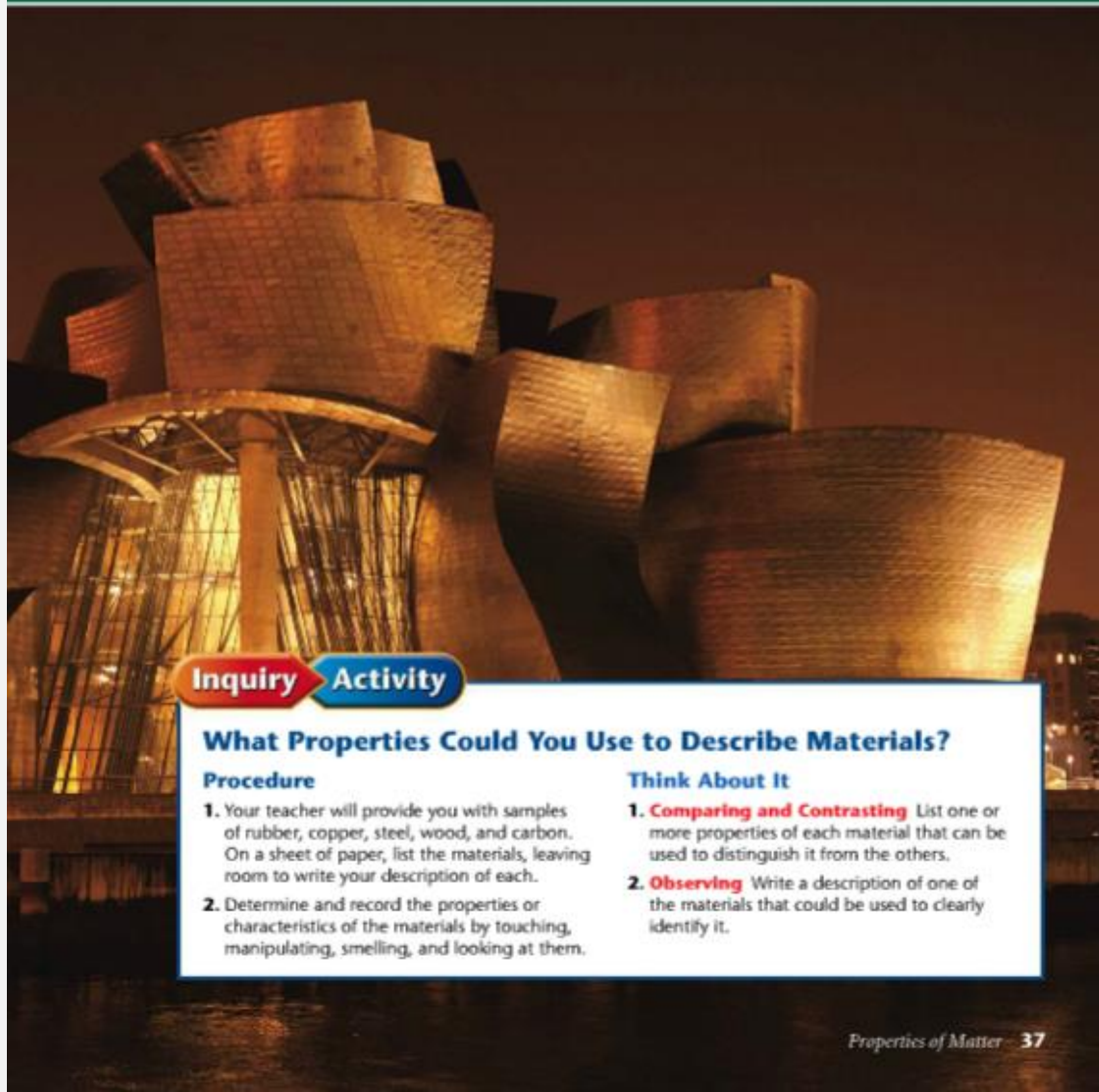


Chapter Preview

- 2.1 Classifying Matter
- 2.2 Physical Properties
- 2.3 Chemical Properties



Inquiry Activity

What Properties Could You Use to Describe Materials?

Procedure

1. Your teacher will provide you with samples of rubber, copper, steel, wood, and carbon. On a sheet of paper, list the materials, leaving room to write your description of each.
2. Determine and record the properties or characteristics of the materials by touching, manipulating, smelling, and looking at them.

Think About It

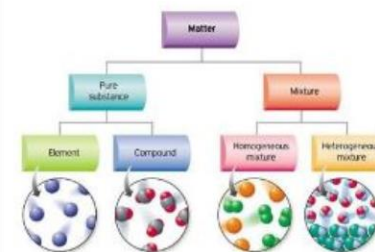
1. **Comparing and Contrasting** List one or more properties of each material that can be used to distinguish it from the others.
2. **Observing** Write a description of one of the materials that could be used to clearly identify it.

Properties of Matter

Chapter 2

Focus Questions

- Why are elements and compounds classified as pure substances?
- How do mixtures differ from pure substances.
- What is the main difference among solutions, suspensions, and colloids?
- What are examples of physical properties? Distinguish extensive and intensive properties.
- What processes are used to separate mixtures?



Find an item near you in the room.



- Describe that item with a phrase or sentence (*without saying what it is*) so that someone else could find it if in the room using your description.
- Write the description in the chat box.
- What was the basis of your description?



MATTER

Can it be physically separated?

yes

no

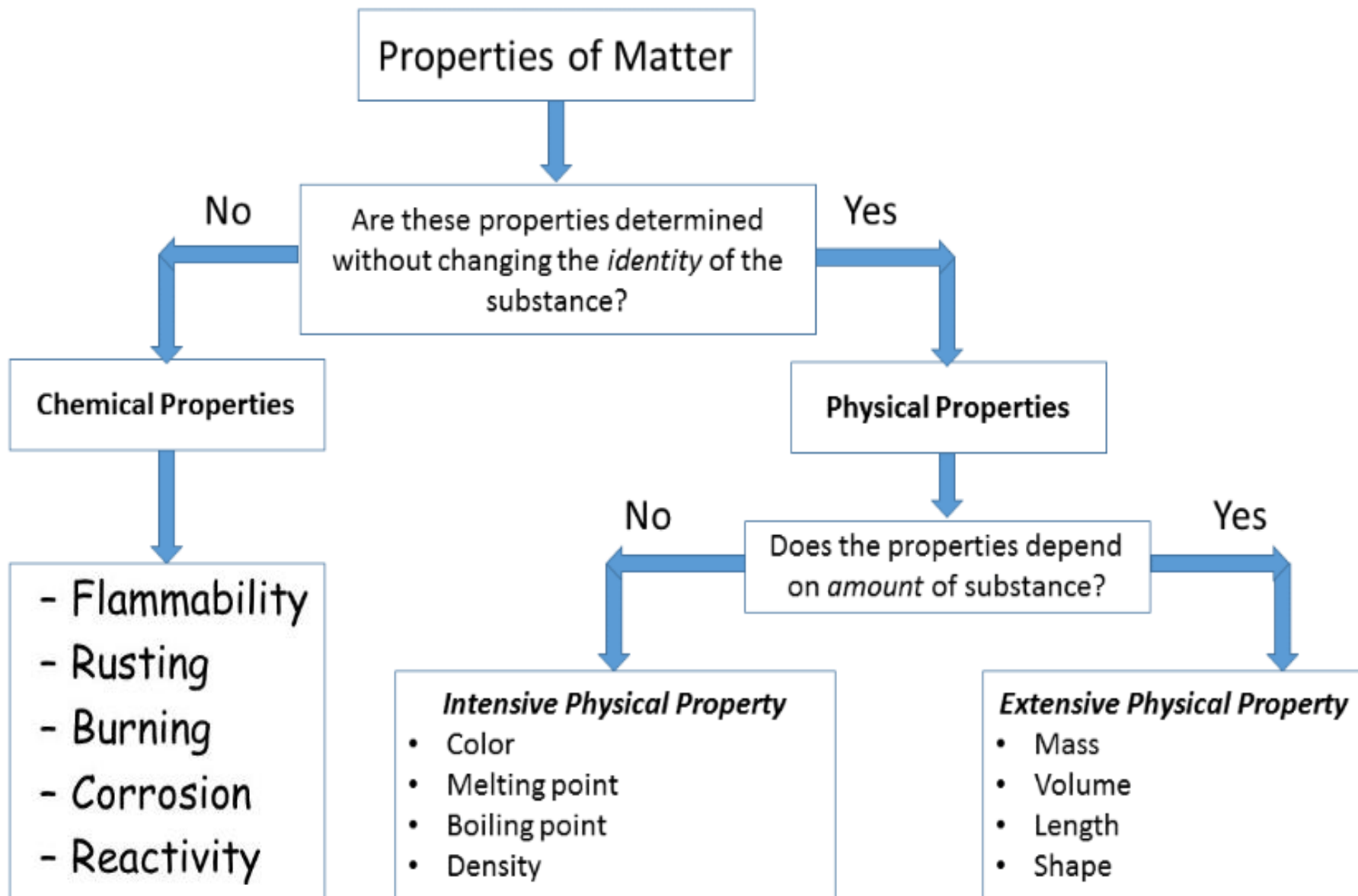
MIXTURE

PURE SUBSTANCE

Consider what the “item” or “object” you chose is composed of?

