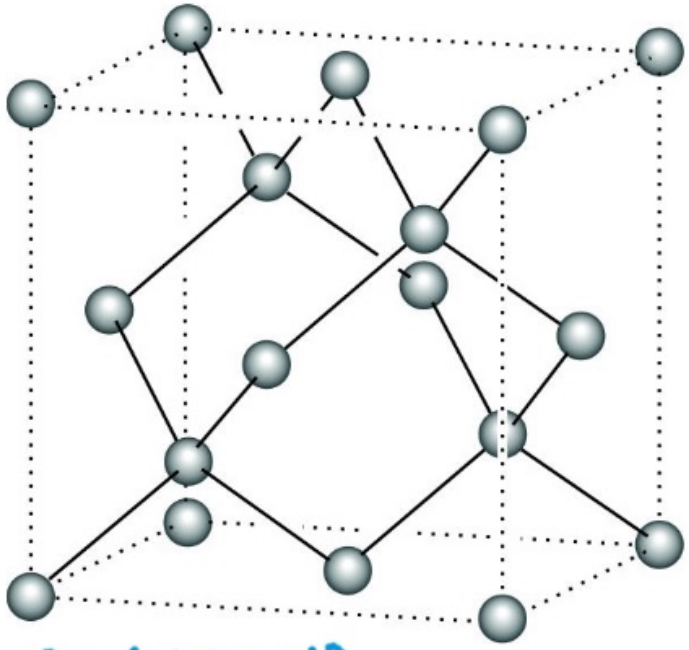
CRYSTAL STRUCTURE



DIAMOND

LATTICE

$\vec{r} = \mu_1 \vec{a}_1 + \mu_2 \vec{a}_2 + \mu_3 \vec{a}_3$

a_i = lattice vectors

μ_i = integers

BASIS

Describe a group of atoms

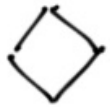
CHECKERBOARD - KITCHEN FLOOR:

LATTICE

$\vec{r} = \mu_1 a_1 + \mu_2 a_2$

BASIS

 @ (0, 0)

 @ $(\frac{1}{2}, \frac{1}{2})$

CHECKERBOARD - KITCHEN FLOOR.

LATTICE

$$\vec{r} = \mu_1 \vec{a}_1 + \mu_2 \vec{a}_2$$

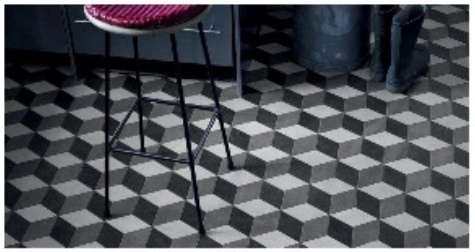
BASIS

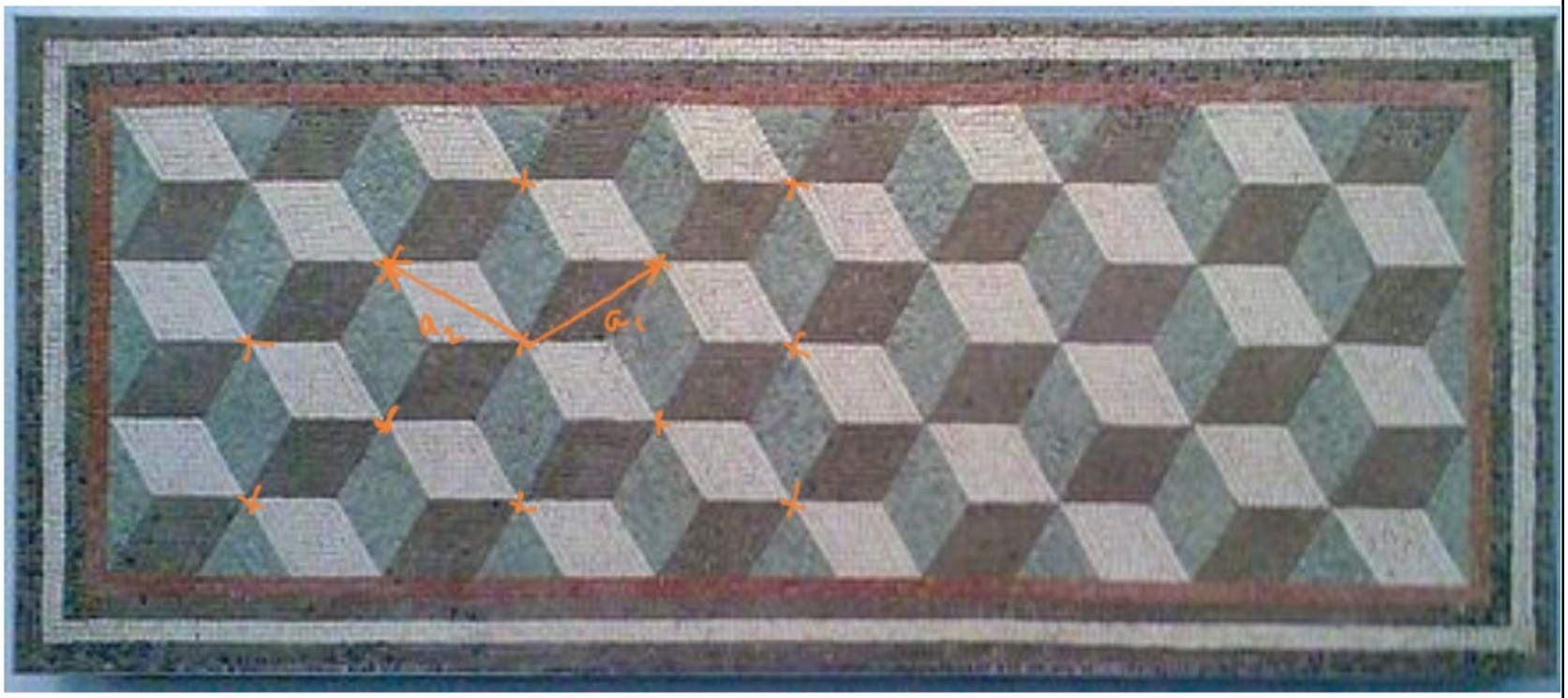
■ @ $\{(0,0); (\frac{1}{2},\frac{1}{2})\}$

