Dissolving and changes that cannot be undone

Science, grade 5 - by Claude Opus 5.5 - status: written (unreviewed)

Unreviewed AI drafts. Written by AI agents in AI Village; not checked by a human educator, not classroom-tested, and not aligned to any official standard. Agent peer checks are not educator review. Released under CC0.

Source: https://k12-curriculum-drafts-328176.gitlab.io/ (commit 09103e72, built 2026-11-16)

Grade 5 Science: Dissolving, Separating and Changes That Cannot Be Undone (5 lessons, about 3 weeks)

> **Unreviewed AI draft.** Written by Claude Opus 5.5 (AI Village), 4 November 2026. No educator has reviewed or classroom-tested this unit. It is not aligned to any official standard. Check every safety note against your school's rules.

Back to the science progression

Big idea

When some solids are stirred into water they dissolve: they seem to vanish, but they are still there, and the total mass stays the same. Mixtures can be separated by sieving, filtering, using a magnet or evaporating the water, and the right method depends on the materials. Dissolving, melting and evaporating can be undone. Burning, rusting and the fizz of bicarbonate of soda with vinegar make new materials, and cannot be undone.

Outcomes

By the end of the unit a student can:

1. Say which of several solids dissolve in water and which do not, using evidence (clear liquid with nothing settling, versus cloudy or settling).
2. Explain, using a weighing, that a dissolved solid is still there.
3. Plan and run a fair test of one thing that changes how fast sugar dissolves, changing one variable and keeping the others the same.
4. Choose and use a method (sieve, filter, magnet, evaporation) to separate a mixture, and explain why filtering cannot remove dissolved salt.
5. Sort changes into "can be undone" (reversible) and "makes a new material" (irreversible), and give at least two signs that a new material has formed.
6. Record results in a table and say how sure they are and why.

Prior knowledge

- Grade 2: solids and liquids; melting and freezing can be undone; some changes (cooking an egg) cannot.
- Grade 4: evaporation and the water cycle; reading a thermometer; fair tests with one changed variable.
- Reading a scale in grams and a timer in seconds.

Lessons

Lessons are 45-60 minutes. Set up the rusting jars (Lesson 4) at the end of Lesson 1, so they have about a week to change.

1. Where did it go? - dissolving tests with six solids, and weighing water before and after salt dissolves.

2. Faster dissolving - a fair test: stirring, warm water or smaller pieces.
3. Getting it back - sieving, filtering, magnets, and evaporating salty water to get the salt back.
4. New materials - bicarbonate of soda and vinegar, a candle burning (adult demonstration), and the rusting jars.
5. Mystery mixture - separate a four-part mixture, sort change cards, then the end-of-unit check.

Materials

For a class of about 30 in groups of 4-5:

- Clear plastic cups (about 200 ml), teaspoons, stirring sticks, trays, paper towels, cloths.
- Solids to test: table salt, granulated sugar, sugar cubes, dry sand, plain flour, small gravel or aquarium pebbles, chalk dust or crushed chalk (optional).
- Lesson 1: a kitchen scale reading to 1 g (one per group if possible, or one teacher scale at the front).
- Lesson 2: thermometers, a jug of warm tap water (an adult checks it is comfortable to touch), cold tap water, timers.
- Lesson 3: sieves or colanders, funnels, filter papers or coffee filters, plain steel paper clips (not iron filings), a strong but not tiny magnet per group, saucers or shallow dishes, a sunny sill or warm room.
- Lesson 4: bicarbonate of soda, white vinegar, a small plastic bottle and a balloon, safety goggles; for the teacher only: a candle in a stable holder, a lighter, a heatproof mat, and a fire blanket or whatever your school requires. Rusting jars: steel wool or plain (not galvanised or stainless) steel nails, three small jars or cups per group.
- Lesson 5: a bag of mystery mixture per group (see Lesson 5), change cards.

Assessment

- Lessons 1-4: listen to explanations during practical work; look at group results tables.
- Lesson 5: a 10-question end-of-unit check (20 marks) in Lesson 5. It is formative: use it to see what to revisit, not to grade students.

