

## WEEK 7

### Lipids

1. Which of the following is a source of lipids?

- Water
- Sugar, fruits, and bread
- Butter and oils**
- Steaks

Water is the by-product of condensation reactions.

Answer the following questions below about lipids.

#### Question 1 / 3

Triglycerides are:

- used for catalysis in the body.
- made of fatty acid monomers.**
- soluble in water.
- always unsaturated.

#### Question 2 / 3

Select all that apply. Saturated fatty acids contain \_\_\_\_\_ functional groups.

- amine
- alkanes**
- alkenes
- carboxylic acid**
- halogen

#### Question 3 / 3

From the condensed structural formula, determine if the structure represents a saturated fatty acid, a monounsaturated fatty acid, or a polyunsaturated fatty acid.

	<b>SATURATED FATTY ACID</b>	<b>MONOUNSATU RATED FATTY ACID</b>	<b>POLYUNSATUR ATED FATTY ACID</b>
$\text{CH}_3\text{CH}_2\text{CHCHCH}_2$ COOH		yes	
$\text{CH}_3\text{CHCHCHCH}_2\text{CH}_2$ COOH		yes	
$\text{CH}_3\text{CHCHCH}_2\text{CH}$ CHCH <sub>2</sub> COOH			yes
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}$ COOH	yes		

#### Question 1 Feedback

Triglycerides are made of fatty acid monomers.

**Question 2 Feedback**

Saturated fatty acids will contain all single bonds, thus contain alkanes, and will contain a carboxylic acid functional group on one end.

**Question 3 Feedback**

Alkanes are saturated fatty acids and are represented by CH<sub>3</sub> on the end carbon and CH<sub>2</sub> for each middle carbon. Monounsaturated fatty acids will contain a single double bond, represented by CHCH in the condensed structural formula; polyunsaturated fatty acids will contain two or more double bonds in the condensed structural formula.

2. Select the correct property for the category of fatty acids that it

describes. Contains carboxylic acid =

Saturated, Unsaturated, **Both Saturated and Unsaturated**

Contains a single double carbon-to-carbon bond =

Saturated, **Unsaturated**, Both Saturated and Unsaturated

Contains multiple double carbon-to-carbon bonds =

Saturated, **Unsaturated**, Both Saturated and Unsaturated

Solid at room temperature =

**Saturated**, Unsaturated, Both Saturated and Unsaturated

Contains no carbon-to-carbon double bonds =

**Saturated**, Unsaturated, Both Saturated and Unsaturated

Liquid at room temp =

Saturated, **Unsaturated**, Both Saturated and Unsaturated

Does not mix with water =

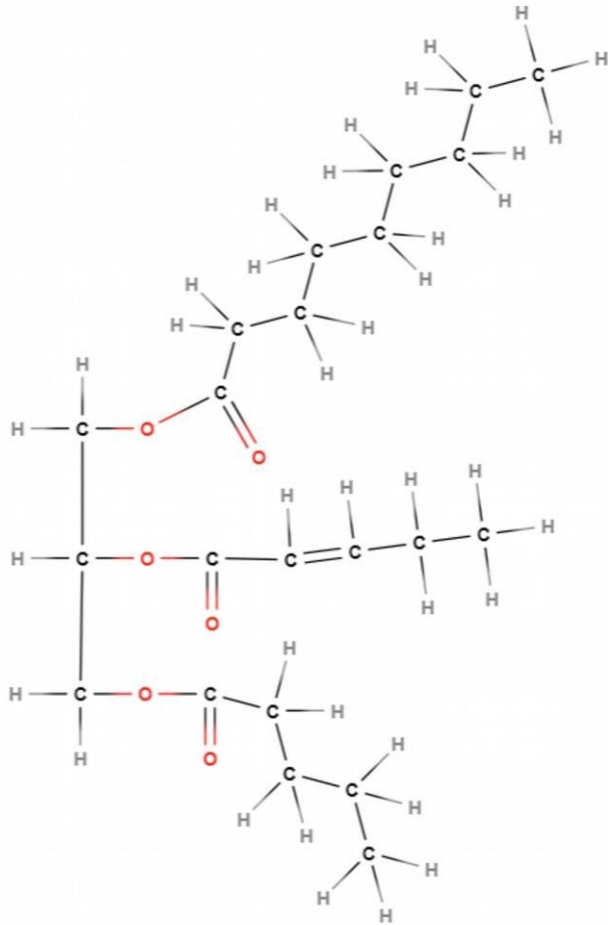
Saturated, Unsaturated, **Both Saturated and Unsaturated**

