

The M-CATs Presents



Lipids

Biochemistry chapter 5

I

Doing too much

Blood type

Soap

Aspirin

Eye sight

Fat

See what I mean? Doing too much

Lipids can

Structure
stuff

Signal
stuff

Store Energy
stuff

Very diverse but:

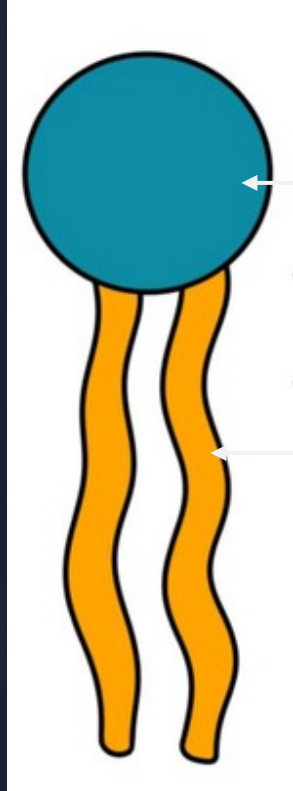
Characteristic insolubility in water

Lipophilic versus hydrophilic

-II-

Structure stuff

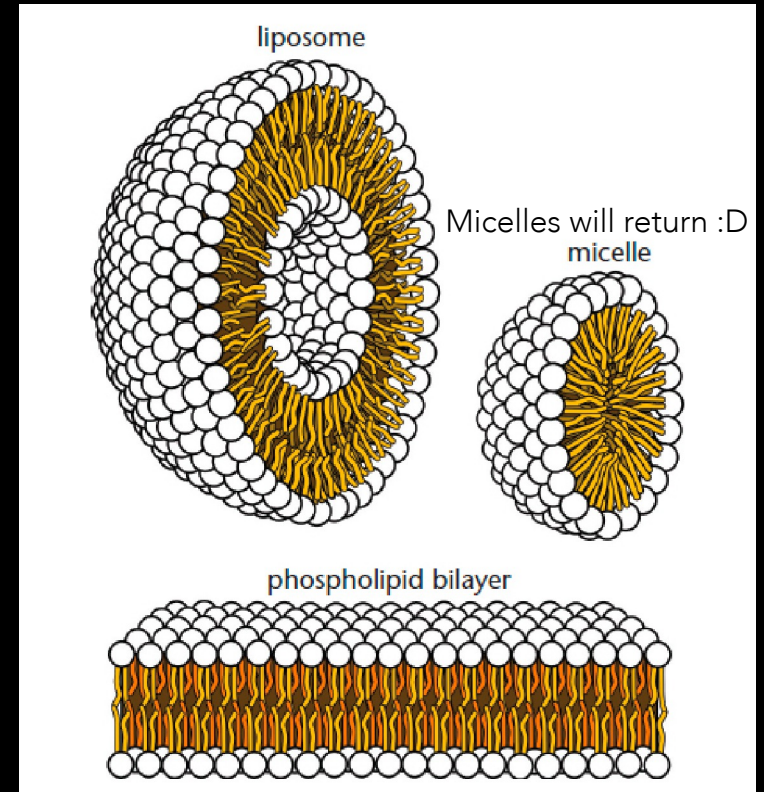
Phospholipids!



Hydrophilic head

Hydrophobic Tails

Structures they can take on
In AQUEOUS Soln.



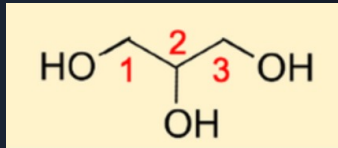
Its about to get complex
There are many types of way to arrange these kinds of lipids, pay attention,
Its kind of like build-a-bear

Classifying structural lipids.

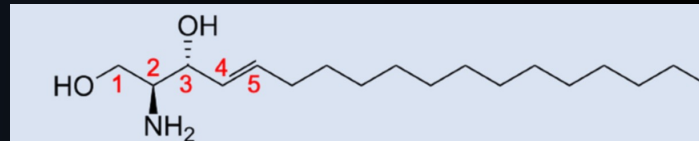
1. What is the backbone?

2 options

Glycerol



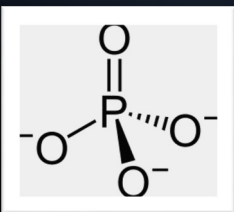
Sphingosine



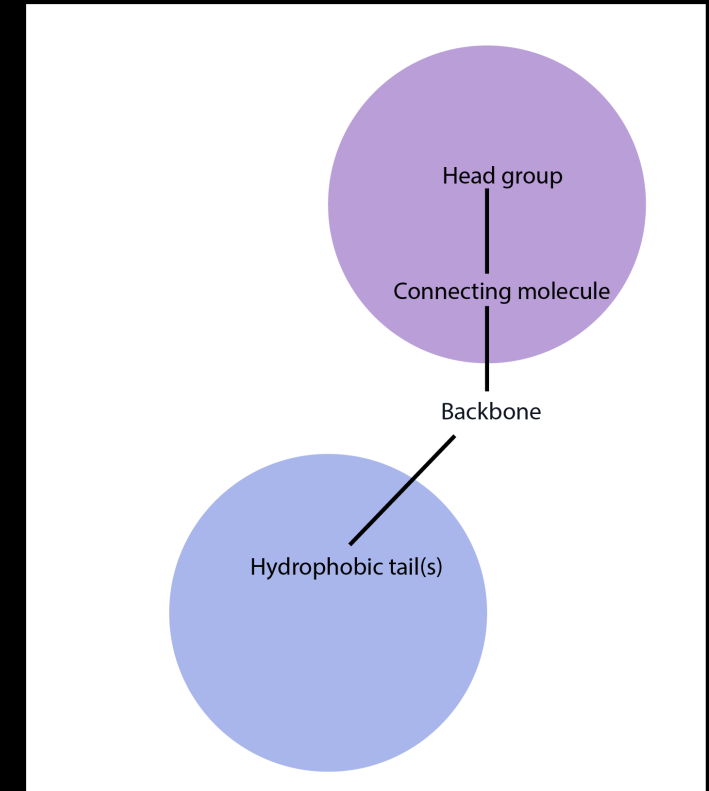
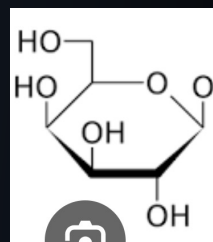
2. What's the head group? How is it attached?