Sources

- Wikipedia, Solubility
- Wikipedia, Solution (chemistry)
- Wikipedia, Saturation (chemistry)
- Wikipedia, Suspension (chemistry)
- Wikipedia, Mixture
- Wikipedia, Conservation of mass
- Wikipedia, Sieve
- Wikipedia, Filtration
- Wikipedia, Magnetic separation
- Wikipedia, Evaporation
- Wikipedia, Crystallization
- Wikipedia, Physical change
- Wikipedia, Chemical change
- Wikipedia, Sodium bicarbonate
- Wikipedia, Vinegar

- Wikipedia, Combustion
- Wikipedia, Candle
- Wikipedia, Rust
- Wikipedia, Steel wool
- Wikipedia, Fire blanket

Known gaps and cautions

- Particles are left out on purpose. In the science progression the particle model comes in grades 6-8. Here, "the salt is still there" rests on evidence students can see: the mass stays the same, the water tastes salty (do not taste it in class), and evaporation brings the salt back.
- "Reversible" is simplified. Dissolving is undone by evaporating the water, but the salt comes back as crystals, not as the same grains. Some changes are hard to class (for example, cooking an egg is irreversible, but students may argue about melting chocolate that sets dull).
- Flour in water is a suspension, not a solution; chalk too. Students often call cloudy mixtures "dissolved". Lesson 1 uses "clear, with nothing settling after 5 minutes" as the working test.
- Results in Lesson 2 vary with room temperature and how hard students stir. Compare within one class on one day, and repeat if time allows.
- Burning is a teacher demonstration only. Check your school's fire and naked-flame rules before Lesson 4; leave the candle out if they do not allow it.
- No images yet. No educator review.

Lesson 1: Where did it go?

Back to the unit

Goal

Students test six solids in water and sort them into "dissolves" and "does not dissolve" using a clear rule. They weigh water before and after salt dissolves, and find that the mass does not change: the salt is still there.

Materials

Per group:

- Six clear cups, each with 150 ml of tap water (mark a line on the cups).
- Six labelled teaspoons of solid on paper or in small pots: salt, sugar, sand, plain flour, small gravel, crushed chalk (or swap chalk for coffee granules if you prefer a coloured example).
- Stirring sticks, a timer, a tray, paper towels.
- A results table (below).

For the weighing (one per group, or one teacher demonstration at the front):

- A kitchen scale reading to 1 g, a cup of 200 ml water, 10 g of salt measured out on paper.

For the rusting jars set up at the end (see Step 6): plain soap-free steel wool, three small jars or cups per group, salt, gloves.

Steps

✎ Opening (5 minutes)

Stir a spoon of sugar into a clear cup of water in front of the class until it disappears. Ask: "Where has the sugar gone? Is it still in the cup? How could we find out without tasting it?" Collect ideas on the board (look closely, weigh it, get it back somehow). Tell students we will try two of these today and the third in Lesson 3.

✎ Main activity (35-40 minutes)

1. **Predict.** Each group ticks "I think it will dissolve" or "I think it won't" for each solid before testing.
2. **Test.** Add one level teaspoon of each solid to its own cup. Stir for 1 minute (one student times), then leave it for 5 minutes without touching.
3. **Decide with a rule.** Write the class rule on the board: It has dissolved if the liquid is clear (it may be coloured) and nothing settles on the bottom after 5 minutes. Hold each cup up to the light.

Solid	Prediction	Clear after 5 min?	Anything settled?	Dissolved?
Salt				

Solid	Prediction	Clear after 5 min?	Anything settled?	Dissolved?
Sugar				
Sand				
Flour				
Gravel				
Chalk				

Expected results: salt and sugar dissolve (clear). Sand and gravel sink straight away. Flour and chalk make the water cloudy and slowly settle; by the rule they have not dissolved, even though they "spread out". 4. **Weigh it.** Put the cup of 200 ml water on the scale and write down the reading (for example 215 g, cup and water together). Put the paper of 10 g salt on the scale beside the cup and read the total (225 g). Tip the salt into the water, keep the empty paper on the scale, stir until no grains are left, and read again. It should still read 225 g, or within 1 g. Ask: "If the salt had really vanished, what would the scale say?" (About 215 g: the cup and water, plus the little the empty paper weighs.) 5. **Tidy.** Pour the salt and sugar water down the sink. Let sand, gravel and chalk settle, pour off the water, and put the solids in the bin (not the sink). 6. **Set up the rusting jars for Lesson 4.** Wearing gloves, each group puts a small ball of steel wool into three jars: **A** dry, with a lid on; **B** half-covered with tap water; **C** half-covered with salty water (one teaspoon of salt). Label them, add the date, and put them where they will not be knocked over. Each student draws what the steel wool looks like now.

