
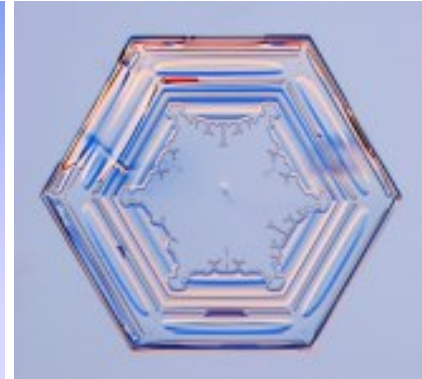


Solids  Crystals

Some beautiful crystals!!



<http://www.its.caltech.edu/~atomic/snowcrystals/>



topaz

Aluminum silicon oxide



quartz

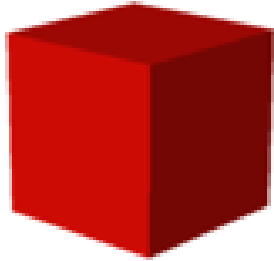
Silicon oxide



pyrite

Iron sulfide

# Platonic shapes



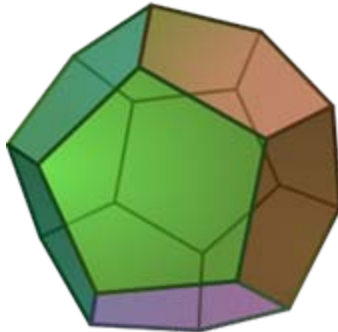
cube



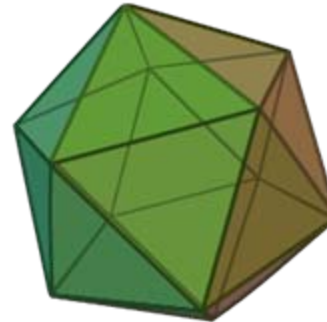
octahedron



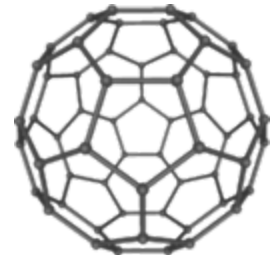
tetrahedron



dodecahedron








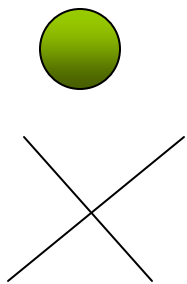
icosahedron



T-icosa

# Nature prefers low SA/V ratio

	S.Area	Volume	SA/V ratio	SA/V for unit V
	$1.7 a^2$	$0.1178 a^3$	$15/a$	7.2
	$6 a^2$	$a^3$	$6/a$	6
	$3.42 a^2$	$0.466 a^3$	$7/a$	5.7
	$20.6 a^2$	$7.66 a^3$	$3/a$	5.3
	$8.66 a^2$	$2.18 a^3$	$4/a$	5.14