□ @ $\{(\frac{1}{2},0); (0,\frac{1}{2})\}$

M.C. ESCHER'S TESSELLATION

ROMAN MOSAIC:





LATTICE:

BASIS

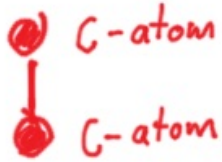
M.C. ESCHER'S TESSELLATION

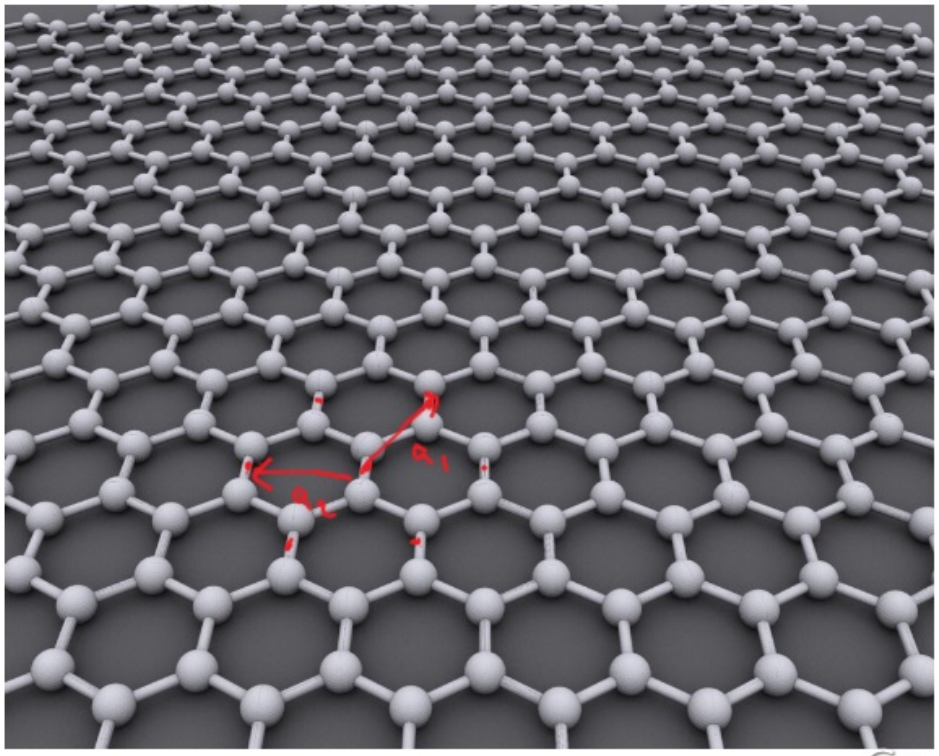
HONEYCOMB:

GRAPHENE:

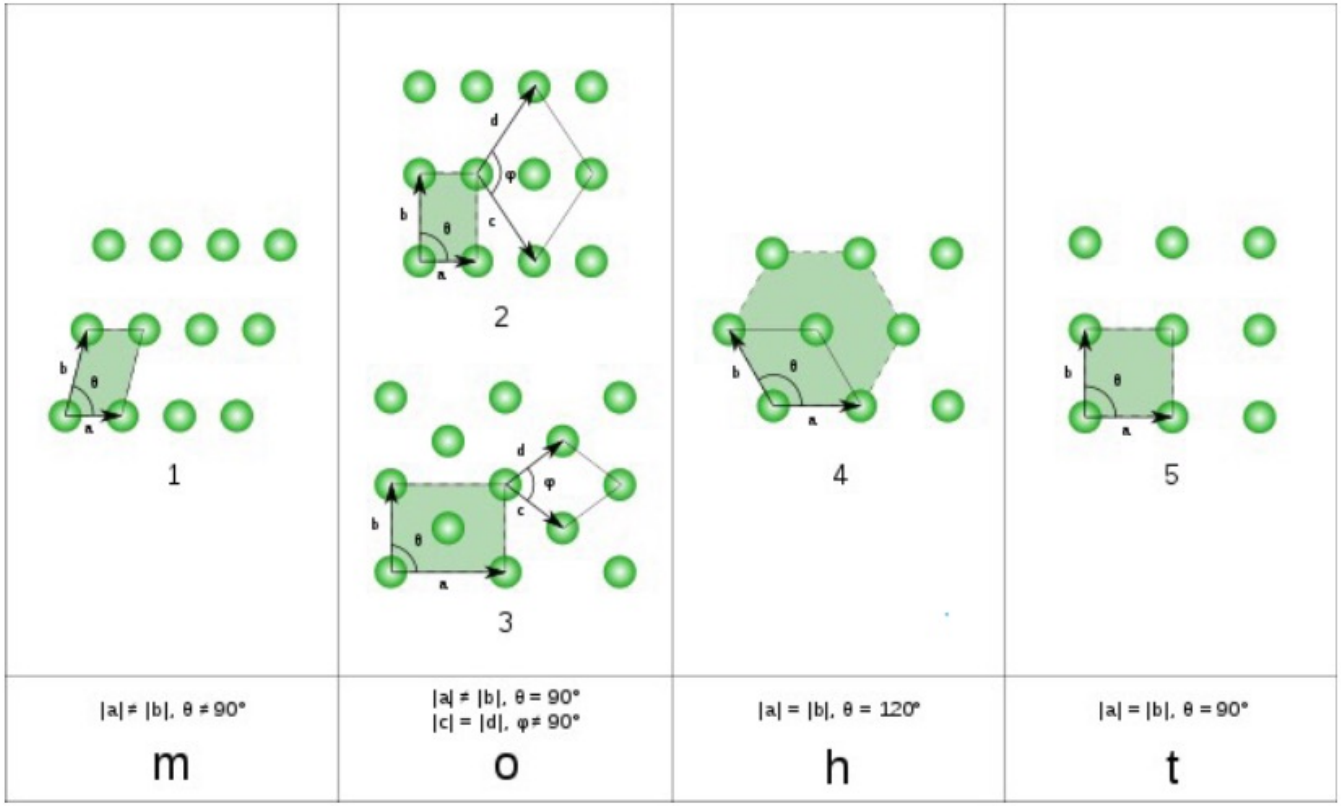
Lattice : $\vec{r} = \mu_1 a_1 + \mu_2 a_2$

