

Organic Compounds

B-3.4 Students will be able to summarize how the structures of organic molecules (including proteins, carbohydrates, and fats) are related to their relative caloric values.

B-3.5 Students will be able to summarize the functions of proteins, carbohydrates, and fats in the human body.



What does it mean to be “*organic*”?!?!?

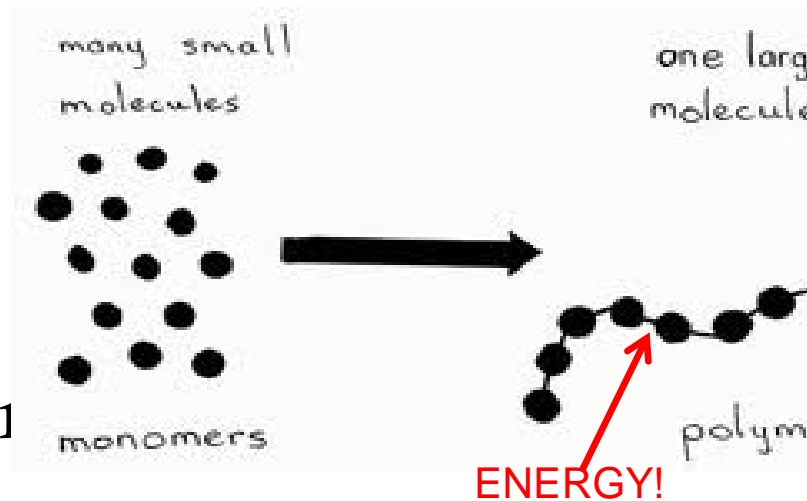
Carbon-the building block of life

- All living organisms are composed of **organic compounds**
- **Organic Compounds** = contain the element carbon- C
 - *Carbon is important because it forms covalent bonds with up to 4 other atoms, including other carbon atoms*
- **Inorganic Compounds** = do not contain carbon- C and hydrogen- H

Organic Compounds

“Macromolecules”

- Macro= Large!
- Most organic molecules are made of **smaller units** that bond to form **larger molecules**.
 - Small units = **monomers**
 - Larger units = **polymers**
- **Energy** is **stored in the bonds** that link the monomers together.
 - The **amount of energy**, depends on the type of organic compound.



Nutrition Facts

Serving Size 1 cup (240 mL)
Servings Per Container About 16

Amount Per Serving

Calories 90 **Calories from Fat** 0

% Daily Value*

Total Fat 0g **0%**

Saturated Fat 0g **0%**

Cholesterol Less than 5mg **1%**

Sodium 135mg **6%**

Total Carbohydrate 13g **4%**

Dietary Fiber 0g **0%**

Sugars 13g

Protein 9g

Vitamin A 10% • Vitamin C 4%

Calcium 30% • Iron 0% • Vitamin D 25%

Look at the label to the left. 3 of the 4 macromolecules can be found in foods... These are the ones we will focus on!

The 3 biochemical molecules

found on a nutrition label are:

1 **FAT** (0 grams in this product)

2 **Carbohydrates** (13 grams in this product)

