Chemistry > Big idea CPS: Particles and structure > Topic CPS1: Substances and mixtures

Key concept (age 11-14)
CPS1.2: Particles in solutions

What's the big idea?

All matter is made up of atoms. The structural arrangement and behaviour of the atoms explain the properties of different substances.

A key concept of this big idea is that the particle model may be used to explain some observations of substances dissolving to form solutions.

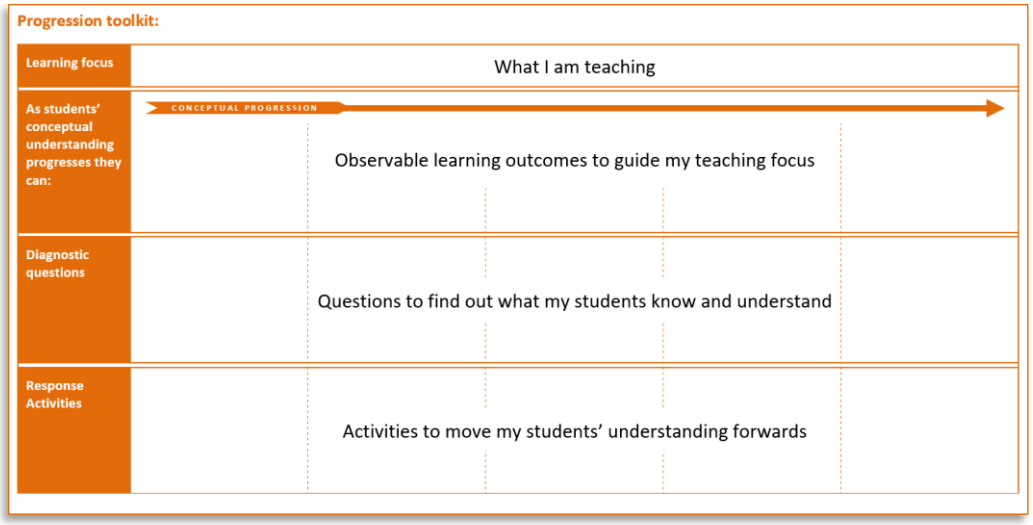
How does this key concept develop understanding of the big idea?

This key concept develops the big idea by applying an understanding of the particle model to the process of dissolving.

The conceptual progression starts by checking students' ability to think about substances at a sub-microscopic (particle) level. It then develops the use of the particle model to describe solutions, in order to enable application of the particle model to explain observations of dissolving (including the lack of a need for stirring).

Using the progression toolkit to support student learning

Use diagnostic questions to identify quickly where your students are in their conceptual progression. Then decide how to best focus and sequence your teaching. Use further diagnostic questions and response activities to move student understanding forwards.



Progression toolkit: Particles in solutions

Learning focus	The particle model may be used to describe and explain solutions.				
As students' conceptual understanding progresses they can:	CONCEPTUAL PROGRESSION →				
	Explain the observed disappearance of a solute in terms of breaking into parts that are too small to see.	Predict and explain the filtrate and residue of a mixture (suspension or solution) when filtered.	Use the particle model to represent a solute dissolved in a solvent.	Explain observations of dissolving using the particle model.	Explain why stirring is not necessary for dissolving.
Diagnostic questions	Where is the salt?	Filtering a mixture	Solution diagram	Dissolving ammonia	Purple crystal
Response activities		Sieving and filtering	Particle diagram matching	Representing solutions	Blue crystals

What's the science story?

All matter is made up of particles. The arrangement and movement of these particles is described by the particle model. The particle model can also explain why a clear solution is formed when a substance dissolves.

What does the research say?

A review of research on solution chemistry studies by Çalýk, M., Aysa, A. and Ebenezer, J.V. (2005) identified a number of areas in which students have difficulties. Ideas about solutions at the macroscopic level are covered in key concept CSU1.2: Solutions.

The review highlighted that students have difficulties in visualizing and representing the dissolving processes at sub-microscopic level. For example, some students depict dissolved sugar as 'bits of sugar' distributed in water. This indicates continuing misunderstanding of the particle model with the particles of sugar being considered as small fragments of the macroscopic substance and the water being viewed as continuous (as opposed to particulate).

The review also described research that linked students' everyday experience of stirring and dissolving, such as stirring sugar into tea, which may lead to the misunderstanding that some sort of mechanical event is necessary for dissolving. Fully understanding dissolving requires a secure understanding of the particle model, including the intrinsic movement of particles.

Guidance notes

The conceptual progression in this progression toolkit follows on from that in the solutions key concept CSU1.2: Solutions. It includes necessary prior understanding for key concept CSU1.3: Separating solutions.

References

Çalýk, M., Aysa, A. and Ebenezer, J.V. (2005). A review of solution chemistry studies: Insights into students' conceptions. *Journal of Science Education and Technology*. 14 (1) 29-50