PHASES OF MATTER
3: SOLIDS

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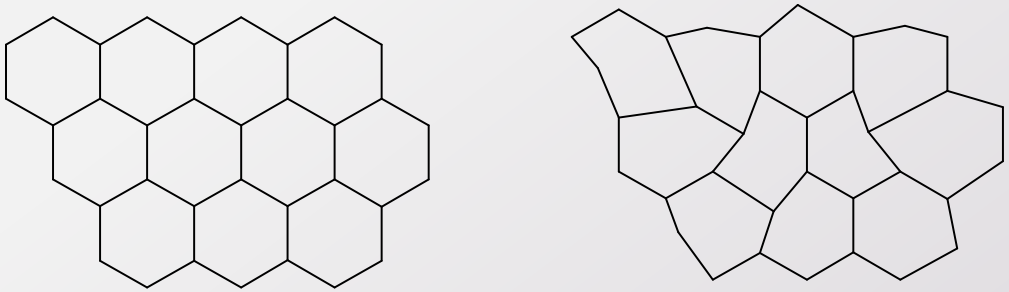
SOLIDS

- Solids have the highest intermolecular forces hence higher melting points.
- Most forces will be ionic, H-bonding and dipole-dipole. The least common force is the London force.
- Solids are of different types:

Molecular	Metallic	Ionic	Covalent network
Covalent molecules Dispersion forces, dipole-dipole forces, H-bonding	Metals Metallic bonds	Ionic compounds Coulombic attractions	Covalent compounds Covalent bonds
Soft; low mpt.	Malleable; high mpt.	Crystalline; high mpt.	Hard; high mpt.
Insulators of electricity	Conduct electricity	Do not conduct heat or electricity as solids – but do as liquids	Insulators of electricity
Ar, CO_2, I_2, $C_{12}H_{22}O_{11}$	Na, Mg, Al etc.	NaCl, MgO, $CaCO_3$ etc.	Diamond (C), quartz (SiO_2)

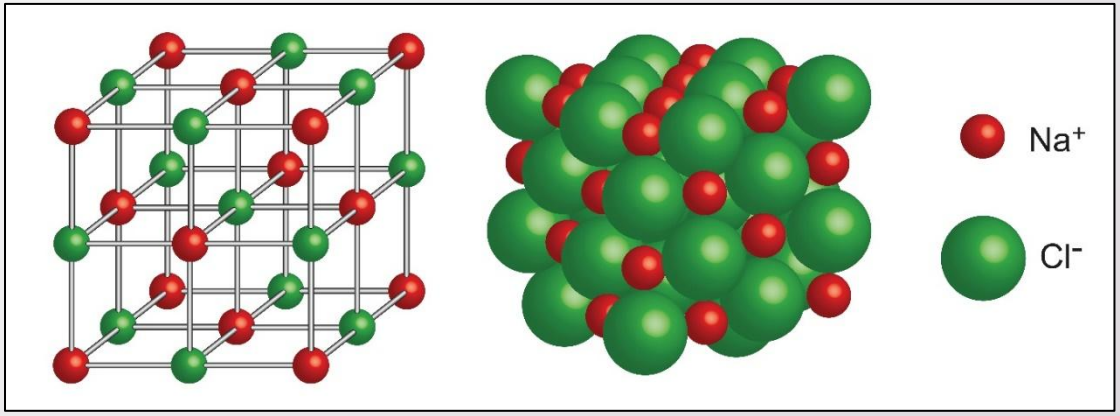
TYPES OF SOLIDS

- Other classification of solids are: crystalline and amorphous.
- Crystalline – generally ordered in structure with repeatable units e.g. most ionic substances and covalent compounds.
- Amorphous – disorderly structure e.g. covalent compounds like sulfur and glass (SiO_2).



CRYSTAL STRUCTURE

- The ordered structure of a crystal is described in terms of its crystal lattice.
- A **crystal lattice** is the geometric arrangement of lattice points of a crystal in which we choose one lattice point at the same location within each of the basic units of the crystal.
- A unit cell is the smallest unit that can be repeated.
- Crystals have faces and edges.