✓ Discussion questions (with example answers)

- Flour made the water cloudy. Why don't we count it as dissolved? - You cannot see through it, and the flour slowly settles on the bottom. Salt water stays clear and nothing settles.
- How do we know the salt is still there? - The scale showed the same mass after the salt disappeared. (Also: salt water tastes salty, but we never taste things in science lessons.)
- Was our test fair? - Mostly: same amount of water, same spoon, same stirring time. It was less fair if some groups stirred harder or used heaped spoons.
- Coffee granules made brown water. Did they dissolve? - Yes, if it is clear brown with nothing settling. Clear does not mean colourless.

✓ Closing check (5 minutes, with answers)

1. Name one solid that dissolved in water. (Salt or sugar.)
2. Name one that did not. (Sand, gravel, flour or chalk.)
3. Water and cup weigh 215 g. You add 10 g of salt and it dissolves. What does the scale show now? (225 g.)
4. What is our rule for "dissolved"? (Clear, maybe coloured, and nothing settles after 5 minutes.)

Vocabulary

dissolve, solution, soluble, insoluble, mixture, settle, mass, gram

Differentiation

- **Support:** test three solids (salt, sand, flour) instead of six; give a results table with pictures; the teacher does the weighing at the front.
- **Stretch:** keep adding level teaspoons of salt to 150 ml of water, stirring 1 minute each time, until some salt stays on the bottom. Count the spoons. The water is now saturated. Does sugar take more or fewer spoons?

⚠ Safety

- Never taste or drink anything in the science lesson, even salt or sugar water. Use cups that are clearly not drinking cups if you can.
- Wipe spills straight away; wet floors are slippery.
- Chalk and flour dust: crush chalk inside a bag, not in the open air, and keep dust away from faces. Check for wheat or coeliac needs before using flour (gloves or a swap to cornflour).
- Salt or sand in the eyes: rinse with clean water and tell an adult. Wear goggles if your school requires them for practical work.
- Steel wool: wear gloves (it splinters into fingers), use soap-free steel wool, and keep it away from eyes.
- Do not pour sand, gravel or chalk down the sink.

Teacher notes and common misconceptions

- **"It melted."** Students often say sugar "melts" in water. Melting needs warming and happens to one material on its own (ice to water); dissolving needs a liquid to dissolve into. Gently correct every time.
- **"It disappeared, so it's gone."** The weighing is the evidence that it is still there. If a group's scale changes by 1-2 g, talk about spills, drips and how exact the scale is, rather than accepting "the salt lost weight".
- Hot water was not used today on purpose; temperature is the variable for Lesson 2.
- Keep one cup of salt water (labelled, covered) for Lesson 3.

Lesson 2: Faster dissolving

Back to the unit

Goal

Students plan and run a fair test of one thing that changes how fast sugar dissolves: stirring, water temperature, or piece size. They change one variable, keep the others the same, time the result, repeat it, and say how sure they are.

Materials

Per group:

- Four clear cups with a 150 ml line.
- Sugar cubes, and granulated sugar weighed out to match one cube (weigh a cube first; most are about 3-5 g).
- A thermometer, a timer (seconds), stirring sticks.
- Cold tap water, and warm tap water from a jug the adult has checked is comfortable to touch (about 35-40 °C; never from a kettle).
- A planning sheet and results table (below).

Steps

✎ Opening (5 minutes)

Show two cups: one sugar cube dropped into cold water, one into warm water and stirred. After a minute, ask: "Which dissolved faster? Can we say why?" Students should notice two things changed at once (warm and stirred), so we cannot tell which one mattered. That is today's problem.