Head group depends, but there are two main
Connecting/attachment molecules

Phosphates



Sugars



What are you responsible for actually knowing?

Connecting Molecule to the Head

Backbone Molecule

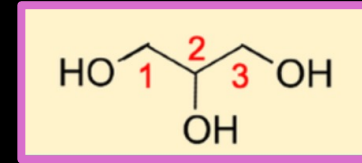
	Phosphate head → phospholipid	Sugar head → glycolipid
Glycerol	Glycerophospholipids (phosphatidylcholine, etc.)	Not tested
Sphingosine	Sphingomyelin	Cerebroside, globoside, ganglioside

Lets start with Glycerol backbone + a Phosphate Connected Head
aka

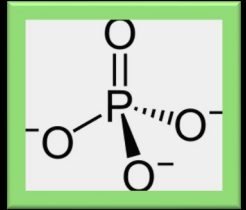
Glycerophospholipids
(or Phosphoglycerides)

Glycerophospholipids (or Phosphoglycerides)

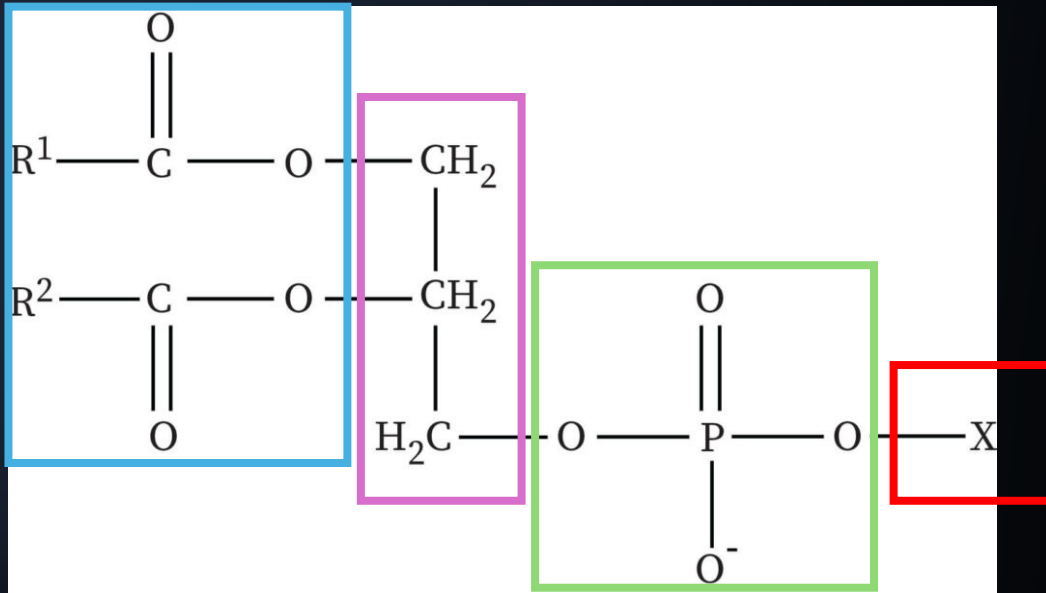
Glycerol



Phosphates



Hydrophobic tails



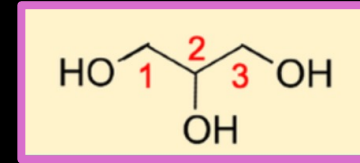
Notice ester linkages

Notice phosphodiester linkages

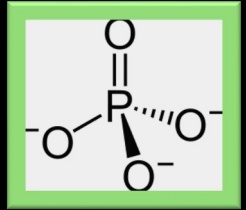
What are the possible head groups??

Glycerophospholipids (or Phosphoglycerides)

