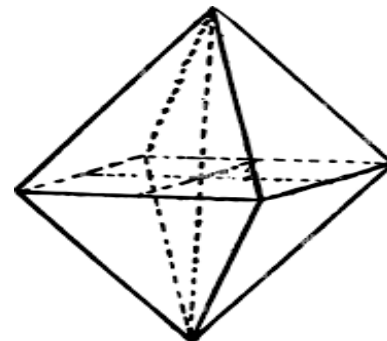
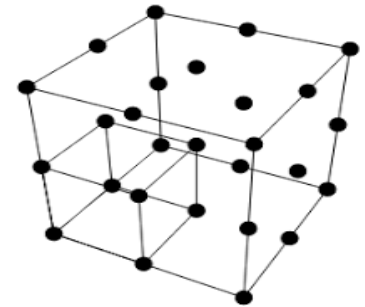


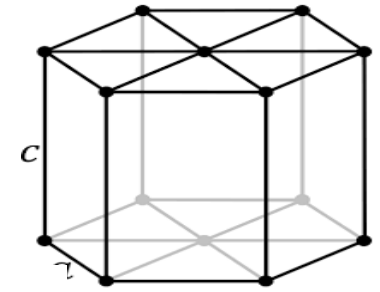
**Solid state**

# A1- crystalline solid

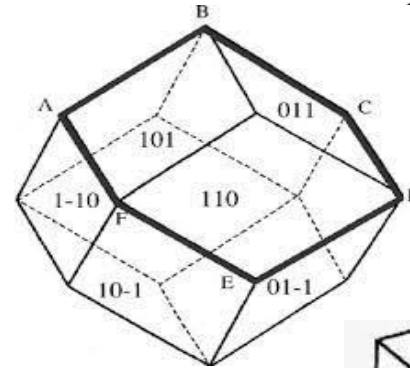
- The structural of crystalline solid are arranged of molecules in fixed geometric patterns or lattice. Un like liquids and gases, it has a definite shapes and orderly arrangement.
- The various crystal are:
  - Cubic (**NaCl**)
  - tetragonal (**Urea**)



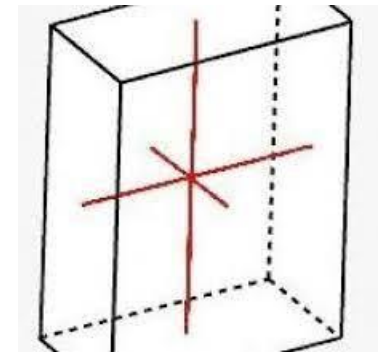
- hexagonal (Iodoform “ $R-CO-Cl_3$ ”)



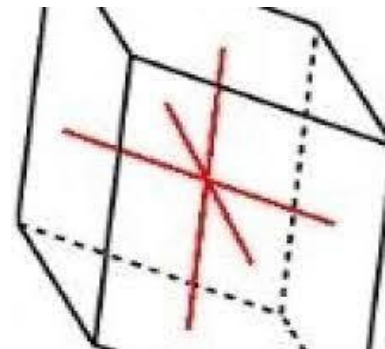
- rhombic ( $I_2$ )



