Science 14 full 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

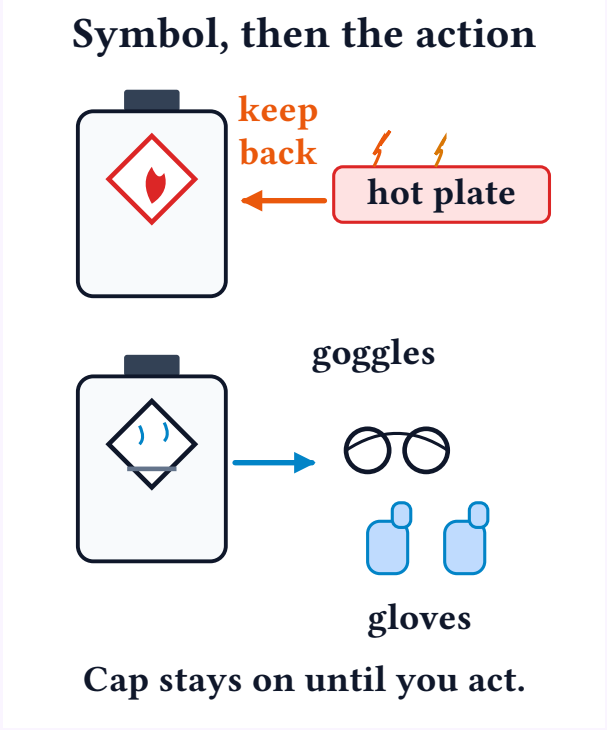
A hazard picture on a household container that warns about fire, corrosion, a sudden reaction, or a health effect.

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.

Science 14

Unit A: Properties of matter

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

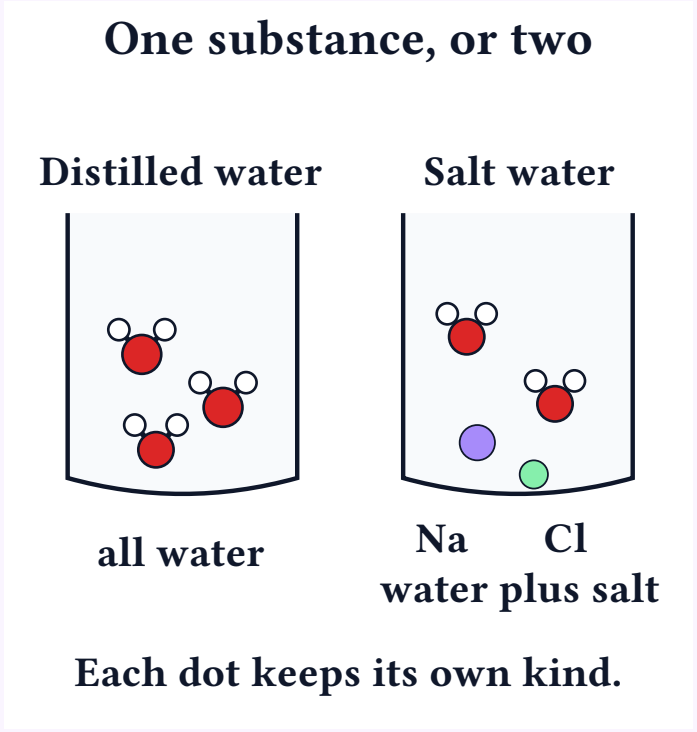
Matter made of two or more substances that keep their own properties and can be present in varying amounts.

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

Science 14

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

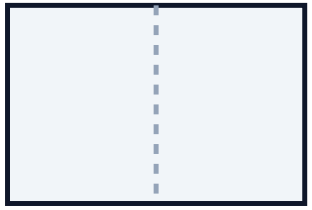
A separation that lets parts of a mixture travel at different speeds through paper or another material.

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.

Science 14

Unit A: Properties of matter

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

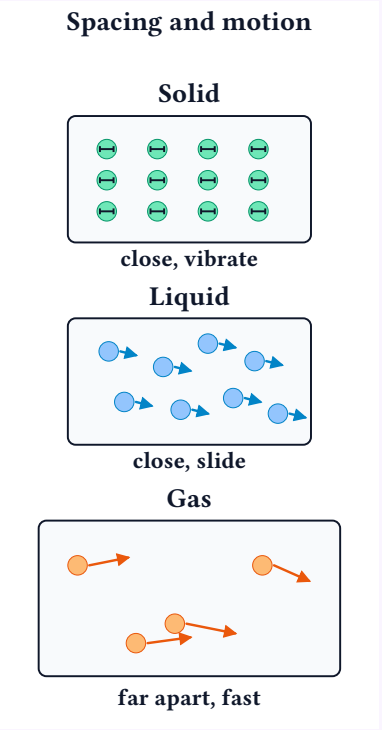
A description of how a substance changes into a different substance, such as the ability to rust or to burn.

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

Science 14

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

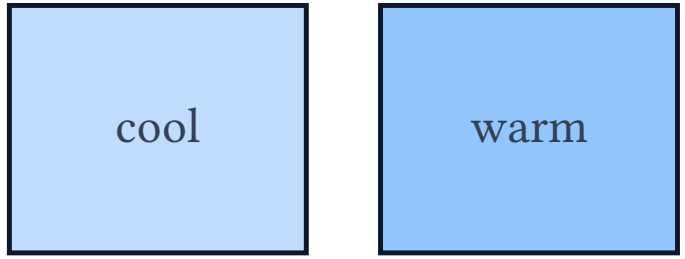
The amount of solute in a stated volume of solution, expressed here as mass per volume. (g/L)

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

Science 14

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

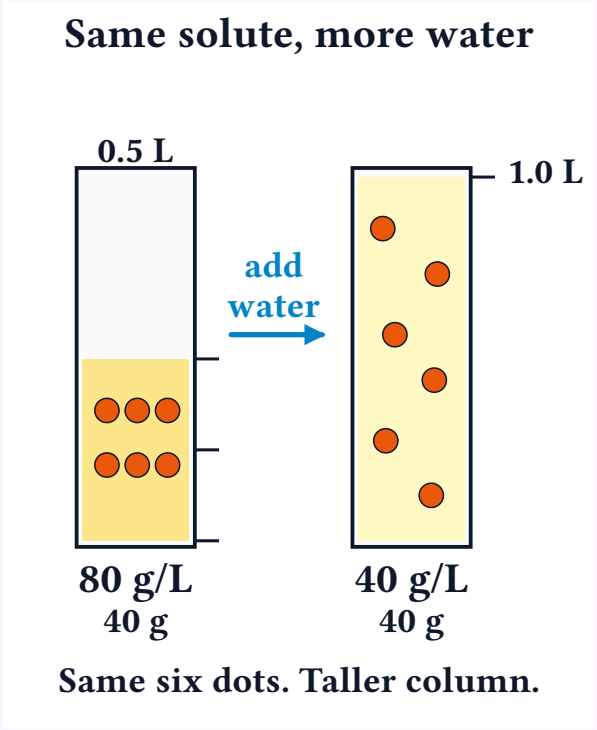
A product sold with a high solute amount so the user adds solvent before use.

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.

Science 14

Unit A: Properties of matter

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

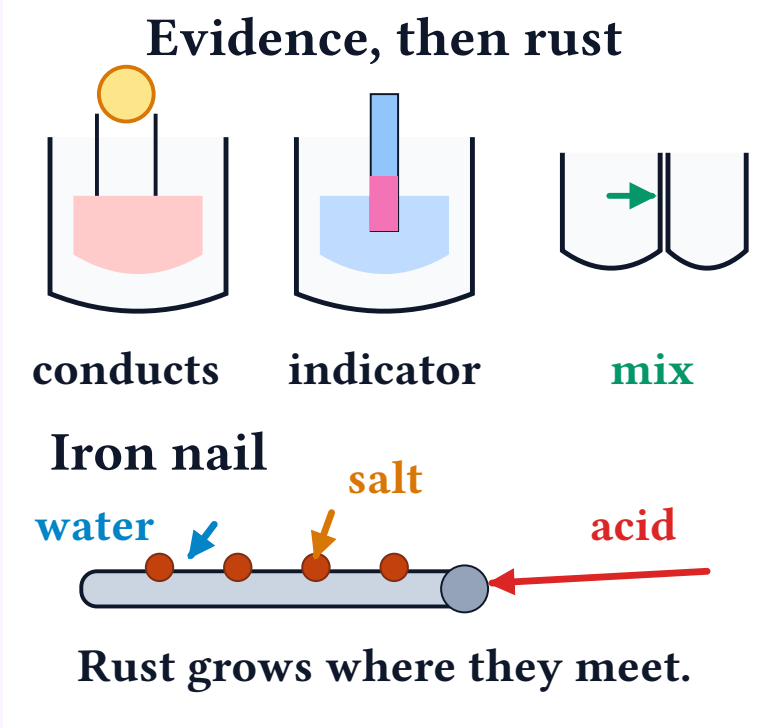
A number scale of acidity and basicity. Values below 7 are acidic, 7 is neutral, and values above 7 are basic. (pH)

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.

