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advancing structural science

How Crystals Are Made.

Crystallisation Activity

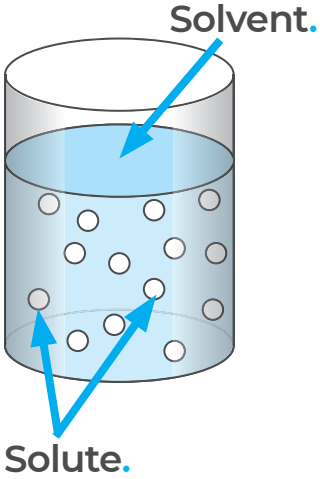
In this second part of the "How Crystals Are Made" activity, we challenge more experienced learners (age 14+) to reflect more in detail on the concepts learnt in the first part.

In the first part of this activity, we observed examples of crystallisation in the world around us and we have learnt what a solution is, what its components are and we have seen what crystallisation is. Make sure you complete the first handout (**Activity Worksheet**), before moving on to the next part.

Tip: Search for the words in **bold** in the glossary at page 7 of the **Activity Worksheet**.

Recap

A **solution** is a liquid that contains different substances. The most abundant component is called the **solvent**, which means that in the solution there is much more of this component, than of the others. The other component, present in smaller amount, is called **solute** and it is **dissolved** in the solvent.



An important property of the solute is its **solubility**.

The solubility is the capability of the solid to dissolve in a solvent. It is usually expressed in g/ml, which means how many **grams** of solute you can dissolve in a **millilitre** of solvent.

When the solid (solute) is added to the solvent until no more will dissolve, this makes the solution **saturated**.

If then you add more solid, the solution becomes **supersaturated**.

Crystallisation is the process through which crystals are made.

It takes place in two steps:

1. The first one is called **nucleation** and it is the formation of a very tiny crystal nucleus.
2. The second step is called **growth** and it is indeed the growth of these little crystal nuclei to become the final bigger crystals.

Nucleation is a change of phase, or **phase transition**, as we learnt in the **"Crystals Showcase" activity**. Indeed, solute molecules go from a liquid disperse phase to the solid state, where all the molecules are now aligned in a regular repeating pattern.

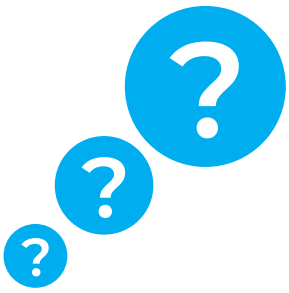
Supersaturated Solution

In the image in the next page you can see an example of how a solution can become supersaturated using heat.

STEP 1: You can observe that in the first glass (or beaker) the solution is saturated.

STEP 2: When the glass is heated, the solubility changes. **This is very important**: at higher temperature the solubility increases, which means that you can dissolve more solute in a warmer solution compared to when the solution is at room temperature. The saturation level is now higher. In this second step, we can add more solute and reach the new higher level of saturation.

STEP 3: When we bring the glass back to room temperature, we obtain a supersaturated solution. You can see that the solution in the glass now has more solute molecules than in the saturation state (shown at the beginning of the process in step one).