$12.56 a^2$



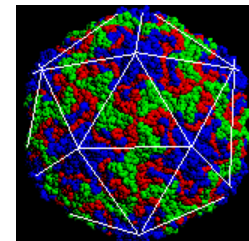
$4.2 a^3$



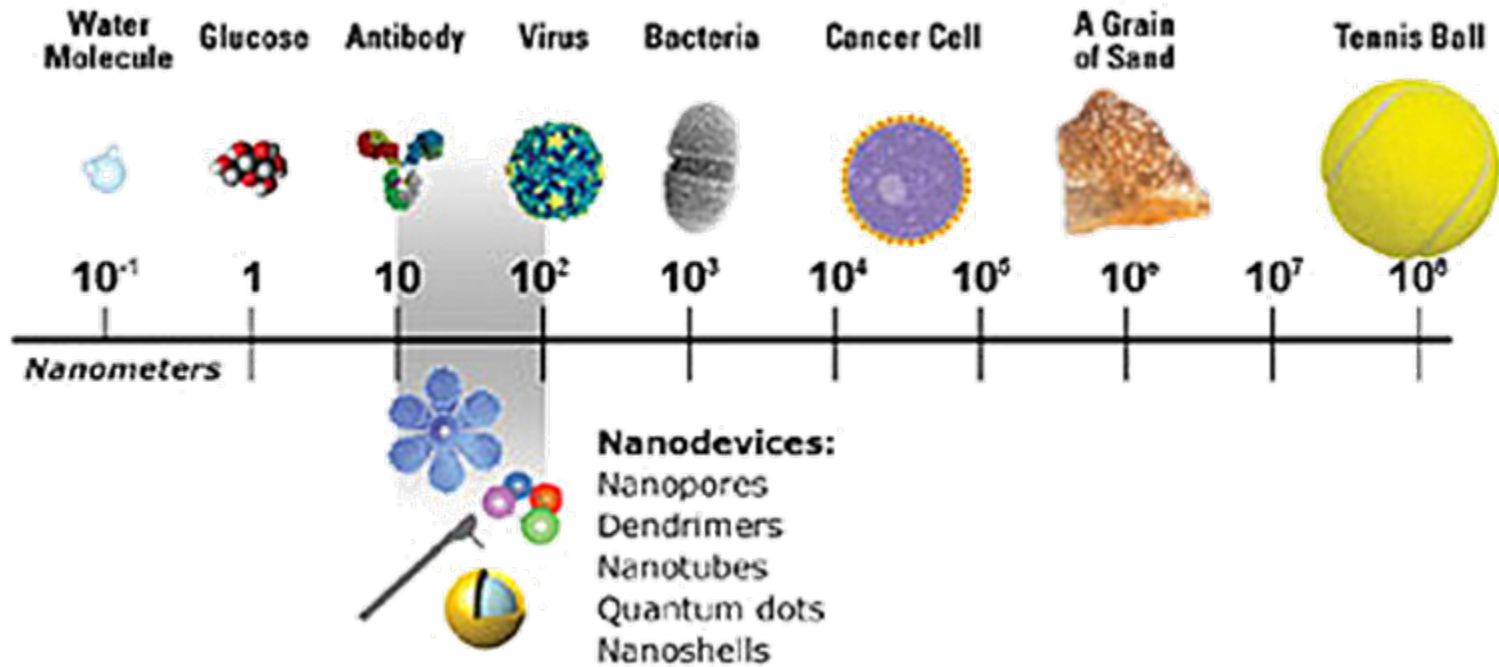
$3/a$



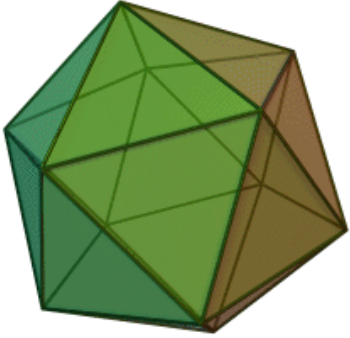
4.8



# What is Nano!!!!



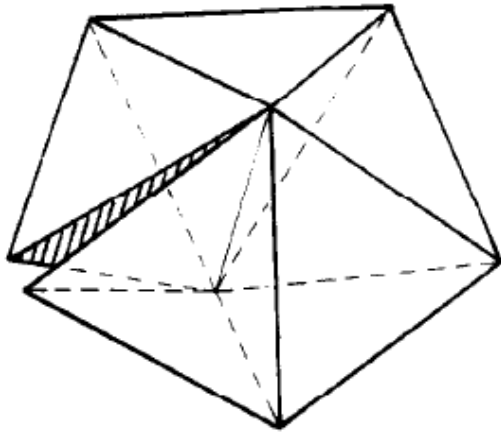
# Icosahedron



12 five fold axes – isolated; cannot grow into a bulk structure

Then how is it connected to symmetrical bulk?

20 tetrahedra stitched together!!!

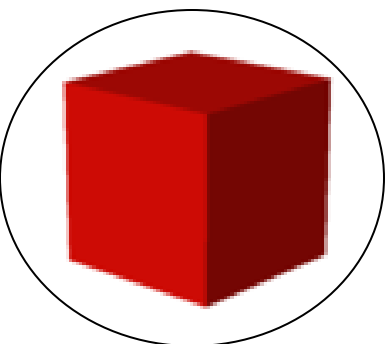


This is a noncrystalline nanostructure with internal strain and hence feasible only in small clusters with high surface to volume ratio!

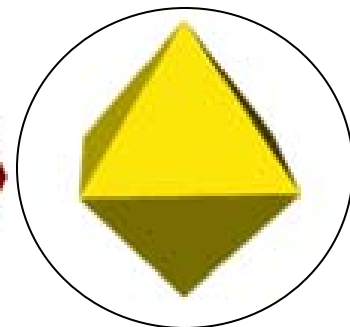
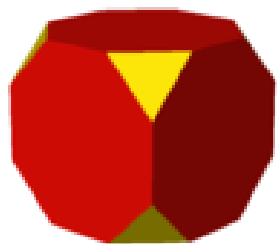
Same case for other pentagon related structures like dodecahedra.

An eg. of 5 tetrahedra together

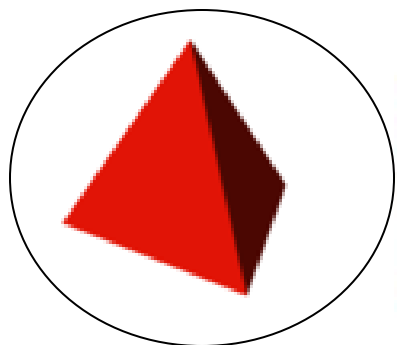
# Some related shapes



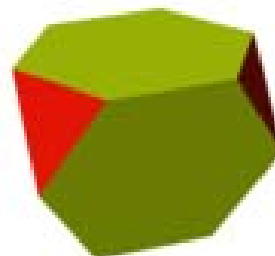
cube



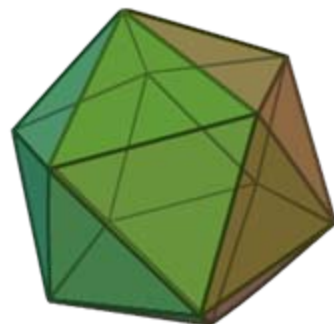
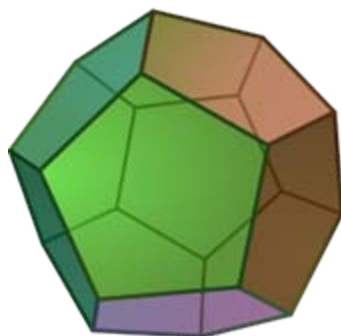
octahedron