Science 14

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

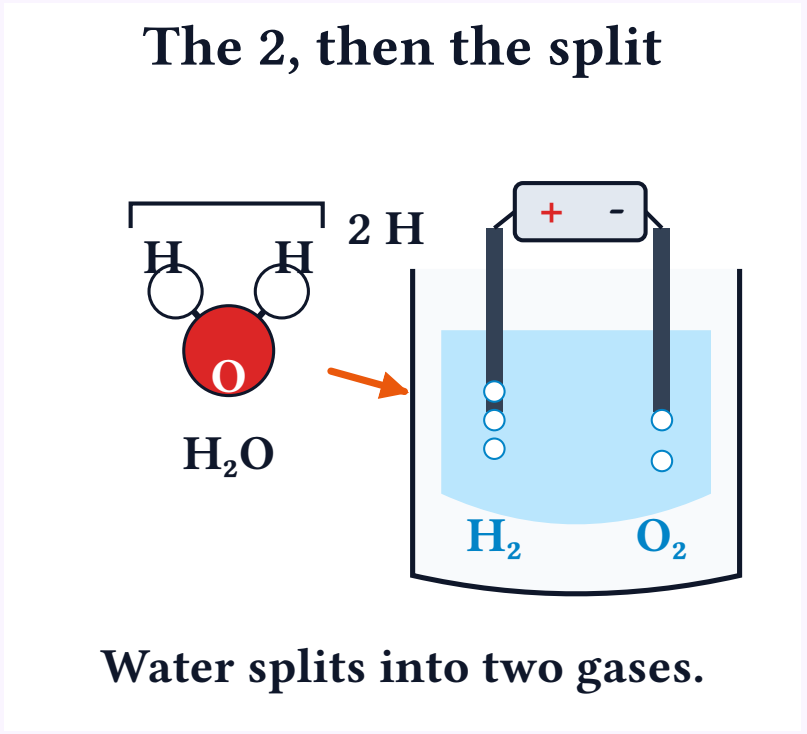
The small number after a symbol that counts atoms of that element in the formula. (H_2O)

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.

Science 14

Unit B: Energy transfer technologies

Heat moves from the hotter object

Heat from refrigerator coils

- The food inside a fridge gets colder while the coils on the back feel warm.
- Those coils are dumping heat into the warmer kitchen air.

Heat and temperature

- Heat is energy moving from a hotter object to a cooler one.
- Temperature tells you how hot the object is, which tracks particle motion.

Key terms

heat

Thermal energy transferred from a hotter object to a colder object.

conduction

Heat transfer through a material by particles passing motion to their neighbours, strongest in metals.

convection

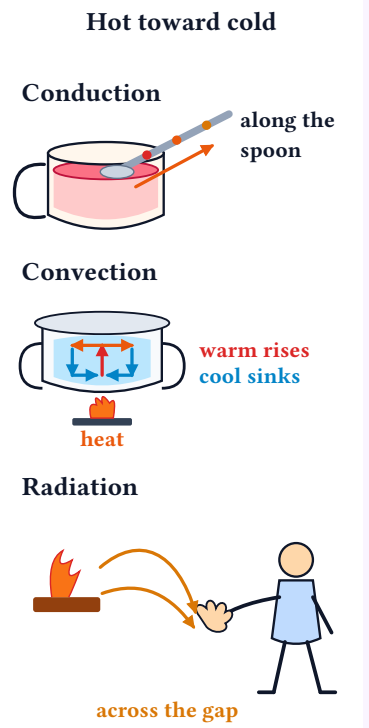
Heat transfer by the movement of a warmed fluid, such as air or water.

radiation

Heat transfer by infrared waves, which can cross empty space from a hot surface.

Three paths, one direction

- Conduction carries heat through a spoon left in a hot drink.
- Convection carries heat as warm air or water rises and cooler fluid sinks.



Fridge coils

- The food inside gets colder.
- The coils on the back pass that heat into the kitchen air.

A metal spoon

- The spoon handle warms by conduction from the hot drink.
- The drink is the hotter object and the handle starts cooler.

Radiant heat from a fire

- Radiation carries heat across the space between the fire and your face.
- The fire is hotter, so the heat moves toward you.

Hot and cold ends

- Every cooling device in this unit has a place where heat leaves and a place where heat arrives.
- The next lesson ties that transfer to particle motion and to local winds.

Science 14

Unit B: Energy transfer technologies

Convection and climate

A dye spiral in a convection tank

- Warm water rises from a heater and cooler water sinks to take its place.
- A drop of dye draws that loop so the current can be seen.

Particle speed and convection

- A higher temperature means the particles move faster on average.
- Convection is a current: warm fluid rises and cooler fluid sinks.

Key terms

temperature

A measure of the average motion energy of the particles in a sample.

thermal energy

The total energy of the random particle motion in a sample.

Brownian motion

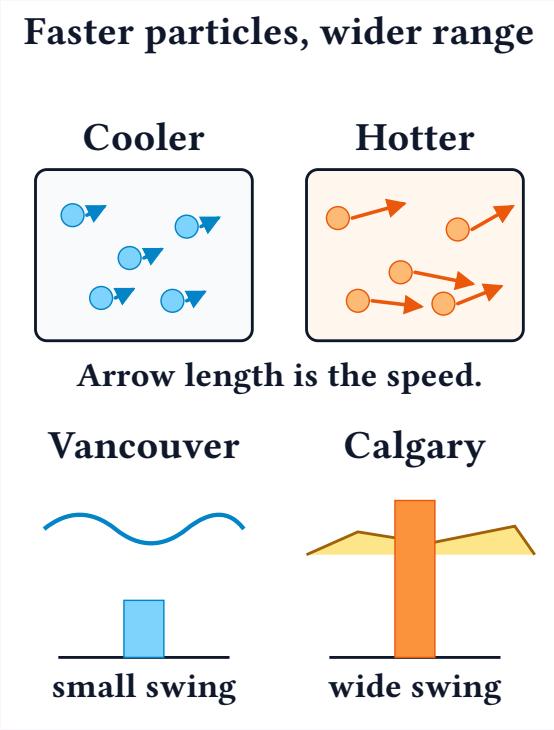
The visible jitter of tiny grains as invisible particles collide with them.

moderating influence

The effect of a large body of water that keeps nearby air from swinging to extreme temperatures.

Convection currents and coastal climate

- Higher temperature means a higher average speed of the particles.
- Vancouver's ocean keeps seasonal temperatures milder than Calgary's prairie air.



Dye in a tank

- Warm water rises from the heater.
- The dye draws the loop as cooler water sinks.

A metal bench in January

- Metal particles pass heat quickly to your hand.
- The bench and the air can share a temperature while the metal feels colder.

Vancouver and Calgary

- Vancouver has a large body of water nearby, so seasons stay milder.
- Calgary's prairie air allows a wider temperature swing.

Convection loops and cities

- A dye loop and a coastline loop are the same convection idea at two sizes.
- Vancouver and Calgary make the water-moderation comparison concrete.

Science 14

Unit B: Energy transfer technologies

Insulation and thermal protection

Heat loss through a window

- A jacket traps air so body heat reaches the winter air more slowly.
- A single pane lets room heat reach the outdoors faster than a double pane.

Insulation and protection

- Insulation slows heat leaving a warm place, as a jacket traps air.
- Protective gear blocks a dangerous heat transfer, as a firefighter’s coat does.

