Lesson 02: Structure of metals

(For visualization of the different crystal lattices use Unit Cell Visualizer or ChemTube3D.)

Exercise 02.1: Cubic crystal lattices

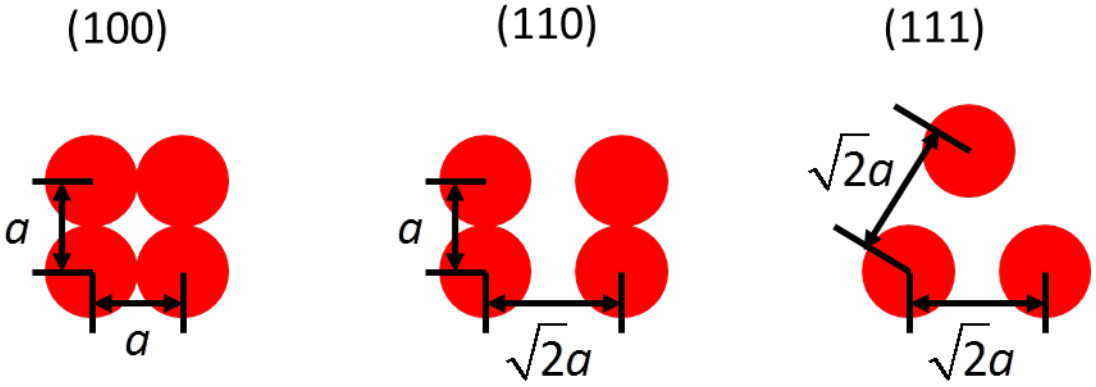
Complete the wanted posters for the two cubic crystal lattices (body-centered cubic and face-centered cubic) in the same manner as for the simple cubic lattice during the lecture.

Hint: (I) Start on the left with number of atoms and coordination number, (II) continue to the right hand side about atoms and their distances along different directions, (III) use the results obtained to fill the missing gaps on the left hand side. The distance between neighbors shall be used for identifying close-packed directions (non-zero results are relevant for lesson 03).

Exercise 02.2: Crystallographic lattices, points, directions and planes

How many atoms are required to describe the unit cell of the fcc lattice and the bcc lattice? Find the coordinates of the positions of all atoms in the basis of an fcc lattice and a bcc lattice.

a) Sketch the arrangement of atoms in the lattice planes (111), (110), (100) of an fcc lattice and a bcc lattice, as shown below for the simple cubic lattice (*a* is the lattice constant). Focus on the directions along which the atoms touch each other.



b) How many crystallographic equivalent <110> directions are in a (111) plane?

c) Find the closest packed directions and planes for the fcc and the bcc lattice. Are they close packed? In how many directions do the atoms touch each other?

	Closest packed	
	planes {hkl}	directions <uvw>
sc	{100}, not close-packed	<100>, close-packed
bcc		
fcc		

Exercise 02.3: Density

Calculate the density for Fe crystallizing in a bcc structure (α-Fe) and Fe crystallizing in an fcc structure (γ-Fe) assuming an atomic radius of 0.124 nm.

Relevant exercises from the Callister Rethwisch book (10th edition)

3.5, 3.6, 3.7, 3.17, 3.18, 3.24, 3.25, 3.26, 3.27