Properties of matter slide deck

Science 14

Unit A: Properties of matter

Labels decide how a chemical is handled

Two clear liquids on one bench

- A clear liquid in a lab bottle and a clear liquid in a bathroom jug can look the same from across the room.
- Read the product name and the hazard picture before anyone opens the cap.

Three names on a label

- WHMIS is the workplace system that ties a pictogram to a safety data sheet.
- A household bottle uses a consumer product symbol as its hazard picture.

Key terms

WHMIS

Workplace Hazardous Materials Information System, the Canadian workplace system of labels and safety data sheets for hazardous products.

consumer product symbol

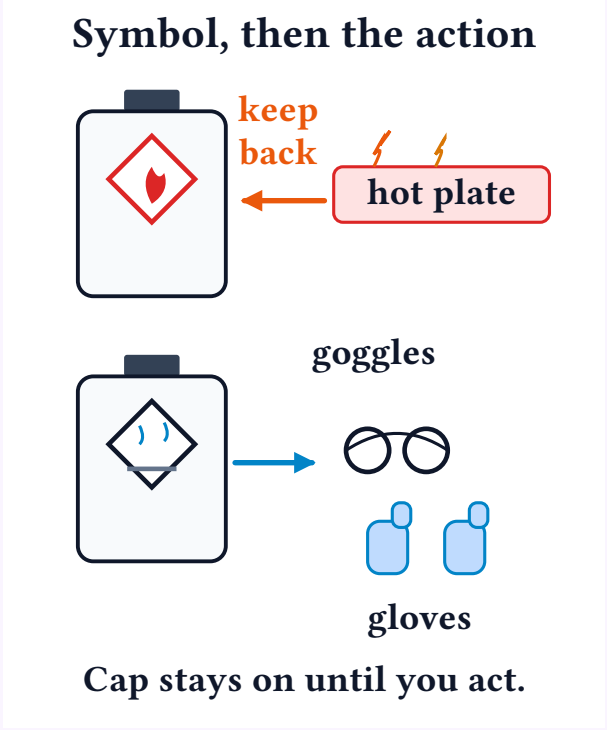
A hazard picture on a household container that warns about fire, corrosion, a sudden reaction, or a health effect.

safety data sheet

The workplace sheet for one product that lists hazards, protective equipment, storage, first aid, spill response and disposal.

WHMIS symbols and actions

- A flame pictogram means the product can ignite, so it stays away from sparks and hot plates.
- A corrosion pictogram means the product can damage skin or metal, so gloves and eye protection come on before the cap turns.



A bleach jug card, worked in order

- The card shows the product name, a corrosion pictogram and a health warning.
- The matching sheet says gloves, eye protection, a ventilated space, and disposal with plenty of water only if the local rule allows that rinse.

A paint thinner label

- The card shows a flame pictogram and the words keep away from ignition sources.
- The safety data sheet also names the cabinet where the closed container sits.

A new corrosive cleaner card

- The card shows a corrosion pictogram and the product name ‘descaler’.
- Name the gloves or goggles, and name the safety data sheet for disposal.

Lab labelling habits

- Every later mixture, solution and acid in this unit starts with the same label reading.
- A partner’s suggestion is useful after you have both pointed at the symbol on the card.

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Pure substances and useful mixtures

Salt on an icy Alberta road

- Rock salt scattered on November ice changes how that ice behaves under tires.
- The salt and the ice keep their own identities while they work together as a mixture.



Pure substance and mixture

- Distilled water is one substance, with the same properties in every sample.
- Salt water is a mixture, and the amount of salt can change.

Key terms

pure substance

Matter with one set of identifying properties throughout, such as distilled water or a sample of the element zinc.

