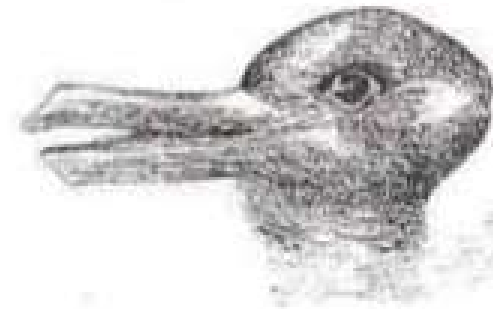


The Nature of Scientific Discovery

- 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 versus 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



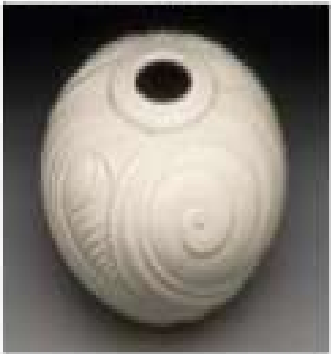
Feel

Rubber bends



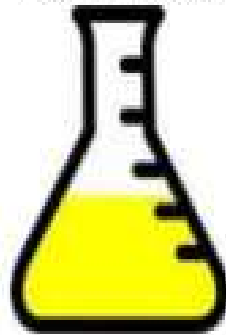
Touch

The ceramic pot is hard



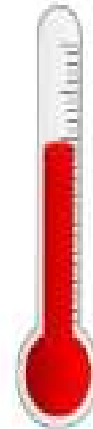
Smell

Acid smells sour



Measure

The temperature is high



5 Senses



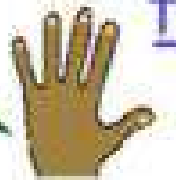
Sight



Hearing



Taste



Touch



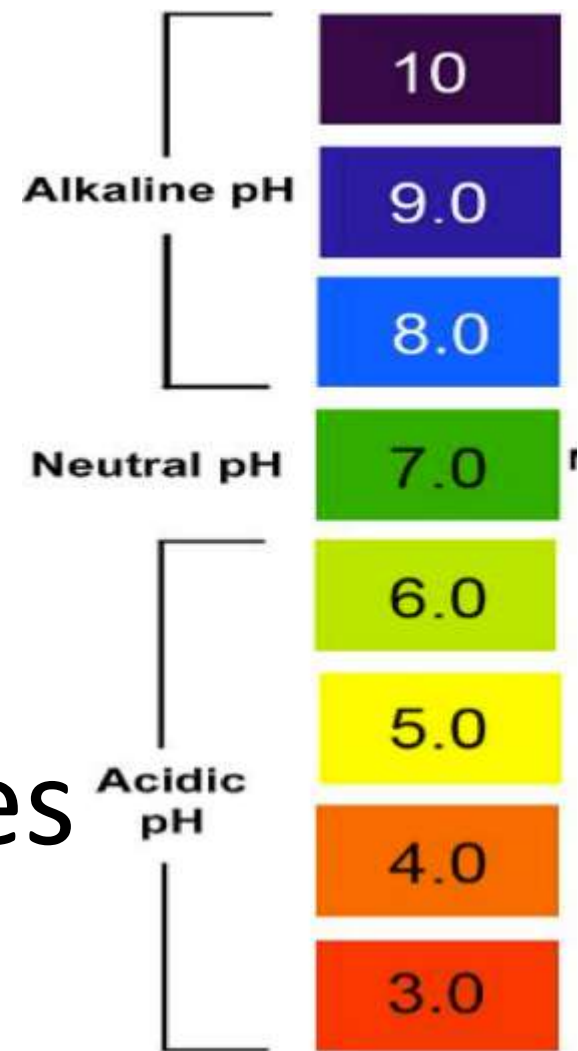
Smell

Properties

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

Examples: acidity or basicity
reactions with oxygen or other gases

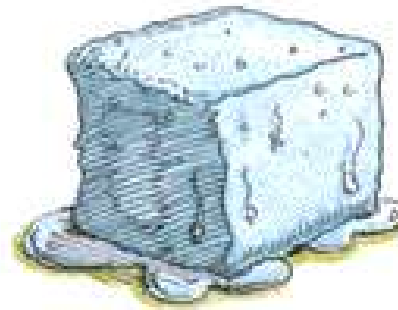
What cause **A** to react with **B** to possibly form **AB**?



Caution: do not get hung up on the nuances between these two.
Simply refer to the definition as defined here in class.

