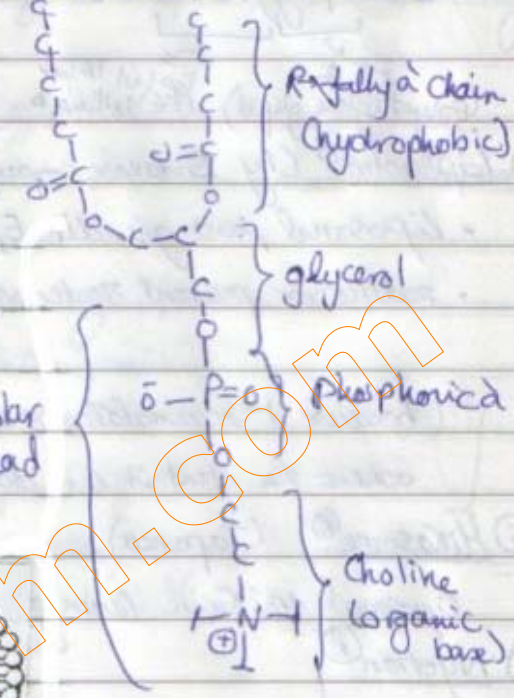
* liposomes are formed from phospholipids as lecithin & cephalin
* the structure of phospholipids is usually represented in a manner to indicate a polar head & 2 non polar tails
* lecithin & cephalin constitute the major structural components of biological membranes.
In animal cell membrane, they are associated w/ cholesterol.
In plant cell mmbs., they are associated w/ phytosterols.



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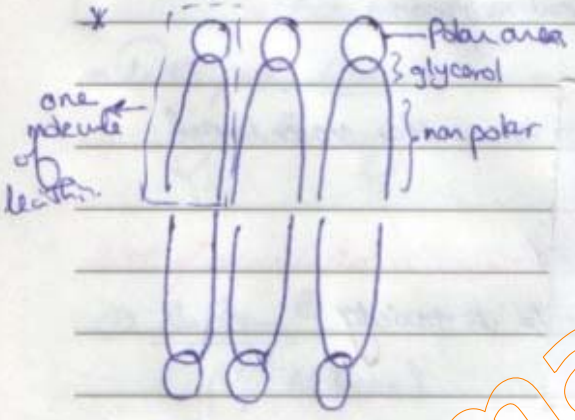


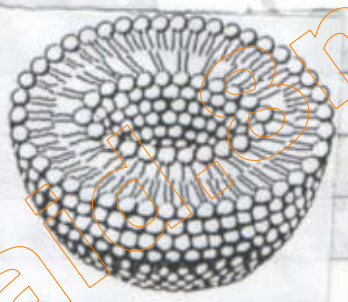
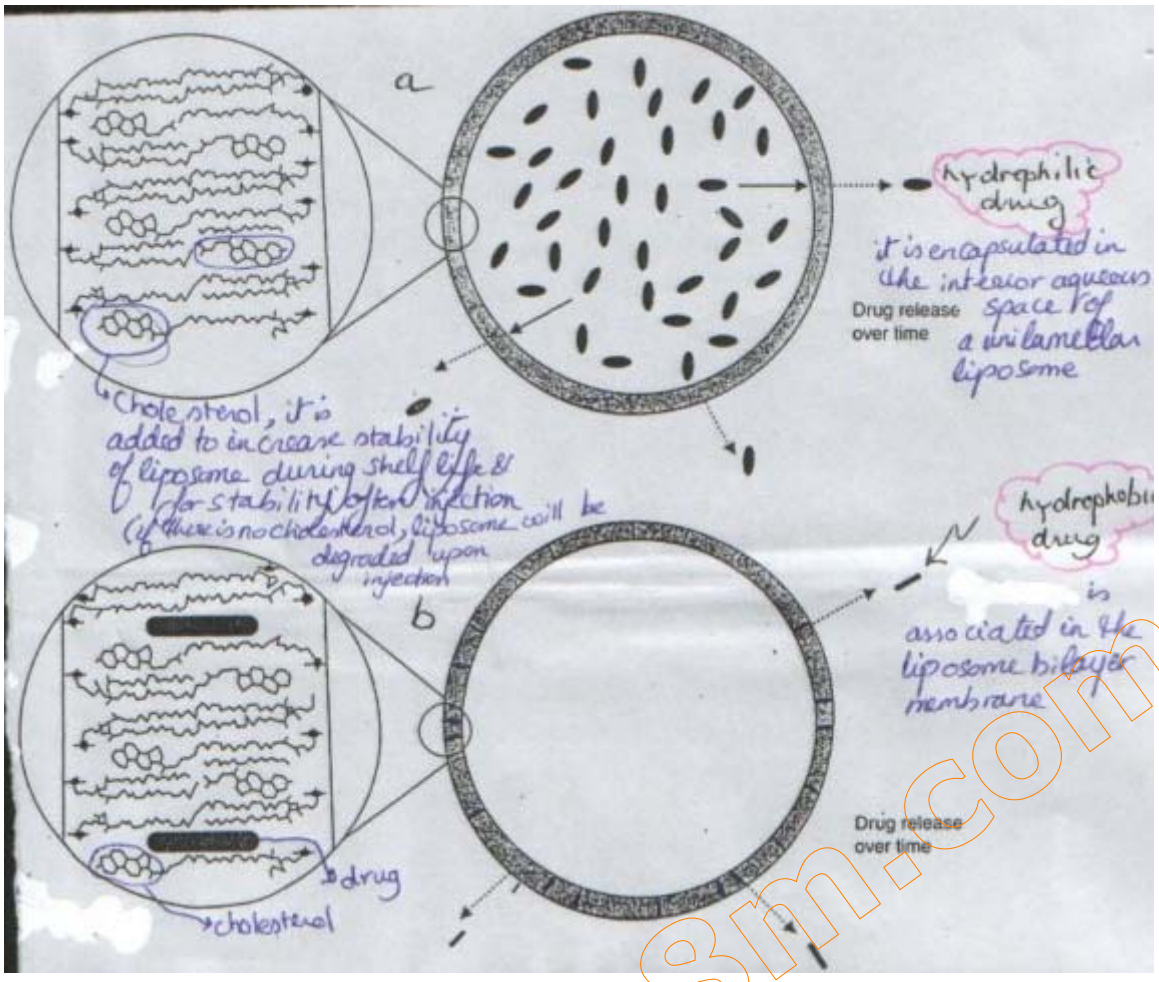


