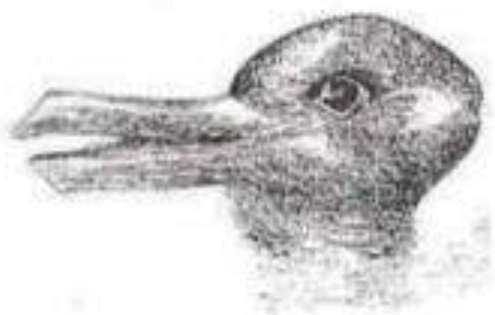
The Nature of Scientific Discovery

- Paradigm 'A framework of belief, usually applied to ruling theories of science'

- Paradigm shift 'A complete change from one paradigm to another, due to a major change in scientific thinking'

- The term was first used by philosopher Thomas Kuhn in his book 'The Structure of Scientific Revolutions' (1962)

- Kuhn used the duck/rabbit illusion to show how a paradigm shift could lead to you seeing the same information in a completely different way



Evidence of Physical verses Chemical Change

VOCABULARY – physical properties, chemical properties, physical change, chemical change, chemical reaction, Law of Conservation of Mass

Physical Properties

All matter has both [ ] properties useful to scientists in the [ ] of it.

Typical physical properties we will consider are: color, odor, density, hardness, solubility, phase of matter, melting points or boiling points.

See

Gold is shiny

Hear

Metal is sonorous

Feel

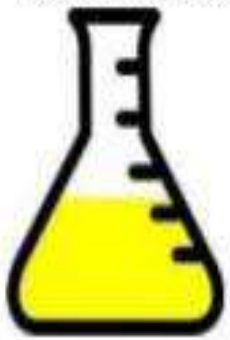
Rubber bends

Touch

The ceramic pot is hard

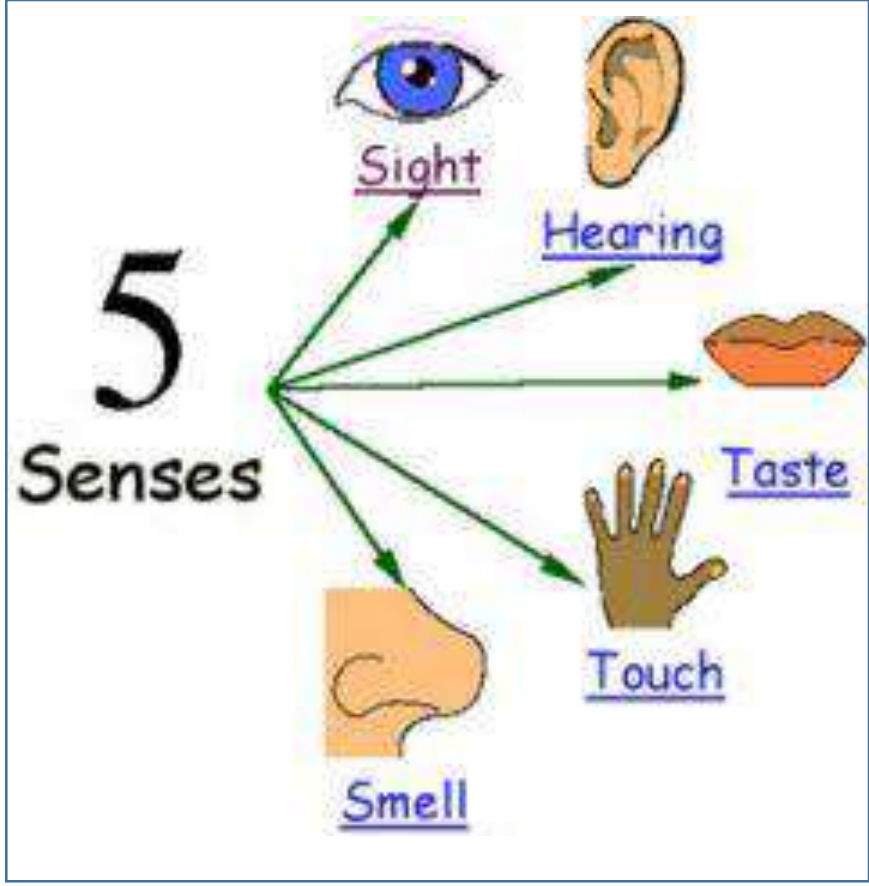
Smell

Acid smells sour



Measure

The temperature is high

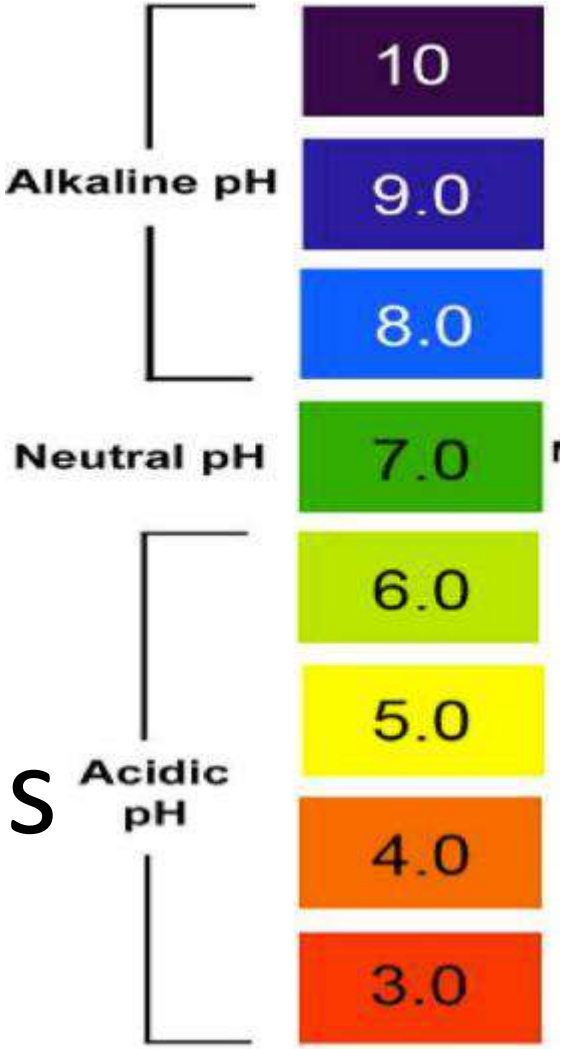


Properties

These are determined by the of a substance with another substance.

Examples: acidity or basicity reactions with oxygen or other gases

What cause **A** to react with **B** to possibly form **AB**?