tetrahedron

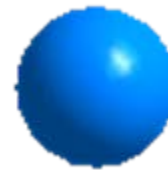
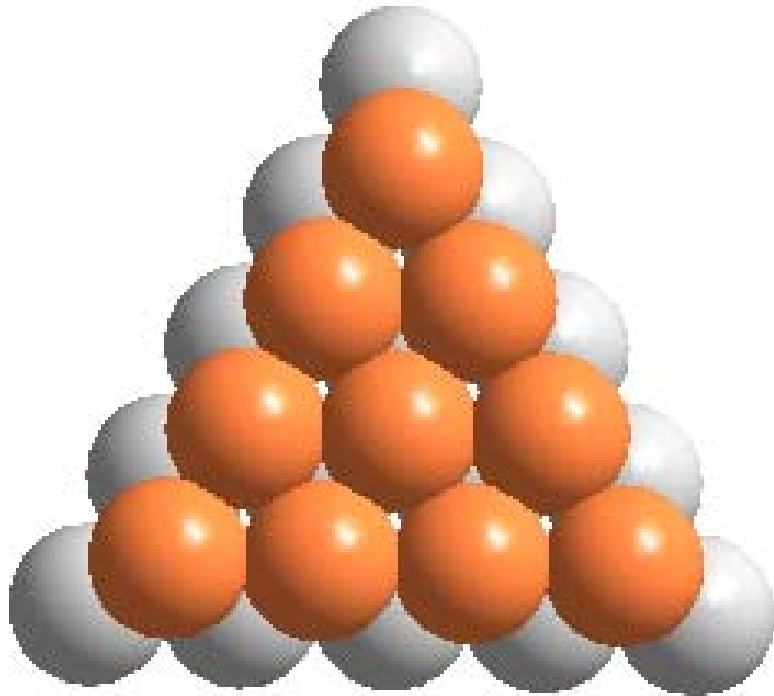
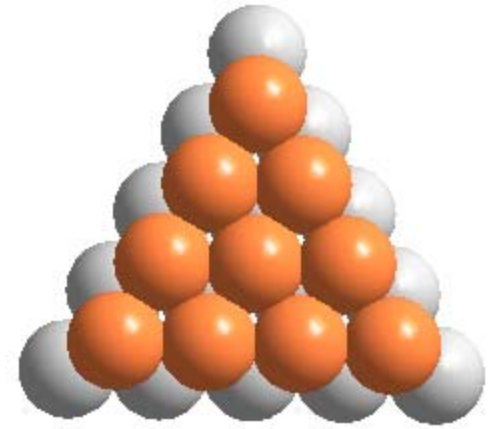
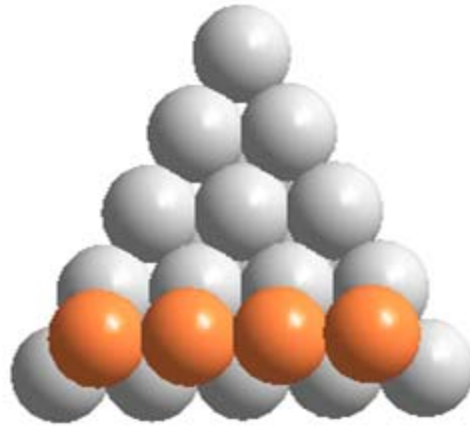
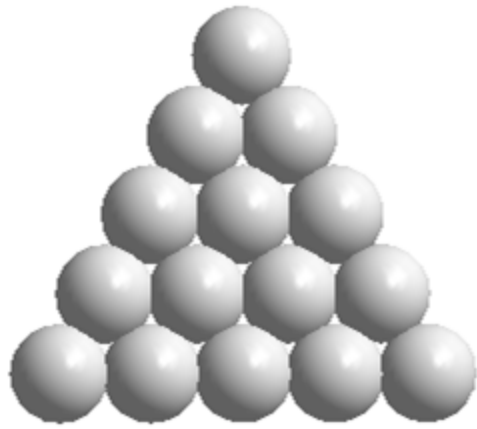