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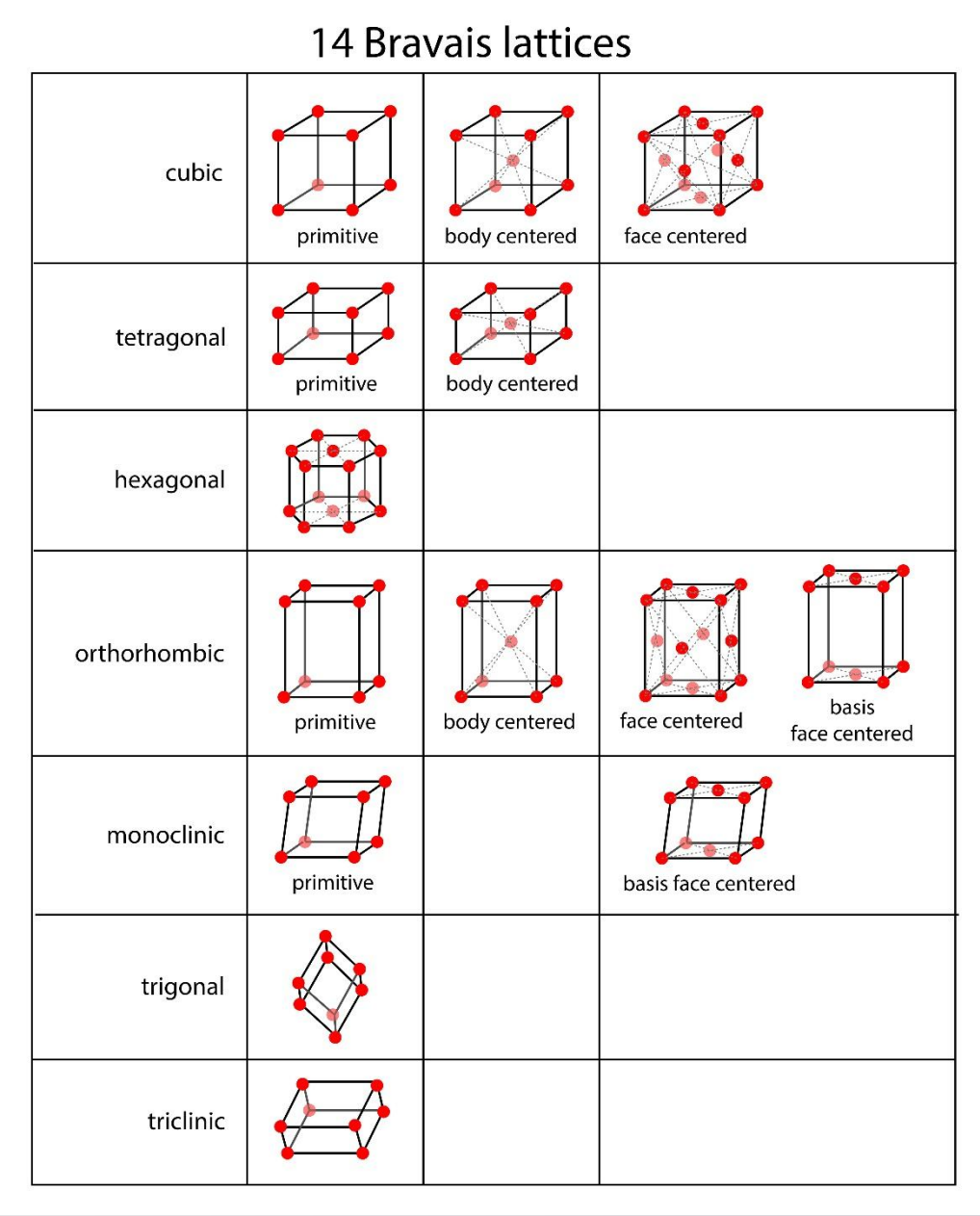
CRYSTAL LATTICES

- The following seven structures are the most common lattice possible.