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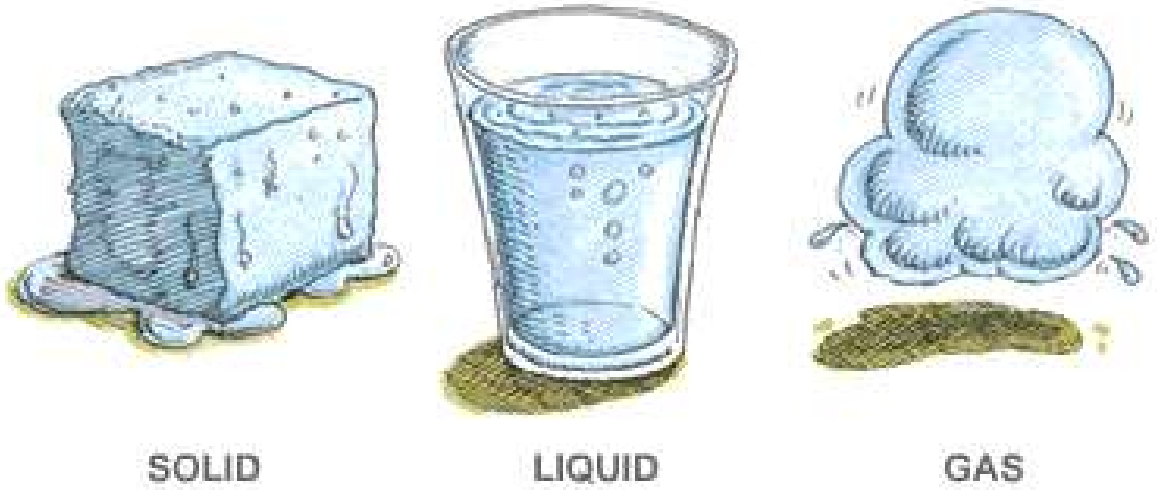
Physical Change

This occurs if the _____, _____ or _____ _____ is changed, but the chemical composition remains the same.



Chemical Change (reaction)

any **change** that results in the formation of new . At the molecular level, involves making or breaking of bonds between atoms. Ex: iron rusting (iron oxide forms)

Note: All chemical changes are also physical changes

Evidence of a Chemical Reaction

Signs of chemical change are: 5 examples

(pigmentation loss or gain)

(oxidation of some metals)

(gas being produced)

produced (release of energy)

(called a precipitate)

Law of Conservation of Mass

Mass or matter can _____ be _____ or _____ during a chemical reactions or physical change. Mass of all substances present _____ a chemical change is _____ to the mass of all new substances produced _____ the chemical change.

History of the Law of the Conservation of Mass

The ancient Greeks first proposed the idea that the total amount of [ ] in the universe is constant. Later, Antoine Lavoisier described this with The Law of Conservation of Mass as a fundamental principle of physics in 1789. He demonstrated it with the following experiment:

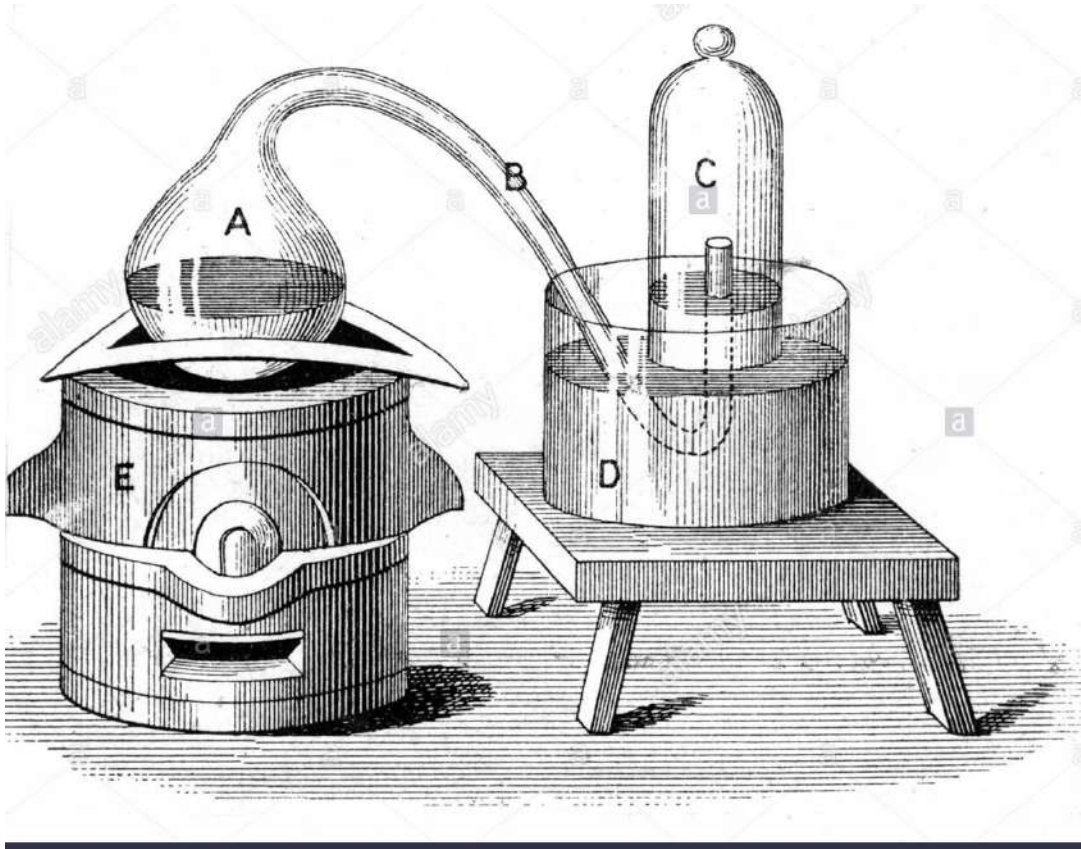
Source: Boundless. “The Law of Conservation of Mass.” *Boundless Chemistry*. Boundless, 26 May. 2016.

History of the Law of the Conservation of Mass

The heating of mercury (Hg) liquid causes it to react with oxygen forming mercury calx (HgO).

The reaction is reversible too.
Heating HgO produces O and Hg.