mixture

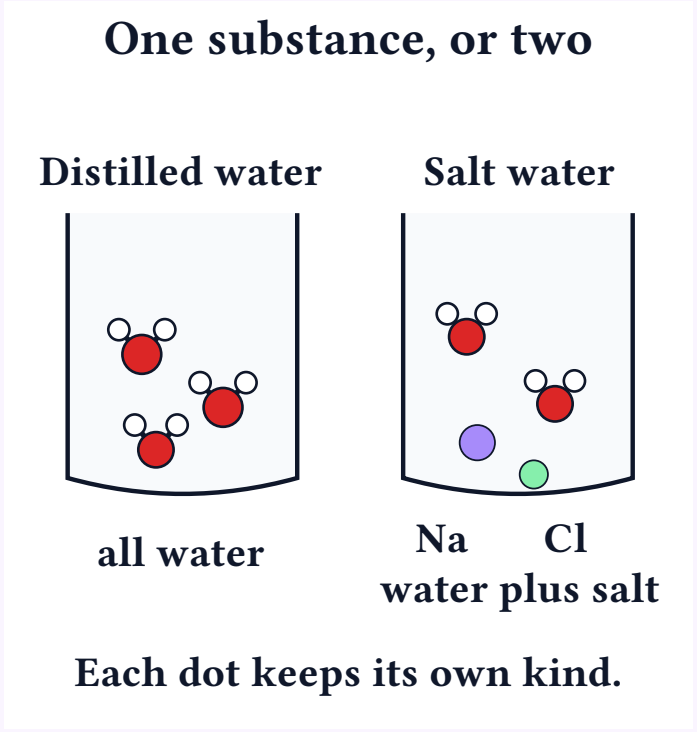
Matter made of two or more substances that keep their own properties and can be present in varying amounts.

mechanical mixture

A mixture whose parts are visibly distinct or settle into different regions, such as sandy water.

Properties that stay with each part

- A pure substance shows one set of identifying properties from sample to sample.
- A mixture can vary in proportion, and each part still brings its own properties.



Salt water on the road

- Salt scattered on ice is a mixture with a job in winter.
- The salt and the water still keep their own properties.

Brass and zinc

- Brass is a mixture of metals, so its recipe can vary.
- Zinc is one metal, with one set of properties.

Vinegar or acetic acid

- Vinegar contains water and acetic acid.
- Say which sample is the mixture and which property still belongs to the acid.

Mixtures for a purpose

- Road salt, radiator antifreeze and kitchen soap are mixtures chosen for Alberta conditions.
- The pure substances inside them still matter because their properties explain the job.

Image credits

Gogerr, Road Salt on a Sidewalk in Canada, CC BY-SA 4.0

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Unit A: Properties of matter

Separate a mixture by a property

Muddy water and a coffee filter

- Sandy water poured through a filter leaves sand on the paper and clearer water below.
- Salt dissolved in water passes through that same paper, so a different property has to do the separating.

Filtrate and distillation

- Filtrate is the liquid that passes through filter paper.
- Distillation boils a solution and collects the cooled vapour.

Key terms

filtrate

The liquid that passes through filter paper when a mechanical mixture is poured through it.

distillation

A separation that boils a solution and condenses the vapour so the liquid part is collected away from dissolved solids.

chromatography

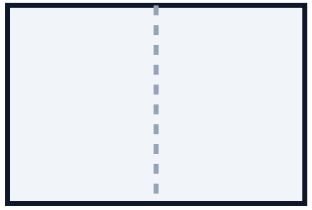
A separation that lets parts of a mixture travel at different speeds through paper or another material.

Choosing a separation method

- Filtration uses particle size when a solid is mixed with a liquid.
- Evaporation and distillation use boiling when the parts of a solution leave at different temperatures.

Choosing a separation method

Filtration: particle size



Evaporation / distillation: boiling

Match the tool to the property that differs

Sand in water

- Sand grains stay on the filter paper.
- The water that drips through is the filtrate.

Clear salt water

- Dissolved salt travels through filter paper with the water.
- Evaporation leaves the salt after the water boils away.

Muddy water and salt water

- One flask is muddy pond water. The other is clear salt water.
- Name a separation for each flask and the property that decided it.

Properties and separation tools

- Agreement on a separation starts when both people name the differing property.
- Water treatment is the large-scale version of the same choice.

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Physical properties and moving particles

Ice on a windowsill becomes liquid water

- The same water sample can be ice, liquid or vapour as the temperature changes.
- Rust on a steel nail is a new substance, so rusting is a chemical change.

Physical and chemical properties

- Melting ice is a physical change because the substance is still water.
- Rust on a nail is a chemical change because a new substance forms.

