

Chemistry of Life Unit: **Key Idea**

- You are what you eat ... or have eaten**

Quaker Quick
Oatmeal


Nutrition Facts		
Serving Size 1/2 cup dry (40g)		
Servings Per Container about 79		
Amount Per Serving		
	Cereal Alone	with 1/2 cup Vitamin A&D Fortified Skim Milk
Calories	150	190
Calories from Fat	25	25
% Daily Value**		
Total Fat 3g*	5%	5%
Saturated Fat 0.5g	2%	2%
Polyunsaturated Fat 1g		
Monounsaturated Fat 1g		
Cholesterol 0mg	0%	0%
Sodium 0mg	0%	3%
Total Carbohydrate 27g	9%	11%
Dietary Fiber 4g	15%	15%
Soluble Fiber 2g		
Insoluble Fiber 2g		
Sugars 1g		
Protein 5g		

Grape Nuts

Nutrition Facts

Serving Size 1/2 cup (58g)
Servings Per Container about 12

Amount Per Serving	Cereal with 1/2 cup Percent Skim Milk	
Calories	200	240
Calories from Fat	10	10
% Daily Value**		
Total Fat 1g*	2%	2%
Saturated Fat 0g	0%	0%
Cholesterol 0mg	0%	0%
Sodium 350mg	15%	17%
Potassium 160mg	5%	10%
Total Carbohydrate 47g	16%	18%
Dietary Fiber 5g	21%	21%
Sugars 7g		
Other Carbohydrate 35g		
Protein 6g		



**How can this plant
digest a frog?**

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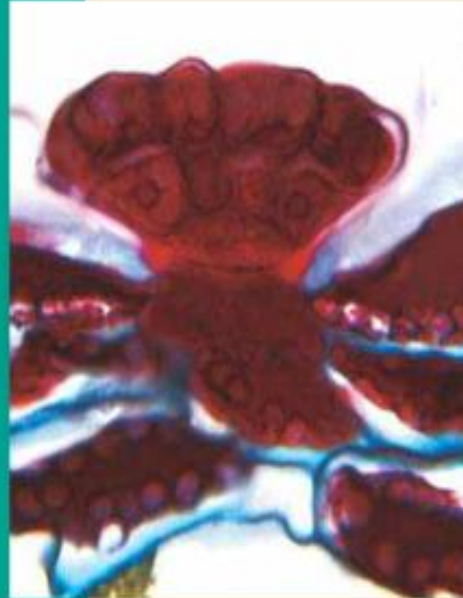
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Connecting CONCEPTS

Like other carnivores, the Venus flytrap eats animals to get nutrients that it needs to make molecules such as proteins and nucleic acids. Other chemical compounds made by the plant's cells enable the Venus flytrap to digest the animals that it eats. These chemicals are similar to the chemicals that allow you to digest the food that you eat.



Cell Function The Venus flytrap has specialized cells on the surfaces of its leaves. Some of these cells allow the plant to snap shut on its prey within 0.5 seconds. Other cells, such as those that appear purple in this light micrograph, secrete digestive chemicals that allow the plant to consume its prey. (LM; magnification 500 \times)

Prefix Preview:

Identify the Latin “root word” that matches each prefix

Prefix	Latin “Root Word”
ONE	Mono
TWO	Di
THREE	Tri
MANY	Poly

All living things contain the same 4 Carbon-based molecules:

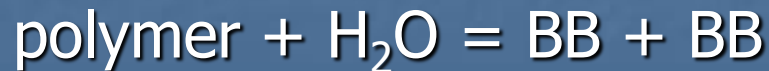
C video



- The Biomolecules are called **POLYMERS**.
 - All Polymers are made up of **monomers**, or “building blocks.”
 - They are all **built** with the same process: Dehydration Synthesis (**Condensation**)



- All are **broken down** by the same process: **HYDROLYSIS**:

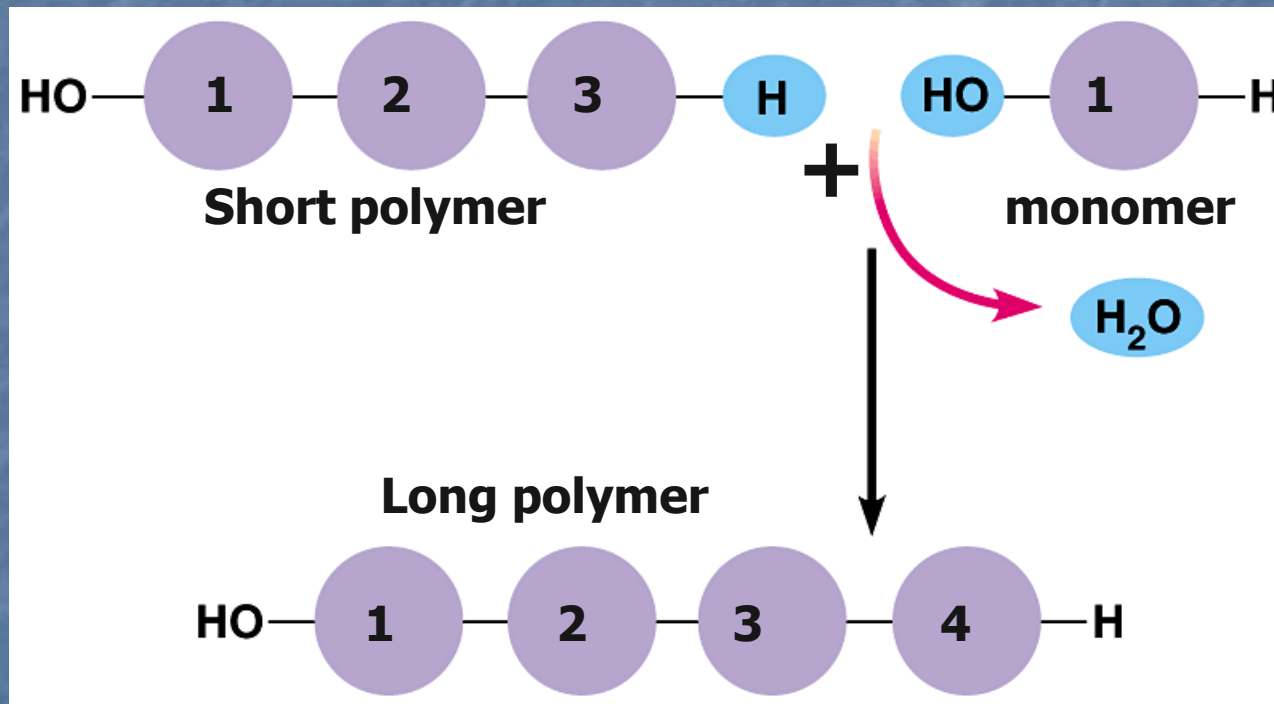


C n H video



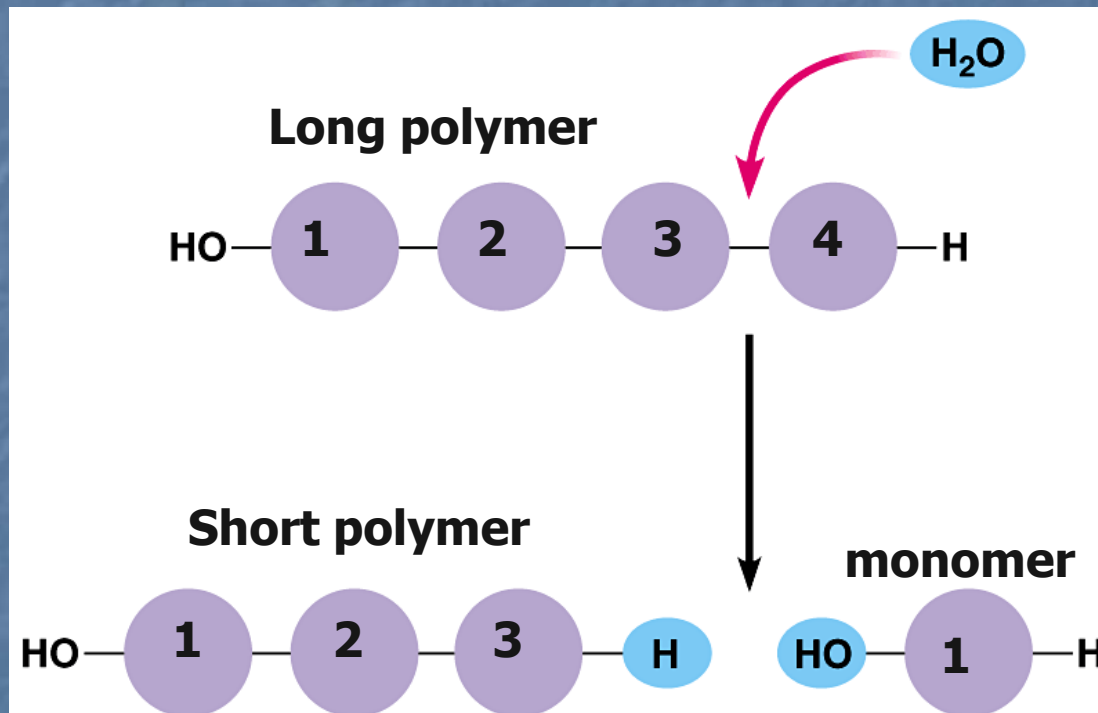
A closer look at the chemistry

- **Condensation** = WATER is formed during a reaction that builds big polymers



A closer look at the chemistry

- **Hydrolysis** = Add **WATER** and then **split** apart big polymers



Let's Review: Which process
(**condensation** or **hydrolysis**) is most
similar to each action below:

1. You drop your cell phone and it breaks into 15 pieces?
2. You staple 8 pages of paper together?
3. You build a castle out of legos?
4. You use a knife to slice a carrot into many pieces?

Let's Review: Which process
(**condensation** or **hydrolysis**) is
most similar to each action below:

5. You drink some water and then digest a donut in your stomach?
6. Your fingernails grow longer in length as your nail bed cells connect protein monomers to build protein polymers?

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(**condensation** or **hydrolysis**) is most
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Hydrolysis

2. You staple 8 pages of paper together?

Condensation

3. You build a castle out of legos?

Condensation

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Hydrolysis

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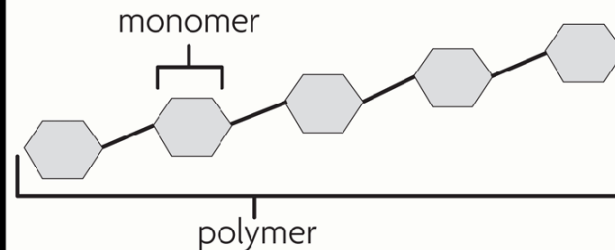
6. Your fingernails grow longer
in length as your nail bed cells
connect protein monomers
to build protein polymers?

Condensation

VISUAL VOCAB

Each smaller molecule is a subunit
called a **monomer**.

mono- = one
poly- = many

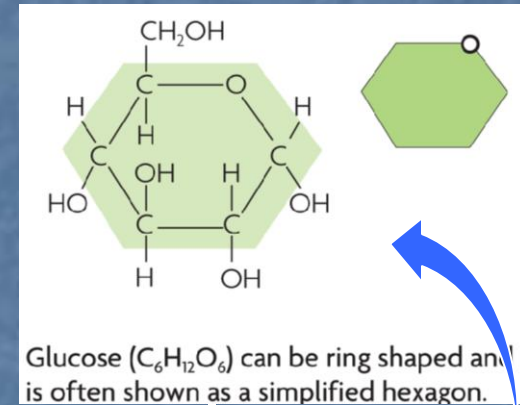


A **polymer** is a molecule that contains
many monomers bonded together.

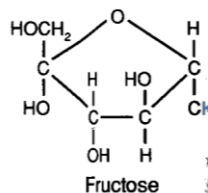
1) Carbohydrates

- BUILDING BLOCK (one sugar subunit or **monomer**) : Monosaccharide

- Shape = Hexagon ring



- 2 common **monosaccharide** examples:
 - 1) All carbohydrates in the diet are digested until they are absorbed into the blood as Glucose
 - 2) The simple sugar found in fruit is Fructose



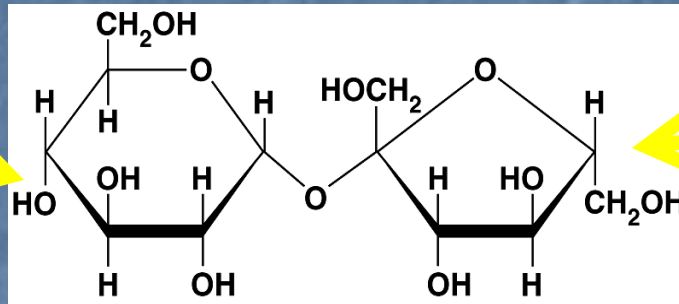
1) Carbohydrates

- Disaccharide- Two linked sugar molecules

- 2 common disaccharide examples:

1. Table sugar is called Sucrose

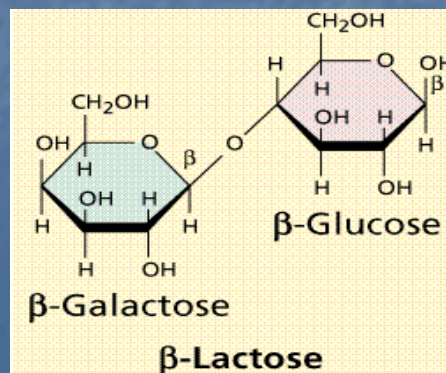
Glucose



Fructose



2. The simple sugar in milk is called Lactose



Disaccharides V



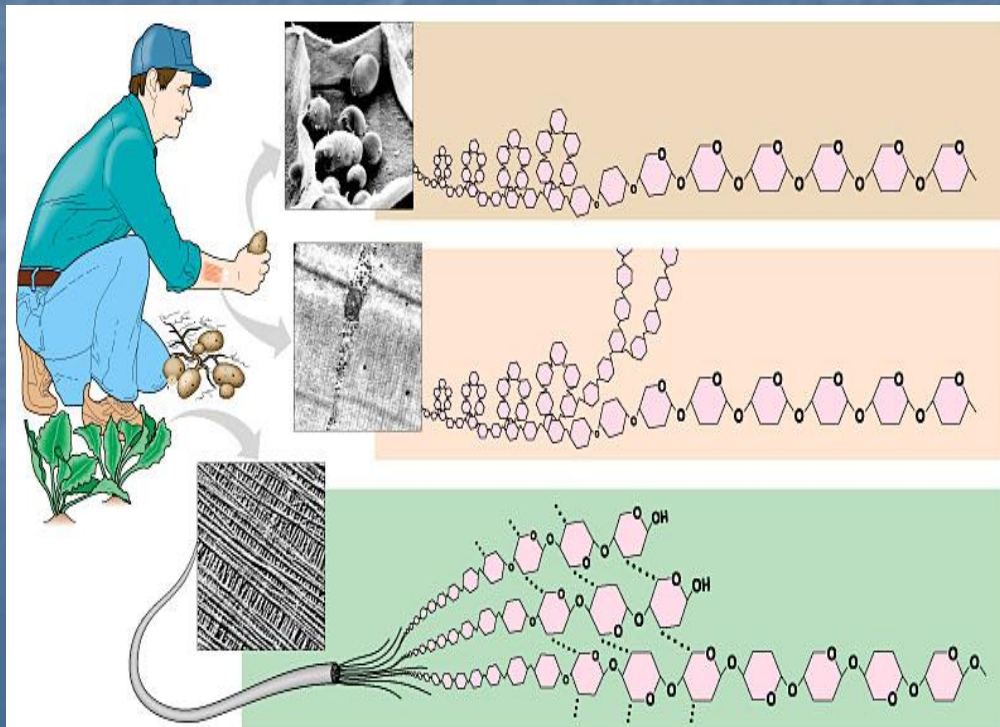
1) Carbohydrates

- Polysaccharide - many linked sugars



- 3 common polysaccharide examples

Poly S video



1) In potatoes = Starch

2) In muscle = Glycogen

3) In plant cell walls = Cellulose

Important things to know about Carbs:

- Many sugars usually end in "**OSE**"
 - Glucose, sucrose, lactose, fructose, cellulose
- Polysaccharides have various **functions**:
 - **Starch** – plant long-term Energy storage
 - **Glycogen** – human long-term Energy storage in liver and muscles
 - **Cellulose** – plant cell walls (cotton fibers) (indigestible by humans = dietary **fiber**)
 - **Chitin** – protective animal coverings (crayfish, shrimp, beetles)



Important things to know about Carbs:

- Easy to use form of stored energy for cells
- What do all the carbohydrate-containing foods below have in common?
Made by plants that captured solar energy



What do these carbs have in common?



- Color = white
- Glycemic Index = HIGH
- Health = BAD **WHY?**

Blood glucose spikes → **Blood insulin spikes** →

Blood glucose plummets → **Triggers HUNGER** →

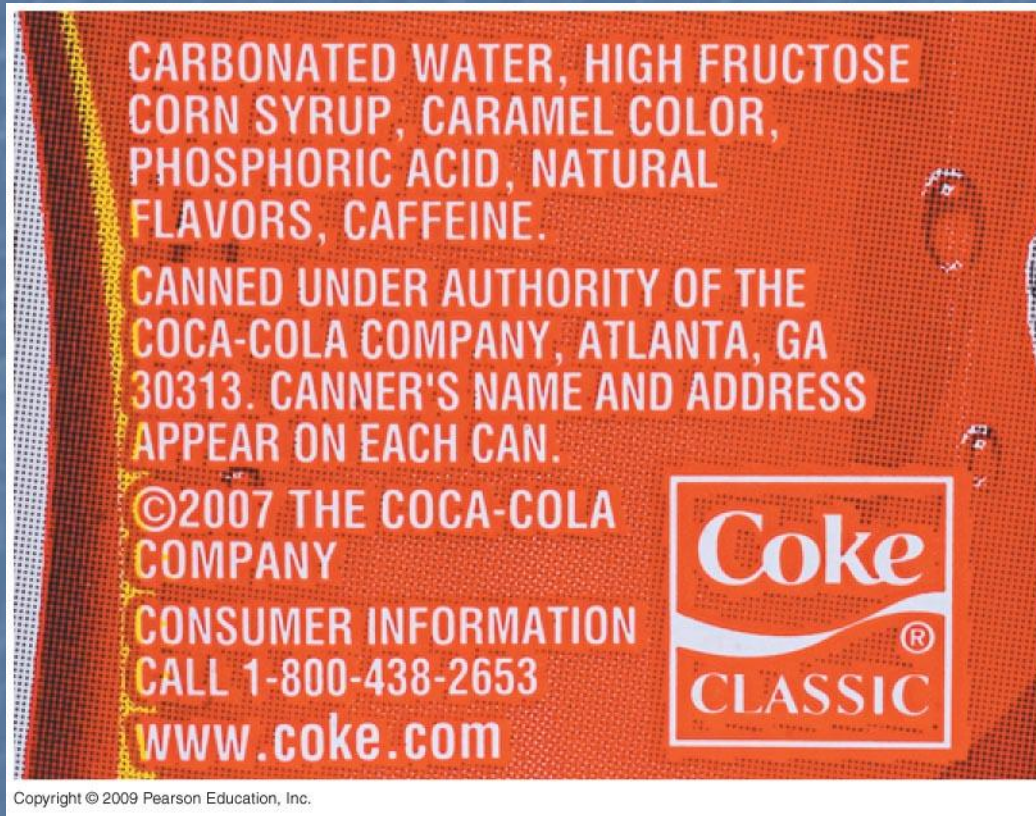
Overeating → **Obesity** →

↑ 3 Major Health Risks:

- 1) Heart Disease (Insulin ↑ artery inflammation and plaque buildup)
- 2) Type 2 Diabetes (↑↓↑↓ Insulin → Insulin resistance & ↑ blood glucose levels)
- 3) Cancer (Insulin triggers other hormones that ↑ cell division and block cell death)

Bottom line: See WHITE carbs: think FAT

See the carbohydrate in this Coke label?



How do they make HFCS?

- Break down corn starch into glucose monomers
- Convert most glucose into fructose

WHY?

- Fructose is sweeter than glucose
- Fructose is easier to work with
- Fructose is cheaper than sucrose (table sugar)

Why does HFCS **concern** nutrition experts?