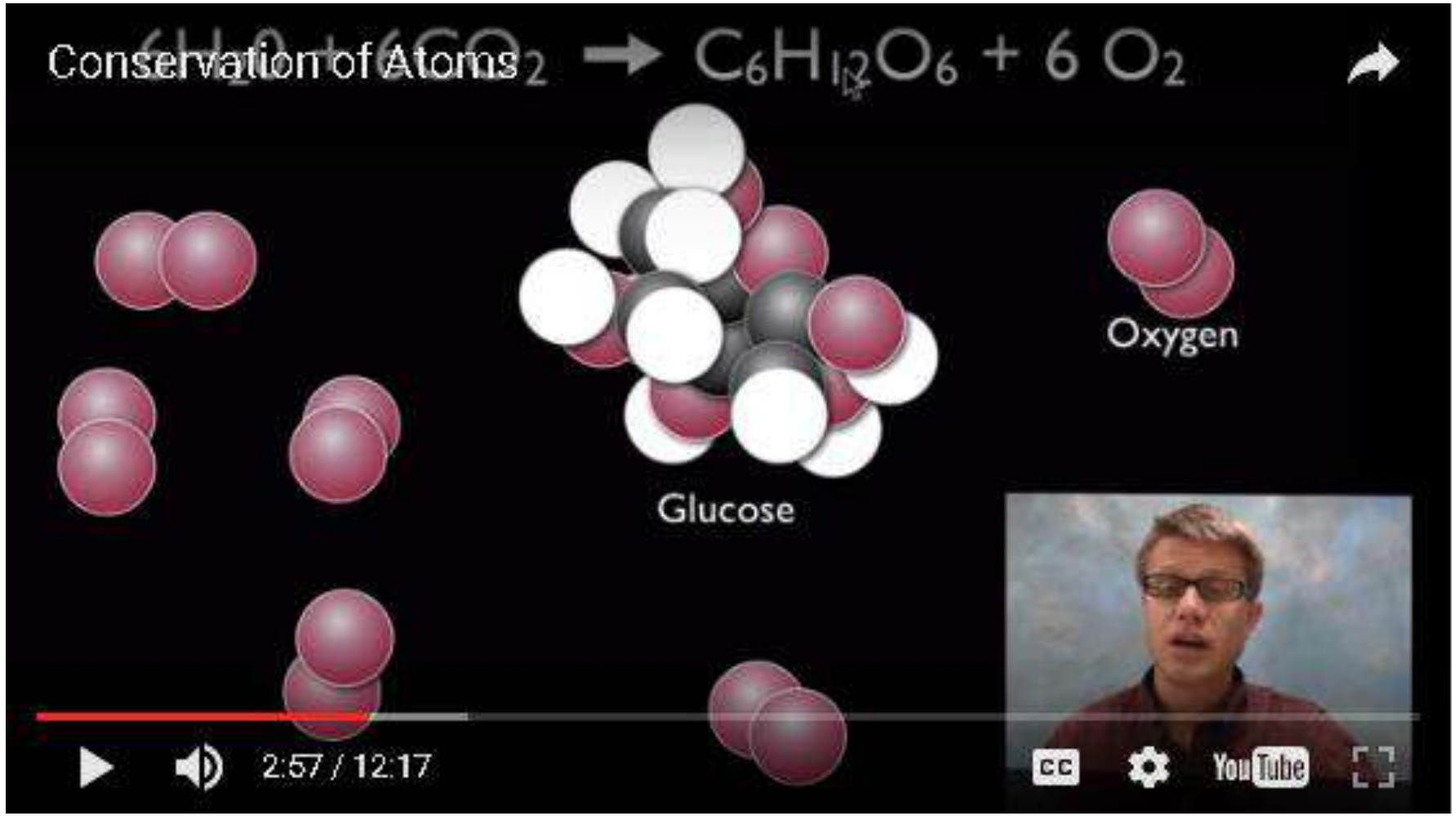
Lavoisier was able to account for all mass on either side of the reactions



