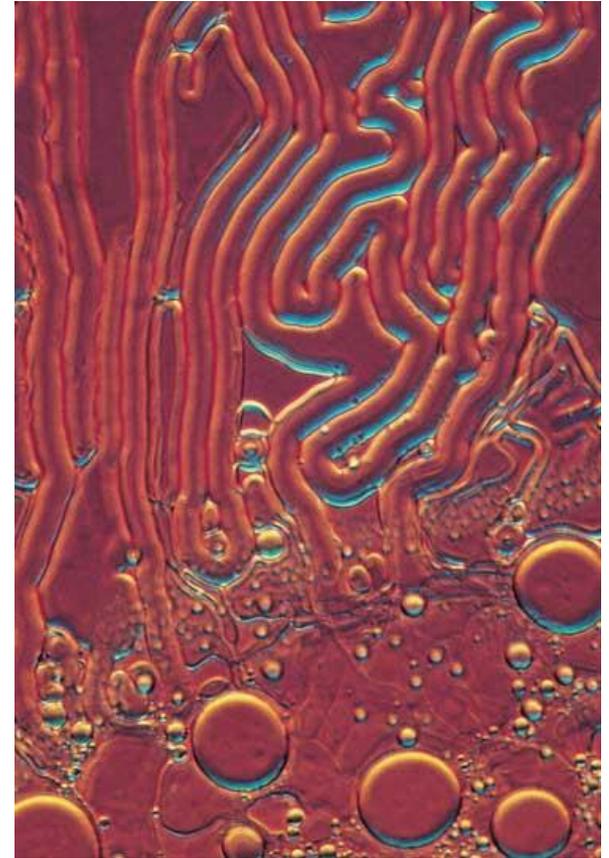
A microscopic view of numerous spherical lipid droplets of varying sizes, appearing as bright, reflective spheres against a lighter background. The droplets are densely packed in some areas and more sparse in others, creating a complex, textured appearance. The lighting highlights the smooth, curved surfaces of the droplets, giving them a three-dimensional quality.

Lipids

What Are Lipids?

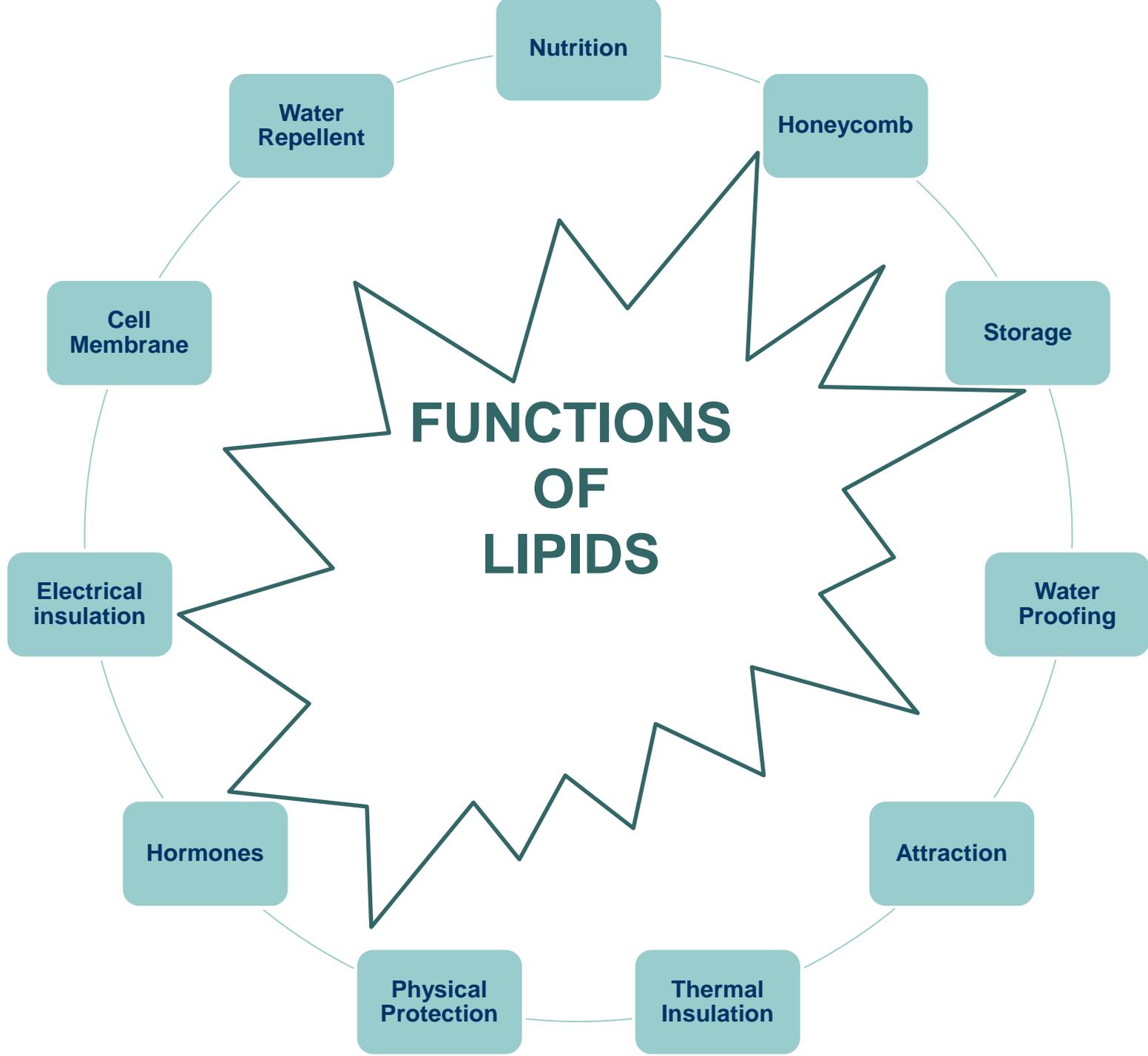
- All lipids contain large chains of nonpolar hydrocarbons (chains of carbon and hydrogen)
- Most lipids are therefore hydrophobic and water insoluble



What Are Lipids?

- Diverse in structure
- Do not form polymers





Types of Lipids

- Triglycerides
- Waxes
- Steroids
- Phospholipids

Triglycerides

- Fats and oils used for long-term energy storage
 - 38 KJ of energy per gram (2X carbs)
 - Slower to build up and break down than carbs

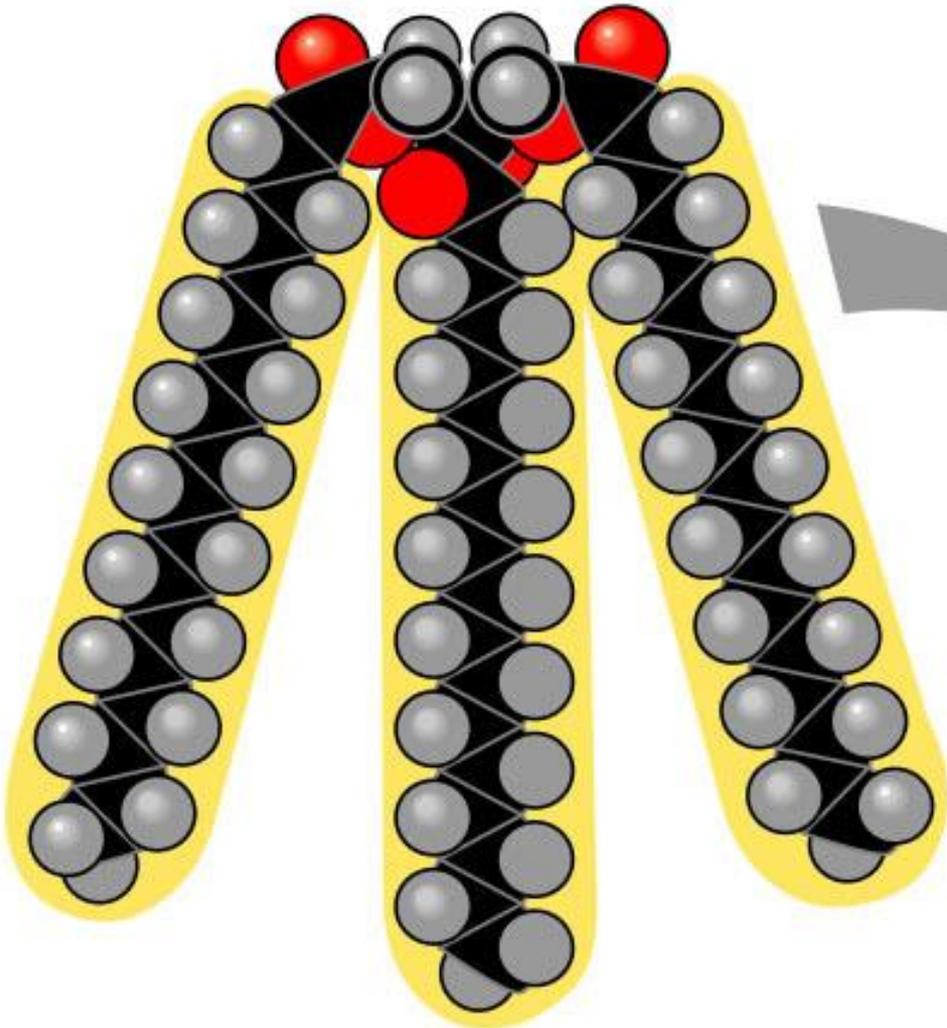


Fat

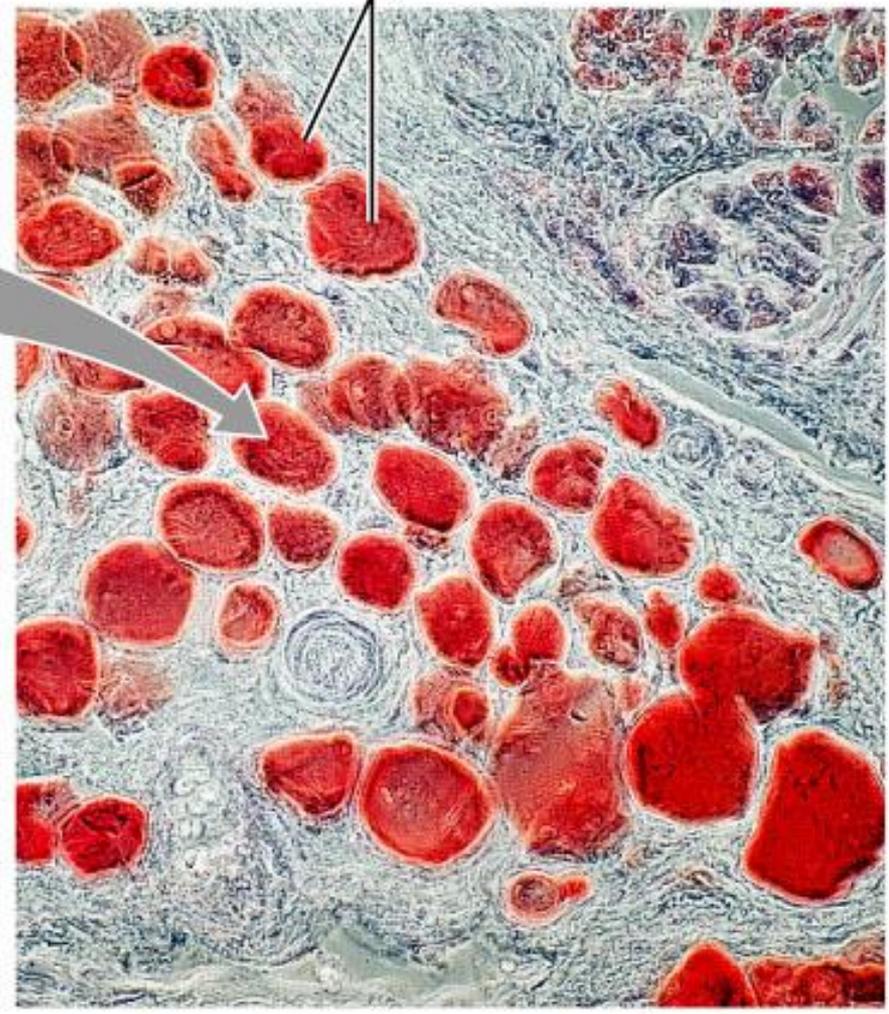
Figure 3-12a Biology: Life on Earth, 8/e
© 2008 Pearson Prentice Hall, Inc.







