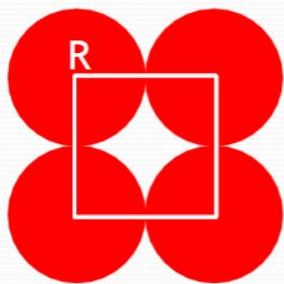


## simple cubic (SC) structure

- Atoms touch each other along cube edges.
- each of 8 corner atoms is shared by eight unit cells:

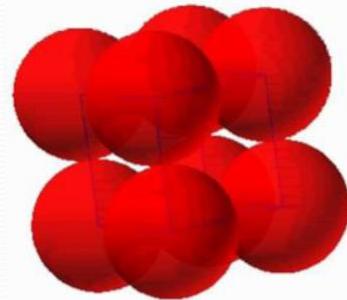
$$8 \times (1/8) = 1 \text{ atom/unit cell}$$



$$a = 2R$$

unit cell

$$\text{volume} = a^3 = 8R^3$$



### *BCC crystal structure*

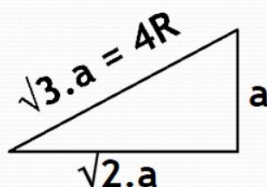
- unit cell has cubic geometry
- atoms are located at the corners of the cube.
- Some of the materials that have a bcc structure include lithium, sodium, potassium, chromium, barium, vanadium, alpha-iron and tungsten.
- Metals which have a BCC structure are usually harder and less malleable than close-packed metals such as copper and gold.
- When the metal is deformed, the planes of atoms must slip over each other, and this is more difficult in the bcc structure.

## body centred cubic (BCC) structure

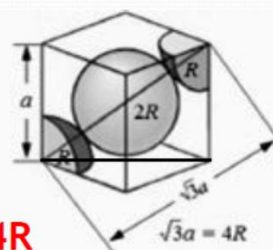
- Atoms touch each other along cube diagonals.
- each of 8 corner atoms is shared by eight unit cells; single center atom is wholly owned:

$$8 \times (1/8) + 1 = 1 + 1 = 2 \text{ atoms/unit cell}$$

- each center atom touches eight corner atoms:  
**8 nearest neighbors**



$$\sqrt{3}.a = 4R$$



**FCC crystal structure**

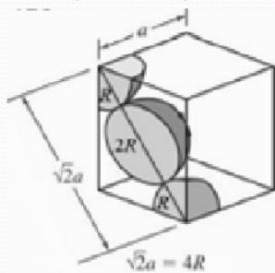
- unit cell has cubic geometry
- atoms are located at the corners and the centers of all the cube faces.
- familiar metals with FCC crystal structure copper aluminium silver gold

# FCC crystal structure

each of 8 corner atoms is shared by eight unit cells; each of 6 face-centered atoms belongs to only two.  
 $8 \times (1/8) + 6 \times (1/2) = 1 + 3 = 4 \text{ atoms/unit cell}$

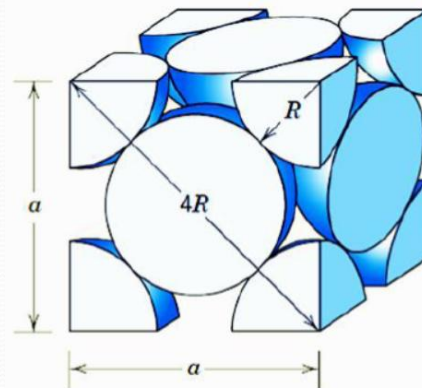
The volume of the unit cell,

$$a^3 = (2R\sqrt{2})^3 = 16R^3\sqrt{2}$$



$$4R = \sqrt{2} \cdot a$$

$$(a = 2R\sqrt{2})$$

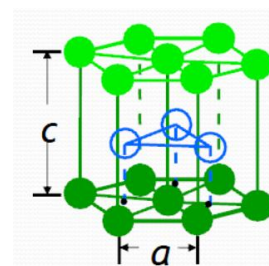


**Hexagonal close packed (HCP) crystal structure**

- The HCP metals: Cd, Mg, Ti, and Zn.
- top and bottom faces consist of six atoms that form regular hexagons and surround a single atom in the center.
- Another plane that provides three additional atoms to the unit cell is situated between the top and bottom planes. The atoms in this mid-plane have as nearest neighbors atoms in both of the adjacent two planes.
- The equivalent of **six atoms** is contained in each unit cell
- one-sixth of each of the 12 top and bottom face corner atoms, one-half of each of the 2 center face atoms, and all 3 midplane interior atoms.:

$$12 \times 1/6 + 2 \times 1/2 + 3 = 2 + 1 + 3 = 6$$

corner      face      midplane

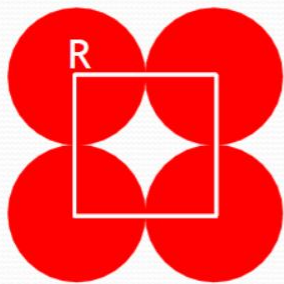




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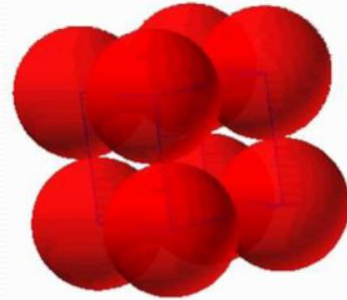
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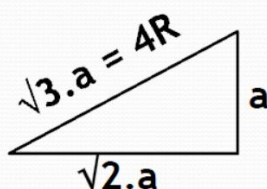
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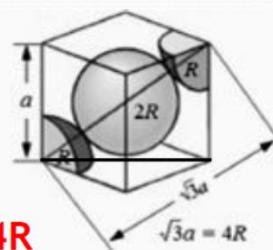
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***FCC crystal structure***

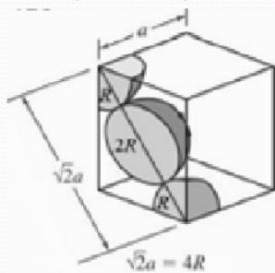
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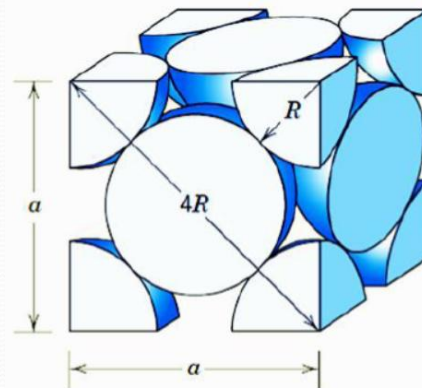
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corner      face      midplane

