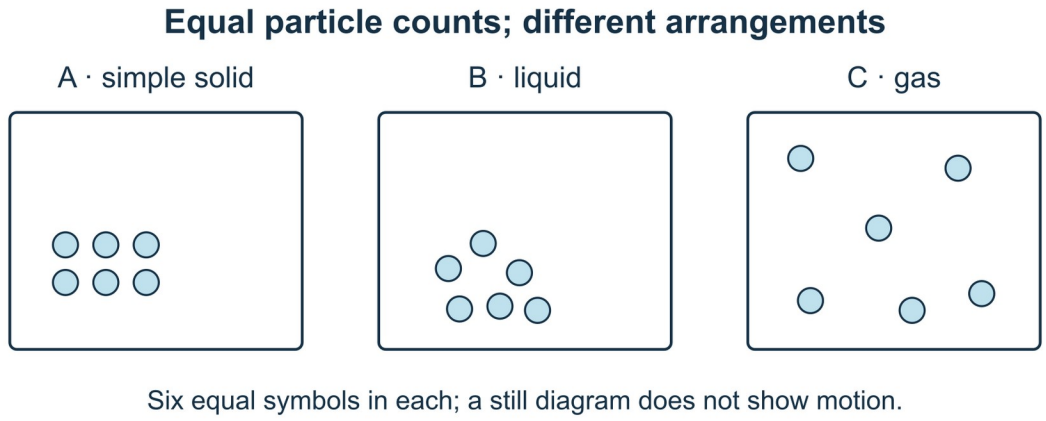
Three particle pictures

How can symbols explain states of matter while showing a model's limits?

Use equal-count dot pictures to discuss arrangement and motion in three simple states-of-matter models.

Explore | 10-20 minutes, or one model comparison | The supplied example, read or heard, Optional scrap paper and a pen or pencil

Start here Each supplied box contains six identical particle symbols. Solid A keeps them close in a regular cluster; liquid B close but irregular; gas C spread through the box.



Same six symbols, different arrangements

1 Count before interpreting

Check that all three pictures contain six dots of the same size. The dots stand for particles; changing the drawing's arrangement does not create extra particles.

2 Describe the arrangement

Compare regular and irregular close arrangements with widely separated positions. Describe what the dots show, rather than treating the empty paper as a different substance.

3 Add the motion the picture omits

In this simple description, solid particles vibrate around positions, liquid particles move past neighbours, and gas particles move around through the available space. A still drawing does not show that motion directly.

4 Label a model limit

Write 'symbols, not a magnified photograph'. These pictures select arrangement and motion ideas, leaving detailed particle shape, forces and scale out.

Original model six symbols in every state

The three schematic pictures are constructed examples of a simple solid, liquid and gas description; no substance is handled.

• A: six close symbols in a regular arrangement; vibration is described, not shown as stillness.

• B: six close symbols arranged irregularly; neighbours can change.

• C: six symbols separated across a larger occupied region; the particles themselves have not grown.

What this example can show Not all solids have a regular structure. Dot spacing is schematic and does not by itself supply measured density, temperature or speed.

A different way

Point to close and separated arrangements or have the models described aloud. You can complete the comparison without drawing or using any substances.

If you want to go further

Redraw one box with motion arrows, explaining what each arrow means. Do not change particle size to represent heating.

Something to notice

Did I mistake a still symbol for a particle that never moves?

Read or explore more

Horizon topic States Matter

https://launchhorizonhq.com/learn/states-matter/

Horizon topic Density Models

https://launchhorizonhq.com/learn/density-models/

Horizon topic Chemistry

https://launchhorizonhq.com/learn/chemistry/

OpenStax, Rice University 1.2 Phases and Classification of Matter

https://openstax.org/books/chemistry-2e/pages/1-2-phases-and-classification-of-matter

OpenStax, Rice University 10.3 Phase Transitions

https://openstax.org/books/chemistry-2e/pages/10-3-phase-transitions

Choose a material from evidence cards

Which stated properties matter for an invented design brief?

Select a fictional material against a clear design brief, then see what changes when an unknown becomes an essential requirement.

Investigate | 15–25 minutes, or one decision | The supplied example, read or heard, Optional scrap paper and a pen or pencil

Start here A drawing sleeve must be transparent and flexible for dry indoor use. Read the supplied cards A, B and C; their features are invented.

Which card meets the stated requirements?

Card	Transparent	Flexible	Water resistant
A	Yes	Yes	Unknown
B	Yes	No	Yes
C	No	Yes	Yes

First two required: A. All three essential: no verified option.

A requirement is different from a wish

1 Read the evidence cards

A: transparent yes, flexible yes, water resistance unknown. B: transparent yes, flexible no, water resistant yes. C: transparent no, flexible yes, water resistant yes.

2 Apply the two required criteria

For the dry-use brief, A meets both stated requirements. B fails flexibility and C fails transparency. Do not let an extra desirable property erase a required one.

3 Change the brief

Now imagine water resistance is also essential. A's unknown is not a yes, so none of the three cards is verified as meeting all requirements.

4 Explain a conditional choice

Write 'A fits the first brief on the supplied evidence'. For the changed brief, request the missing evidence or revise the design instead of guessing.