Fat droplets (stained red)



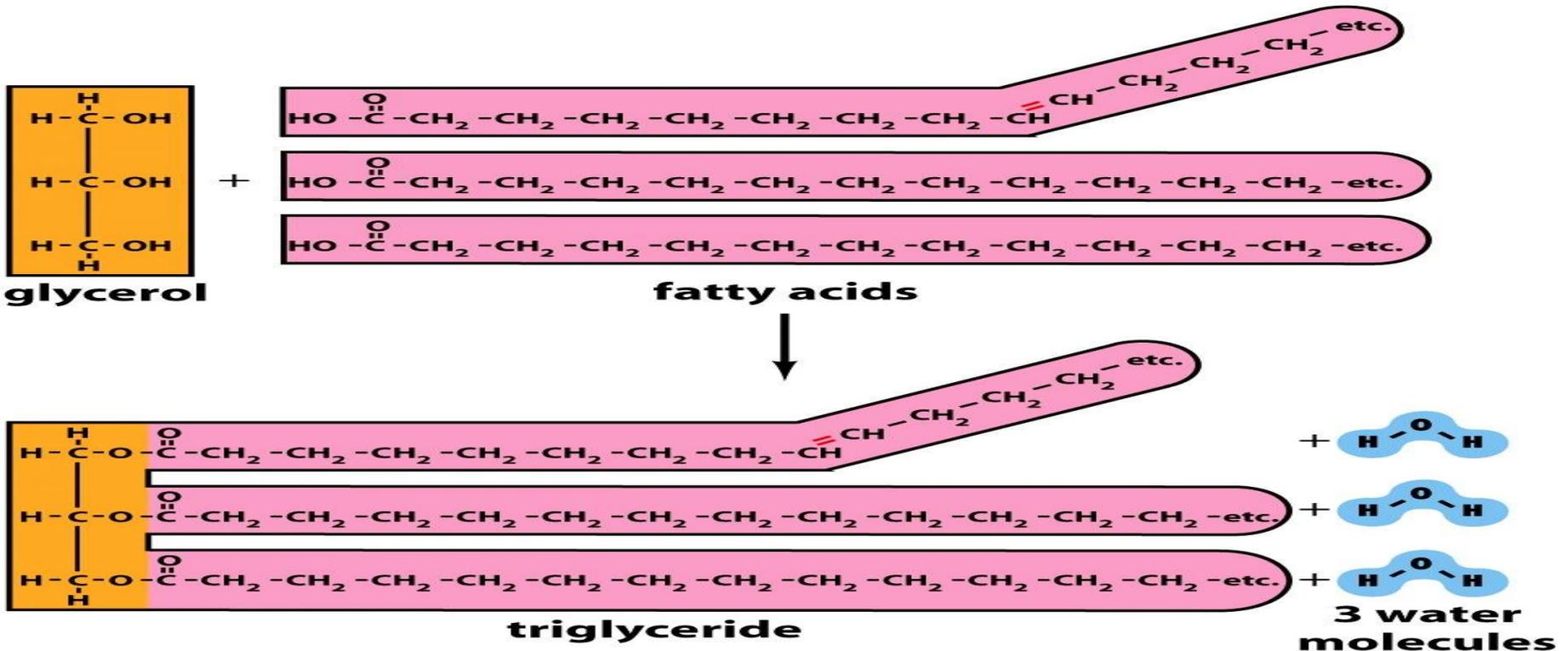
100 μm

(a) A fat molecule

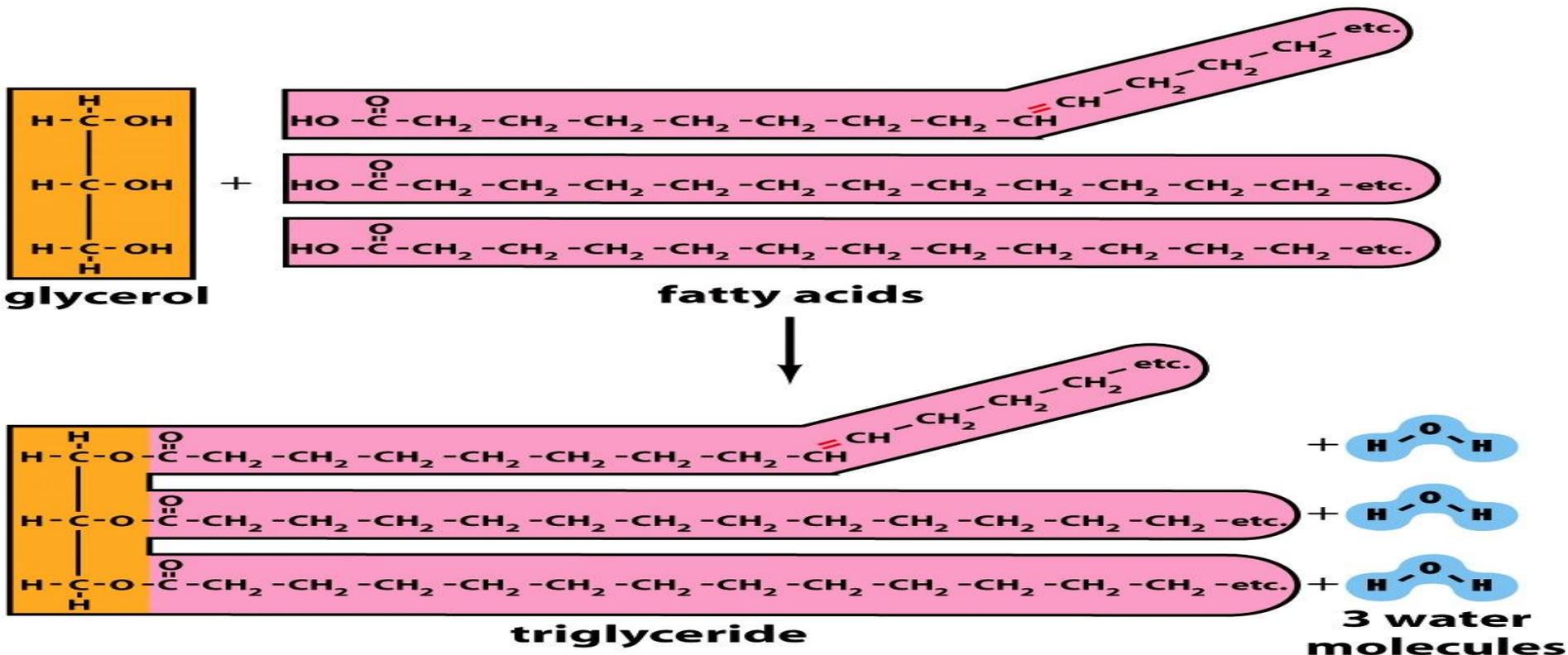
(b) Mammalian adipose cells

Triglycerides

- Formed by condensation reactions
 - 3 fatty acids + glycerol → triglyceride



Build a phospholipid using the paper models provided.
Tape/glue into your notes.



Go to the previous page in your notes to fill this out!

A fatty acid is a long chain of mostly carbon and hydrogen atoms with a COOH group (“carboxyl”) at one end.

Fatty Acid Structure

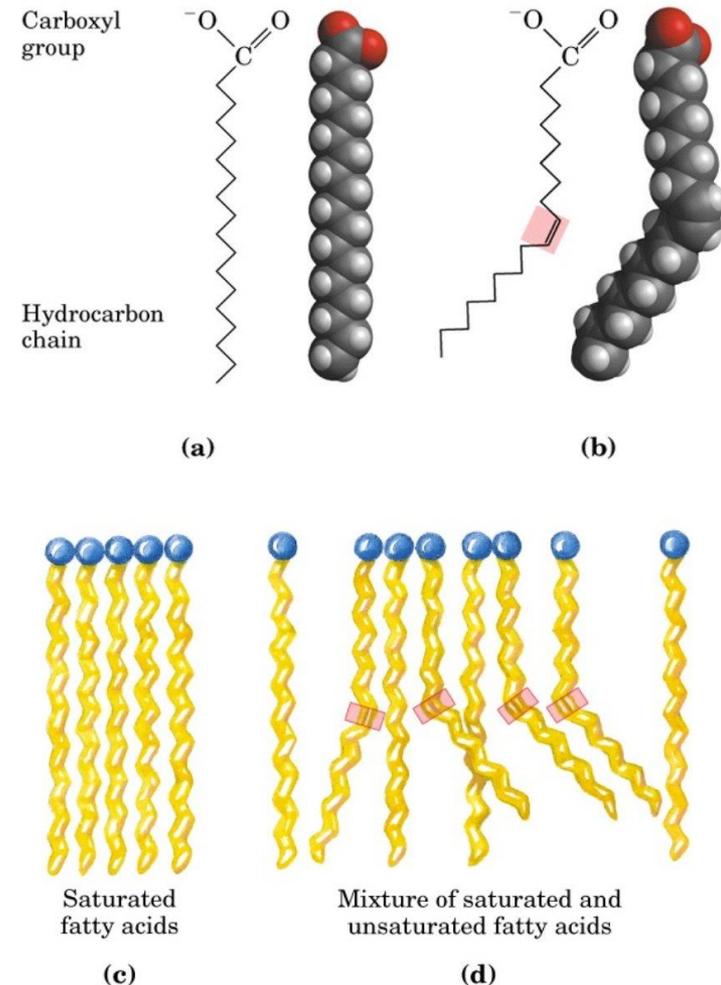
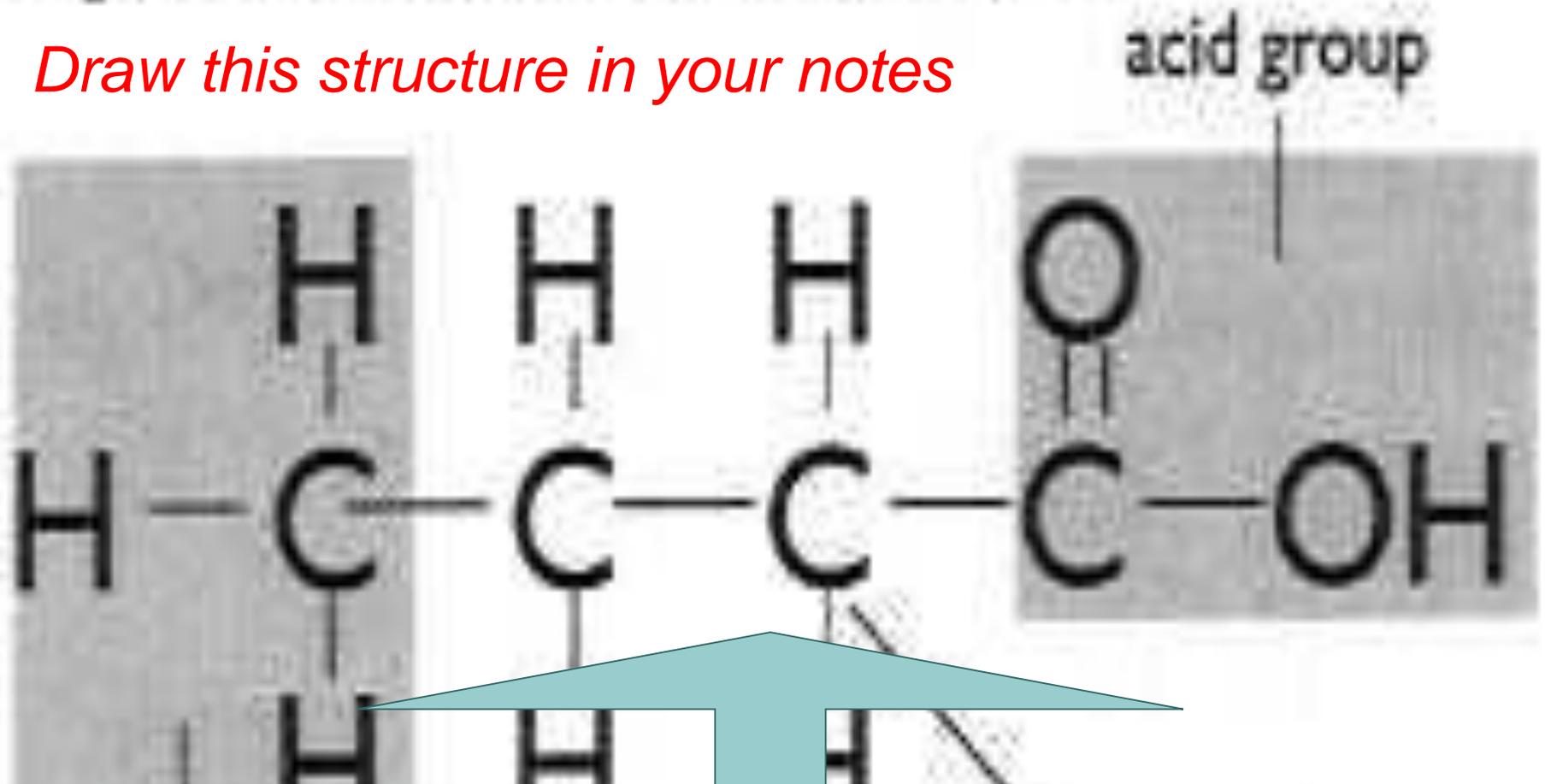