Does the question above apply?

All substances possess either physical or chemical properties.



Classifying Matter

We use physical and chemical properties to identify, distinguish, choose certain materials over another, and to separate items or objects.

Physical Properties can be “extensive”, “intensive” or general.

Watch the video (1:53 min.)

<https://screencast-o-matic.com/watch/cF660bY3h9>

Properties are used to describe matter & can be classified as **extensive** or **intensive**.

Extensive Properties

An extensive property depends on the **amount of matter** in a sample.

e.g. The **mass** of an object, a measure of the amount of **matter** the object contains, is an extensive property.



The mass of a basketball is greater than the mass of a golf ball.



Extensive Properties

The **volume** of an object, a measure of the **space** occupied by the object, is an extensive property.

The volume of a basketball is greater than the volume of a golf ball.

Weight is also an extensive property; (mass x gravity).

Length can be an extensive property when describing how much wire or rope one needs. **E.g. 2 m of rope**



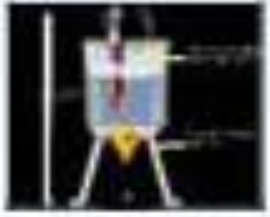
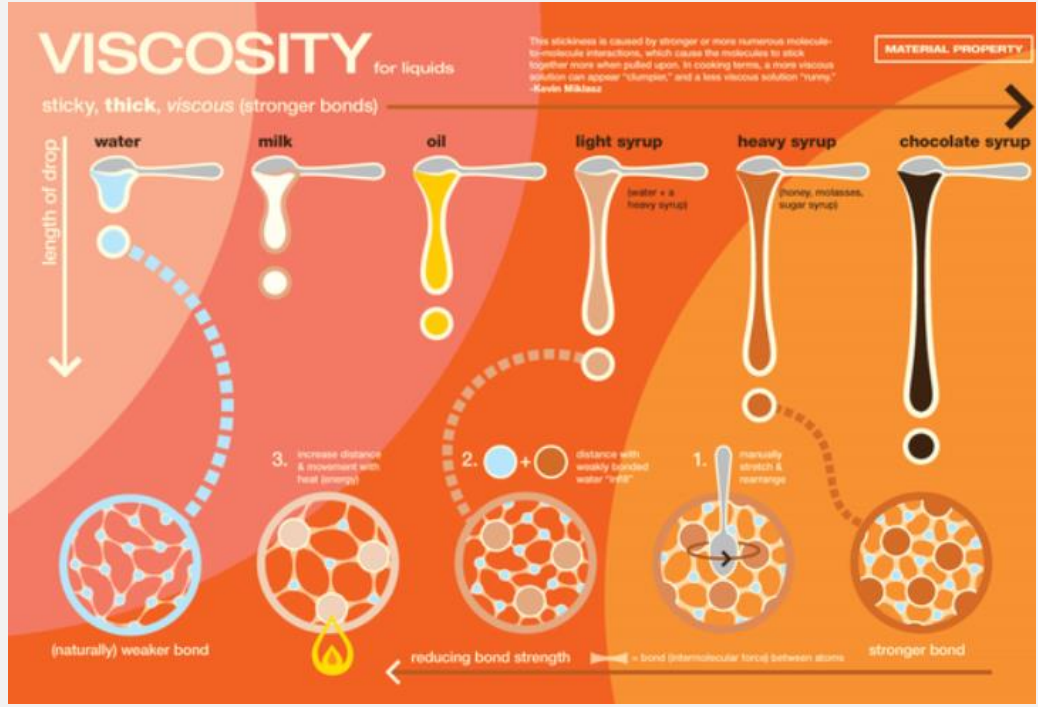
Intensive Properties - help **IDENTIFY** a substance; NOT based on the *amount* of matter.

Types of intensive properties :

Give some examples



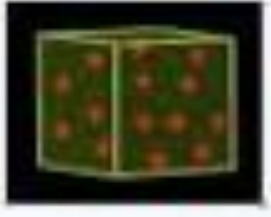
Intensive Properties - help IDENTIFY a substance; NOT based on the *amount* of matter.



Melting and Boiling point



Specific heat capacity



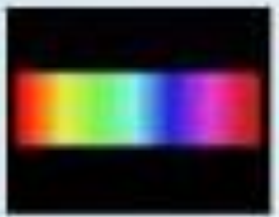
Density



Pressure

Some **Intensive Properties** – may be “general”, depending on what is being compared.

Types of intensive properties :



Colour



Odour



Luster

M
B



Malleability



Ductility



Conductivity

e.g. color

Color is intensive when dealing with a traffic signal. However, it is general when no other parameters are given.

“I see something blue” does not help us identify that substance unless all the other items are non-blue.



Distinguishing / identifying table salt, sugar, and hydrochloric acid

<https://screencast-o-matic.com/watch/cF6eq5YIsI> (1:13 min.)

<https://screencast-o-matic.com/watch/cF6eq8YIMI> (1:31 min.)



Define the types of physical properties (**extensive**, **intensive**, **general**) and then label the following:

boiling point

color

conductivity

density

ductility

hardness

length

malleability

mass

melting point

odor

solubility

state of matter

taste

volume

weight

Graphic Organizer

Extensive (amount)	Intensive (identification)	General (both, unknown)	Intensive and/or General
length	boiling point	ductility	color
mass	density	hardness	conductivity
volume	melting point	malleability	taste
weight	solubility	state of matter	



If you had to separate all matter into a few categories, what would they be?

List 2-4 categories in the chat box.

Consider coffee, aluminum cans, a mud puddle, cars, a diamond, water, oxygen, etc.

MATTER

Can it be physically separated?