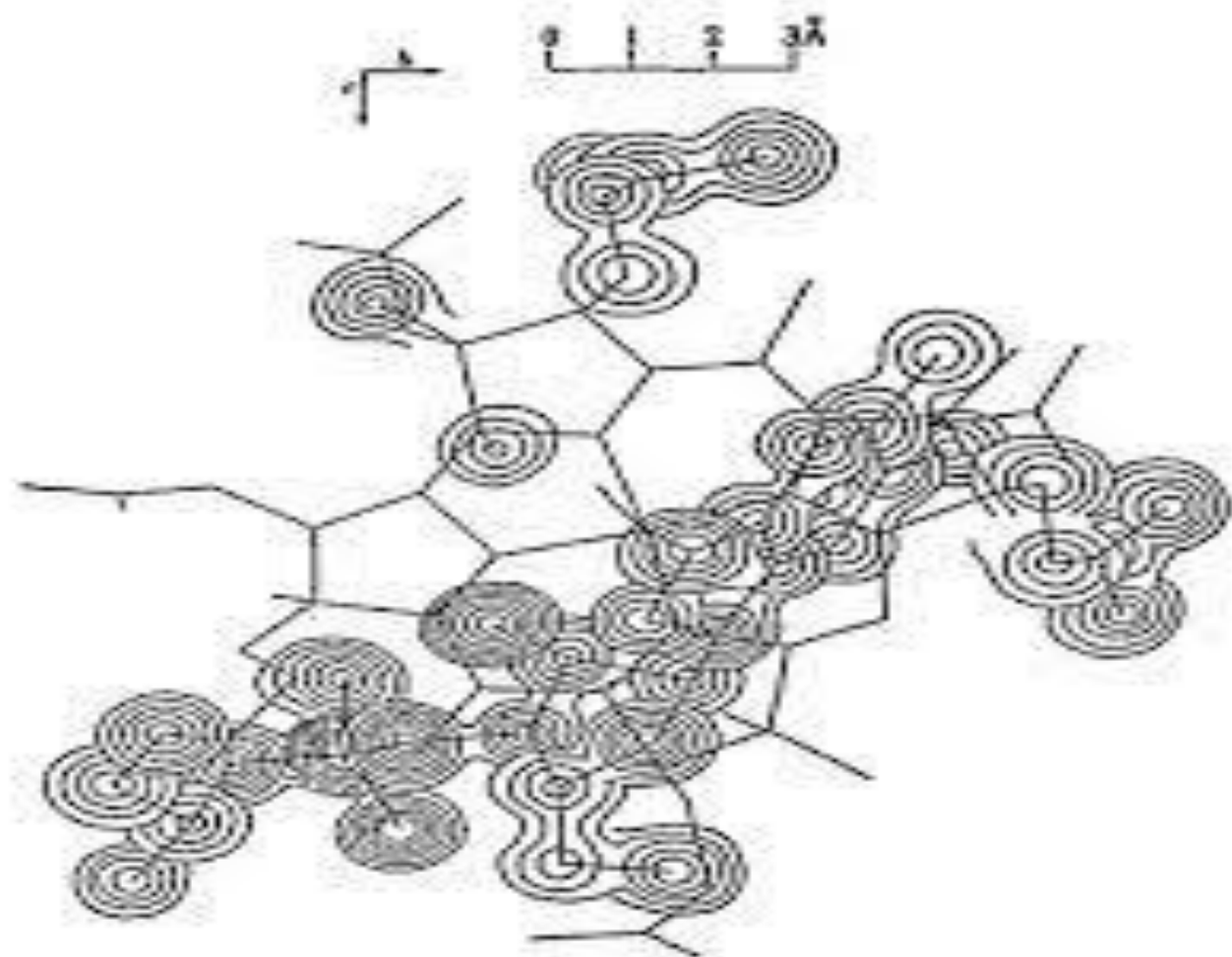
- monoclinic (Sucrose)



- triclinic ( $B(OH)_3$ )



- Intermolecular interaction in crystalline state suggested the m.p. of substance.
- The electron density map of crystalline (**the atoms in structure**) obtained by *X ray* diffraction data.



