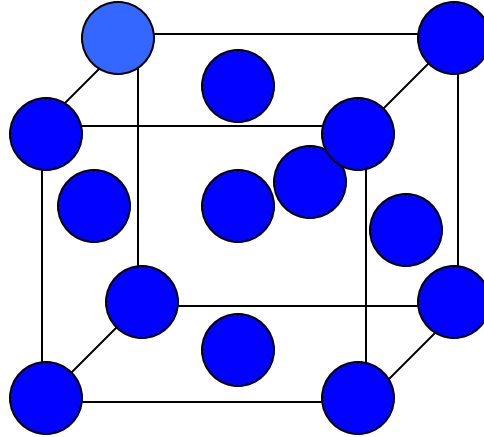
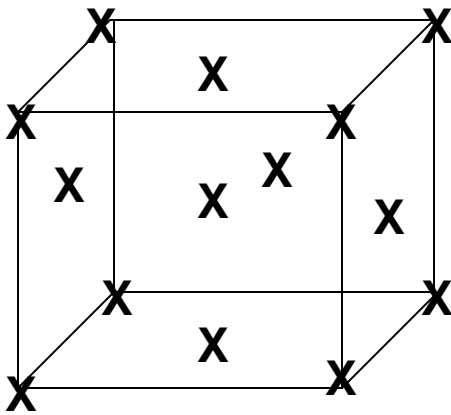


In-Class Exercise FCC and BCC Crystal Structure SOLUTIONS

1. Draw an FCC lattice with “x” marking the lattice sites.



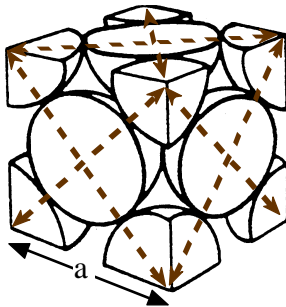
Question 1

2. In your diagram above, add a basis of 1 atom per lattice site.

3. How many atoms are there per unit cell?

$$8 \cdot \frac{1}{8} + 6 \cdot \frac{1}{2} = 4 \text{ atoms/ unit cell}$$

4. If the atoms expand to touch along the face diagonal, calculate the a to r ratio of your structure.



Adapted from Fig. 3.1(a),
Callister 6e.

$$\text{face diagonal} = 4r$$

$$(\text{face diagonal})^2 = a^2 + a^2 = 2a^2$$

$$\text{face diagonal} = 4r = \sqrt{2}a$$

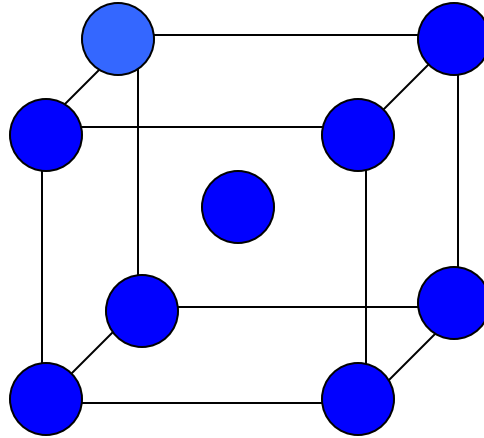
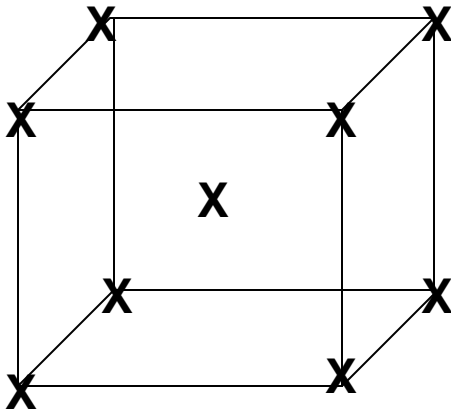
$$a = \frac{4r}{\sqrt{2}}$$

5. Calculate the APF

$$\text{APF} = \frac{\# \frac{\text{atoms}}{\text{unit cell}} \cdot \text{vol of atom}}{\text{vol of unit cell}} = \frac{4 \cdot \frac{4}{3} \pi r^3}{a^3} = \frac{4 \cdot \frac{4}{3} \pi r^3}{\left(\frac{4r}{\sqrt{2}}\right)^3} = \frac{4 \cdot \frac{4}{3} \pi}{\left(\frac{4}{\sqrt{2}}\right)^3} = 0.74$$

6. If you have time, repeat question 1-4 for the low temperature solid phase of Nitinol which is BCC.

1. Draw a BCC lattice with "x" marking the lattice sites.



Question 1

Question 2

2. In your diagram above, add a basis of 1 atom per lattice site.

3. How many atoms are there per unit cell?

$$8 \cdot \frac{1}{8} + 1 = 2 \text{ atoms / unit cell}$$

4. If the atoms expand to touch along the face diagonal, calculate the a to r ratio of your structure.



Adapted from Fig. 3.2, *Callister 6e*.

$$\text{cube diagonal} = 4r$$

$$(\text{cube diagonal})^2 = a^2 + (\text{face diagonal})^2 = a^2 + (\sqrt{2}a)^2 = 3a^2$$

$$\text{cube diagonal} = 4r = \sqrt{3}a$$

$$a = \frac{4r}{\sqrt{3}}$$

5. Calculate the APF

$$\text{APF} = \frac{\# \frac{\text{atoms}}{\text{unit cell}} \cdot \text{vol of atom}}{\text{vol of unit cell}} = \frac{2 \cdot \frac{4}{3} \pi r^3}{a^3} = \frac{2 \cdot \frac{4}{3} \pi r^3}{\left(\frac{4r}{\sqrt{3}}\right)^3} = \frac{2 \cdot \frac{4}{3} \pi}{\left(\frac{4}{\sqrt{3}}\right)^3} = 0.68$$