Physical Change

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



SOLID



LIQUID



GAS

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



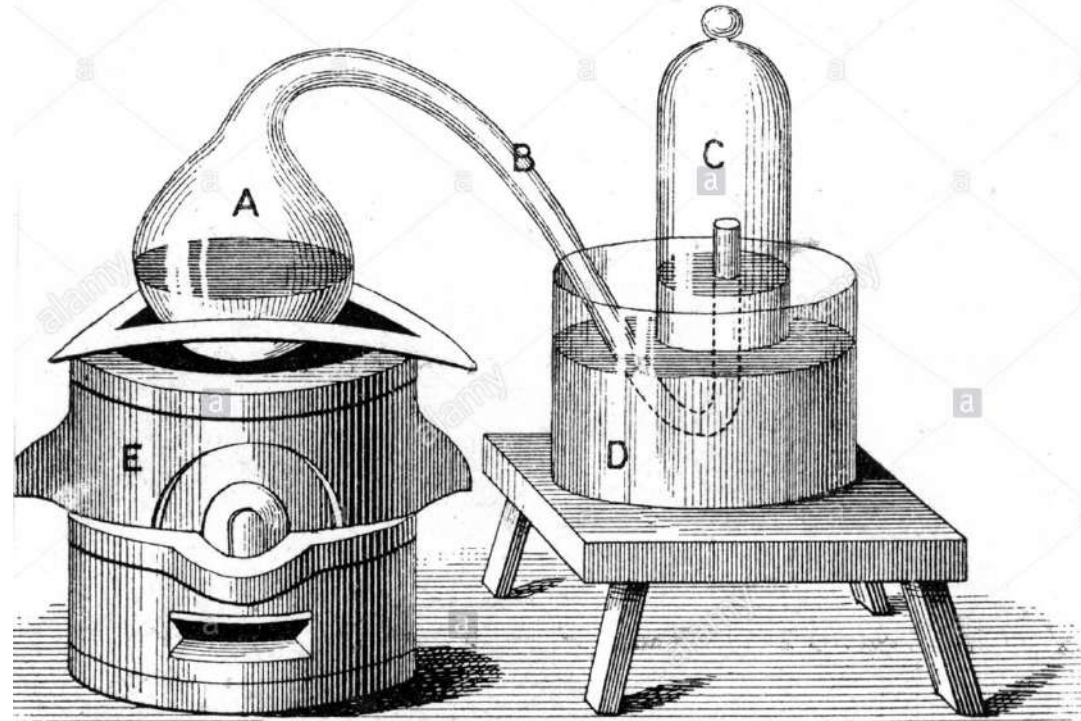
The ancient Greeks first proposed the idea that the total amount of in the universe is constant. Later, Antoine Lavoisier described this with The Law of Conservation of Mass as a fundamental principle of physics in 1789. He demonstrated it with the following experiment:

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/4a2PKuIH1So> min 0 – 3

Conservation of Atoms $6\text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

Oxygen

Glucose

2:57 / 12:17

CC YouTube



peanuts

grinding



peanut butter

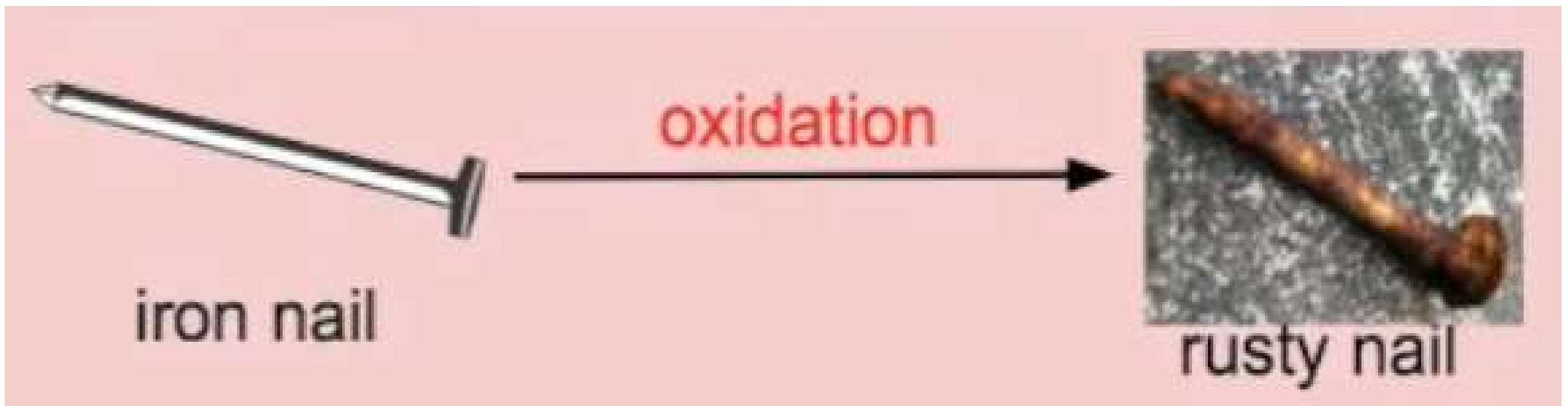
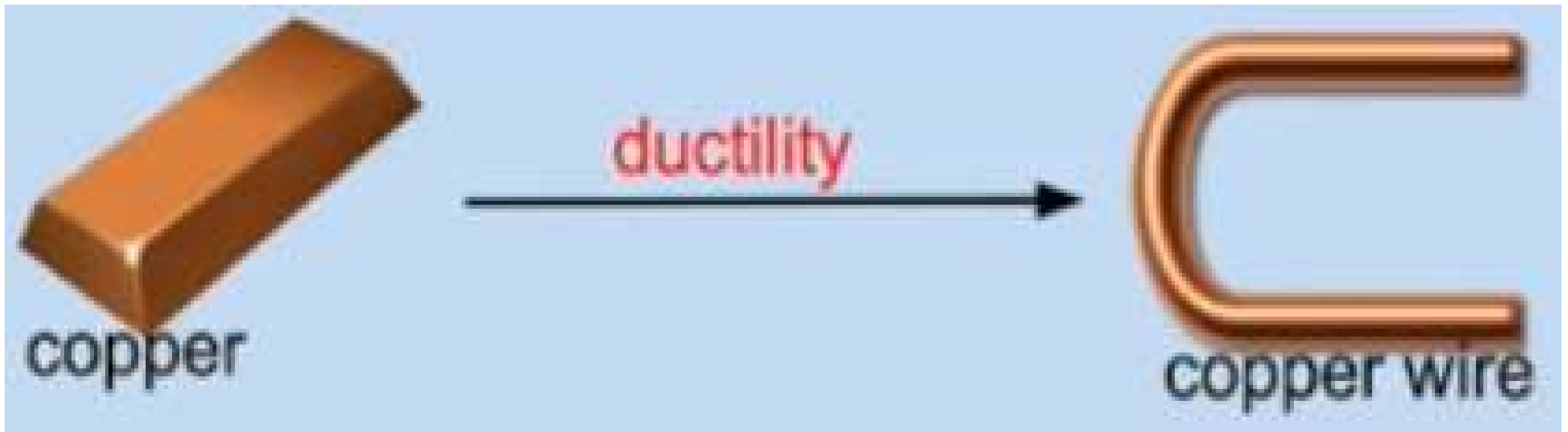