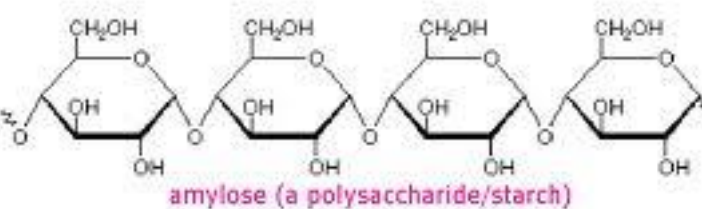
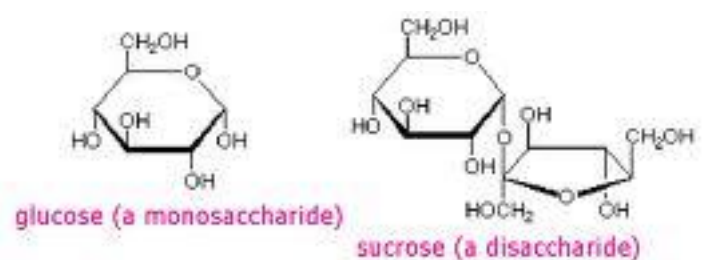
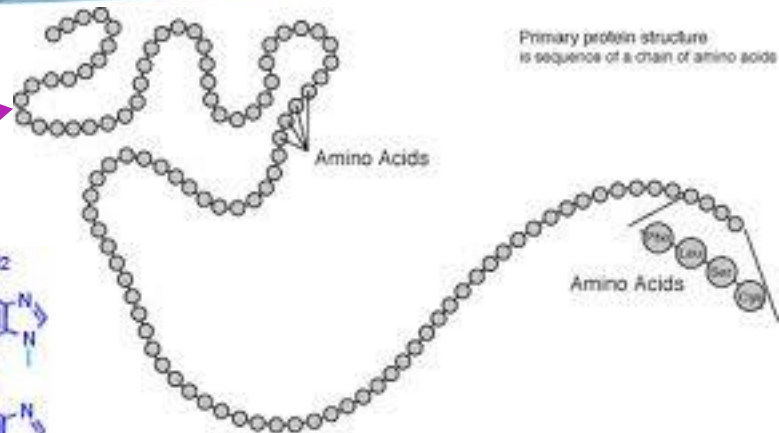
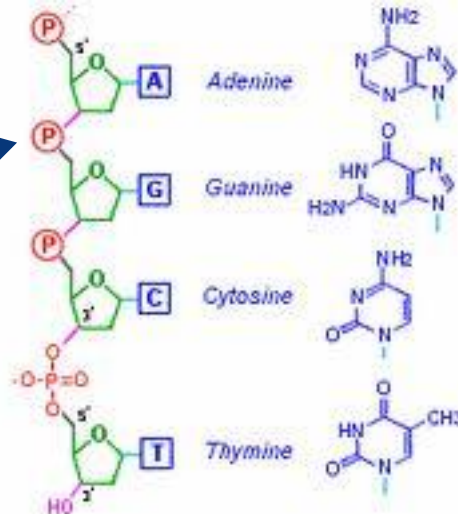
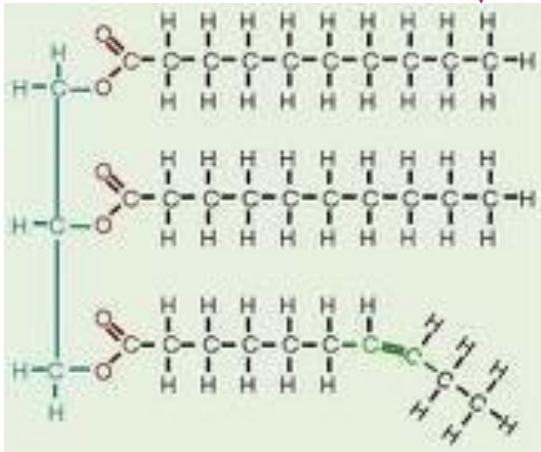
3 **Protein** (9 grams in this product)

4 Major Organic Compounds

“Macromolecules”

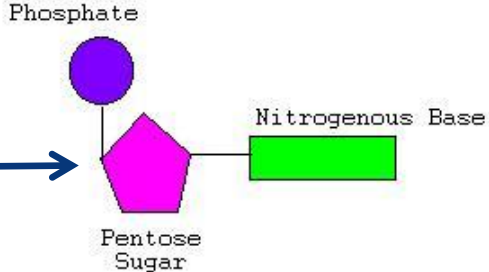
There are **4 major organic compounds** found in nature:

- 1) **Proteins**
- 2) **Carbohydrates**
- 3) **Lipids/Fats**
- 4) **Nucleic Acids**



Nucleic Acids



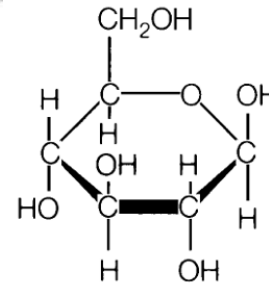
- **Nucleic acids** are made up of 5 atoms:
 - Carbon, Hydrogen, Oxygen, Nitrogen, and Phosphorous
- They are **polymers** made up of **monomers**
- **Monomer = Nucleotide** → 
- Nucleic acids **function as the genetic material** of all living things
- There are **2 types** of nucleic acids:
 - **DNA**- *deoxyribonucleic acid*
 - **RNA**- *ribonucleic acid*