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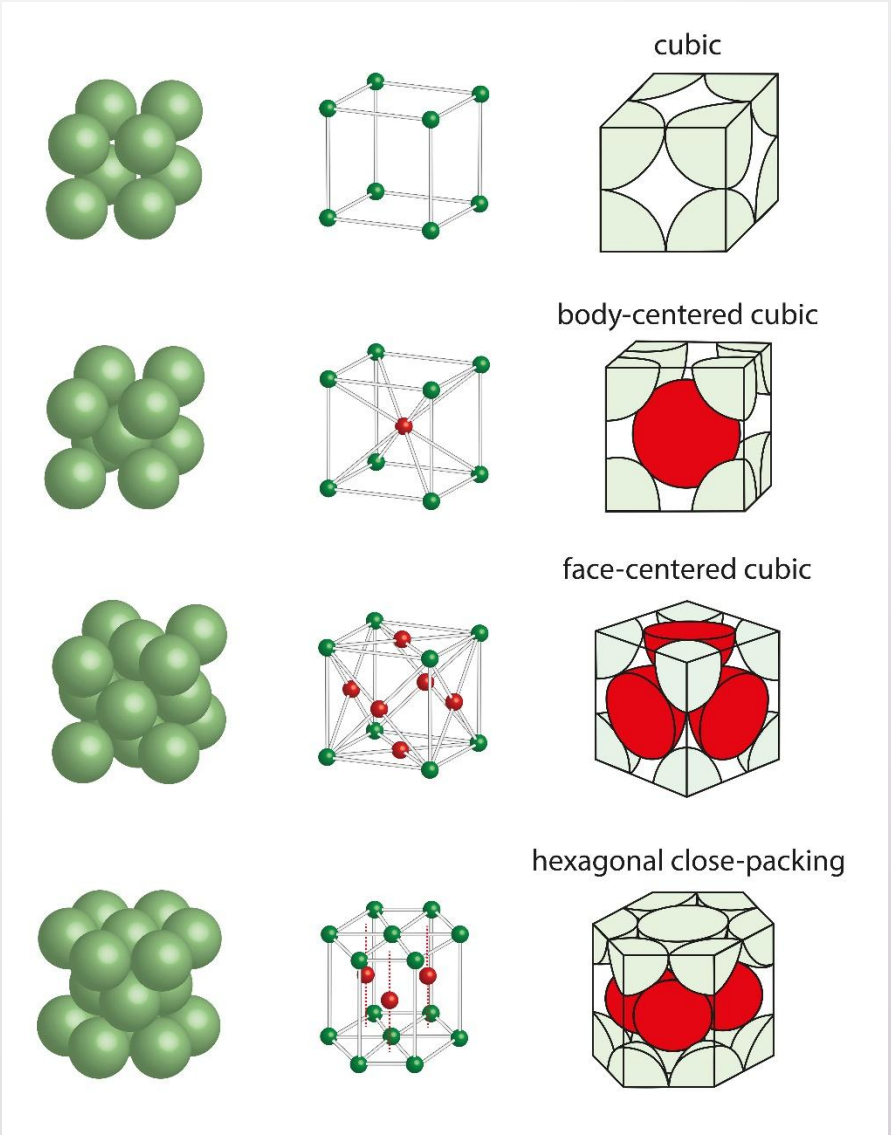
FURTHER ON CRYSTAL LATTICE

- A cubic crystal lattice may be of different kinds.