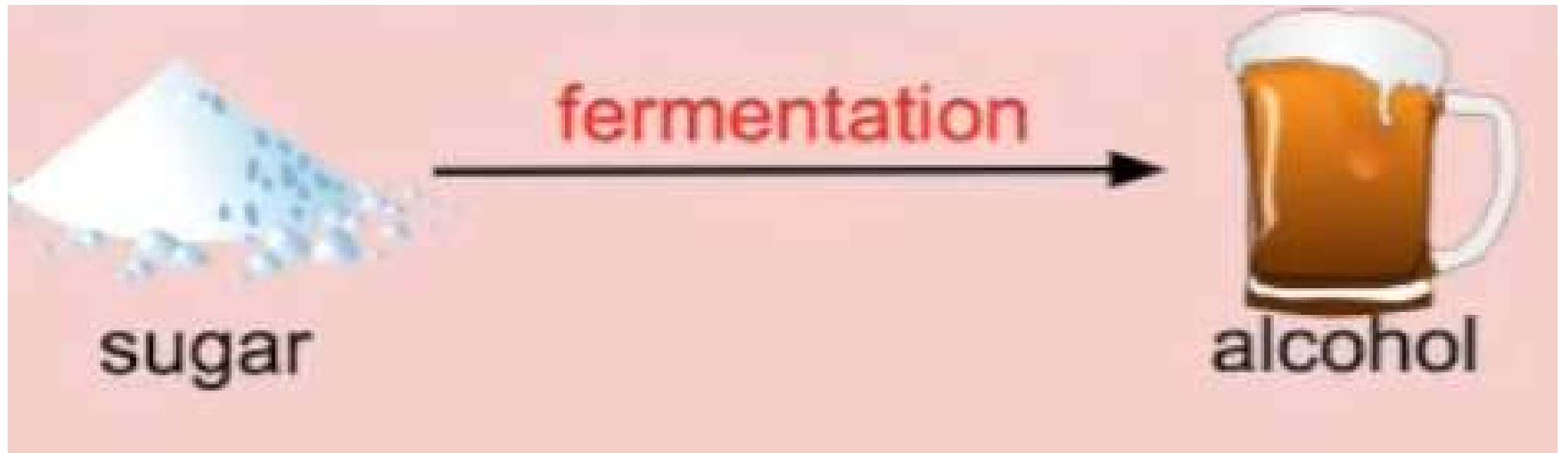
logs

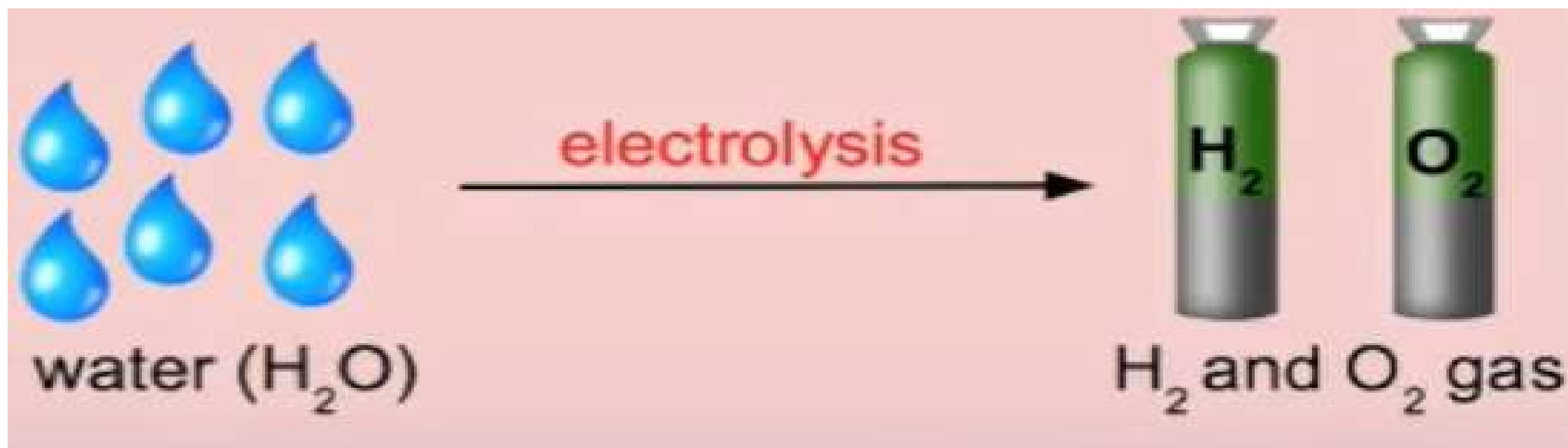
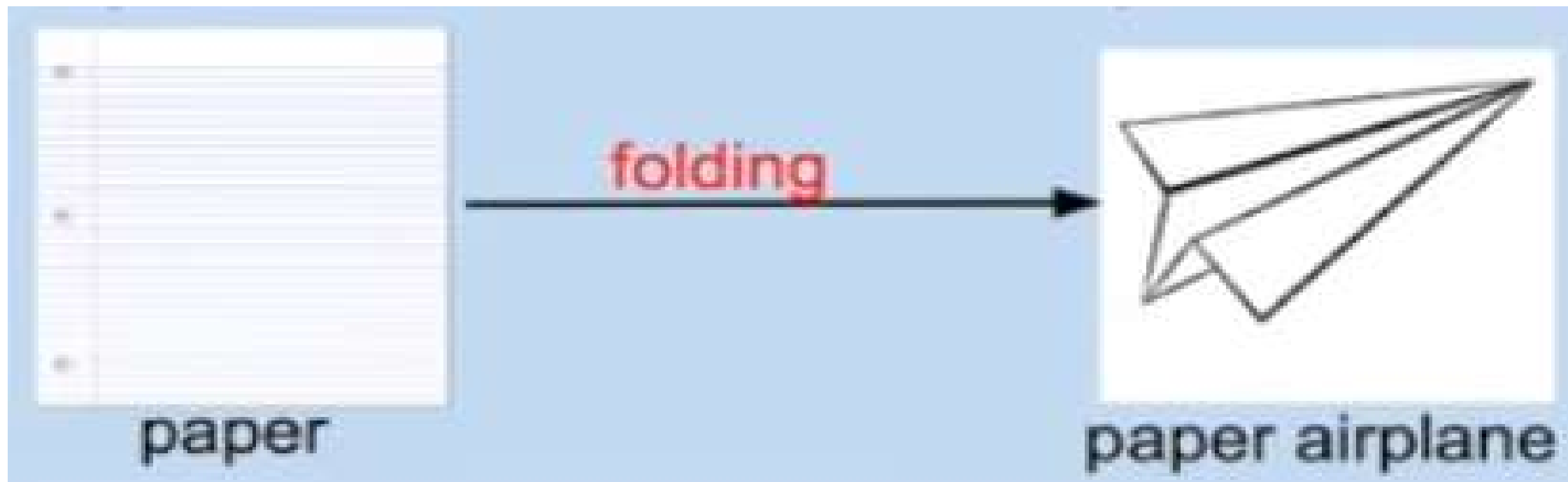
combustion



burning logs







VIDEO LINKS

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

- <https://youtu.be/X328AWaJXvl>

Physical Vs. Chemical Changes - Explained

- <https://youtu.be/4ZGULLWEy1c>

Evidence of Physical versus 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