yes

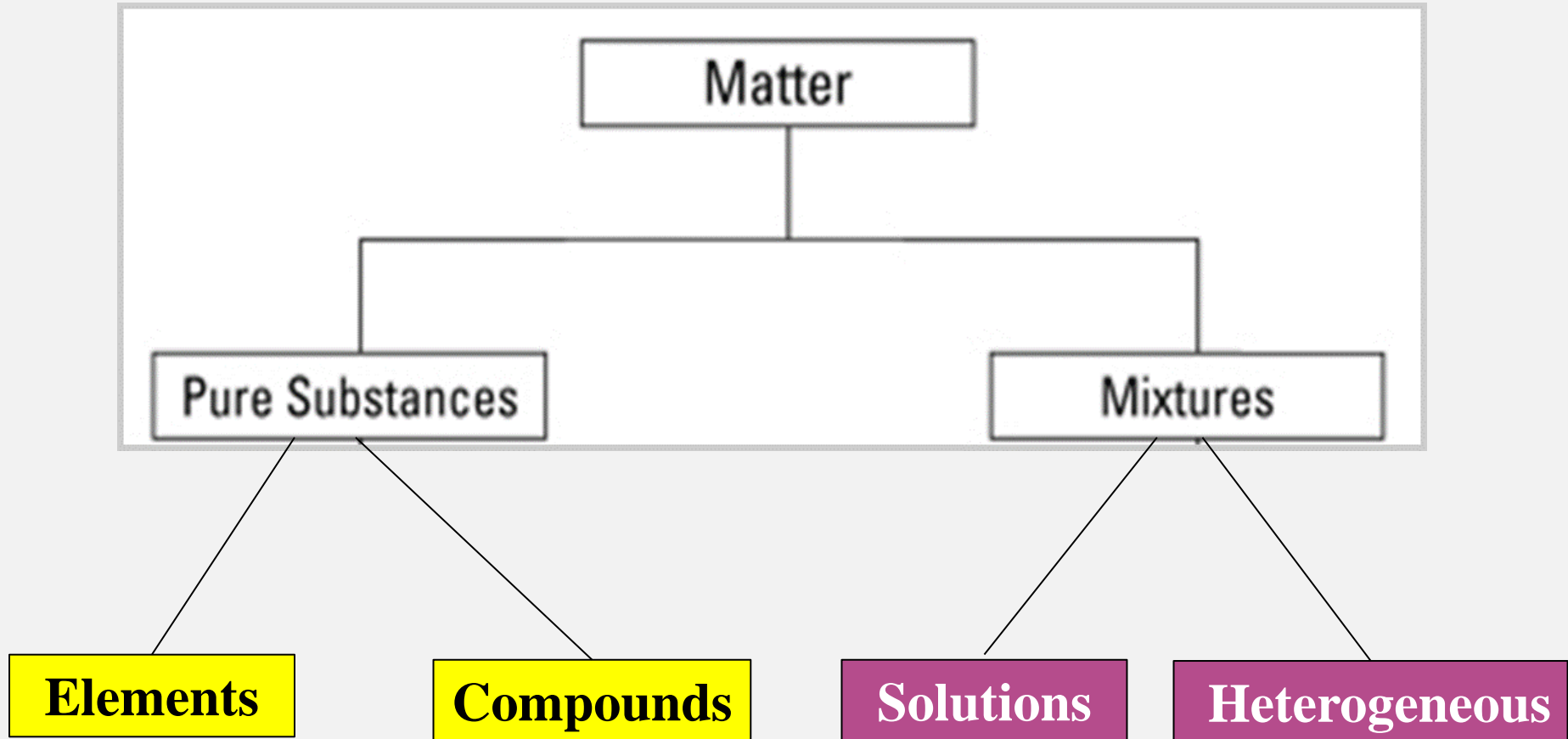
no

MIXTURE

PURE SUBSTANCE

All matter consists of **pure** substances and **mixtures**.

Classifying Matter



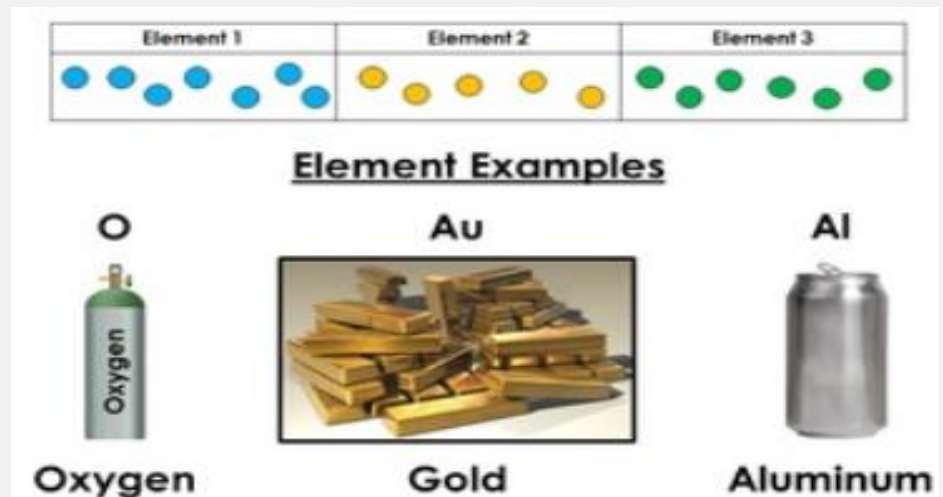
<https://screencast-o-matic.com/watch/cF6XFbY0Im> (1:52)

Elements

Homogeneous (“same kind”) matter that cannot be broken down by ordinary chemical means.

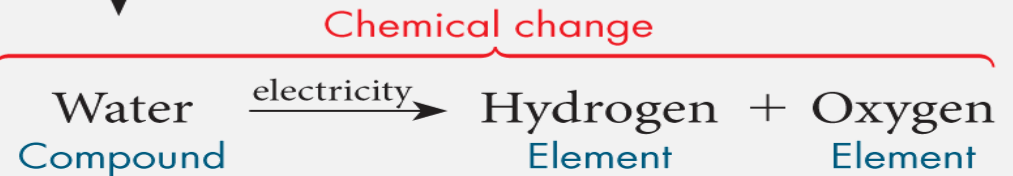
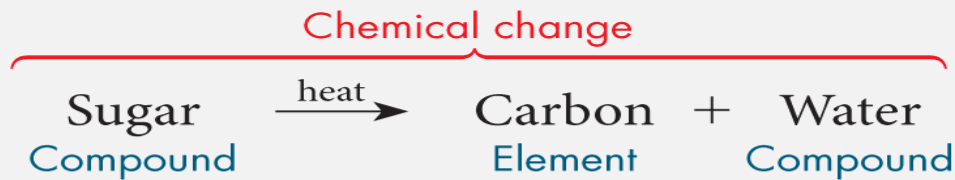


An element has a fixed composition because it contains only **one type of atom**.

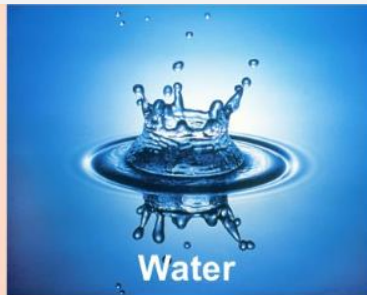


Compounds

Homogeneous matter made up of two or more elements and/or compounds that are **chemically combined** in a **fixed proportion**.



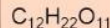
Sodium hypochlorite - Bleach
 NaClO



Water



sugar





Which are **elements** versus **compounds**?

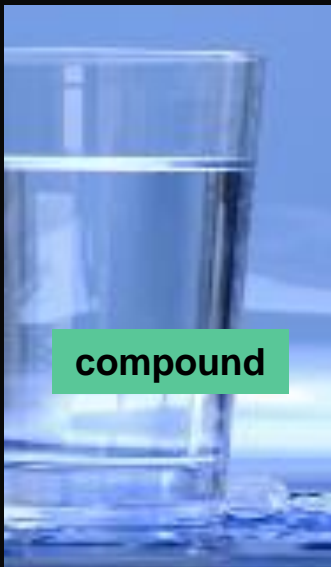
silver, copper, baking soda, gold, water, salt





Which are **elements** versus **compounds**?

