LIPIDS – (you DO need to know this material for lecture quizzes and exams!)

Recall that there are four types of biomolecules
1) Sugars
2) Proteins
3) Lipids
4) Nucleic acids

We will focus on 3 types of lipids for Bot 100, and all three contain **fatty acids**

I. Fats and oils (aka triglycerides)
II. Phospholipids
III. Waxes and cutin
(steroids are a fourth…that we won't discuss in detail)

Fatty acid: long chains of carbon atoms with a carboxyl group at one end (you don't need to know what a carboxyl group looks like…). Fatty acids are hydrophobic (this is CRITICAL – you DO need to know this!). We drew saturated and unsaturated fatty acids on the board – consult your notes.

> **Saturated fatty acid:** fatty acid in which every C atom in the C-C chain (except the two at the very tips) is bonded to two H atoms, and therefore can't carry any more (they are therefore *saturated* with H atoms). All C atoms are connected to each other via single covalent bonds. Saturated fatty acids have a straight shape; they are not kinked.
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> **Unsaturated fatty acid:** fatty acid in which two or more C atoms in the C-C chain (not including the two at the very tips) are bonded to only one H atom (they are therefore said to be *unsaturated* with H atoms). The C atoms that are bonded to a single H atom are bonded to each other with a double covalent bond. The double bond causes the molecule to kink.

I. Fats. Fats are constructed from two types of molecules:
a) Glycerol ***head,***
b) ***Fatty acid tails;*** there are three fatty acid tails on fats – for that reason they are also called **triglycerides**

There are many different fatty acid tails found in triglycerides. You do not need to know their names. What is important to know is that they can be either *saturated* or *unsaturated* (see above…)

Saturated fat: A fat in which all three fatty acid tails are saturated. Because the fatty acid tails are straight, saturated fats pack tightly together and are solid at room temperature (palm oil, lard, butter).

Unsaturated fat: A fat in which one or more fatty acid tail is unsaturated. Because the fatty acid tail(s) are kinked, unsaturated fats pack together more loosely, and are liquid at room temperature (olive oil, peanut oil, sesame oil, castor oil).

(You should also be able to explain the difference between mono- and poly unsaturated fats.)

Primary function of fats is long term energy storage.
Fat provides 2x the energy, per unit weight, compared to carbohydrates.
The energy released from "burning" (i.e., metabolizing, or breaking down with enzymes) 1 gram of fat is equal to the energy derived from burning ~ 2grams of polysaccharide (e.g., starch).

Triglycerides are found in the fruits and seeds of plants. In seeds, they act as a storage reserve for young plants. What is one hypothesis for the evolutionary purpose of a plant placing these energetically expensive molecules in fruit (outside the seed where it will not be used by the plant's offspring)?

We discussed palm oil production and conservation of tropical habitats/species (with emphasis on orangutans) – you should have these notes recorded in your personal notebook!

Soap molecules: I expect you to know the basics we covered in lab. That is to say, the basic chemistry of a soap molecule (hydrophobic tail and hydrophilic head) and why soap works as a cleaner (acts as a bridge between water and hydrophobic impurities).

II. Phospholipids
Similar to fats (triglycerides), but different in two important ways:

1) contain only two fatty acid tails
2) Phosphate group attached to Glycerol head

Head is **hydrophilic**
Tail is **hydrophobic**

Phospholipids assemble in bilayers in which the hydrophobic tails are oriented inwards, and the hydrophilic heads are oriented outwards towards and interact with water molecules. These bilayers are the fundamental structure of **membranes**. (Be aware that membranes contain other molecules such as cholesterol and proteins – we'll talk about this in a future lecture, but for the most part we will not focus on membrane structure in great detail.)

III. Waxes and cutin
Waxes and cutin are "jumbled" polymers of fatty acids. The fatty acids are typically very diverse in terms of length, unsaturated vs saturated, and how they bond together. What is important to know is that these jumbled collections of fatty acids are hydrophobic, thus waxes and cutin are effective waterproofing sealants for leaves, stems and other plant tissues.