dodecahedron



icosahedron

**How do we fill these shapes?**

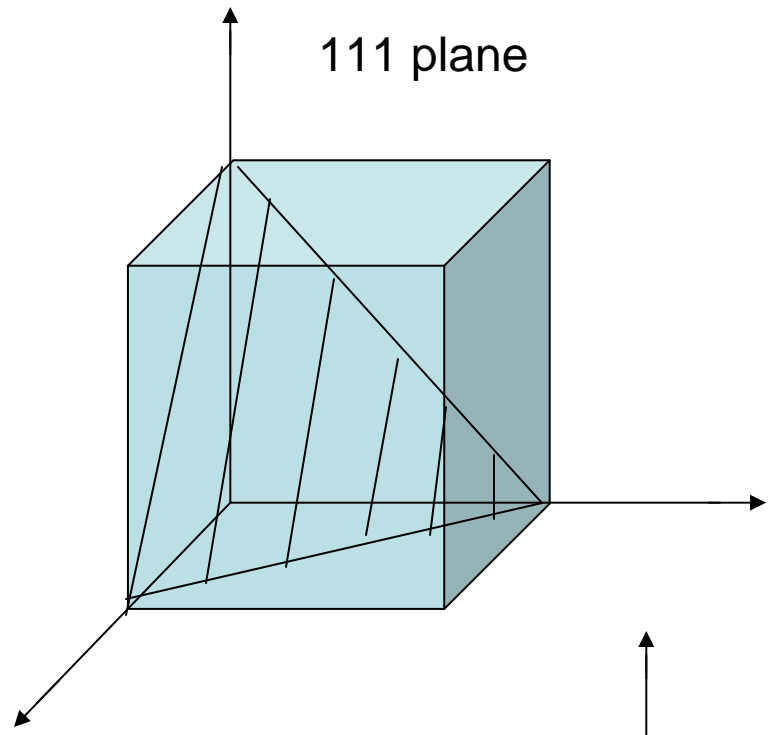


Hexagonal close packing

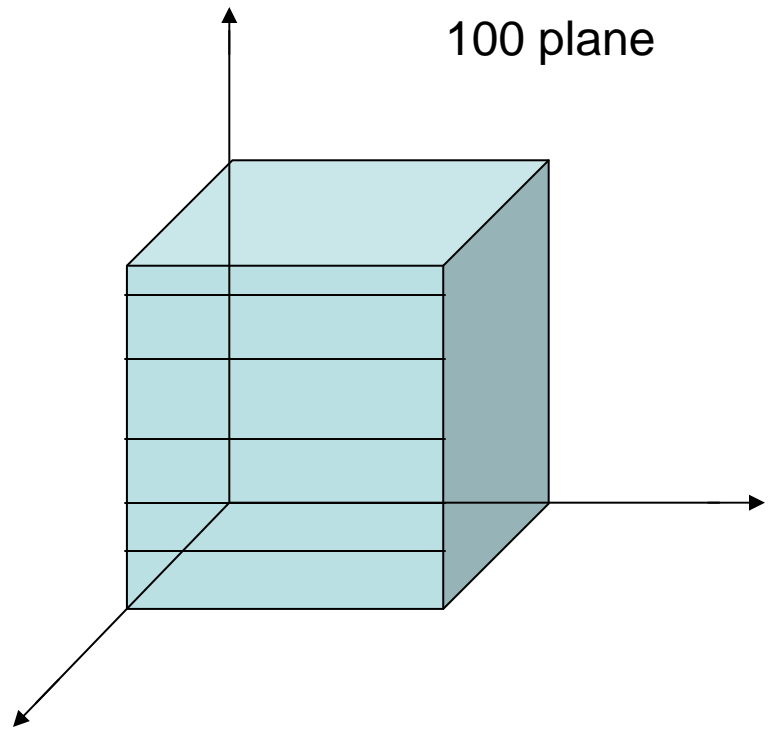
Cubic close packing



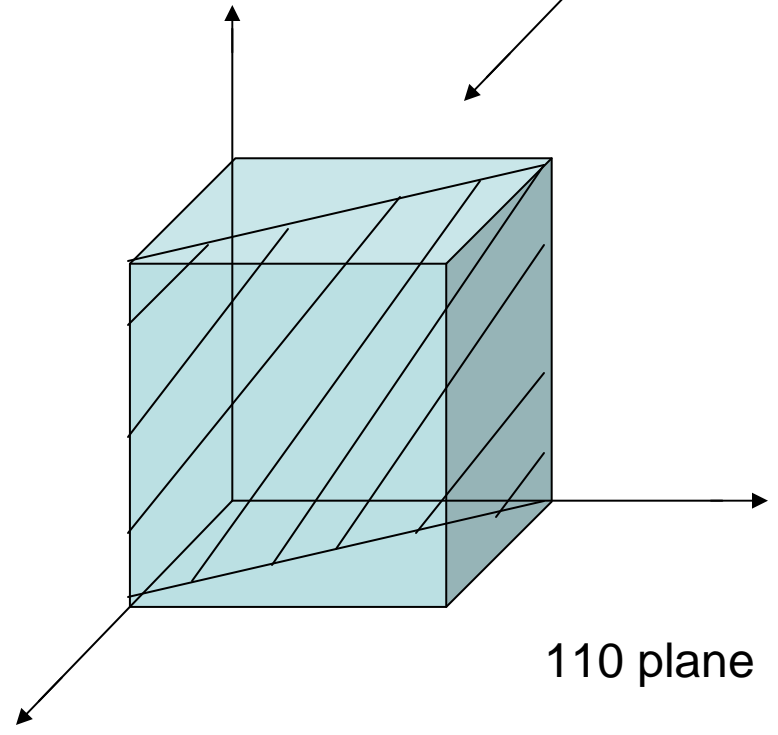
111 plane



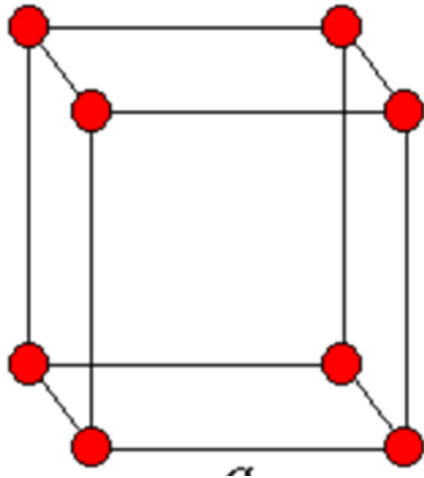
100 plane