silver, copper, baking soda, gold, water, salt

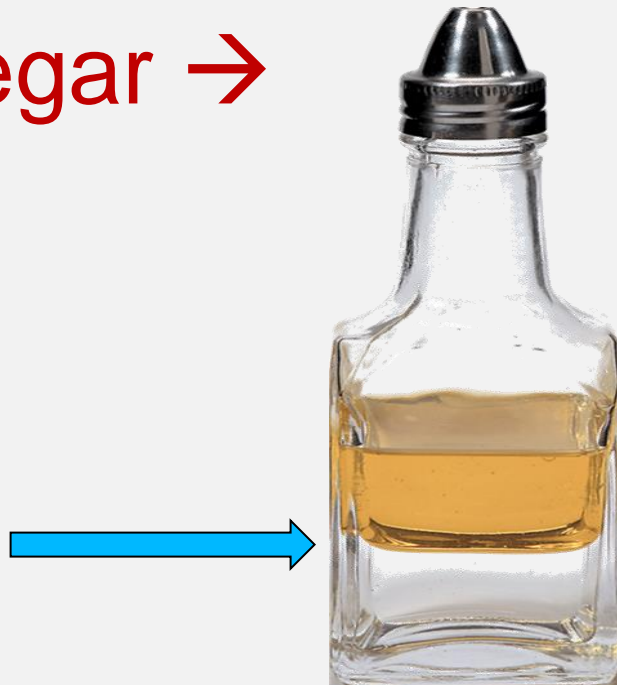


Mixtures

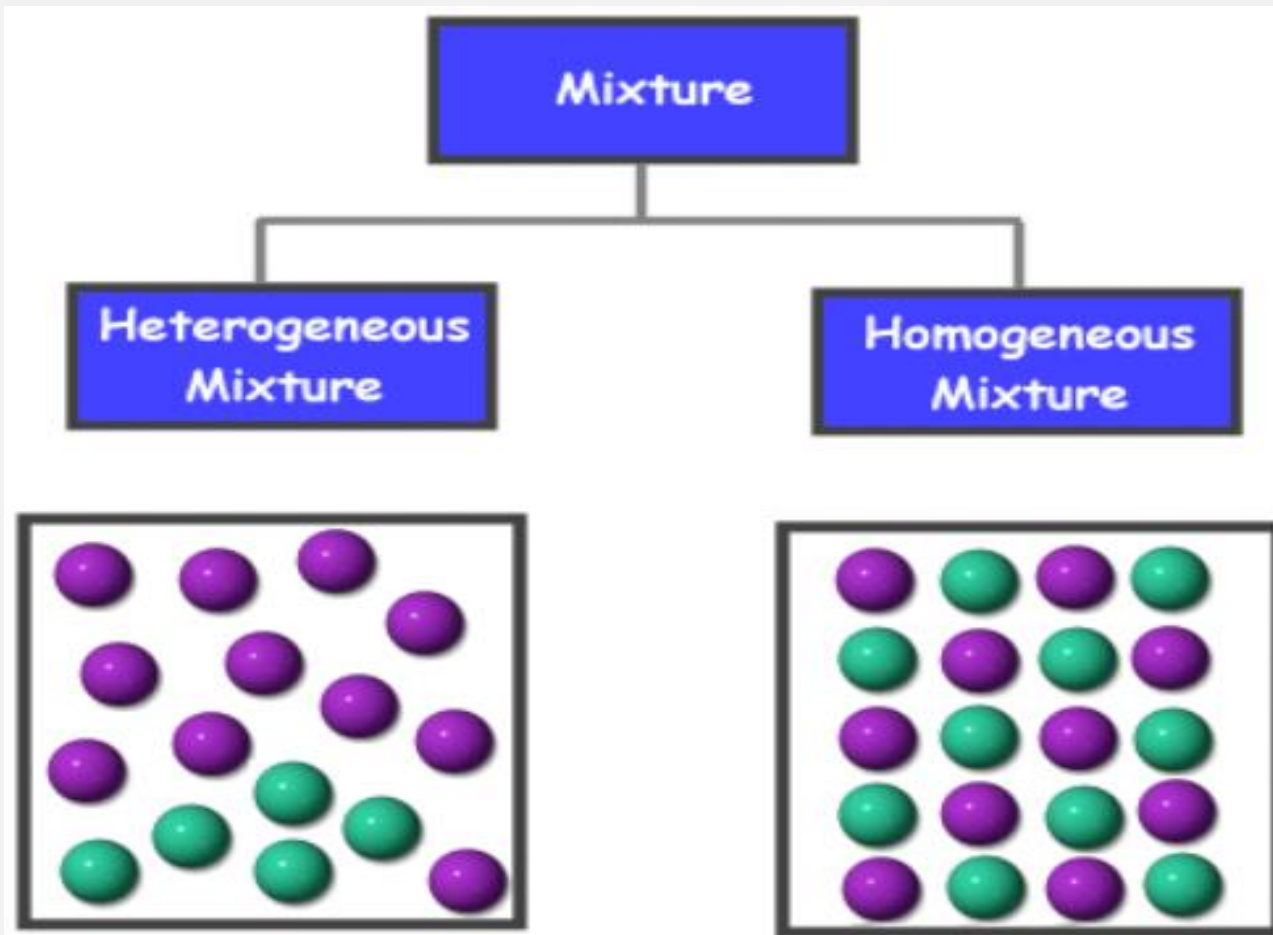
Mixtures do NOT have uniform composition or properties.

Each substance (*atom/element/compound*) in a mixture retains its own properties.

E.g. oil & vinegar →



Clear boundary between the oil and water



Mixtures can be classified by how well the parts of the mixture are distributed throughout the mixture (even or uneven).

Homogeneous Mixtures

The substances are so evenly distributed that it is difficult to distinguish one substance in the mixture from another.

Called **Solutions**

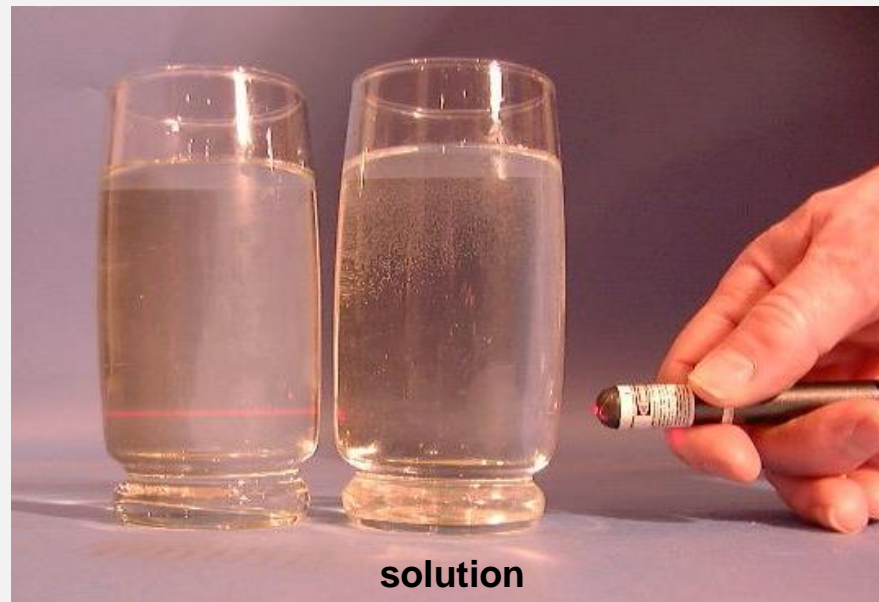
E.g. **air**, apple juice, tea, alloys (steel, brass),
soda pop, Gatorade.

Solutions can be any state of matter (s, l, or g).



Solutions

- Substances dissolve and form a **homo**geneous mixture.
- Particles are too small to settle out.
- Do Not separate into layers over time.
- Cannot be filtered out.
- Tyndall Effect → light passes through a transparent solution undetected.



Heterogeneous Mixtures

“Different Kind”

The parts of a heterogeneous mixture are noticeably different from one another.

E.g. smoke, trail mix, protoplasm, concrete, salsa, Italian salad dressing.



Heterogeneous Mixtures

“Different Kind”

<http://somup.com/cqjhoneybqd>

Dancing Raisins (1:06)

Identify components of the mixture.



Heterogeneous Mixtures

SUSPENSIONS


- Particles large enough to settle out (form layers).
- Capable of being filtered out.
- **SHAKING** is needed.

- Paint
- Orange juice
- Mud
- Mayonnaise
- Ketchup



COLLOIDS

Heterogeneous Mixtures



A special class of suspensions
which tend NOT to settle out quickly.

(smaller “suspension” particles)

COLLOIDS

Heterogeneous Mixtures

- Particles that are intermediate in size between the small particles in a solution and the larger particles in a suspension.
- Colloids do not separate into layers quickly.
- Demonstrate the **Tyndall Effect** (*light is detected when passing through a transparent colloid*).

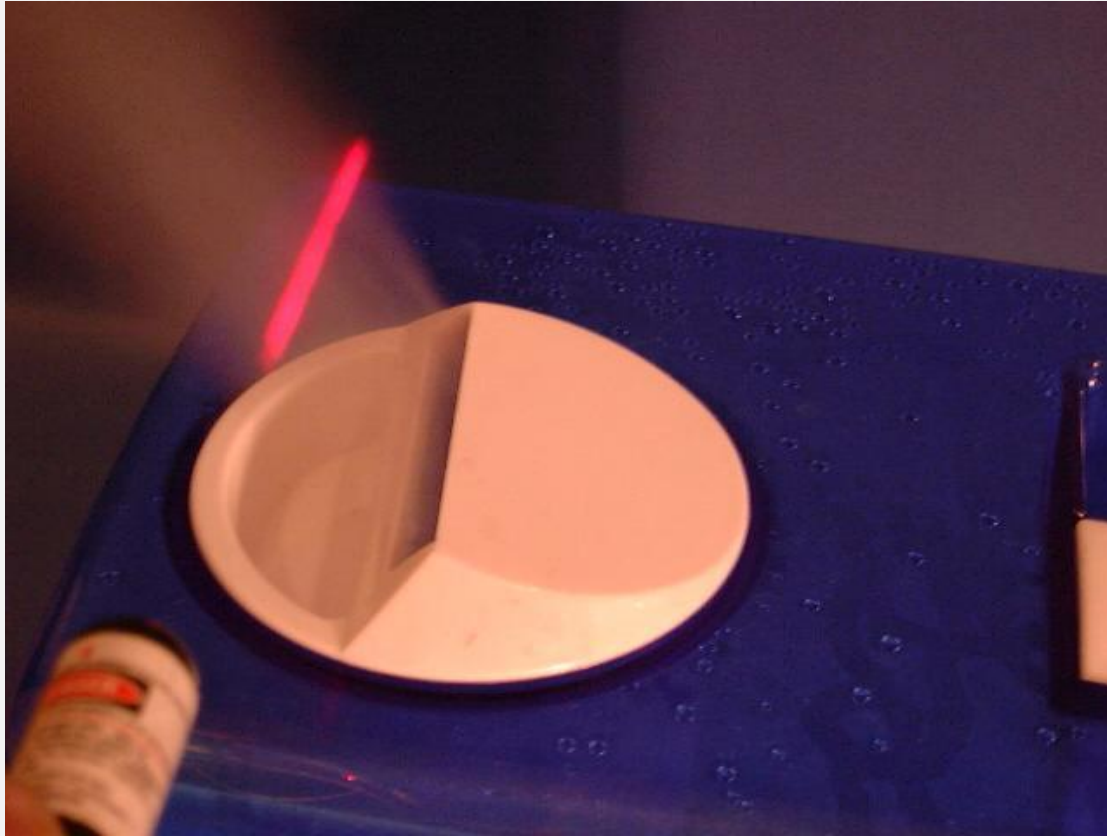
Examples

colored glass, gems, gels, jello, pearl, smoke, milk, fog, clouds, mist, root beer, beer, lava, meringue.