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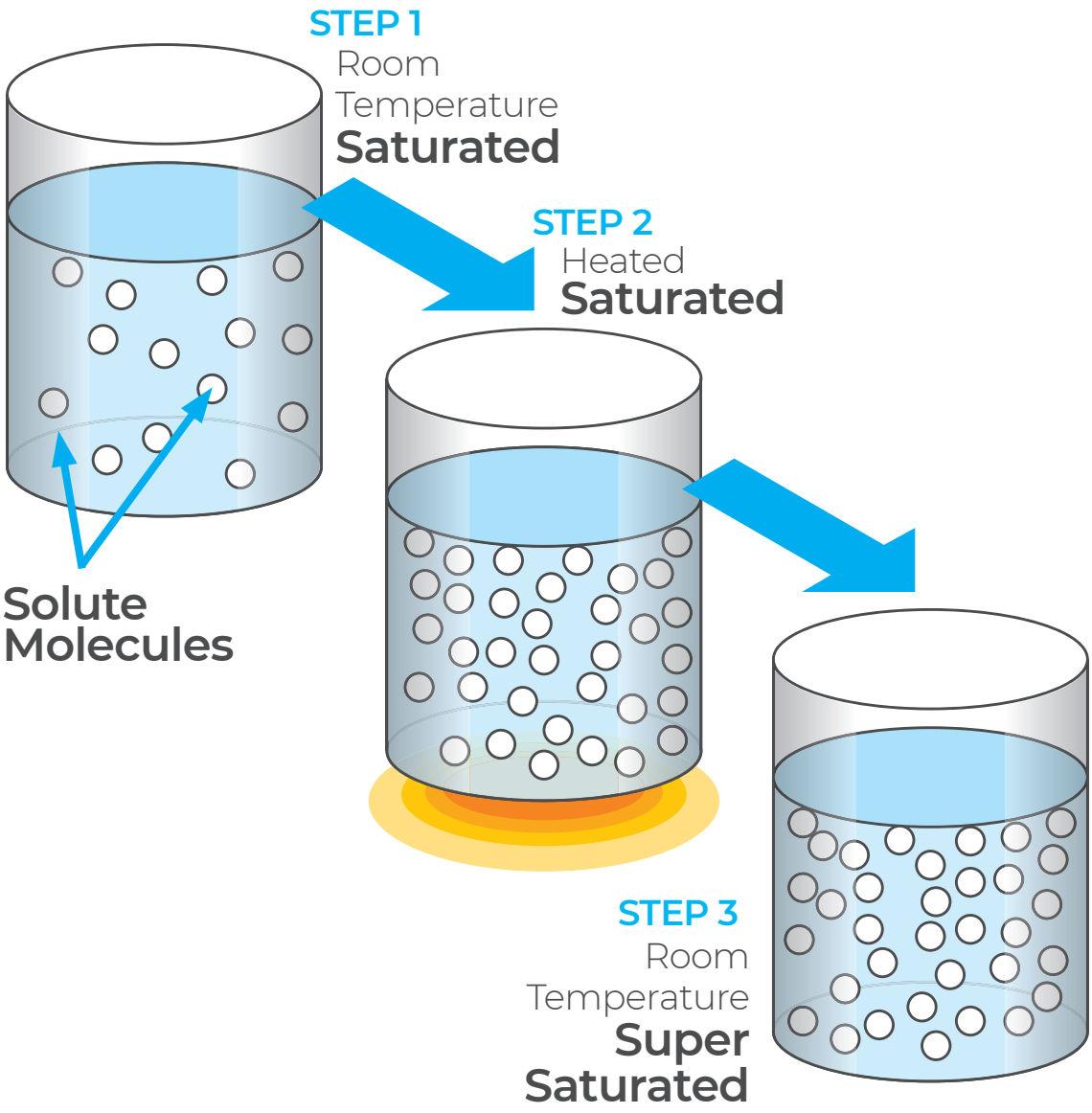
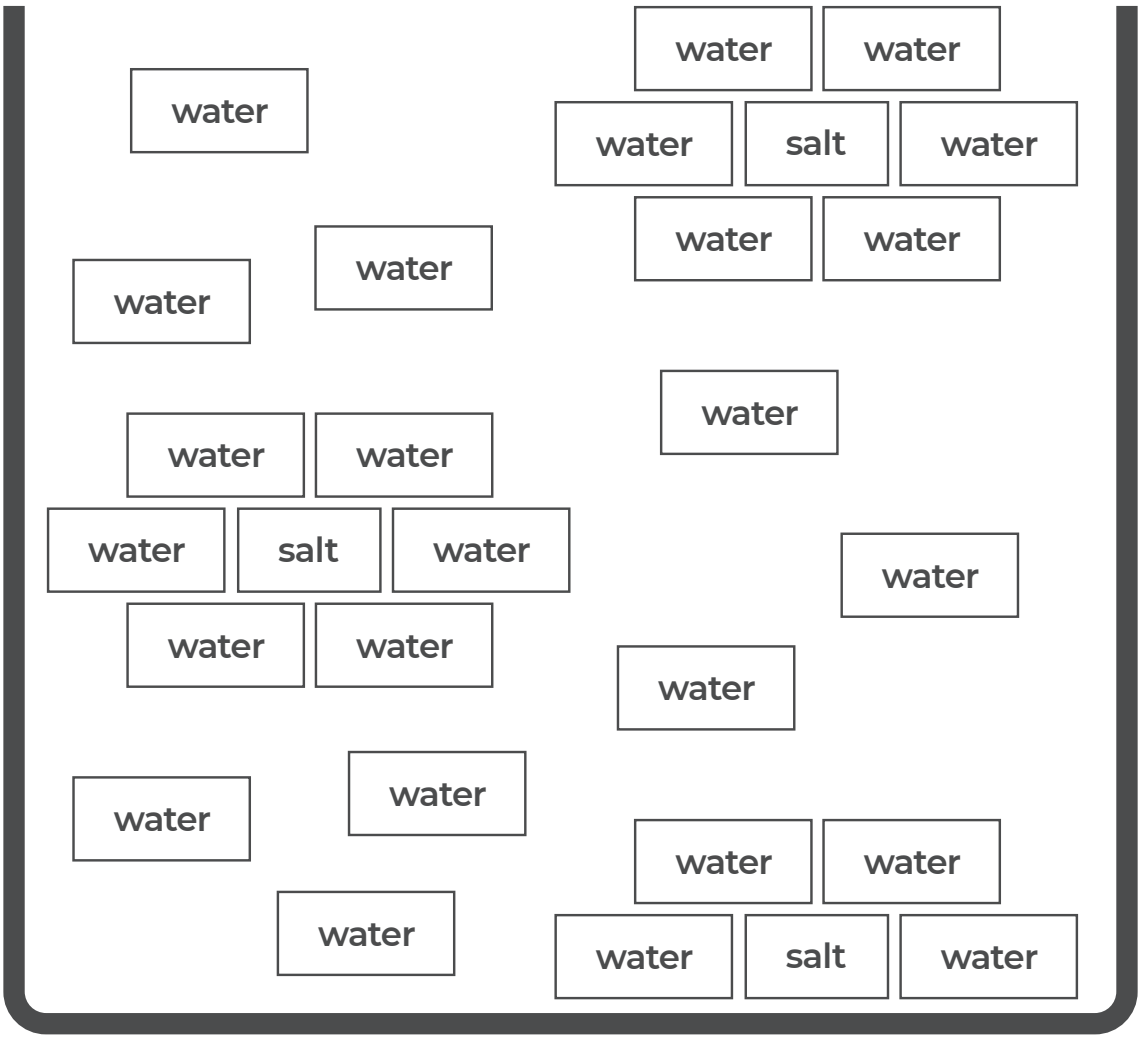