- Fructose blocks the burning of **Body fat**
- Fructose stimulates production of liver **fat**
which → ↑ Insulin **resistance**
- Fructose stimulates **appetite**






**WOW ... cutting 1 16-ounce soda
each day = losing 20 lbs in 1 year?**

“Superstar” Carbohydrate foods include:

beans, whole grains, Fruits & Vegetables

These foods are full of natural chemicals which help us by:

- 1) .  inflammation
- 2) Neutralize harmful “free radical” molecules that constantly harm cells
- 3) .  immune system
- 4) .  Body toxins

Let's Review

C video



Disaccharides V



C n H video



Poly S video

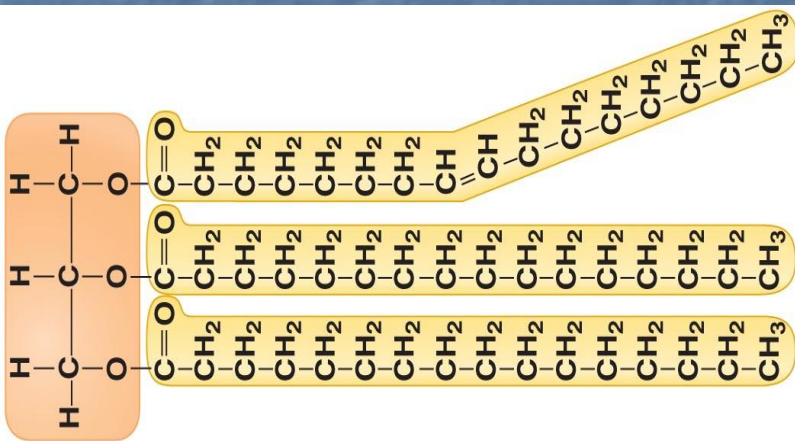


Lipid video



2) Lipids

- BUILDING BLOCK: **1 Glycerol** head with **three fatty acid tails**



- Looks like a long Capital "**E**". **Pattern**

Lipid video



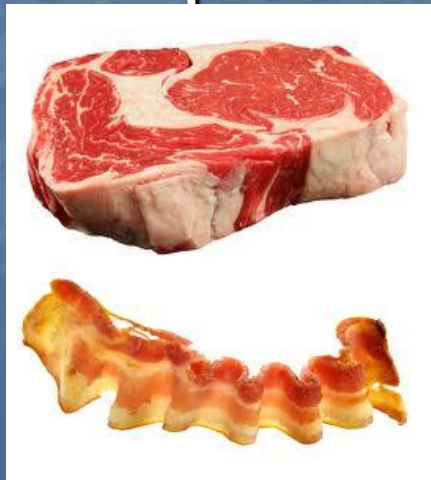
Important things to know about **Lipids**:

- NOT soluble in water (**nonpolar**)



- 3 main types of Lipids

1) **fats**



2) **oils**



3) **waxes**



Important things to know about **Lipids**:

- Foods high in Lipids: **Fried foods**

Butter



**Whole
Milk**



cheese



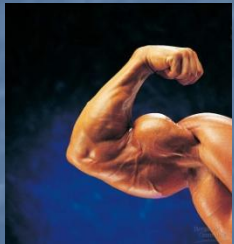
Red meat

- Lipids have various **Functions** in cells:

- Fats – **long-term Energy storage**



- Phospholipids – **cell membranes**

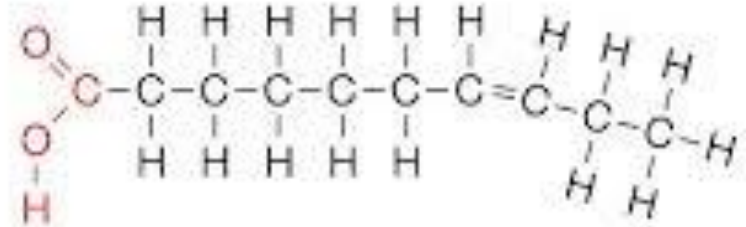
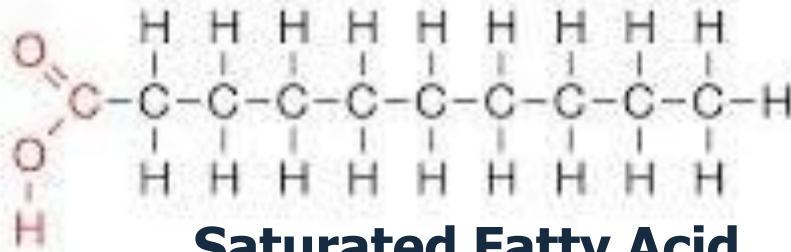


- Steroids – **cholesterol and hormones (estrogen, testosterone)**



- Pigments – **light-absorbing chlorophyll** in plants

Notice any difference between these
2 Fatty Acids?

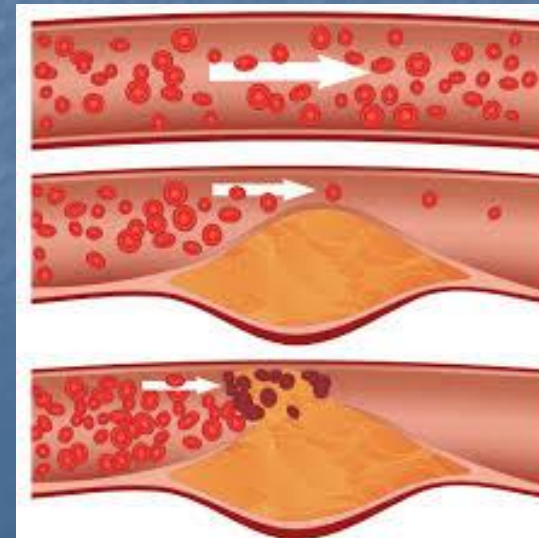
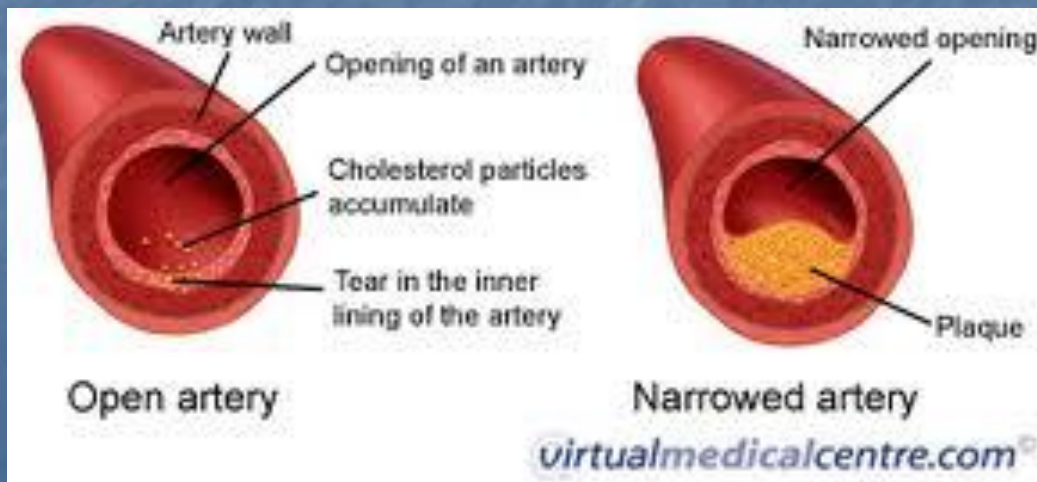


Which **fatty acid** is full of **hydrogen**?

