

Choosing a method to separate mixtures

Grade 6 science (Year 7 · Class 6) · Lesson

Quick answer: To separate a mixture, choose a method that uses a physical difference between its parts. Use a sieve for different sizes, a magnet for iron, decanting or filtering for an undissolved solid in a liquid, and evaporation to recover a dissolved solid. Several methods can be combined.

Level: Grade 6 science (Year 7 · Class 6) · **Curriculum:** MS-PS1-2

Why can mixtures be separated?

The substances in a mixture are not chemically joined, so each one keeps its own properties. To separate them, you pick a method that takes advantage of a physical difference between the parts. The difference might be size, magnetism, whether a substance dissolves, or whether it settles in water.

Definition

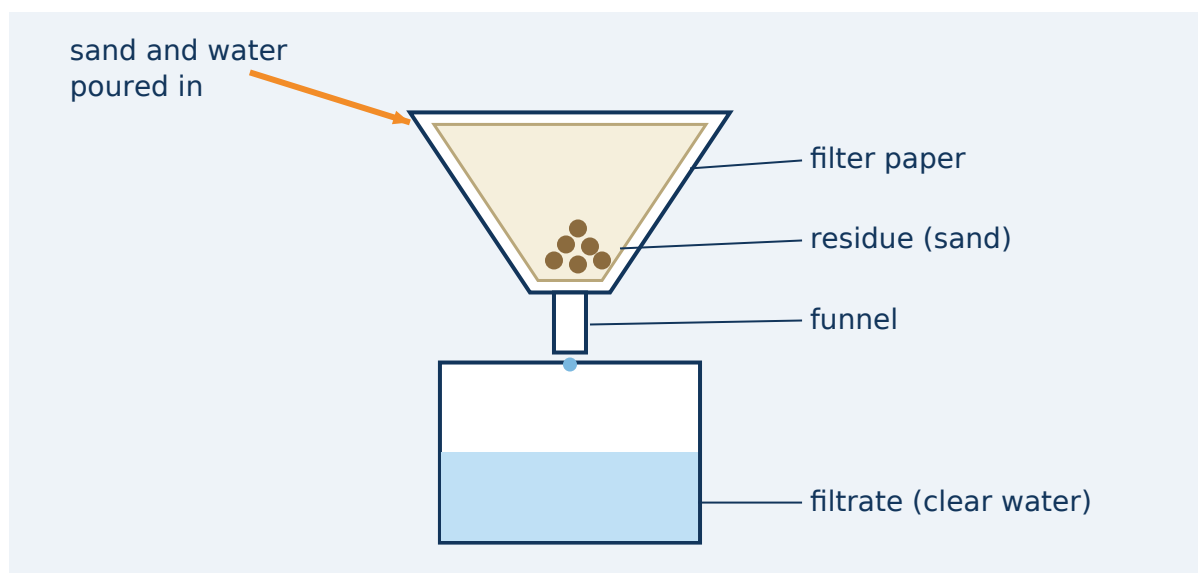
Separating a mixture means using a physical method, such as sieving or filtering, to pull the parts of a mixture apart without changing the substances themselves.

Method	Uses this difference	Example
Sieving	particle size	lumps from flour; stones from sand
Magnet	only some metals are magnetic	iron filings from sand
Decanting	an insoluble solid settles	pouring clear water off mud
Filtering	solid pieces too big for the paper	sand from water
Evaporation	a dissolved solid stays when the liquid leaves	salt from salt water

How do decanting and filtering work?

Decanting is the simplest way to remove an undissolved solid. Let the mixture stand until the solid has settled, then carefully pour the liquid into another container. Filtering gives a cleaner result. The mixture is poured through filter paper, which has tiny holes. Liquid and dissolved particles pass through, but solid pieces are stopped.