STEP 1
Room
Temperature
Saturated
STEP 2
Heated
Saturated
Solute
Molecules
STEP 3
Room
Temperature
Super
Saturated

2 In the **"Crystals Showcase" activity**, we learnt the word "**microscopic**", which we used in the description the arrangement of molecules in solid, liquid, and gas states. In the following image you can observe how moleules are arranged in solution.

"Water" bricks represent the solvent, while "salt" bricks the solute.

In solution, the solute molecules are not close to each other in a nice ordered way as they are in the solid. They are, instead, dispersed in the liquid state. In the image, you can observe that solvent molecules surround each solute brick.



3 Supersaturation Activity

Can you represent the microscopic arrangement of solute and solvent molecules in a supersaturated solution?

To complete the activity, you can cut and arrange the bricks representing salt (i.e., the solute) and water (i.e., the solvent) on the glass drawing underneath, glue them to it, or you can draw them, to represent a supersaturated solution.

You can find the material for this activity at page 7 of this handout. Note for the activity leaders: you can find our suggestion and discussion of the activity on page 8 to support the learners.

4 Nucleation Activity

Can you represent the microscopic arrangement of solute and solvent molecules during nucleation from solution?

To complete the activity, you can cut and arrange the bricks representing salt (i.e., the solute) and water (i.e., the solvent) on the glass drawing underneath, glue them to it, or you can draw them, to represent a supersaturated solution.

You can find the material for this activity at page 7 of this handout. Note for the activity leaders: you can find our suggestion and discussion of the activity on page 9 to support the learners.

Material

Hereafter, you can find the material to carry on activities 2 (Supersaturation Activity) and 3 (Supersaturation Activity).