Basis :



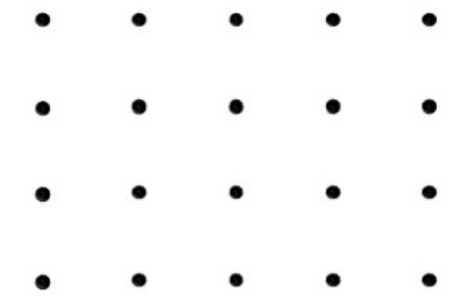


POSSIBLE TWO-DIMENSIONAL LATTICES



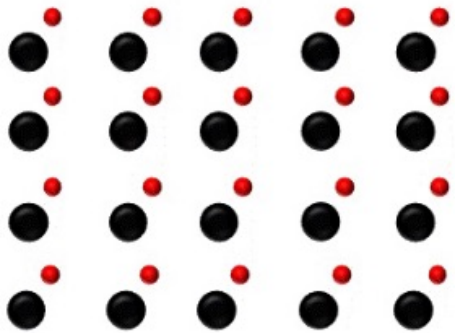
BRAVAIS LATTICES (2D)

LATTICE + BASIS = CRYSTAL STRUCTURE



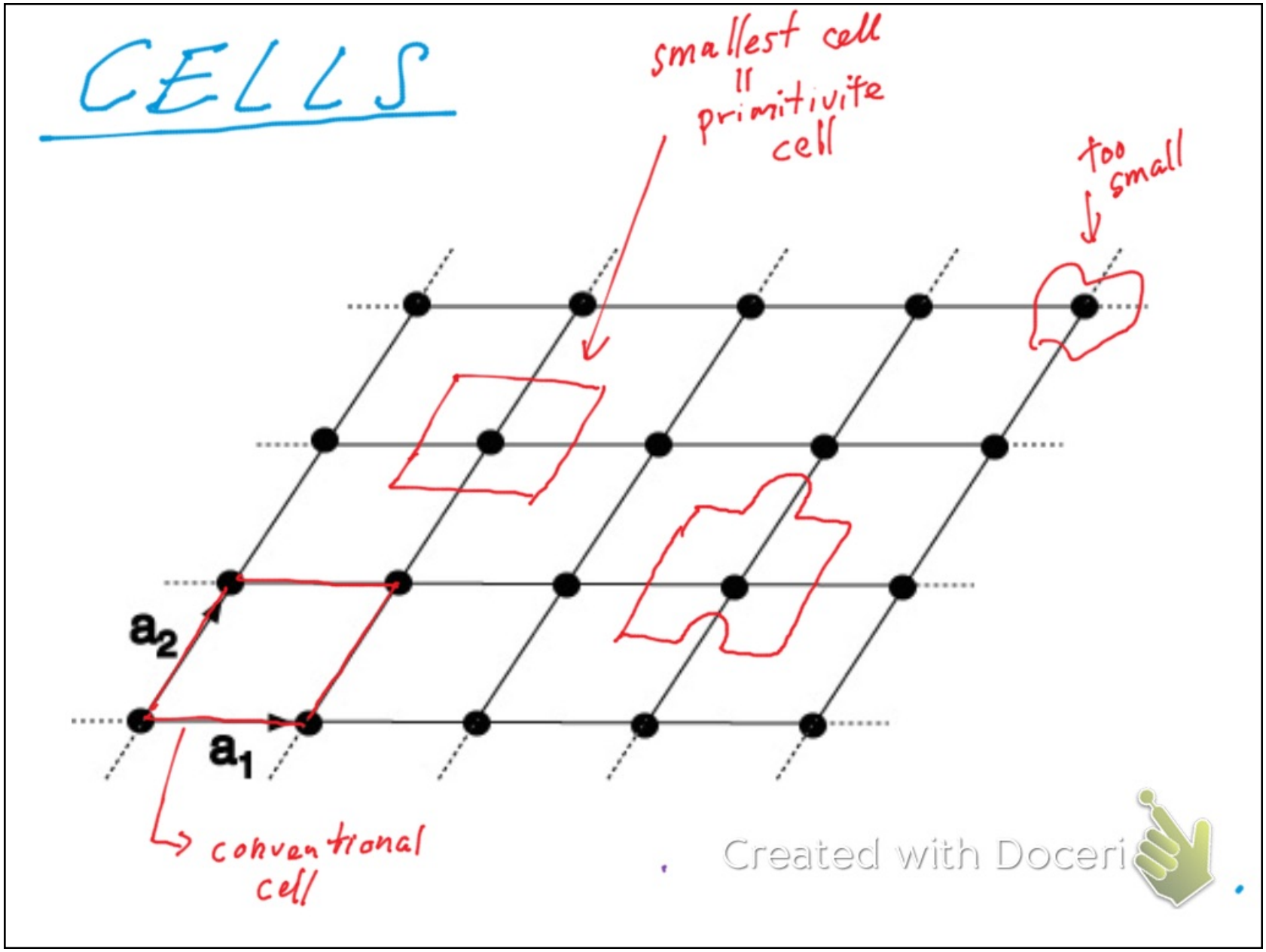
Space Lattice

Basis (atoms)