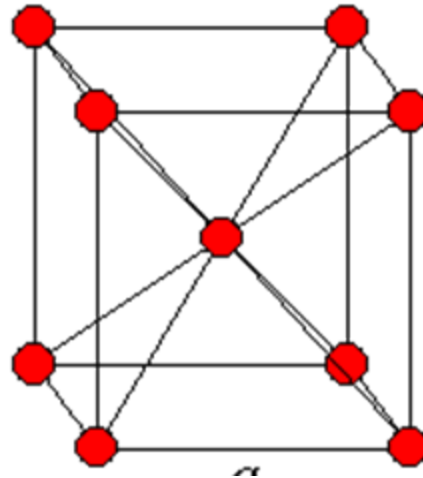
110 plane



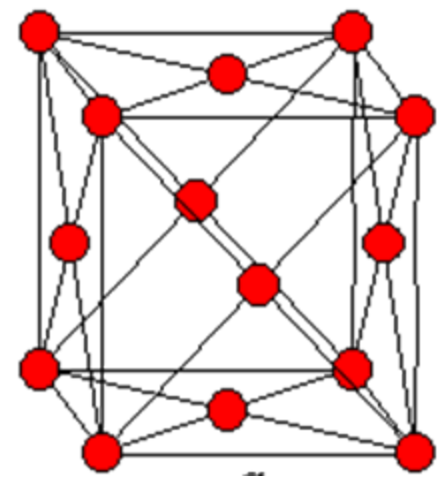
Simple cubic



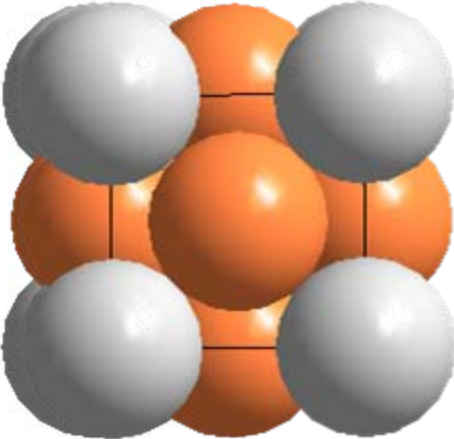
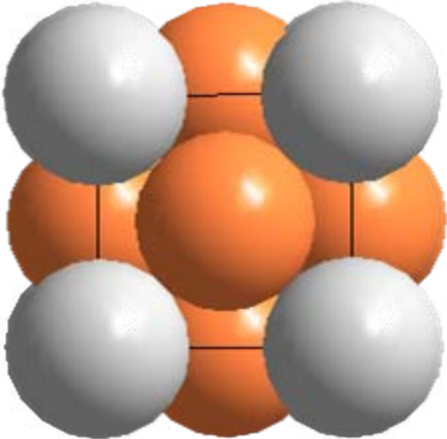
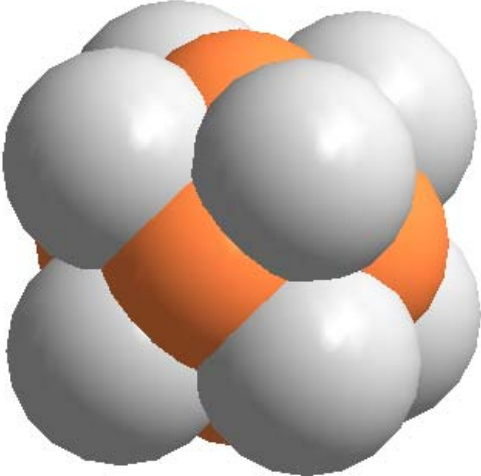
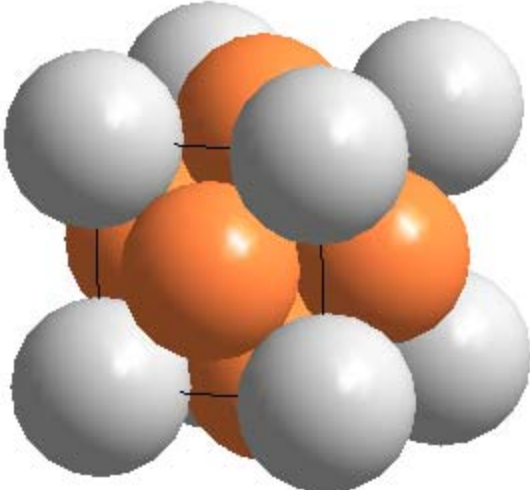
Body centered cubic