Figure 1: Liposome model

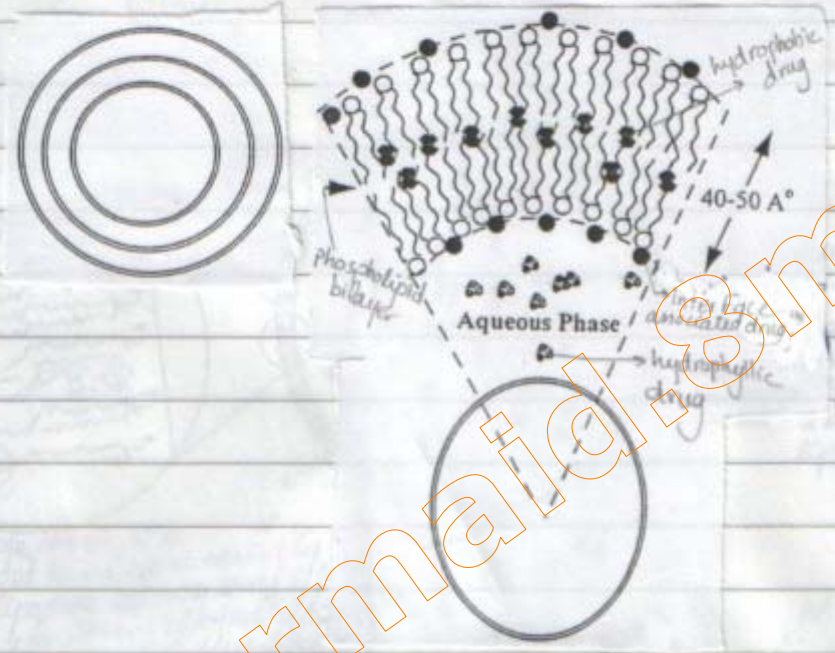
in aqueous medium, phospholipids arrange themselves as vesicles, the wall of which is composed of a bilayer of phospholipid molecules
(in H_2O, it forms a bilayer because it tries to hide the hydrophobic part so they can be stable & expose hydrophillic part to H_2O)
* Drawing showing the location of a drug within the liposome.
The drug molecules are present in the aqueous interior if hydrophyllic, or are present in the bilayer wall of the liposome vesicle if hydrophobic.



* inside the liposome vesicle there is a very small amount of H_2O, this water can be very different from the water outside in ions, PH, enzymes, ...
* liposomes are broken up by enzymes to release the drug.

Size & Types of liposomes:-

multilamellar vesicle (MLV) (>0.1 μm)	large unilamellar vesicle (LUV) (>0.1 μm)	Small unilamellar vesicle (SUV) (<0.1 μm)
		they are called microscopic vesicles.



Pegylated liposomes (Stealth liposome - sterically stabilized liposome)

* pegylation: surface attachment of PEG chains
* pegylated liposomes are not recognized by reticulo endothelial system & remains in blood for a long time (Doxil®)
* another way to prevent recognition or uptake of liposome by RES is making very small liposomes.

opsonin absorption is inhibited by water layer at liposome surface so the liposome pass through the liver normally & circulate with blood. So they are called long-circulating liposomes

Therapeutic application of liposomes as drug delivery system for injectable drugs :-

1. Liposomes can act as nontoxic vehicles for insoluble drugs : for example paclitaxel (anticancer drug) is insoluble in water and the conventional injection contains a surfactant and a cosolvent which contribute to the product toxicity. The liposomal product is free from surfactant and cosolvent.

2. Liposomes can prolong the biological half life of some drugs by protecting the drug from enzymatic degradation in the blood. For example the anti-leukemic drug cytarabine has a half life in the body of only 20 minutes due to the enzyme cytidine deaminase in blood, while the liposomal product has a half life of several hours.

3. Liposomes can target drugs to the reticuloendothelial system (RES) also called the mononuclear phagocyte system (MPS) consisting of liver (hepatic Kupffer cells), spleen (fixed macrophages) and bone marrow. For example liposomal amphotericin injection is effective against leishmania protozoa in the liver.

4. Liposomes can target drugs to tumours. For example pegylated liposomes carrying doxorubicin or daunorubicin are recommended for treating kaposi's sarcoma in AIDS patients.

5. Liposomes can reduce drug toxicity since liposome uptake by heart and kidney tissues is poor. In addition, since the drug is inside the liposomes, free drug concentration in plasma is low which reduces toxicity. For example, liposomal amphotericin shows reduced nephrotoxicity and liposomal doxorubicin is less cardiotoxic.

6. Liposomes can reduce the painful vesicant effect of some cytotoxic drugs upon extravasation from the injection site. for example conventional doxorubicin is both vesicant and irritant upon extravasation while liposomal doxorubicin is irritant but not vesicant.