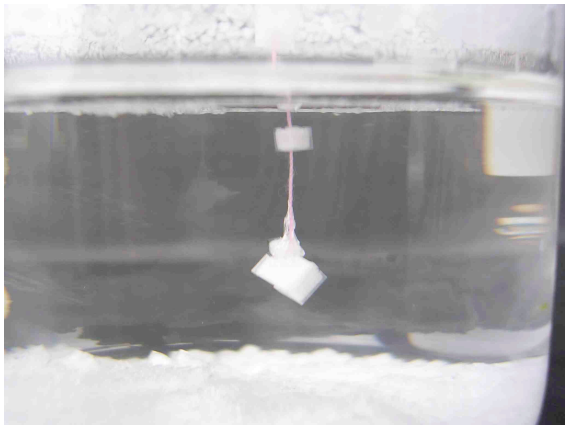
Salt of the Earth
Who can make the biggest salt crystal?

Your pupils may know that crystals of salt (sodium chloride) form when salty water evaporates, but do they know how to grow a big crystal? They have probably only seen tiny grains of salt, or perhaps a large shapeless lump extracted by evaporation under the sun in an open “pan”.

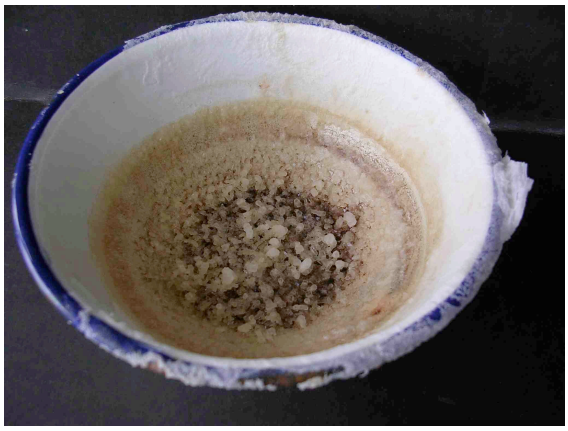
Make up a strong salt solution by slowly dissolving about 50g of salt in about 250ml of hot water.
Glue a salt grain to a piece of thin thread, as a “seed” crystal, and dangle it in the solution from a supporting stick resting across the top of the container. Cover it loosely with a piece of card to keep out the dust.
Leave it for a week or two, or for as long as it takes for a salt crystal to grow around the “seed” crystal.
This activity could be made into a challenge, with pupils trying to make the biggest crystal with the most perfect shape (*a cube with stepped, hollow faces).*

An extension activity is to model what happens when a shallow evaporating area of “sea” dries up. Schools within reach of the sea can take a bottle of real sea water and pour some of it into a shallow dish, such as a wok, and leave it to evaporate in a warm place. If the dish is topped up at intervals with additional sea water, there is a better chance of producing a more impressive rim of crystals.
In addition to the dominant sodium chloride, there are other salts dissolved in natural sea water, including calcium hydrogen carbonate, calcium sulphate and potassium compounds. With appropriate facilities, these may be tested as described under “Following up the activity” below.

Schools which are distant from the sea can make up some artificial “sea water” by dissolving sodium chloride and other soluble salts in hot water (see below).



Salt crystals growing in a strong solution of sodium chloride



Crystals formed by the slow evaporation of sea water (Extension)

Salt pseudomorphs. These cubic shapes were formed on an ancient salt flat, which dried out to leave salt crystals. The next flood of water dissolved the salt and washed clay into the cubic shapes. This then hardened to give the shapes you can see. (*Photos; P. Kennett*)

The back up

Title: Salt of the Earth

Subtitle: Who can make the biggest salt crystal?

Topic: Growing crystals of salt by evaporation of salty water under controlled conditions.

Age range of pupils: 8 – 16 years

Time needed to complete activity: 15 minutes to set up, but maybe a week or two to see the results

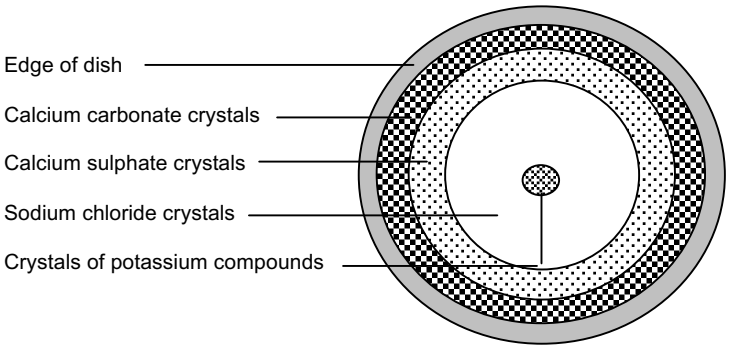
Pupil learning outcomes: Pupils can:

- describe what happens when salt solution is allowed to evaporate slowly;
- describe how larger crystals may be produced by slower rates of evaporation;
- explain how evidence of former salt deposits may be seen in the geological record;
- (Extension) explain that salts of higher solubility will crystallise last in a sequence of crystallisation.

Context: The activity provides a practical example of chemistry in action.

Following up the activity:
Investigate the main sources of the supply of salt (sodium chloride – a vital commodity), for the pupils' own country.

For schools with appropriate facilities – carry out flame tests on a range of salts from the lab reagent bottles, e.g. calcium chloride, sodium chloride, potassium chloride, to see which colours are associated with each metallic ion. Wearing eye protection, a nichrome wire is dipped in dilute hydrochloric acid and heated in a hot flame to clean it. It is then dipped into the salt being tested and held in the hot flame. Note the colour of the flame (brick-red for calcium; yellow for sodium; pale lilac for potassium, best seen through a piece of blue glass. The sodium yellow tends to swamp the other colours). Then conduct the tests on the successive rims of salts in the dish as described above. The red colour comes from the least soluble deposits of calcium salts nearest to the rim of the dish: the middle zone of deposits produces the yellow colour from sodium salts; and the pale lilac comes from the residual deposits of the highly soluble potassium salts in the centre of the dish.
In ideal circumstances, the deposits of different salts can look like this:



Underlying principles:
- Salt is produced by the evaporation of salty water, either by natural processes or when controlled by humans.
- The size of the resulting crystals depends on the rate of crystallisation – the slower the rate, the larger the crystal.
- Compounds have very different solubilities in water. The most soluble ones are the last to crystallise when the solution is evaporated.

Thinking skill development:
- Pupils establish a pattern that salt crystals may be formed by evaporation of salt solution.
- A cognitive conflict arises when they realise that different compounds have different solubilities.
- Metacognition is involved in predicting outcomes and in discussion of results.
- The application of the activity to the sources of the country's salt supplies involves bridging.

Resource list:
- any suitable glass or plastic container e.g. about 250 ml
- salt (sodium chloride) at the rate of 50g per container
- hot water
- cotton
- small stick
- glue (non water-based)

For extension:
- shallow dish, e.g. a wok
- sea water, or "home made" equivalent, using laboratory reagants, viz: chlorides of calcium, sodium and potassium
- Nichrome wire
- dilute hydrochloric acid
- Bunsen burner, Primus stove or similar source of a hot flame
- piece of blue glass

Useful links: See Earthlearningidea activity "Rocks to eat? How do we get the elements we need to stay healthy?" published 27th October 2008.
See: http://www.ehow.com/how_3864_grow-salt-crystals.html to see how to make coloured crystals
See: http://www.saltsense.co.uk/aboutsalt-prod03.htm to find out what mines into ancient salt deposits look like.

Source: This activity was devised by Peter Kennett of the Earthlearningidea team.