Figure 2. Structure of a fatty acid

Draw this structure in your notes



**The hydrocarbon chain can vary in length ...
from 4 to about 24 carbons long,
depending on the type of fatty acid.**

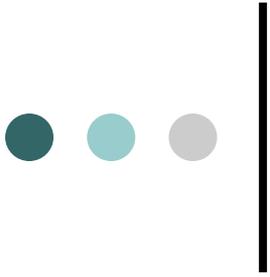
(in humans, 16 and 18 are the most common)

- ● ●

Build a 4 carbon fatty acid



Stamp when complete



Think...pair...share

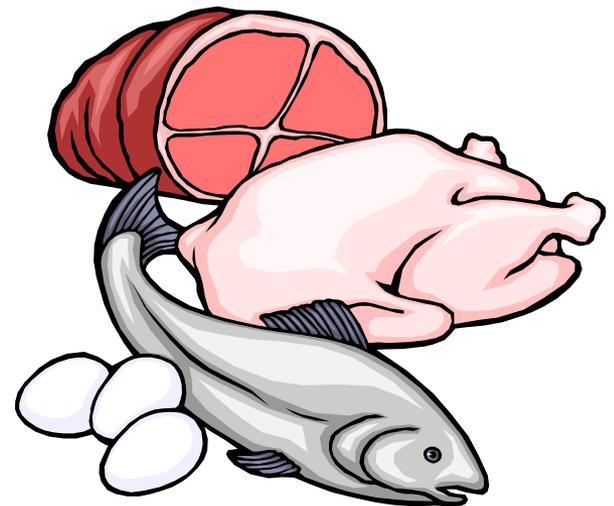
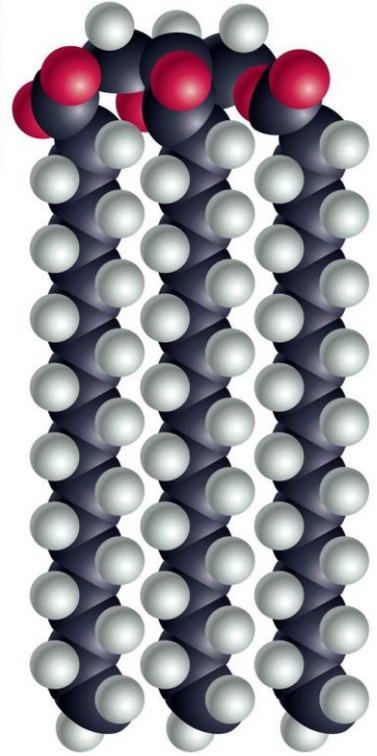
SATURATED VS. UNSATURATED

What do these words mean? When have you used them in other contexts?

Saturated Fatty Acids

- Have mostly single C-C bonds in the fatty acid chains
- Are typically solid at room temperature
- Are often from animal sources

Figure 3.13 Biology: Life on Earth, 8/e
© 2008 Pearson Prentice Hall, Inc.



Unsaturated Fatty Acids

- Have one or more C=C double bond in the fatty acid chain
- Are typically liquid at room temperature, because kinks in the tails prevent tight packing
- Are often from plant sources

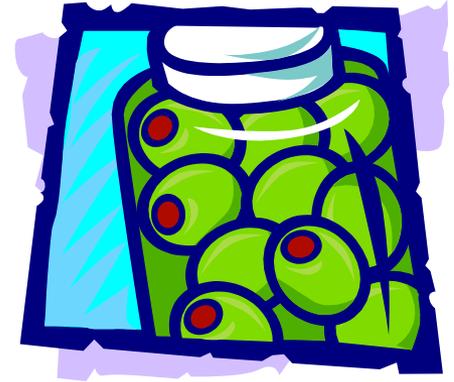
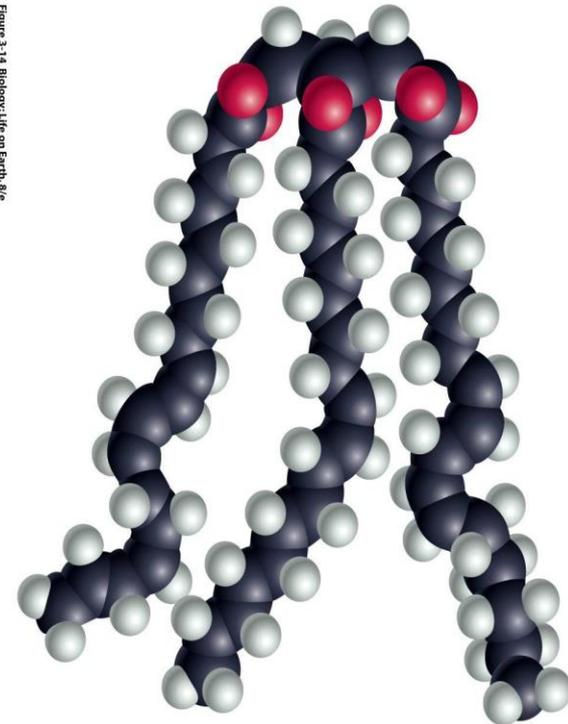
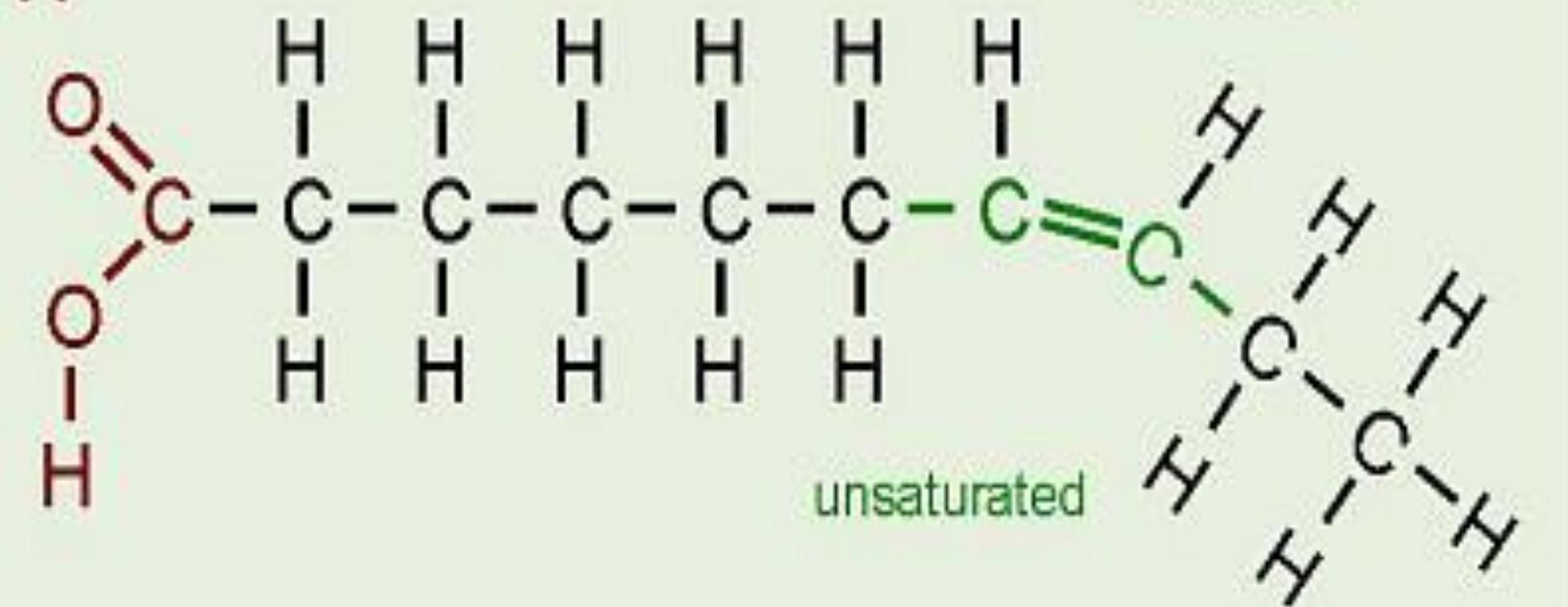
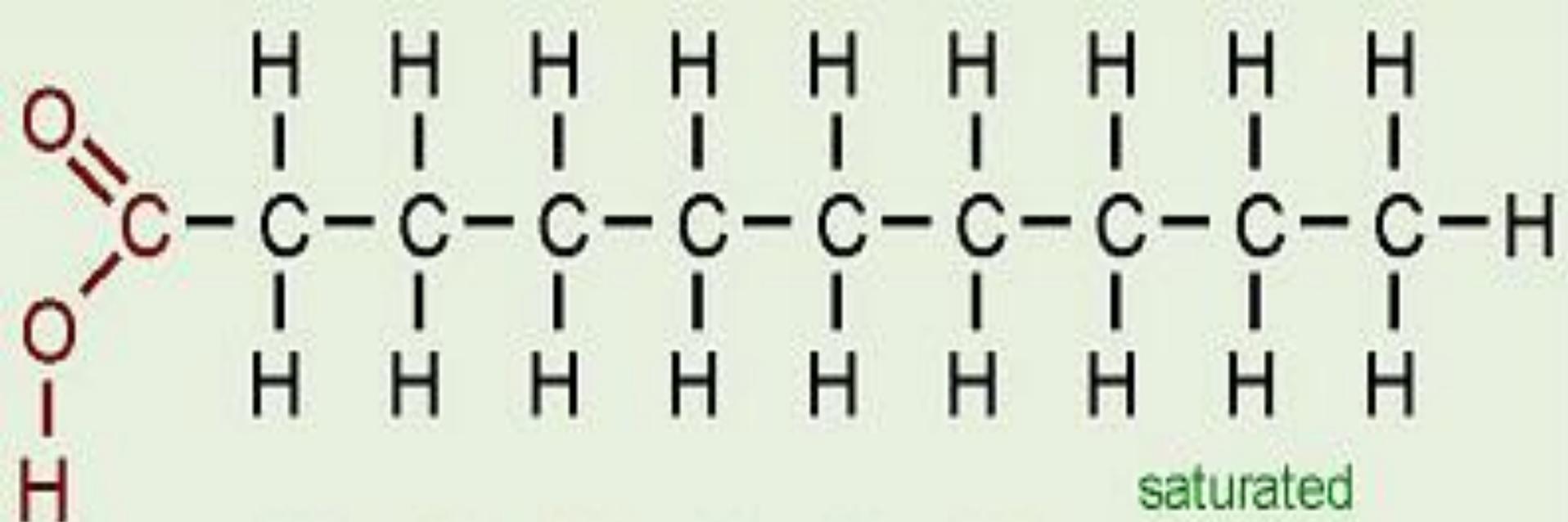
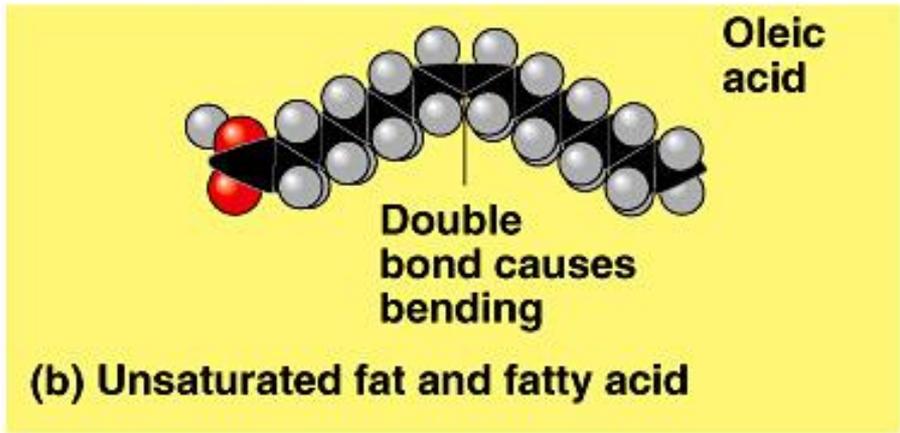
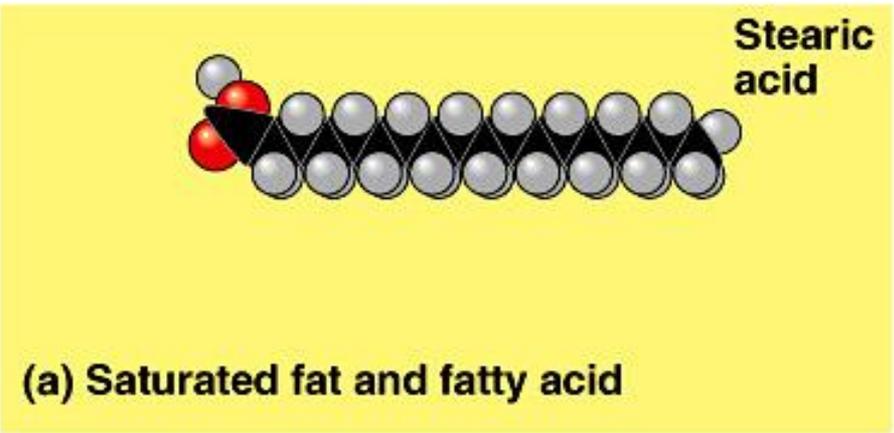


