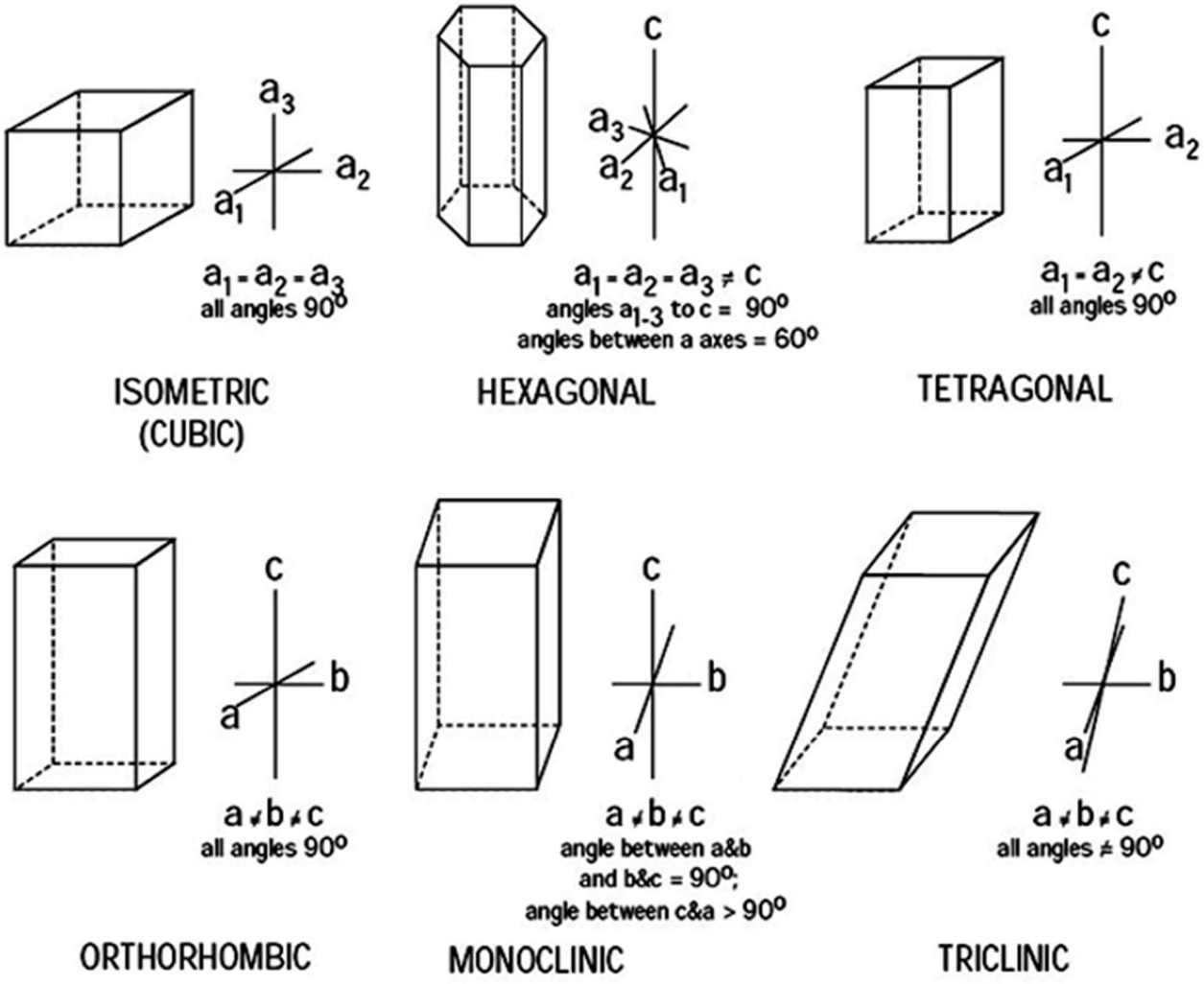
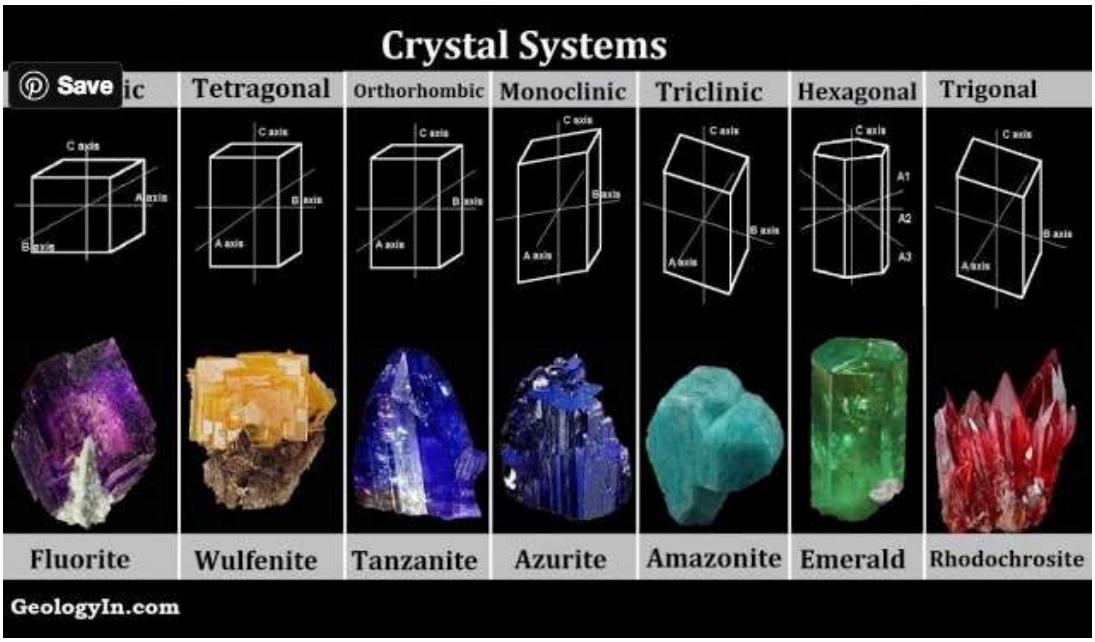
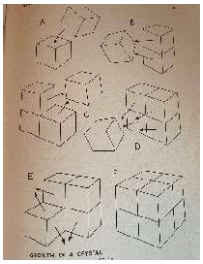
ISOMETRIC (CUBIC) MINERALS