See

Gold is shiny



Hear

Metal is sonorous



Feel

Rubber bends



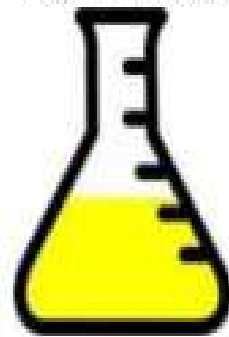
Touch

The ceramic pot is hard



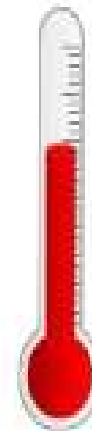
Smell

Acid smells sour



Measure

The temperature is high



5
Senses



Sight



Hearing



Taste



Touch



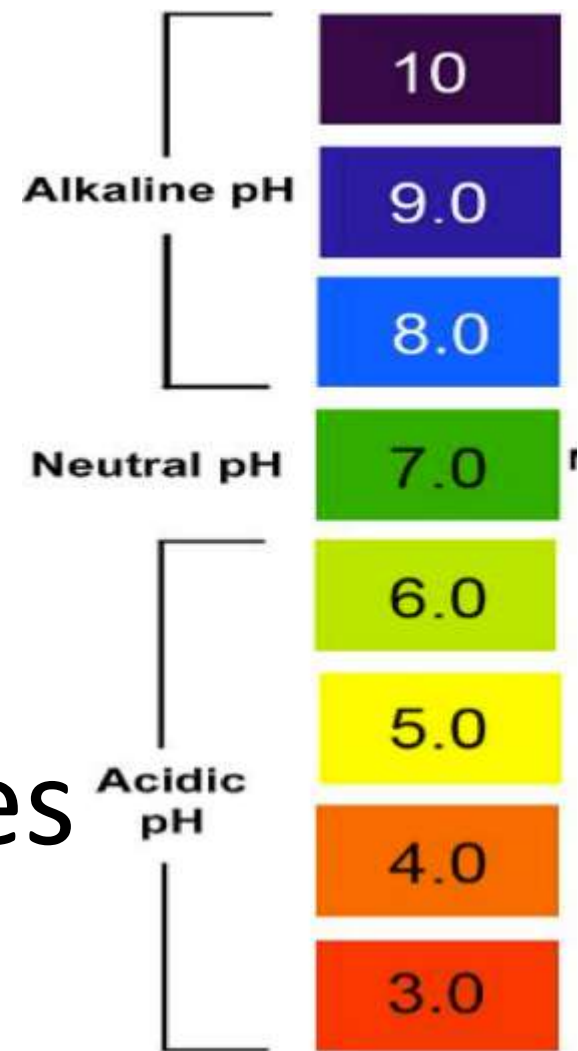
Smell

Chemical Properties

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

Examples: acidity or basicity
reactions with oxygen or other gases

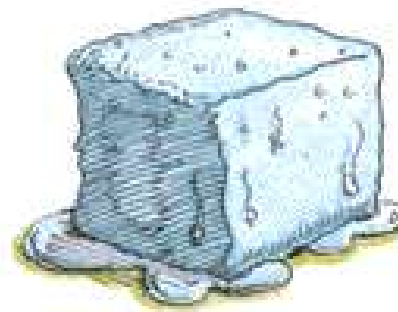
What properties cause A to react with B to possibly form AB?



Caution: do not get hung up on the nuances between these two.
Simply refer to the definition as defined here in class.

Physical Change

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



SOLID



LIQUID



GAS

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



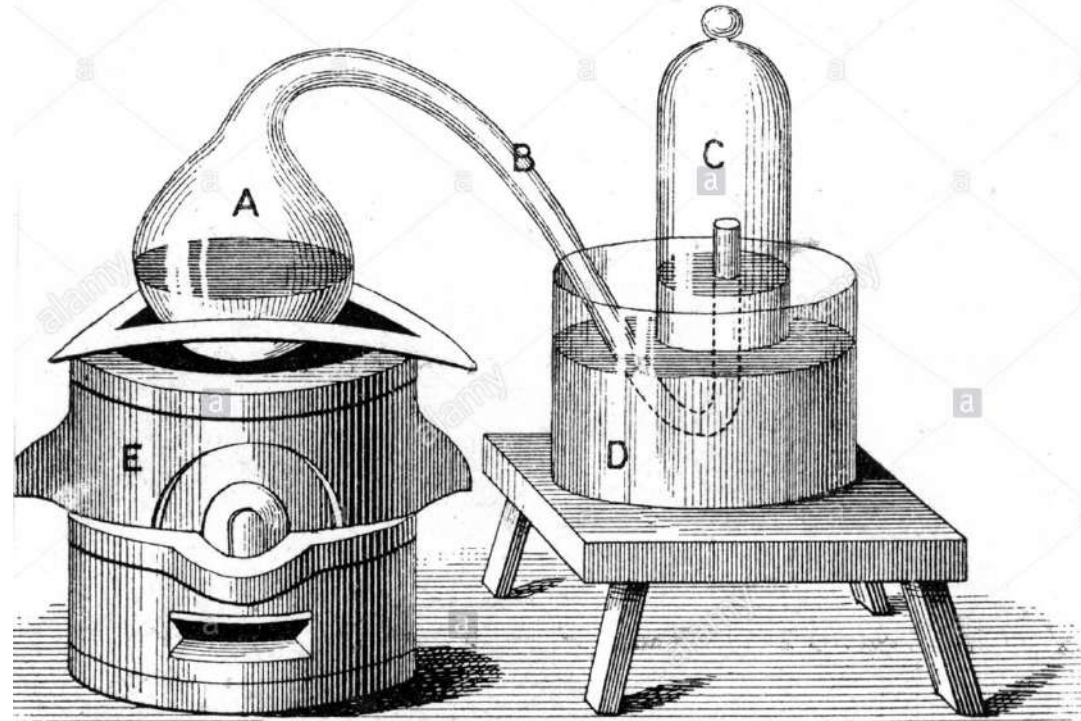
The ancient Greeks first proposed the idea that the total amount of matter in the universe is constant. Later, Antoine Lavoisier described this with The Law of Conservation of Mass as a fundamental principle of physics in 1789. He demonstrated it with the following experiment:

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/4a2PKuIH1So> min 0 – 3

Conservation of Atoms $6\text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