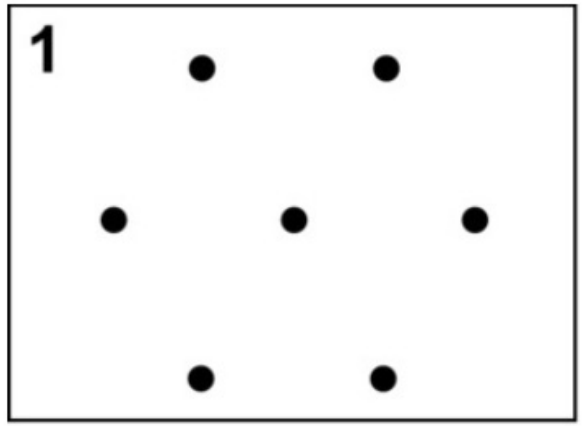


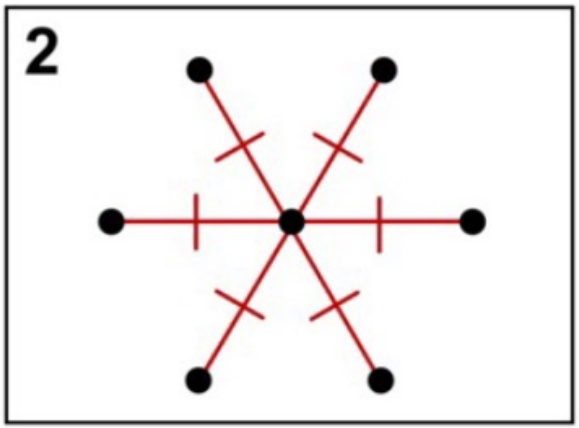
Crystal structure

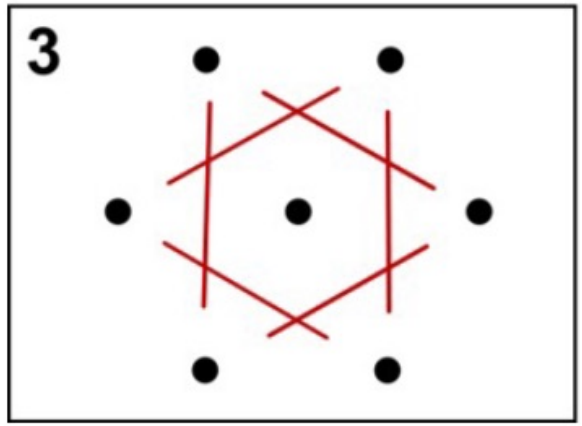
The crystal structure is formed by adding basis (atoms) to every lattice points of the lattice. The number of atoms in the basis may be one or more than one.

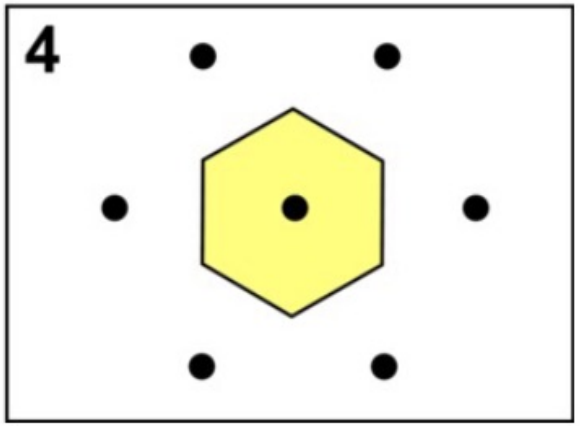

CELLS
smallest cell
II
primitivite
cell
too
small
a_2
a_1
conventional
cell
Created with Doceri

WIGNER-SEITZ CELL:



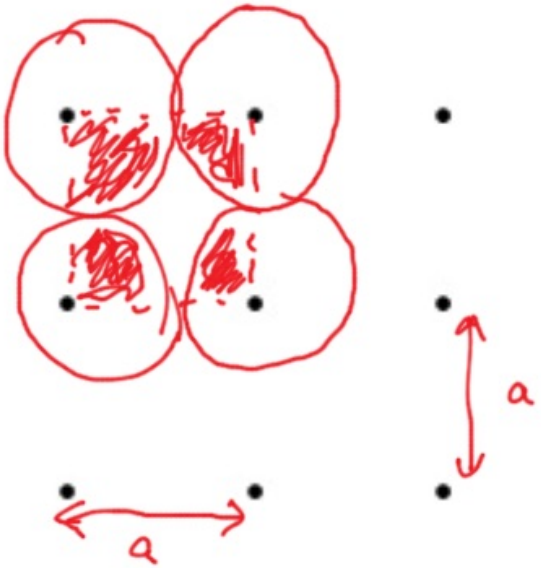






"PIZZA DELIVERY STRUCTURE"

PACKING RATIO'S

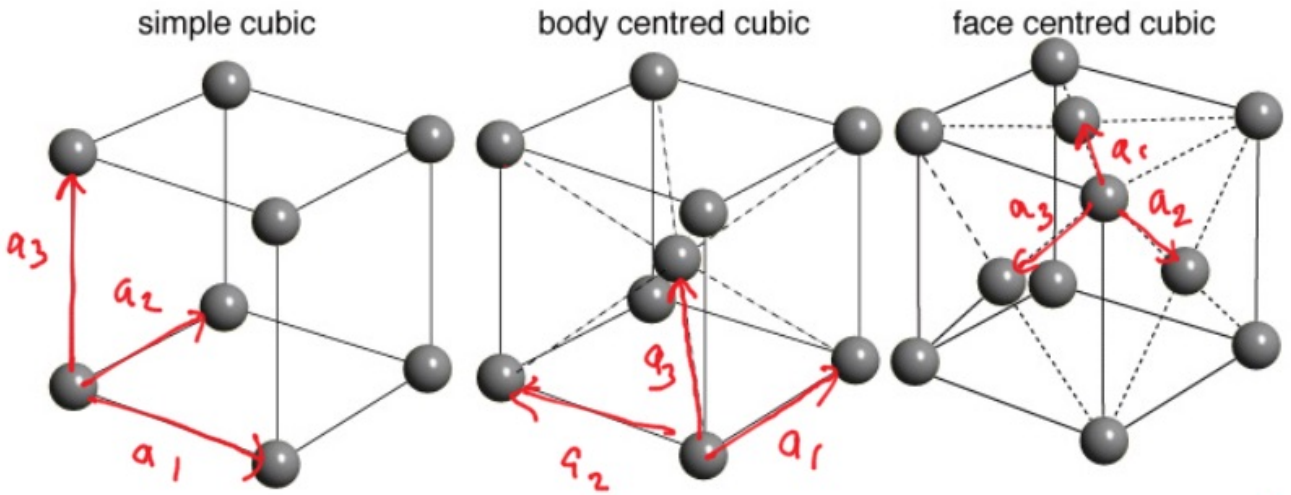


$$\text{P-ratio} \equiv \frac{\text{Area Circel}}{\text{Area cell}}$$

$$= \frac{\pi \left(\frac{a}{2}\right)^2}{a^2}$$

$$= \frac{\pi}{4}$$

CUBIC LATTICES: (Simplify Basis)



