Making a crystal garden | Chemistry and art | 11–14 years

Teacher notes

In this practical, students will:

- Set up the practical enquiry for growing crystal gardens, ensuring that the experiment is fair.
- Report on the size, colour and rate of growth for the different crystals.
- Use their scientific knowledge and understanding to explain the results of the experiment.

How to use this experiment

This is a nice experiment and an old one. Many a teacher will probably remember making a crystal garden. Yet it continues to fascinate young students. The chemistry can be a little difficult for primary level but using the garden and seeds analogy is a good one to enable a simple explanation to be attempted. For secondary level they should be able to understand some of the chemistry involved.

It can be introduced as a 'fun' lesson or be used at a science club session. The best discussions take place after they have done the experiment and the students can observe the growth of the crystals. The students need to be warned that the growth is not immediate and it takes about a week to see the full effects but during the lesson they may see some growth.

The beakers should be moved as little as possible once the chemicals are placed into them.

Health, safety and technical notes

1. Read our standard health and safety guidance.
2. Wear eye protection (goggles) and disposable gloves throughout. Remember to handle the crystals only with a pair of forceps. Do not use your fingers.
3. Sodium silicate (water glass) solution (CORROSIVE) – see CLEAPSS Hazcard HC095B and CLEAPSS Recipe Book RB000. Sodium silicate is supplied in solution as an egg preservative. This type of solution is ideal for these experiments, as it is very difficult to dissolve the solid.
4. Cobalt(II) nitrate, $Co(NO_3)_2.6H_2O(s)$ (OXIDISING, HARMFUL) – see CLEAPSS Hazcard HC025 AND note 9 below.
5. Iron(III) nitrate, $Fe(NO)_3.9H_2O(s)$, (OXIDISING, IRRITANT) – see CLEAPSS Hazcard HC055C.
6. Magnesium nitrate, $Mg(NO_3)_2.6H_2O(s)$, (OXIDISING) – see CLEAPSS Hazcard HC059b.
7. Manganese(II) sulfate, $MnSO_4.7H_2O(s)$, (HARMFUL, DANGEROUS FOR THE ENVIRONMENT) – see CLEAPSS Hazcard HC060.
8. The metal salts chosen are known to be reasonably soluble in water. If a particular metal compound is unavailable, a nitrate is usually a safe choice as an alternative, or even the chloride if a Data Book indicates that the solubility is as high as that of the nitrate or sulfate.

9. Nickel and cobalt compounds are CARCINOGENIC and SENSITISERS (and more). They should not be used by 11–14 year old pupils. If it is required, the teacher can set up a demonstration garden with these.
10. Powders of the chemicals can be used if crystals are unavailable. The powder can be carefully dropped against the side of the beaker just above the water line. If any floats on the surface it can be nudged under the water to drop to the bottom of the beaker. The powders still produce an interesting array of crystal tendrils.

Results

A strong water glass solution will grow a crystal formation more quickly than a weak one.

Crystals of chemicals will produce further growths of crystals on the original one over time, chemical powders grow tendrils.

Although cobalt chloride and nickel sulphate produce colourful crystals (magenta/purple and green/blue respectively) a very good and colourful chemical garden can be created with the less toxic chemicals.

Curriculum range

This experiment is applicable for upper primary and lower secondary dependent upon the chemical used. It links with:

- Setting up simple practical enquiries, comparative and fair tests;
- Reporting on findings from enquiries and observations, including oral and written explanations, displays or presentations of results and conclusions;
- Using straightforward scientific evidence to answer questions or to support their findings;
- Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience;
- Use appropriate techniques, apparatus, and materials during laboratory work, paying attention to health and safety;
- Make and record observations using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements;
- Present observations using appropriate methods;
- Interpret observations and identify patterns using those observations to draw conclusions;
- Present reasoned explanations, including explaining data in relation to predictions and hypotheses;
- Learn about the concept of dissolving of metal salts to form silicates.

Taking the work further

Students could experiment with different strength solutions of sodium silicate.

Sodium silicate solution is highly alkaline and therefore it may be best for younger students to only test dilutions of the solution that have already been provided for them.