

## CARBOHYDRATES, LIPIDS, AND PROTEINS (handout)

### Carbohydrates:

- Combinations of carbon (C), hydrogen (H), and oxygen (O) usually in the ratio of 1:2:1 (for example: glucose is  $C_6H_{12}O_6$ )
- It's as if water ( $H_2O$ ) has been added around a backbone of carbons. Thus the name "hydrated carbon"
- primary use = as a fuel for production of ATP. Cells 'burn' glucose as a fuel to store energy in molecules of ATP

Examples of carbohydrates include: glucose, sucrose, fructose, lactose, starch, & glycogen. All these are converted to glucose by the small intestine or liver. The only carbohydrate reaching the cells should be glucose.

- secondary use = as structural components for cell membranes to help create the shape of binding sites and marker molecules. Recall that all cells are "sugar coated" with a glycocalyx.

### Lipids:

- are also composed of C, H, & O but the ratio is less predictable than in carbs
- primary use = as a fuel for production of ATP and for fuel storage.
- secondary use = as structural components of cell membranes and hormones
- examples: The most common type of lipid we consume as food and have in our bodies as fat is triglycerides. Other types include phospholipids and cholesterol used in cell membranes and to make some hormones such as estrogen, progesterone, & testosterone.

### Proteins:

- are composed of chains of amino acids (AAs). There are only 20 different AAs in humans but limitless possible combinations. Whole proteins typically have at least 3000 AAs in a specific sequence.
- Each AA is composed of C, H, O, & nitrogen (N) Some also contain sulfur or phosphorus.
- Four cardinal rules about proteins:
  1. The sequence of AAs determines the shape of the protein
  2. The shape of the protein determines its function (what it can or can't bind with; what it can or can't do)
  3. If you alter the AA sequence you will likely alter the shape and therefore the function.
  4. If you attach something to or detach something from a protein this will also likely alter the shape and function. Keep in mind that changing shape sometimes is the function of the protein. For example – the  $Na^+/K^+$  pumps.
- primary use = as structural proteins to connect, anchor, contract, etc. (examples: collagen, actin, myosin)  
OR as functional proteins to stimulate metabolism of target cells or to stimulate chemical reactions such as digestion. (examples: enzymes and some hormones)
- secondary use = as a fuel for energy but your body prefers not to use protein for this purpose. In desperate situations such as starvation and cancer your body will consume its own proteins for energy in an effort to stay alive.

Energy Yield = Measured in kilocalories per gram = 4, 9, 4 respectively