Key terms

physical property

A description you can observe while the substance stays the same substance, such as state, density, colour or melting point.

chemical property

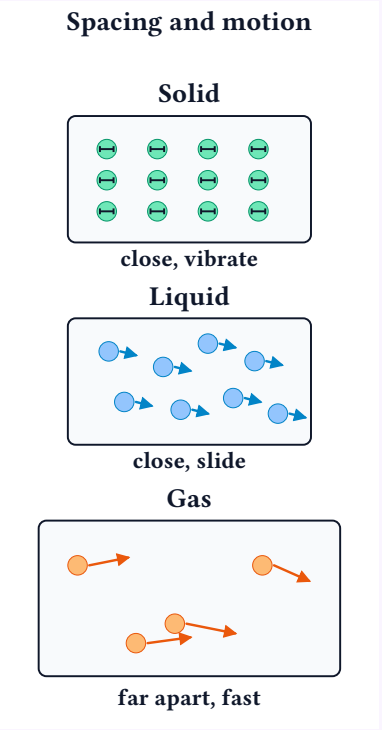
A description of how a substance changes into a different substance, such as the ability to rust or to burn.

particle model

The model that matter is made of tiny particles in motion, with spacing and speed that differ in solids, liquids and gases.

Spacing and motion explain the phase

- Solid particles stay close and vibrate in place, so the sample holds its shape.
- Gas particles are far apart and move quickly, so a gas fills the container.



Melting point and rust

- The melting point of ice describes water that is still water.
- Rusting describes iron becoming a new substance.

Visible rust

- Seeing a colour change is the observation.
- A new substance is what makes rusting chemical.



Copper density and propane

- Density of copper describes copper that is still copper.
- The ability of propane to burn describes a change into new substances.

Recording the property beside the particle picture

- A lab table lists the physical property and whether the substance stayed the same.
- The particle sketch shows spacing and motion for the phase you observed.

Image credits

Ahmed Saad, Some rusty nails in a beam, CC BY 3.0

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Unit A: Properties of matter

Solutions and solubility

Vinegar mixes, oil forms a layer

- Vinegar stirred into water becomes one liquid.
- Oil stirred into water returns to a separate layer.



Solute and solvent

- The solute is the substance that dissolves, such as salt.
- The solvent is the substance that does the dissolving, often water.

Key terms

solute

The substance that dissolves, present in the smaller amount in most classroom solutions.

solvent

The substance that does the dissolving, often water in this course.

solubility

The mass of solute that dissolves in a stated amount of solvent at a stated temperature.

concentration

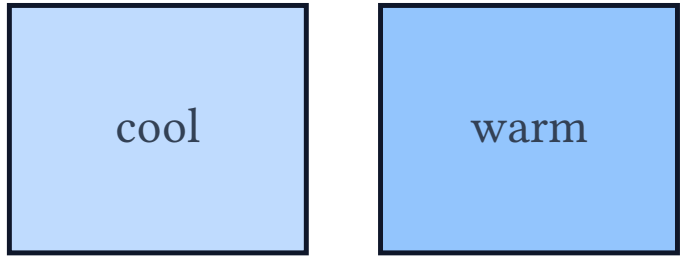
The amount of solute in a stated volume of solution, expressed here as mass per volume. (g/L)

Concentration and temperature

- Concentration in grams per litre is the solute mass divided by the solution volume.
- A warmer solvent often dissolves more solid solute because the particles move faster.

Concentration and temperature

c = mass solute ÷ volume (g/L)



Warmer solvent often dissolves more solid

Oil and vinegar

- Oil and water stay in layers, so that pair is insoluble.
- Vinegar and water stay mixed, so that pair is soluble.

A shaken oil bottle

- Shaking spreads the oil for a moment.
- After the bottle rests, the oil layer returns.

Salty water

- Salt is the solute and water is the solvent.
- Solubility is how much salt dissolves at a stated temperature.

Solubility graphs

- Pickle brine and canning syrup are concentration decisions with a temperature attached.
- A rising solubility graph lets you estimate a value between two measured points.

Image credits

Twinproject126, Vinegar on olive oil, CC BY-SA 4.0

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Unit A: Properties of matter

Dilution and packaging

Frozen orange juice in a small can

- A small can of juice concentrate becomes a pitcher after water is added.
- The juice solids stay the same mass while the volume of the drink grows.

Dilution and a concentrate

- Dilution adds water so the same solute is spread through more volume.
- A concentrate is sold strong so you add the water at home.