Key terms

insulation

A material or gap that slows conduction, convection or radiation so heat transfer falls.

double glazing

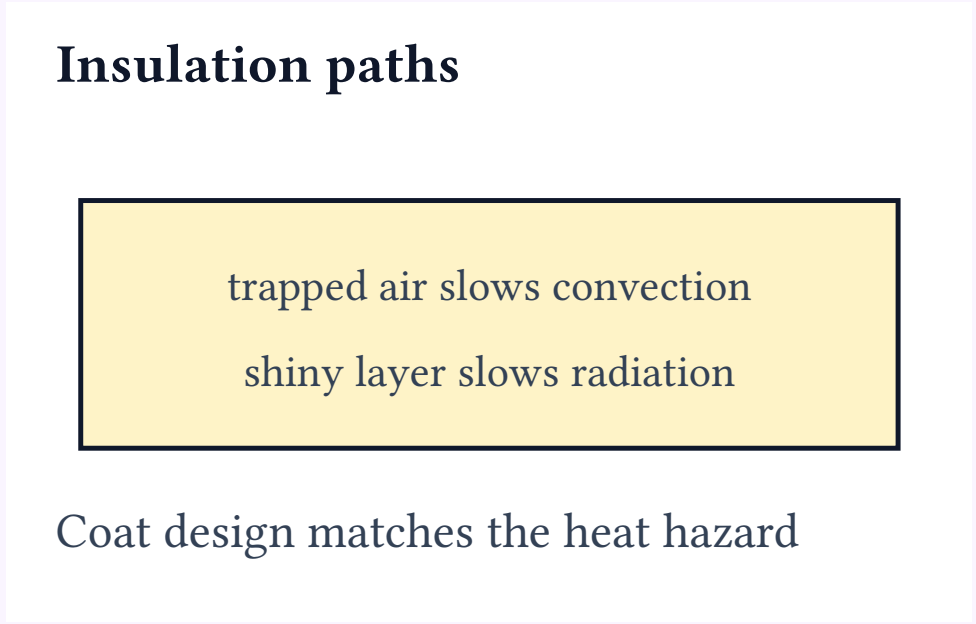
Two panes with a trapped gap, used so conduction and convection through a window slow down.

protective clothing

Gear that keeps a dangerous heat flow away from skin, such as a firefighter's layers.

Insulation and heat transfer paths

- Trapped air slows convection, and a shiny layer slows radiation.
- A firefighter's coat is built for extreme heat. A winter jacket is built for a cold walk.



Double glazing

- Two panes with a gap slow the heat leaving a room.
- The trapped air is the barrier in that gap.

A shiny layer

- A shiny layer sends radiation back.
- Trapped air slows the convection path.

Bottle test

- The bottle whose temperature rises slowest has the stronger insulator.
- Rank the materials from that temperature record.

Insulation test graph

- The slowest temperature rise marks the stronger insulator in your bottle test.
- House upgrades and safety gear are two uses of that ranking.

Science 14

Unit B: Energy transfer technologies

Why water changes temperature slowly

Water and oil heating rates

- Equal masses of water and cooking oil receive the same heating time.
- The oil’s temperature climbs faster than the water’s.

Specific heat capacity

- Water takes in a lot of heat for each degree its temperature rises.
- Cooking oil changes temperature faster under the same heat.

Key terms

specific heat capacity

The heat a stated mass of a substance absorbs or releases for each degree of temperature change.

controlled variable

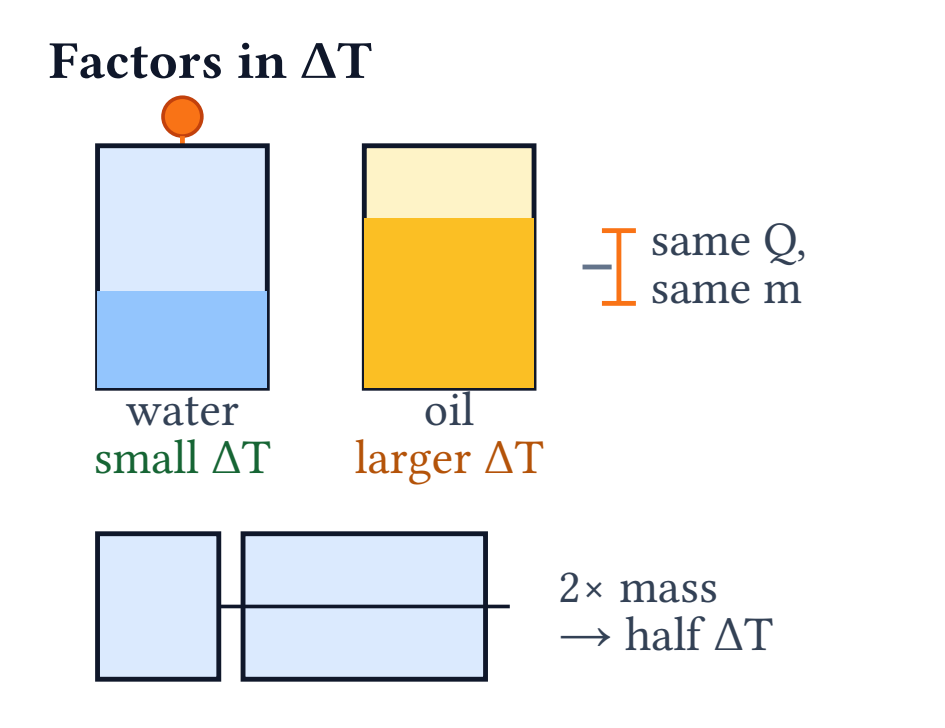
A factor you keep the same so the comparison is fair, such as starting temperature or heater setting.

manipulated variable

The factor you deliberately change, such as the type of liquid or the mass.

Factors in temperature change

- A high specific heat capacity means a smaller temperature change for the same heat and mass.
- Doubling the mass, with the same heat, cuts the temperature change for that material.



Oil and water, same heat

- The oil rises about 12 degrees and the water rises about 5.
- Water has the higher specific heat capacity in that test.

Same heat, different climb

- The heater setting and the time stay the same.
- The larger temperature climb belongs to the lower specific heat capacity.

A heavier pot of water

- The same heat spread through more mass gives a smaller temperature change.
- Material and mass both belong in the comparison.

The manipulated variable

- Material in one trial, mass in the next, and the heater stays the controlled variable.
- The lake and the kettle are the same specific-heat story at two sizes.

Science 14

Unit B: Energy transfer technologies

Simple machines and work

A crowbar lifts a stuck board

- A long crowbar lets a small push on the handle produce a larger push on the board.
- Your hand travels farther than the board moves.

Work and the fulcrum

- Work is the force times the distance, and the unit is the joule.
- A fulcrum is the pivot on a lever, between the input force and the output force.

Key terms

work

Energy transferred when a force moves an object in the direction of the force. (W = Fd)

joule

The SI unit of work and energy. One joule equals one newton metre. (J)

newton

The SI unit of force. (N)

fulcrum

The pivot or turning point of a simple machine, such as the hinge of a lever or the axle of a doorknob.

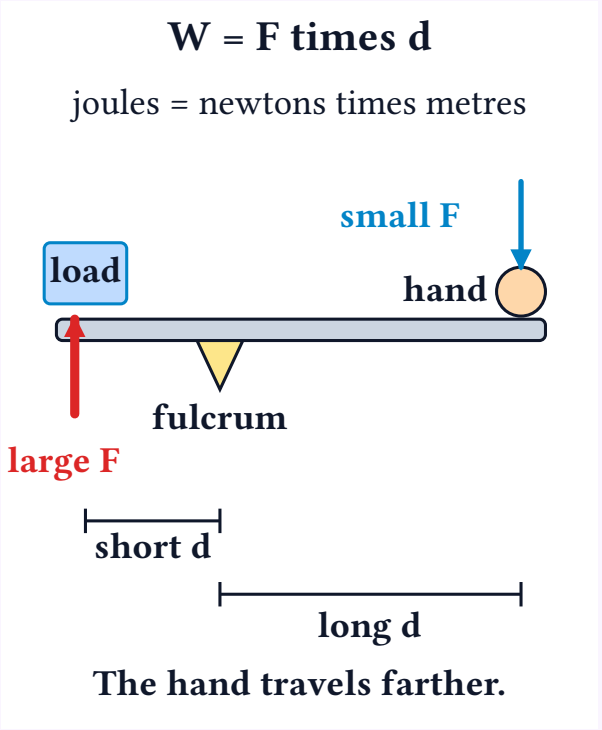
Key terms

force multiplier

A machine whose output force is larger than the input force, while the input moves farther than the load.

Work and mechanical advantage

- Work in joules is the force in newtons multiplied by the distance in metres.
- A lever can push harder than your hand, and your hand moves farther to do it.