Figure 3-14 Biology: Life on Earth, 8/e
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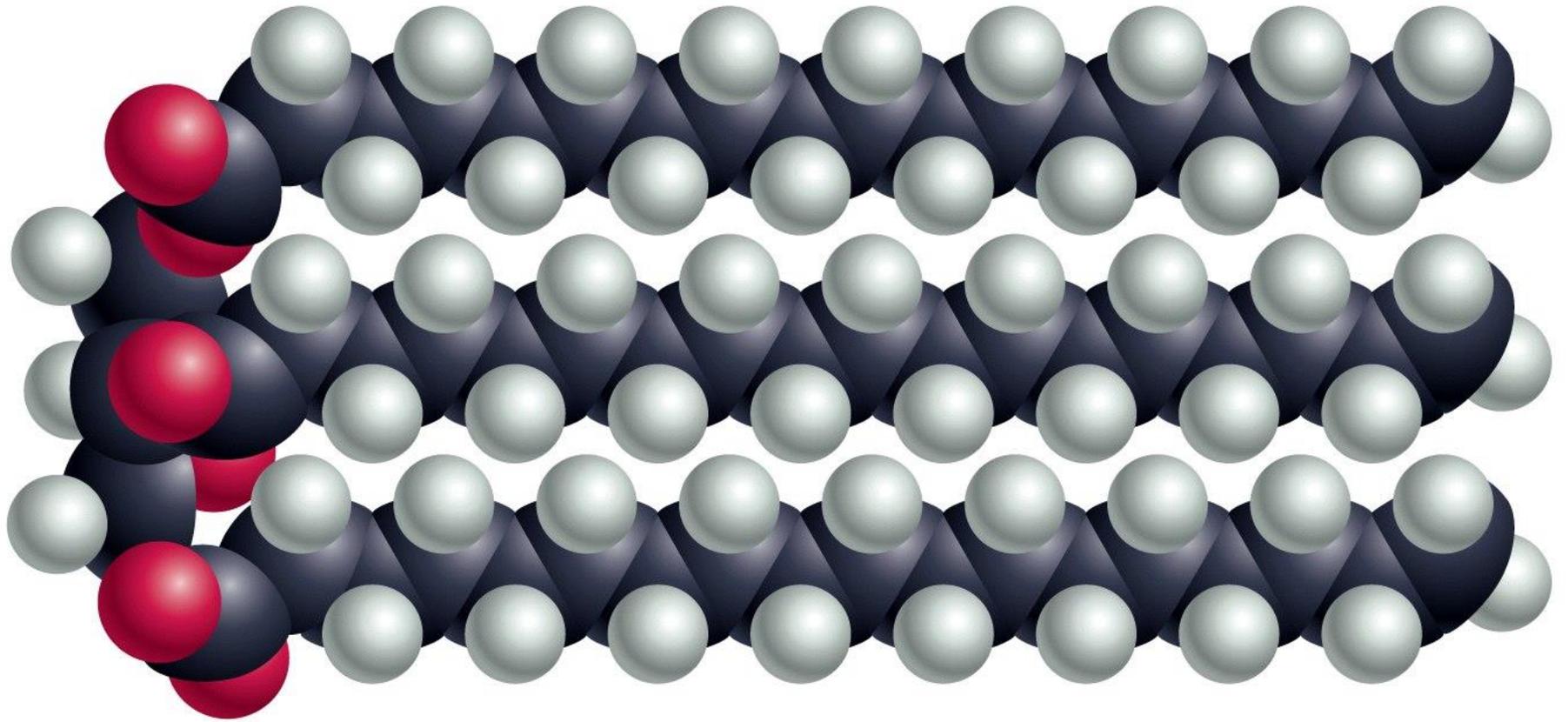


Figure 3-13 *Biology: Life on Earth, 8/e*
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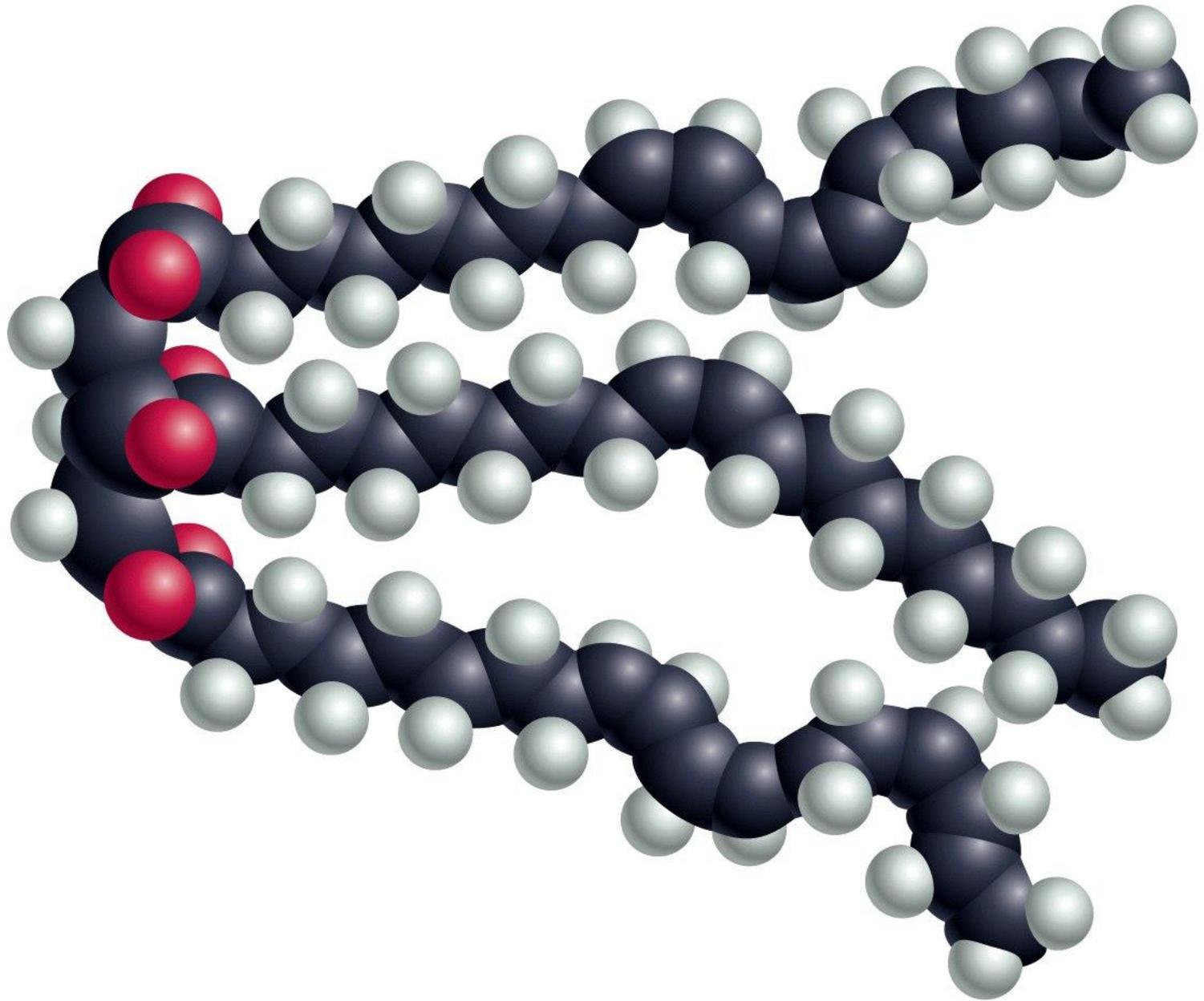


Figure 3-14 Biology: Life on Earth, 8/e
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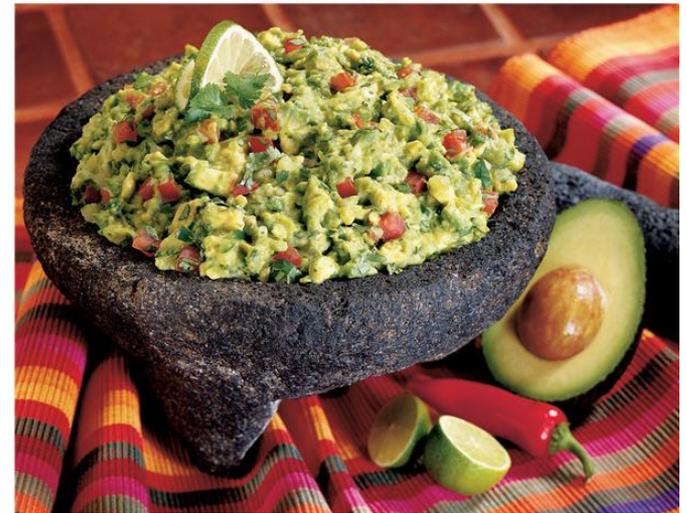


Peanut-butter can separate!

Is this peanut butter made up of more saturated or unsaturated fats? How can you tell?



