## Three Crystallographic Aids for Teaching Early Science Classes. Start Them Young!

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Crystallographers, like crystals, have to begin with a nucleating step. This presentation explains three separate exercises, designed to present some basic crystallographic principles to students before or at the beginning of their formal scientific education. Each of these aids will be explained and the results illustrated.

The first exercise builds on the startling beauty and symmetry of snowflakes, and illustrates how an almost limitless number of snowflake designs can arise from the same basic pattern using the crystallographic concepts of symmetry, unit cell, and lattice. It has been used successfully with those aged 8 and older. A template marked by each individual shows where to cut. Using a special punch and properly folded paper yields a beautiful, unique, paper snowflake for each participant.

The second exercise involves a model constructed of uniform spheres to illustrate closest packing in cubic and hexagonal crystals. Either ccp or hcp unit cells fit the model as the layer ordering is changed. This can also serve to illustrate the concepts of *lattice* and *motif*.

The third exercise uses laser diffraction from carefully designed slides. Several motif patterns are constructed on identical 2-D lattices, showing the unchanging diffraction geometry. A student calculates lattice constants from diffraction measurements and infers from intensities, the orientation and bond length of 'diatomic' scatterers.

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