Law of the Conservation of Mass

Mr. Bozeman – Conservation of Atoms

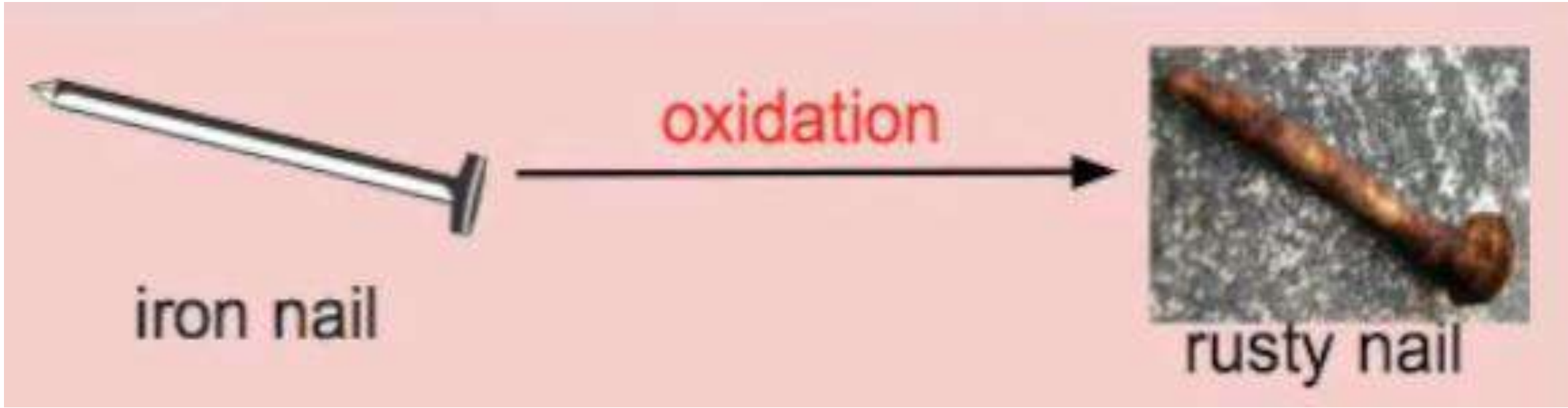
https://youtu.be/4a2PKulH1So min 0 – 3



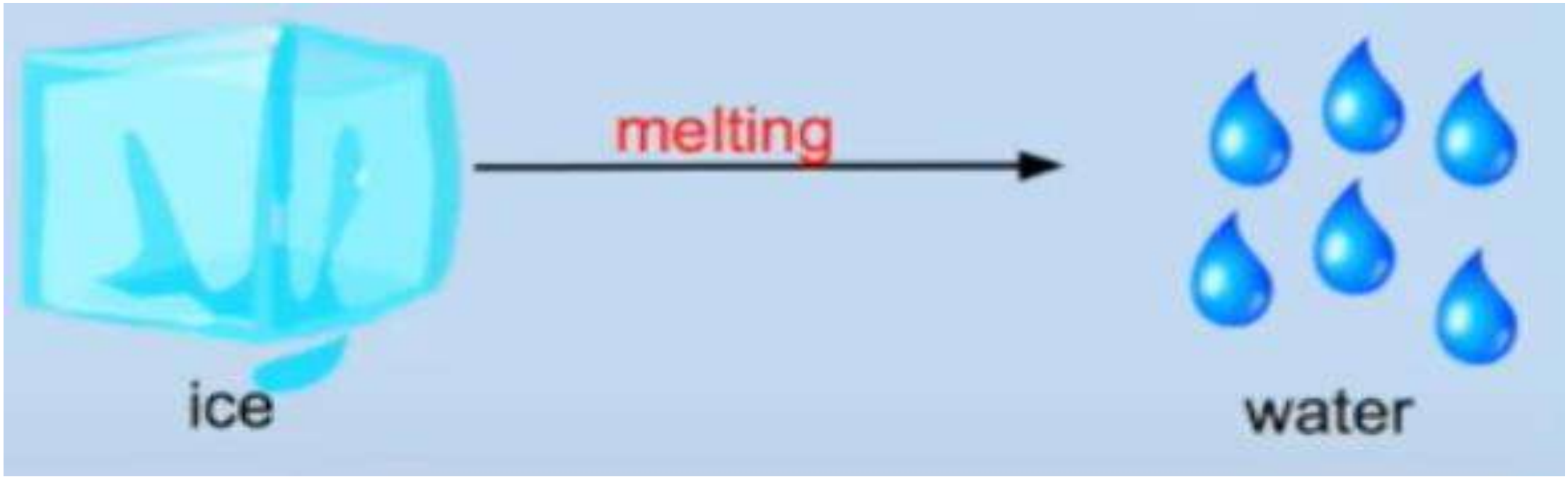

grinding
peanuts
peanut butter

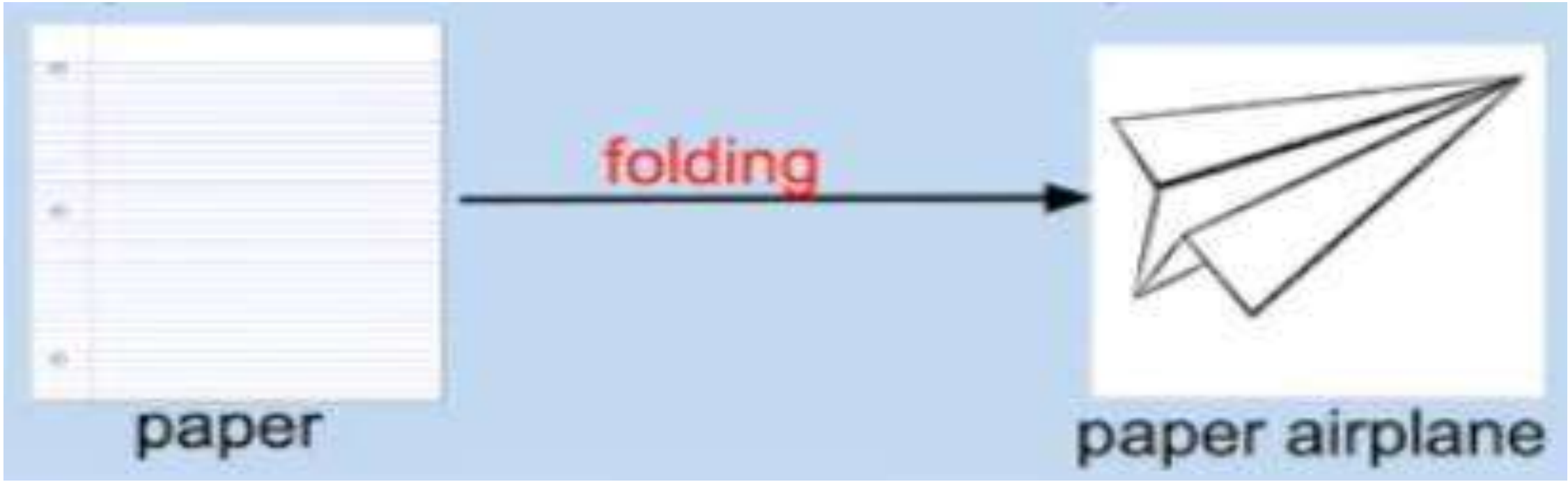

combustion
logs
burning logs

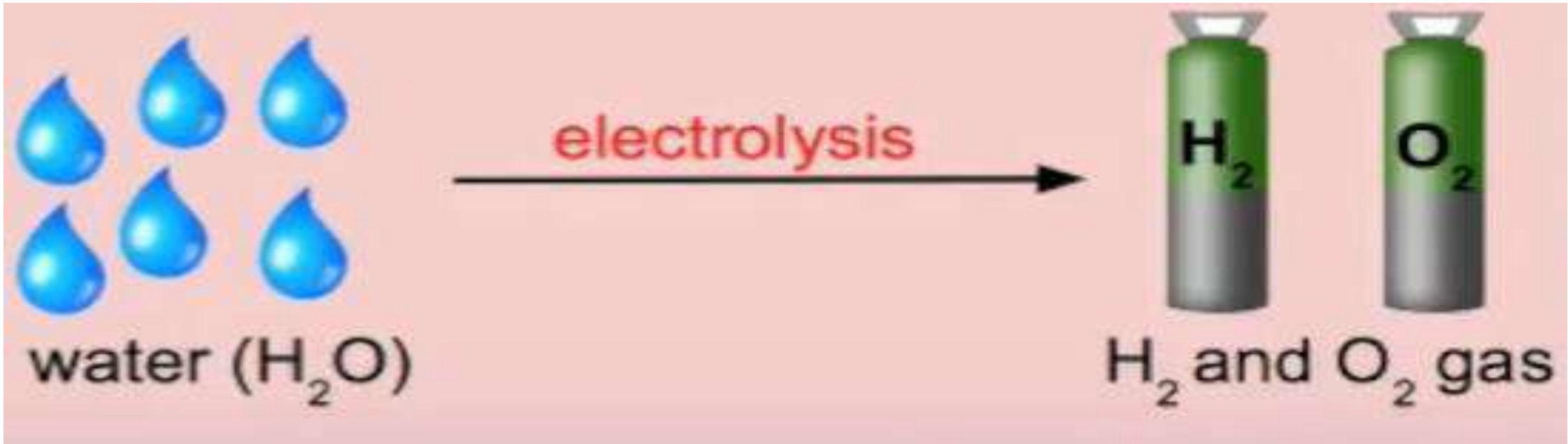

ductility
copper
copper wire


oxidation
iron nail
rusty nail


fermentation
sugar
alcohol


melting
ice
water


folding
paper
paper airplane


electrolysis
H_2
O_2
water (H_2O)
H_2 and O_2 gas

VIDEO LINKS

Physical and Chemical Changes - Mr. Bozeman (11min)

- https://youtu.be/X328AWaJXvI

Physical Vs. Chemical Changes - Explained

- https://youtu.be/4ZGULLWEy1c

Evidence of Physical verses Chemical Change

VOCABULARY – physical properties, chemical properties, physical change, chemical change, chemical reaction, Law of Conservation of Mass

Physical Properties

All matter has both **physical and chemical** properties useful to scientists in the **classification** of it.

Typical physical properties we will consider are: color, odor, density, hardness, solubility, phase of matter, melting points or boiling points.