We will talk more about nucleic acids in Standard 4

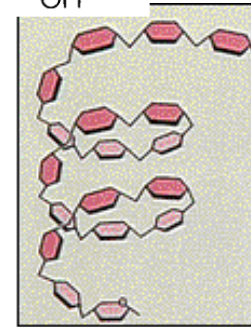
Carbohydrates

the basics about sugars and starches

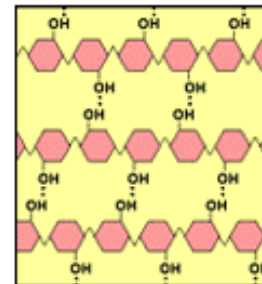
- ◆ **Carbohydrates** are commonly known as **sugars and starches**
- ◆ Carbohydrates can be **simple** or **complex**
 - ◆ **Monomers**- monosaccharides
 - ◆ “simple sugars”
 - ◆ Ex: glucose
 - ◆ **Polymers**- polysaccharides
 - ◆ “complex carbohydrates”
 - ◆ Ex: glycogen, starch, OR cellulose
- ◆ Made up of **3 types of atoms**: carbon, hydrogen, and oxygen



amylose
(a starch)



cellulose



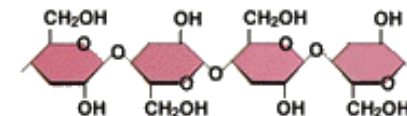
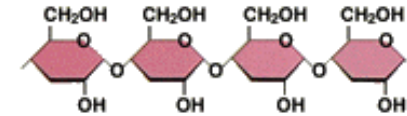
Classifications of Carbohydrates

Ribose
Aldose
Pentose

Glucose
Aldose
Hexose

Fructose
Ketose and Hexose

Glyceraldehyde
Aldose
Triose



Carbohydrates

main source of quick energy for the cell



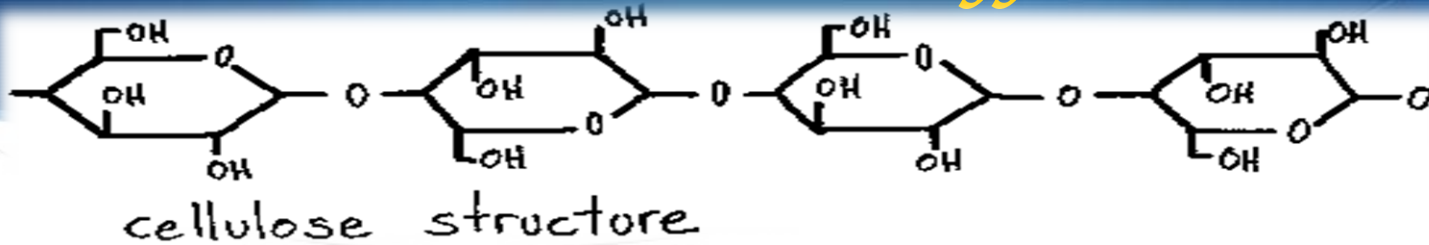
- ◆ The **main function** of carbohydrates in the body is **main source of energy for the cell**
- ◆ **Plants** (and some bacteria too)- **make/synthesis carbohydrates** through photosynthesis as a source of food/energy
- ◆ **Animals**- consume/**eat carbohydrates** for energy
 - ◆ *Complex carbohydrates are broken down into simple sugars during digestion*
 - ◆ *These simple sugars enter the blood stream and are used to make cellular energy within all cells.*