**Both saturated and unsaturated do not mix with water.**

**Saturated contains no double carbon-to-carbon bonds and is solid at room temperature.**

**Unsaturated contains a single double carbon-to-carbon bond (monounsaturated) or multiple double carbon-to-carbon bonds (polyunsaturated) and are mostly liquid at room temperature.**

4. Using the molecule below, answer the following questions.



**Question 1 / 3**

**This molecule is best described as**

- a. a fatty acid.
- b. a triglyceride.**
- c. a polyunsaturated fatty acid.
- d. an unsaturated fatty acid.

**This image is a lipid, not a fatty acid. It is made from three fatty acids combined with a molecule of glycerol, and is called a triglyceride or triacylglycerol.**

**Question 2 / 3**

**How many fatty acids were used to create this triacylglycerol molecule?**

- a. One
- b. Two
- c. Three**
- d. Four

**Triacylglycerols are made from three fatty acids attached to one glycerol.**

**Question 3 / 3**

The fatty acids used to create this triacylglycerol are

- a. all identical.
- b. all unsaturated.
- c. all saturated.
- d. **all connected through an ester linkage.**

All three fatty acids are connected to the glycerol through ester linkages. They are all different, some being saturated and some unsaturated.

**5. Click and drag the name of the lipid to match the function**

Comprises the majority of cell membranes because it contains a polar head and a nonpolar tail. ---  
**glycerophospholipids**

Used in soap making. --- **triacylglycerol**

Structure includes three six-member rings fused with a five-member ring, and in cell membranes provides stability and is a precursor for vitamin D. --- **cholesterol**

cholesterol

glycerophospholipids

Triacylglycerol

**Glycerophospholipids comprise the majority of cells due to their polar head and nonpolar tails, allowing them to create a stable bi-layer structure.**

**Triacylglycerols are commonly used in soap making when combined with sodium hydroxide (lye).**

**The fused ring structure is cholesterol, one type of steroid.**

**6. Select all that apply. Which of the following are typically solids at room temperature?**

- a. Polyunsaturated lipids
- b. **Trans lipids**
- c. Monounsaturated lipids
- d. **Saturated lipids**
- e. Unsaturated lipids

**Both saturated fats and trans fats are solids at room temperature due to their linear structures.**

**7. Which class of lipids is found in cell membranes?**

- a. Sterols
- b. Triacylglycerol
- c. Glycerolphospholipid
- d. Steroids and Triacylglycerol
- e. **Steroids and Glycerolphospholipid**

**Glycerophospholipids make up the majority of the cell membrane, and sterols such as cholesterol are also found in the membrane and used for stability.**

**8. What type of linkage is found in triacylglycerols?**

- a. Glycoside
- b. Ether
- c. Amide
- d. peptide
- e. Ester

**Triacylglycerols have ester linkages between the glycerol and fatty acids.**

**9. Which of the following is true for both saturated and unsaturated fatty acids?**

- a. Both contain carboxylic acid groups
- b. Both are solid at room temperature
- c. Both are considered alkenes
- d. Both are soluble in water
- e. Both contain ester linkages

**Both saturated and unsaturated fatty acids are monomers that contain a carbon chain and a carboxylic acid group.**

**10. Triacylglycerols contain\_\_\_\_\_.**

- a. 1 molecule of glycerol and 3 steroids
- b. 3 molecules of glycerol and 1 molecule of fatty acid
- c. 1 molecule of glycerol and 3 molecules of fatty acid
- d. 3 molecules of glycerol and 1 steroid

**Triacylglycerols are made of 1 molecule of glycerol and 3 fatty acids.**

### Proteins

**11. Rank the levels of protein structure from top (least complex/structured) to bottom (most complex/structured).**

- a. Secondary – alpha helices, beta strands, and loops
- b. Quaternary – interaction of multiple tertiary structures
- c. Primary – sequence of amino acids
- d. Tertiary – the three dimensional structure