Glycerol

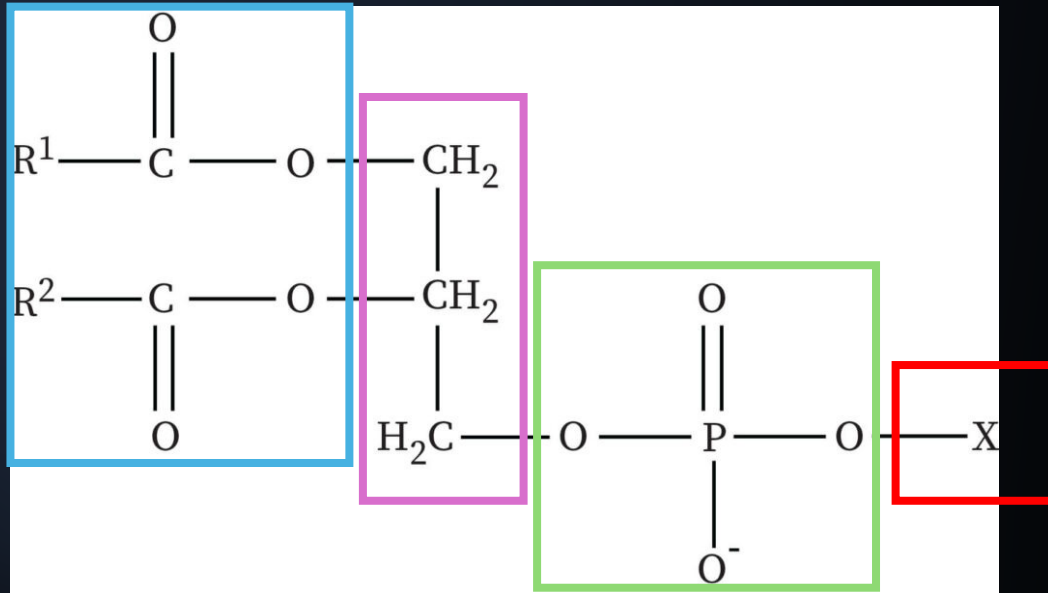


Phosphates



General structure

2 Hydrophobic tails

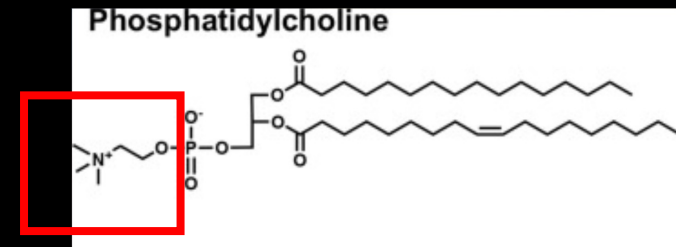


Notice ester linkages

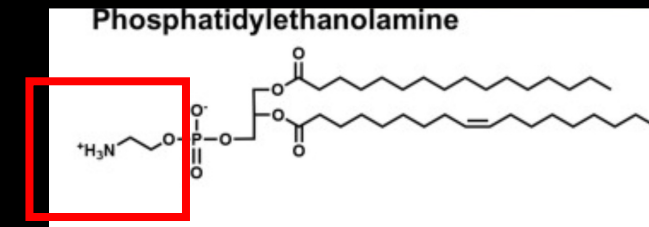
Notice phosphodiester linkages

What are the possible head groups??

Choline
(Thus named
Phosphatidylcholine)



Ethanolamine
(Thus named
Phosphatidylethanolamine)



Functions?

Cell Recognition, signaling, binding

What are you responsible for actually knowing?

Connecting Molecule to the Head

Backbone Molecule

Phosphate head → phospholipid		Sugar head → glycolipid
Glycerol	Glycerophospholipids (phosphatidylcholine, etc.)	Not tested
Sphingosine	Sphingomyelin	Cerebroside, globoside, ganglioside

IMPORTANT

Sphingolipids are used for
ABO blood typing

Now sphingosine + sugars!
aka Glycosphingolipids

Sphingophospholipids

Sphingosine
(backbone)



Lipid Tail



Phosphate

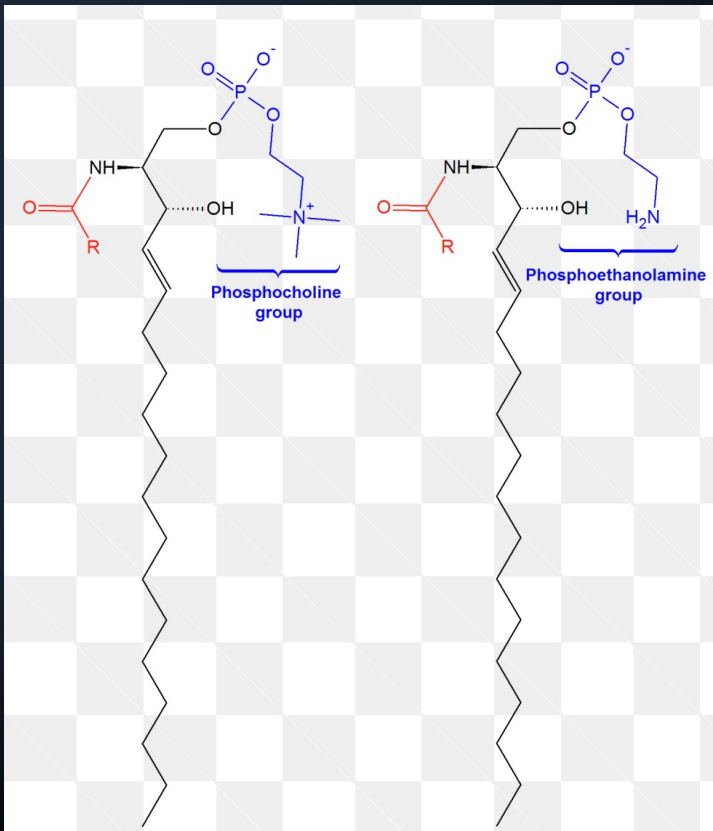


Ethanolamine



Choline

Sphingo
myelins



Both of these are types of sphingomyelin
So we refer to them by sphingomyelins

Properties to know!

- No net charge on head group
- Part of plasma membranes of cells that produce *myelin* (oligodendrocytes & schwann cells)

That is all of the
sphingophospholipids you need to know

What are you responsible for actually knowing?