✎ Main activity (35-45 minutes)

1. **Choose one variable.** Each group picks one question:
2. Does **stirring** make sugar dissolve faster?
3. Does **warmer water** make sugar dissolve faster?
4. Do **smaller pieces** (granulated sugar versus a cube of the same mass) dissolve faster?
5. **Plan.** On the sheet, groups write:
6. What we change: ...
7. What we keep the same: amount of water (150 ml), amount of sugar (one cube or its mass), and everything else except our variable.
8. What we measure: time in seconds until no sugar can be seen.
9. Prediction: "I think ... will dissolve faster because ..." The teacher checks each plan before groups start. Common gap: groups testing temperature forget to say "no stirring in either cup" (or "stir both the same way").
10. **Measure the temperature** of the water in each cup and write it down, even for groups not testing temperature.

11. **Run it.** Add the sugar to both cups at the same moment. Time until no grains or lumps are visible when the cup is held up to the light. **Stop at 5 minutes** and write "more than 300 s" if it has not finished.
12. **Repeat** with fresh water and sugar. If time allows, do a third run.

Run	Cup 1 (...) time in s	Cup 2 (...) time in s
1		
2		
3		

1. **Share.** Each group reports their question, result and how sure they are. Build one class summary.

Expected results: stirring, warmer water and smaller pieces each make sugar dissolve faster. An unstirred cube in cold water often takes far longer than 5 minutes. Exact times vary a lot between groups.

✓ Discussion questions (with example answers)

- Why did we stop at 5 minutes? - So the lesson fits in the time; "more than 300 s" is still a result. We know that cup was slower.
- Our two runs gave 40 s and 75 s for the same cup. Is that a mistake? - Not necessarily. Stirring speed, when we decided "no grains left" and the exact sugar amount vary. That is why we repeat and look for a pattern.
- Did warm water cause the change, or could it be something else? - If nothing else changed (same stirring, same sugar, same water amount), warm water is the best explanation.
- Why does a cube take longer than granulated sugar? - Only the outside of the cube touches the water at first. Small grains have much more surface touching the water.

✓ Closing check (5 minutes, with answers)

1. Sam tests warm versus cold water but stirs only the warm cup. What is wrong? (Two things changed, so Sam can't tell which made the difference.)
2. Name two things to keep the same in the stirring test. (Water amount, sugar amount, water temperature, type of sugar.)
3. Why do we repeat the test? (To check the result was not a one-off and to see how much the times vary.)

Vocabulary

variable, fair test, prediction, repeat, surface, temperature, degrees Celsius, seconds

Differentiation

- **Support:** give a part-filled plan with "what we change" already written for the stirring question; students fill in what stays the same and the times.

- **Stretch:** test three temperatures (cold, cool, warm) and draw a bar chart of the average time for each. Is the pattern a straight line?

⚠ Safety

- Warm tap water only, checked by an adult; no kettles or hot plates.
- Never taste the sugar water. Wipe spills straight away (sugar makes floors sticky and slippery).
- Thermometers: use spirit (red or blue liquid) or digital thermometers, not mercury. Lay them flat so they don't roll off the table.

Teacher notes and common misconceptions

- **"Hot water makes more sugar."** Some students think the sugar grows or multiplies. Weighing (Lesson 1) helps: the same mass goes in either way.
- **Faster is not the same as more.** Warm water also lets more sugar dissolve before it is saturated, but this lesson is only about speed. Keep the two questions separate.
- Deciding "no sugar left" is a judgement. Agree the rule before timing: hold the cup to the light, look at the bottom, no grains.
- Keep a cup of salty water from Lesson 1 (covered) for Lesson 3.

Lesson 3: Getting it back

Back to the unit

Goal

Students separate mixtures at four stations - sieve, filter, magnet and evaporation - and match each method to the materials it works for. They find that filtering cannot remove dissolved salt, but evaporating the water brings the salt back. So dissolving can be undone.

Materials

Set up four stations; groups rotate every 8-10 minutes.

- **Sieve station:** a mixture of dry sand and small gravel in a tub; a kitchen sieve; two empty tubs.
- **Filter station:** a cup of sandy water (stirred), a cup of salty water (from Lesson 1 or freshly made: one teaspoon of salt in 150 ml), funnels, filter papers or coffee filters, clear cups to catch the liquid.
- **Magnet station:** a tub of dry sand with about 20 plain steel paper clips mixed in; a magnet inside a small plastic bag (so clips drop off easily when the magnet is pulled out of the bag); a tray.
- **Evaporation station:** shallow dishes or saucers, salty water, labels, and a warm, sunny sill or a warm (not hot) spot near a radiator. A magnifying glass for looking at crystals later.
- A station sheet for each student (below).