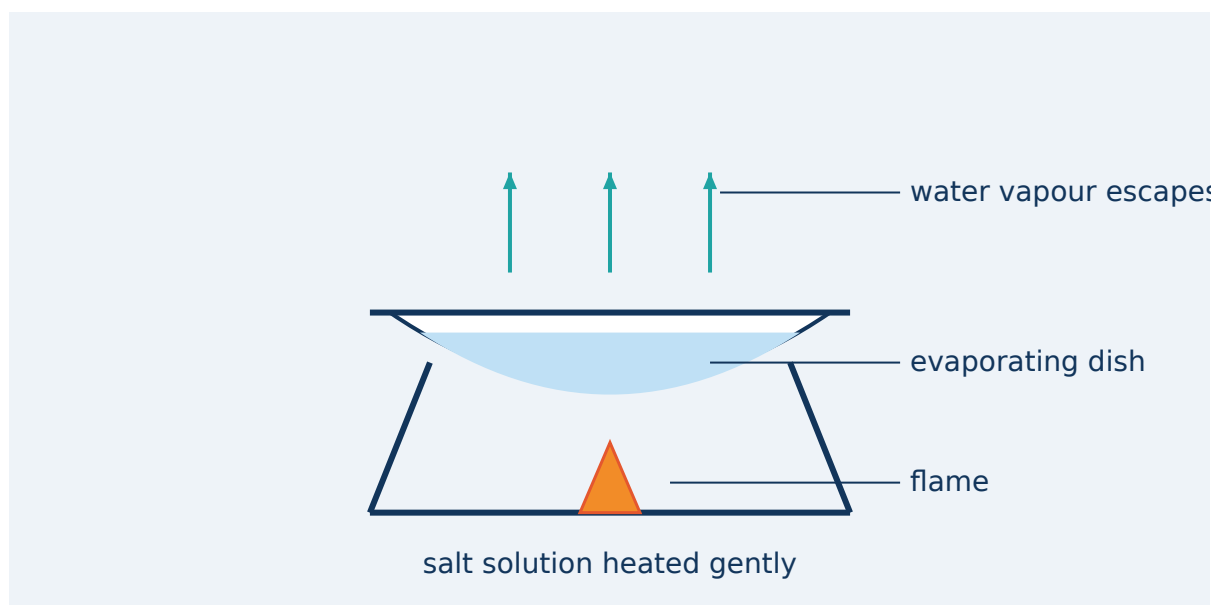
The solid left on the paper is the **residue**. The liquid that passes through is the **filtrate**.



Filtration separates an insoluble solid from a liquid.

How do you get a dissolved solid back?

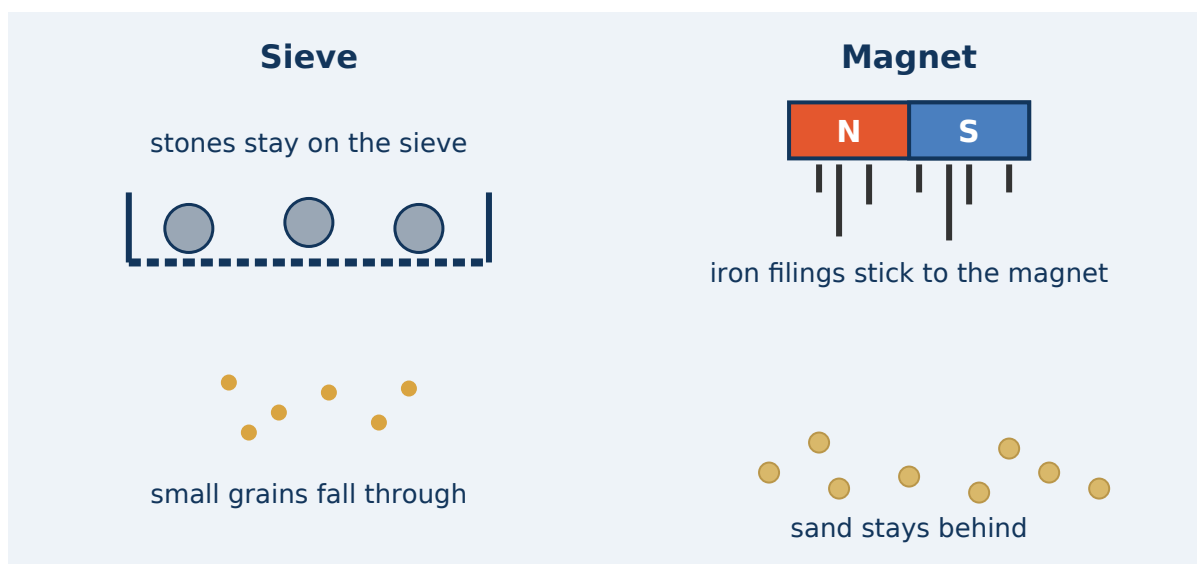
Filter paper cannot remove dissolved salt, because dissolved particles are far smaller than the holes in the paper. Instead, you heat the solution so the water evaporates. The salt cannot evaporate, so it stays in the dish. Stop heating when crystals start to form, then let the last drops dry by themselves so the salt does not spit.



Evaporation separates a dissolved solid from its solvent.

How do sieves and magnets work?

