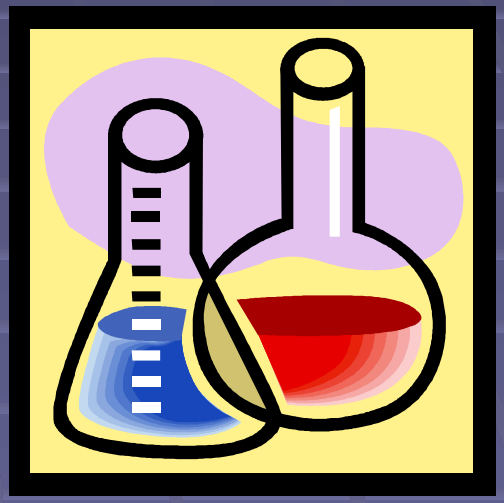
STATES OF MATTER

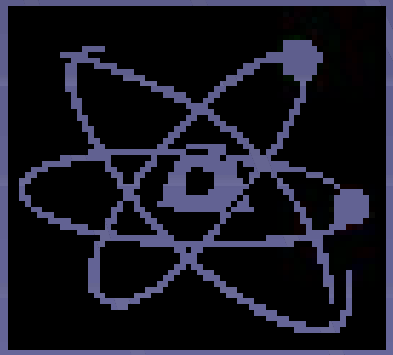
- ***The Four States of Matter***

- Solid
- Liquid
- Gas
- Plasma



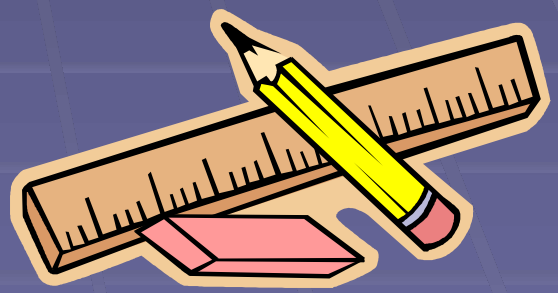
Materials

- Everything is made from some sort of ‘material’
- Materials are made up of lots and lots of tiny pieces
- These tiny pieces are known as particles
- Solids, liquids and gases are all made of lots of particles



Solids

- A solid is something that we can hold on to
- A solid keeps its shape, unless we cut it or shape it ourselves
- In a solid, all of the particles are packed together very tightly



Liquids

- They can be poured
- The particles are less tightly packed, so they can move about
- If poured from one container to another, they will take the shape of their new container

