10.4: Crystal Systems

Unit cells need not be cubes, but they *must* be parallel-sided, three-dimensional figures. A general example is shown in Figure 10.4.1. Such a cell can be described in terms of the lengths of three adjacent edges, *a*, *b*, and *c*, and the angles between them, α, β, and γ.

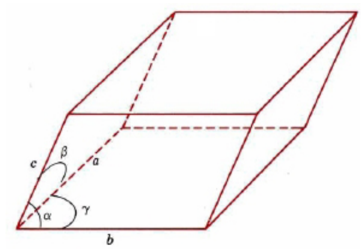

Figure 10.4.1 A generalized unit cell with sides a, b, and c, and angles α, β, and γ.

Crystals are usually classified as belonging to one of seven crystal systems, depending on the shape of the unit cell. These seven systems are shown in the image below.

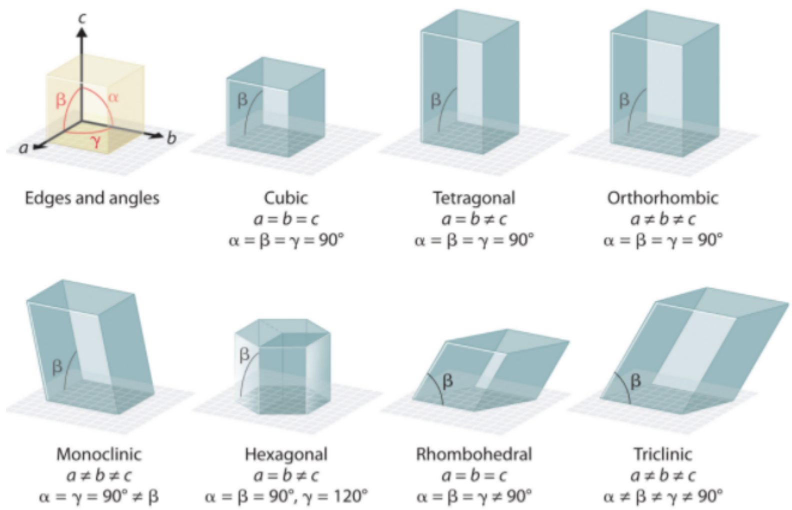

Figure 10.4.1" The Seven Crystal Systems.

The simplest is the cubic system, in which all edges of the unit cell are equal and all angles are 90°. The tetragonal and orthorhombic classes also feature rectangular cells, but the edges are not all equal. In the remaining classes, some or all of the angles are not 90°. The least symmetrical is the triclinic, in which no edges are equal and no angles are equal to each other or to 90°. Special note should be made of the hexagonal system whose unit cell is shown in Figure 10.4.2. It is related to the two-dimensional cell encountered previously as the second example of a 2D crystal lattice structure, in that two edges of the cell equal and subtend an angle of 120°. Hexagonal crystals are quite common among simple compounds, like quartz, seen here below.

Figure 10.4.2 The hexagonal unit cell a = b ≠ c, α = β = 90°, γ = 120° and an example of a material, quartz, with a hexagonal unit cell.