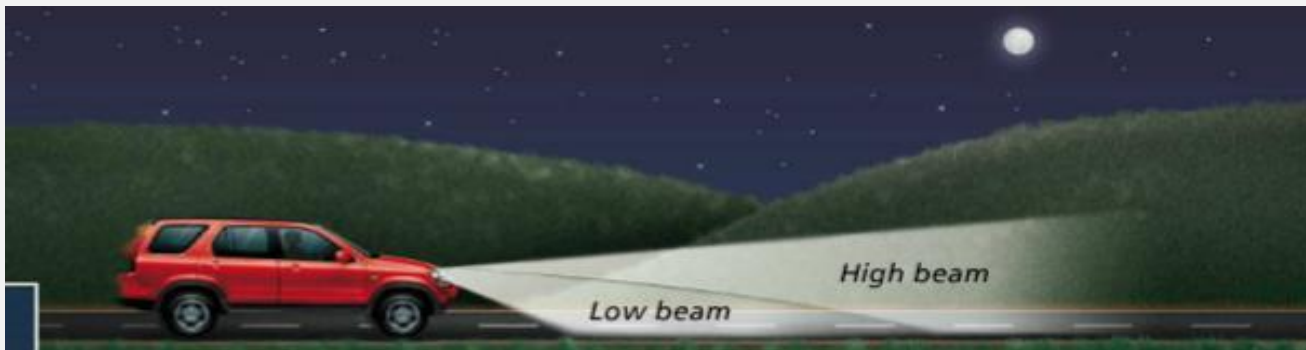


COLLOIDS

Heterogeneous Mixtures



Tyndall Effect (*light is detected when passing through a transparent colloid*).



Colloid Versus Solution

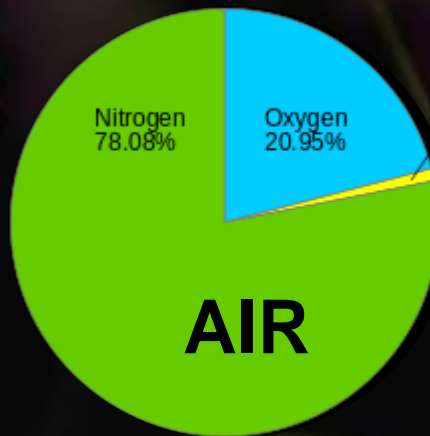
(Tyndall Effect)



True solutions do NOT exhibit the Tyndall Effect.



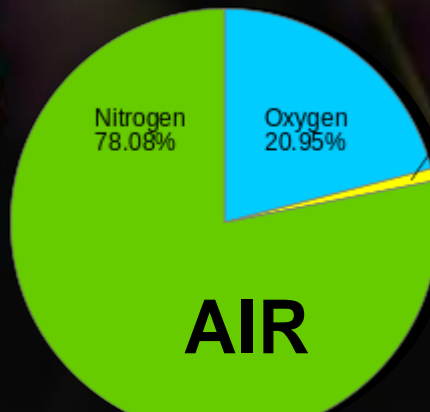
Distinguish between **Homogeneous** & **Heterogeneous Mixtures**:





Distinguish between **Homogeneous** & **Heterogeneous Mixtures**:

Heterogeneous



Matter

Pure Substances

Composed of only one compound or element

Examples:



table
salt



sulfur



sugar



iron

Mixtures

Composed of at least two different compounds and/or elements

Examples:



cereal
and



Coke®



salt
water



Italian
dressing

Name and define classes of Matter.

TRY IT

Matter

Pure Substances

Composed of only one compound or element

Examples:



table salt



sulfur



sugar



iron

Mixtures

Composed of at least two different compounds and/or elements

Examples:



cereal and



Coke®



salt water



Italian dressing

Elements

Composed of only one type of atom

Examples:

Compounds

Composed of only one type of molecule

Examples:

Homogeneous

Mixtures that have the same composition throughout

Heterogeneous

Mixtures with a varied composition throughout

Place the 8 items in the proper category



Matter

Pure Substances

Composed of only one compound or element

Examples:



table salt



sulfur



sugar



iron

Mixtures

Composed of at least two different compounds and/or elements

Examples:



cereal and



Coke®



salt water



Italian dressing

Elements

Composed of only one type of atom

Examples:



sulfur



iron

Compounds

Composed of only one type of molecule

Examples:



table salt



sugar

Homogeneous

Mixtures that have the same composition throughout

Examples:



Coke®



salt water

Heterogeneous

Mixtures with a varied composition throughout

Examples:



cereal and milk



Italian dressing

TRY IT

Most of the things around us are mixtures.

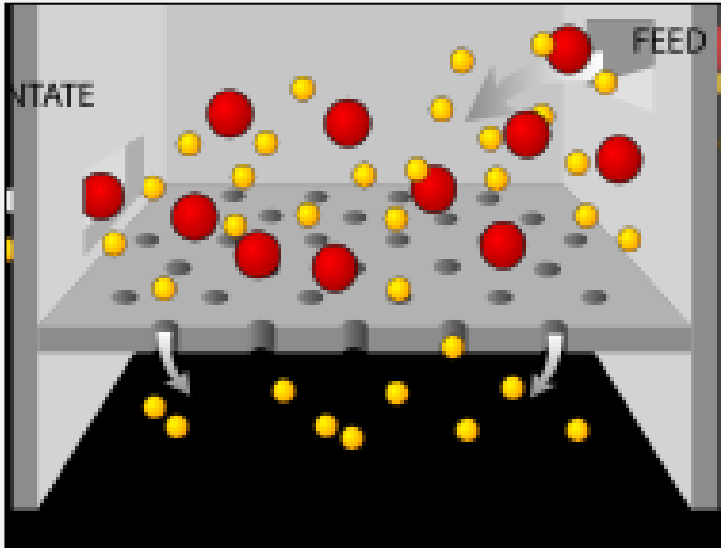
- To understand, analyze, and evaluate substances for the myriads of reasons (medicine, cleanliness, organization, functionality, etc.), we need to separate mixtures into their pure components.
- **Pick a mixture that comes to mind and give TWO reasons why you would want to separate it.** [e.g. organize room or refrigerator]

Differences in physical properties are used to separate components of mixtures.

Separating Mixtures (Heterogeneous)

Filtration separates a mixture based on **particle size**.

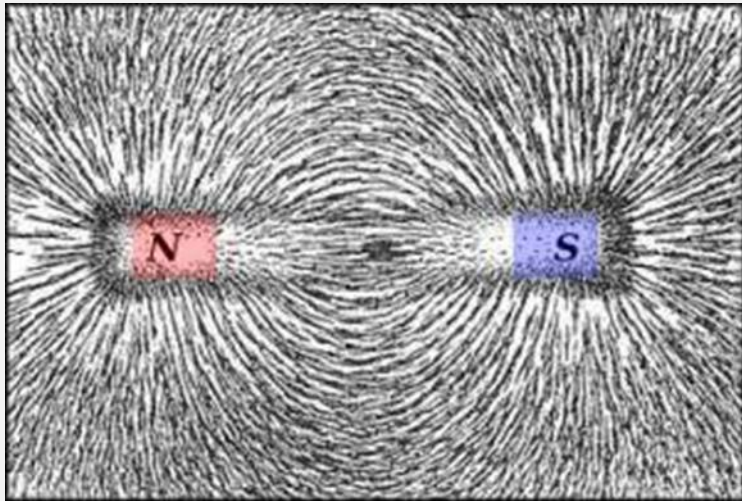
Solutions cannot be filtered out.