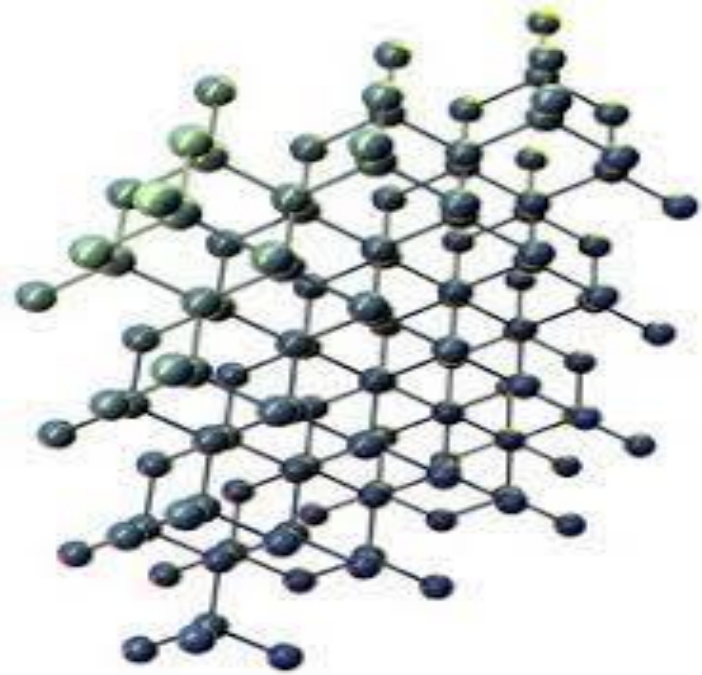
# Melting point $T_m$ or freezing point $T_f$

- A **temperature** at which the pure liquid and solid exist in equilibrium at 1 atmosphere **known** as the normal  $T_m$  or  $T_f$ .
- The changes of  $T_m$  or  $T_f$  with P maybe obtained by Clapeyron equation:
- $(T_m - T^0)/(P - P^0) = T^0 (V_l - V_s)/\Delta H_f$
- **Or**  $\Delta T/\Delta P = T^0 \Delta V/\Delta H_f$

- $V_l$ : Liquid Molar volume =  $Mw/\rho_l$
- $V_s$ : Solid Molar volume =  $Mw/\rho_s$
- $\Delta H_f$ : Heat of fusion =  $1436 \text{ cal.mol}^{-1}$  for water
- $T_m$ : melting temperature at pressure P

# A2 Polymorphism

- Substance exist in more than one crystalline form, such as C, S, Fe, .....
- Polymorphism have different melting points and different solubilities, even though they are chemically identical.
- Theobroma oil or cacao butter is capable of existing in four polymorphic forms:
  - 1-The unstable gamma form, melting at 18°C
  - 2- The alpha form, melting at 22°C
  - 3-The beta prime form, melting at 28°C
  - 4- The stable beta form, melting at 34.5°C

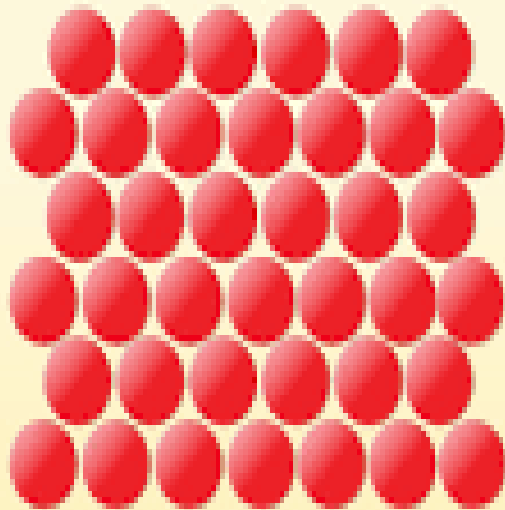


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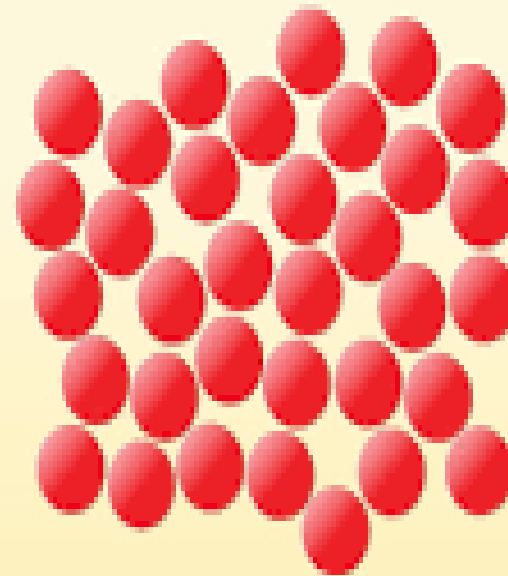
## B- Amorphous solid