Key terms

dilution

Adding solvent so the same solute mass is spread through a larger solution volume.

concentrated product

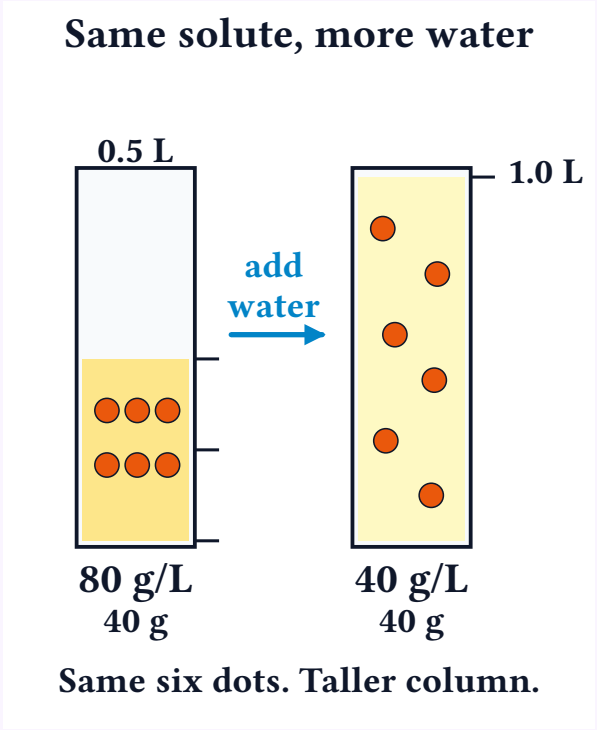
A product sold with a high solute amount so the user adds solvent before use.

ratio

A comparison of two amounts, here the amount of solute compared with the amount of solvent.

Dilution and concentration

- Dilution adds solvent and lowers the mass of solute in each litre.
- A concentrate can uses less packaging than the same number of ready-to-drink cartons.



Syrup and added water

- Thirty grams of sugar stay in the pitcher.
- Tripling the volume drops the concentration from 150 g/L to 50 g/L.

Sugar stays in the pitcher

- Added water increases the volume.
- Each litre then holds less sugar.

Juice from a small can

- The juice solids stay in the pitcher.
- Added water increases the volume, so the drink is weaker.

Ratios and container waste

- One job is the new grams per litre. The other job is which empty packages pile up.
- A darker drink can hint at a stronger mix. Mass and volume give the number you record.

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Acids and bases in corrosion

Indicators in household products

- Vinegar and household ammonia are both clear solutions with different indicator colours.
- Vinegar reads below 7. Household ammonia reads above 7.

Acid and base

- Vinegar is an acid in this lesson, and its pH number is below 7.
- Household ammonia is a base, and its pH number is above 7.

Key terms

acid

A solution that turns indicator the acid colour, conducts electricity and can neutralize a base.

base

A solution that turns indicator the base colour, conducts electricity and can neutralize an acid.

pH

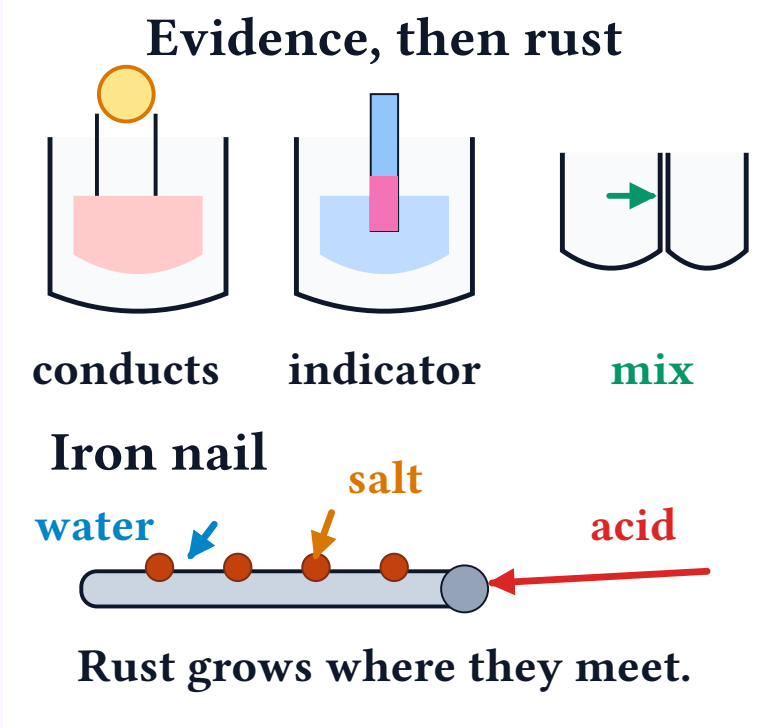
A number scale of acidity and basicity. Values below 7 are acidic, 7 is neutral, and values above 7 are basic. (pH)

neutralization

The reaction in which an acid and a base consume one another's characteristic properties.