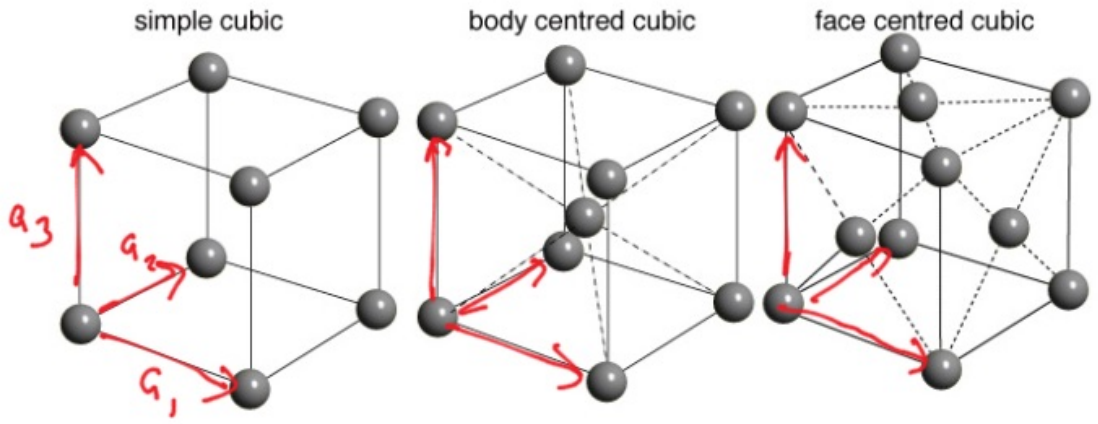
Basis
atom
at
(0,0,0)

$a_1 = (1\ 0\ 0)$
$a_2 = (0\ 1\ 0)$
$a_3 = (0\ 0\ 1)$

$a_1 = (1\ 0\ 0)$
$a_2 = (0\ 1\ 0)$
$a_3 = (1/2\ 1/2\ 1/2)$

$a_1 = (1/2\ 1/2\ 0)$
$a_2 = (0\ 1/2\ -1/2)$
$a_3 = (1/2\ 0\ -1/2)$

CUBIC LATTICES: (Simplify Lattice vectors)



$a_1 = (1\,0\,0)$

$a_2 = (0\,1\,0)$

$a_3 = (0\,0\,1)$

Basis

$(0,0,0)$

Basis

$(0,0,0)$

$(1/2, 1/2, 1/2)$

Basis

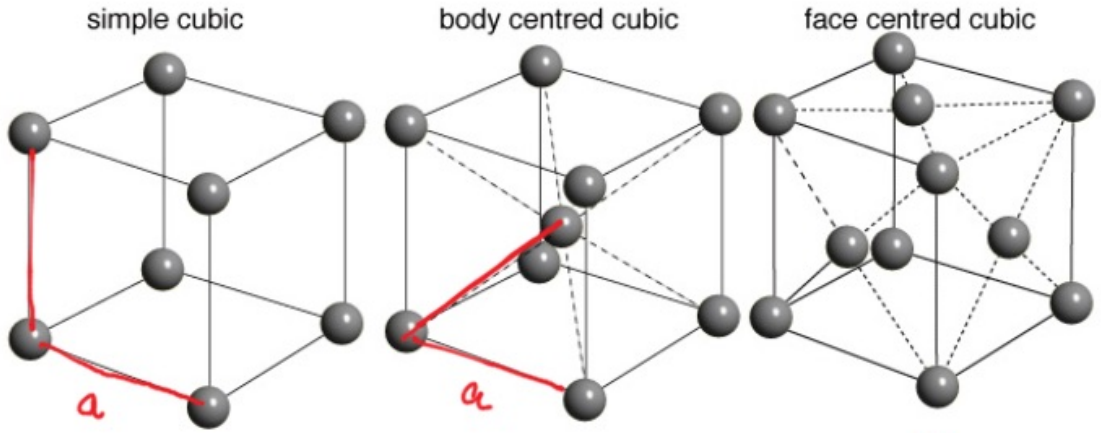
$(0,0,0)$

$(1/2, 0, 1/2)$

$(0, 1/2, 1/2)$

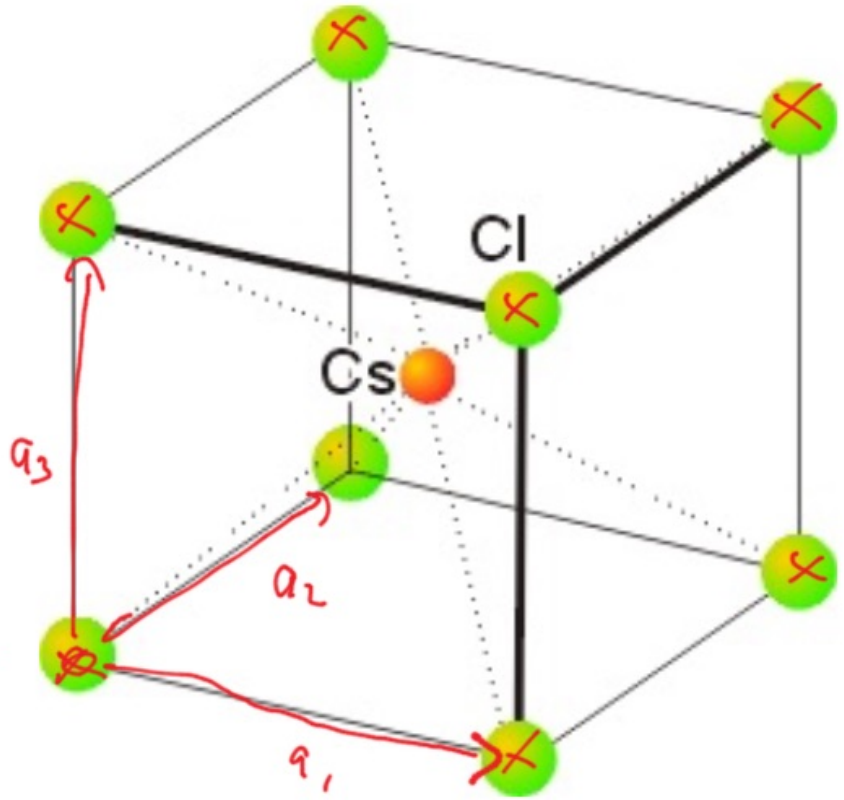
$(1/2, 1/2, 0)$

CUBIC LATTICES:



	simple cubic	body centred cubic	face centred cubic
Lattice points/cell	1	2	4
Number of Nearest Neighbour (NNN)	6	8	
Nearest Neighbour Distance	a	$\frac{\sqrt{3}}{2}a$	