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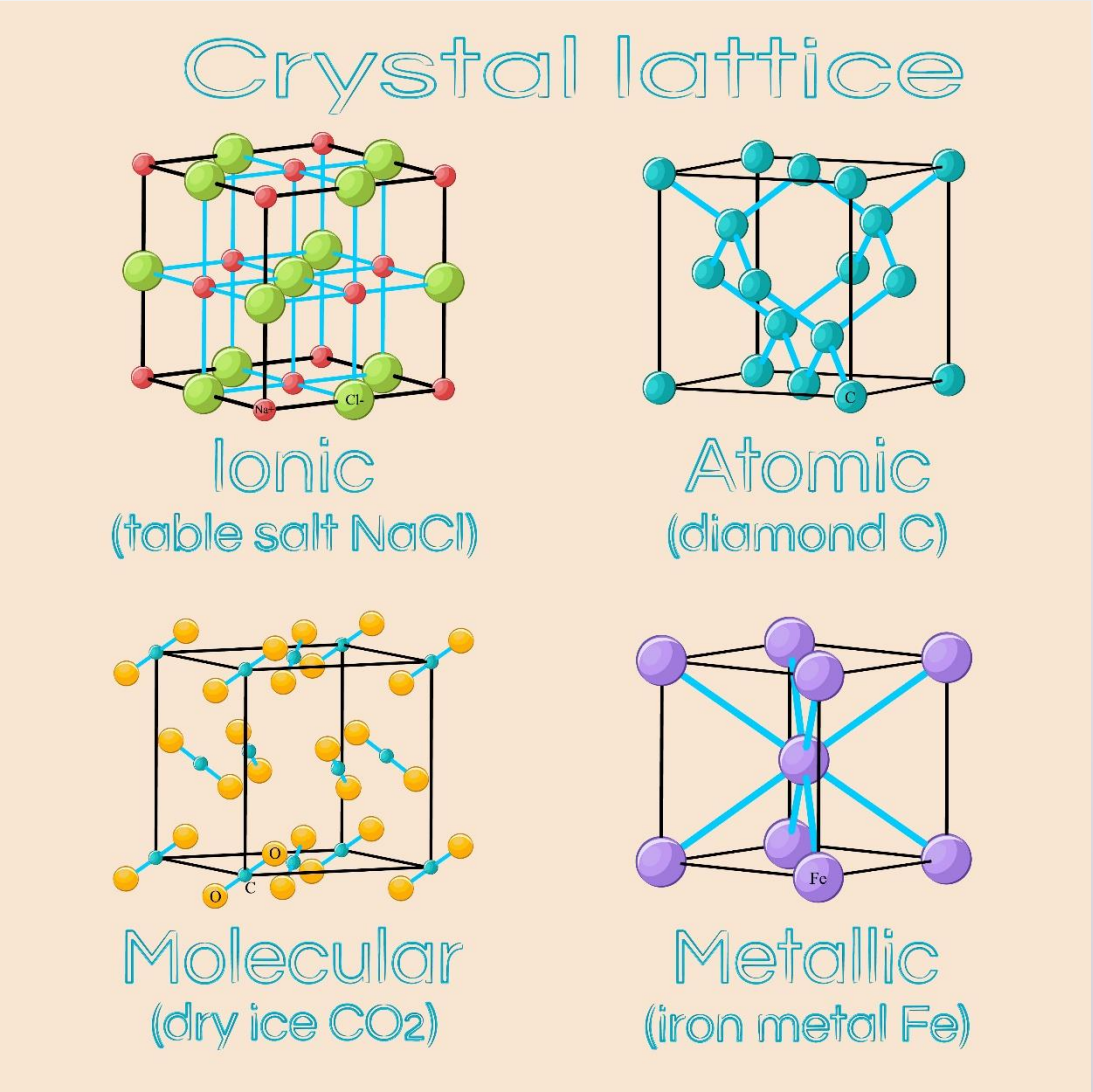
MOLECULAR AND METALLIC SOLIDS

- Most are cubic or hexagonal packed structures.
- The number of nearest neighbors is called the coordination number.
- Very dense structures.
- The electrons are delocalized over all the atoms.