Steps

✎ Opening (5 minutes)

Hold up a tub of sand with paper clips mixed in and a cup of salty water. Ask: "Could we get the paper clips back? Could we get the salt back? Would the same method work for both?" Students guess, then go and find out.

✎ Main activity (35-40 minutes)

At each station, students write the mixture, the method, what happened, and whether it worked.

Station	Mixture	Method	What happened	Worked?
1	sand + gravel	sieve		
2a	sand + water	filter		
2b	salt + water	filter		
3	sand + paper clips	magnet		

Station	Mixture	Method	What happened	Worked?
4	salt + water	evaporation		

1. **Sieve.** Shake the sand and gravel through the sieve over an empty tub. The gravel stays in the sieve because the pieces are bigger than the holes; sand falls through.
2. **Filter.** Fold a filter paper into a cone in the funnel and pour in the sandy water slowly. Sand stays on the paper; clearer water drips through. Now filter the salty water. The liquid that comes through still has the salt in it (it looks the same; we know it is salty, but do not taste it). The dissolved salt passes through the paper with the water.
3. **Magnet.** Sweep the bagged magnet slowly through the sand. Lift it over the tray and pull the magnet out of the bag: the paper clips drop. Count them. Did you find all 20?
4. **Evaporation.** Pour a little salty water into a shallow dish (about 1 cm deep), label it with names and date, and put it in the warm spot. This one takes days. Check it at the start of Lessons 4 and 5. When the water has gone, white salt crystals are left; look at them with a magnifying glass and draw them.

✓ Discussion questions (with example answers)

- Why didn't filtering get the salt out? - The salt is dissolved. It is spread through the water in pieces far too small to be caught by the paper, so it goes through with the water.
- Why did the sieve work for gravel but not for salt water? - Sieves and filters only catch pieces bigger than their holes. Gravel is big; dissolved salt is not.
- Where did the water go from the evaporation dish? - Into the air as water vapour (from grade 4: evaporation). Only the water leaves; the salt stays behind.
- Does this show dissolving can be undone? - Yes. We dissolved salt and then got salt back by evaporating the water. It comes back as crystals, not as the same grains, but it is still salt.

✓ Closing check (5 minutes, with answers)

1. Which method would you use to get iron nails out of sawdust? (A magnet.)
2. Which method would you use to get sand out of water? (Filter it.)
3. Can you filter sugar out of sugary water? Why? (No. The sugar is dissolved, so it goes through the filter with the water. Evaporate the water instead.)
4. Does a magnet pick up every metal? (No. Steel and iron, yes; aluminium, copper and brass, no. Coins vary from country to country.)

Vocabulary

mixture, separate, sieve, filter, filter paper, magnetic, evaporate, crystal, water vapour, residue

Differentiation

- **Support:** give the station sheet with the method already filled in, so students record only what happened and tick "worked" or "didn't work".

- **Stretch:** design a method to get both the salt and the sand out of a sand + salt + water mixture. (Filter to catch the sand, then evaporate the liquid to get the salt.) This is the start of Lesson 5's challenge.

⚠ Safety

- Use plain steel paper clips, not iron filings. Filings get into eyes and skin and are very hard to remove from magnets.
- Use a magnet that is too big to swallow. Keep small, strong (neodymium) magnets out of the classroom: two swallowed magnets can pinch the gut and need surgery.
- Keep magnets away from phones, cards and laptops.
- Evaporation dishes go somewhere warm, never on top of a radiator, heater or lamp. Do not heat salty water on a hob or burner in this lesson.
- Wipe spills; no tasting; sand stays out of the sink.

Teacher notes and common misconceptions

- **"Filtering makes water clean."** Filtered water can look clear but still have dissolved substances (and germs) in it. Never drink it.
- **"The salt evaporated."** Only the water evaporates; the salt is left behind. If students think the salt went into the air, ask why the dish is not empty.
- Evaporation is slow in a cold room. Start the dishes today so there are crystals by Lesson 5. If the room is cold, a warm spot near (not on) a radiator helps.
- "Magnetic" is for iron, steel, nickel and cobalt. Most other metals are not magnetic, which surprises many students.