Separating Mixtures (Heterogeneous)

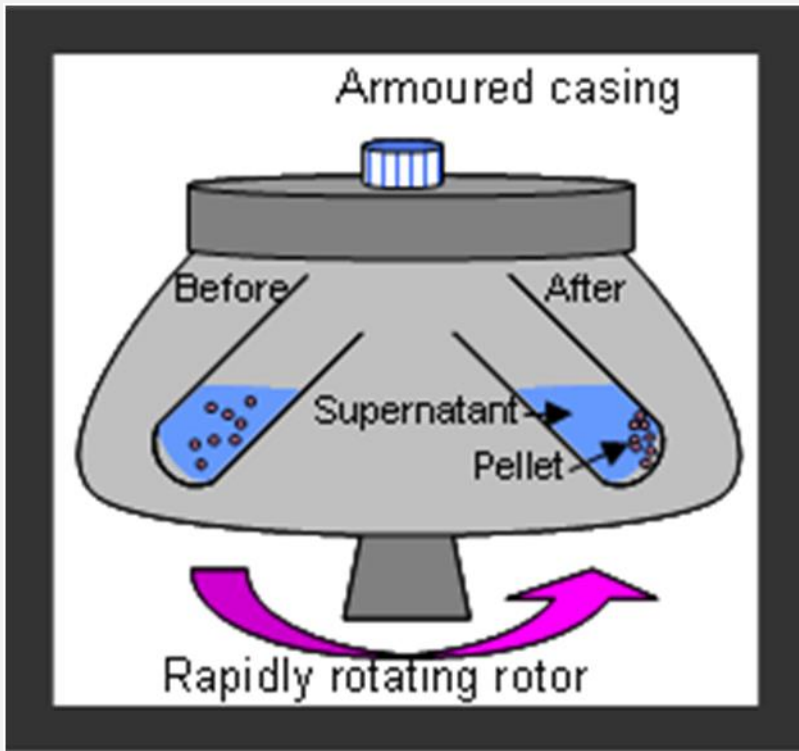
Magnetism: separates mixtures based on the presence of magnetic physical properties.

The strongest magnets are alloys of iron and boron (neodymium) & samarium-cobalt.



Separating Mixtures (Heterogeneous)

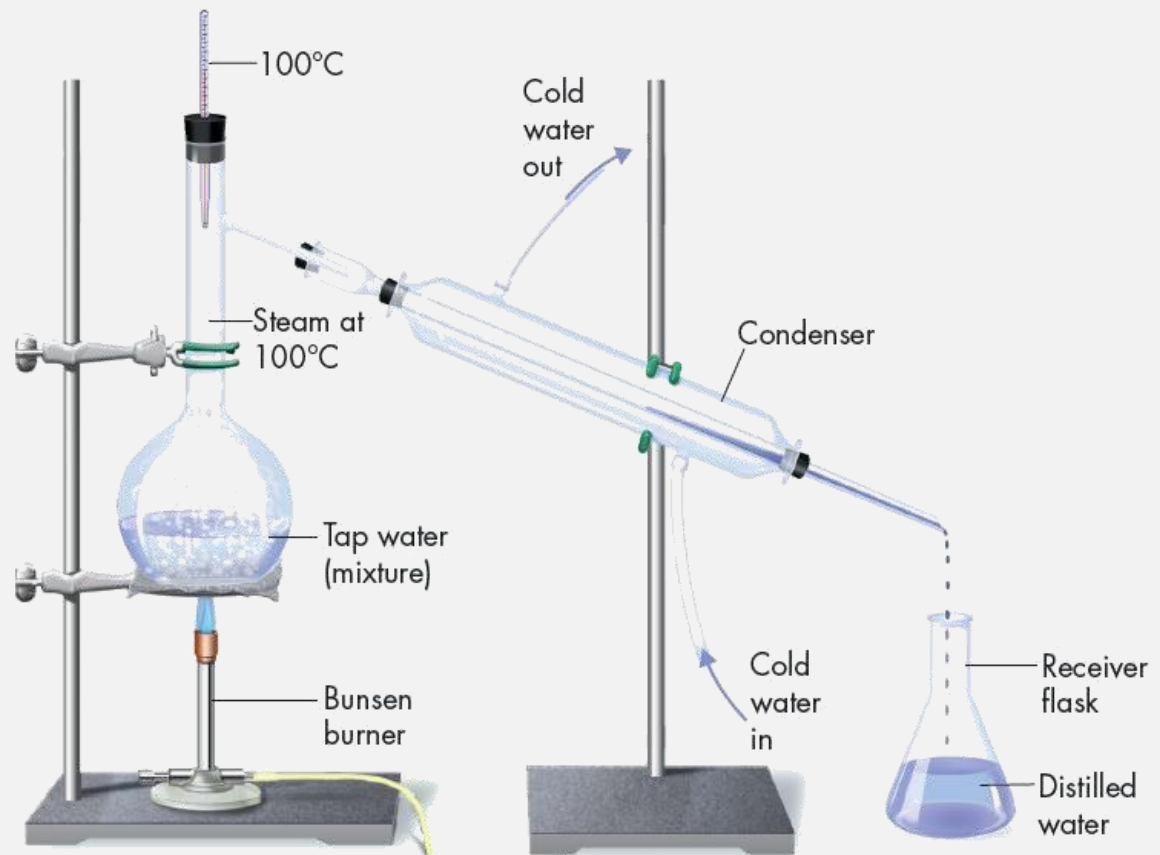
Centrifugation separates elements of a heterogeneous mixture based on different **densities**. *E.g. hematocrit (Red blood cell separation) & protein analysis*



Separating Mixtures (Homogeneous)

Distillation Video Demonstration (2:32)

<https://screencast-o-matic.com/watch/cFfnDFDGtZ>



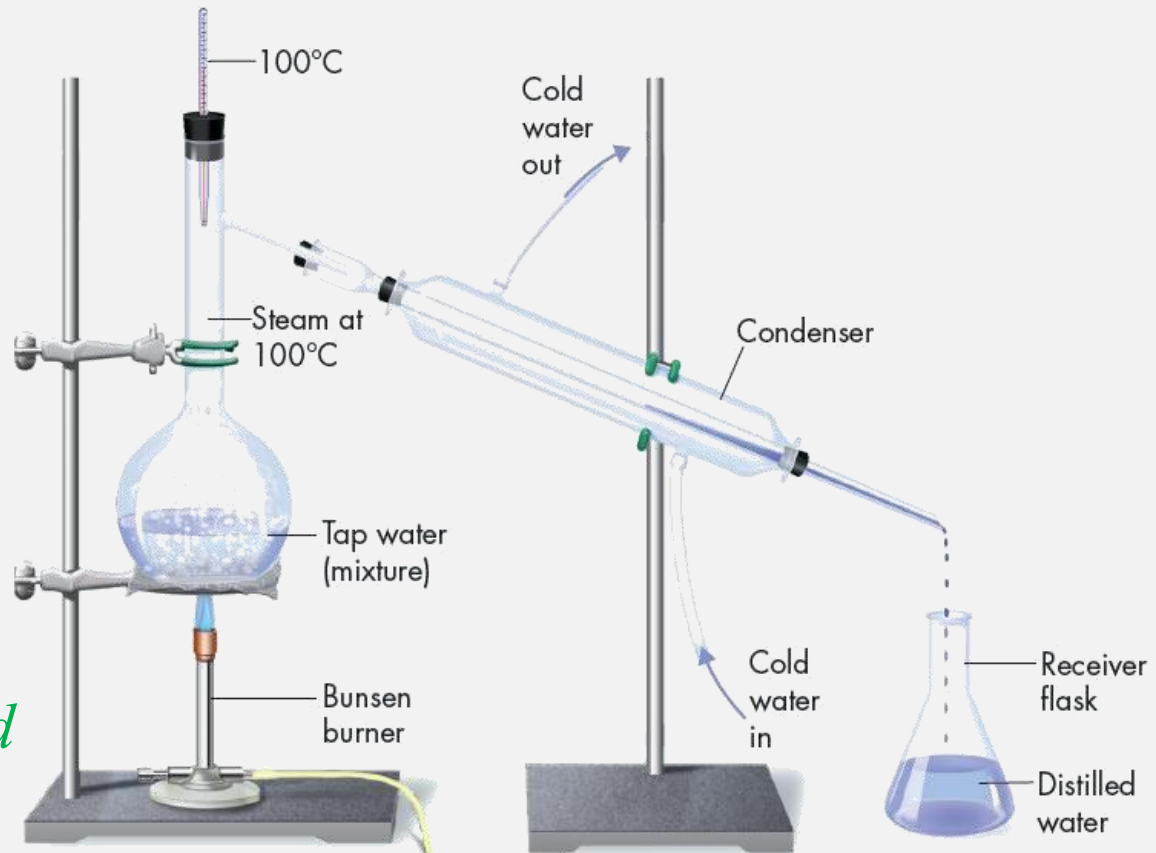
Separating Mixtures (**Homogeneous**)

Distillation, separates **solutions** based on varying **boiling points** (*intensive physical property*).

