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Matter: Phases, Properties + Behavior

Atom – Smallest particle that maintains identity of the element

Compound – a set of atoms bonded together that have unique characteristics

Pure substances – atoms & compounds

Phases of matter

	Shape	Volume	energy
Solid	definite	definite	low energy
Liquid	- not defined - takes shape of container	definite	higher energy
Gas	- not defined - takes shape of container - free expansion/compression	not defined	highest energy

Changes in phase:

Solid → liquid	melting	absorb energy
liquid → solid	freezing	lose energy
Solid → gas	sublimation	absorb large amt. of energy
gas → solid	deposition	large loss of energy
liquid → gas	vaporization	gain energy
gas → liquid	condensation	lose energy

* evaporization – happens at any temperature (+ only on the surface)

Law of conservation of matter

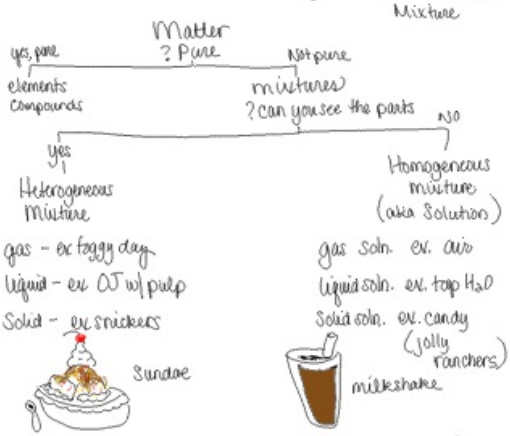
Matter can not be created or destroyed, only changed (phases)

$2Na(s) + Cl_2(g) \longrightarrow 2NaCl$

$2(23.00g) \quad 2(35.45g) \longrightarrow 2(58.45)$

$46.00g \quad 70.90g \longrightarrow 116.90g$

Matter can be divided into 3 categories: Element, Compound Mixture



Practice: Pure or mixture (homogeneous/heterogeneous)

1. granola: heterogeneous
2. carbon: pure
3. apple juice: homogeneous (filtered)
4. pizza: heterogeneous
5. diamond: pure
6. gravel: heterogeneous

Change – Physical vs. Chemical

Physical change – does not change the identity of the substance
tearing paper, grating cheese, changing color (exterior)
Zesting fruit, change in phase, cutting

Chemical change – changes identity of substance
Carmelized (grilled) onions, fall leaves change color
rusting, hair color, frying food.

Physical change can be separated into extensive + intensive

Extensive requires a measurement
"How much?"
length, volume, mass, temperature

Intensive is a property that exists without mention of quantity.
Color, texture, shape, taste
Smell, luster, luminescence

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Properties of Matter

Matter → Pure Substances: elements + compounds
↓
Mixtures

elements (atoms): the smallest particle that maintains the identity of an element

Compound: two or more elements bonded together to create unique properties

Phases of matter

	Shape	Volume	Energy
Solid	defined (set)	defined (set)	low energy no free movement
Liquid	takes the shape of its container	defined (set)	more energy free movement inside container
Gas	no shape free expansion & compression	no volume	very high energy can fill any space

Changes in phase of matter

Solid → liquid	melting	absorb energy
liquid → solid	freezing	release energy
liquid → gas	vaporization	absorb energy
gas → liquid	condensation	release energy
solid → gas	sublimation	absorb a large amt. of energy
gas → solid	deposition	large rapid release of energy

Law of Conservation of Matter

mass cannot be created or destroyed, it can only change phase

$2\,Na(s) + Cl_2(g) \rightarrow 2\,NaCl$

$2 \times 28.00\,g = 46.00\,g$ (Reactants)

Cl_2: $35.45 \times 2 = 70.90\,g$

$2 \times 58.46\,g = 116.90\,g$ (product)

Matter
? Pure
- Yes
  - element (atom)
  - Compound – 2 or more atoms bonded
- No
  - mixture ? Can you see the parts
    - No
      - Homogeneous (aka solution) particles are blended together w/ no visible differences
      - Examples:
        - Gas → Air (Atmosphere)
        - Liquid → salt water
        - Solid → cheese, jolly ranchers
      - 
      - milkshake
    - Yes
      - Heterogeneous – visible differences
      - Examples:
        - Gas → Fog, Smoke
        - Liquid → OJ w/ pulp
        - Solid → trail mix, pepperjack, cheese
      - 
      - sundae

Changes: Physical vs. Chemical

Physical changes – maintain the identity of the substance
paint, cut, fold, crush it, freezing (phase change)

Chemical changes – change the identity of the substance
explosion, rust, bleaching, carmelization

Physical Properties

Extensive:
"How much?"
amounts – mass, length, volume, temperature

Intensive:
Quantity doesn't matter
color, shape, texture (feel)
smells, taste
* Density
* freezing/melting pts.
* boiling pts.

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Matter: Properties + Behavior

Pure
- element (atom) – the smallest particle that maintains the identity of the element
- Compound – 2 or more atoms bonded together resulting in unique characteristics.

Mixtures – 2 or more particles blended together.

States of Matter

	Shape	Volume	energy
Solid	definite (set)	definite (set)	low energy fixed in position
Liquid	take shape of container	definite (set)	more energy freedom to move in the container
Gas	undefined • free expansion & compression	undefined (not set)	high energy free movement

Changes in the state of matter (aka phase change)

Solid → liquid	melting	absorb energy
liquid → solid	freezing	lose energy
liquid → gas	vaporization	absorb energy
gas → liquid	condensation	lose energy
solid → gas	sublimation	absorb energy
gas → solid	deposition (snow)	lose energy

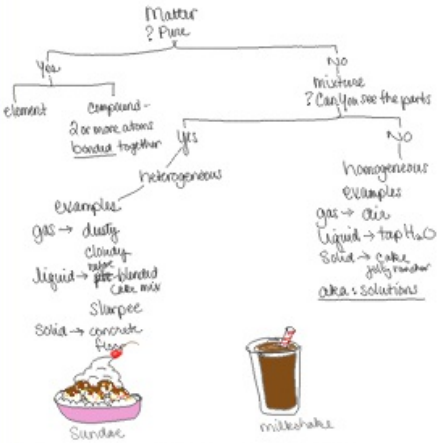
The law of conservation of Matter

mass can not be created or destroyed, it can only change phase.

$2\,Na(s) + Cl_2(g) \longrightarrow 2\,NaCl(s)$

$2 \times 23.00\,g = 46.00\,g$ + $70.90\,g$ → $2 \times 58.45\,g = 116.90\,g$

Reactants → product



Practice: Pure element, Pure compound, homogeneous or heterogeneous

1. gravel heterogeneous
2. Carbon pure element
3. Trail mix heterogeneous
4. Kool-aide homogeneous
5. diamond pure element
6. Sugar pure compound $C_6H_{12}O_6$

Physical + Chemical Changes / Properties

? Does it change the identity

No → Physical
- ? How much
  - Extensive: Length, temperature, mass, volume
- ? quantity does not matter
  - Intensive: Color, smell, texture, taste, shape, Boiling Pt, Freezing Pt, Density

Yes → Chemical

Examples: Burning, oxidation, explosions, caramelization

Practice: EP IP Chm

1. Reacts w/ H_2O Chm
2. Red IP
3. conducts electricity Chm
4. ductile IP
5. 16 inches EP
6. Flammable Chm

Distillation: separation based on boiling points.