Oxygen

Glucose

2:57 / 12:17

CC YouTube



peanuts

grinding



peanut butter

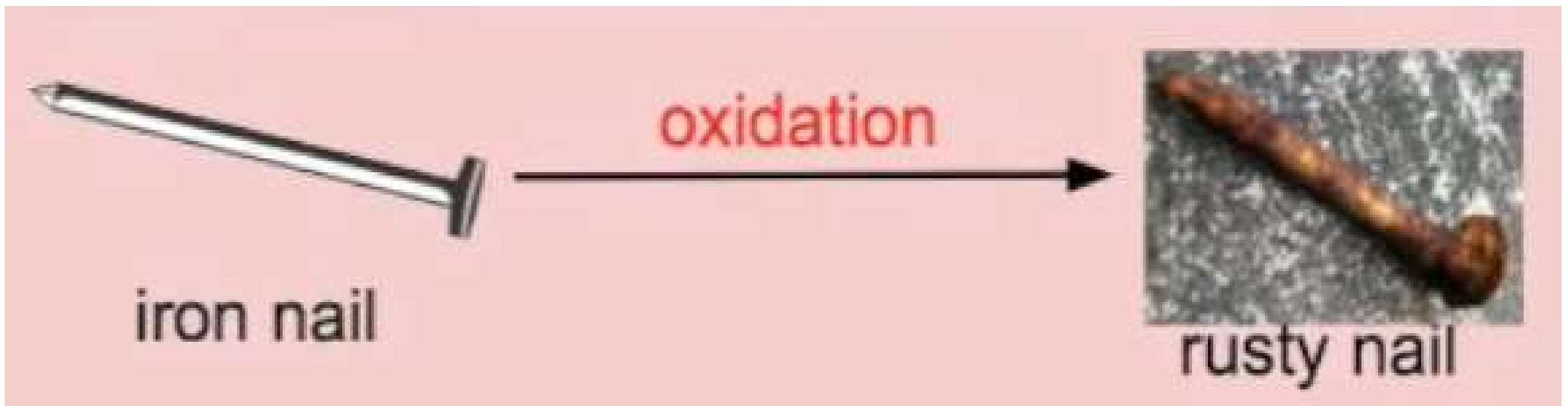
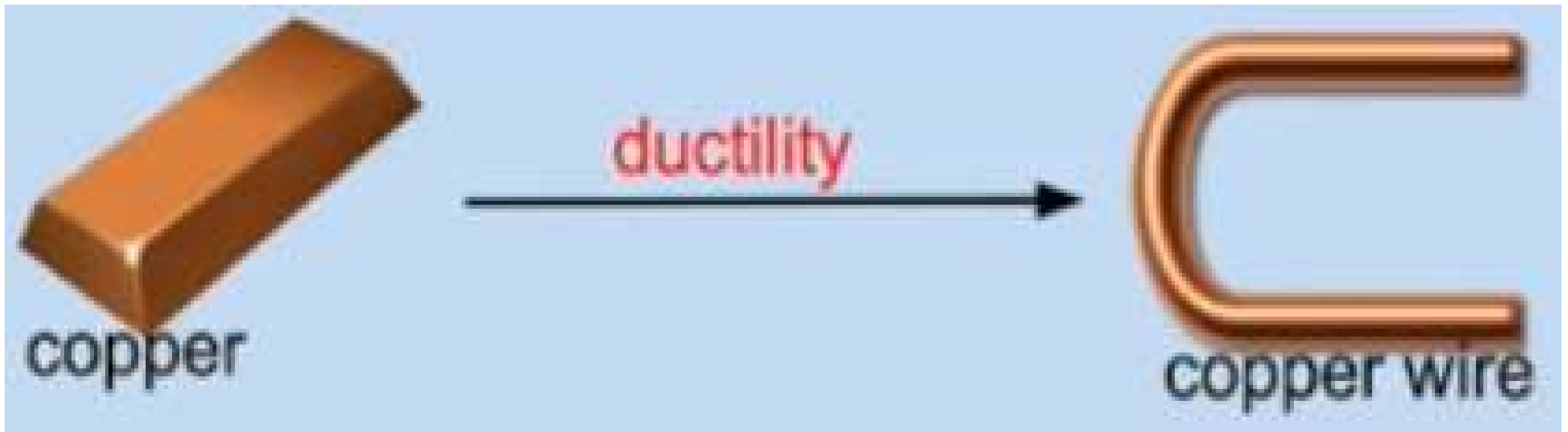