A mixture is boiled to produce vaporization & then condensed to liquid again.

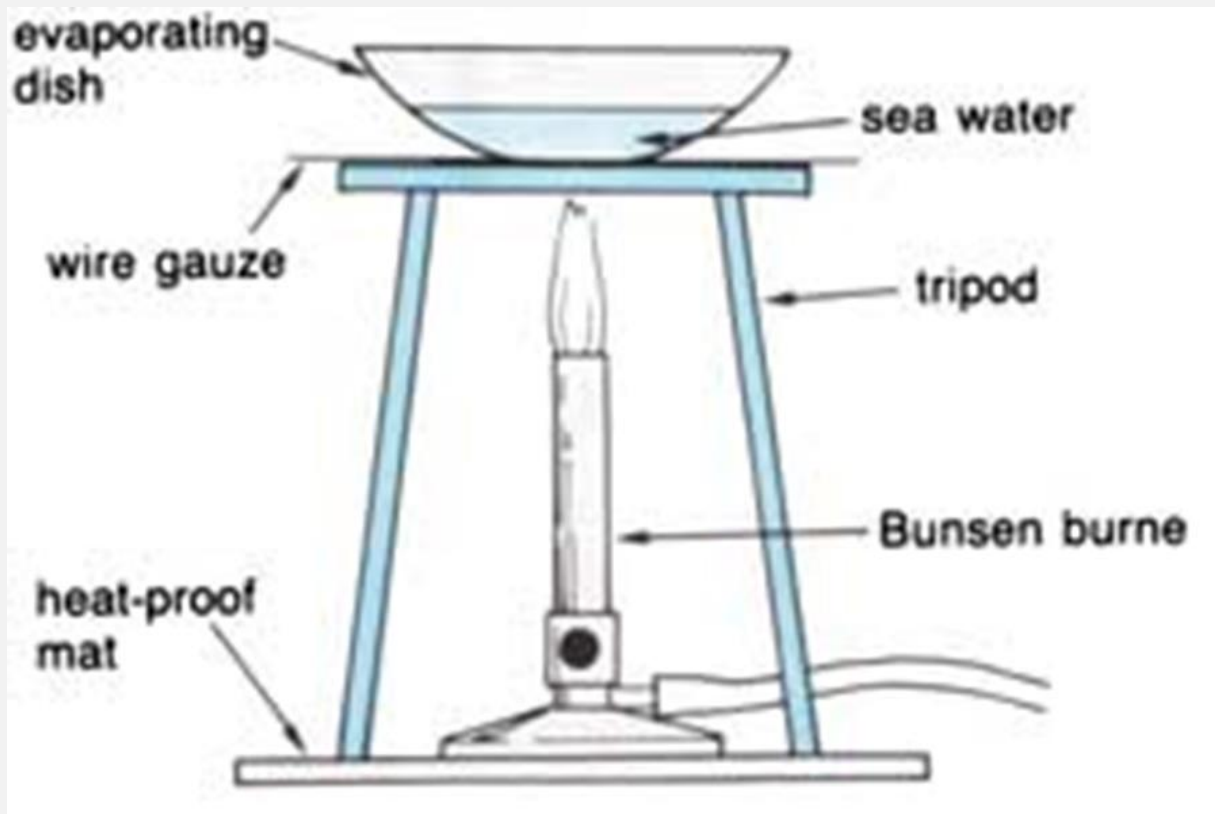
e.g. *alcohol boils ~80 °C while water boils ~100 °C ... so alcohol decants first.*

e.g. *“purified” or distilled water (bottled)*



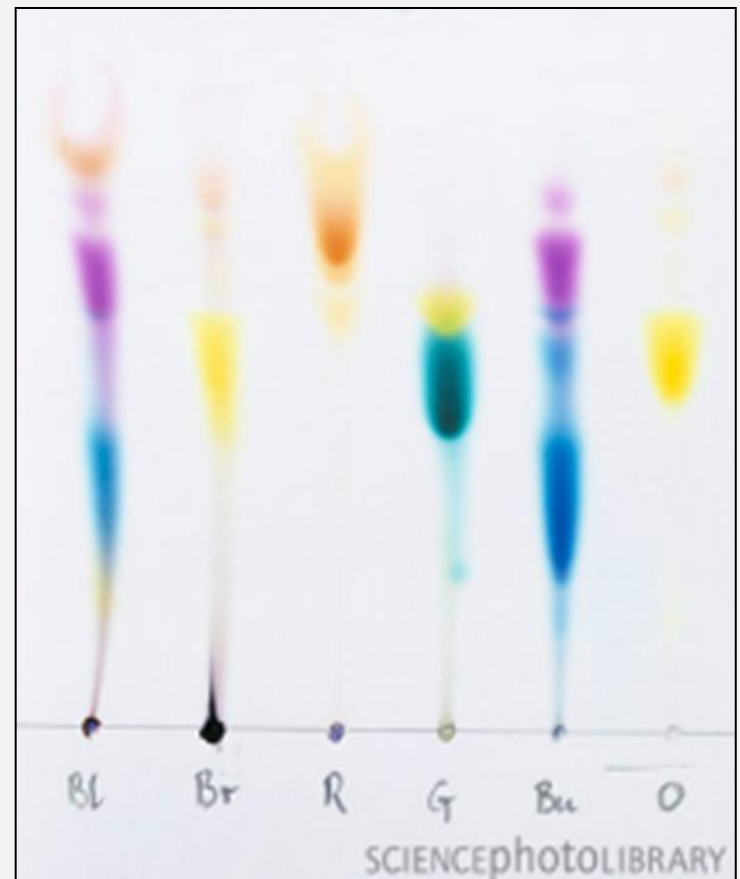
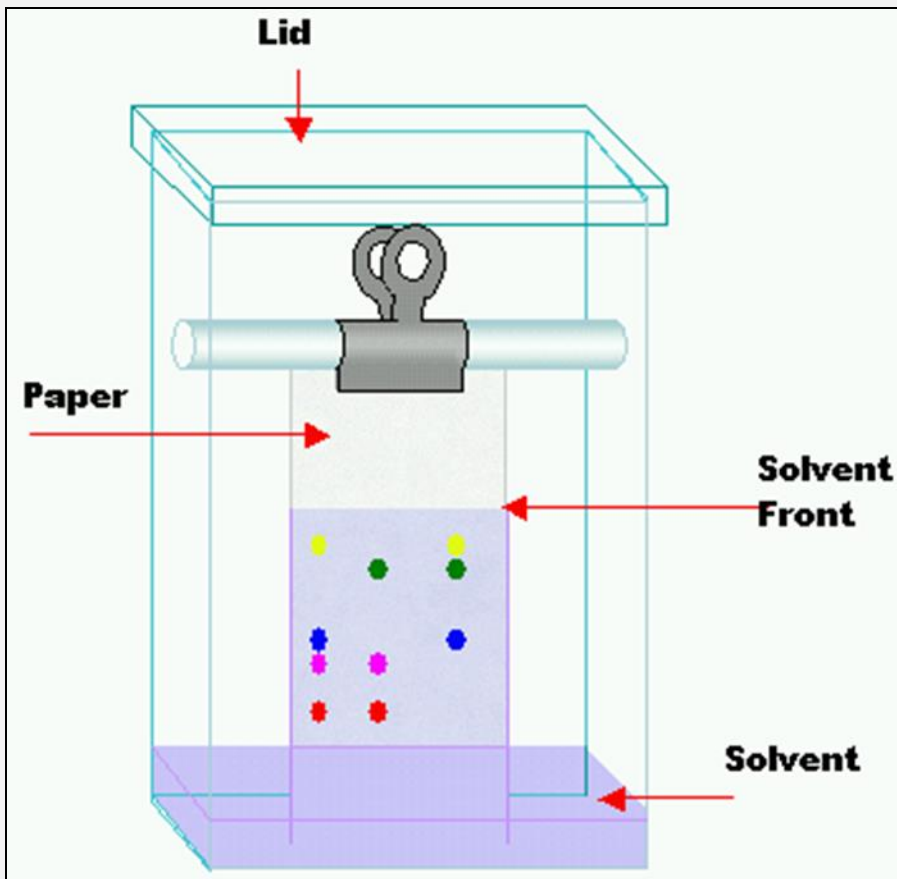
Separating Mixtures (**Homogeneous**)

Crystallization purifies dissolved **solids** from the liquid they are dissolved in using evaporation.