QUIZ 1:



(1) SIMPLE CUBIC ✓

(2) BCC

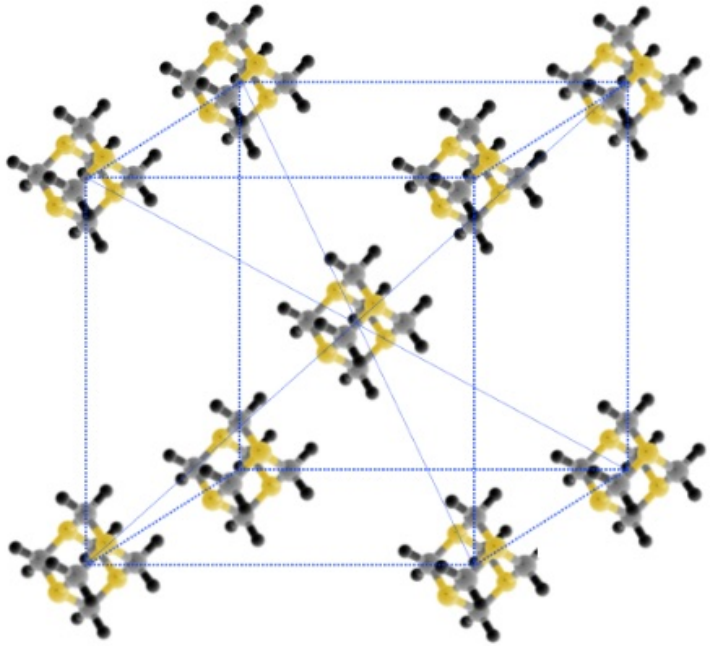
(3) FCC

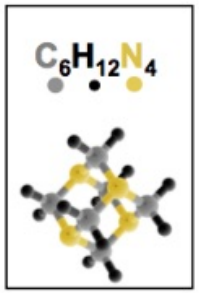
Basis

Cl atom @ (0, 0, 0)

Cs atom @ (½ ½ ½)

QUIZ 2



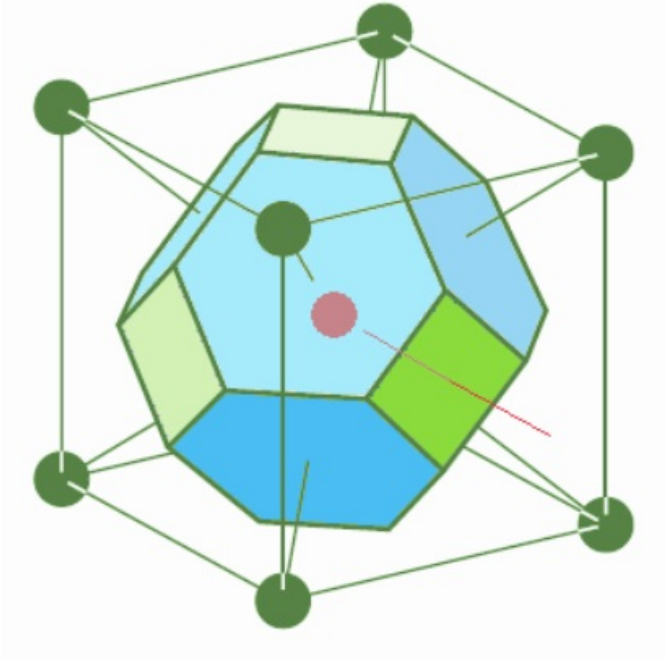


(1) SIMPLE CUBIC

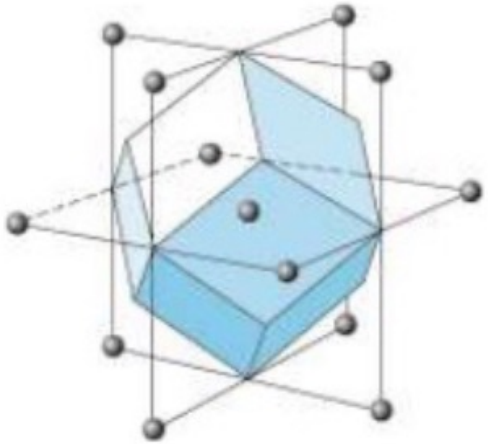
(2) BCC ✓

(3) FCC

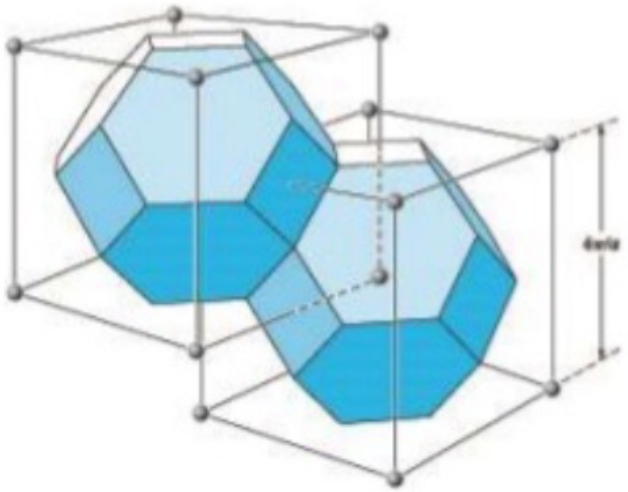
WIGNER-SEITZ CELL:



Wigner-Seitz Cell - 3D



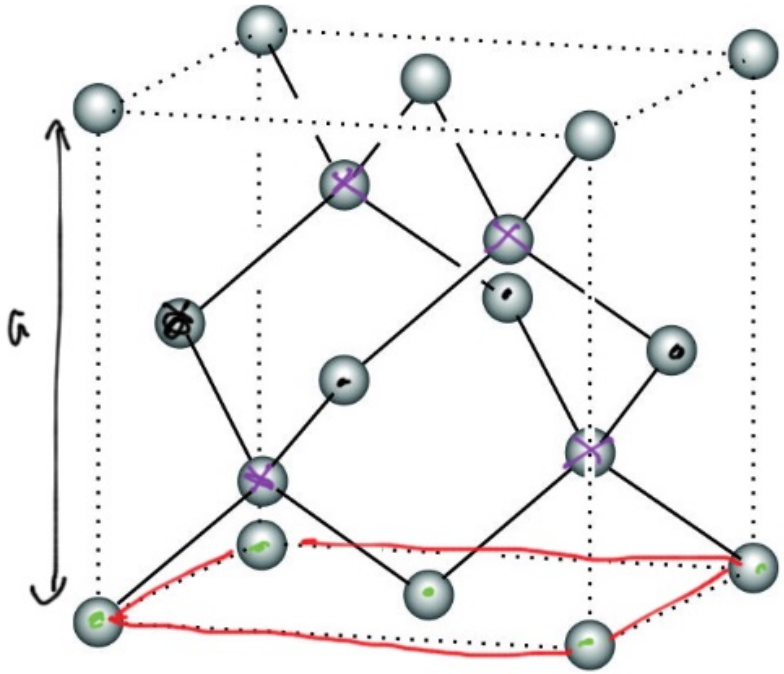
fcc wigner-seitz cell

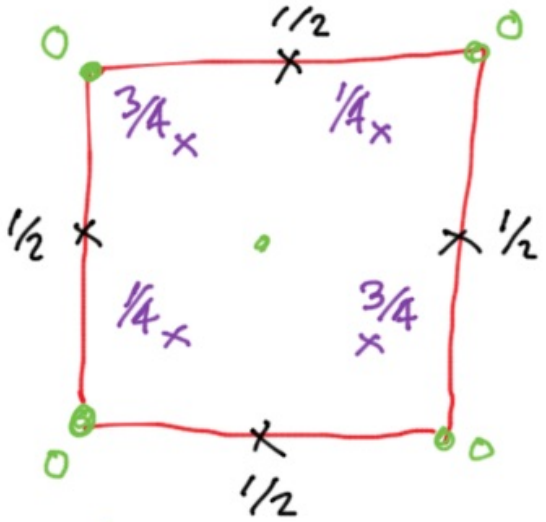


bcc wigner-seitz cell

Solid State Physics

DIAMOND STRUCTURE:





Vectors

$a_1 = (1/2, 0, 1/2)$

$a_2 = (0, 1/2, 1/2)$

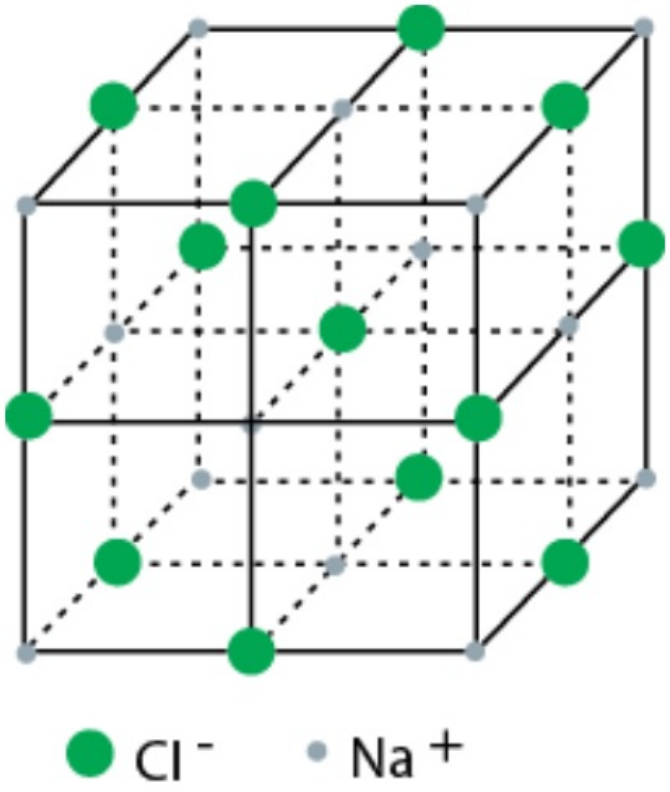
$a_3 = (1/2, 1/2, 0)$

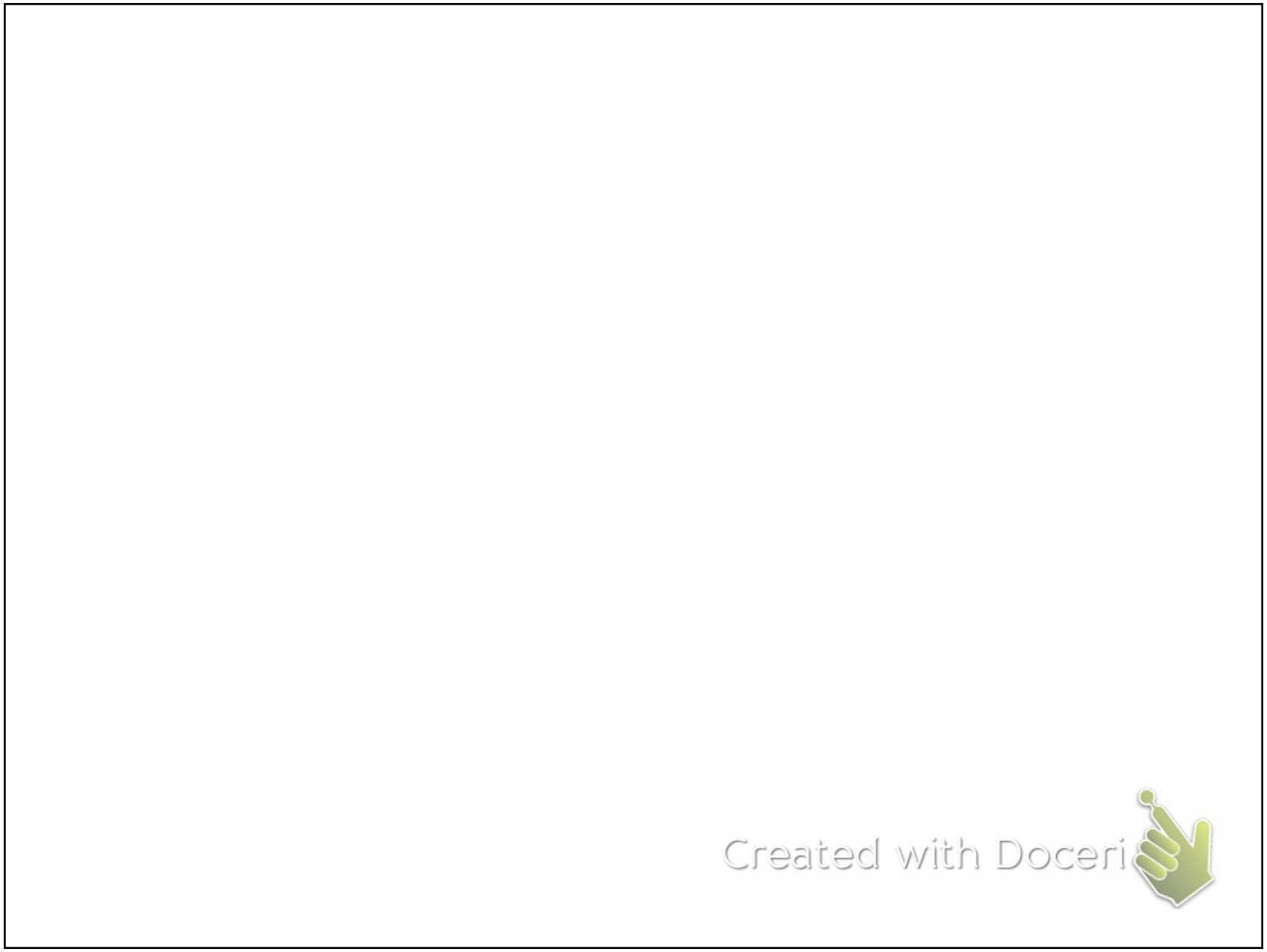
Basis

C atom (0, 0, 0)

C atom (1/4, 1/4, 1/4)

TABLE-SALT STRUCTURE:

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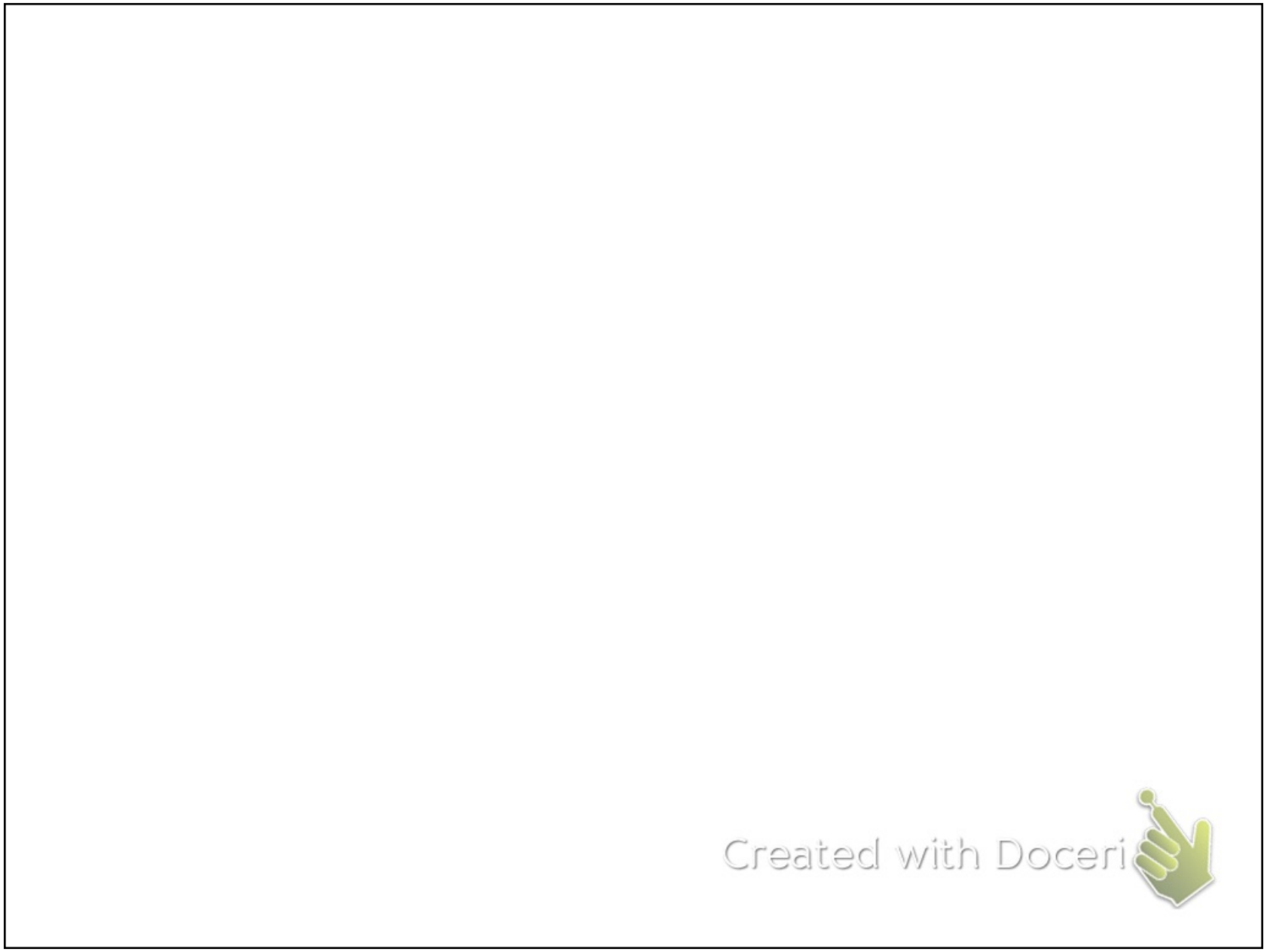
Created with Doceri