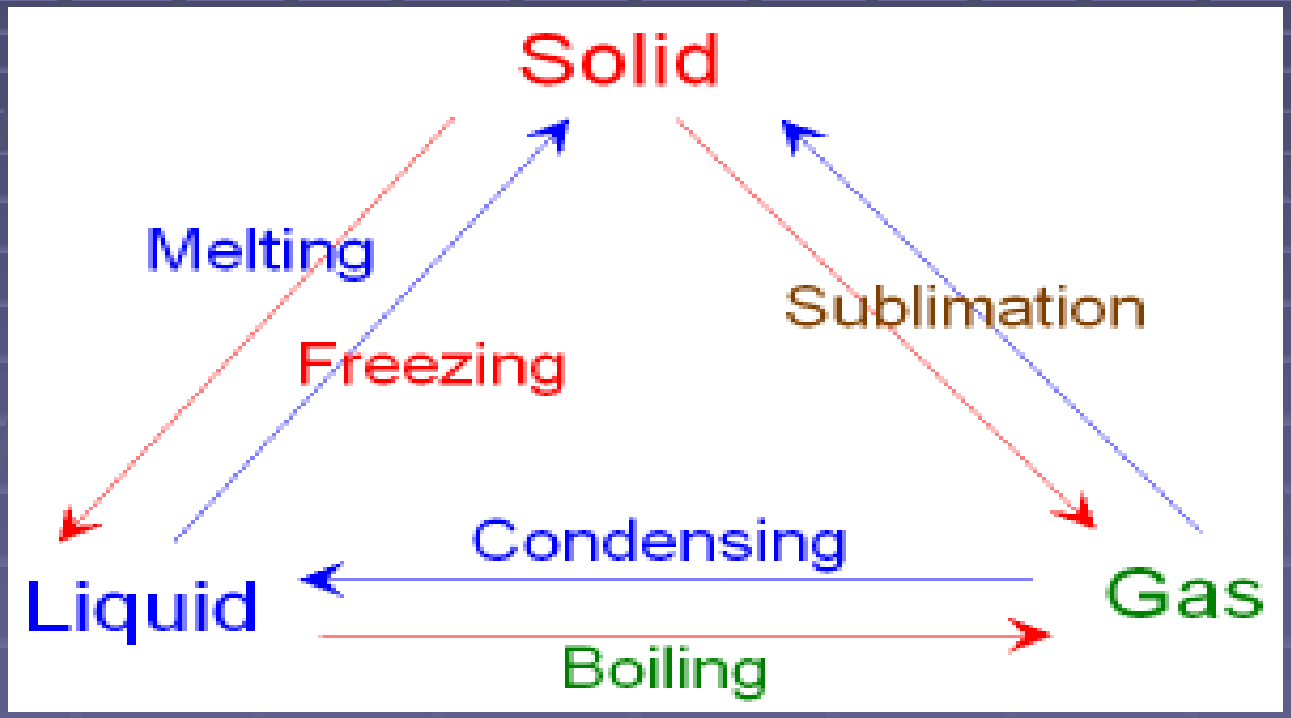
Gases

- The particles in gases have lots of room to move
- Gases are all around us
- They spread into all of the empty places they can
- Most are invisible

An example – water

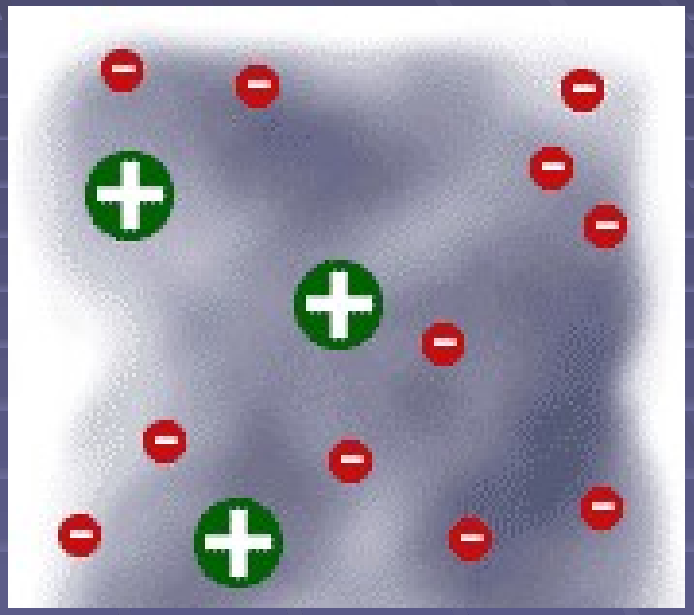
- Water can be a solid, a liquid or a gas.
- When it is cold it is solid – ICE
- When it is at room temperature it is a liquid – WATER
- When it is hot it is a gas – STEAM