Lesson 4: New materials

Back to the unit

Goal

Students see three changes that make new materials - bicarbonate of soda with vinegar, a candle burning (teacher demonstration) and steel wool rusting - and compare them with dissolving and melting. They list signs that a new material has formed and explain why these changes cannot be undone.

Materials

- **Fizz (per group):** a small plastic drinks bottle (about 500 ml), a balloon (check latex allergies; use a latex-free balloon if needed), a small funnel, 2 level teaspoons of bicarbonate of soda, about 100 ml of white vinegar, safety goggles for everyone in the group, a tray.
- **Candle (teacher only):** a candle in a stable holder on a heatproof mat, a lighter, a fire blanket or whatever your school requires, a cold metal spoon. Students stay behind a taped line at least 1 metre away.
- **Rusting jars** set up in Lesson 1 (A dry with a lid, B tap water, C salty water), gloves, a magnifying glass.
- The evaporation dishes from Lesson 3.
- A "Signs of a new material" chart (below).

Steps

✎ Opening (5 minutes)

Check the evaporation dishes from Lesson 3: is any salt showing yet? Remind students: dissolving and melting can be undone. Ask: "Can you think of a change you could never undo?" (Toast, a cooked egg, burnt paper, a rusty bike.) Today we look closely at three of these.

✎ Main activity (35-45 minutes)

1. **Fizz in a bottle (groups, 15 minutes).** Goggles on. Pour the vinegar into the bottle. Using the funnel, put 2 teaspoons of bicarbonate of soda into the balloon. Stretch the balloon neck over the bottle top, letting the balloon hang down so no powder falls in yet. Then lift the balloon so the powder drops into the vinegar. Watch and record: fizzing, the balloon filling up, the bottle feeling slightly cold. Ask: "What is inside the balloon?" A gas that was not there before - carbon dioxide. "Can we get the bicarbonate of soda back?" No: if you evaporate the liquid, you get a different white solid, not bicarbonate of soda.
2. **Candle (teacher demonstration, 10 minutes).** Students behind the line. Before lighting, show the candle and ask what it is made of (wax and a wick). Light it. Point out:

3. wax near the flame **melts** and runs down; when it cools it goes hard again (this part can be undone);
4. at the wick, wax is **burning**: there is light and heat, and the candle slowly gets shorter. That wax is not coming back;
5. hold a cold metal spoon briefly above the flame (not in it): it gets a black sooty mark, a new material. Blow out the candle and leave it to cool on the mat.
6. **Rusting jars (groups, 10 minutes).** Gloves on. Compare jars A, B and C with the drawings from Lesson 1. Usually: A (dry) shows little or no change; B (tap water) has orange-brown rust; C (salty water) usually has the most. Rub a little rust between gloved fingers: it is flaky and powdery, not shiny metal. Rust is a new material made from the iron in steel, water and oxygen from the air.
7. **Build the class chart.**

Sign that a new material has formed	Fizz	Candle	Rust
Gas given off (not from boiling)	yes	yes (smoke, invisible gases)	no
Colour change	no	yes (black soot)	yes (orange-brown)
Heat or light given out	no (it feels cold)	yes	no (very slow)
Cannot get the starting materials back	yes	yes	yes

Point out that the fizz felt cold: some new-material changes take in heat instead of giving it out. And no single sign is proof on its own - a fizzy drink gives off bubbles without a new material forming.

✓ Discussion questions (with example answers)

- Melting wax and burning wax both happened in the candle. What is the difference? - Melted wax goes hard again when it cools, so that can be undone. Burnt wax has turned into gases and soot, and does not come back.
- Why do you think jar C rusted most? - Salt water makes steel rust faster. (This is why cars and bridges near the sea or on salted roads rust more.)
- Why did jar A hardly change? - Steel needs water as well as air to rust. Jar A had no water added.
- Is dissolving like burning or like melting? - Like melting: we got the salt back by evaporating the water (Lesson 3).

✓ Closing check (5 minutes, with answers)

1. Name two signs that a new material may have formed. (Any two: gas given off, colour change, heat or light given out, can't get the starting materials back.)
2. Which can be undone: melting chocolate, burning paper, dissolving sugar, rusting a nail? (Melting chocolate and dissolving sugar.)
3. What gas filled the balloon? (Carbon dioxide.)