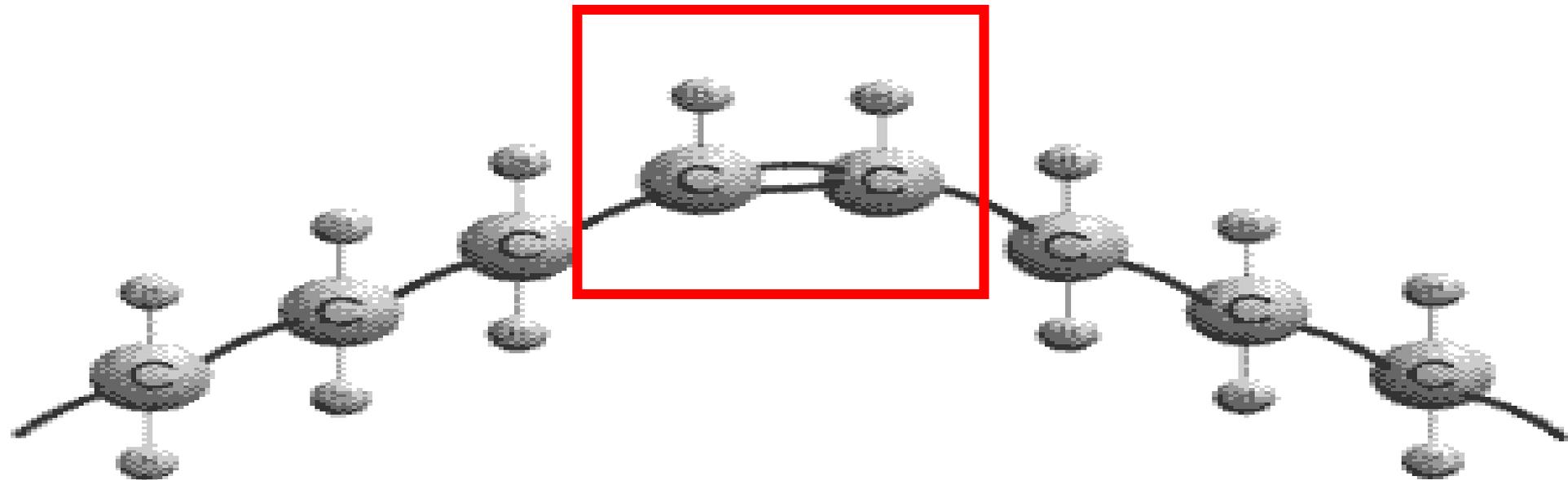
Fish oil would be an exception to the rule of unsaturated fats coming from only plant sources.



Avocados would be an exception to the rule of saturated fats coming from only animal sources.

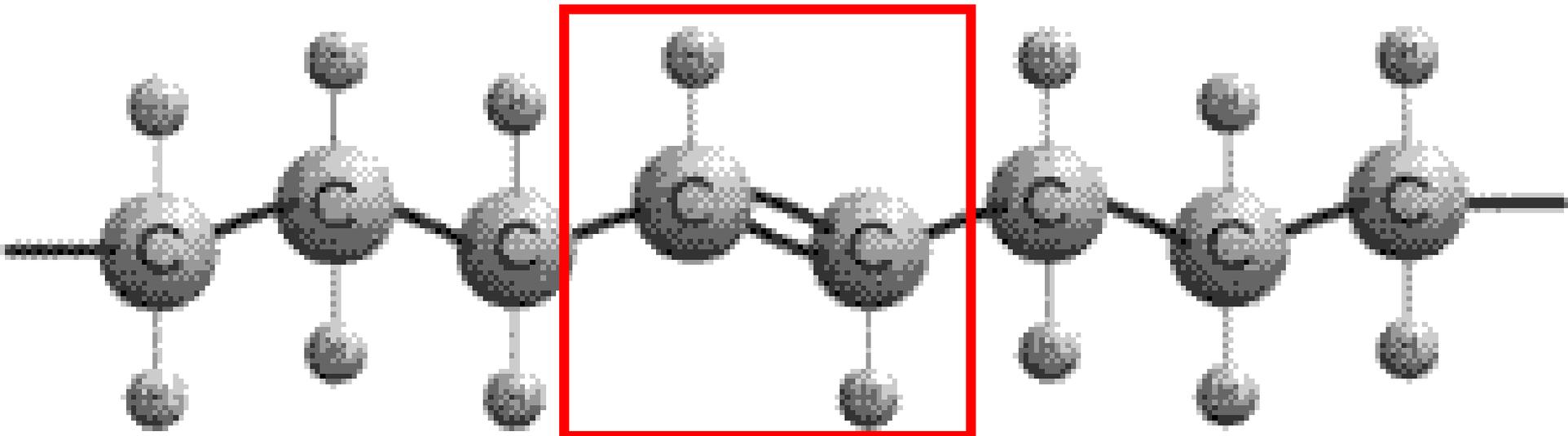
Cis-unsaturated fatty acids

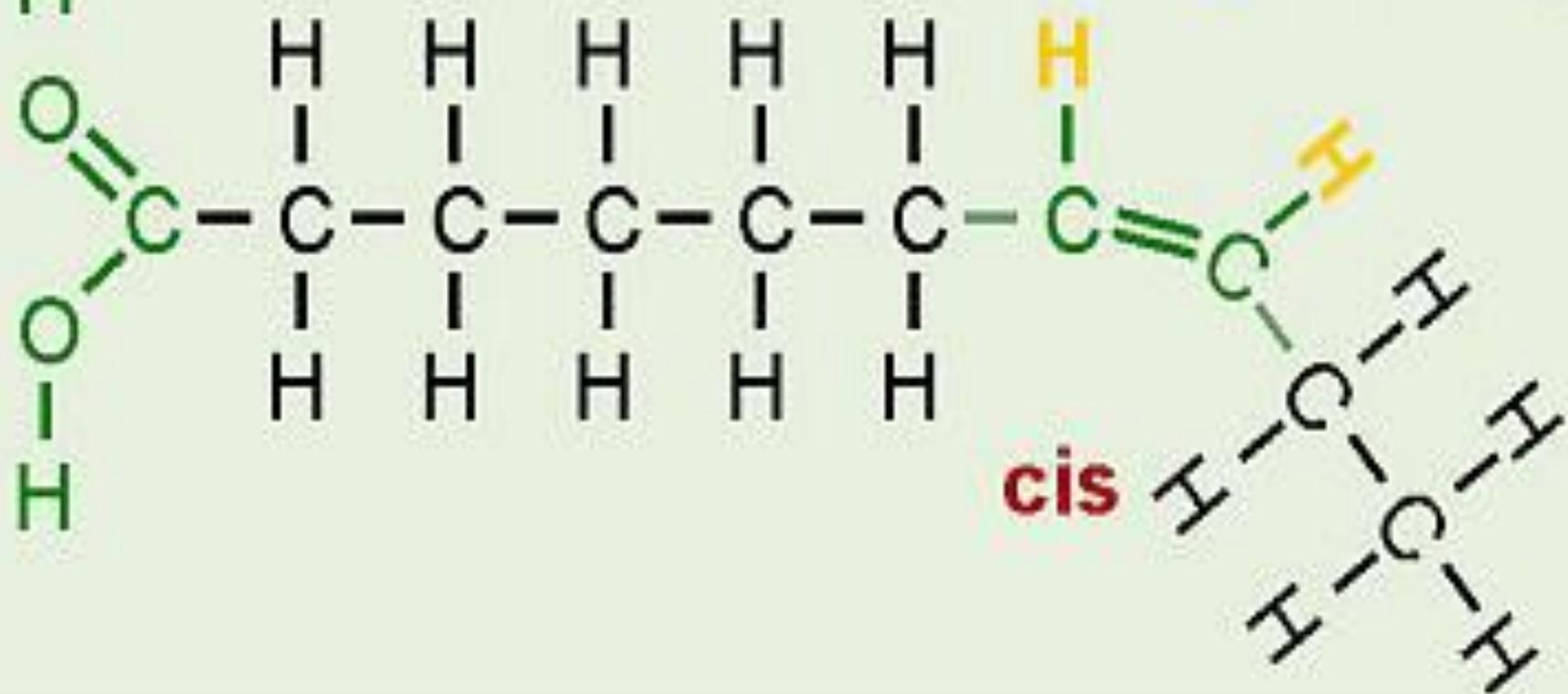
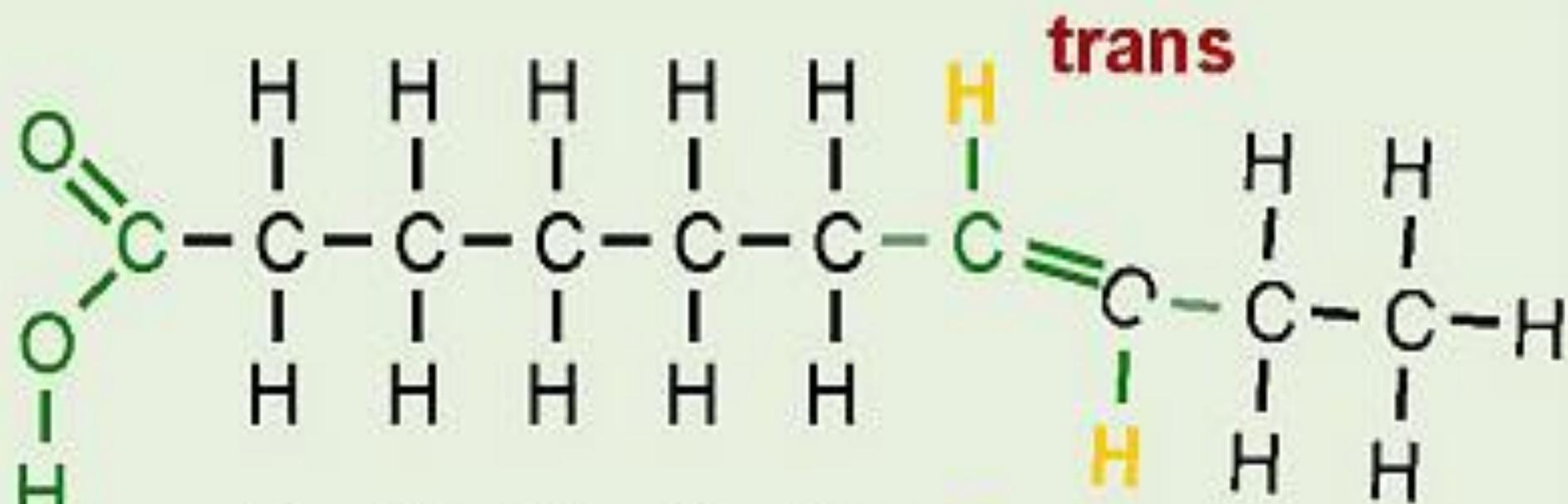
- Naturally occurring
- ***Cis*** is a Latin word meaning "on the same side"
- Causes a kink in the fatty acid chain

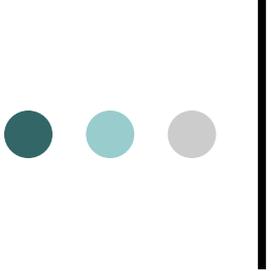


Trans-unsaturated fatty acids

- Are not found in nature and are the result of human processing
- **Trans** is a Latin word meaning "across", "on the opposite side"
- Causes a straight(er) fatty acid chain (even though it is unsaturated)







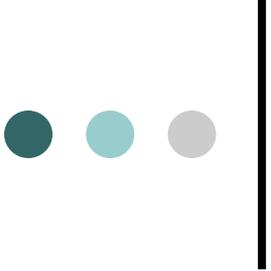
With a partner, build a triglyceride with:

1 saturated 4C fatty acid

1 cis-unsaturated 4C fatty acid

1 trans-unsaturated 4C fatty acid

Stamp when complete



Types of Lipids

- Triglycerides
- Waxes
- Steroids
- Phospholipids

Waxes

- Composed of long hydrocarbon chains and are strongly hydrophobic
- Highly saturated
- Solid at room temperature
- Form waterproof coatings





Leaves and stems of plants

Fur in mammals

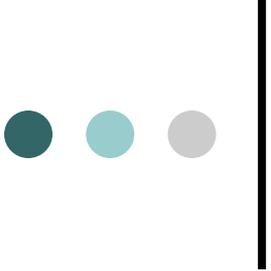




Insect exoskeletons



Wax



Types of Lipids

- Triglycerides
- Waxes
- Steroids
- Phospholipids

What is common amongst all these structures?