30 newtons through 4 metres

- Multiply the force by the distance: 30 times 4.0.
- The work is 120 joules.

A small push on a crowbar

- The hand travels farther than the board moves.
- The board receives a larger force than the hand applied.

A teeter-totter

- A heavier rider sits closer to the fulcrum.
- A lighter rider sits farther out so the board can balance.

Force and distance on a lever

- The teeter-totter shows the force-and-distance balance with two masses.
- A crowbar, a pair of scissors, and a car jack each have an input, an output, and a fulcrum.

Science 14

Unit B: Energy transfer technologies

Efficient machines and renewable sources

A solar cooker and a hand-wound radio

- A solar cooker sends sunlight into a pot and some of that energy warms the food.
- A hand-wound radio turns muscle work into sound and also into wasted heat in the gears.

Efficiency and renewable energy

- Efficiency compares the useful output with the total energy you put in.
- Sunlight and wind are renewable because they can supply energy again in a person's lifetime.

Key terms

efficiency

The fraction of the energy input that becomes useful output in a device.

renewable energy source

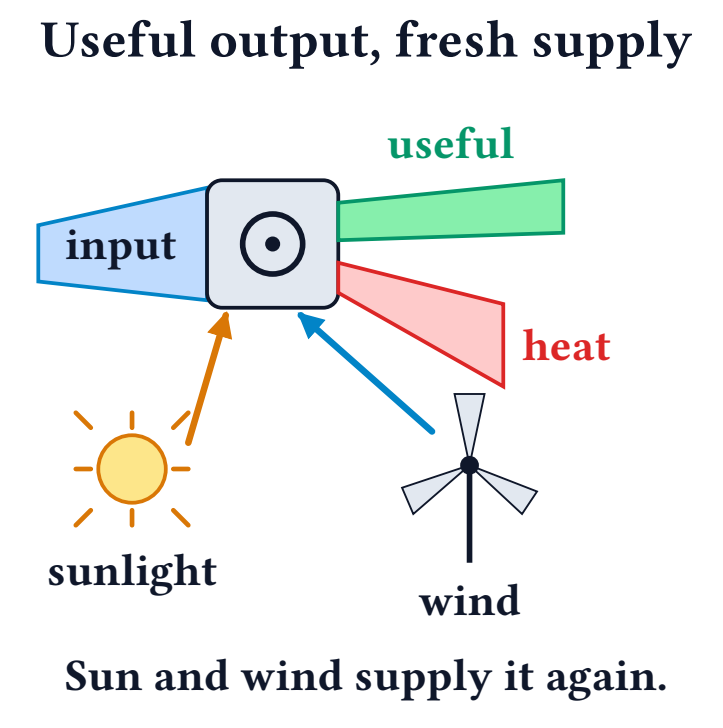
A source that is replenished on a human timescale, such as sunlight or wind.

nonrenewable energy source

A source that is used far faster than Earth replaces it, such as coal, oil or natural gas.

Useful output over input, then the source

- A machine does better when more of the energy you put in becomes the job you wanted.
- Sunlight and wind can supply that energy again within a person's lifetime.



A solar cooker

- Sunlight goes in and hot food is the useful output.
- Some of the energy also leaves as thermal energy around the pot.



A hand-wound radio

- Muscle work goes in.
- Sound is the useful output, and the gears also warm up.

A week of meter readings

- Cooking, hot water, and laundry make the daily peaks.
- A more efficient appliance lowers the energy those jobs use.

A peer unit check

- Name the input, the useful output, the energy source, and one change that would waste less.
- Meter readings over a week show when the household demand peaks.

Image credits

Solarbroman, Parabolic Solar Cooker, CC BY-SA 4.0

Science 14

Unit C: Matter and energy in living systems

Food labels and diets

Two lunches, two labels

- A packaged soup and a homemade bowl can look like the same meal.
- The label on the package lists sodium, fat and calories per serving.

Nutrients and two diet patterns

- A nutrient is a substance in food the body uses, such as protein or fat.
- A mixed diet includes animal foods and plants. A vegetarian diet is built from plants, sometimes with dairy or eggs.

Key terms

nutrient

A substance in food that the body uses, such as protein, carbohydrate, fat, vitamins or minerals.

mixed diet

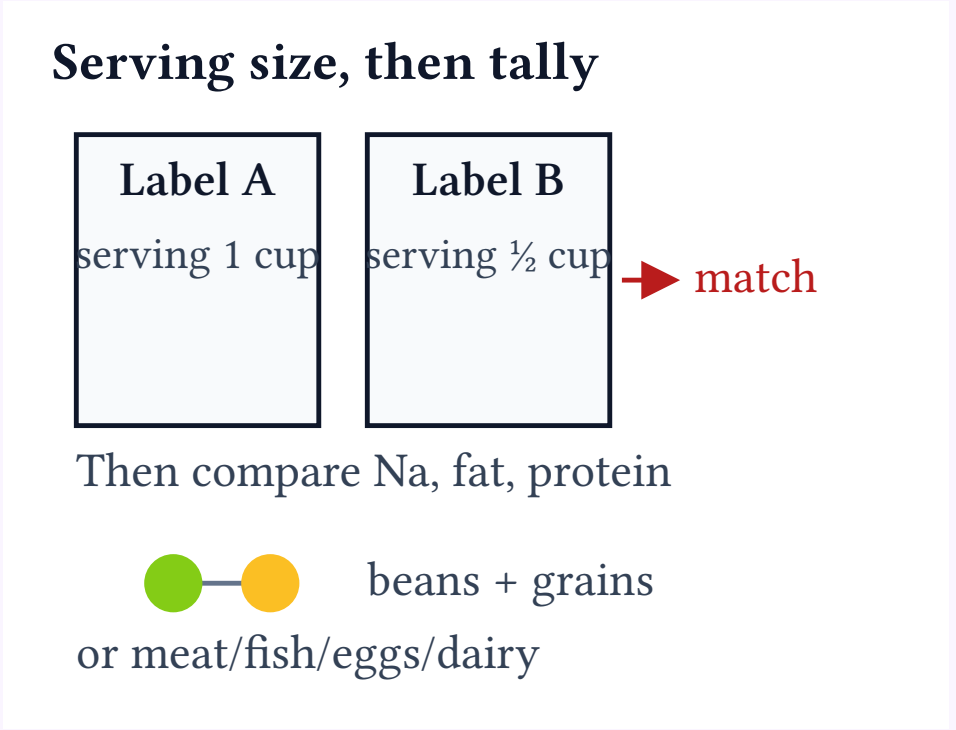
A pattern of eating that includes foods from animals and from plants.

vegetarian diet

A pattern of eating built from plant foods, sometimes with dairy or eggs, and planned so nutrient needs are met.

Serving size, then the nutrient tally

- Match the serving sizes first, then compare sodium, fat, and protein.
- Beans with grains can cover protein in a vegetarian pattern. Meat, fish, eggs, or dairy can cover it in a mixed pattern.



Two cups of soup

- The label says 700 mg of sodium in one cup.
- Two cups are two servings, so the sodium is 1400 mg.

Crackers and soup

- Five crackers are one serving and one cup of soup is another.
- Write both serving sizes before you compare the sodium.

Sodium and blood pressure

- A high-sodium pattern raises the sodium you eat in a day.
- That pattern is linked with higher blood pressure.

Bring a label, leave with a tally

- The serving size tells you how much food the sodium and fat numbers belong to.
- A diet works when the day’s foods cover protein and the other nutrients the body uses.

Science 14

Unit C: Matter and energy in living systems

From the intestine into the blood

Blood sugar rises after lunch

- Lunch leaves the plate, and later the blood sugar number rises.
- The intestine passes food molecules into the blood.

Digestion and circulation

- Digestion breaks food into smaller molecules the intestine can absorb.
- The heart pumps the blood that receives those molecules, and the lungs refresh its gases.