Connecting Molecule to the Head

Backbone Molecule

Phosphate head → phospholipid		Sugar head → glycolipid
Glycerol	Glycerophospholipids (phosphatidylcholine, etc.)	Not tested
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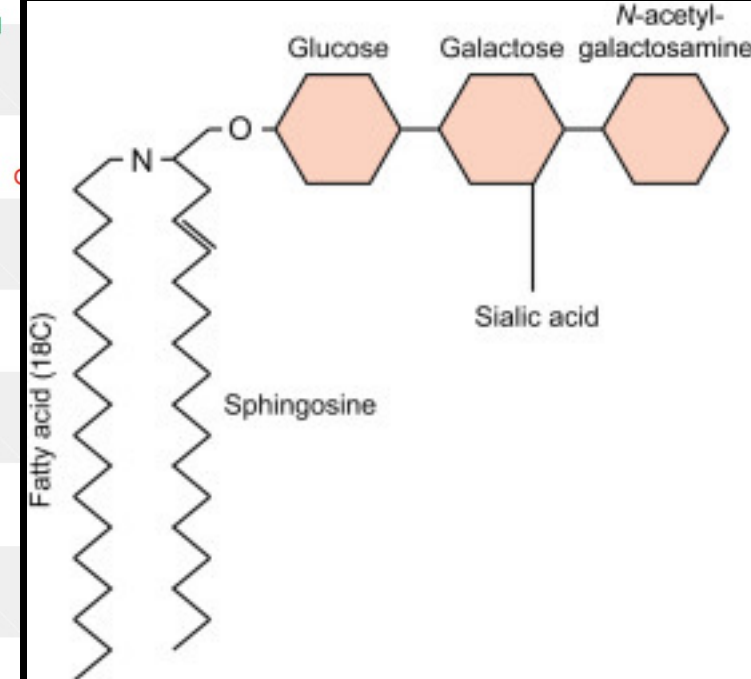
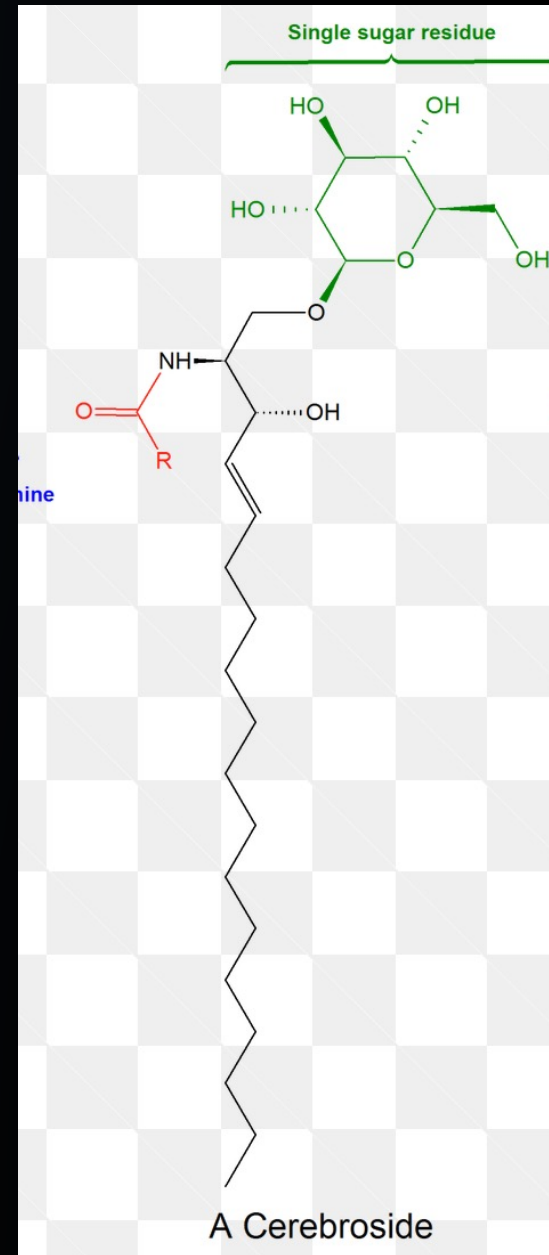
Now sphingosine + sugars!
aka Glycosphingolipids

Glycosphingolipids

3 main types

1. Cerebrosides (single sugar attached)
2. Globosides (two or more sugars attached)
3. Gangliosides (a little more complex)