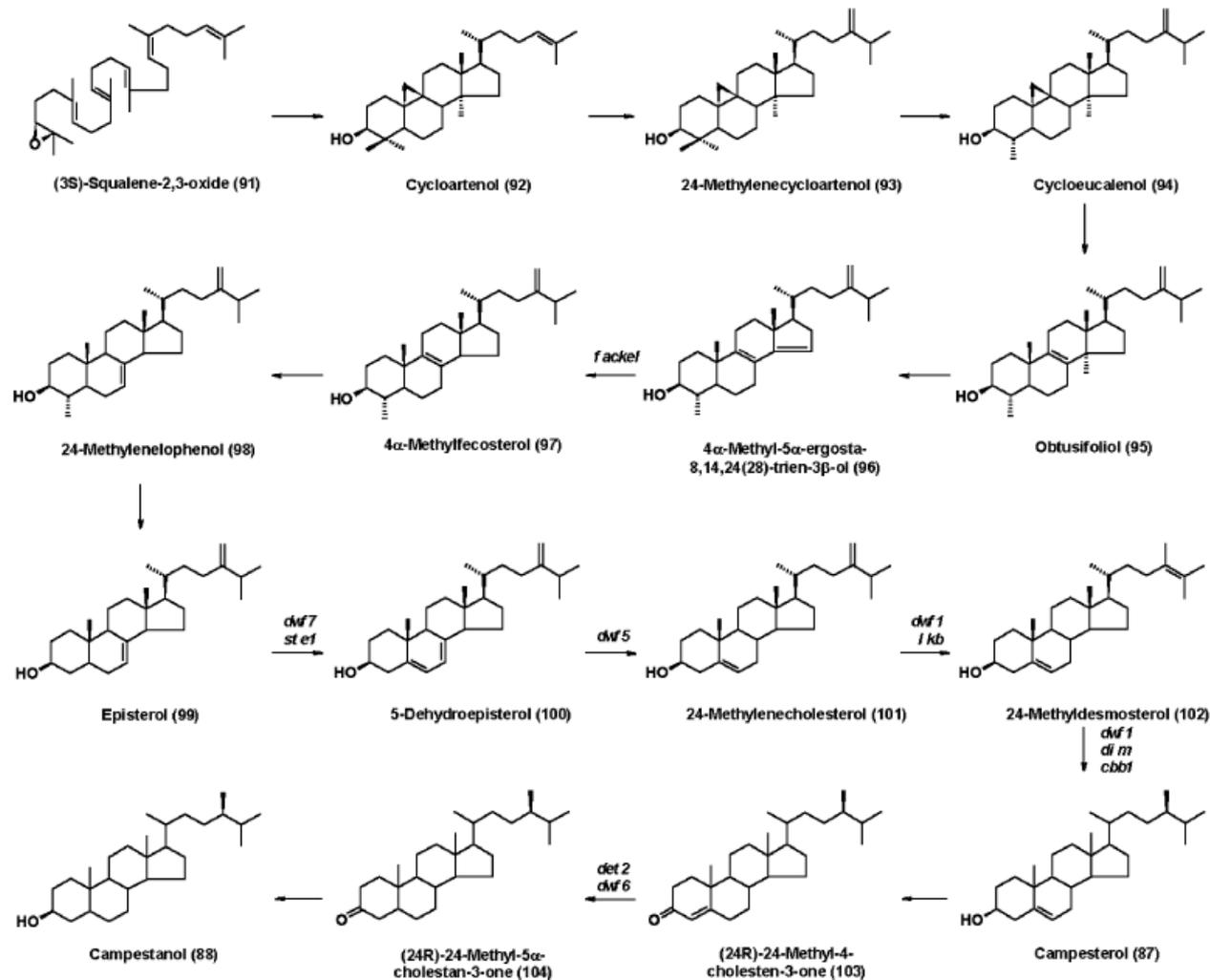
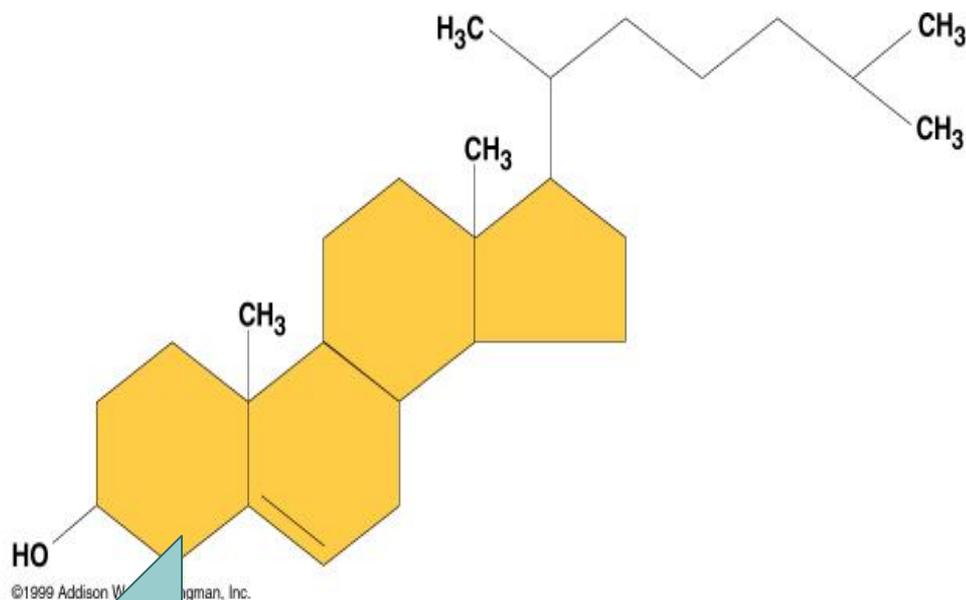


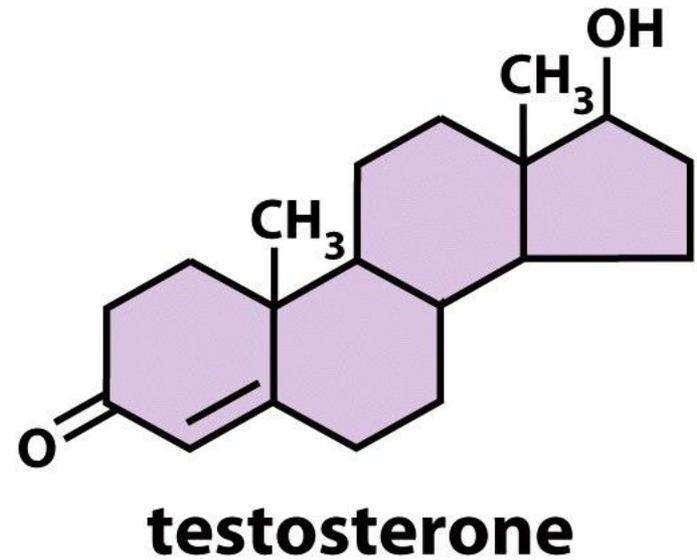
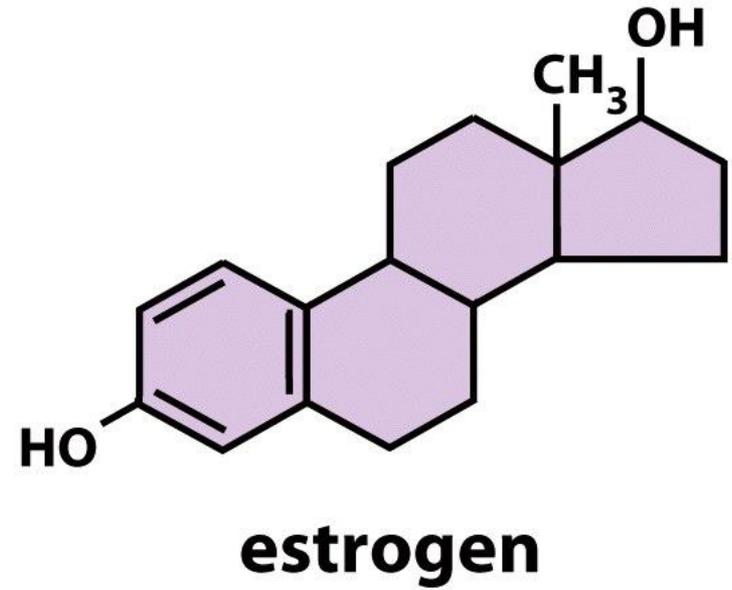
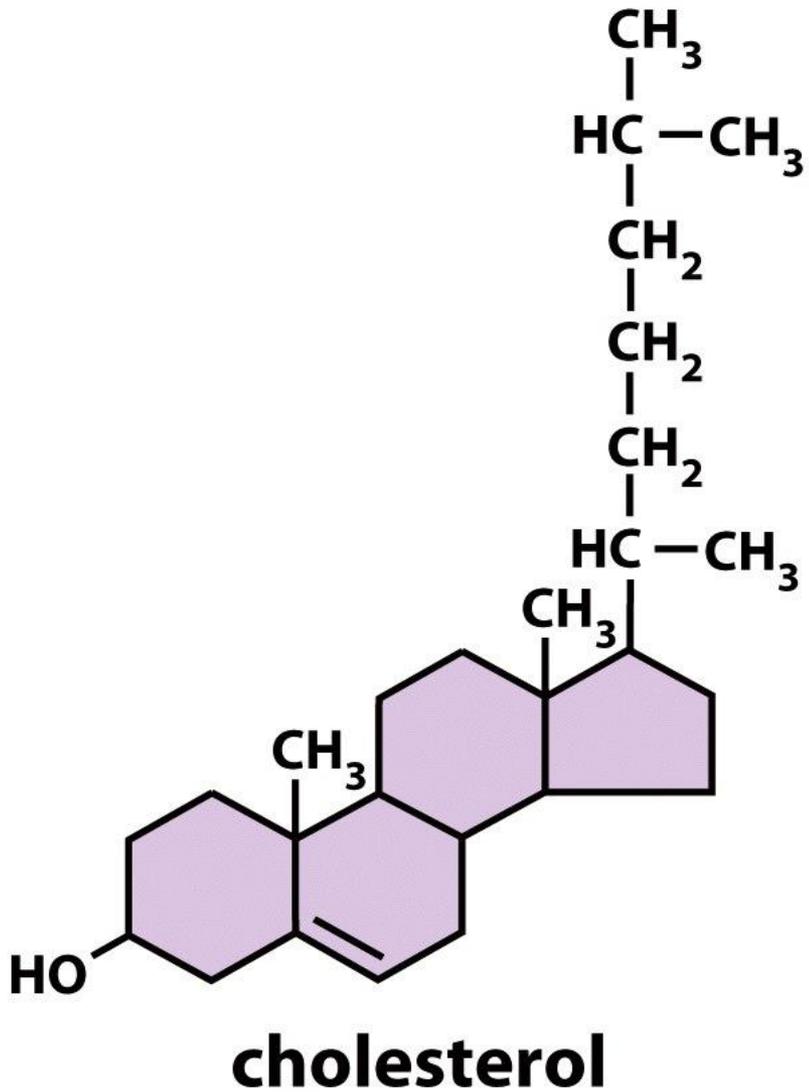
Figure 9. Biosynthesis of campestanol (88) from (3S)-squalene-2,3-oxide (91).