Introduction

There are 6 geometry systems which every mineral in the world will fall into. Although daunting at first, learning these systems and being able to visualize the common variants will enable you to identify well developed minerals on sight or at least the mineral family (eg- carbonates all look the same)





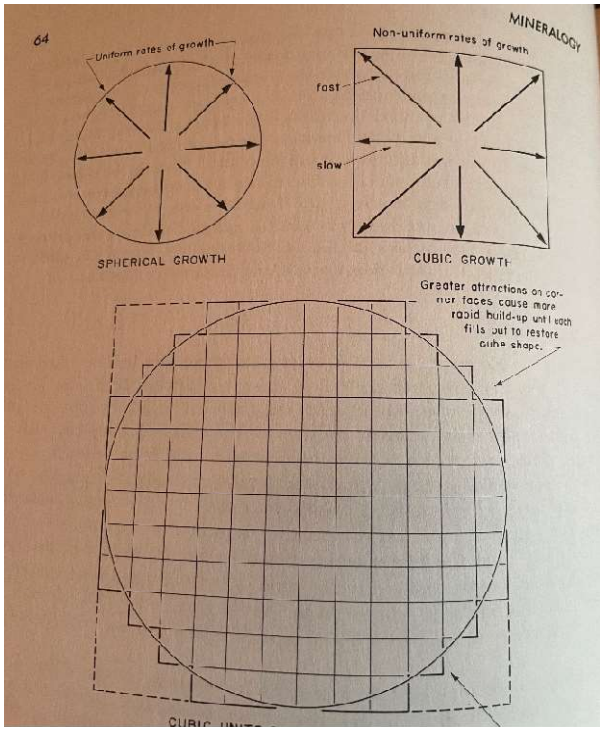


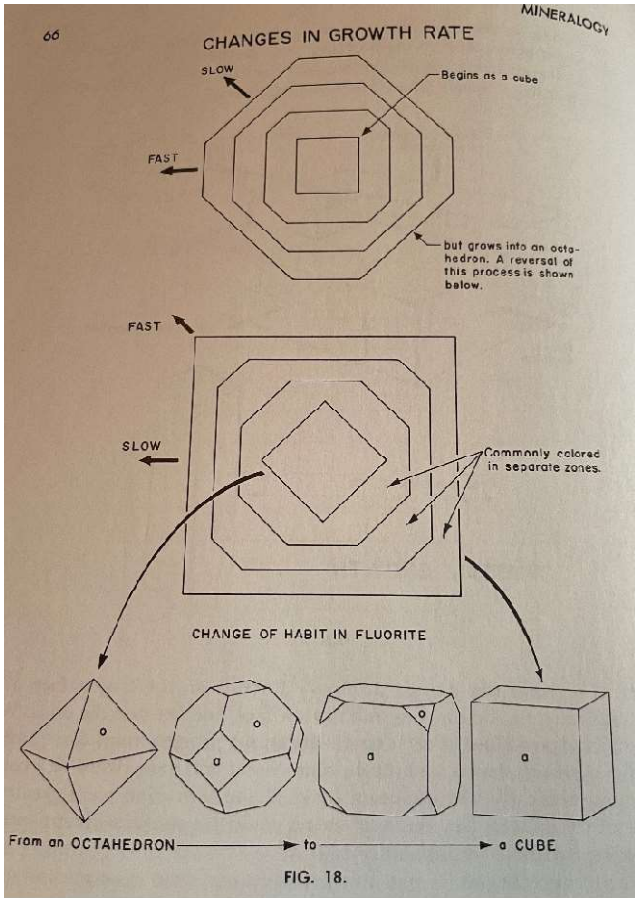
Isometric (Greek: iso=same, metric= measure, meaning all sides are the same length)

- **Isometric = cubic = hexahedron** (6 sides, this is European nomenclature)

