lipids

1. Like all lipids, a triglyceride is **insoluble in water** because it lacks many _______________ functional groups.

2. Triglycerides are made from two subunits:
   a single molecule of _______________
   plus three molecules of _______________

3. Lipids, which includes triglycerides, phospholipids and steroids, are used by the body for ______________, ______________, and ______________ (in addition to many other things).

   - Hydrophobic
   - Hydrophilic
   - Fatty acids
   - Glycerol
   - Amino acid
   - Glycogen
   - Long-term energy storage
   - Quick and ready source of energy
   - Storing genetic information
   - Making the cell membrane
   - Sending messages between different parts of the body through the blood
Figure 3.12 Synthesis and breakdown of fat

Dehydration synthesis reaction: 3 Fatty acids + Glycerol → Fat

Hydrolysis reaction: Fat → 3 Fatty acids + 3 Water
1. All lipids…

a) are made from glycerol and fatty acids.
b) contain nitrogen.
c) have low energy content.
d) are acidic when mixed with water.
e) do not dissolve well in water.
f) are hydrophilic.
2. Assuming the fluidity of fish oils is comparable when observed in their natural habitat conditions, then oils from arctic fish will have _______ than tropical fish oils.

a) more unsaturated fatty acids.
b) more cholesterol.
c) fewer unsaturated fatty acids.
d) more trans-unsaturated fatty acids.
e) more hydrogenated fatty acids.
3. A trans fatty acid is one
   a. that has no carbon-carbon double bonds directly adjacent to each other.
   b. that is a major component of phospholipids in cell membranes.
   c. in which the hydrogens attached to adjacent carbons in a carbon-carbon double covalent bond are on opposite sides of the molecule.
   d. in which the hydrogens attached to adjacent carbons in a carbon-carbon double covalent bond are on the same side of the molecule.
   e. that is saturated with hydrogens.
4. Types of polyunsaturated fatty acids that are necessary in the human diet because they cannot be synthesized by the body are called _____________ fatty acids.

a. essential

b. important

c. trans

d. omega-3

e. hydrophobic
5. Generations of Americans were introduced to trans fats in their diet in the form of ____________ which was hailed as a healthy alternative to the saturated fats found in butter and lard.

a. Coconut oil
b. Olive oil
c. Margarine
d. Canola oil
e. Beef tallow
7. A triglyceride is composed of glycerol and three fatty acids. What type of reaction is used to link each of the fatty acids to a glycerol molecule?

a. Dehydration
b. Hydrolysis
c. Dehydrohalogenation
d. Hydrogenation
e. Hydroxylation
8. Which one of the following would be solid at room temperature?
   a. Cis fatty acids
   b. Corn oil
   c. Peanut oil
   d. Saturated fats such as lard (pig fat)
   e. Unsaturated fats
9. Which one(s) of the following diagrams represents a trans fatty acid?
10. Which one(s) is a saturated fatty acid?

(a) (b) 

(c) (d) 

(e) None of the above
11. Food companies can tag their products on the nutrition label as having 0g of trans fats if they have <0.5g of trans fat per serving. What could be found in the ingredients list that is probably a better indicator of the presence of trans fats in foods than the trans fat line on the nutrition label?

a. Lard
b. Hydrogenated oils
c. Palm oil
d. Olive oil
e. Almonds
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Extra Credit

1. **Explain** one negative health effect associated with eating foods that contain trans fat.

   Restriction:
   You must get your answer from the Harvard School of Public Health website on the Unit 1 reading list.

2. Identify **three** foods you’ve eaten in the past week that have trans fat added to them. If you are already health-conscious and avoid trans fat, list three foods you avoid because of their trans fat.

   *Do not include natural foods that contain trace amounts of natural trans fat, such as beef and dairy.*

   *You must list the name of the food and the ingredient present that is the source of the trans fat*

   ...and again, from Harvard School of Public Health website listed on the Unit 1 reading list:

3. **Describe** one positive health effect of eating omega-3-fatty acids.