Phase Changes



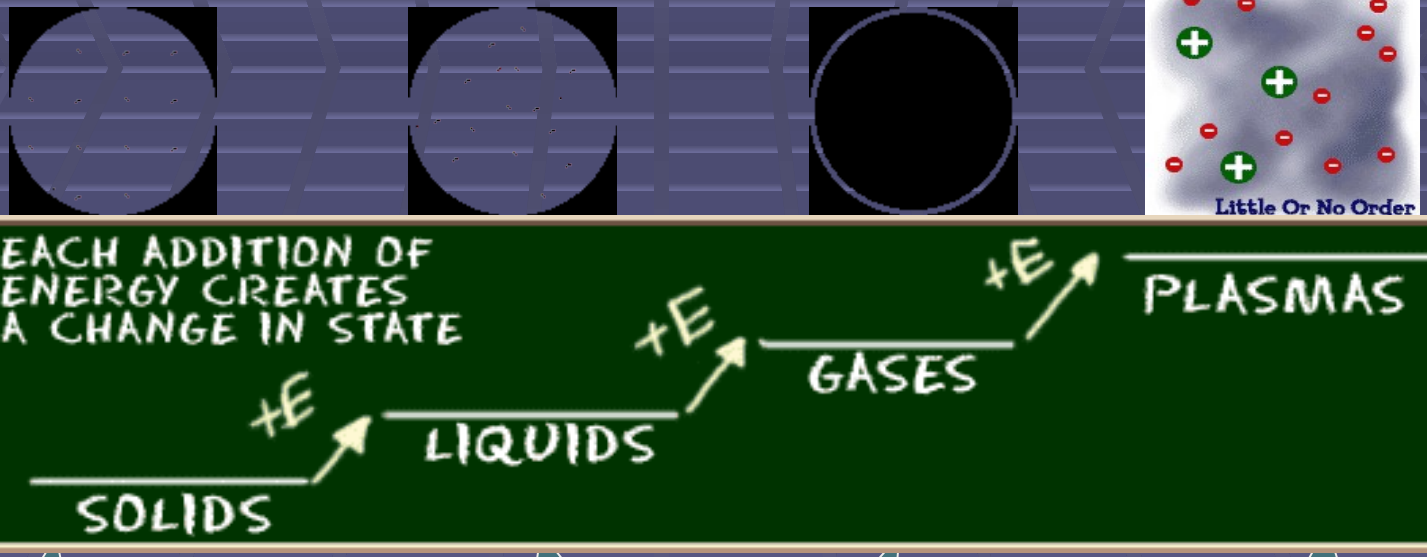
PLASMA

- Heating a gas may ionize its molecules or atoms, turning it into a plasma, which contains charged particles: positive ions and negative electrons or ions.



- Like gas, plasma does not have a definite shape or a definite volume.

CHANGES OF STATES



SOLID

Tightly packed, in a regular pattern Vibrate, but do not move from place to place

LIQUID

Close together with no regular arrangement. Vibrate, move about, and slide past each other

GAS

Well separated with no regular arrangement. Vibrate and move freely at high speeds