Physical properties

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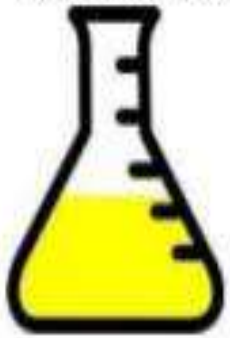

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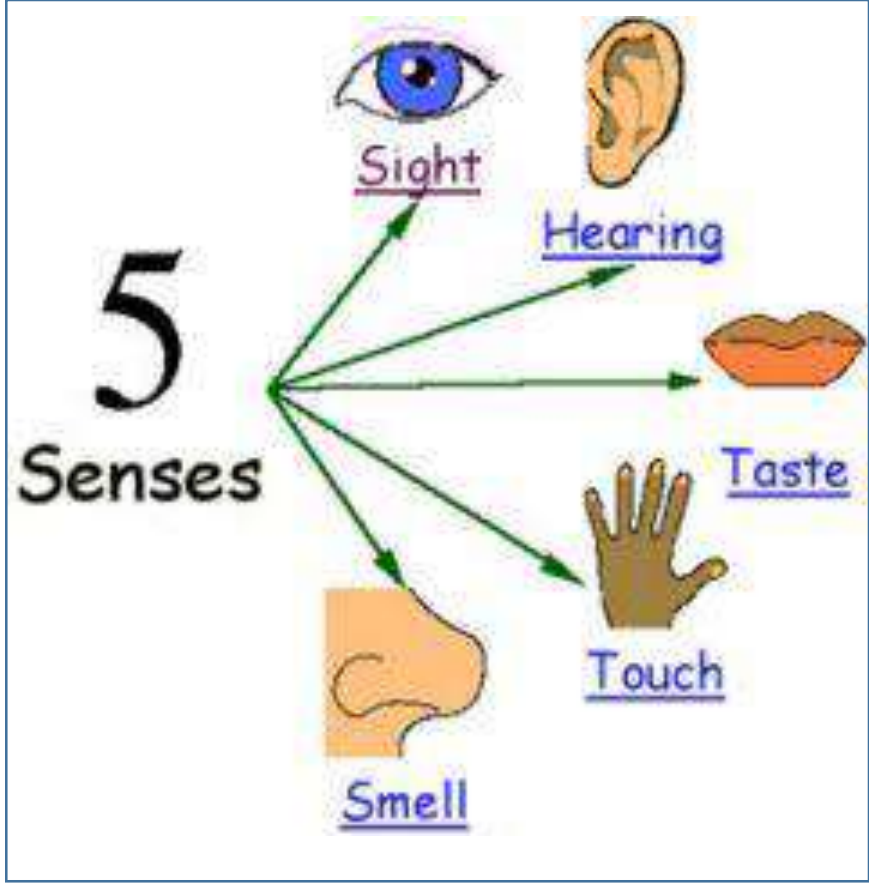


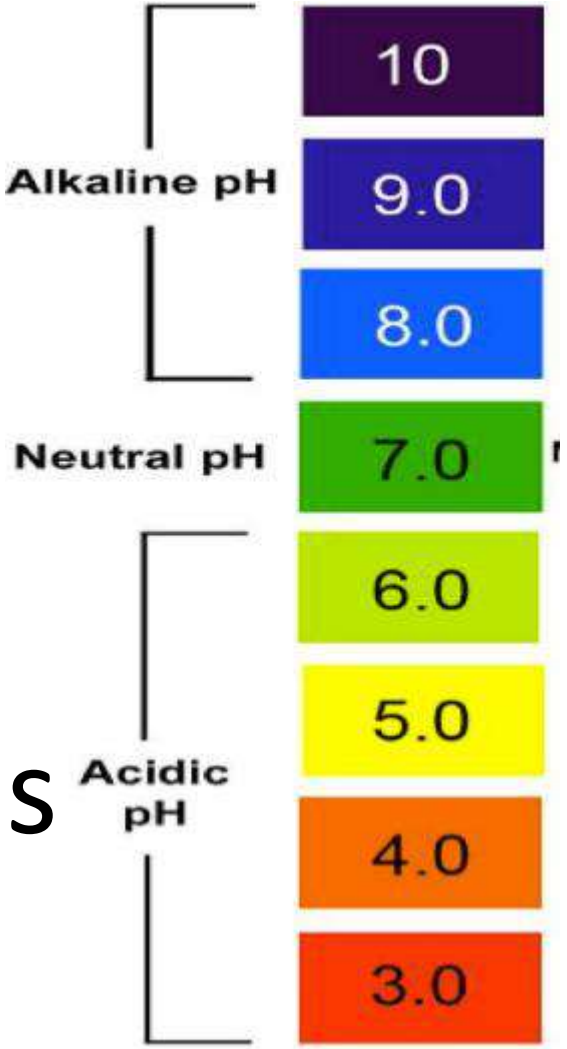
Chemical Properties

These are determined by the **reactivity** of a substance with another substance.

Examples: acidity or basicity

reactions with oxygen or other gases

What **properties** cause **A** to react with **B** to possibly form **AB**?



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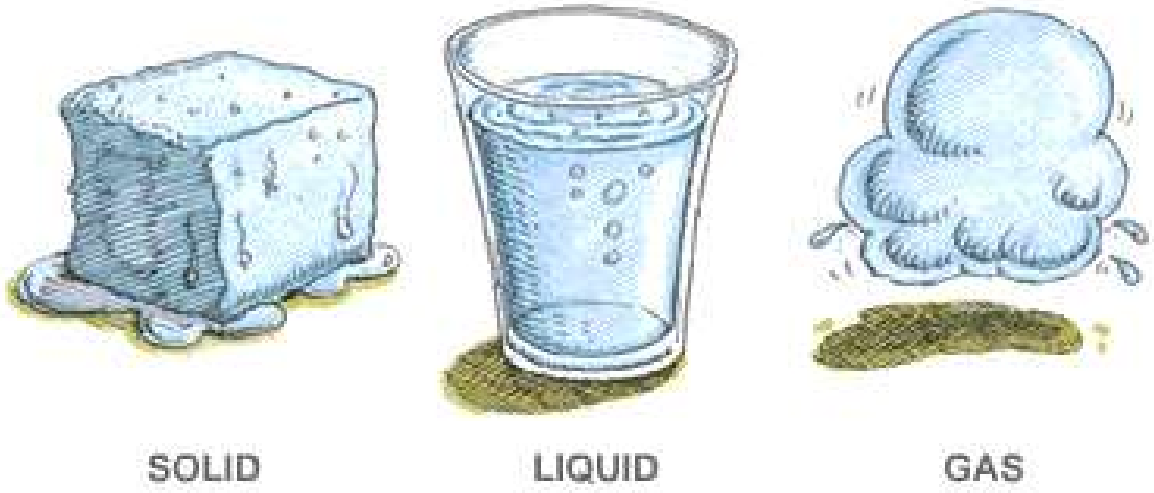
Physical Change

This occurs if the **shape, size** or **physical state** is changed, but the chemical composition remains the same.



Chemical Change (reaction)

any **change** that results in the formation of new **chemical substances**. At the molecular level, **chemical change** involves making or breaking of bonds between atoms. Ex: iron rusting (iron oxide forms)

Note: All chemical changes are also physical changes

Evidence of a Chemical Reaction

Signs of chemical change are: 5 examples

change in color (pigmentation loss or gain)

rust formation (oxidation of some metals)

bubbling or fizzing (gas being produced)

light or heat produced (release of energy)

formation of a solid (called a precipitate)

Law of Conservation of Mass

Mass or matter can **never** be **destroyed** or **created** during a chemical reactions or physical change. Mass of all substances present **before** a chemical change is **equal** to the mass of all new substances produced **after** the chemical change.