Constructed cards a dry use sleeve

The cards are invented property reports, not test results about named plastics or products. Y means yes, N no and ? unknown.

• A: transparent yes, flexible yes, water resistance unknown.

• B: yes, no, yes. C: no, yes, yes. Only A meets the first two required criteria.

• When all three become essential, no card is confirmed to meet them all.

What this example can show This table does not certify a real material, establish its safety or tell you what an unknown result would be.

A different way

Compare only A and B, or direct someone else to mark the two required columns. No real materials need testing.

If you want to go further

Add a fourth invented card with all three properties known. State its entries before deciding whether it meets the changed brief.

Something to notice

Did I treat a desirable property or an unknown as if it met a requirement?

Read or explore more

Horizon topic Material Properties

https://launchhorizonhq.com/learn/material-properties/

Horizon topic Materials Constraints

https://launchhorizonhq.com/learn/materials-constraints/

Horizon topic Design Constraints

https://launchhorizonhq.com/learn/design-constraints/

Science Learning Hub, University of Waikato Properties of materials - introduction

https://www.sciencelearn.org.nz/resources/2659-properties-of-materials-introduction

NASA 6.8 Decision Analysis

https://www.nasa.gov/reference/6-8-decision-analysis/

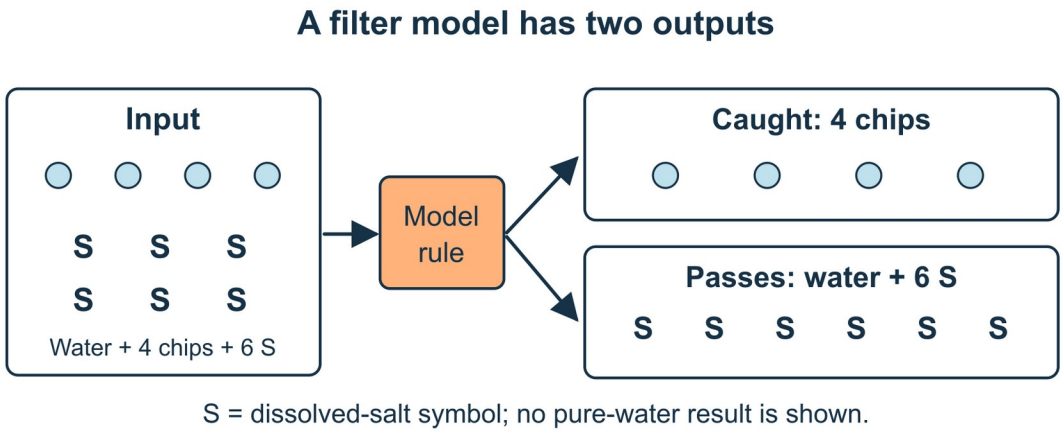
Plan a separation on paper

Which property would a proposed separation use, and what remains assumed?

Trace a paper filter model and explain why removing visible solids would not remove a dissolved substance.

Investigate | 10-20 minutes, or one trace | The supplied example, read or heard, Optional scrap paper and a pen or pencil

Start here Use a fictional mixture diagram containing four large blue chip symbols and six S symbols for dissolved salt in water. All of it stays on paper.



Two outputs, with every symbol accounted for

1 State the model rules

In this supplied model, a filter catches the large chips but allows water and the dissolved salt to pass. These are declared model rules, not results of a performed test.

2 Trace both outputs

Move or redraw all four chip symbols into ‘caught by filter’. Put all six S symbols with the water in ‘passes through’. Keep each kind of symbol accounted for.

3 Name what remains mixed

The passed-through liquid still contains dissolved salt. Removing the visible chips does not turn it into pure water or make it suitable to drink.

4 Keep a next method separate

If separating salt from water is a new goal, it needs a different justified process. State that question without heating, evaporating or trying anything physically.

Constructed filter model account for both parts

The four chip symbols represent an insoluble large-particle component; the six S symbols mark portions of dissolved salt, not individual molecules.

• Input: four chips plus water containing six S symbols.

• Caught: four chips. Passed through: water containing all six S symbols.

• The model separates the chips, while the salt-water mixture remains.

What this example can show Actual filtration depends on material properties and filter size. This diagram is not a water-treatment instruction or a claim that a real filter was tested.

A different way

Follow the symbols by pointing or explain where they go aloud. No filter, salt, water, containers or scissors are required.

If you want to go further

Change the model so the solid chips are smaller than its stated filter openings. Explain why the previous 'caught' output would no longer follow.

Something to notice

Did every symbol reach an output, and did I confuse clear-looking with pure?

Read or explore more

Horizon topic Mixtures Separation

https://launchhorizonhq.com/learn/mixtures-separation/

Horizon topic Solutions Dissolving

https://launchhorizonhq.com/learn/solutions-dissolving/

Horizon topic Chemistry

https://launchhorizonhq.com/learn/chemistry/

OpenStax, Rice University 1.2 Phases and Classification of Matter

https://openstax.org/books/chemistry-2e/pages/1-2-phases-and-classification-of-matter

Science Learning Hub, University of Waikato Soluble

https://www.sciencelearn.org.nz/glossary/soluble