PLASMA

Has no definite volume or shape and is composed of electrical charged particles

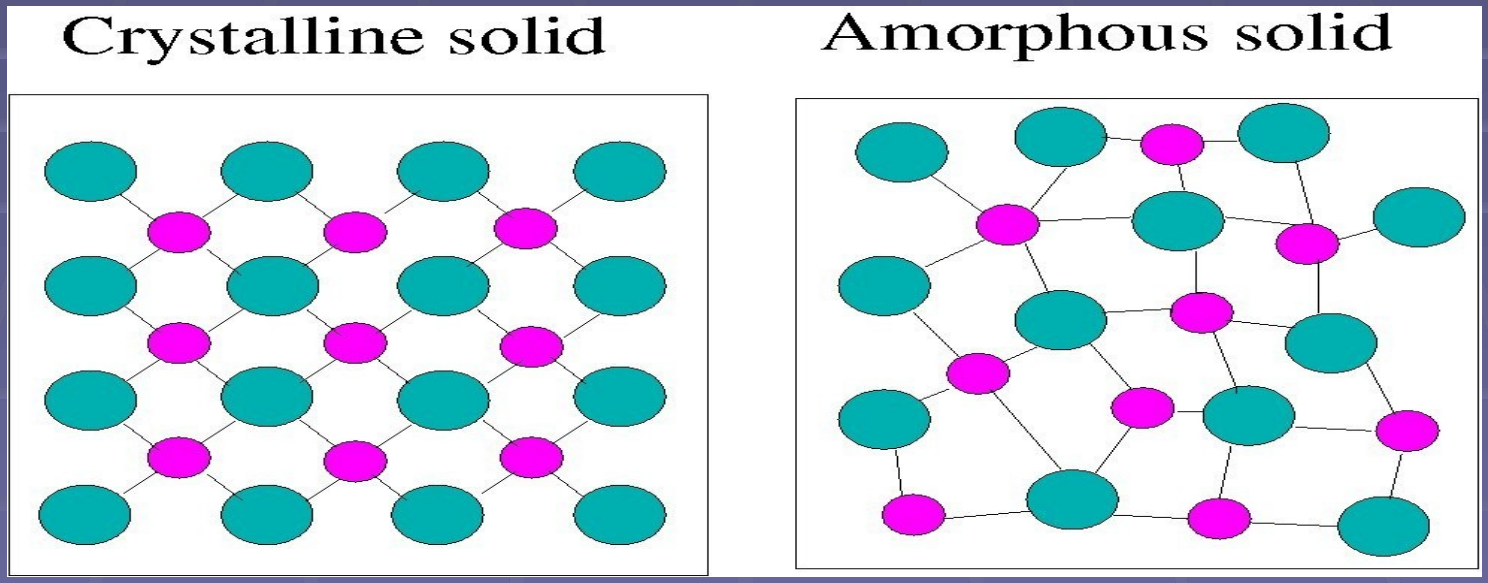
In general solids can be classified into two categories such as:

(i) Crystalline

(ii) Amorphous or Non- crystalline

Crystalline solid: In crystalline solid the atoms or molecules are arranged in a definite, repeating pattern. Constituent atoms or molecules are arranged in a regular manner and produced by the repetition of pattern unit. *Examples:* Salt and sugar.

Amorphous or Non-crystalline solid: In Non-crystalline solid the atoms or molecules do not repeat periodically. *Examples:* Plastic, rubber and glass.

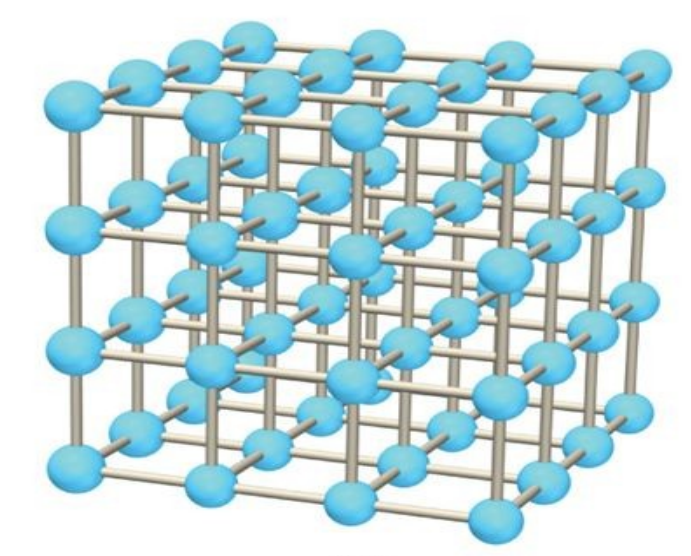


Differences between Crystalline & Amorphous solids:

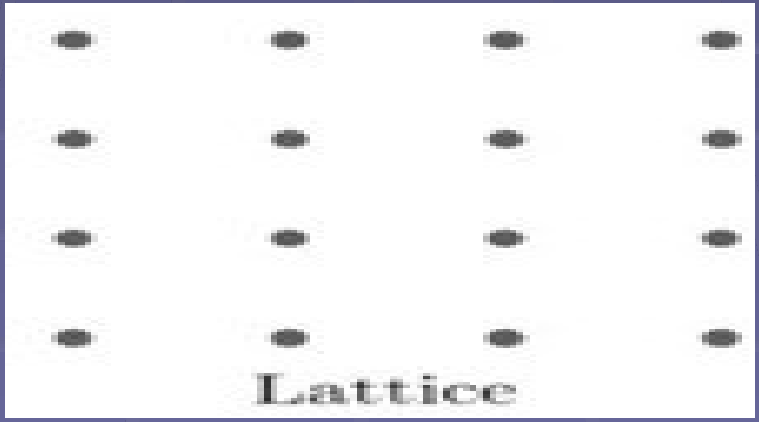
Property	Crystalline solids	Amorphous solids
Shape	Definite characteristic geometrical shape	Irregular shape
Melting point	Melt at a sharp and characteristic temperature	Gradually soften over a range of temperature
Cleavage property	When cut with a sharp edged tool, they split into two pieces and the newly generated surfaces are plain and smooth	When cut with a sharp edged tool, they cut into two pieces with irregular surfaces
Heat of fusion	They have a definite and characteristic heat of fusion	They do not have definite heat of fusion
Anisotropy	Anisotropic in nature	Isotropic in nature
Nature	True solids	Pseudo solids or super cooled liquids
Order in arrangement of constituent particles	Long range order	Only short range order.

Some Definitions

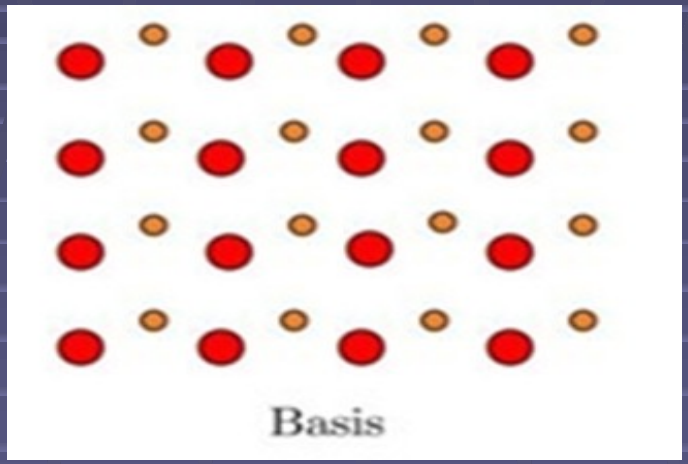
Crystal: **A crystal is a three dimensional regular and periodic arrangement of atoms. An ideal crystal is formed by the infinite regular repetition of identical structural units.**