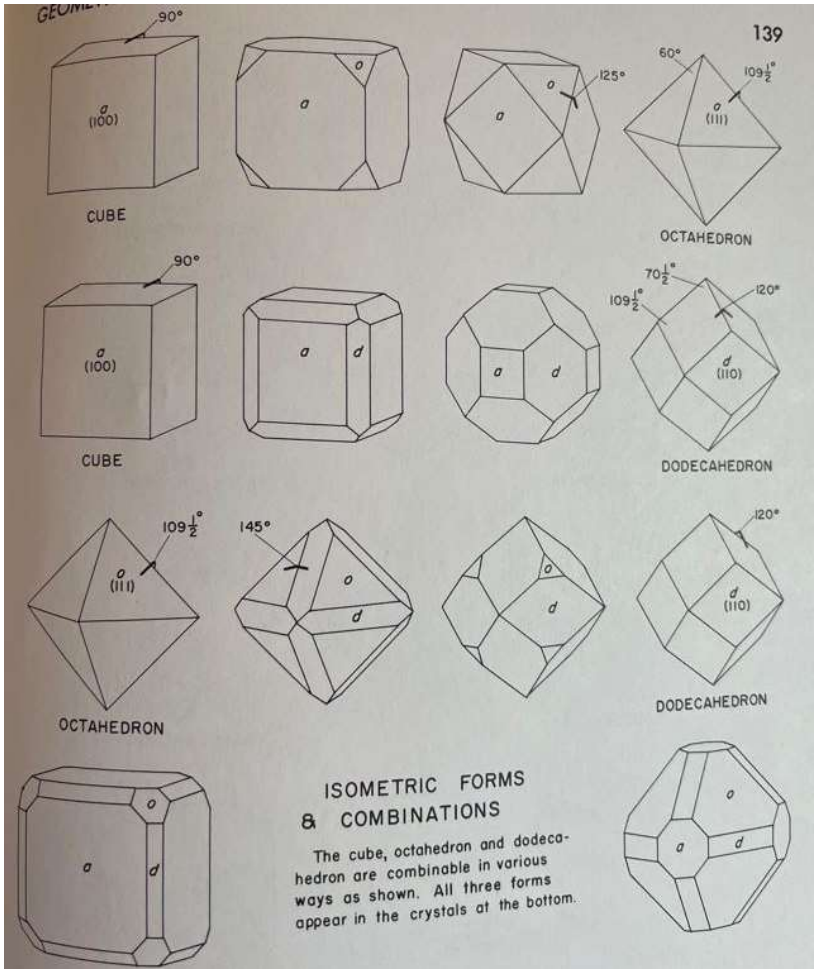
Crystal Growth

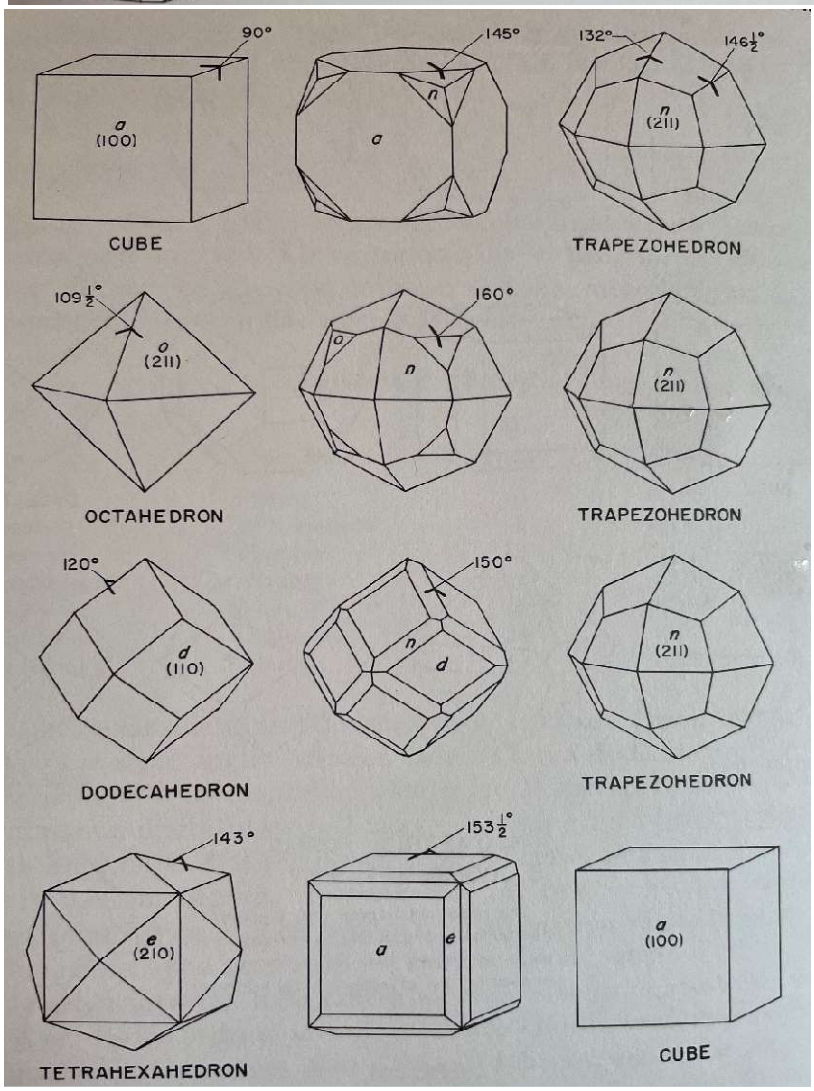
- Crystals grow from cooling and solidifying molten melts or precipitation of hot vapors
- They start as tiny blocks and grow (typically) in all directions at the same time – think of Russian nesting dolls or a growing insect- the outer growth completely surrounds the inner 3D shape
- The starting block is the **unit cell** which is the smallest distinct group of atoms which has all the essential parts of the mineral including its chemical, physical, and geometric properties. In cubic minerals this is a cube (different shapes for other mineral forms.) These unit cells will begin to stack as the crystal forms. In cubic minerals, these will stack just like children's blocks or Nintendo's Tetris game.
- The outer form will reflect the unit cell which will stack over a trillion trillion times in even the smallest visible crystal. A cubic unit cell will never form a hexagonal crystal.
- Crystal growth occurs as a unit cell drifts and attaches to another and so on. Where it attaches depends on several factors. It may be the area that is most exposed, an area not hidden by other crystals, or the area with strongest attraction chemically or electromagnetically. Therefore, different areas on a crystal can grow at different rates leading to classic variations which allow us to identify certain minerals on sight.





- It is common for there to be selective growth of either the flat crystal faces or on the edges or corners. Depending on where the growth is fastest this can make a cube, octahedron, dodecahedron, or the in between forms which are called "modifications," "bevels," or "extra crystal faces." So, in fig 18 above, common naming would be from left to right- octahedron, dodecahedron, cube modified by the octahedron, and cube.
- With further growth, any cubic form can become any other form. That is why some fluorite phantoms are different from the outer shape (for example). The phantom reflects what the crystal used to look like.
- Sidenote: when a formed crystal is later dissolved by hot fluids, the reuptake is also stereotypical, leading to some crystal surface details which can also look cubic – so even partially dissolved minerals can still be ID'd as cubic.