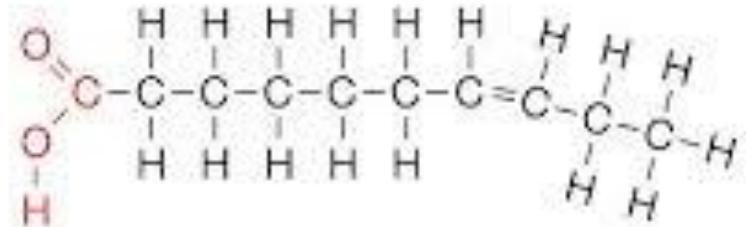
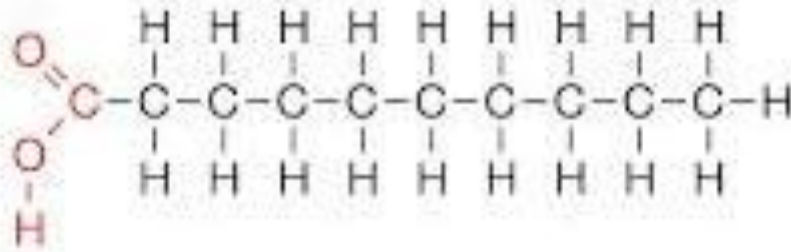
- **Saturated** fat- **Solid** at room temperature (like butter, lard, solid fat in red meat)
 - Health = **Bad** → linked to **cholesterol** buildup in arteries



- Here's how the "4-legged" **Saturated** fats cause cardiovascular trouble:
 - 1) Stimulate production of the LDL "bad" cholesterol
 - 2) Cripple the HDL "good" cholesterol leading to artery wall inflammation
 - 3) Block appetite-suppressing brain hormones which leads to 3 days of overeating.



Notice any difference between these
2 Fatty Acids?



Unsaturated Fatty Acid

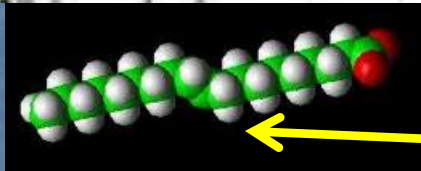
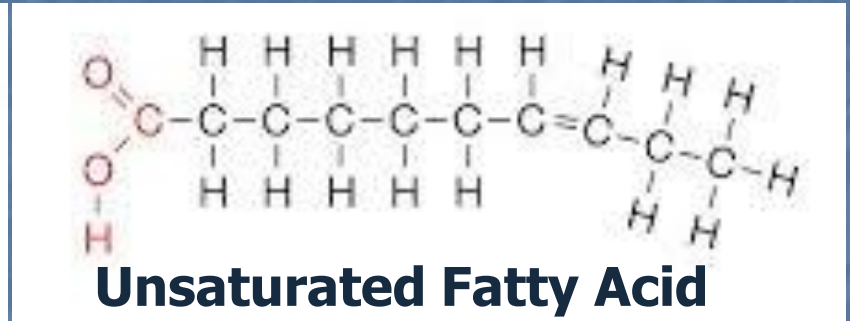
Which **fatty acid** has room to bond with more **hydrogen atoms**?

- **Unsaturated** fat- liquid at room temperature (like plant oils)

- Health **OK** → less risk for cholesterol buildup



Notice any difference between these
2 Fatty Acids?



That little difference in structure creates a "kink" in the trans fatty acid that causes a lot of trouble

- **Trans** Fat – found in some oils used for frying
 - Health **Bad** → linked to
 - 1) **Cardiovascular disease**
 - 2) **Type 2 Diabetes**
 - 3) **↓ Mental function**

Beware the **Trans Fat** !!!

■ Foods that are likely to have trans fats:

- Fried Fast foods
- Donuts, muffins
- Pie Crusts
- Crackers
- Cookies
- Chips
- Cake, cake icing
- Microwave popped corn
- Canned biscuits

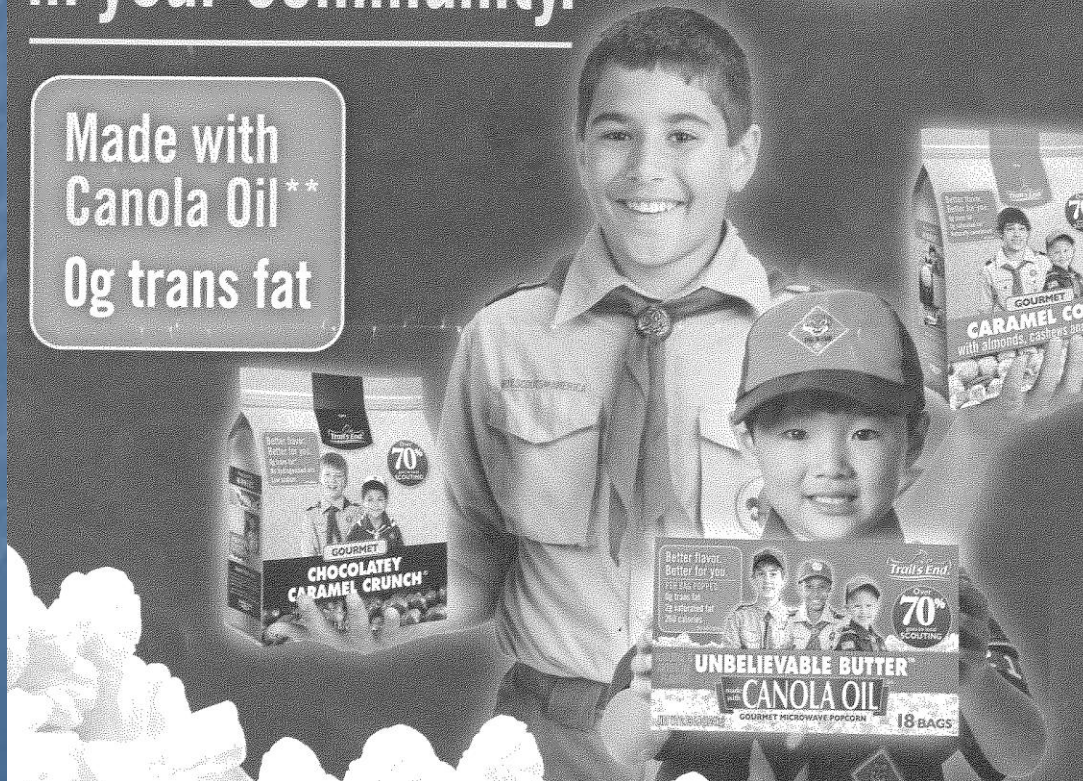


Beware the **Trans Fat** !!!