History of the Law of the Conservation of Mass

The ancient Greeks first proposed the idea that the total amount of **matter** in the universe is constant. Later, Antoine Lavoisier described this with The Law of Conservation of Mass as a fundamental principle of physics in 1789. He demonstrated it with the following experiment:

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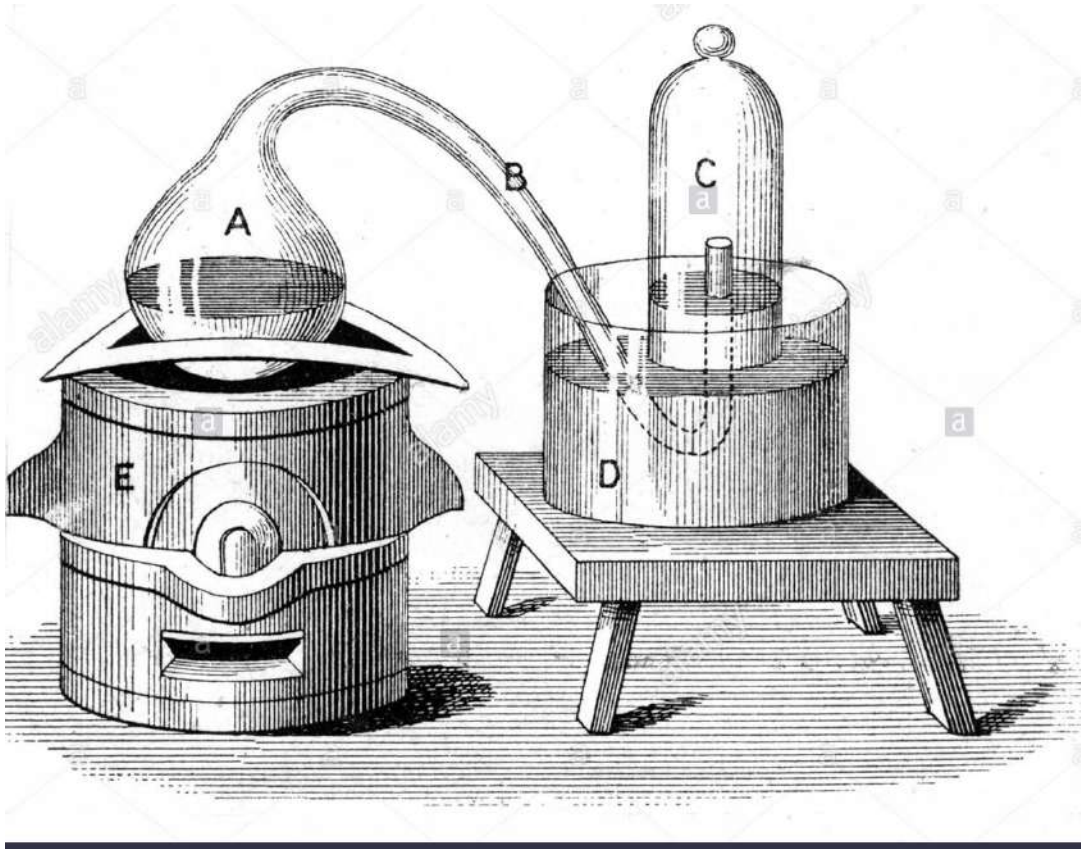
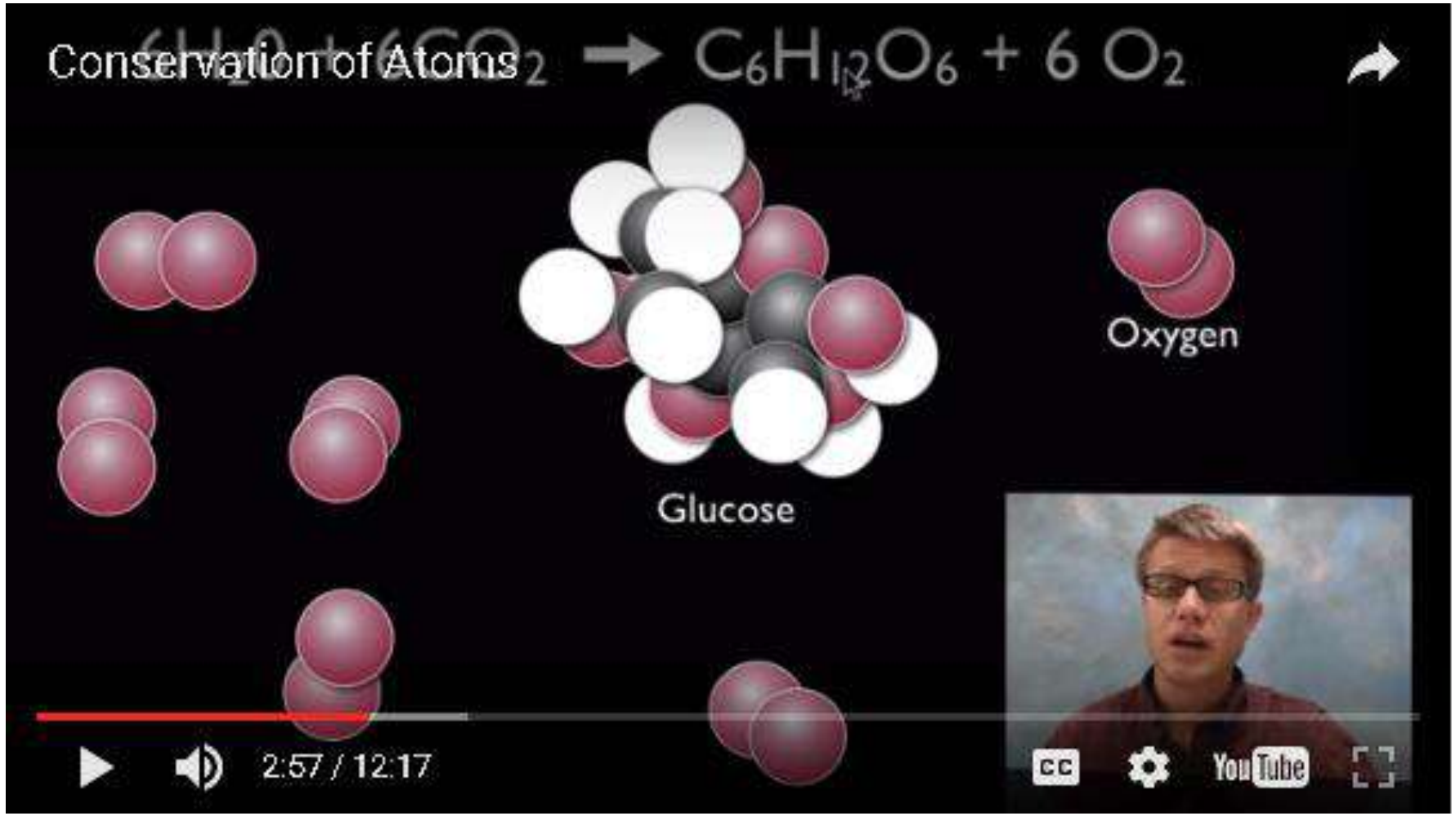


