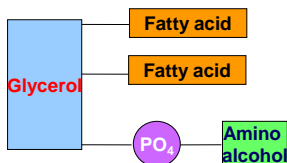


## 15.5 Glycerophospholipids

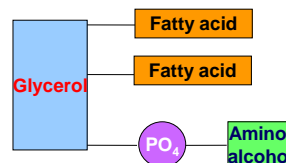


1

## Glycerophospholipids

**Glycerophospholipids** are

- the most abundant lipids in cell membranes.
- composed of glycerol, two fatty acids, phosphate, and an amino alcohol.

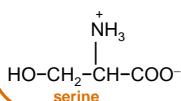
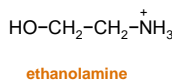
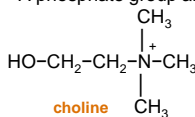


2

## Polarity of Glycerophospholipids

A **glycerophospholipid** has

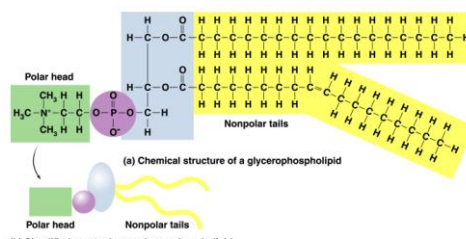
- two nonpolar fatty acid chains.
- A phosphate group and a polar amino alcohol.



Amino alcohols

3

## Structure and Polarity of A Glycerophospholipid



(b) Simplified way to draw a glycerophospholipid

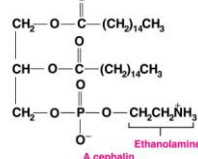
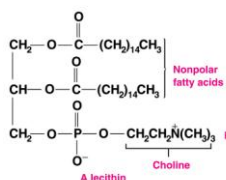
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## Lecithin and Cephalin

**Lecithin** and **cephalin** are glycerophospholipids

- abundant in brain and nerve tissues.
- found in egg yolk, wheat germ, and yeast.



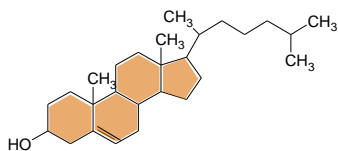
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There are different kinds of head group:

| Membrane phospholipid                 | Percent of total membrane phospholipid | Distribution in membrane |                 |
|---------------------------------------|--|--------------------------|-----------------|
|                                       |  | Inner monolayer          | Outer monolayer |
| Phosphatidylethanolamine              | 30                                     | 100                      | 0               |
| Phosphatidylcholine                   | 27                                     | 0                        | 100             |
| Sphingomyelin                         | 23                                     | 0                        | 100             |
| Phosphatidylserine                    | 15                                     | 100                      | 0               |
| Phosphatidylinositol                  | 5                                      | 100                      | 0               |
| Phosphatidylinositol 4-phosphate      | 5                                      | 100                      | 0               |
| Phosphatidylinositol 4,5-bisphosphate | 5                                      | 100                      | 0               |
| Phosphatidic acid                     | 5                                      | 100                      | 0               |

## 15.6 Steroids: Cholesterol, and Steroid Hormones



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## Steroid Nucleus

A **steroid nucleus** consists of

- 3 cyclohexane rings.
- 1 cyclopentane ring.
- no fatty acids.



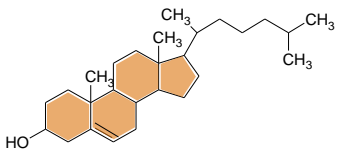
steroid nucleus

8

## Cholesterol

### Cholesterol

- is the most abundant steroid in the body.
- has methyl  $\text{CH}_3$ - groups, alkyl chain, and  $-\text{OH}$  attached to the steroid nucleus.



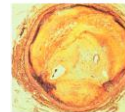
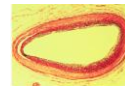
9

## Cholesterol in the Body

### Cholesterol

- is obtained from meats, milk, and eggs.
- is synthesized in the liver.
- is needed for cell membranes, brain and nerve tissue, steroid hormones, and Vitamin D.
- clogs arteries when high levels form plaque.

A normal, open artery.