Lattice: **It is a regular and periodic arrangement of points in space.**

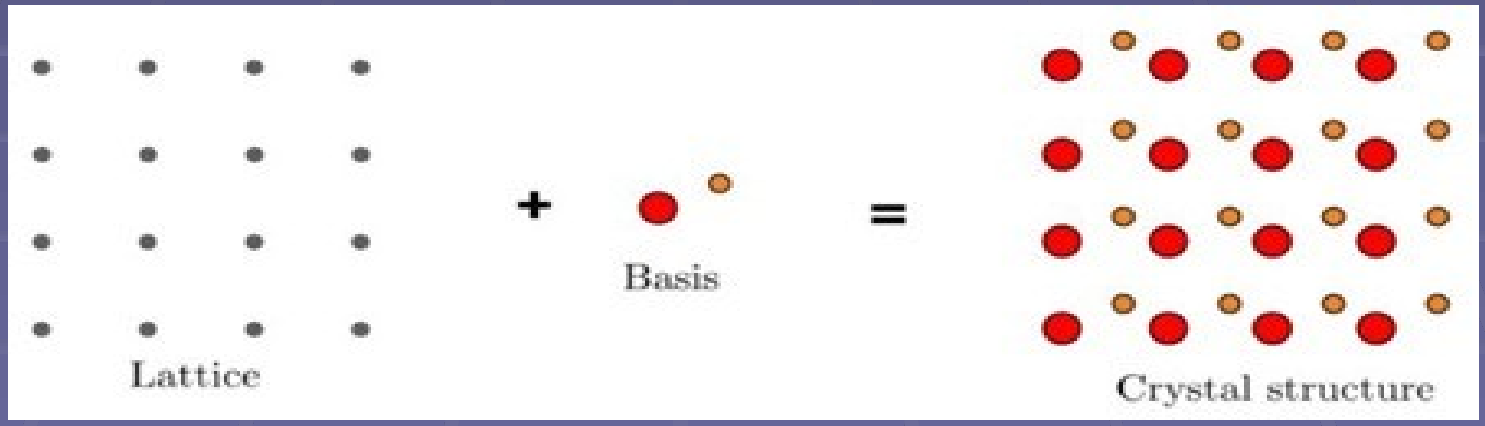


Basis: **The structure of all crystal is described in terms of a lattice with a group of atoms attached to each lattice point. The number of atoms or molecules present at the lattice is called basis. It is repeated in space to form the crystal structure.**