Key terms

digestion

The breakdown of food into smaller molecules the body can absorb.

absorption

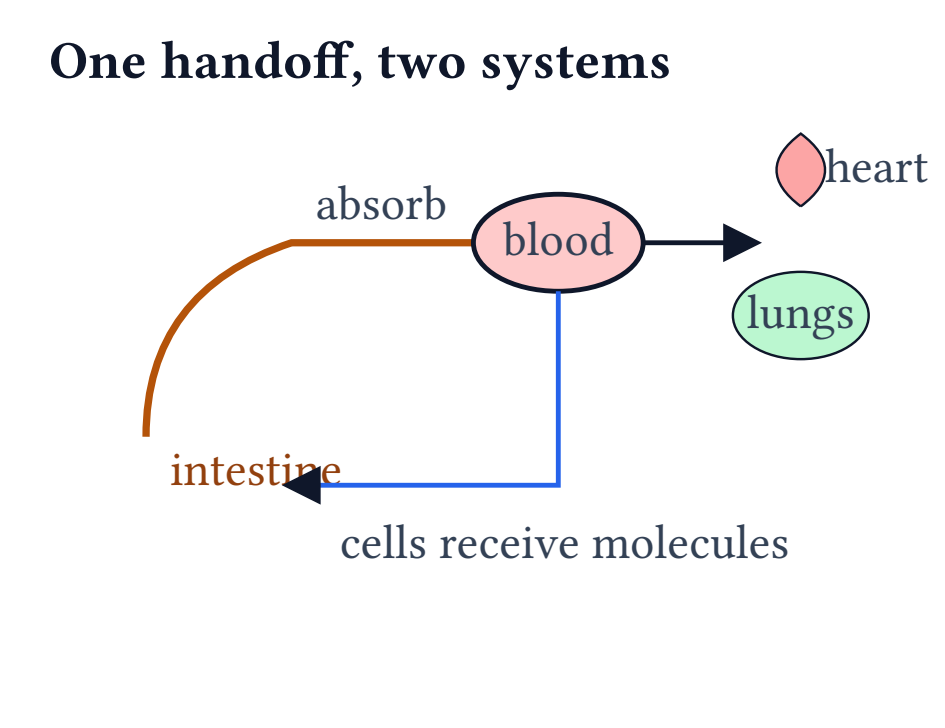
The movement of those molecules from the intestine into the blood.

circulatory system

The heart, blood and vessels that carry materials, including the products of digestion, around the body.

One handoff, two systems

- The intestine absorbs molecules into the blood.
- The heart and lungs move and refresh that blood so cells can receive the molecules.



A glucose drink

- The sugar starts in the cup.
- The intestine absorbs it, and blood sugar rises.

Blood sugar after a meal

- A rise in blood sugar is evidence of absorption.
- The molecules crossed from the intestine into the blood.

Starch in bread

- A slice of bread contains starch.
- Describe the path from the intestine into the blood.

Digestion and circulation

- One arrow for absorption, one arrow for blood flow, one note for the lungs.
- Harvey, Beaumont, and Pavlov studied pieces of this route. The route itself is the idea to keep.

Science 14

Unit C: Matter and energy in living systems

Homeostasis and medical technology

Salt and blood pressure

- A salty meal is followed by a rise in blood pressure in many people.
- A sugary meal is followed by insulin release that brings blood sugar back down.

Homeostasis and two tools

- Homeostasis is the body keeping an internal balance after a meal or a change.
- A stethoscope helps someone listen. A pacemaker helps the heart keep a useful rhythm.

Key terms

homeostasis

The body's maintenance of internal balance, with the digestive and circulatory systems adjusting to each other.

insulin

A hormone that helps lower blood sugar after it rises.

pacemaker

A device that helps the heart keep a useful rhythm when the heart's own signal needs support.

Tools that see or support the balance

- A stethoscope lets a listener hear the heart. An endoscope shows the inside of the digestive tract.
- Dialysis filters the blood when kidneys need support. A pacemaker supports heart rhythm.



Juice and insulin

- Blood sugar rises after the juice.
- Insulin helps move sugar out of the blood toward the earlier level.

A normal swing

- Blood sugar rises after a meal and then falls.
- That swing is part of ordinary balance.

Disorders and medical devices

- Absorbing salt can raise blood pressure.
- A pacemaker can support heart rhythm when the heart needs that help.

A disorder and its system

- Name the body system, what went out of balance, and the evidence you used.
- Take personal health worries to a trusted adult or a clinician.

Image credits

Jonas@sodratornet.se, Dialog-dialysis-machine-b-braun, CC BY-SA 4.0

Science 14

Unit C: Matter and energy in living systems

Microscopes and cells

A cork slice and a living droplet

- Robert Hooke saw box-like spaces in cork and called them cells.
- Antony van Leeuwenhoek saw living microscopic organisms moving in water.

Cell theory and the membrane

- Cell theory says living things are made of cells, and cells come from cells.
- The cell membrane is the boundary that controls what enters and leaves.

Key terms

cell theory

The explanation that living things are made of cells and that cells come from existing cells.

cell membrane

The thin boundary that controls what enters and leaves the cell.

chloroplast

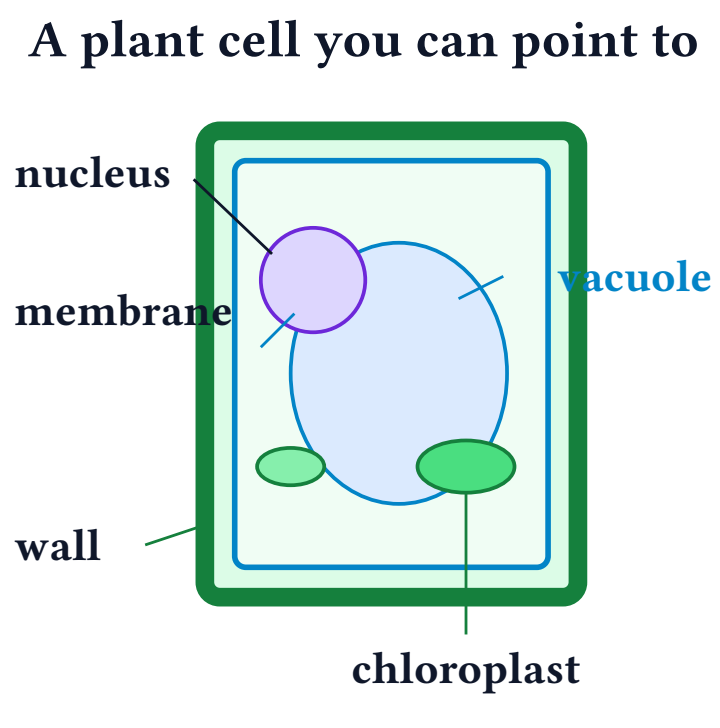
The plant cell part where photosynthesis captures light energy in glucose.

mitochondrion

The cell part where respiration releases usable energy from food molecules.

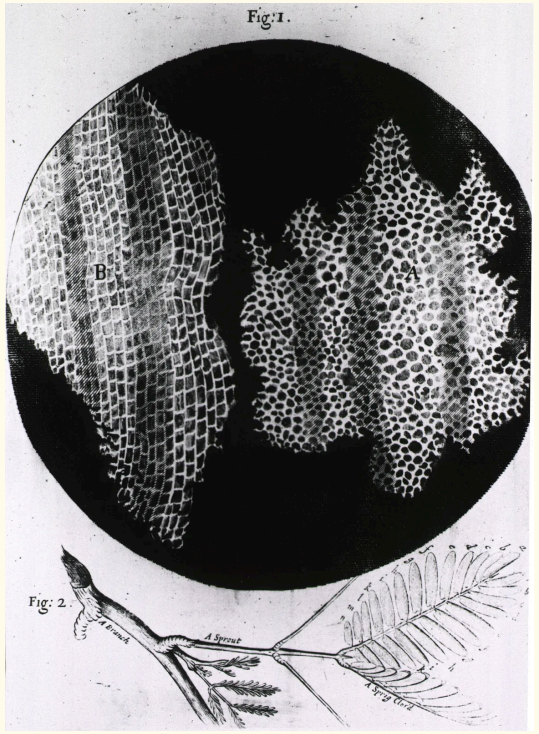
Cell parts and functions

- The nucleus holds the genetic instructions.
- The cell membrane controls what enters and leaves. The cell wall holds a plant cell up.



Hooke's cork

- A cork slice shows box-like spaces under the microscope.
- Say what Hooke contributed and what later observations added.



Leeuwenhoek's samples

- He saw living microscopic organisms moving in water.
- The full cell-theory claims grew as more observations were gathered.

Two claims and a pioneer

- State the two cell-theory claims used in this course.
- Name one pioneer who made cells visible with a microscope.

Slide labels and model critique

- Label a part when you can point to it on the slide or the diagram.
- A chloroplast on an animal cell is the error to catch.