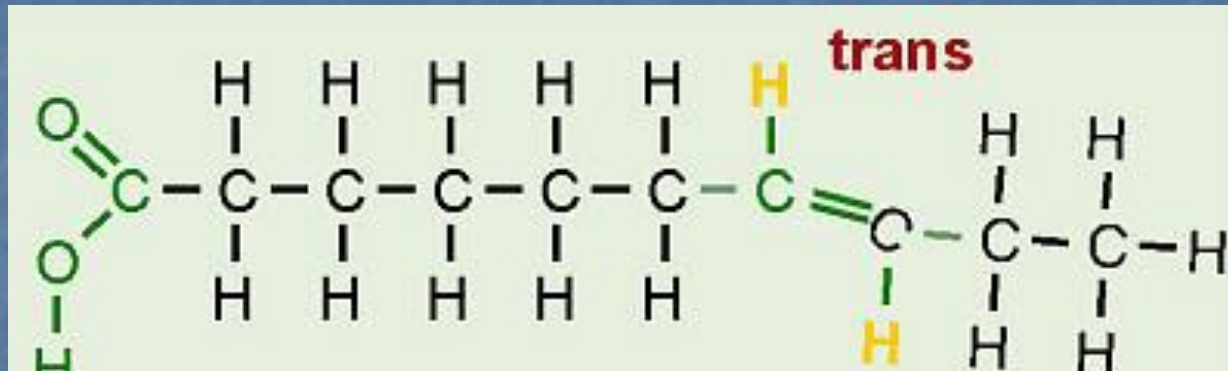
Better flavor.
Better for you.
Better for Scouts
in your community.

Over
70%
goes to local
SCOUTING

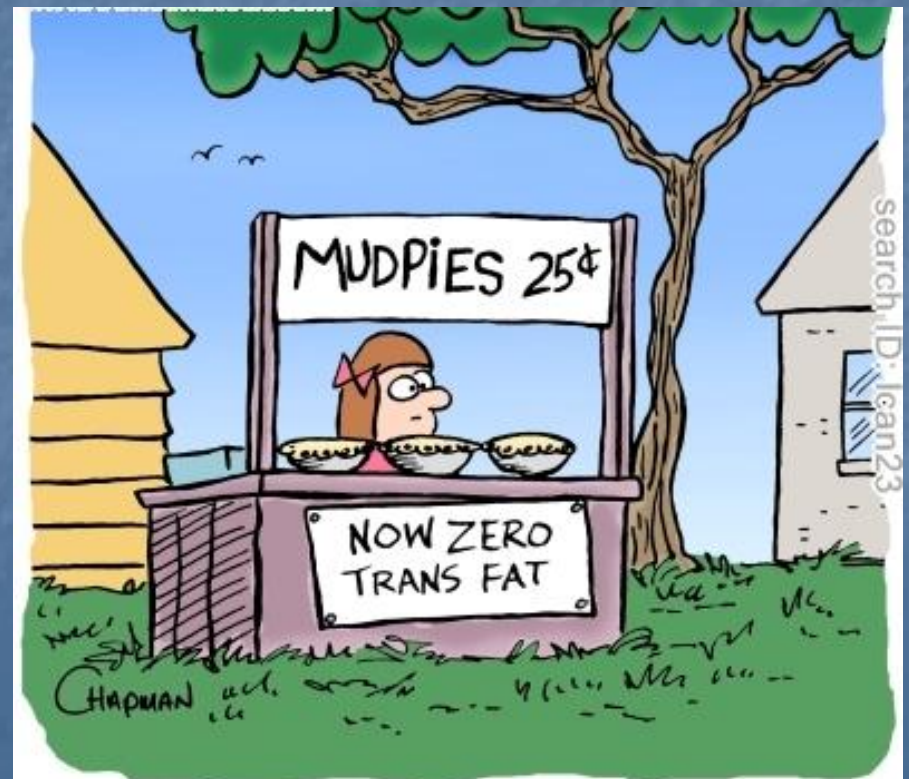
Made with
Canola Oil**
0g trans fat



Beware the **Trans Fat** !!!



"Apparently, it's extremely bad for the heart. But I wouldn't worry – it only affects people who have one."



Beware the **Trans Fat** !!!



"Bless me father for I have sinned. I use trans fats for all of my pie crusts."

Even **McDonalds** changed the “sacred” frying oil in 2008

McDonald's fries are now **trans fat-free** in U.S., Canada



Lipid Health Guidelines: Look for “good” fats

1) Consume monounsaturated fats

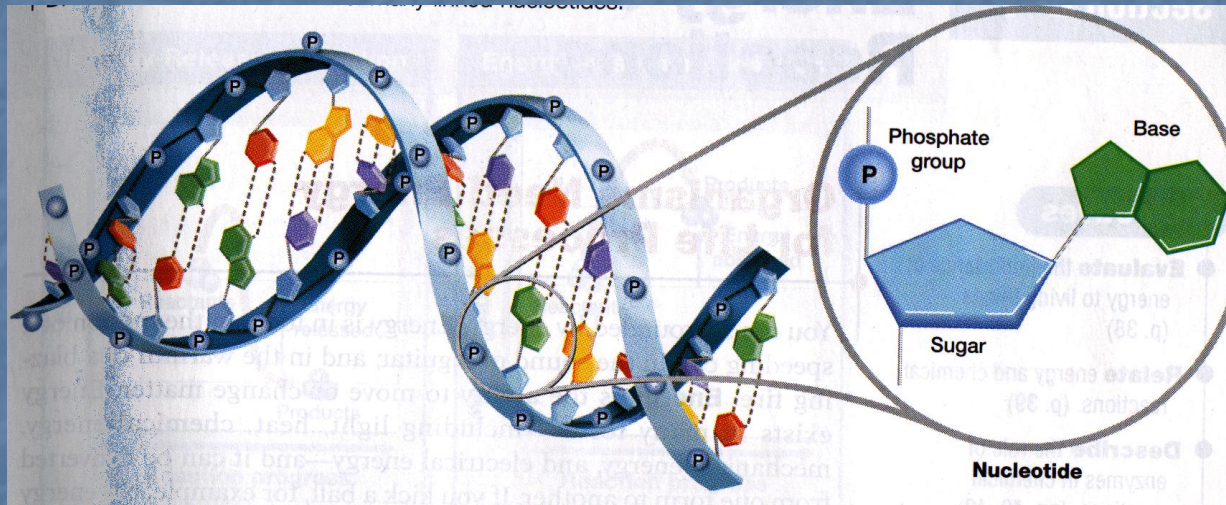


2) Get plenty of Omega-3 fats to help your heart health and brain function



Nucleic Acids

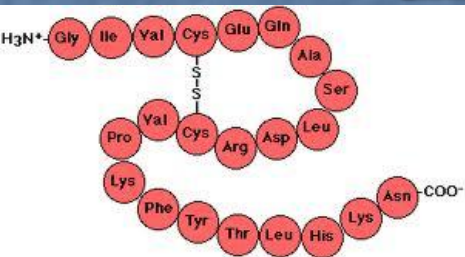
- BUILDING BLOCK: **Nucleotides = "L"**
 - Phosphate
 - Sugar
 - Nitrogen base



