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The Crystals Cave in a test tube

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It's quite easy to understand formation of crystals in Nature by evaporation of the solutions that contain minerals, but many times we have realised that our pupils hardly understand that precipitation is a process mostly caused by changing parameters in a solution, like pH, temperature, etc. and not necessarily depending on evaporation.

We propose a hands-on activity using the context of the Cave of the Crystals in Naica's mine, Mexico. The Crystals Cave is a wonderful place where giant crystals of selenite (gypsum) have grown feeding from a supersaturated anhydrite solution[1]. Miners discovered the cave filled with hot water, and drained it to explore the gallery. The cave is now a giant laboratory where scientists are looking for the keys to understand geological processes.

Teaching sequence (for students 15 years old) is as follows:

DISCOVERING A MARVELLOUS PLACE: We showed our pupils several images and a short video of the Cave of the Crystals and ask them about the process that may have caused the phenomenon. Whole-class discussion.

PRESENTING A CHALLENGE TO OUR STUDENTS: "COULD WE CREATE A CRYSTALS CAVE IN A TEST TUBE?"

EXPERIMENTING TO IMITATE NATURE: Students tried to grow crystals simulating the same conditions as those in Naica's mine.

We have chosen KNO_3, a salt more soluble than gypsum. We added 85 g of salt to 200 ml of water (solubility of KNO_3 at 25ºC is 36 g per 100 gr of water) and heated it until it is dissolved. Afterwards, we poured the solution into some test tubes and other recipients and let them cool at room temperature. *And they got a beautiful crystals cave!!*

THINKING A LITTLE MORE**:** we asked pupils some questions to make them think about the process and to predict what would happen in different situations. For example:

a) What would happen with crystals if we heated the tubes again? or

b) What would happen if we took the remaining solution from the tubes and keep it in the fridge?

PROVING A NEW HYPOTHESIS**:** Pupils collected the remaining solutions from all the containers, poured them in a Petri dish and let them inside the fridge for a day:

New crystals grew at the bottom of the Petri dishes!!!

LOOKING FOR THE SCIENTIFIC EXPLANATIONS**:** We made them work in pairs in order to find an explanation about giant crystals in Naica's mine, by using short videos[2], a scientific article or any information they can find on line.

THINKING OF FUTURE**:** Should we close Naica's mine in order to preserve it? Whole-class discussion

[1] *J.M. GARCIA-RUIZ et al. Formation of natural gypsum megacrystals in Naica, Mexico. Journal Geology V.35, Issue 4 (April 2007) pp. 327-330. It can be accessed at http://www.goesociety.org/pubs*

[2] *Video La cueva de los cristales grandes Universitat de Barcelona. It can be accessed at http://www.youtube.com/watch?v=ldJQwLwhb2Q*