Sterols

- Have a backbone of four carbon rings
- different steroids created by attaching different functional groups to rings
- different structures create different function

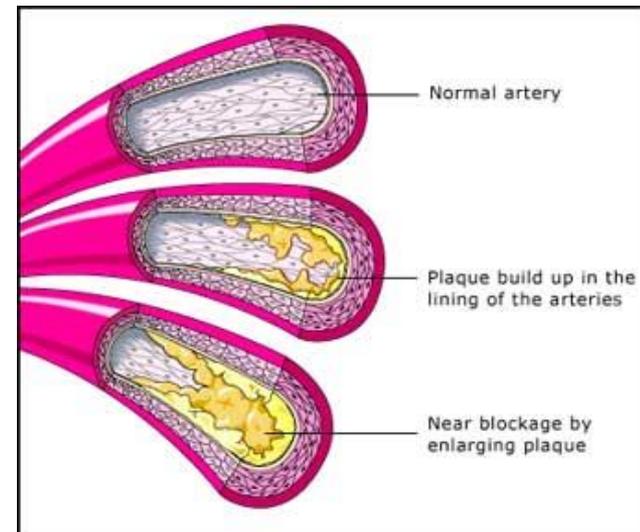
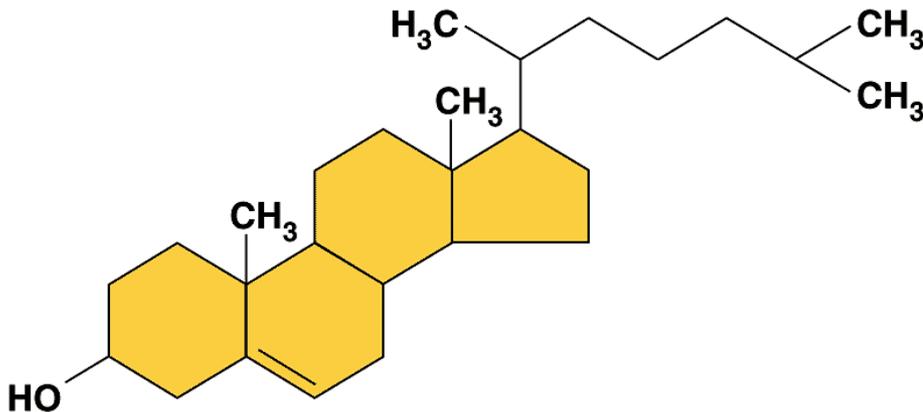


FIND AND REVIEW FUNCTIONAL GROUPS IN YOUR CARBON CHEMISTRY NOTES



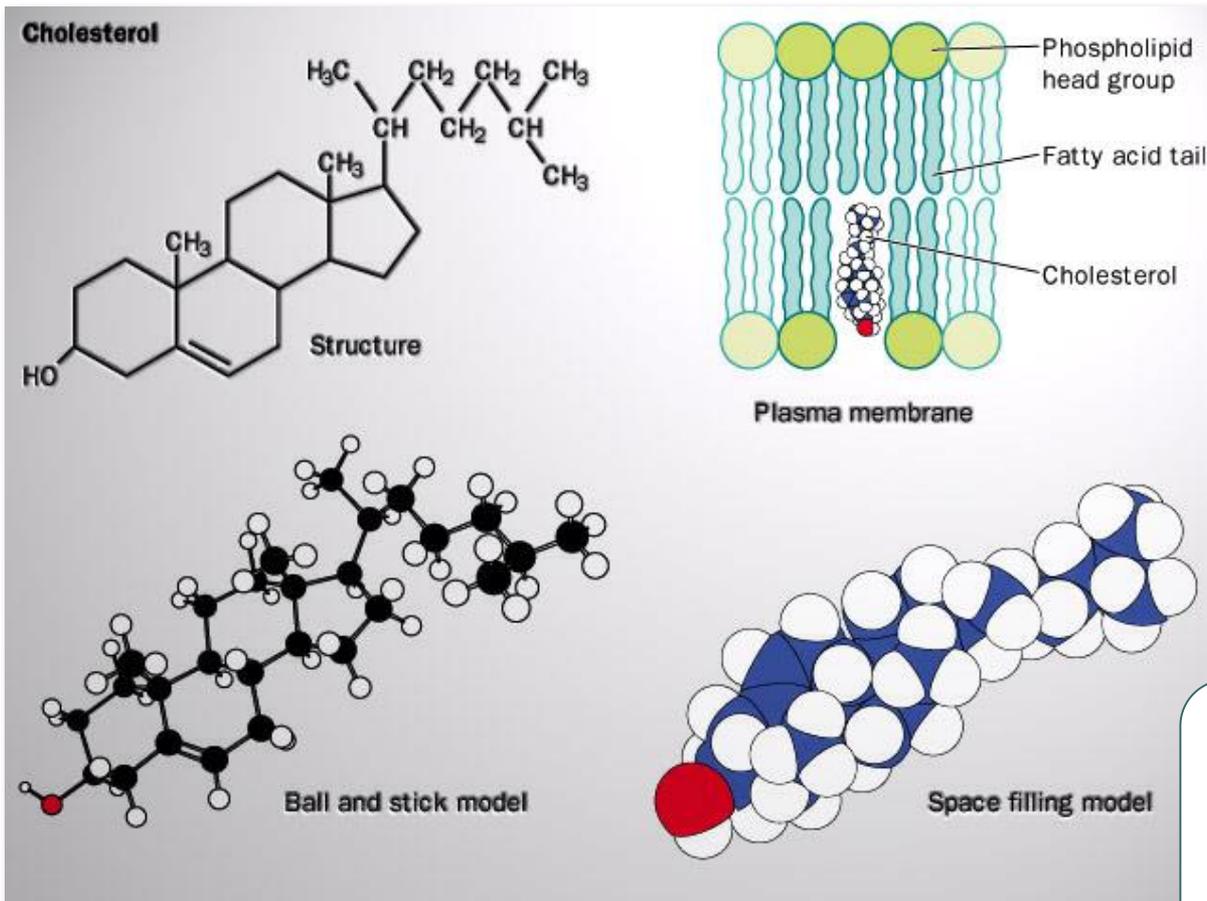
Cholesterol

- animal cell membranes
- precursor of all other steroids
 - including vertebrate sex hormones
- high levels in blood may contribute to cardiovascular disease



● Cholesterol

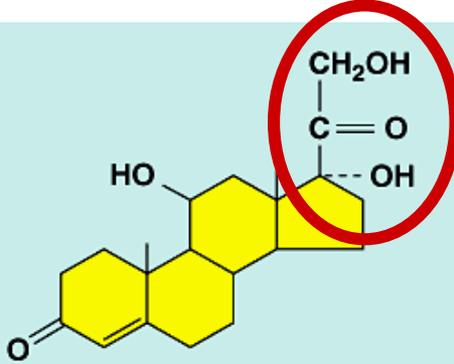
Important component of cell membrane



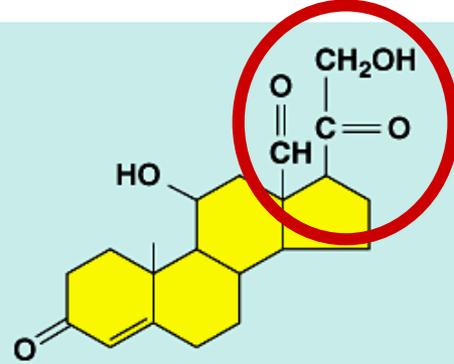
helps keep
cell membranes
fluid & flexible

From Cholesterol → Other Hormones

○ What a big difference a few atoms can make!

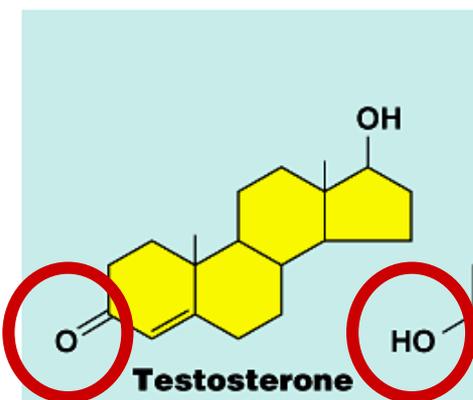


Cortisol
(a glucocorticoid)

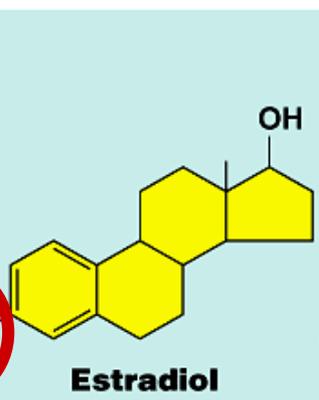


Aldosterone
(a mineralocorticoid)

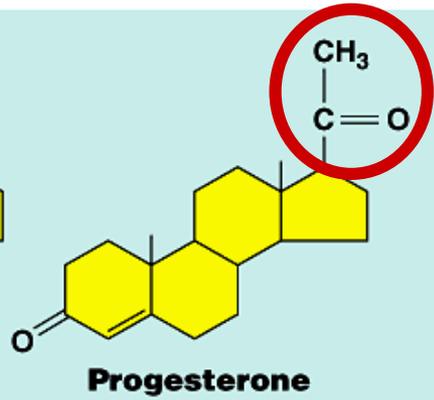
(a) Steroid hormones made in adrenal cortex



Testosterone
(an androgen)

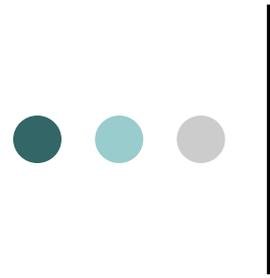


Estradiol
(an estrogen)



Progesterone
(a progestin)

(b) Steroid hormones made primarily in gonads



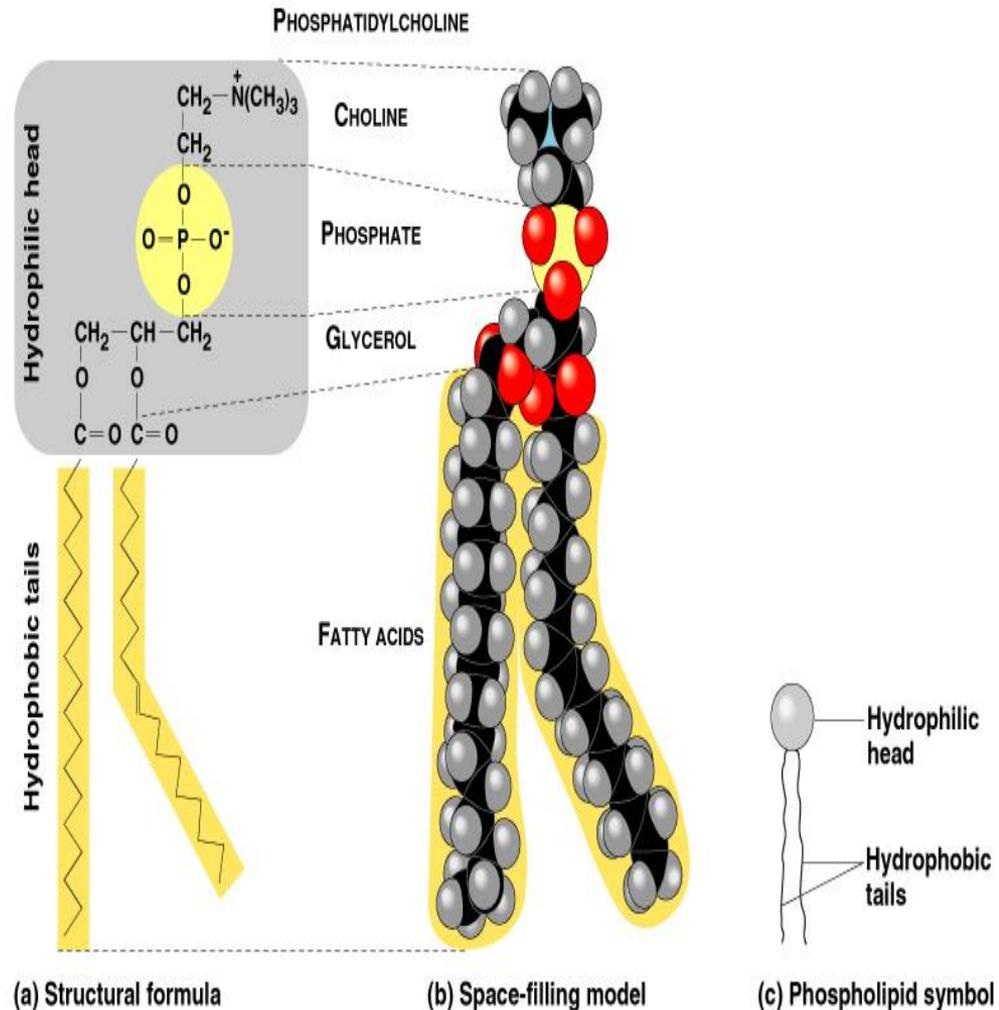
Types of Lipids

- Triglycerides
- Waxes
- Steroids
- Phospholipids

Phospholipids

Formed by attachment of two fatty acids plus a phosphate group to a glycerol.