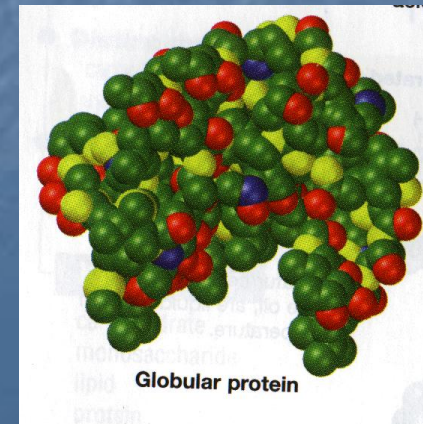
- Examples: DNA and RNA
- Function: store genetic information

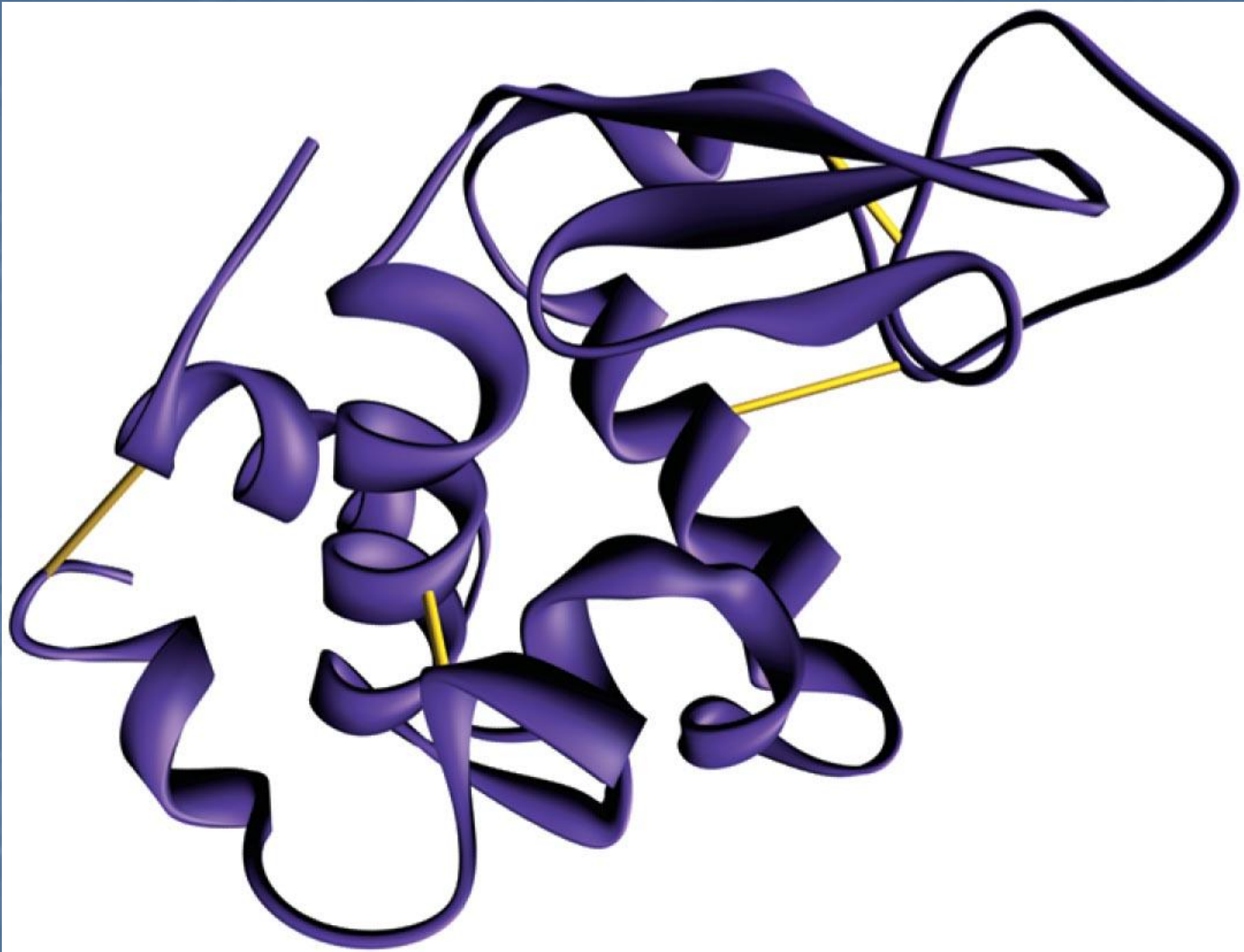
Proteins

- BUILDING BLOCK: **Amino Acids**
 - There are **20** different types of amino acids
 - 10 are Essential → must be eaten in diet for health
 - 10 are Nonessential → can be produced by the body