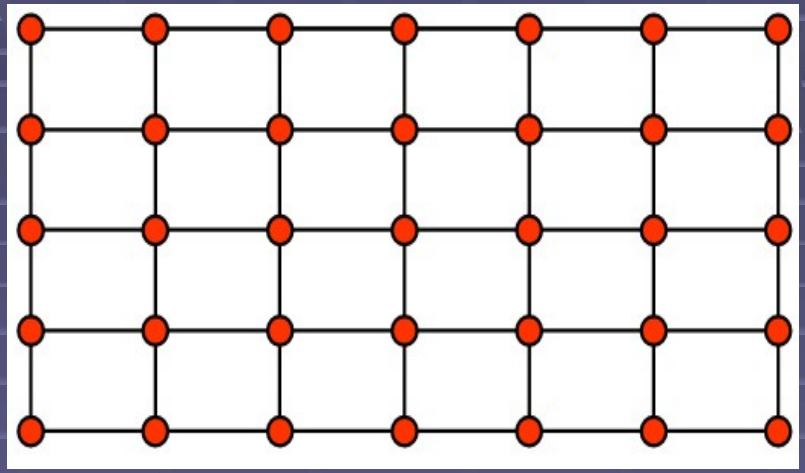


Crystal structure: **It is formed when a basis is attached to lattice**

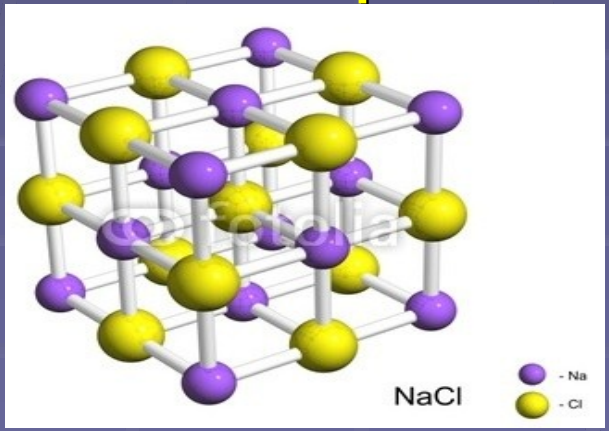
Lattice + Basis = Crystal Structure



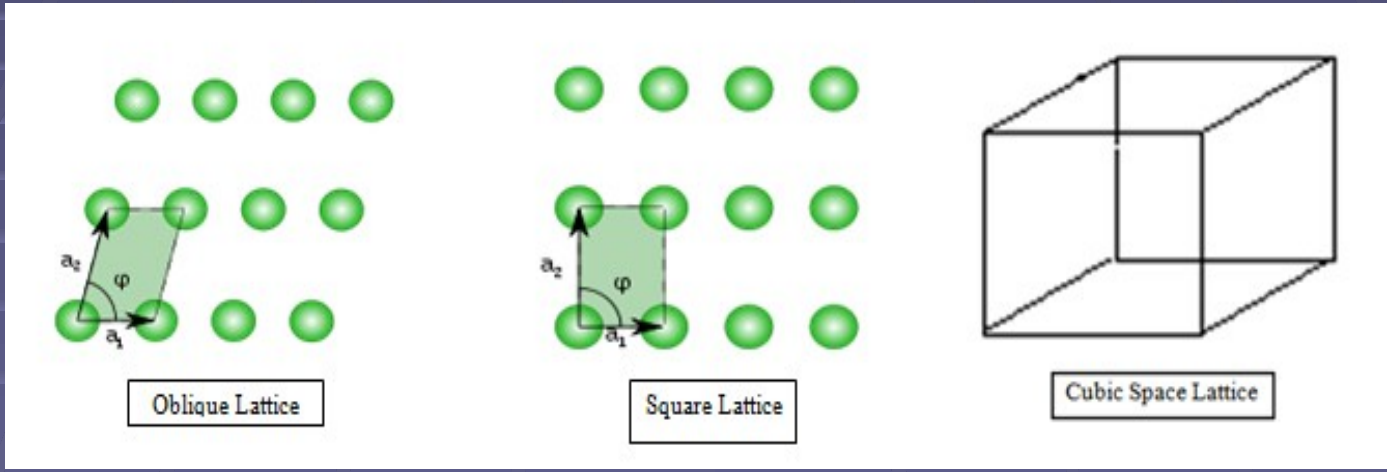
Plane lattice: **If all the atoms are arranged in a plane, then it would be visible like below picture. In this way in two dimension plane all points will have same atomic surroundings.**



Space lattice: **If all the atoms are having similar surroundings in three dimensional spaces like the adjacent figure, then such type of atomic arrangement is called space lattice.**



Bravais lattice: **There are various ways of positioning points (lattice) in space such that all points have same identical surroundings, *i.e.* all points are of same kind and equivalent. These lattices are known as Bravais lattices. Bravais showed that, there exist no more than 14 space lattices in three dimensions. In order to specify the arrangements of points in a space lattice, he introduced 7-system of axes or crystal system.**

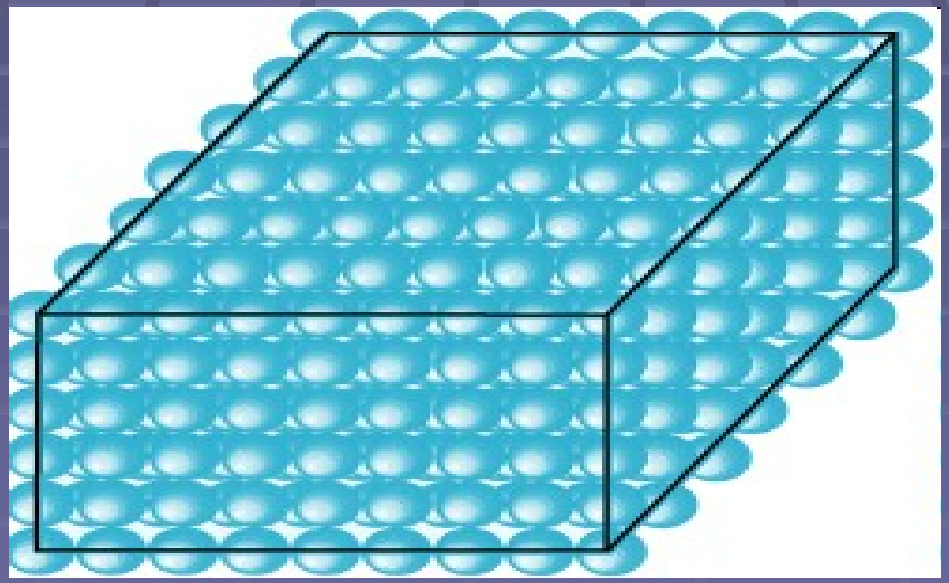


Non-Bravais lattice: **All points are not identical compared to each other known as non-Bravais lattices.**