- The molecules are arranged in a random manner as crystalline state, they don't have definite  $T_m$  differ from crystalline and when subjected to sufficient pressure they tend to flow.
- Glass, Plastic are amorphous solid .
- A drug is a **amorphous** or **crystalline** has been shown to affect its therapeutic activity, thus crystalline of antibiotic **novobiocin acid** is poorly absorbed and has no activity, whereas the amorphous form is readily absorbed and active

Crystalline

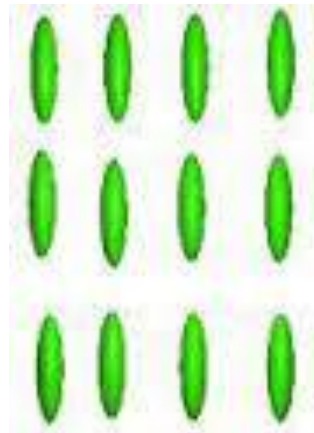


Amorphous

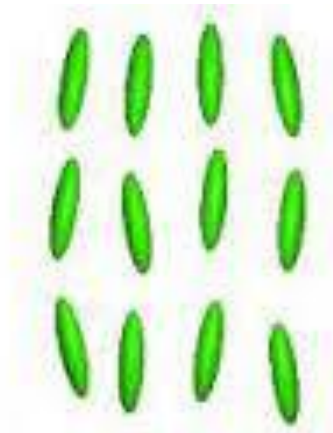


# Liquid crystalline (L.C.)

- Liquid crystalline state are intermediate between liquid and solid state, molecules in liquid state are mobile in three dimensions and rotate about three axes,
- But in solid state immobile and rotated are not possible,
- That in liquid crystal (L.C.) intermediate state of mobility and rotation should exist to give different **mesophases**.



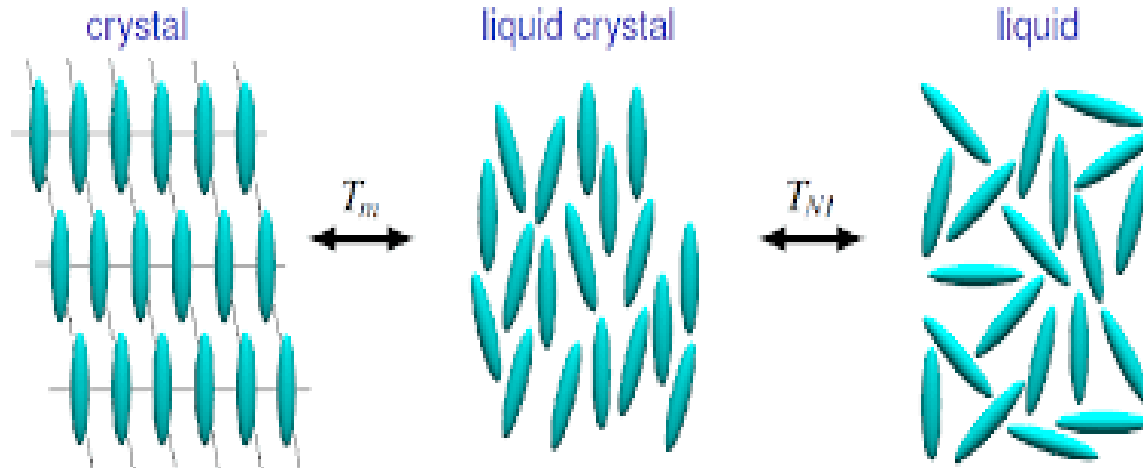
**Solid**



**Liquid Crystal**



**Liquid**



- L.C. or mesophase must be:

1-Rigid

2-Organic molecules

3-Elongated and rectilinear

4-Posses strong dipoles

X: must be unsaturated grub (=) or ( $\equiv$ )

L.C.