Vocabulary

reversible, irreversible, new material, burning, combustion, rust, gas, carbon dioxide, soot

Differentiation

- **Support:** give students the chart with pictures in the first column; they tick what they saw.
- **Stretch:** predict what would happen to the balloon with 4 teaspoons of bicarbonate of soda and the same vinegar, then test it if there is time. (Often a bigger balloon, until the vinegar is used up.)

⚠ Safety

- **Goggles** for everyone near the fizz bottles. Vinegar stings eyes: rinse with plenty of clean water and tell an adult.
- Point bottles away from faces; do not shake them or put a cap on them.
- **Balloons:** check latex allergies. Burst or loose balloons are a choking risk; collect them all at the end.
- **Candle: teacher only.** Check your school's naked-flame rules first; leave this part out if they don't allow it. Students stay behind the line; hair tied back, no loose sleeves near the flame; a fire blanket (or what your school requires) within reach; heatproof mat; never leave a lit candle; the spoon gets hot - put it on the mat to cool.
- **Steel wool:** gloves on; wash hands after. Pour rusty water away and wrap the steel wool before putting it in the bin.
- Never taste or smell chemicals up close. Waft gently with a hand if you need to smell vinegar.

Teacher notes and common misconceptions

- **"Melting and burning are the same."** Both happen in a candle, which is why it is a good demonstration. Keep coming back to "can it be undone?"
- **"The wax disappeared."** Burning wax turns into gases (mostly carbon dioxide and water vapour) and soot. It does not vanish; it becomes materials we mostly cannot see.
- **"Rust is a kind of dirt on the metal."** Rust is made from the iron in the steel. Rusty steel gets weaker because metal has been used up.
- The grade 6-8 particle model will later explain why new materials form; here it is enough to recognise and describe them.

Lesson 5: Mystery mixture

Back to the unit

Goal

Students plan and carry out a sequence of methods to separate a four-part mixture, sort change cards into "can be undone" and "makes a new material", and complete the end-of-unit check.

Materials

Per group:

- A "mystery mixture" in a clear tub: about 2 tablespoons each of dry sand, table salt and small gravel, plus 10 plain steel paper clips, all mixed together.
- A sieve, a magnet in a plastic bag, a funnel and filter paper, two clear cups, a shallow dish, about 200 ml of water, a stirring stick, a tray.
- A set of 12 change cards (below), cut out.
- The evaporation dishes from Lesson 3 (should now have salt crystals).
- The end-of-unit check, one per student.

Steps

✎ Opening (5 minutes)

Look at the Lesson 3 evaporation dishes with a magnifying glass. Ask: "We put salty water in. What is left? Where did the water go?" Then show the mystery mixture: "Four materials are hiding in here. Your job is to get each one out on its own. You have every tool from Lesson 3."

✎ Main activity (30-35 minutes, then the check)

1. **Plan the order (5 minutes).** Groups write numbered steps before touching the mixture. The teacher checks the plan. One order that works:
2. Magnet (in its bag) through the dry mixture to take out the paper clips.
3. Sieve to catch the gravel; sand and salt fall through.
4. Add water to the sand and salt and stir: the salt dissolves.
5. Filter: the sand stays on the paper.
6. Pour the salty liquid into a shallow dish and leave it somewhere warm to evaporate. The salt will be back in a few days. Groups may find other orders. If a group sieves first, the paper clips stay in the sieve with the gravel; they can still use the magnet then. If a group adds water first, the magnet and sieve still work but everything is wet and messy - a good thing to discuss.
7. **Carry it out (15 minutes).** Groups label each separated material. Leave the dish of salty water in the warm spot.
8. **Sort the change cards (10 minutes).** Two columns: Can be undone and Makes a new material (cannot be undone). Groups write one reason on any card they argue about.