Carbohydrates

Carbs 3

the extra stuff

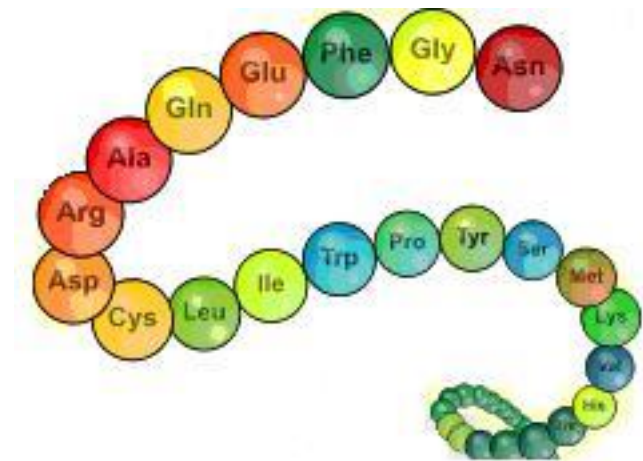
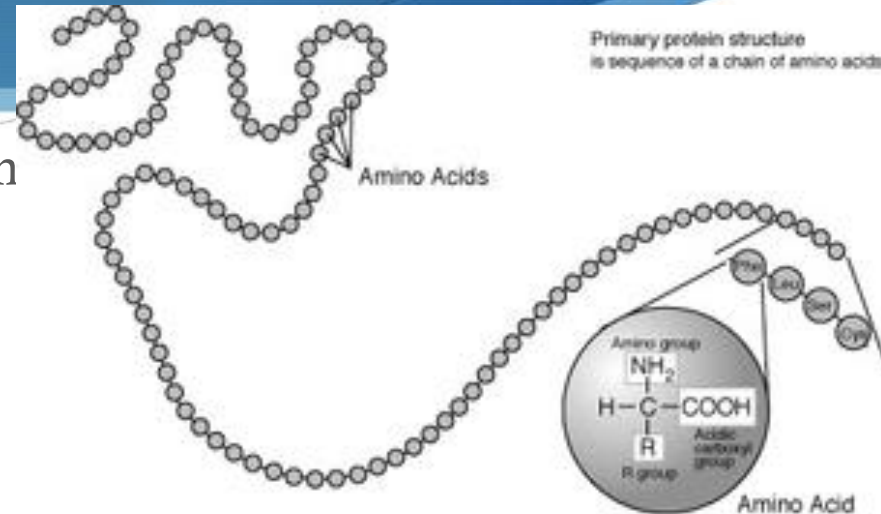
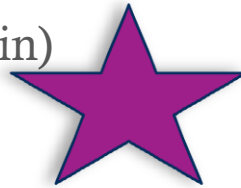


- The **secondary function** of carbohydrates in the body is **short-term energy storage** (*starch, glycogen*)
 - If an organism **consumes more carbs than it needs**, the extra energy is **converted to fat** and stored by the body
- While the **main function of carbohydrates is energy**, carbs **may also be used as a structural molecule** in many organisms
 - Ex: **cellulose** is a structural carbohydrate found in plants
 - For most animals, foods that contain these type of carbohydrates are important. For example, fiber which stimulates the digestive system.

Proteins

polymers and monomers

- ◆ **Proteins** are molecules composed of chain of **amino acids**.
 - ◆ **Polymer** = polypeptide (protein)
 - ◆ **Monomer** = amino acid
- ◆ Amino acids are molecules that are composed of **carbon**, **hydrogen**, **oxygen**, **nitrogen**, and sometimes **sulfur**.
 - ◆ There are **20 amino acids** that chemically bond in various ways to make proteins.
 - ◆ When you eat proteins, they are broken down into amino acids. These amino acids are used to build new proteins for you.



Proteins

many functions and types

◆ Because of their structures, **proteins serve different functions.**

1. **Structural proteins** are used for support

Ex: keratin that forms hair and finger nails

2. **Transport proteins** transport many substances throughout the body

3. **Hormone proteins** coordinate body activities Ex: insulin

4. **Contractile proteins** help control movement Ex: muscles

5. **Enzymatic proteins** accelerate the speed of chemical reactions

Ex: break down food



Proteins

Proteins 3

can even be used as an energy source?!?!

yes, but only sometimes...

- ◆ Proteins are **more important as a source of building blocks** than as a source of energy.
- ◆ However, proteins **can** be used for energy **only if there is a shortage of carbohydrates or lipids**.



Lipids

Lipids 1

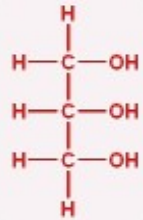
aka: fats, oils, and waxes

- ◆ **Lipids**, including *fats, oils, and waxes*, are **polymers** composed of 3 atoms:
 - ◆ **carbon, hydrogen**, and **oxygen**
- ◆ While made up of the same atoms, **lipids are VERY different** from carbohydrates:
 1. Lipid molecules are made of **two monomer molecules**
 - ◆ **glycerol** and **fatty acids**
 2. Fats/lipids have **more carbon-hydrogen bonds** than carbohydrates
 - ◆ this is why **lipids have the highest caloric** value!!



