Key Stage 3 – Quality Crystal

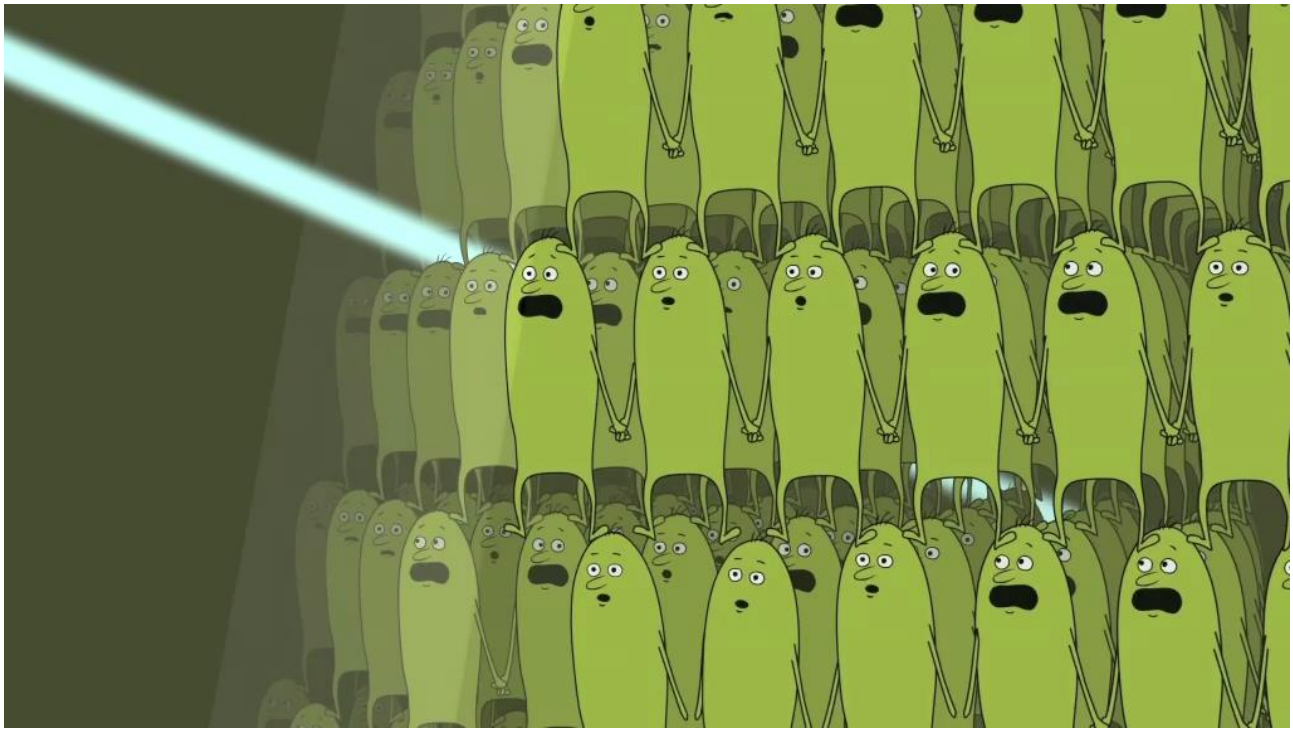
Notes for teachers

At a glance

Scientists have used X-ray crystallography to elucidate the structure of more than half a million substances. This powerful technique relies on complex mathematics, high energy X-rays, and the skill of crystallographers in making high quality crystals.

In this activity students make crystals of copper sulfate, potassium aluminium sulfate, or potassium hexacyanoferrate(III). They identify the factors that make high quality crystals, and consider briefly how crystals are used in X-ray crystallography to determine structure.

This activity takes place over several days. It is suitable for use in a science club as well as in science lessons.



Learning Outcomes

- Students understand the importance of X-ray crystallography in elucidating structures.
- Students identify factors in making high quality crystals.

Each group of two or three students will need

- 1 copy of the pupil worksheet
- 1 copy of *Making crystals*
- 1 copy of the *Record sheet*

- Access to top pan balance
- Spatula
- 100 cm^3 measuring cylinder
- Two 250 cm^3 beakers
- Bunsen burner, tripod, gauze, heatproof mat
- Thermometer
- Stirring rod
- Card to cover top of beaker
- Method of naming beakers
- Watch glass
- Magnifying glass
- Tweezers
- Thread
- Pencil
- Pure water
- Hydrated copper sulfate (65 g per group) **OR** potassium aluminium sulfate (alum) (40 g per group) **OR** potassium hexacyanoferrate(III) (75 g per group)

Possible Lesson Activities

1. **Starter activity**
   - Show the animation "A Case of Crystal Clarity" to the class.
   - Show the International Year of Crystallography video to outline why crystals, and X-ray crystallography, are important (web link 1).

2. **Main activity**

First day (allow up to one hour)

- Divide the class into groups of two or three and outline the activity as described on the pupil worksheet.
- Allow students time to read the pupil worksheet.
- Student groups then make saturated solutions, as detailed on the *Making crystals* sheet. Instruction number 7 tells students to leave their solutions for two or three days.

Two or three days later (allow up to 15 minutes)

- Student groups follow instruction number 8 to finish making their saturated solutions.
- They then follow instruction numbers 1 and 2 in the section on *making a seed crystal.*

A few days later (allow up to 20 minutes)

- Student groups follow instruction number 3 to choose their seed crystal.
- They then follow instruction numbers 1 to 4 in the section on *Making a big crystal.*

Over the next few days (allow up to 10 minutes for each observation)

- Student groups observe their growing crystals as often as possible, and note down their observations in the table on the *Record sheet.*

When the crystals have been growing for one week (allow up to 30 minutes)

- Student groups look at each others' crystals.

- They discuss – in groups or as a class – factors that might affect crystal quality, and record them in the table on the *Record sheet*.

3. Plenary

- Students complete the box *The best crystal* on the *Record sheet*.

Web link

Web link 1: www.iycr2014.org/about/video
International year of crystallography video: *What can crystallography do for you?*

Web link 2: *www.nationalstemcentre.org.uk/dl/ad91db027cb2592ae7b97afe1d0088c7cd2dc5d4/6187-Growing%20Crystals.pdf*
Very detailed instructions for crystal growing, including questions (p. 8)