As light approaches a cube from any side, it "sees" the same molecular arrangement no matter where it arrives from (as opposed to say an aquamarine crystal which has a short side and a long side.) Therefore, cubic minerals will be easily identified in the following tests:

- Stays dark in polariscope or polarized light- **isotropic**
- Will have a single line in the refractometer, all other mineral systems will have double refraction or 2 lines
- Will be one single color in the dichroscope

Collectable Cubic Minerals:

Diamond
Native Gold, Silver, Copper
Garnets (all of them and synthetics – YAG)
Pyrite
Galena
Sphalerite
Fluorite
Halite
Sylvite
Magnetite
Spinel
Tetrahedrite / Tennantite
Boleite
Analcime
Carrollite
Helvite
Skutterudite
Cobaltite
Cuprite
Bixbyte
Lazurite
Leucite

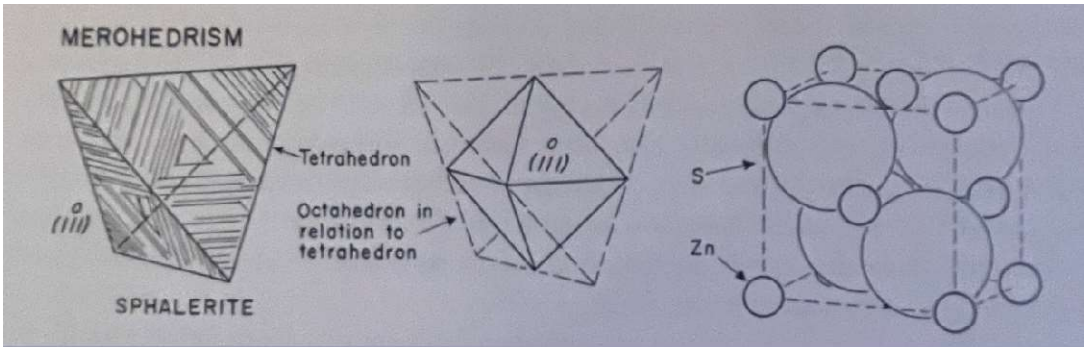
References / Resources

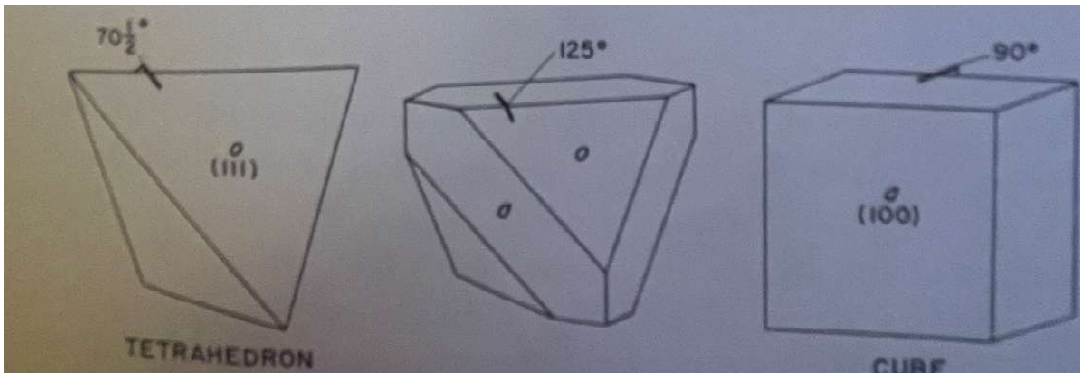
Smorf.nl
Mineralogy by John Sinkankas
Webmineral.com
Mindat.com

Special Forms in the Cubic Mineral System

Tetrahedron

- Sometimes it is chemically or energetically advantageous for a cubic mineral to not place the 4 anions in the corners of the cube, but instead to group them as two dumbbells overlying each other. This special (and denser) grouping is a tetrahedron. Tetrahedrons have a handedness (not mirror images) which are called positive and negative forms. Certain minerals tend to form this way – eg tetrahedrite, sphalerite, helvite.





Pyritohedron

- Occasionally, pyrite forms a "special" type of dodecahedron which has only 5 sided faces (instead of 4 or 6 sided faces as in "normal" dodecahedrons) called a pyritohedron.