An artery clogged by cholesterol plaque

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## Cholesterol in Foods

### Cholesterol

- is considered elevated if plasma cholesterol exceeds 200 mg/dL.
- is synthesized in the liver and obtained from foods.

| Cholesterol Content of Some Foods |              |                  |
|-----------------------------------|--------------|------------------|
| Food                              | Serving Size | Cholesterol (mg) |
| Liver (beef)                      | 3 oz.        | 370              |
| Egg                               | 1            | 250              |
| Lobster                           | 3 oz.        | 175              |
| Fried chicken                     | 3½ oz.       | 130              |
| Hamburger                         | 3 oz.        | 85               |
| Chicken (no skin)                 | 3 oz.        | 75               |
| Fish (salmon)                     | 3 oz.        | 40               |
| Butter                            | 1 tablespoon | 30               |
| Whole milk                        | 1 cup        | 35               |
| Skim milk                         | 1 cup        | 5                |
| Margarine                         | 1 tablespoon | 0                |

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## LIPID TRANSPORT

### Lipoproteins

- Lipids are transported in the blood as lipoproteins
- are soluble in water because the surface consists of polar lipids.

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• Combine lipids with proteins and phospholipids.

Lipids:

Cholesterol

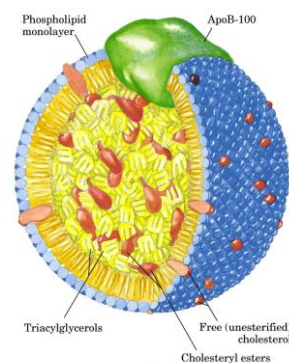
Apolipoproteins + Cholesteryl esters → lipoproteins

Triacylglycerols

Phospholipids

Lipid transport

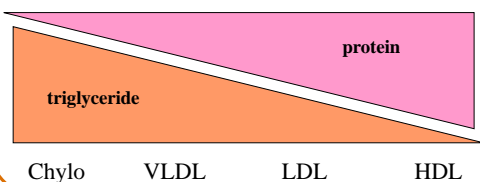
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## There are 4 types of lipoprotein

- The lipoprotein formed depends on the constituent protein and lipids



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## Composition of lipoproteins

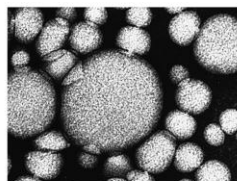
table 21-2

Major Classes of Human Plasma Lipoproteins: Some Properties

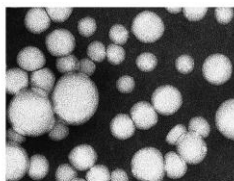
| Lipoprotein  | Density (g/mL) | Composition (wt %) |               |                  |                    |
|--------------|----------------|--------------------|---------------|------------------|--------------------|
|              |                | Protein            | Phospholipids | Free cholesterol | Cholesteryl esters |
| Chylomicrons | <1.006         | 2                  | 9             | 1                | 3                  |
| VLDL         | 0.95-1.006     | 10                 | 18            | 7                | 12                 |
| LDL          | 1.006-1.063    | 23                 | 20            | 8                | 37                 |
| HDL          | 1.063-1.210    | 55                 | 24            | 2                | 15                 |

Source: Modified from Kritchevsky, D. (1986) Atherosclerosis and nutrition. *Nutr. Int.* 2, 290-297.

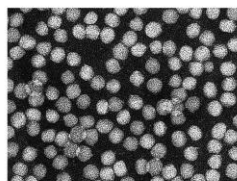
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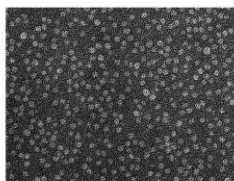
Chylomicrons (x60,000)



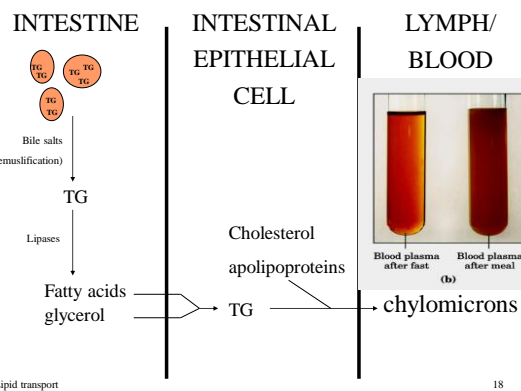
VLDL (x180,000)



LDL (x180,000)