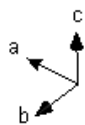
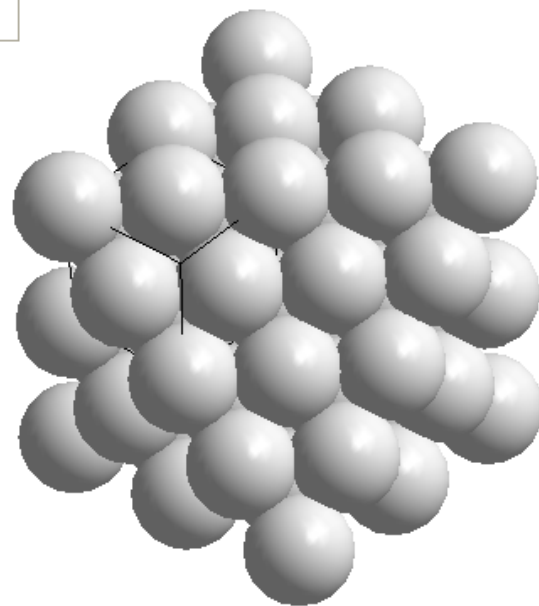
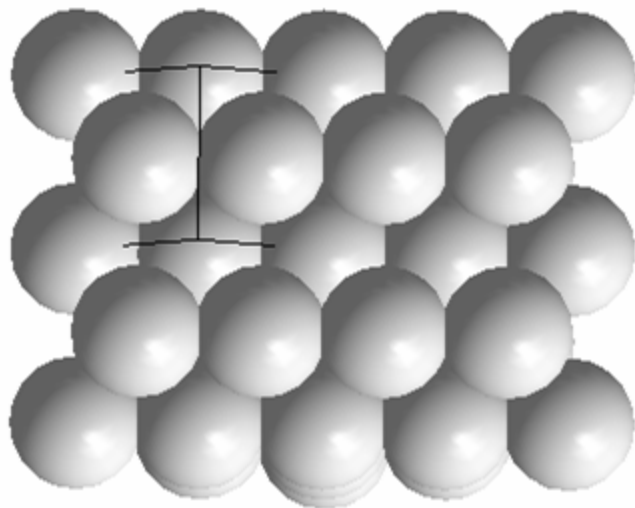
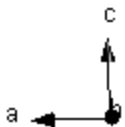
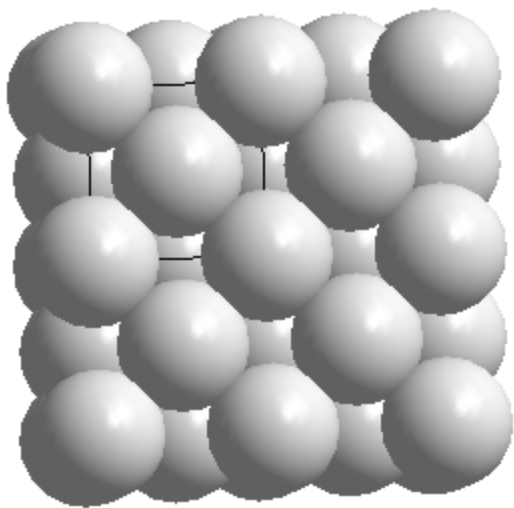


Face centered cubic

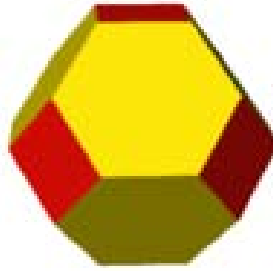


fcc unit cell of Pt

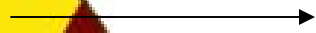
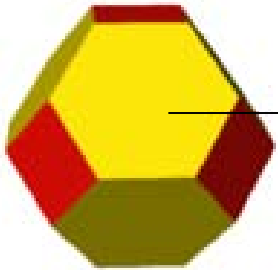




How does



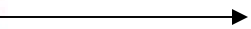
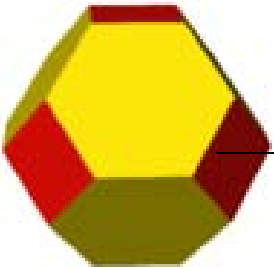
transform?