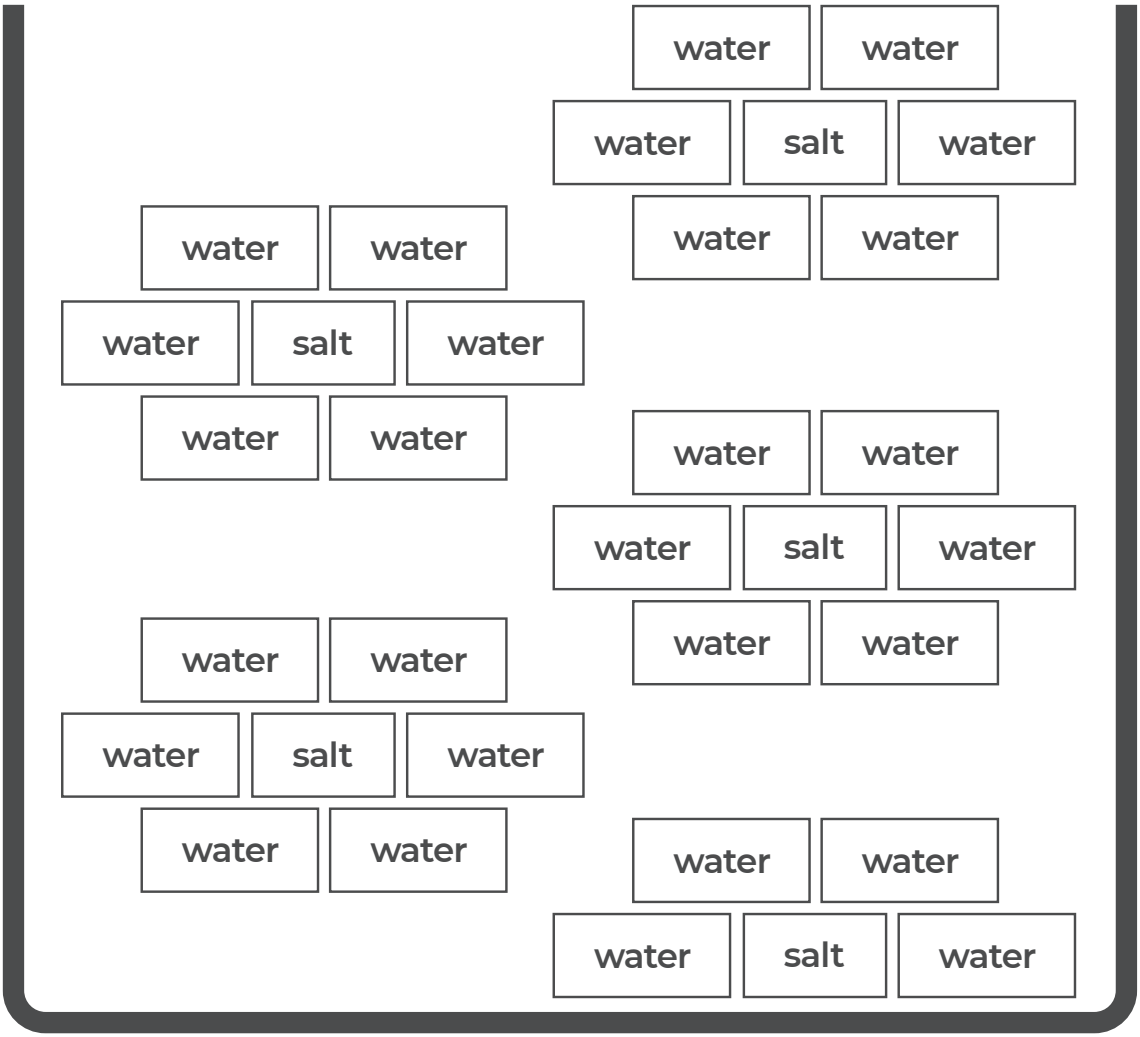
You can cut the bricks of solute and solvent below and glue them or simply arrange them on the two beakers in pages 5 and 6. Alternatively, you can draw the bricks, and even the beakers on a piece of paper, or carry out the activity as a discussion.

water	water	water	water	water	water
water	water	water	water	water	water
water	water	water	water	water	water
water	water	water	water	water	water
water	water	water	water	water	water
water	water	water	water	water	water

salt	salt	salt	salt	salt	salt	salt
salt	salt	salt	salt	salt	salt	salt
salt	salt	salt	salt	salt	salt	salt
salt	salt	salt	salt	salt	salt	salt
salt	salt	salt	salt	salt	salt	salt

Answers for Supersaturation Activity

- In the liquid state of the super saturated solution, the salt **ions** are dissolved by being surrounded by water molecules.
- Even though it's still the liquid state, no more salt can be dissolved in the solvent (water).



Answers for Nucleation Activity

- The salt molecules are now aligned in a regular repeating pattern, the solid state.
- Nucleation is a change of phase.