Evidence first, then the corrosion story

- Conductivity, indicator colour and neutralization are the three identifying behaviours.
- Acids, bases, salts, humidity and heat speed the corrosion of iron.



A drink at pH 3

- The indicator turns the acid colour.
- A pH of 3 agrees, so the drink is an acid.

Soapy water

- Soapy water feels slippery in the sink.
- Use the indicator colour or the pH number to place it.

pH 11 and a base colour

- The sample conducts and turns the base colour.
- A pH of 11 places it with the bases.

Classification key

- Use the indicator colour or the pH number to call a solution an acid or a base.
- Use one cleaner at a time. Keep ammonia and bleach in separate jobs.

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Unit A: Properties of matter

Elements and compounds

An element and a compound

- Copper conducts and can be drawn into wire, which fits a metal.
- Water can be split into hydrogen and oxygen, which fits a compound.

Element and compound

- Copper is an element: one kind of atom, and it can be drawn into wire.
- Water is a compound: hydrogen and oxygen joined in a fixed ratio.

Key terms

element

A pure substance made of one kind of atom, such as copper or oxygen.

compound

A pure substance made of two or more elements joined in a fixed ratio, such as water.

subscript

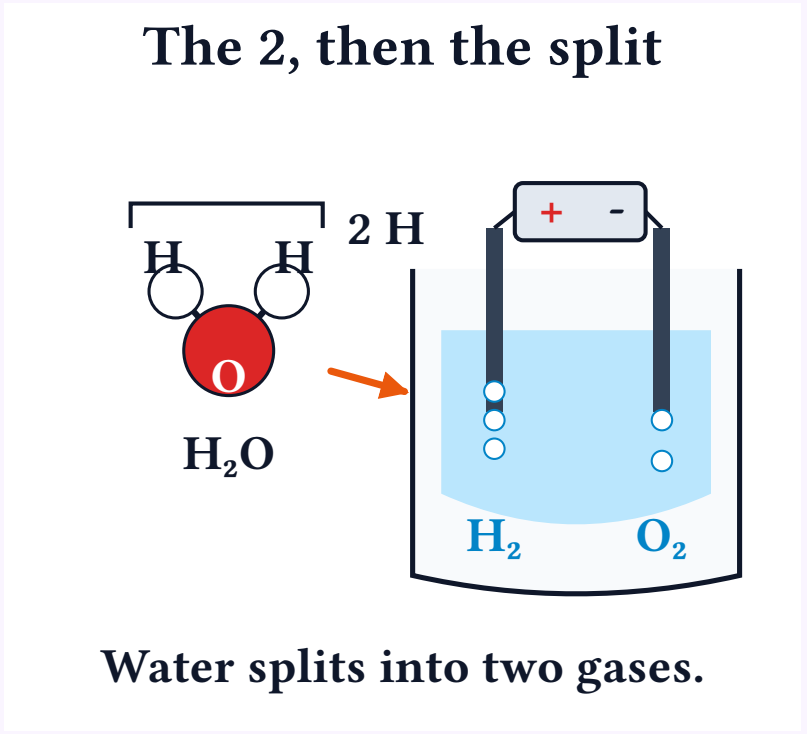
The small number after a symbol that counts atoms of that element in the formula. (H_2O)

metalloid

An element whose properties sit between typical metals and typical nonmetals, such as silicon.

Symbols and subscripts

- In H_2O the small 2 counts hydrogen atoms in one water unit.
- Electrolysis splits water into hydrogen and oxygen, so water is a compound.



A brittle grey solid

- Poor conductivity and brittleness point toward the nonmetals.
- The periodic table is where you confirm the name.

Solids are a mixed group

- State, shine, conductivity, and malleability belong in the decision together.
- A brittle solid that fails to conduct stays with the nonmetals or metalloids.

Copper and oxygen

- Copper can be drawn into wire. Oxygen is a gas in the room.
- Say which one is the metal and name the property you used.

Evidence for a compound

- Shine, conductivity, and brittleness point to a region of the table. The table names the element.
- Read the symbols in the formula. A sample that splits into elements was a compound.