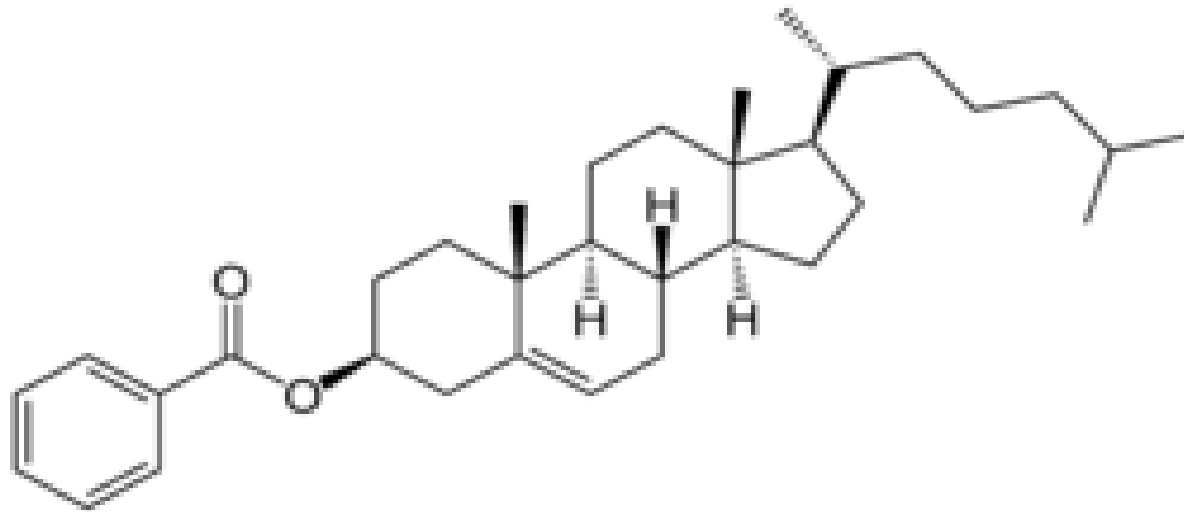
# Types of L.C.

- A- **Smectic state:**
- The molecules are mobile in **2** dimensions and rotate about **one** axis

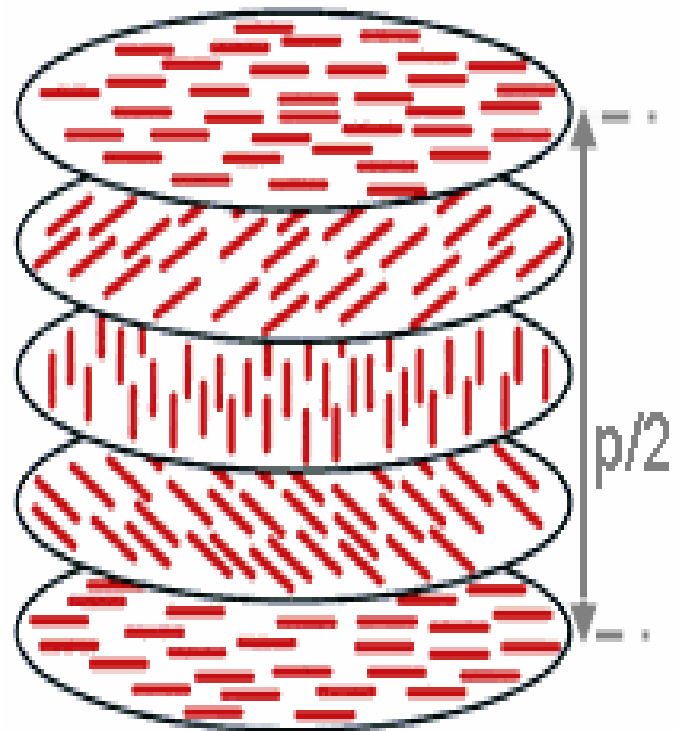
- B- **nematic state**:
- The molecules mobile in **3** dimension and rotated about **one** axes

