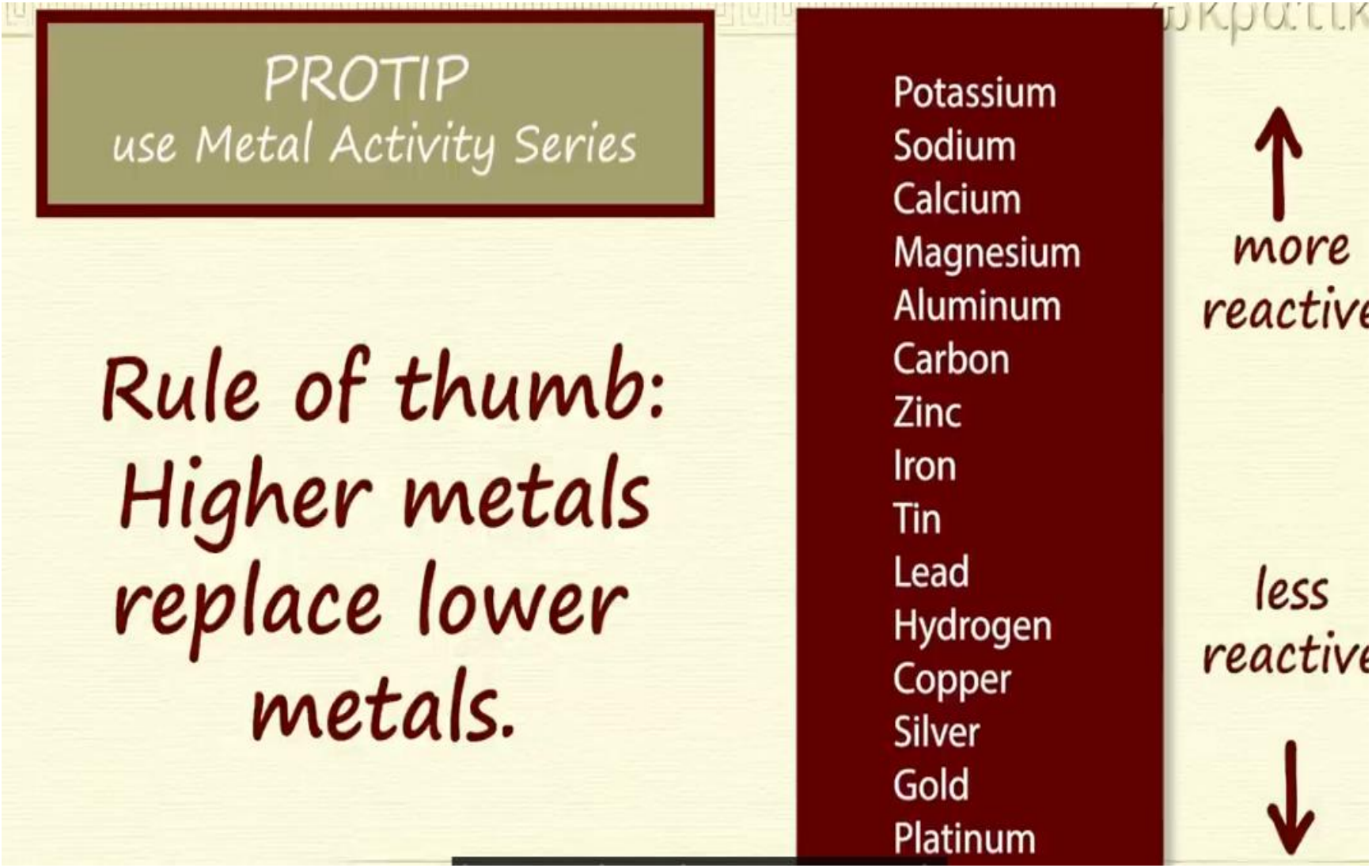


Electrolysis of water

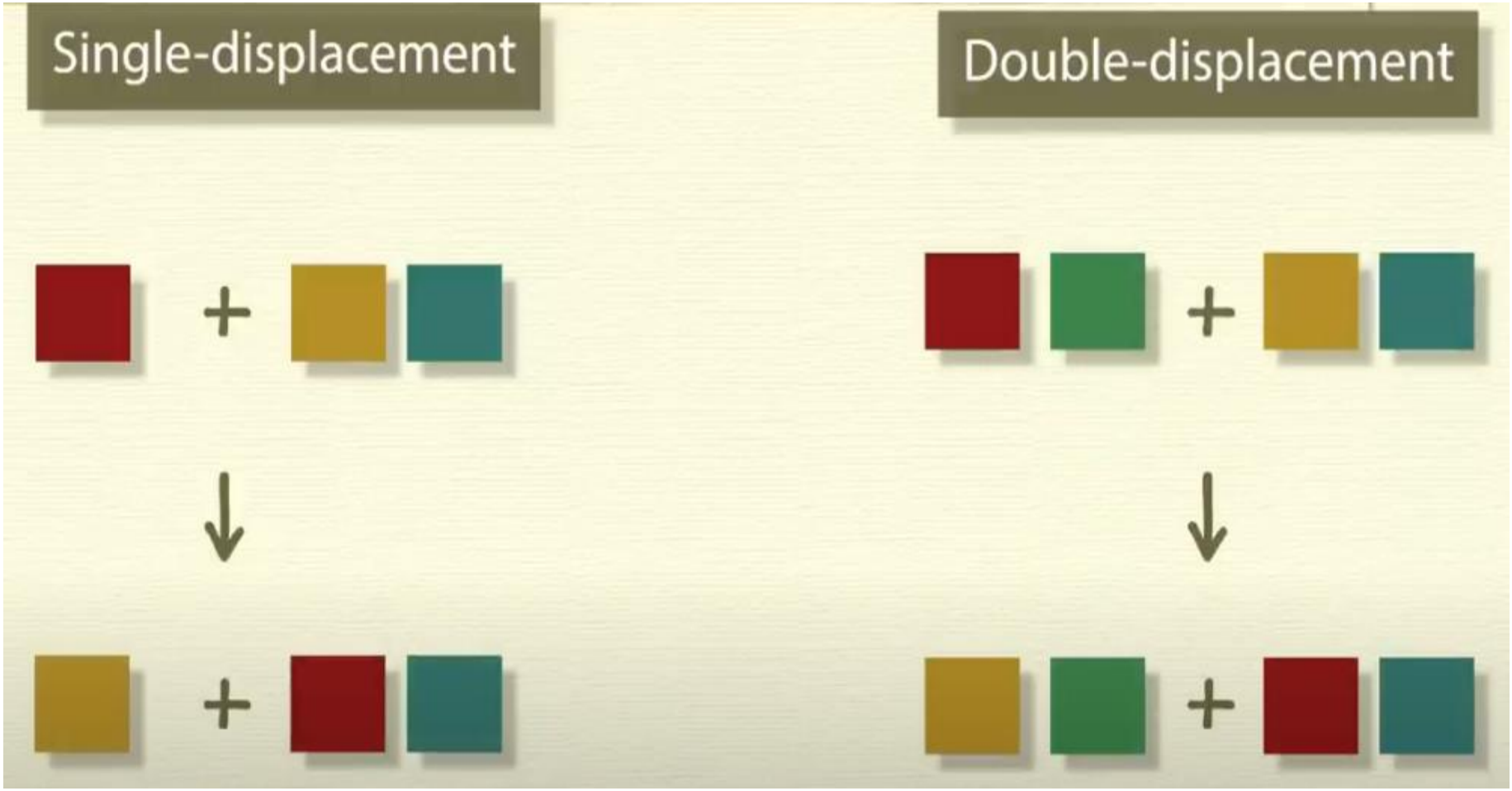
Single Displacement: look for swapping ions; cation with cation or anion with anion



Add copper solid to aqueous silver


PROTIP
use Metal Activity Series
Rule of thumb:
Higher metals
replace lower
metals.
Potassium
Sodium
Calcium
Magnesium
Aluminum
Carbon
Zinc
Iron
Tin
Lead
Hydrogen
Copper
Silver
Gold
Platinum
more
reactive
less
reactive

One set of component swap places
Two sets of component swap places



Double-displacement

$$AB + CD \rightarrow AD + CB$$

sodium hydroxide + calcium chloride → sodium chloride + calcium hydroxide

$$2NaOH + CaCl_2 \rightarrow 2NaCl + Ca(OH)_2$$

Double-displacement

$$AB + CD \rightarrow AD + CB$$

acid + base → water + a salt

$$HA + BOH \rightarrow H\text{-}OH + BA$$

$$HCl + NaOH \rightarrow H_2O + NaCl$$

Precipitation

Combustion: Substances react with oxygen (usually releases carbon dioxide and water)