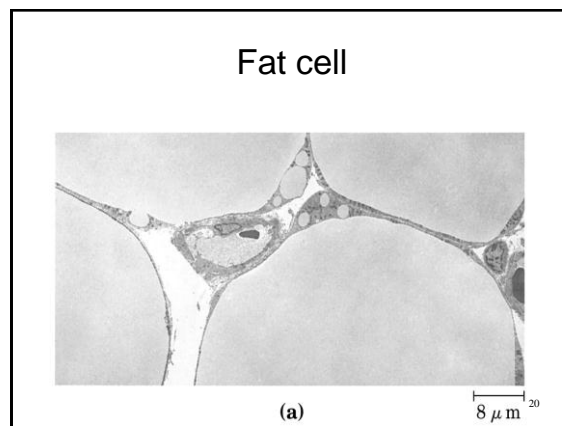
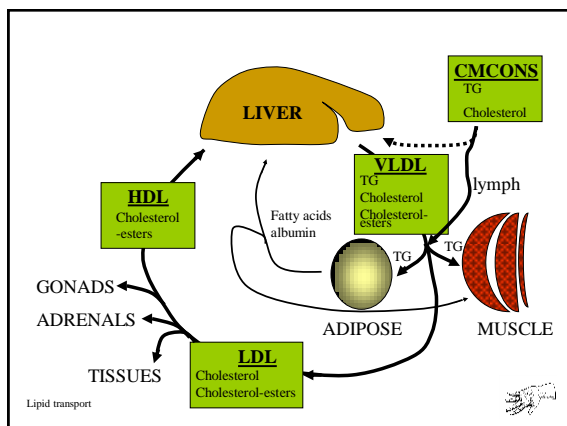


HDL (x180,000)



Lipid transport

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## Steroid Hormones

### Steroid hormones are

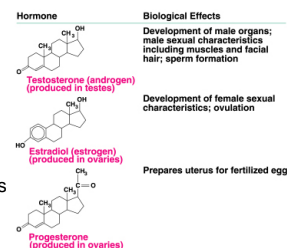
- chemical messengers in cells.
- sex hormones.
  - Androgens in males (testosterone)
  - Estrogens in females (estradiol)
- Adrenocortical hormones from adrenal glands.
  - mineralocorticoids (electrolyte balance)
  - glucocorticoids regulate glucose level

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## Steroid Hormones

### Steroid hormones

- are produced from cholesterol.
- include sex hormones such as androgens (testosterone) in males and estrogens (estradiol) in females.



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## Adrenal Corticosteroids

### Steroid hormones called adrenal corticosteroids

- are produced by the adrenal glands located on the top of each kidney.
- include *aldosterone*, which regulates electrolytes and water balance by the kidneys.
- include *cortisone*, a glucocorticoid, which increases blood glucose level and stimulates the synthesis of glycogen in the liver.

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## Anabolic Steroids

### Anabolic steroids

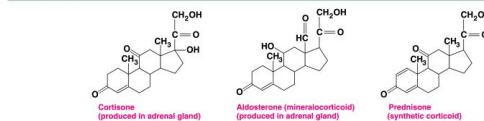
- are derivatives of testosterone.
- are used illegally to increase muscle mass.
- have side effects including fluid retention, hair growth, sleep disturbance, and liver damage.



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## Adrenal Corticosteroids

### Corticosteroids



### Biological Effects

Increases the blood glucose and glycogen levels from fatty acids and amino acids

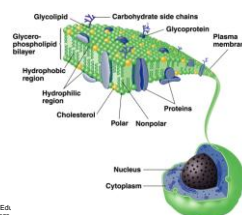
Increases the reabsorption of  $\text{Na}^+$  in kidneys; retention of water

Reduces inflammation; treatment of asthma and rheumatoid arthritis

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## 15.7 Cell Membranes



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## Cell Membranes

### Cell membranes

- separate cellular contents from the external environment.
- consist of a lipid bilayer made of two rows of phospholipids.
- have an inner portion made of the nonpolar tails of phospholipids with the polar heads at the outer and inner surfaces.

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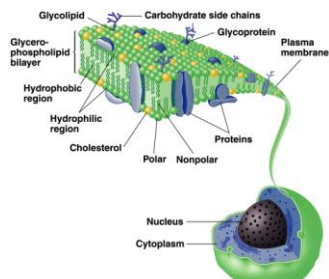
## Fluid Mosaic Model of Cell Membranes

### The lipid bilayer

- contains proteins, carbohydrates, and cholesterol.
- has unsaturated fatty acids that make cell membranes fluid-like rather than rigid.
- has proteins and carbohydrates on the surface that communicate with hormones and neurotransmitters.

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## Fluid Mosaic Model of Cell Membranes



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