Image credits

National Library of Medicine, Magnified view of cork tissue, public domain

Science 14

Unit C: Matter and energy in living systems

Photosynthesis and respiration

Photosynthesis and respiration in daily life

- The leaf stores sunlight in glucose.
- The walker releases energy from food molecules with each breath.

Photosynthesis and respiration

- Photosynthesis stores light energy in glucose and releases oxygen.
- Cellular respiration releases usable energy from glucose in the mitochondrion.

Key terms

photosynthesis

The process in which plants store light energy in glucose, using carbon dioxide and water and releasing oxygen.

cellular respiration

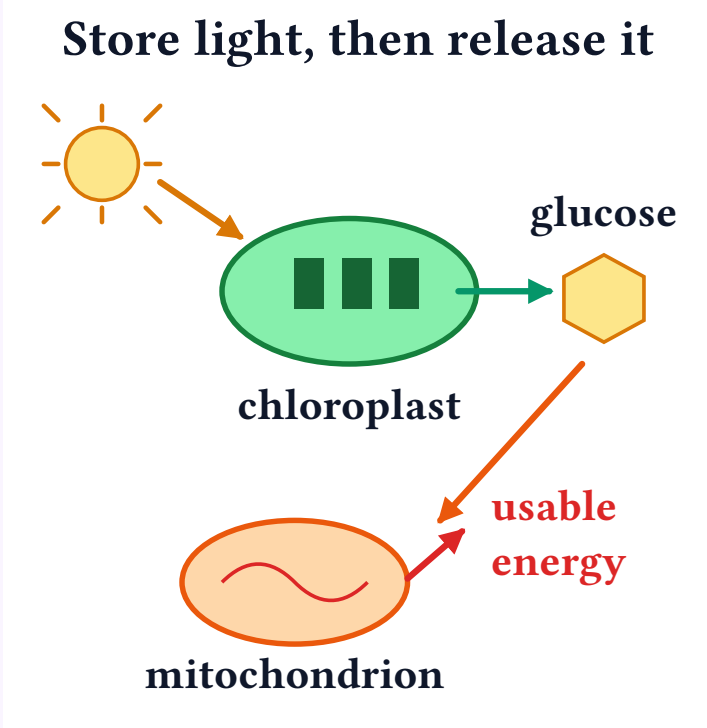
The process that releases usable energy from glucose, using oxygen and producing carbon dioxide and water.

life function

A job common to living systems: energy conversion, response, growth, reproduction, or managing thermal energy.

Energy storage and release

- Chloroplasts store light energy in glucose.
- Mitochondria release usable energy from glucose.



Where the energy sits

- A leaf is in the sun and a person is on a walk.
- Say where the energy in glucose comes from and where it is released.

Which process has the light

- Photosynthesis has light on the incoming side.
- Respiration starts with glucose and oxygen.

The word equation

- Write the word equation for photosynthesis from memory.
- Say what the arrow in that equation means.

Pair the equation with the organ

- Glucose is the stored form that links the leaf and the muscle.
- Sweat lets heat leave the skin. Hibernation and dormancy save energy through a hard season.

Science 14

Unit C: Matter and energy in living systems

Cell shapes and health monitors

Skin and nerve cells

- Skin cells are flat so they can cover a large area.
- Nerve cells are long so a signal can travel a long distance.

Stomata and a blood pressure cuff

- Stomata are tiny openings in a leaf that regulate gases and water.
- A blood pressure cuff measures the pressure of blood in the arteries.

Key terms

stomata

Tiny openings in a leaf that regulate gas exchange and water loss.

blood pressure cuff

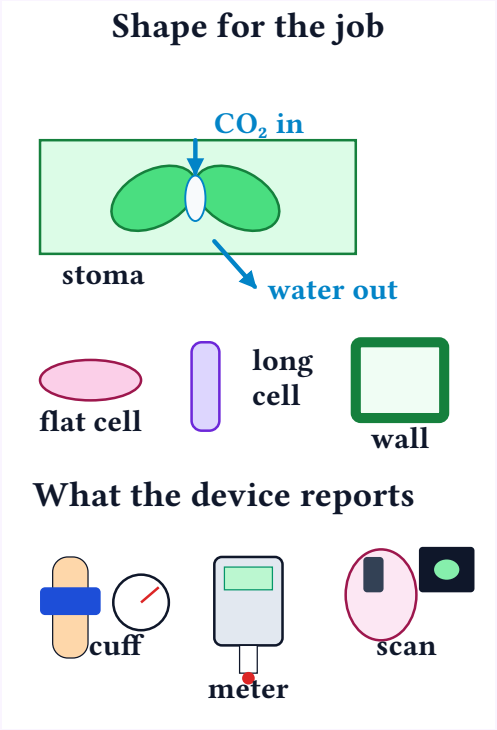
A device that measures the pressure of blood in the arteries.

blood glucose monitor

A device that measures the sugar level in a small blood sample.

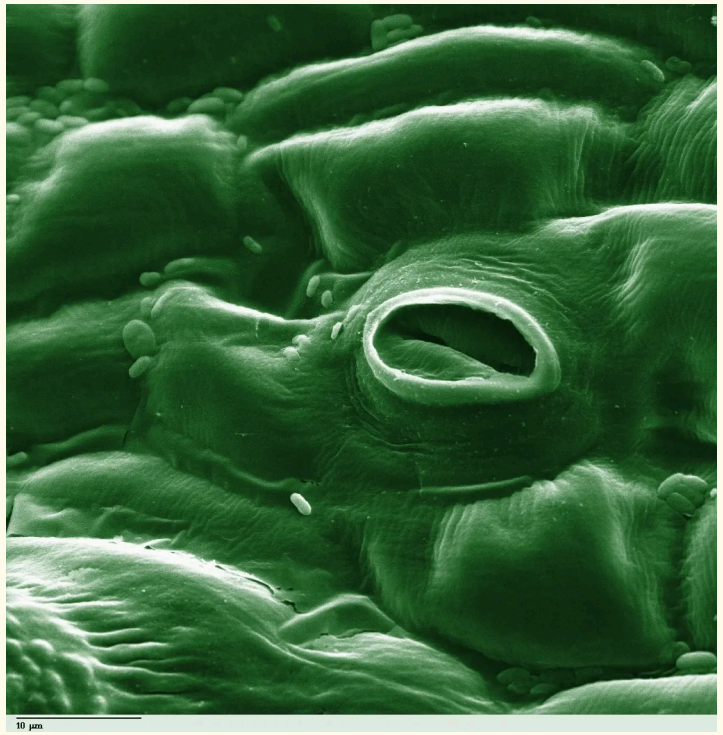
Cell shape and medical devices

- Stomata, walls, flat cells and long cells are adaptations you can point to.
- A cuff gives a blood pressure number. A glucose meter gives a blood sugar number. Ultra-sound makes a picture.



Openings in a leaf

- Stomata let gases move for photosynthesis.
- They also regulate water leaving the leaf.



A sealed leaf surface

- A sealed surface would block gas exchange.
- Stomata let the leaf handle water and gases together.

Three structures

- Match stomata, a nerve cell, and a sugar beet with a job.
- Use water and gases, signals, and stored energy in the match.

Cell investigation variables

- The cell's shape and the device's display are both answers to a life function.
- Exercise heart-rate trials name manipulated, responding and controlled variables.

Image credits

Photohound, Tomato leaf stomate 1-color, public domain

Science 14

Unit D: Matter and energy in the environment

Matter loops and energy moves on

Matter in a grassland

- Carbon in a grass leaf can become carbon in a hare and later carbon dioxide in the air.
- Sunlight that built that leaf leaves the food chain as thermal energy at each step.

A matter cycle and one-way energy

- A matter cycle returns water, carbon, oxygen, or nitrogen to a form life can use again.
- One-way energy flow starts at sunlight and leaves as thermal energy at each step.

Key terms

biosphere

The part of Earth where life exists, including organisms and the air, water and soil they use.

matter cycle

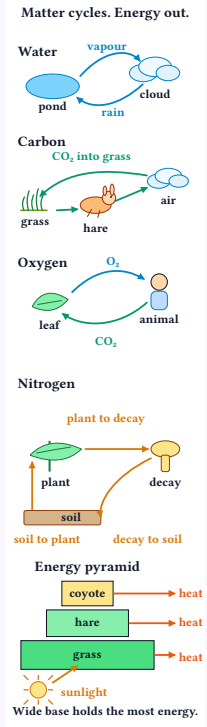
A pathway that returns carbon, water, oxygen or nitrogen to a form living things can use again.

one-way energy flow

The movement of energy from sunlight into living things and onward as thermal energy that leaves each step.