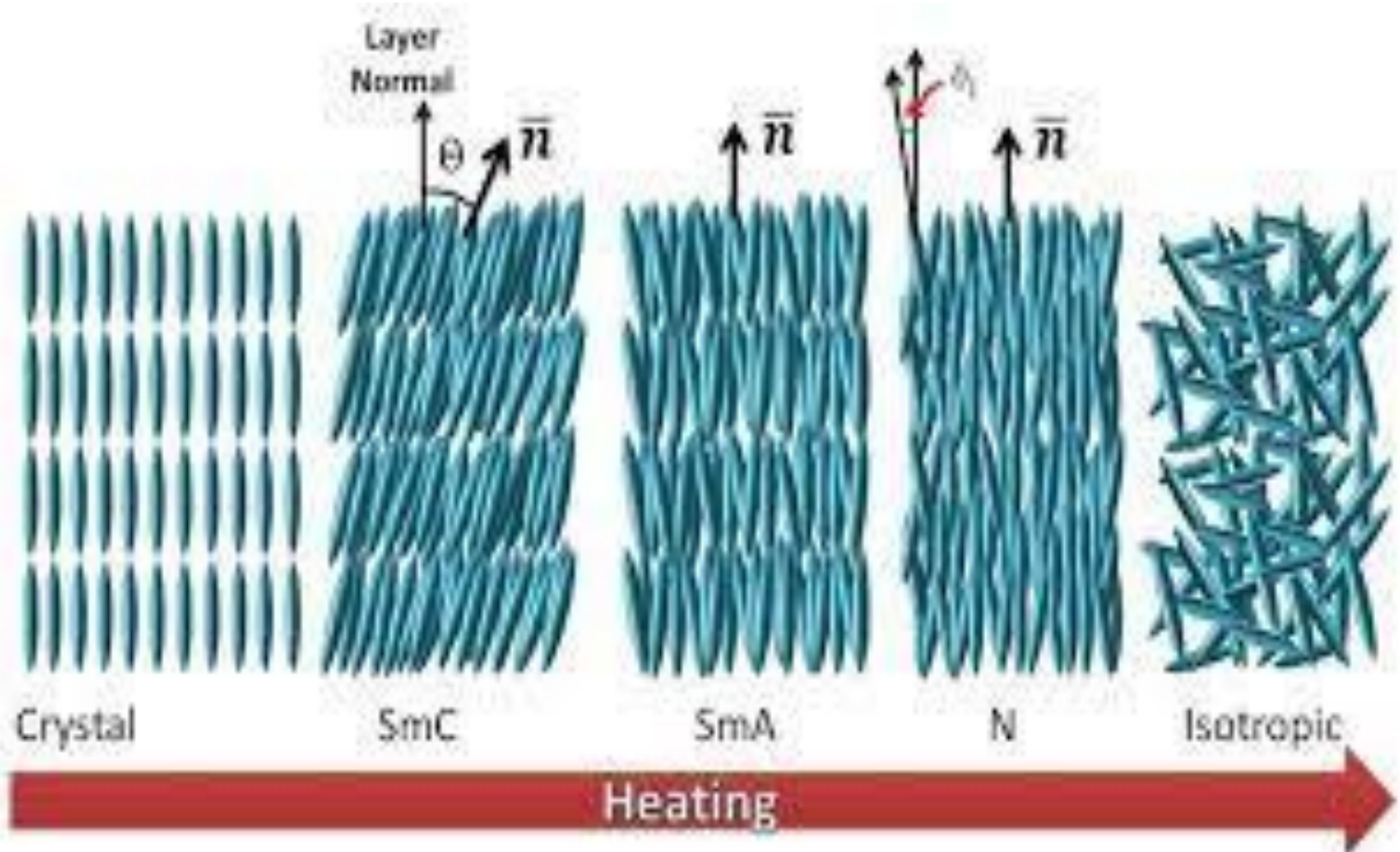
## C-Cholesteric state:

It is a special case of nematic



Chemical structure of [cholesteryl benzoate](#) molecule





- L.C. states result from
- A- Heating of solid crystal (thermotropic L.C.)

Semictic, Nematic, Cholesteric

- B- action of certain solvents (Lyotropic L.C.)

Cell membrane

- Some L.C. show color change with temperature, used thermometer.
- Nematic L.C. sensitive to electric fields, used in display systems