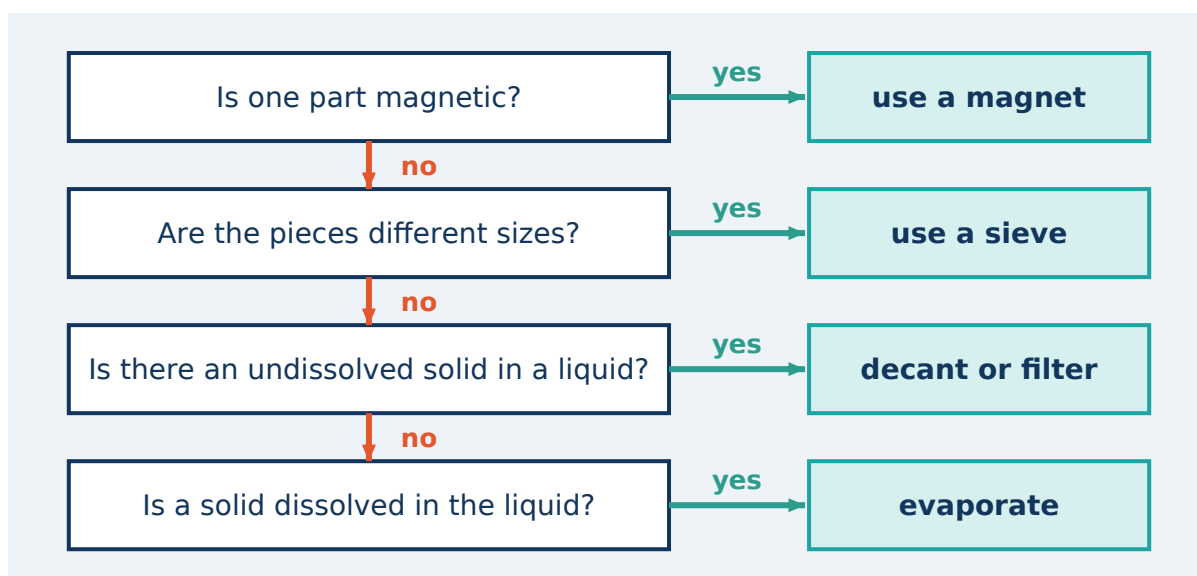
A sieve is a mesh with holes of a fixed size. Small pieces drop through the holes, and bigger ones stay on top. A magnet attracts only a few materials, mainly iron, steel, nickel and cobalt. Aluminium, copper, plastic and sand are not attracted, so a magnet can pick iron out of a mixture.



A sieve separates by size; a magnet separates by magnetism.

How do you choose a method?

Ask what is different between the parts, then follow the chart from the top. The first question that you can answer with yes tells you which method to use. For mixtures with three parts, you may need several methods one after another.



A chart for choosing a separation method.

Worked example

Ngozi in Lagos has a mixture of sand, salt and iron filings. Plan how to separate all three.

1. Use a magnet to remove the iron filings, since only iron is magnetic.
2. Add water and stir so the salt dissolves; the sand does not.
3. Filter: sand is the residue and salt solution is the filtrate.
4. Evaporate the filtrate to get the salt.

Order: magnet, dissolve, filter, evaporate.

Worked example

A mixture contains 12.0 g of salt. After separating it, Tomás in Cusco collects 11.1 g of dry salt. Find the percentage recovered.

Percentage = $11.1 \div 12.0 \times 100 = 92.5 \%$.

He recovered 92.5 % of the salt. The rest was lost, for example as spots stuck to the glassware.

Common mistake

Filtering salt water will not give you the salt, because the dissolved salt passes through the paper with the water. Use evaporation for a dissolved solid. Also, filtered water is not automatically safe to drink: dissolved substances and germs can pass through.

Lina's tip

Start by asking what is different between the two parts. Size means sieve, magnetism means magnet, undissolved means filter or decant, dissolved means evaporate.

Key points to remember

- Sieving separates by particle size; a magnet picks out iron, steel, nickel or cobalt.
- Decanting and filtering separate an undissolved solid from a liquid.
- Filtering leaves a residue on the paper and a filtrate in the beaker.
- Evaporation recovers a dissolved solid; filtering cannot do this.
- Percentage recovered = mass collected $\div$ mass in the mixture $\times 100$.

Choosing a method to separate mixtures: frequently asked questions

How do you separate sand from water?

Let the sand settle and decant the water, or pour the mixture through filter paper in a funnel. The sand stays on the paper as the residue and the water passes through as the filtrate.

How do you separate salt from salt water?

Heat the salt water in an evaporating dish so the water evaporates. The salt cannot evaporate, so it stays behind as crystals. Filtering does not work because the salt is dissolved.

What is the difference between residue and filtrate?

The residue is the solid left behind on the filter paper. The filtrate is the liquid that passes through the paper into the container below.

Which materials can a magnet separate?

A magnet attracts iron, steel, nickel and cobalt. It can pick them out of a mixture with materials such as sand, plastic, aluminium or copper, which it does not attract.

Can you use more than one method on a mixture?

Yes. A mixture of iron filings, sand and salt needs three methods: a magnet for the iron,

filtering for the sand and evaporation for the salt.