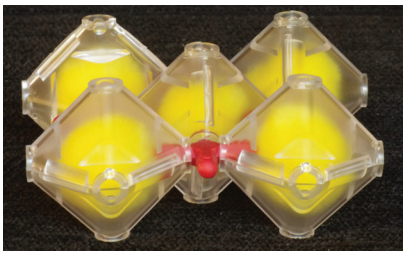
Salt Model

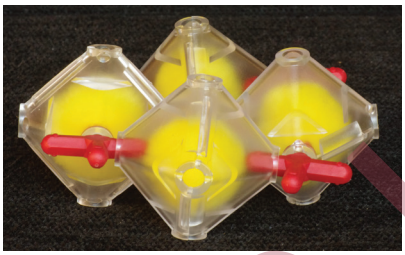
Using the Salt (NaCl) Unit Cell Polyhedral Model

Kit Contents

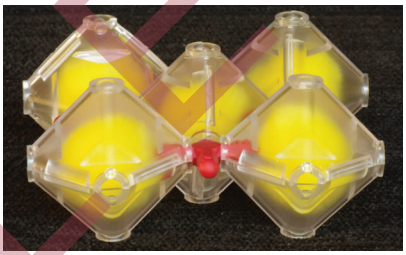
Your Salt Model has been shipped as three separate square layers, as shown below.



a. A 5-octahedron layer.



b. A 4-octahedron layer.



c. A second 5-octahedron layer.

Each layer consists of *octahedra* and *flexible red connectors*. The yellow pom-poms inside the octahedra represent sodium ions, Na^+ and the corners of the octahedra represent chloride ions, Cl^-. The connectors hold the octahedra so that each octahedron shares edges with other octahedra in the layer. Two of the layers (right most, **a**) and left most, **c**) have five octahedra; one of the layers (**b**, middle) has four octahedra.

Why Octahedra?

In the NaCl crystal lattice, each sodium ion is surrounded by six chloride ions that are located at the corners of an octahedron. (The name *octa*hedron comes from the eight triangular faces of the octahedron, not from the six corners.) Each Na^+ ion is said to occupy an octahedral hole; the hole is the space not occupied by the six Cl^- ions, which are assumed to be spheres. (Note that when you pack spheres as close as possible to each other there is still empty space between them. Students could experiment with marbles, ping-pong balls, or an ICE Solid-State Model Kit[1] to see this.) Because each sodium ion is in an octahedral hole, it is reasonable to represent the sodium ions (cations) as yellow pom-poms inside an octahedron. The octahedra then can be packed by sharing edges to form two-dimensional layers and the layers can be stacked to form the overall three-dimensional structure of the crystal lattice.

This polyhedral model is less effective at representing the chloride ions, which are located at the six corners of each octahedron. In the model, the red rubber connectors that hold adjacent octahedra together can represent the chloride ions, but the connectors are not spherical and the relative size of the chloride ions is not accurately represented. Instead the arrangement of the ions in space is emphasized. Your students may already know that cations typically have smaller radii than anions: the radius of a sodium ion is 116 pm (116×10^{-12} m) and the radius of a chloride ion is 167 pm. In this model the sodium cations (pom-poms), which are smaller than chloride ions, are in octahedral holes among the chloride anions, which are not represented by spheres at all.