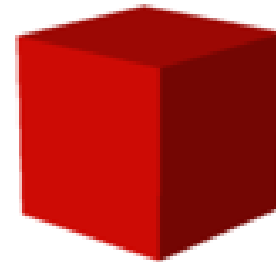
If you let (111) planes grow



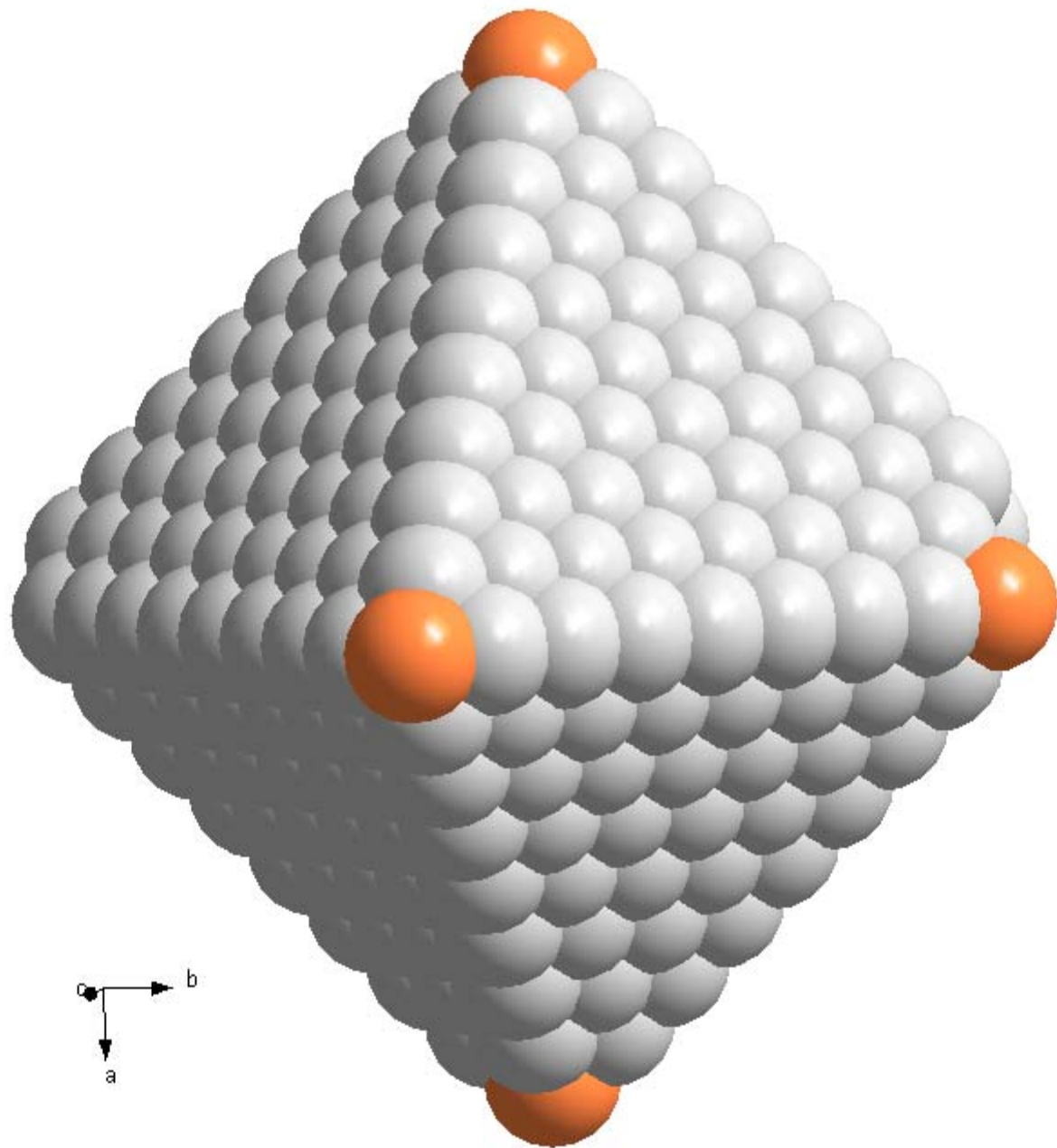
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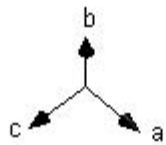
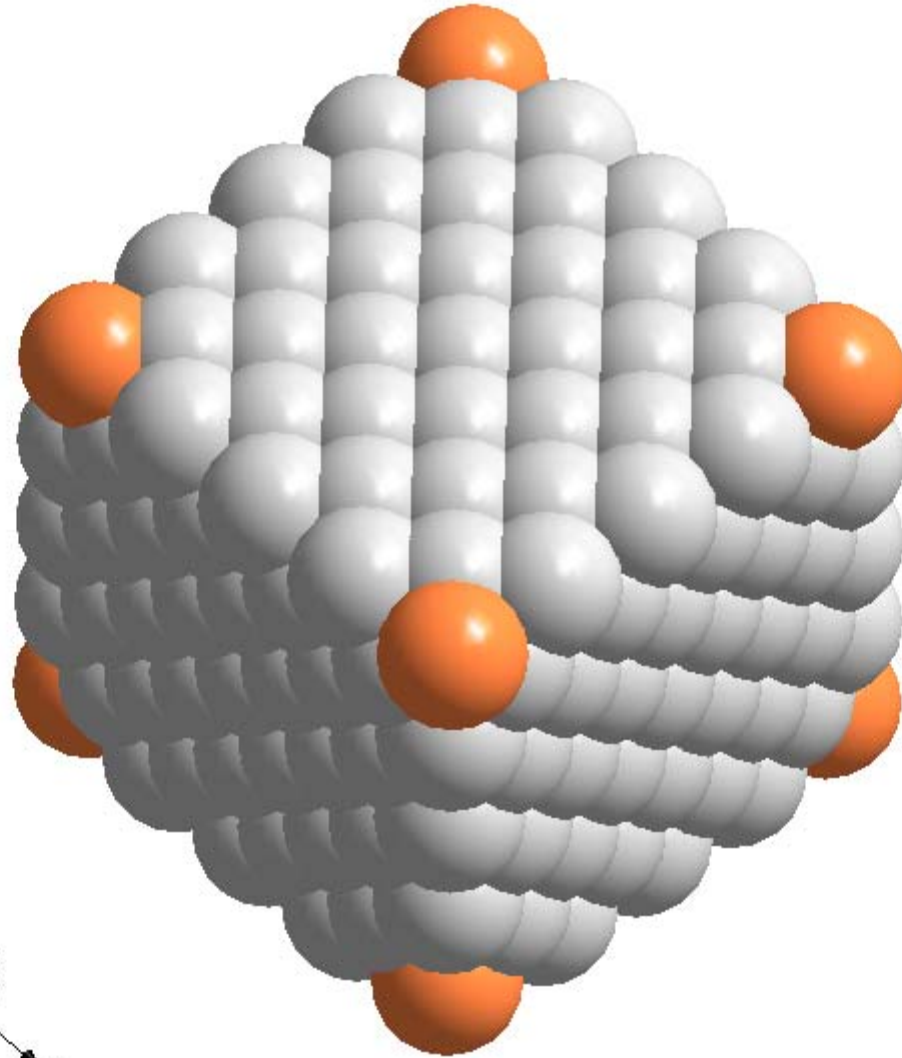