4. Identify three **whole foods** (*not pills or spreads*) that contain omega-3-fatty acids that you would realistically eat.
Figure 3.14
Phospholipids from membranes

- **a. Phospholipid structure**
  - Polar head
  - Phosphate group
  - Glycerol
  - Fatty acids

- **b. Plasma membrane of a cell**
  - Inside of cell
  - Outside of cell
Lipids, part 2

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Review last time: Gameshow
Saturated or unsaturated?
straight or bent?
stacks well or not stack well ?.
solid or liquid?
Saturated vs. unsaturated
straight vs. bent
stacks well vs. not stack well
solid vs. liquid
Match structure on left with item on right

saturated

Unsaturated
(poly or mono?)
Saturated vs unsaturated
Match structure on left with item on right
Match structure on left with item on right

- Structure 1: [Chemical structure]
- Structure 2: [Chemical structure]
- Structure 3: [Chemical structure]
- Item 1: [Image of butter]
- Item 2: [Image of beef]
- Item 3: [Image of chips]
Vitamin D is a hormone that signals intestine cells to make the protein ion channels and pumps that allow absorption of calcium (and phosphate) from diet. Vitamin D deficiency results in rickets - osteomalacia.

Cholesterol and its many uses:
Vitamin D is a hormone that signals intestine cells to make the protein ion channels and pumps that allow absorption of calcium (and phosphate) from diet. Vitamin D deficiency results in rickets - osteomalacia. Rickets is among the most frequent childhood diseases in many developing countries suffering from severe malnutrition, usually resulting from famine or starvation.

What is Vitamin D?
How does it work?
Where does it come from?

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Why do people with darker skin need more sunlight to make Vitamin D?
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People with darker skin need more sunlight to make Vitamin D! Isn’t this bad? Where did people with dark/light skin live 200,000 years ago?
It is increasingly common for people in the US to have “light therapy” to increase Vitamin D levels...

Is this because we have a problem with *too little* cholesterol?
Cholesterol and its many uses

Cell membranes

Used to make other things:
- **Sex steroids** (hormones)
- **Corticosteroids** (hormones):
  - Mineralocorticoids: control electrolyte and water levels
  - Glucocorticoids: Immune system; Inflammation; carbohydrate, fat and protein metabolism

- **Bile**: fat absorption

- **Vitamin D** (a hormone)
Cholesterol and its many uses:

Cholesterol reduces membrane fluidity at moderate temperatures (helps hold phospholipids together), but at low temperatures hinders solidification (prevents tight packing).

Is there cholesterol in *animal* cell membranes?  
Hint: animals have no cell wall

What about plants...would you expect a lot of cholesterol in *plant* cell membranes?  
Hint: plants do have cell wall
Figure 7.5

(a) Unsaturated versus saturated hydrocarbon tails

**Fluid**
Unsaturated tails prevent packing.

**Viscous**
Saturated tails pack together.

(b) Cholesterol within the animal cell membrane

Cholesterol reduces membrane fluidity at moderate temperatures, (helps hold phospholipids together) but at low temperatures hinders solidification (prevents tight packing).
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Glucocorticoids: Immune system; Inflammation; carbohydrate, fat and protein metabolism

Bile: fat absorption

Vitamin D (a hormone)
Corticosteroids (hormones):

Mineralocorticoids:
control electrolyte and water levels (blood osmolarity)

Glucocorticoids:
Immune system;
Inflammation;
carbohydrate, fat and protein metabolism

Made in the adrenal cortex - part of the adrenal gland (above kidney)
Cholesterol and its many uses

Cell membranes

Used to make other things:

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- **Corticosteroids** (hormones):
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  - *Glucocorticoids:* Immune system; Inflammation; carbohydrate, fat and protein metabolism

- **Bile:** fat absorption

- **Vitamin D** (a hormone)
Cholesterol and its many uses:

Cholesterol used to make

**Bile**: fat absorption

chlesterol

Bile acid: (-) charged

Made in liver
stored in gall bladder
Dumped into small intestine
Cholesterol and its many uses:

Cholesterol used to make

**Bile:** fat absorption
6. HDL stands for
   a. Highly dense lipid.
   b. Hydrogenated dark lipid.
   c. High density lipid.
   d. Hydrogenated dense lipoprotein.
   e. High density lipoprotein.
12. Consumption of which of the following is most likely to raise your HDL and also lower your LDL levels?

a. Trans fats
b. Saturated fats
c. Lard
d. Polyunsaturated fats
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