Lipid Images

Glycerol



A "free" Fatty Acid



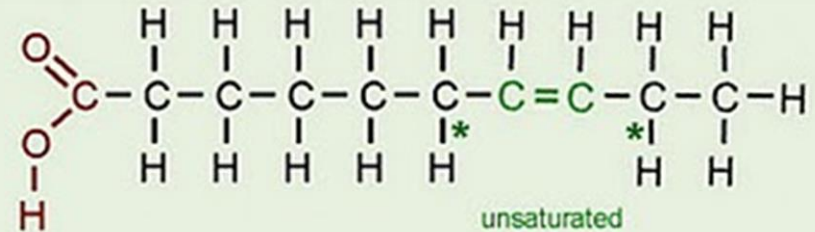
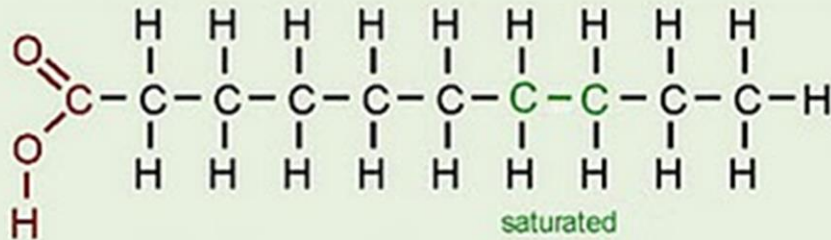
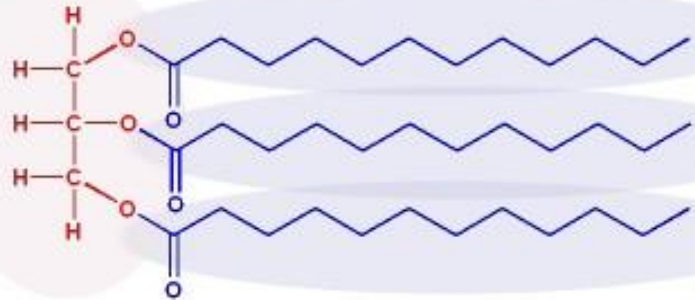
A "free" Fatty Acid



A "free" Fatty Acid



Triglyceride



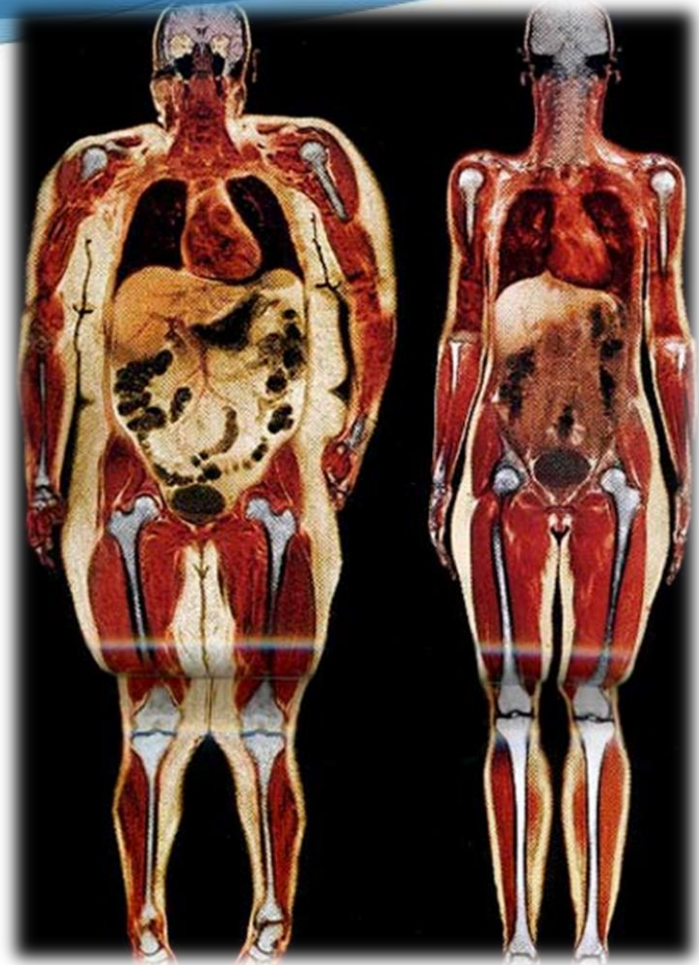
Lipids

Lipids 3

many functions

Lipids are important to organisms for energy when carbohydrates are scarce

1. Provides **long-term energy**
2. **Cushions** vital organs
3. **Insulates/warms** the body
4. Major component of **cell membranes**
5. Used in making some **vitamins and hormones**



Compounds and Calories

- The **caloric value** (calorie value) of each organic compound is determined by its stored energy
- **Proteins, carbohydrates, and fats/lipids** are the 3 organic molecules with *different structures and different caloric values* based on those structures
 - **Proteins**- 4 calories per gram
 - **Carbohydrates**- 4 calories per gram
 - **Fats/lipids**- 9 calories per gram