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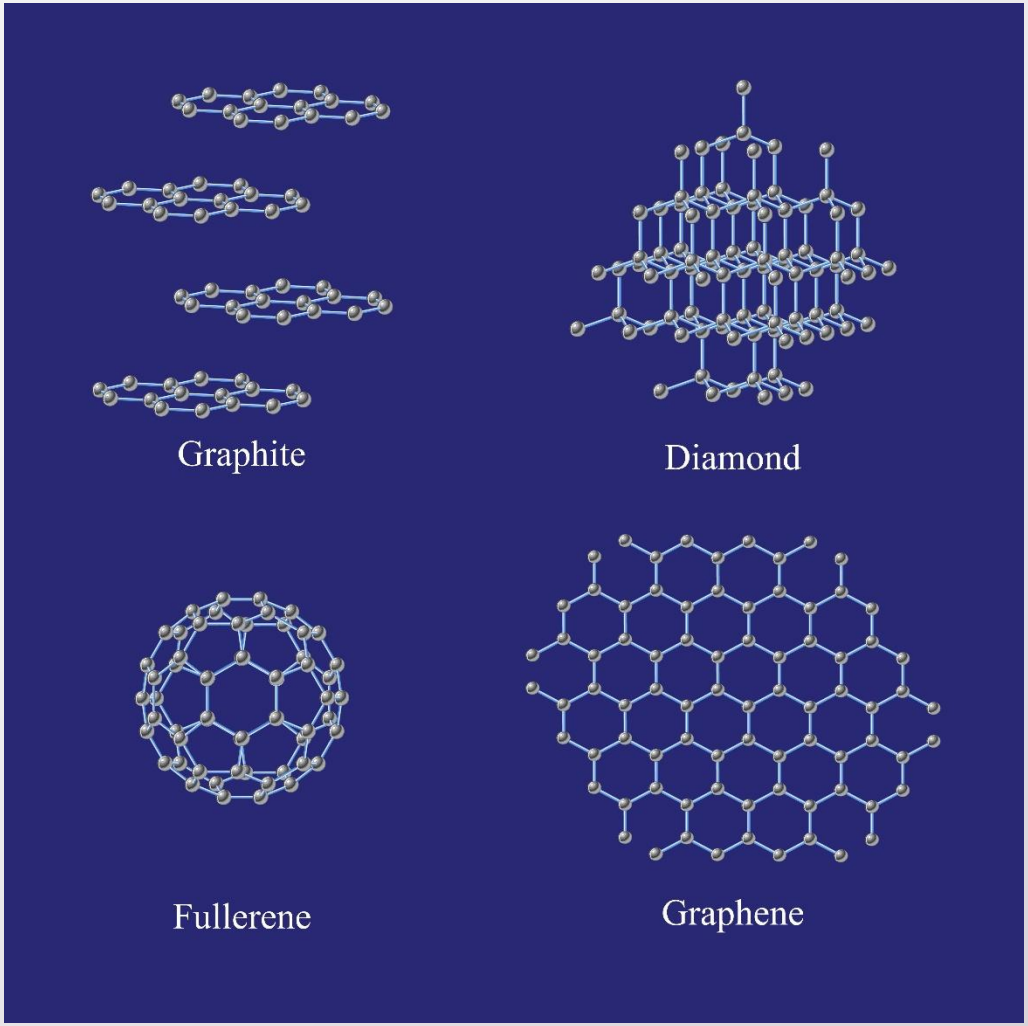
DIAMOND AND GRAPHITE

- These two allotropes of carbon have very different structures and properties.
- Diamond is tetrahedral geometry while graphite is hexagonal.



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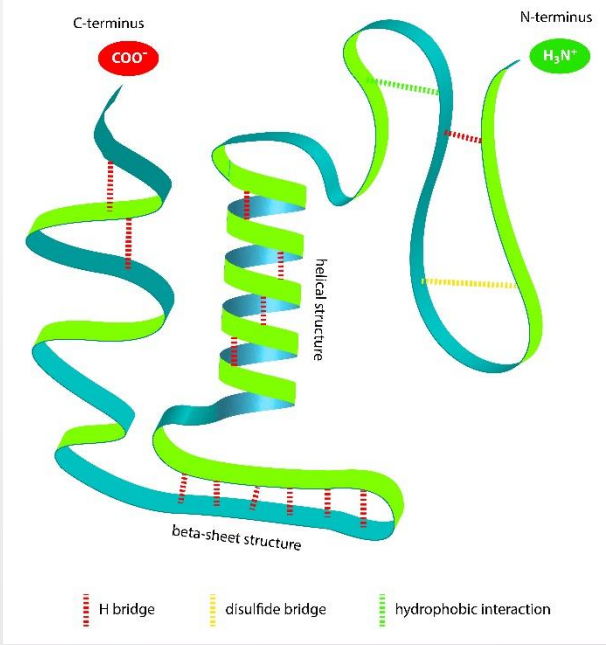
CRYSTAL STRUCTURE: PROTEINS AND DNA

- Protein crystal structure is very complicated and gives vital information about how it functions.



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- DNA crystal structure was determined by Rosalind Franklin along with Watson and Crick. Only after crystallography did they know that DNA is a double helical structure.

KEY CONCEPTS

- Types of solids
- Unit cell
- Amorphous and crystalline solids