Separating Mixtures (Homogeneous)

Chromatography separates components of a mixture based on their differential migration due to **density**. *60% of chemical analysis worldwide is currently done with chromatography.*



Separating Mixtures is based on **Physical Change**

- Any change that occurs without altering the chemical composition of a substance
- **NO new substance** is formed and the physical & chemical properties of the constituents remains.

e.g. *The element gallium can melt in a person's hand (the melting point of gallium metal is 30°C)*



Solutions, Suspensions, and Colloids

These liquids represent three categories of mixtures.

- Windshield wiper fluid is a **solution**.
- Muddy water collected from a swamp is a **suspension**.
- Milk is a **colloid**.



Which of these substances is a compound?

Review

- a. copper
- b. water
- c. oxygen
- d. carbon

Which of the following statements does NOT apply to a compound?

- a. It is made of two or more elements.
- b. It has components that are joined in fixed proportions.
- c. It can be separated into components by physical methods.
- d. It can be broken down into elements or other compounds by chemical means.

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- c. It can be separated into components by physical methods.**
- d. It can be broken down into elements or other compounds by chemical means.

Which of these materials is a heterogeneous mixture?

- a. air
- b. seawater
- c. sand
- d. steel

Which of the following can be easily separated with a filter and also settles out quickly?

- a. colloids
- b. compounds
- c. solutions
- d. suspensions

Which of these materials is a heterogeneous mixture?

- a. air
- b. seawater**
- c. sand**
- d. steel

Which of the following can be easily separated with a filter and also settles out quickly?

- a. colloids
- b. compounds
- c. solutions
- d. suspensions**

Which of the following is NOT a physical property?

- a. density
- b. boiling point
- c. flammability
- d. conductivity

Which of these statements best describes a physical change in a pure substance?

- a. The substance changes into one or more new substances.
- b. Some of the properties of the substance change, but the material remains the same.
- c. The properties of the material do not change, and the material remains the same.
- d. The substance is separated into two or more simpler substances.

Which of the following is NOT a physical property?

- a. density
- b. boiling point
- c. flammability**
- d. conductivity

Which of these statements best describes a **physical** change in a **pure** substance?

- a. The substance changes into one or more new substances. (chemical)
- b. Some of the properties of the substance change, but the material remains the same.**
- c. The properties of the material do not change, and the material remains the same. (no change takes place at all)
- d. The substance is separated into two or more simpler substances. (chemical change or physical change of a mixture)

State whether the following relates mainly to homogeneous or heterogeneous mixtures:

1. filtration
2. distillation
3. Tyndall effect
4. crystallization
5. air
6. milk
7. centrifugation
8. chromatography

State whether the following relates mainly to homogeneous or heterogeneous mixtures:

1. filtration (heterogeneous / suspension)
2. distillation (homogeneous / solutions)
3. Tyndall effect (heterogeneous / colloid)
4. crystallization (homogeneous / solutions)
5. air (homogeneous / solutions)
6. milk (heterogeneous / colloid)
7. centrifugation (heterogeneous / suspension)
8. chromatography (homogeneous / solutions)

Physical changes that occur in matter

blending



Rubbing/scraping



Phase changes



dissolving



cutting



Chemical changes

- alter the *chemical composition* of a substance
- **produce NEW substances** with physical & chemical properties **DIFFERENT** from the constituents.
e.g. Sodium (Na) explodes in air, Chlorine gas (Cl_2) is lethal
But table salt ($NaCl$) tastes great!

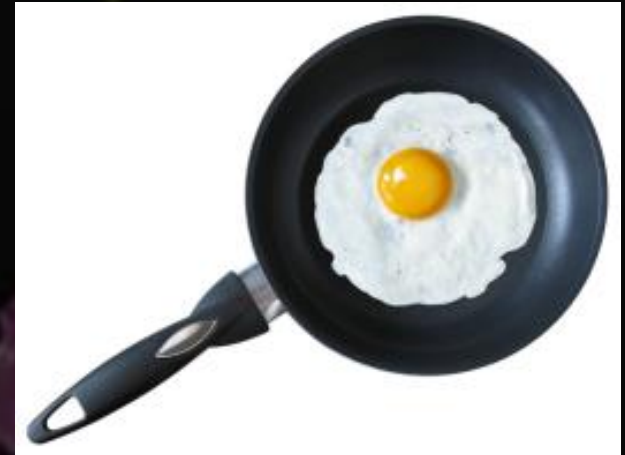
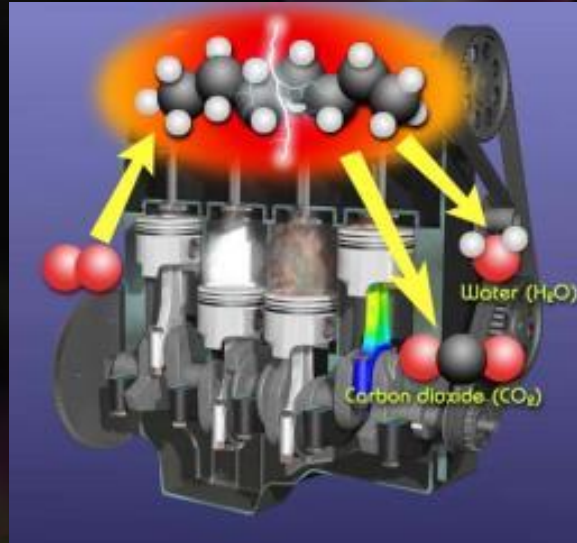


Chemical properties can be observed only when the substances are changing into **NEW and different substances.**

- **Flammability**
- **Reactivity**



Chemical changes that occur in matter





Distinguish Physical & Chemical Changes



cutting hair

A bonfire

washing your car

popping a balloon with a pin

tearing a piece of paper

excavating of soil

burning of coal

peeling or cracking an egg

a color change in a reaction

exploding a hydrogen filled container

kicking a football 40 yards

tarnishing of silverware

filing nails

making a cake

dissolving sugar in water

exploding TNT

burning of coal for heat



Answers

$2\text{HCl} + \text{CaCO}_3 \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$... is a chemical reaction (chemical change)

Ice melting Is a physical change (changes state)

Washing your car **physical ... dirt is rinsed off**

Dissolving sugar in water ... **physical ... sugar & water still exist**

A bonfire ... **chemical ... combustion always produces a new substance**

A color change in a reaction of elements or compounds ... *a general color change can be physical (you turn red when embarrassed), but the word “reaction” indicates a chemical change that produces a new substance is produced*

Popping a balloon with a pin **physical ... still a balloon and pin**

Exploding a hydrogen filled container ... **chemical ... combustion always produces a new substance**

Making a cake ... **physical when mixing ingredients ... baking includes both physical (increase in size) and chemical changes (heat produces chemical reactions)**

Burning of coal ... **chemical ... combustion ... new substance**

Tearing a piece of paper ... **physical ... no new substance, just smaller**

Kicking a football 40 yards ... **physical ... no new substance**

Tarnishing of silverware ... **chemical ... similar to rust ... new substance**

Excavating soil ... **physical ... no new substance ... just digging up the soil**

How can we distinguish chemical change from physical?



Similarities of both physical & chemical changes:

- Energy transfer (e.g. absorbed or released)
- State of matter change
- Gas formation*
 - bubbles form when you boil water or open a carbonated drink [physical]
 - bubbles* also form when an acid reacts with metal [chemical].
- **Precipitate*** (*a solid forms in a liquid*)
 - rain [physical]
 - solutions chemically react to form to a precipitate* [chemical]
- Color Change* or Odor
 - “red hot” iron [physical]
 - Rust (corroded iron hydroxide) [chemical]



Recognizing Chemical Changes

When matter undergoes a chemical change, the composition of the matter changes. When matter undergoes a physical change, the composition of the matter remains the same.

CHEMICAL CHANGES:

- **NEW** chemical substances form.
- A chemical **“REACTION”** occurred.
- Combustion



Physical Versus Chemical Properties (2:36)

<https://screencast-o-matic.com/watch/cFQiooqpMR>

Physical Versus Chemical Changes Demonstrations
Part 1 (5:01)

<https://screencast-o-matic.com/watch/cFQilLqp5O>

Physical Versus Chemical Changes Demonstrations
Part 2 (5:04)

<https://screencast-o-matic.com/watch/cFQil3qpGD>



Which of these properties is a chemical property of sulfur?

- a. yellow
- b. flammable
- c. brittle
- d. Soft

Which of the following is not a common type of evidence for a chemical change?

- a. a change of state
- b. a color change
- c. a gas produced
- d. a precipitate formed

You can be certain that a chemical change has occurred when

- a. there is a visible change.
- b. the change is irreversible.
- c. the temperature changes.
- d. a new substance is formed.



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