Lets get (1) & (2) out of the way



Both are neutral

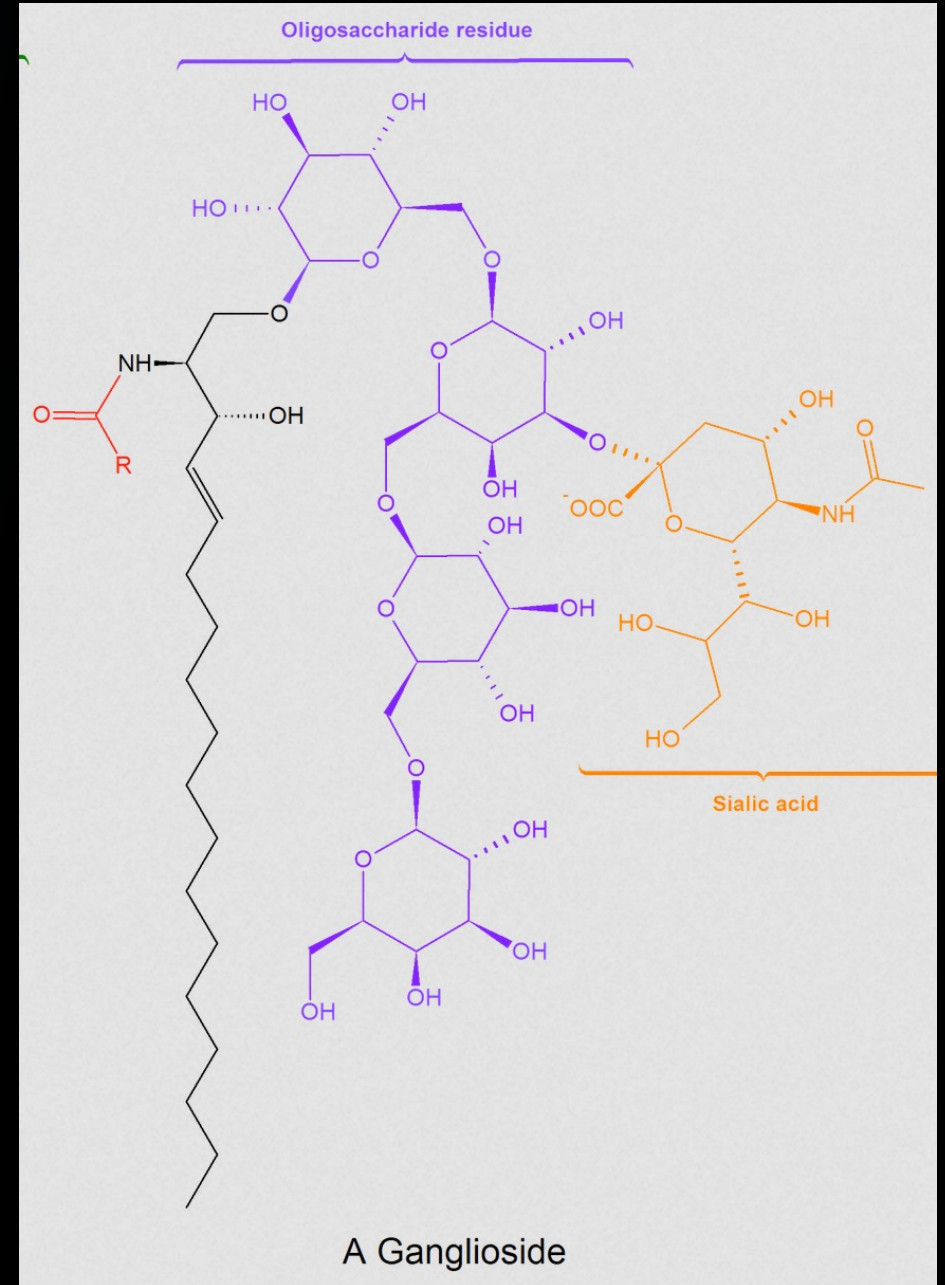
Glycosphingolipids

3 main types

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Gangliosides

- Polar head groups w/ Oligosaccharides w/ one or more N-acetylneuraminic acid (NANA aka Sialic acid)
- Negatively charged due to sialic acids
- Major role in
 - Cell interaction
 - Cell Recognition
 - Signal Transduction



Two quick asides

Saturated vs unsaturated

Waxes

-III-

Signaling stuff

Three main classifications

Steroids

Prostaglandins

Fat-Soluble Vitamins
(xxx, ifykyk)

Three main classifications

Steroids

Prostoglandins

Fat-Soluble Vitamins
(xxx, ifykyk)

Terpenes



Steroids

Terpenes

Made up of isoprenes (trust ik it is dumb)

Mostly made by plants and insects

Strongly Scented

Play a protective role

Originally discovered from Turpentine

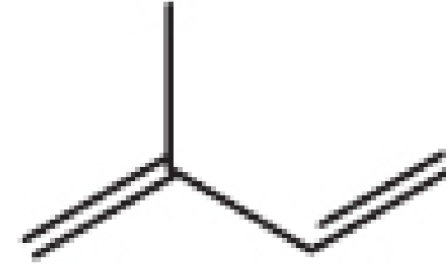


Figure 5.5 Isoprene

Terpenes

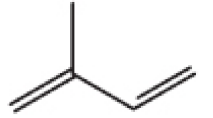


Figure 5.5 Isoprene

Monoterpene
(2 isoprenes, $C_{10}H_{16}$)



Many essential oils

Sesquiterpenes
(3 isoprenes)

Diterpenes
(4 isoprenes)



Vitamin A

Triterpenes
(6 isoprenes)



Cholesterol &
Steroids

Tetraterpenes
(8 isoprenes)



Carotenoids
(Beta-carotene)

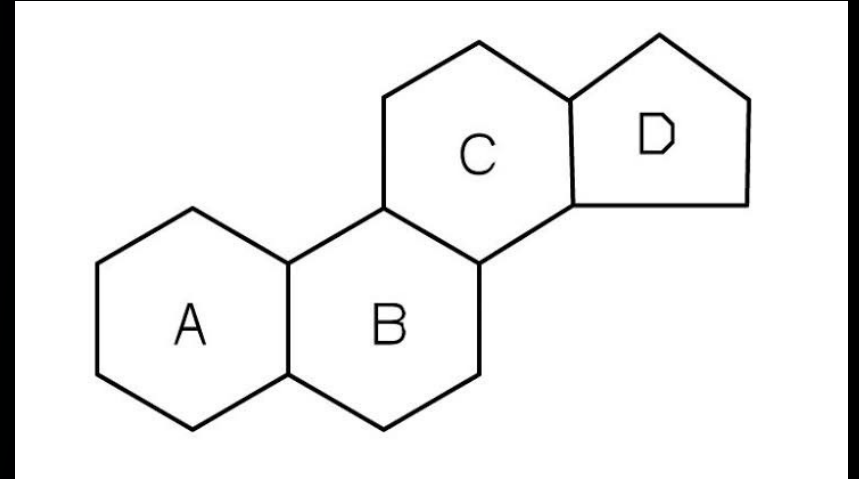
Aside: Rubber - made up of 5K-10K isoprene units => polyterpene