If you let (100) planes grow

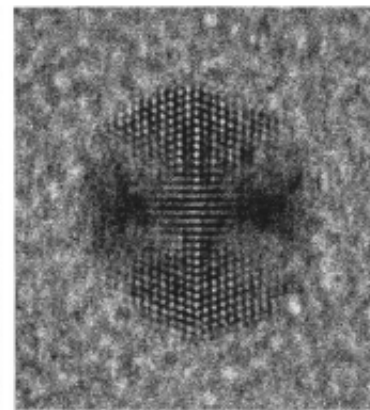
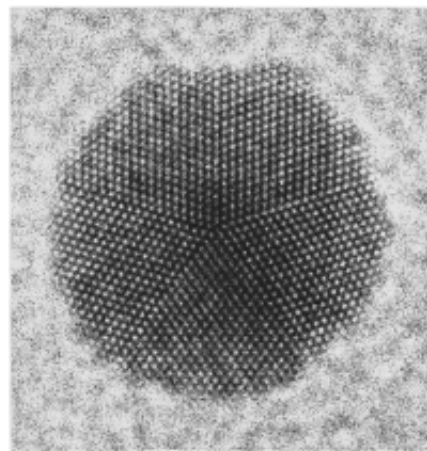
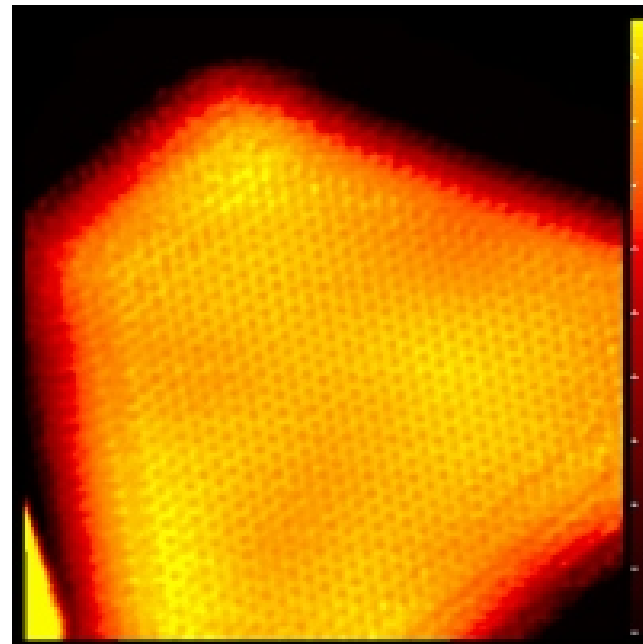
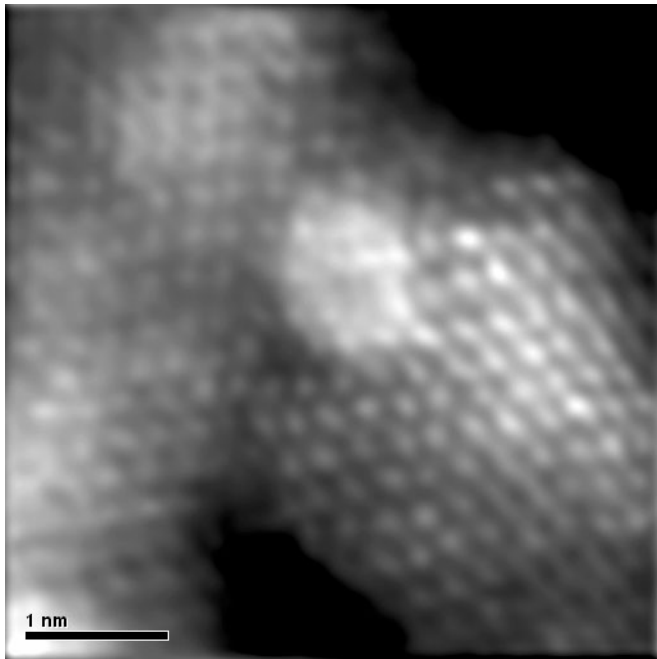


forms





# Some true pictures of nano!!!



a

2 nm

b



Let us build sodium chloride!