Are the main structural components of membranes.



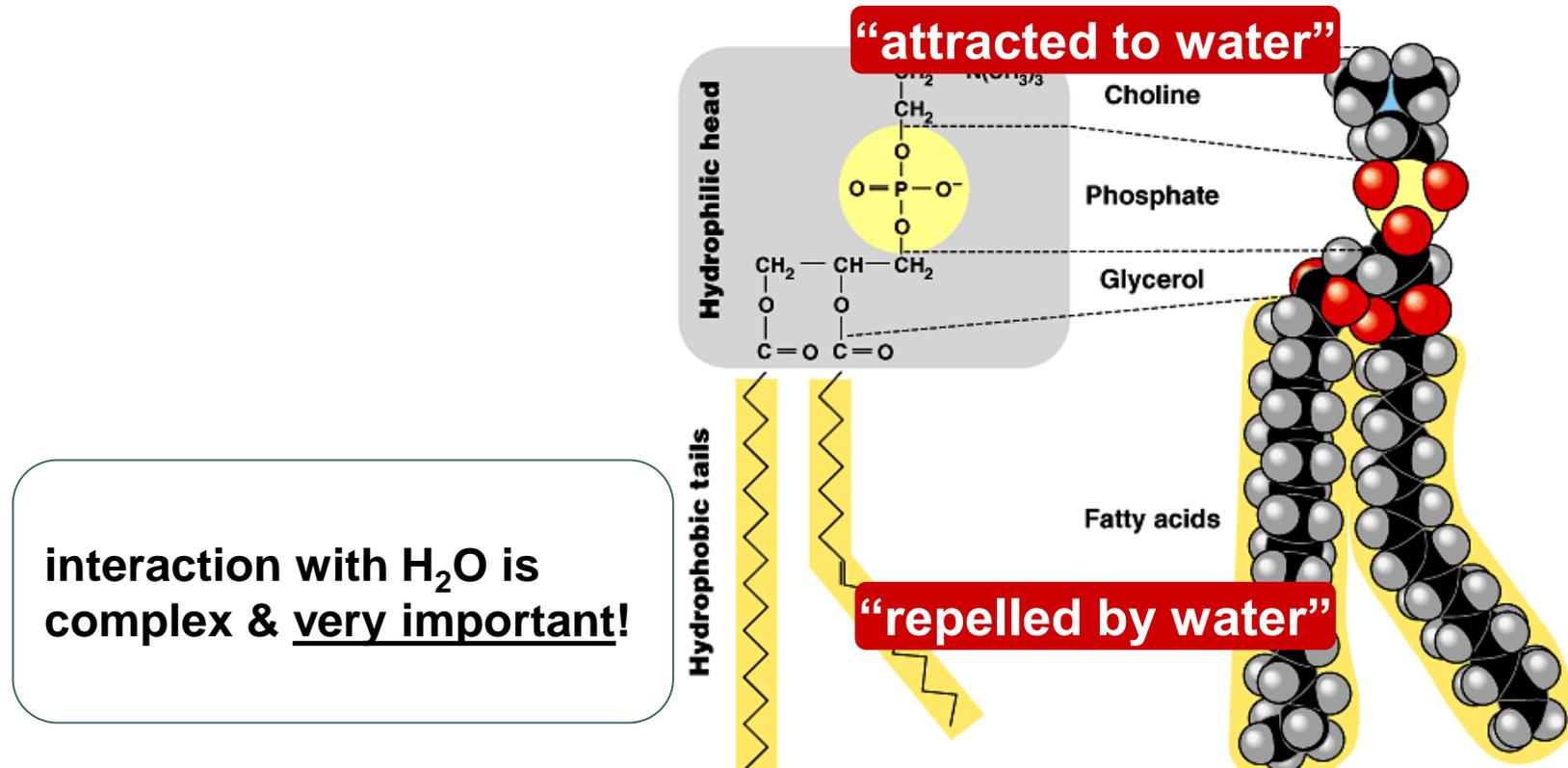
(a) Structural formula

(b) Space-filling model

(c) Phospholipid symbol

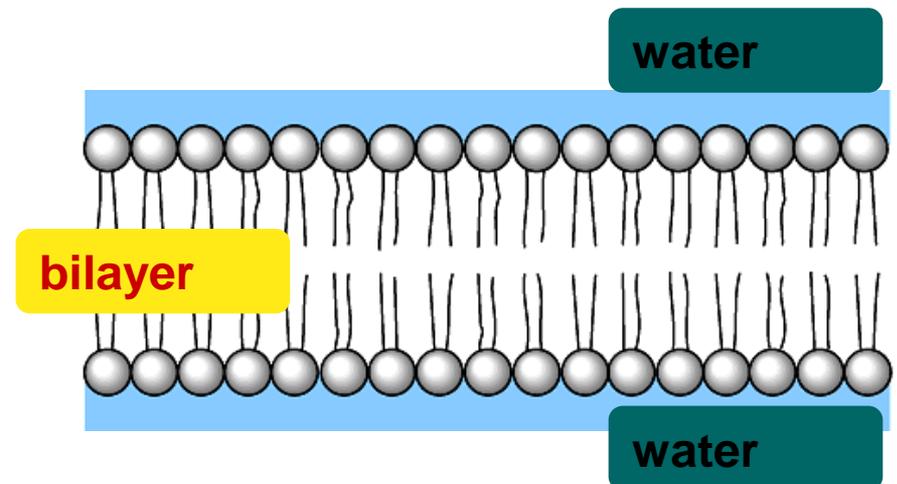
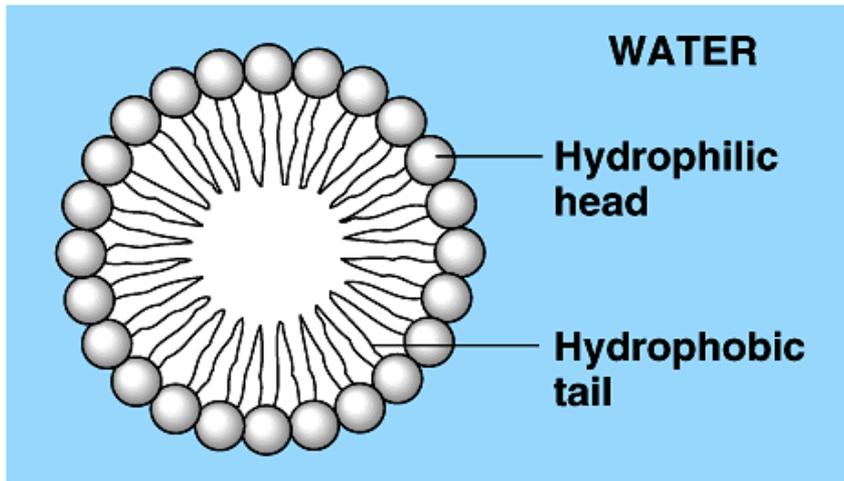
Phospholipids

- Hydrophobic AND hydrophilic
 - fatty acid tails = Hydrophobic “hide” from H₂O
 - PO₄ head = Hydrophilic “attracted” to H₂O



Phospholipids in water

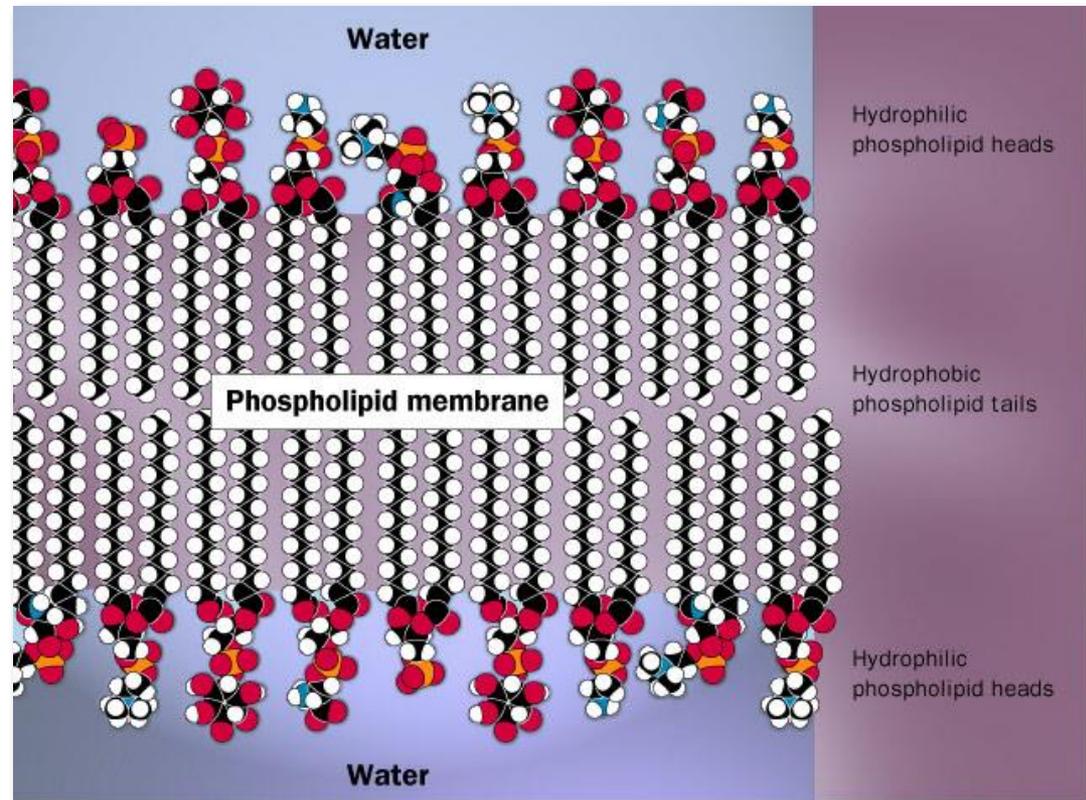
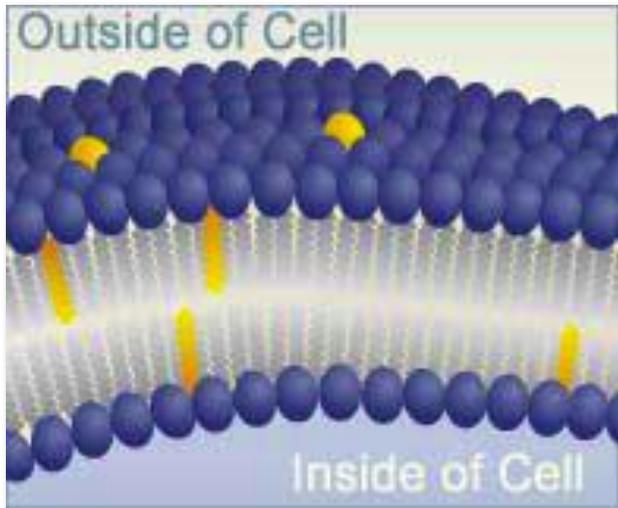
- can self-assemble into:
 - bubbles = “micelle”
 - can form a **bilayer**
 - early evolutionary stage of cells?



Why is this important?

- Phospholipids create a barrier in water
 - define outside vs. inside
 - they make cell membranes!

Life is “organized”

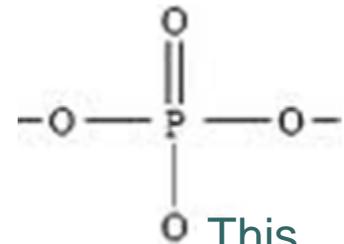


BUILD A PHOSPHOLIPID!

Connect two fatty acids to a glycerol.

Connect a phosphate group (PO_4) off the open 3rd carbon of glycerol.

(These are the cut-outs-
Tape in your notes)



This oxygen connects to the carbon