Law of the Conservation of Mass

Mr. Bozeman – Conservation of Atoms

https://youtu.be/4a2PKulH1So min 0 – 3




grinding
peanuts
peanut butter


combustion
logs
burning logs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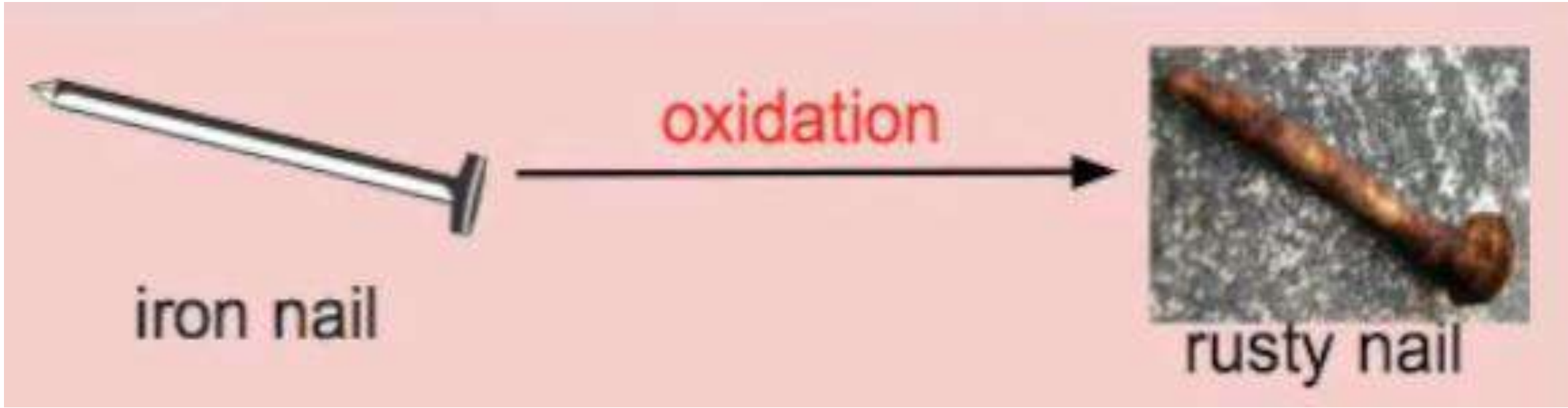
oxidation
iron nail
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fermentation
sugar
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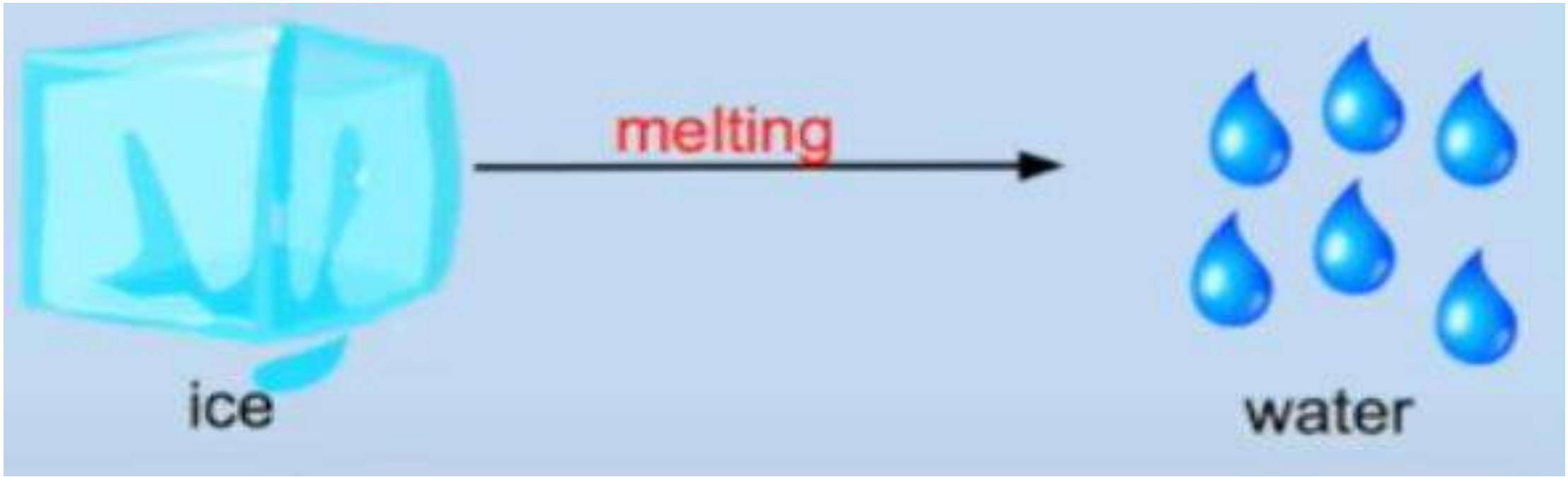
melting
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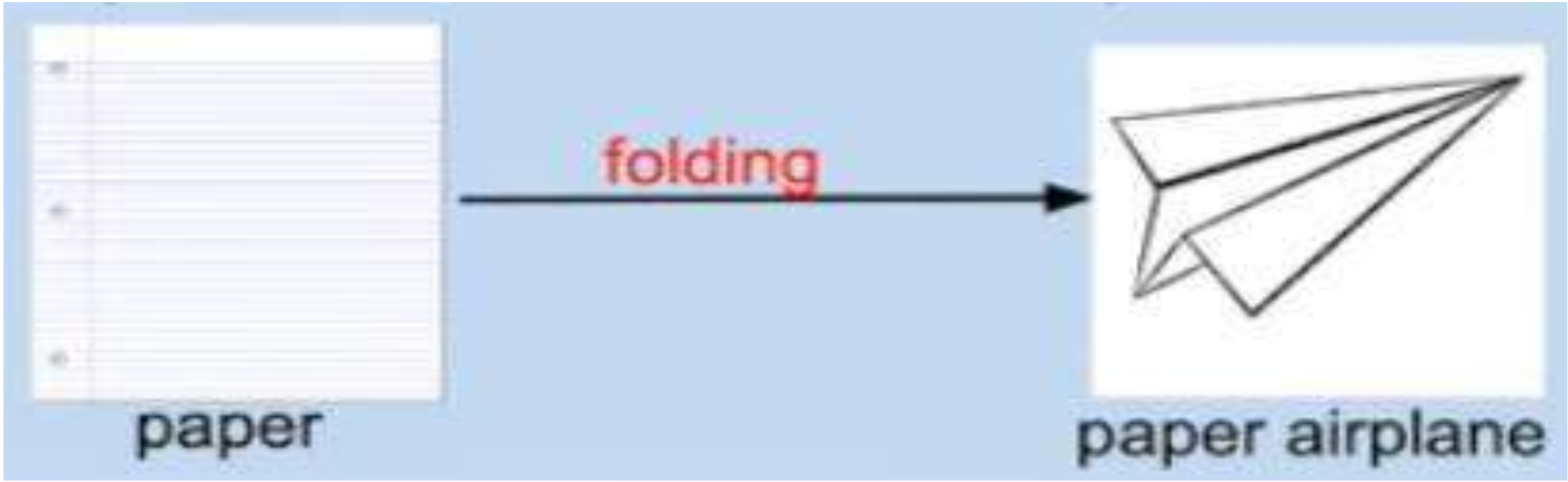
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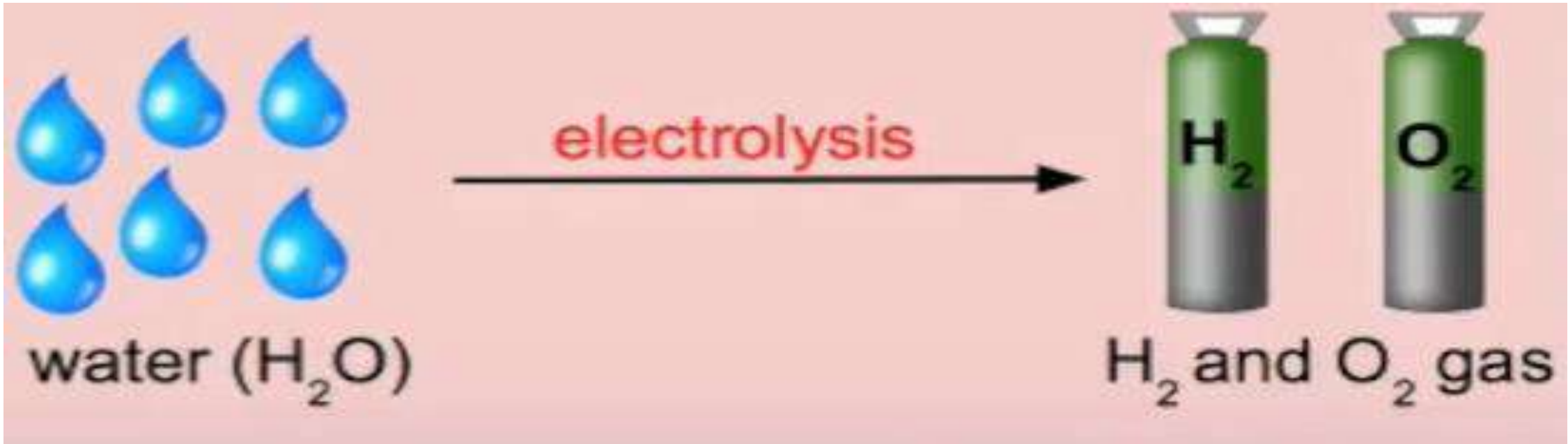
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Evidence of Physical or Chemical Changes Lab