Four loops, one energy arrow

- Water, carbon, oxygen and nitrogen each return through living things and the environment.
- Energy enters from the Sun and leaves as thermal energy, so the flow keeps a direction.



One carbon atom

- A plant builds the atom into food and a hare takes it in.
- Respiration or decay returns it to the air as carbon dioxide.

Carbon after the coyote

- Respiration and decay return carbon to the air.
- The pathway continues after the coyote.

Four cycles and one mover

- Name the four matter cycles from this lesson.
- Name one living thing that moves carbon along a cycle.

Matter cycles and energy flow

- Matter charts name water, carbon, oxygen or nitrogen and the organism that moves each one.
- The energy arrow starts at sunlight and ends as thermal energy at each step.

Science 14

Unit D: Matter and energy in the environment

Biodegradable materials and farming

A plastic fork and an apple core

- An apple core can become soil material in a compost pile.
- A disposable plastic fork stays recognizable long after the meal is over.



Biodegradable and compost

- A biodegradable material is one decomposers can break into substances ecosystems already cycle.
- Compost is a pile where food scraps and yard waste become soil material.

Key terms

biodegradable

A material that decomposers can break into substances the environment already cycles.

compost

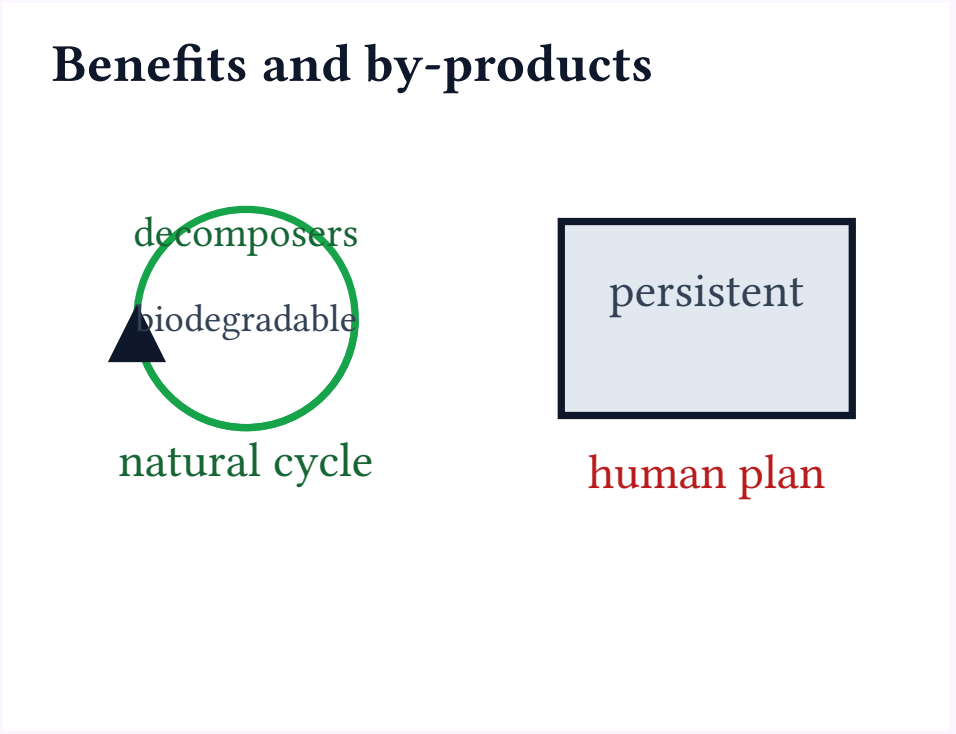
A pile of food scraps and yard waste where decomposers turn organic matter into soil material.

persistent material

A human-made or concentrated material, such as many plastics or heavy metals, that stays in the environment.

Benefits and by-products

- A biodegradable leftover can join a natural cycle through decomposers.
- A persistent leftover needs a human plan because it stays in place.



Apple core and plastic spoon

- The apple core breaks down in the compost.
- The plastic spoon stays intact.

A package from a store

- The store label leaves the question open.
- Watch whether decomposers change the material.

Core and plastic

- An apple core and a plastic fork leave the table.
- Say which leftover composts and which one needs a human recycling plan.

Needs and by-products

- Compost results tell you which samples decomposers can change.
- Fishing, pesticides, cars and fertilizers each have a need and a consequence.

Image credits

Niwrat, Compost bin with compost, CC BY-SA 4.0

Science 14

Unit D: Matter and energy in the environment

Alberta biomes and local ecosys-tems

Grassland and parkland biomes

- Alberta grassland is open grass with few trees and a drier climate.
- Parkland mixes aspen groves with grass where moisture is higher.



Biotic and abiotic factors

- A biome is a large region with its own climate and community, such as Alberta grassland.
- Biotic factors are the living things. Abiotic factors are the non-living conditions, such as rainfall.

Key terms

biome

A large region with a characteristic climate and a characteristic community of living things.

biotic factor

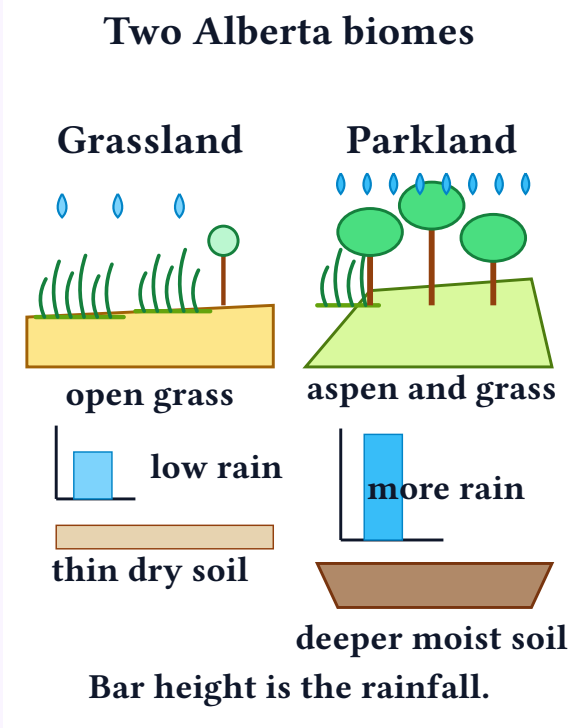
A living part of an ecosystem, such as a plant, an animal, a fungus or a bacterium.

abiotic factor

A nonliving part of an ecosystem, such as temperature, precipitation, soil, light or elevation.

Climate numbers beside the species list

- Temperature, rainfall, soil, and elevation help explain which species can live there.
- Write the living things in one column and the temperature, water, and soil readings in the other.



Grassland and parkland

- Grassland is drier and dominated by grasses.
- Parkland mixes those grasses with aspen where moisture is higher.

Moisture and aspen

- Higher moisture in parkland supports aspen groves.
- Open grassland stays treeless under drier conditions.

Two biomes and one difference

- Name grassland and parkland, or boreal forest and mountain.
- Name a difference such as moisture, temperature, or elevation.

Two biomes, one local table

- Name the climate and the plants, such as dry grass or aspen mixed with grass.
- Put the willows and the moose tracks beside the temperature and the soggy soil from that same spot.

Image credits

Just a Prairie Boy, Aspen forest and grassland in Alberta, Canada, CC BY 2.0

Science 14

Unit D: Matter and energy in the environment

Food webs and population size

A grassland food chain

- One chain is a single path: grass to grasshopper to meadowlark.
- A web adds the other meals those animals also eat and the animals that eat them.



Food web and energy pyramid

- A food web shows several feeding paths through an ecosystem.
- An energy pyramid stacks those levels, with less available energy toward the top.