Types of Crystalline Materials

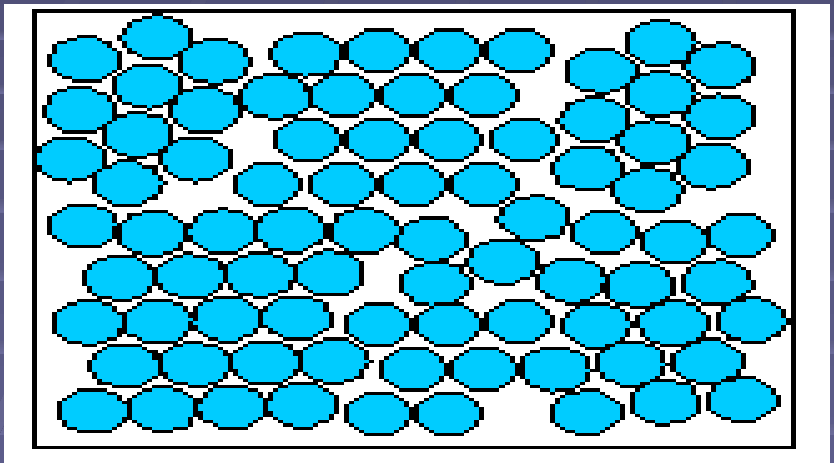
- Single Crystalline materials
- Polycrystalline materials

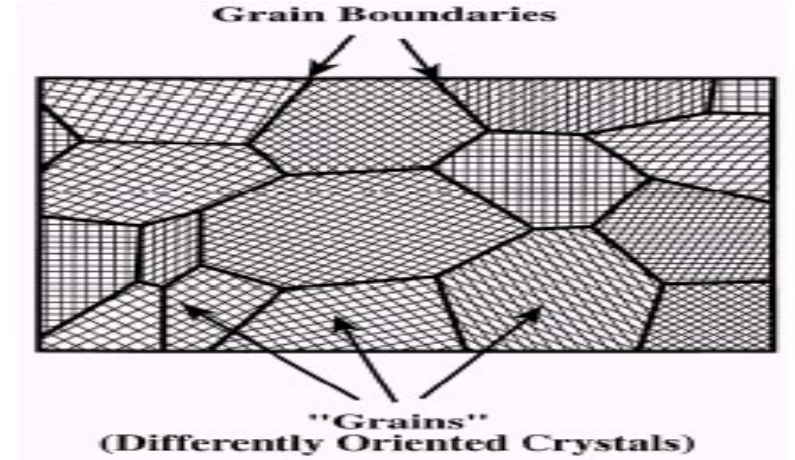
Single Crystal: It is a material in which the crystal lattice is continuous and unbroken to the edges of the sample, with no grain boundaries. When periodicity of the pattern stretch out to many *cubic cm* in volume is called single crystal. A homogenous solid formed by a repeating, three-dimensional pattern of atoms, ions, or molecules are having fixed distances between constituent parts. The unit cell is of such a pattern. *Example:* Diamond.



Polycrystal: **Polycrystalline materials are composed of a number of smaller crystals. Most of the crystalline solids are made up of millions of tiny crystals called grains and are called to be polycrystalline.**

In polycrystalline crystals the periodicity does not extend throughout the crystal but is interrupted at grain boundaries.





Polycrystalline is the structure of a solid material that forms crystallite grains at different points within it. The areas where these crystallite grains meet are known as grain boundaries.


Physics is hopefully simple but Physicists are not