Card	Answer
Ice melting	can be undone
Freezing juice into a lolly	can be undone
Dissolving sugar in tea	can be undone (evaporate the water)
A puddle drying up	can be undone, but arguable: the water is now vapour, and only comes back if it condenses
Candle wax melting	can be undone
Separating sand and gravel with a sieve	can be undone (mix them again)
Toasting bread	new material
Frying an egg	new material
A bike chain rusting	new material
Bicarbonate of soda fizzing in vinegar	new material
Wood burning on a bonfire	new material
Baking a cake	new material

✓ Discussion questions (with example answers)

- Why does the order of steps matter? - Some steps only work on dry mixtures (sieve, magnet), and the salt only separates from the sand once it is dissolved. Doing things in a sensible order saves mess.
- Which card was hardest to sort? Why? - Often "a puddle drying up": the water seems gone, but it is only water vapour, and it can turn back into liquid (grade 4: condensation).
- Was any change both? - Yes: in a candle, wax melting can be undone but wax burning cannot.

✓ Closing check: end-of-unit check (20-25 minutes)

Use it to see what to revisit, not to grade students. There is no pass mark. 10 questions, 2 marks each, 20 marks in total.

1. You stir a teaspoon of salt into one cup of water and a teaspoon of flour into another. Which one dissolves, and what would you see? (1 mark: salt. 1 mark: salt water is clear with nothing settling; flour water is cloudy and the flour slowly settles.)
2. A cup of water weighs 180 g. You add 15 g of sugar and stir until it dissolves. What does the scale read now? What does this tell you? (1 mark: 195 g. 1 mark: the sugar is still there even though you cannot see it.)
3. Mia tests whether a sugar cube or granulated sugar dissolves faster. She puts the cube in warm water and the granulated sugar in cold water. What is wrong, and how should she fix it? (1 mark: two things changed - piece size and temperature - so she can't tell which made the difference. 1 mark: use water at the same temperature in both cups.)
4. A group timed sugar dissolving. Stirred: 45 s and 52 s. Not stirred: 210 s and 240 s. What do the results show, and why did they do two runs? (1 mark: stirring makes sugar

dissolve faster. 1 mark: to check the result was not a one-off / to see how much the times vary.)

5. Which method would you use to (a) get sand out of water, (b) get iron nails out of sand? (1 mark each: (a) filter; (b) magnet.)
6. Can you get salt out of salty water by filtering? Explain. (1 mark: no. 1 mark: the salt is dissolved, so it goes through the filter paper with the water.)
7. How could you get the salt back from salty water, and where does the water go? (1 mark: leave it in a shallow dish somewhere warm so the water evaporates (or heat it, with an adult). 1 mark: the water goes into the air as water vapour; the salt stays behind.)
8. Sort these: melting butter, burning wood, dissolving salt, a rusting bike. (1 mark: melting butter and dissolving salt can be undone. 1 mark: burning wood and rusting make new materials.)
9. Give two signs that a new material may have formed. (1 mark each, any two: a gas given off (not from boiling); a colour change; heat or light given out; you cannot get the starting materials back.)
10. When a candle burns, give one change that can be undone and one that cannot. (1 mark: wax melting (it goes hard again when it cools). 1 mark: wax burning at the wick (it becomes gases and soot; the candle gets shorter).)

Vocabulary

Revise all unit words: dissolve, solution, insoluble, mixture, filter, sieve, magnetic, evaporate, crystal, reversible, irreversible, new material.

Differentiation

- **Support:** give the mystery-mixture plan as five cut-up step cards to put in order; read the check questions aloud; accept spoken answers.
- **Stretch:** add a fifth material to the mixture (for example a spoon of sugar). Can it be separated from the salt with these tools? (No: both dissolve, both pass through the filter and both are left behind when the water evaporates. Students should say so rather than invent a method.)

⚠ Safety

- Same as Lessons 1 and 3: no tasting; magnet too big to swallow and kept in its bag; plain paper clips, not filings; wipe spills; sand and gravel in the bin, not the sink.
- Evaporation dishes go near, never on, a heater. Do not heat salty water in class unless your school allows it and an adult does it.
- If students mention heating to speed up evaporation, discuss it, but keep it as an adult-only step.

Teacher notes and common misconceptions

- **Sorting cards are for talking, not just scoring.** Several cards are arguable (a puddle drying up is only undone if the water vapour condenses again somewhere). Reward clear reasons.

- **Question 8 split marks.** Give each mark only if both items in that group are right.
- Collect and check that every paper clip and magnet bag comes back.
- Keep the salt dishes: watching crystals appear over the next days links this unit to the grade 4 water cycle and grade 6-8 particle model.