1. Read and highlight pg 1
2. Complete Physical Properties notes pg 2
3. Complete hands on portion of lab
4. Complete pg 3 prep. Reference reading pg 1 to find the answers.

Physical Properties

Baking soda: $NaHCO_3$
solid – powder, fine, white

Vinegar: CH_3COOH (acetic acid)
liquid – transparent, clear, sour acidic odor
acid

Baking Soda & Vinegar

1. Observe the physical properties of baking soda and vinegar. Record observations.

2. Put 1 spoonful of baking soda into the petri dish.

3. Place a pipette full of vinegar onto baking soda in the petri dish.

4. Observe and record any changes

Physical Properties

Corn Starch: $NaHCO_3$
solid – powder, fine, white

Iodine (povidone-iodine): $I\text{-}NCHOCH_2$
liquid - colloid, opaque, brownish/red tint

Water: H_2O - liquid, transparent, polar, wet ☺

Cornstarch, Water and Iodine

1. Observe the physical properties of cornstarch and iodine. Record observations.

2. Put 1 spoonful of cornstarch into water. Stir

3. Using the dropper, drip one drop at a time of iodine into the mixture and stir after each.

4. Observe and record any changes

Physical Properties https://youtu.be/TOllLQSzzGI

Epsom salts : $MgSO_4$ magnesium sulfate solid -coarse, crystalline white w/ blueish tinge

washing soda : Na_3CO_3 (sodium carbonate) solid - powder pale white to yellowish tint

Water: H_2O - liquid, transparent, polar, wet ☺

Epsom Salt, Washing soda and water in solution

1. Observe the physical properties of Epsom Salt and Washing soda . Record observations.

2. Put 1 spoonful of each into water. Stir

3. Then pipette several samples of each onto a petri dish.

4. Observe and record any changes

Physical Properties

Copper penny: Cu .... CuO_2H
solid – metallic, Abe Lincoln,
patina or tarnish greenish tinge

Table Salt: NaCl
solid - crystalline granular, cuboidal, white

Vinegar – liquid, transparent, clear, sour acidic odor

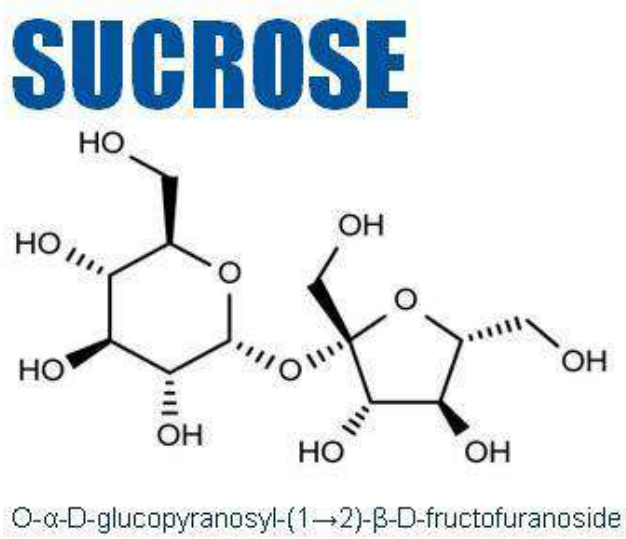
Sugar and Water

1. Observe the physical properties of sugar and water. Record observations.

2. Put 1 spoonful of sugar into water. Stir

3. Observe and record any changes

Physical Properties



Sugar : $C_6H_{12}O_6$
solid – solid, granular crystalline, pale white

Water: H_2O - liquid, transparent, polar, wet ☺

Form a solution – observe

Physical Properties

https://youtu.be/MEvYVxXHEGY?t=60

Steel wool: (Iron)Fe

solid - metallic, fibrous, luster, some shine

Vinegar – (acetic acid)

liquid, transparent, clear, sour acidic odor