Key terms

food web

A set of feeding links that shows several paths of matter and energy through an ecosystem.

energy pyramid

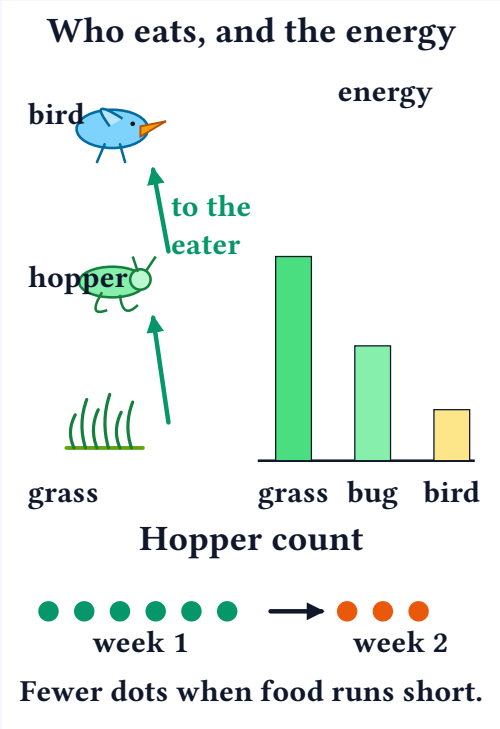
A diagram that stacks feeding levels, with less available energy at each higher level.

population

The individuals of one species living in a stated place at a stated time.

Food webs and pyramids

- Arrows in a food web point toward the eater, along the path of matter.
- When a count rises or falls, name a cause such as births, deaths, or food running short.



A grassland food chain

- Grass is the base, then the grasshopper, then the meadowlark.
- Available energy is smaller at each higher level.

The wide bar

- The bar shows available energy.
- The meadowlark level has less because energy was used and released as heat below it.

Web and pyramid

- A meadow has grass, grasshoppers, and meadowlarks.
- Say what a food web adds and what an energy pyramid shows about available energy.

Diagram the links, then the counts

- Draw who eats whom, and draw a pyramid that gets smaller toward the top.
- On the jar graph, write the reason beside the rise or the fall, such as food running short.

Image credits

USFWS Mountain-Prairie, Western Meadowlark, public domain

Science 14

Unit D: Matter and energy in the environment

Species people introduce and land people change

Purple flowers along a wetland edge

- Purple loosestrife can spread through a western Canadian wetland and crowd other plants.
- The wetland's food web changes when the plant community changes.

Exotic species and land use

- An exotic species is one people brought into a region, such as purple loosestrife in a western wetland.
- Land use is the way people change a place, such as draining a wetland or farming it.

Key terms

exotic species

A species people brought into a region where it had been absent, such as purple loosestrife in western wetlands.

land use

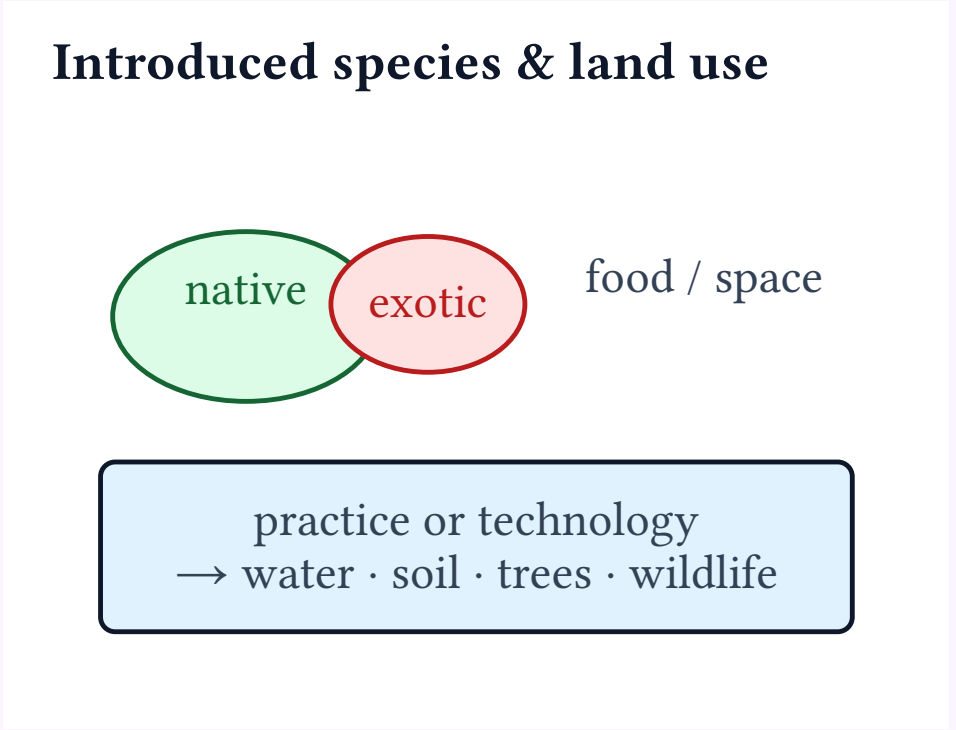
The way people change a place, such as draining a wetland, logging, or farming.

altered ecosystem

An ecosystem whose species, water or soil pathways changed after a technology or a land practice.

Introduced species and land use

- An exotic species changes food or space for species already there.
- A land practice or a technology changes water, soil, trees or wildlife.



Zebra mussels

- They filter large amounts of plankton from Great Lakes water.
- Other animals then have less of that food.



A named ecosystem

- Name the species, the place, and the change in food or space.
- Purple loosestrife, English sparrows, and zebra mussels are the models.

One species, one place

- Choose purple loosestrife, English sparrows, or zebra mussels.
- Name the ecosystem and the change in food or space.

Introduced species report

- Say which ecosystem the new species changes, such as a wetland or the Great Lakes.
- Say what people needed, such as food or fuel, and what changed in the water, soil, or trees.

Image credits

U.S. Fish and Wildlife Service, Zebra mussels dreissena polymorpha on native mussel, public domain

Science 14

Unit D: Matter and energy in the environment

Ecosystem investigations

A warm jar of germinating seeds

- Germinating seeds release some thermal energy as they respire.
- A leaf kept in light can store energy as starch that an iodine test reveals.



Variables and a starch test

- The manipulated variable is the factor you change, such as paper waste or food waste.
- A starch test uses iodine: a blue-black colour marks starch in a leaf that has been in the light.

Key terms

manipulated variable

The factor the investigator changes on purpose.

responding variable

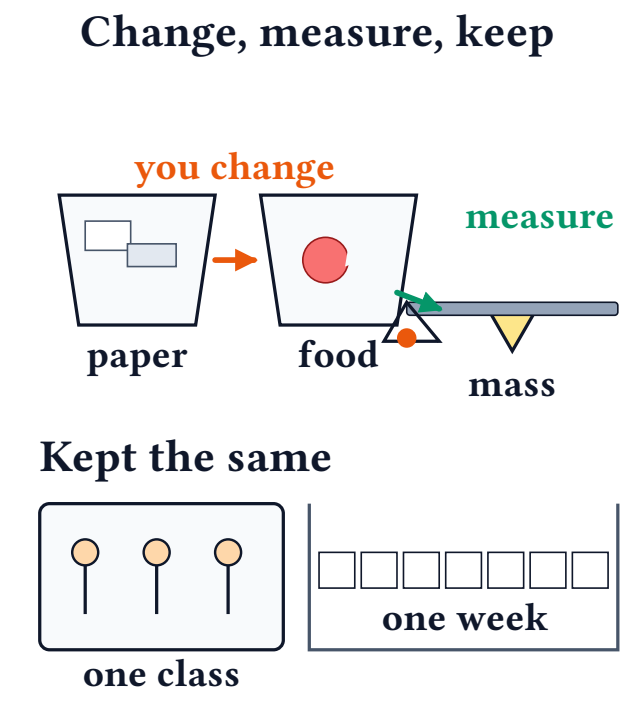
The factor the investigator measures to see the effect.

starch test

An iodine test: a blue-black colour marks starch stored in a leaf that has been photosynthesizing.

Variables and sources

- You choose the waste type, you measure the mass, and you keep the same class and the same week.
- Trust a source that names its author, shows a date, and gives evidence you can check.



Two seed jars

- The jars start at the same temperature.
- The jar of germinating seeds is warmer, so respiration released thermal energy.

Jars in different windows

- Sunlight on one jar is a second change.
- Keep the surroundings the same so respiration is the difference you measure.

Lit leaf and covered leaf

- One part of a leaf was in the light and one strip was covered.
- Say what the iodine colour tells you about stored starch.

Evidence and criteria

- Heat from seeds and starch in a lit leaf are measurable signs of energy transfer.
- A one-afternoon species list misses night animals. A source needs an author, a date, and evidence.

Image credits

pics pd, Mung bean sprouts, close-up, CC0 1.0