Suggestions and Information for Using the NaCl Kit

Note:

* sections written in blue are primarily ‘teacher background information’
* this handout is online at: <http://blogs.sd41.bc.ca/science/dlrc/nacl-info/>

Main Ideas

* The bonds associated with salt (NaCl) are different than the bonds associated with water
* Ions are atoms (or groups of atoms) that have obtained a positive or negative electric charge due to electrons being gained or lost
* Ionic bonding – type of intramolecular bonding involving ions of opposite charge attracted to each other
* Solutions can be better understood by discussing atomic theory

More Ideas

* Positive Charge for sodium ion (Na+) & negative charge for Chloride ion (Cl-)
* Dissolving salt and sugar - in salt, the NaCl molecules break apart into Na+ and Cl- ions which are surrounded by water molecules whereas in sugar, entire sugar molecules stay together and are surrounded by water molecules
* sugar dissolving is a physical change
* it is debatable about whether or not salt dissolving is a chemical or physical change because the NaCl breaks into ions – various views can be found if you search this subject online but generally, chemists classify the dissolution of salt in water as a physical change <https://www.learner.org/courses/essential/physicalsci/session4/closer1.html>
* Positive ions are called cations and negative ions are called anions
* Covalent vs. Ionic Bonding – see following link

<https://www.khanacademy.org/science/chemistry/atomic-structure-and-properties/introduction-to-compounds/a/paul-article-2>

* Is NaCl a molecule? See following link

<http://www.digipac.ca/chemical/molemass/moles5.htm>

Suggestion for Lesson(s)

1. NaCl Model

* Inform students they will be working with models of sodium ions (blue) and chloride ions (green) – these ions can be used to model sodium chloride (which is common salt)
* Perhaps use one of the following videos as a ‘hook’ for engagement and curiosity

<https://www.youtube.com/watch?v=2mzDwgyk6QM>

<https://www.youtube.com/watch?v=ji_25I_q4LQ>

* videos show reactions between sodium (solid) and chlorine (gas) – under the correct conditions sodium atoms loses electrons to chlorine atoms forming ions Na+ and Cl- (the ions are then attracted to each other to form NaCl)

1. Give partners 10 ions ( 5 blue Na+ and 5 green Cl- ) and 1 water molecule

* the kit contains 14 cubes (each 3x3x3) in plastic bags
* remove 10 ions from each plastic bag
* each student pair begins with only 10 ions – they receive the rest of the contents in the bag afterwards – at end of class, students arrange ions back into 3x3x3 cube and then store in plastic bag

1. ask students to place all the ions in a single line (1d pattern)
2. then ask students to place ions in a 2d pattern

( for example, form a 3x3 square with the extra 10th ion attached to it, or a 2x5 rectangle, or . . . )

**What have you noticed about the ions?** (give students a bit of time)

Here are some examples of what students might notice:

* there are blue and green ions
* green ion is larger than the blue ion
* the blue and green ions are attracted to each other
* when the ions are joined together they need to alternate in colour
* blue ions (sodium) are attracted to oxygen in water molecule (so sodium ion has a positive charge)
* green ions (chloride) are attracted to hydrogen atoms in water molecule (so chloride has a negative charge) note: chlorine atom has gained one extra electron to form chloride ion Cl- and sodium atom has lost one electron to form sodium ion Na+
* each ion has 6 magnets so a green ion can attract 6 blue ions and vice versa

1. give each pair the rest of the ions in the plastic bag – ask students to place all of their ions in a 3d pattern (for example, a cube, or a rectangular prism, or something like these but with a few extra ions attached)

🡪 students are forming a simple repeated pattern – these patterns model the crystal lattice structure of NaCl

1. Have students physically model the lattice structure
2. ask 4 students to model the 2d pattern of NaCl (2 x 2 ) – move to a large open area – use pinnies (or raised hands ) to distinguish between Na+ and Cl-
3. ask ‘How many more students are needed if want to make the next square?’

* need 5 more students to form 3x3 square
* have 5 students join the first 4 – try to get students to arrange themselves with little or no guidance from teacher
* do again for 4 x 4 (and 5x5 or bigger if you want)

1. ask students ‘Are the ions moving?’ 🡪 since this is the solid phase, have the students vibrate (there is movement but ions are not moving in linear paths like a liquid or gas)
2. notice that the interior students are ‘really stuck’

* lots of nearby ions to keep them ‘locked in’ and it is very difficult to vibrate away from each’
* the ions on the outside have a much better chance of ‘escaping’ since the outside ions have less ions attracting them to the lattice
* when water arrives, the outside ions become attracted to the water and have a much improved chance of escaping the lattice

1. now check out the animation showing how salt dissolves

see link at <http://blogs.sd41.bc.ca/science/dlrc/nacl-info/>

🡪 ‘Dissolving NaCl link’

At some point, discuss the limitations/benefits of the NaCl kit model

For example:

Limitations:

* ions are not blue and green
* ionic bonds are not magnetic
* ions are mostly space – if an ion were the size of a large cathedral, the nucleus would be about the size of a fly
* ions have subatomic components not shown in the model

The model supports the following:

* there is an attraction between Na+ and Cl- ions
* analyzing salt lattices

FYI

Covalent versus ionic bonding - which is stronger?

🡪 it depends upon the elements involved

Optional items of interest:

* Why does salt help dissolve ice?

<http://antoine.frostburg.edu/chem/senese/101/solutions/faq/why-salt-melts-ice.shtml>

* see 3D Molecular Designs Lesson Plans for NaCl kit

<http://www.3dmoleculardesigns.com/Teacher-Resources/NaCl-Lattice.htm>

* videos of H2 and 02 forming water

<https://www.youtube.com/watch?v=DP05fxR4oUk>

<https://www.youtube.com/watch?v=VmTZcNVzp7A>

<https://www.youtube.com/watch?v=hm9me9i13Q8>