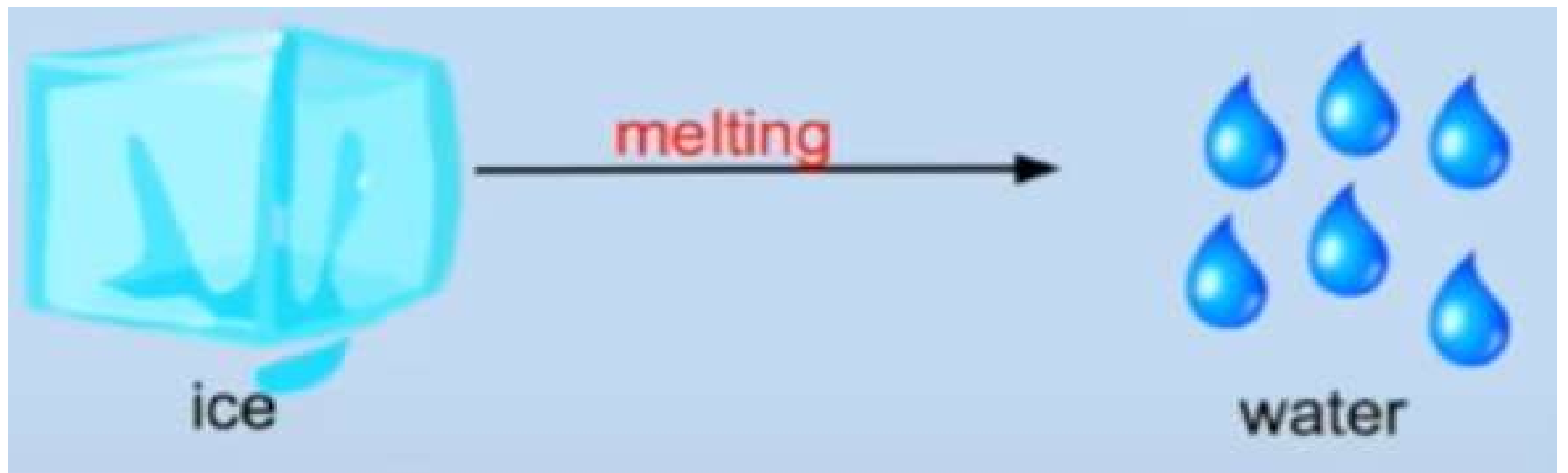
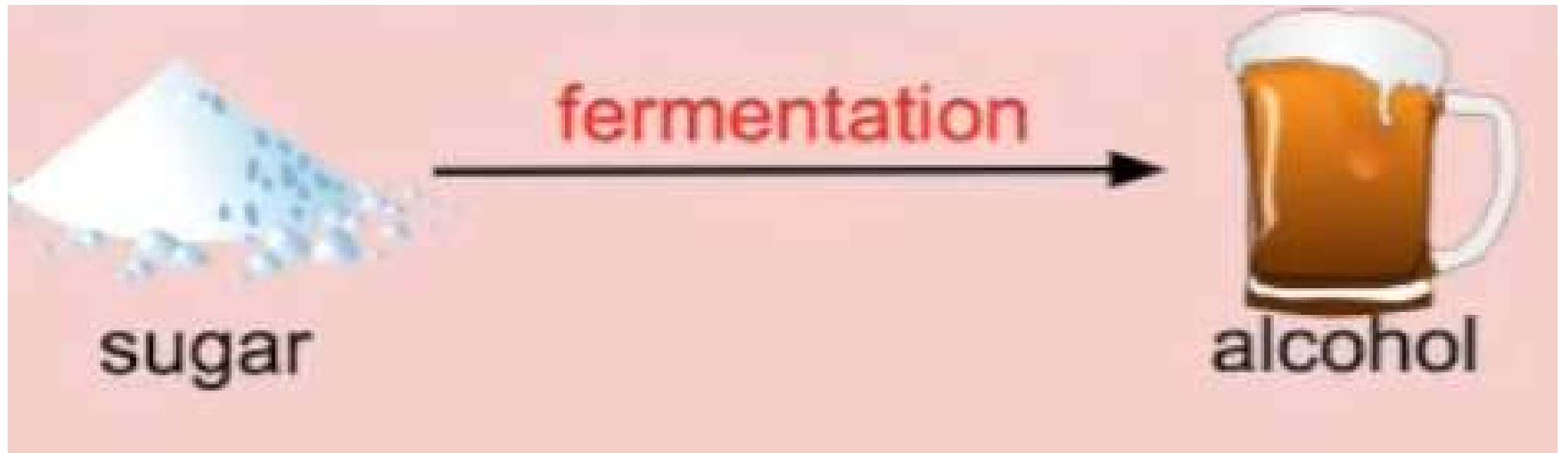
logs

