

## Crystal System

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In crystallography the terms crystal system refer to one of several classes of space groups, lattices, point group or crystals.

Informally two crystals are in the same crystal system if they have similar symmetries, although there are many exceptions to this.

Space groups and crystals are divided into seven crystal systems according to their point groups and into seven lattice systems according to their Bravais lattices. Five of the crystal systems are essentially the same as five of the lattice systems but the hexagonal and trigonal crystal systems differ from the hexagonal and rhombohedral lattice systems. The six crystal families are formed by combining the hexagonal and trigonal crystal systems into one hexagonal family in order to eliminate the confusion.

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A lattice system is a class of lattices with the same set of lattice point groups which are subgroups of the arithmetic classes. The 14 Bravais lattices are grouped into 7 lattice systems: ~~triclinic~~ triclinic, monoclinic, orthorhombic, tetragonal, rhombohedral, hexagonal and cubic.

In a crystal system a set of point groups and their corresponding <sup>space</sup> groups are assigned to a lattice system. Of the 32 point groups that exist in three dimensions, most are assigned to only one lattice system, in which case both the crystal and lattice systems have the same name. However five point groups are assigned to two lattice systems, rhombohedral and hexagonal because both exhibit threefold rotational symmetry. These point groups are assigned to the trigonal system. In total there are seven crystal systems; triclinic, monoclinic, orthorhombic, tetragonal, hexagonal, ~~and~~ cubic and trigonal.

A crystal family is determined by lattices and point groups. It is formed by combining crystal systems

which have space groups assigned to a common lattice system. In three dimensions the crystal families and systems are identical except the hexagonal and trigonal crystal systems which are combined into one hexagonal crystal family. In total there are six crystal families; triclinic, monoclinic, orthorhombic, tetragonal, hexagonal and cubic.

spaces with less than three dimensions have the same number of crystal systems, crystal families and lattice systems. In one dimensional space there is one crystal system. In 2D space there are four crystal systems; oblique, rectangular, square and hexagonal.

The relation between three dimensional crystal families, crystal systems and lattice system is shown in the following table.

Crystal family 06	Crystal system 07	Required Symmetry of Point groups	Point groups	Space groups	Bravais Lattice	Lattice System
Triclinic		None	2	2	1	Triclinic
Monoclinic		1 two fold axis of rotation or 1 mirror plane	3	13	2	Monoclinic

Orthorhombic	3 two fold axis of rotation or 1 2 fold axis of rotation and two mirror planes	3	59	4	Orthorhombic	
Tetragonal	1 four fold axis of rotation	7	68	2	Tetragonal	
Hexagonal	Trigonal	1 three fold axis of rotation	7	18	1	Rhombohedral
	Hexagonal	1 six fold axis of rotation	7	27	1	Hexagonal
Cubic	3 four fold axis of rotation	5	36	3	Cubic	
06	07	Total	32	230	14	07