Cholesterol & Steroids

Steroids are a class of molecules,
Characterized by their 3 room-house
+ garage

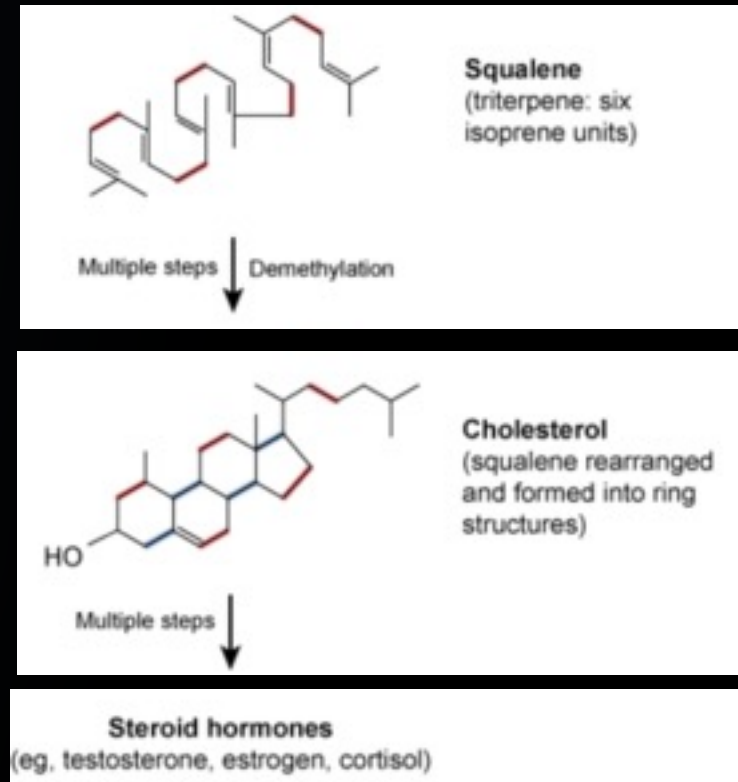
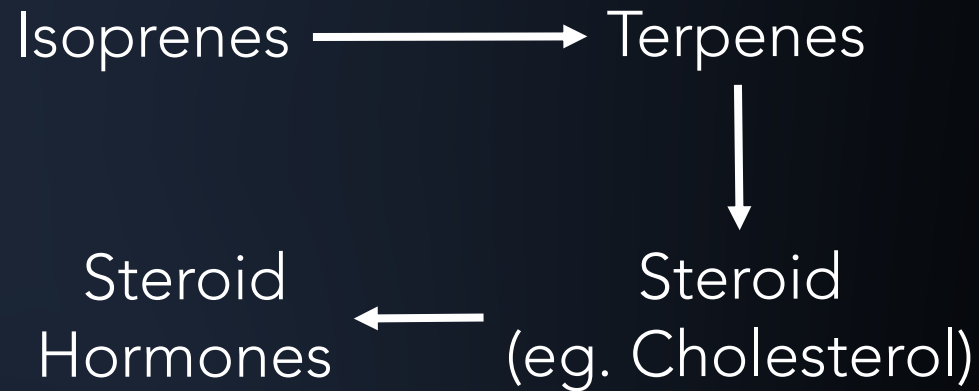
Steroids can be a lot of things, but
we mostly care about **steroid
hormones**

How can we obtain this 1 million
dollar house?



Cholesterol & Steroids

So the full path:



Cholesterol

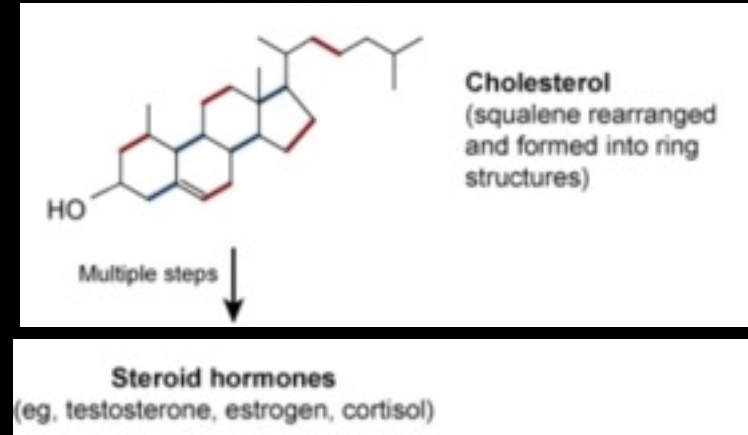
- Big component of phospholipid bilayer
 - maintains fluidity via amphipathic interactions!
 - at low temp, prevents membrane from solidifying
 - at high temp, holds membrane intact and prevents high permeability

Precursor to:

Steroid hormones

Bile acids

Vitamin D



Three main classifications

Steroids

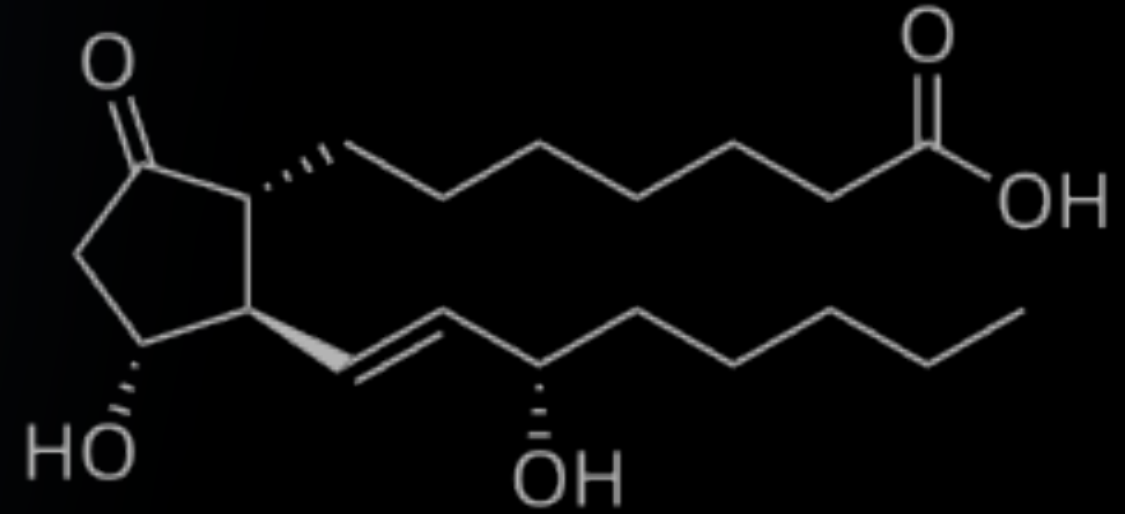
Prostaglandins

Fat-Soluble Vitamins
(xxx, ifykyk)

Prostaglandins

Characteristics u need to know

- 20 Carbon molecules
- Unsaturated carboxylic acids
- Derived from arachidonic acid
- Contain at least one cyclopentane
- Paracrine or autocrine signaling
- Regulates synthesis of cAMP



Prostaglandins



cAMP
controls:

Smooth muscle function

Sleep-wake cycle

Elevation of body temp (fever/pain)

Aside: NSAIDs, inhibit enzyme cyclooxygenase (COX) which catalyzes production of prostaglandins

Three main classifications

Steroids

Prostaglandins

Fat-Soluble Vitamins
(xxx, ifykyk)

Fat-Soluble Vitamins

(xxx, ifykyk)

A

D

E

K

Fat-Soluble Vitamins (xxx, ifykyk)

A Aka carotene

Unsaturated hydrocarbon

Important for vision, growth & development, immune function

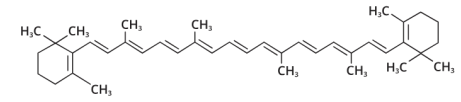
Converted to active aldehyde form -> retinal

Retinal = helps with light sensing in eye

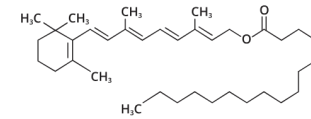
Converted to storage form -> retinol

Retinol can be oxidized to retinoic acid: hormone that regulates gene expression during epithelial development

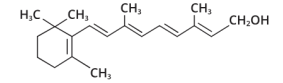
Figure 1. Chemical Structures



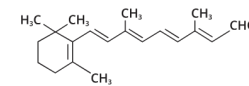
β-CAROTENE



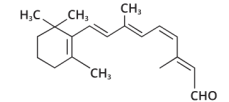
RETINYL PALMITATE



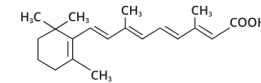
ALL-TRANS-RETINOL



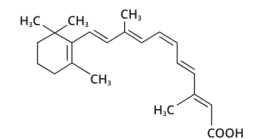
ALL-TRANS-RETINAL



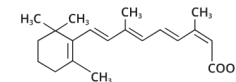
11-CIS-RETINAL



ALL-TRANS-RETINOIC ACID



9-CIS-RETINOIC ACID



13-CIS-RETINOIC ACID

Fat-Soluble Vitamins (xxx, ifykyk)

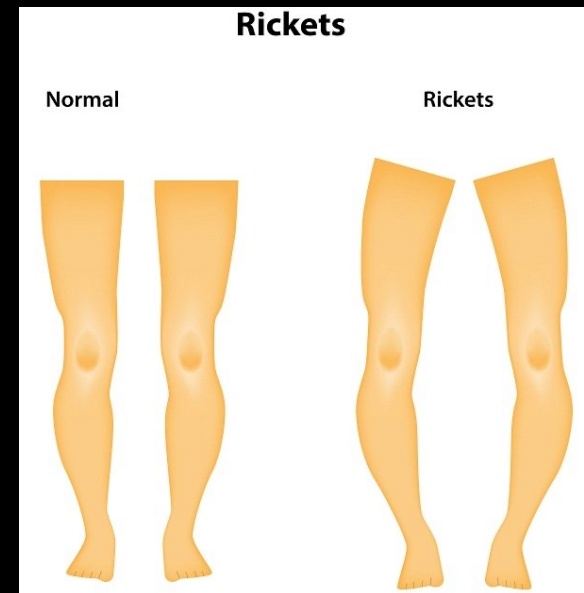
D Aka cholecalciferol

Obtained via diet or UV absorption (touch grass)

Liver and kidneys -> convert to calcitriol (active version of vit D)

Calcitriol -> inc. in calcium and phosphorus uptake + bone production

What endocrine hormone uses vit D?