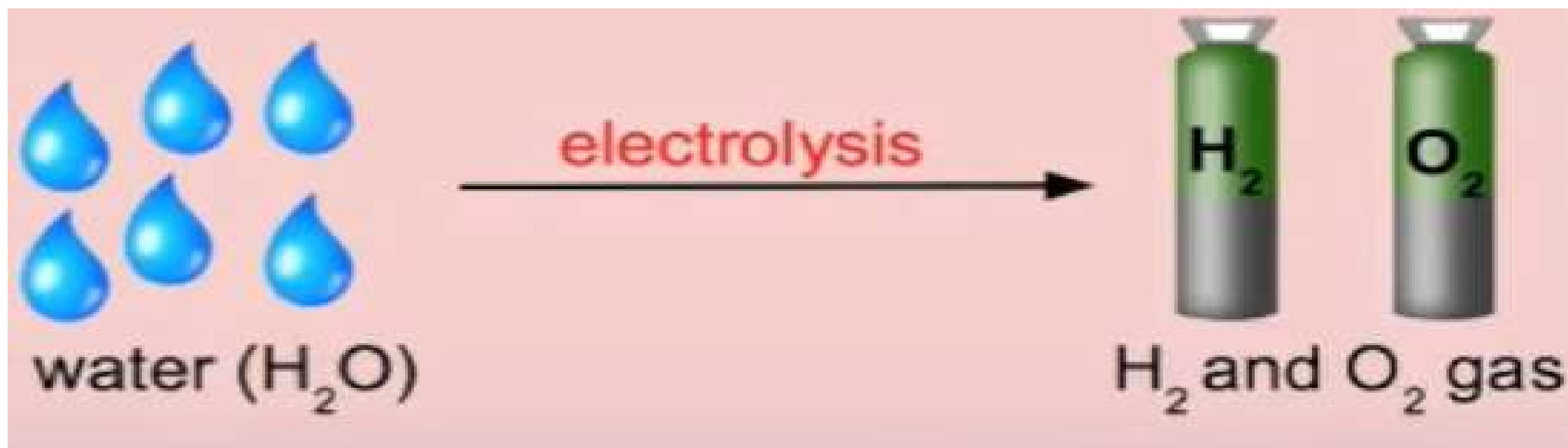
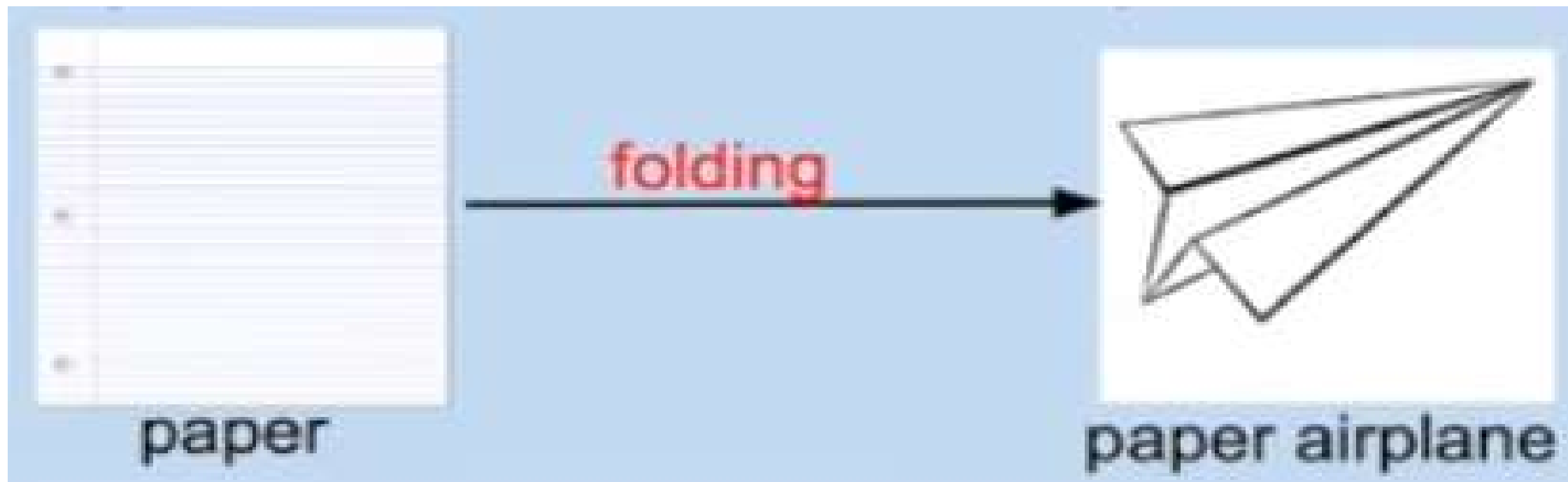
combustion



burning logs







VIDEO LINKS

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

- <https://youtu.be/X328AWaJXvl>

Physical Vs. Chemical Changes - Explained

- <https://youtu.be/4ZGULLWEy1c>

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-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/TOILLQSzzGI>

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

washing soda : Na_2CO_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: $\text{Cu} \dots \text{CuO}_2\text{H}$
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

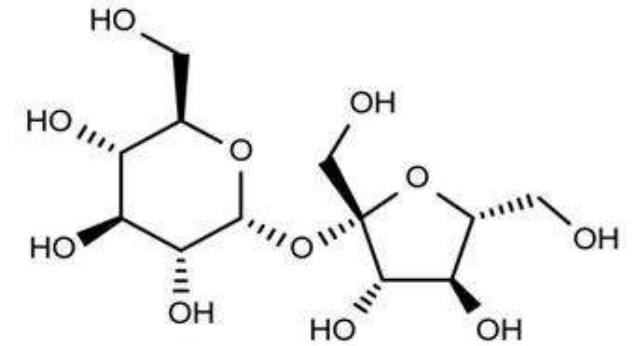
Sugar : $C_6H_{12}O_6$

solid – solid, granular crystalline, pale white

Water: H_2O - liquid, transparent, polar, wet

Form a solution – observe

SUCROSE



O- α -D-glucopyranosyl-(1 \rightarrow 2)- β -D-fructofuranoside

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