**The levels of protein structure in order of complexity are: primary, secondary, tertiary, and quaternary.**

**12. Examples of proteins include**

- a. meat and muscle
- b. sugars and candy
- c. butter and oil
- d. all of these

**Meat and muscle are example of proteins.**

**13. Answer the following questions about the structure of amino**

**acids. Question 1 / 3**

**The backbone of an amino acid refers to all of the following except**

- a. the amine.
- b. the carboxylic acid.
- c. **the sidechain.**
- d. the alpha

carbon. **Question 2 / 3**

**Select all that apply. What functional groups are found in amino acids?**

- a. Alkene
- b. **Amine**
- c. Ester
- d. Hydroxyl
- e. **Carboxylic**

**acid Question 3 / 3**

**Alpha carbons are always bound to**

- a. the amine.
- b. a hydrogen.
- c. the carboxylic acid.
- d. the sidechain.
- e. **All of these.**

**Question 1**

**Feedback**

**The backbone is the portion of the amino acids that is consistent in each of the 20 amino acids. This includes the amine, the alpha carbon, and the carboxylic acid. The sidechain will be different for each amino acid, so that is not part of the backbone.**

**Question 2 Feedback**

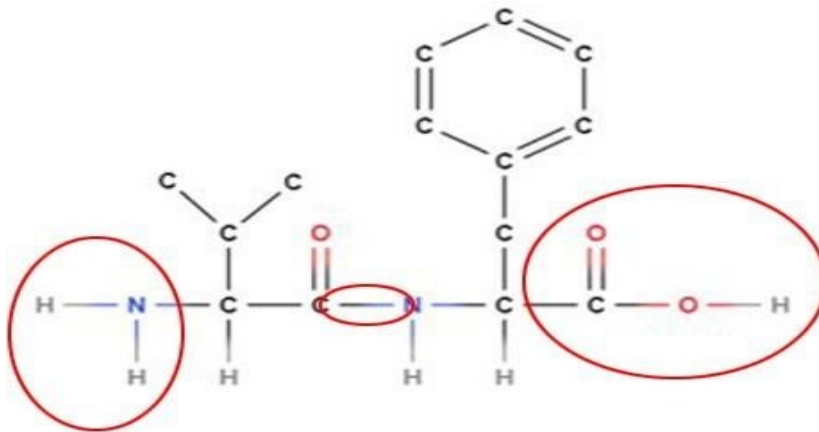
**Amino acids all contain amine and carboxylic acid functional groups. Question 3**

**Feedback**

**Alpha carbons are the center of the amino acid, bound to an H, the amine, the acid, and the sidechain.**

**14. Dipeptide**

**Locate these parts of the dipeptide: Peptide Bond , N-Terminus and C-Terminus**



c

**15. Protein sequences go from the N terminus, to the C terminus. The N terminus represents the first amino group of the protein backbone, and the C terminus---represents the last carboxylic acid group of the protein backbone.**

N terminus, C terminus

N terminus, C terminus

N terminus, C terminus

N terminus, C terminus

**Protein sequences are defined as amino to acid: from N terminus to C terminus. The N terminus is called the “N” terminus because it refers to the first functional group in the chain, the amine which contains a nitrogen atom. The final functional group is the C-terminus because it is the carboxylic acid.**

**16. Click and drag to match the structure to the**

**description LEVEL OF STRUCTURE, DESCRIPTION**

**PRIMARY** sequence of amino acids held together by peptide bonds

**SECONDARY** the way that the local amino and carboxylic acid groups interact with each other in space

**TERTIARY** the overall, three-dimensional and completely folded structure **QUATERNARY** the combination of two or more tertiary protein

structures **QUATERNARY, SECONDARY, TERTIARY, PRIMARY**

**Primary structure** – sequence of amino acids held together by peptide bonds.

**Secondary structure** – the way that the local amino and carboxylic acid groups interact with each other in space

**Tertiary structure** – the overall, three-dimensional and completely folded structure

**Quaternary structure** – the combination of two or more tertiary protein structures

**17. What is the driving force for each level of structure?**

	<b>Peptide bonds</b>	<b>H-bonding of the backbone</b>	<b>Hydrophobic sidechain interactions</b>
Primary	yes		
Secondary		yes	
Tertiary			yes

The primary structure is the sequence of amino acids, and is driven by the covalent peptide bonds between amino acids in the polypeptide. The secondary structure is formed due to the backbone Hydrogen bonding, specifically the carbonyl of the acid and the amine found in each amino acid. The tertiary structure is primarily driven by the burying of hydrophobic sidechains, as they rearrange to be away from surrounding water.

### **18. Modeling Protein Structure with Wire**

Complete the following activity and then answer the questions below about protein structure.

Locate two long pieces of thin, bendable wire in your home (such as pipe cleaner, garden wire, electrical wire, or similar), preferably 5-10 inches in length as well as a pencil.