Fat-Soluble Vitamins (xxx, ifykyk)

E

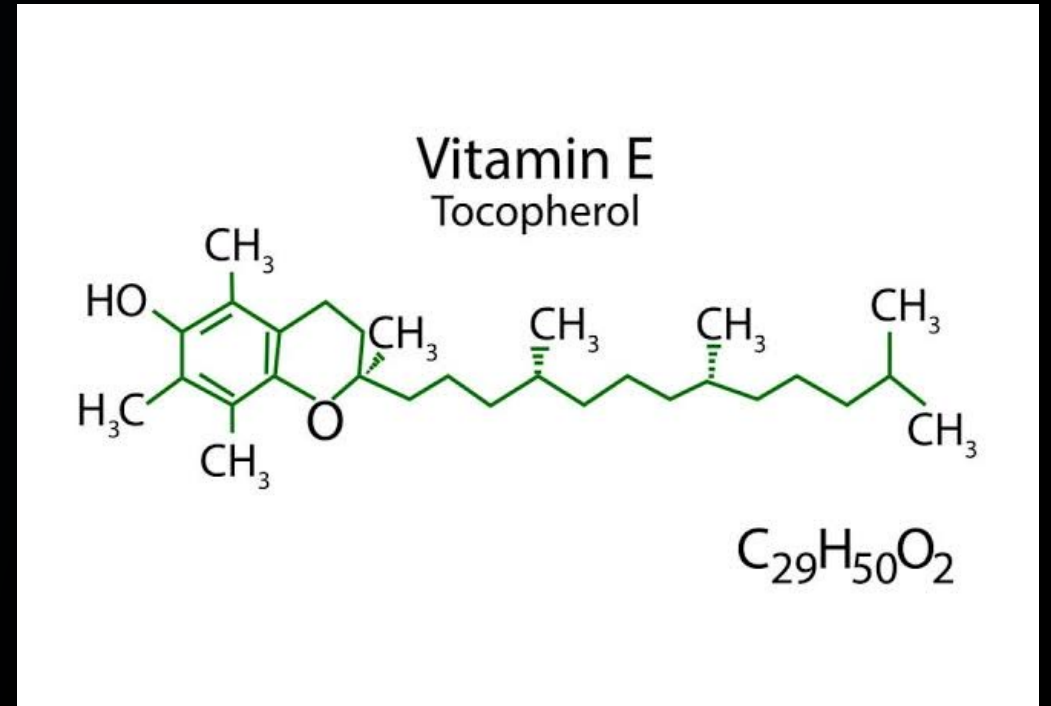
Aka tocopherols and tocotrienols

Hydrophobic (obv)

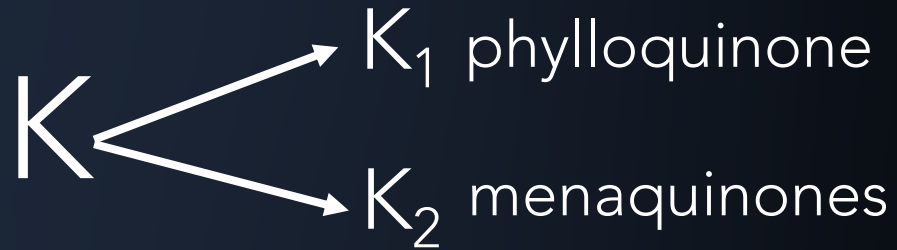
Aromatic ring + long isoprenoid side chain

Biological Antioxidants

Aromatic ring reacts w/ free radicals, destroying them



Fat-Soluble Vitamins (xxx, ifykyk)



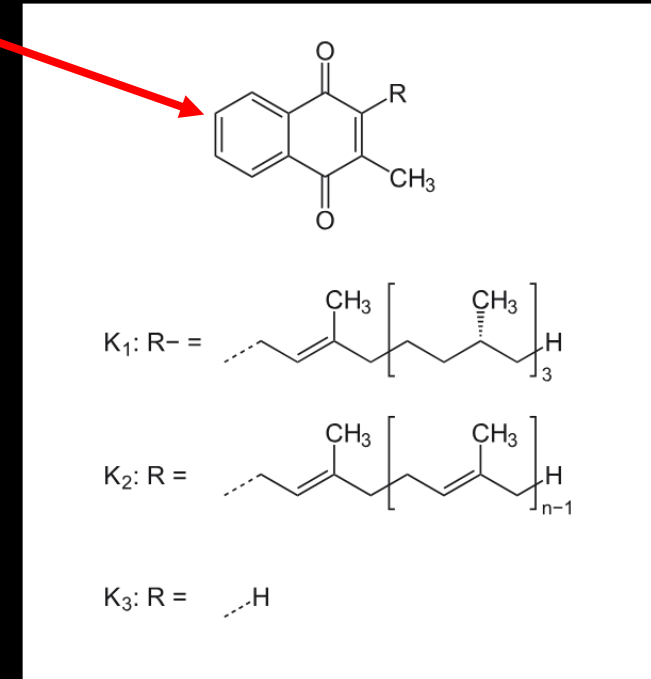
Used for

Necessary for the Post translational
modifications needed to make
prothrombin

Prothrombin – important clotting
factor for blood

Introduces calcium binding sites on
calcium dependent proteins

Aromatic ring allows for
Oxidation and reduction reactions



-IV-

Energy
stuff