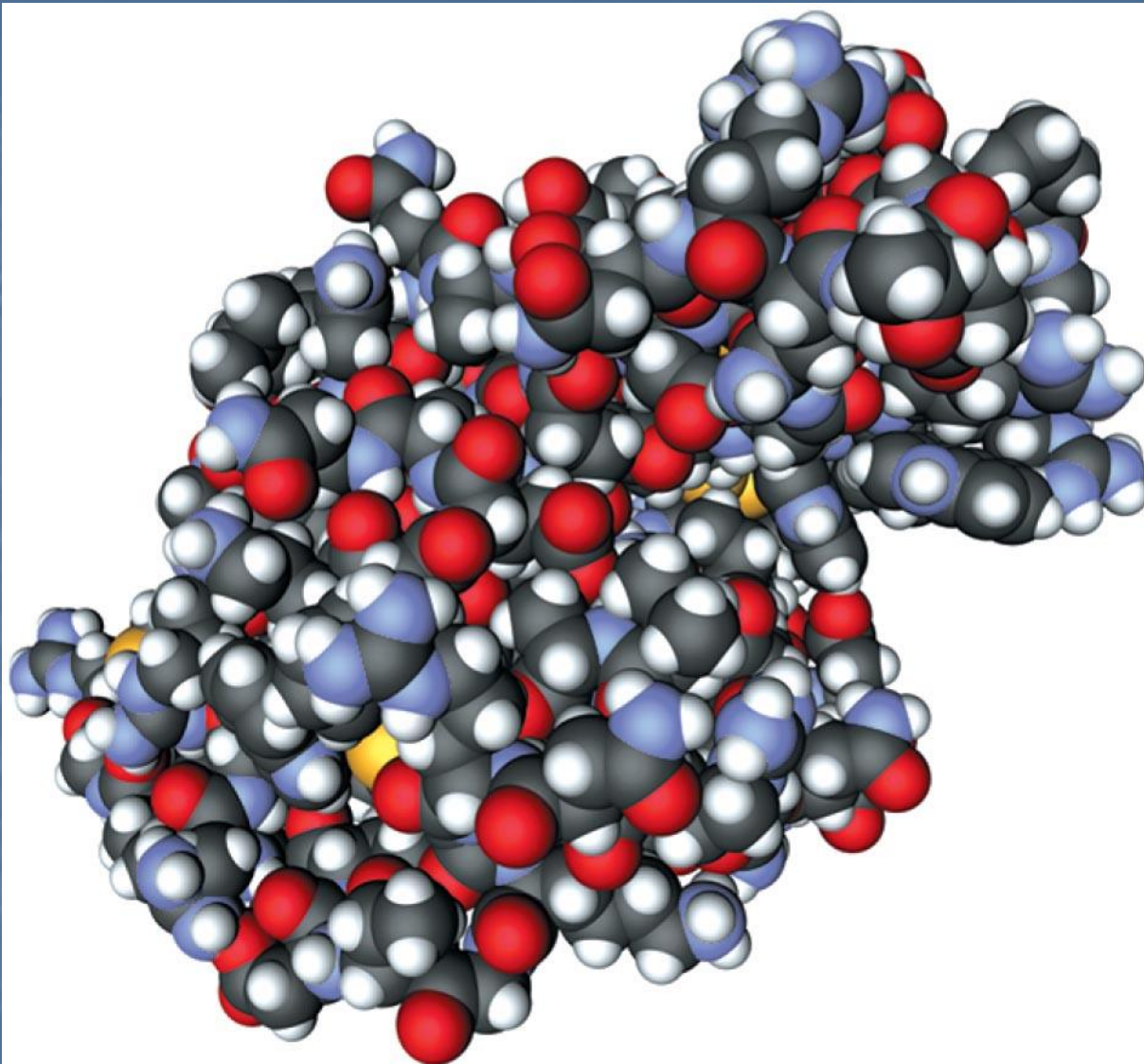


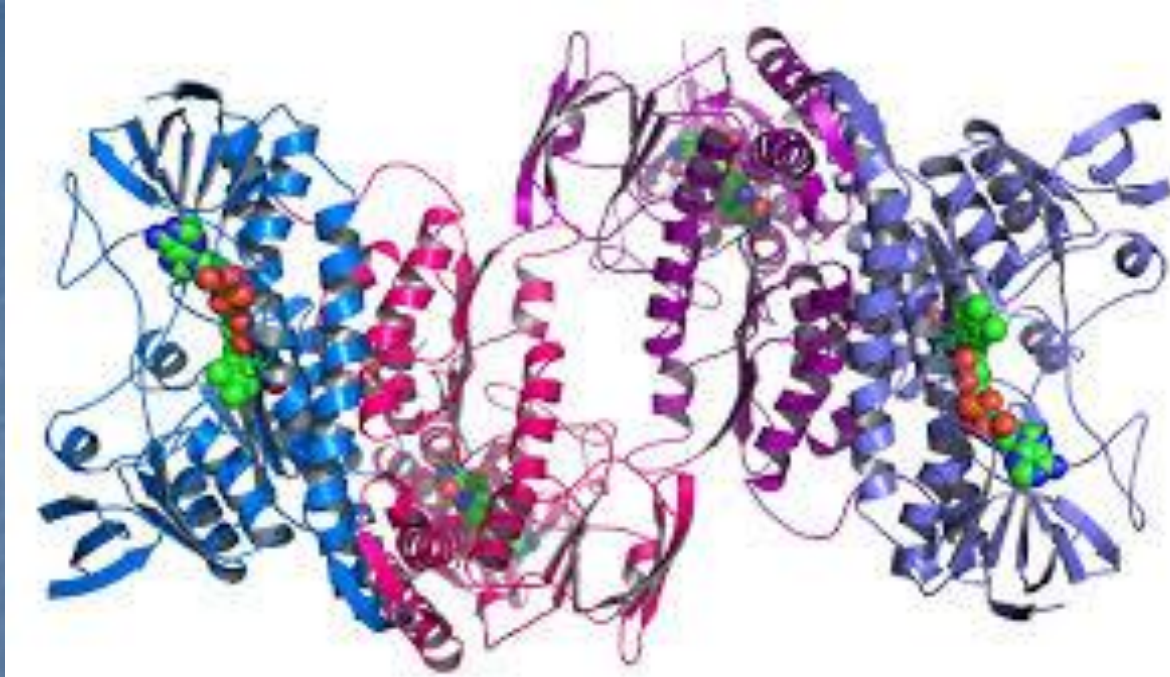
- Many times, proteins fold up into weird 3D **globular** shapes



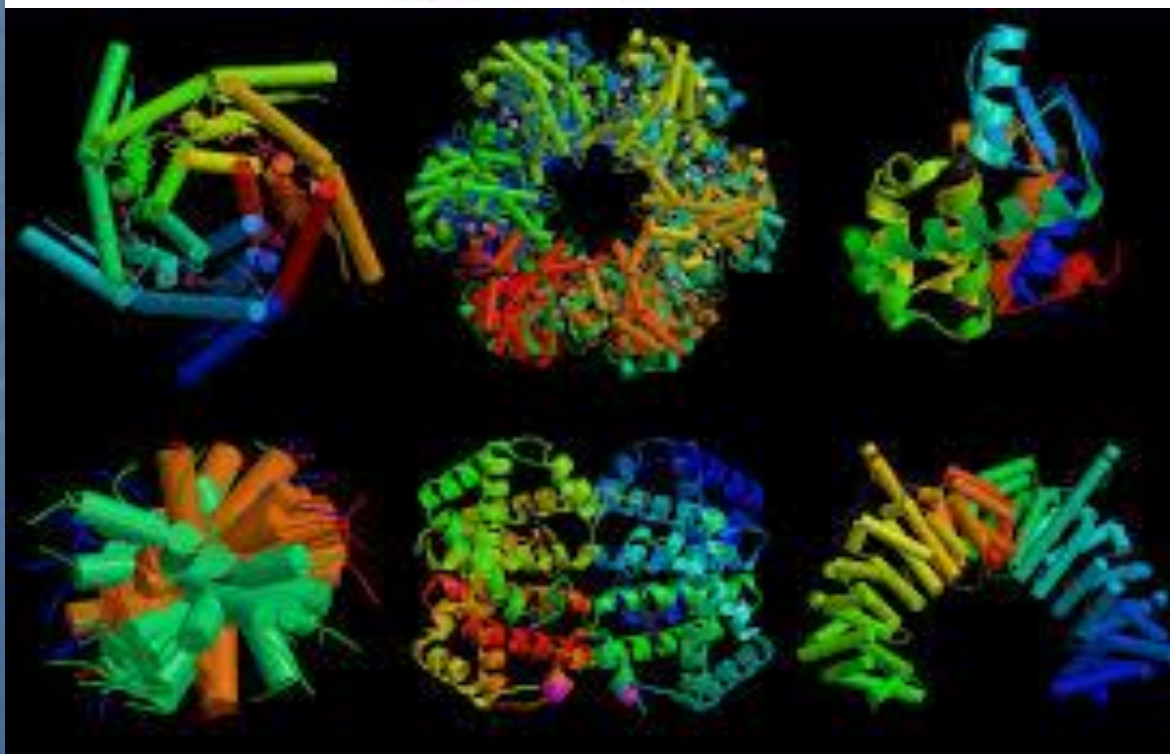


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Protein intro



Protein 1

Protein 2

Protein 3

Important things to know about Proteins:

- AA + AA = **Di**peptide
- AA + AA + AA + AA = **Poly**peptide

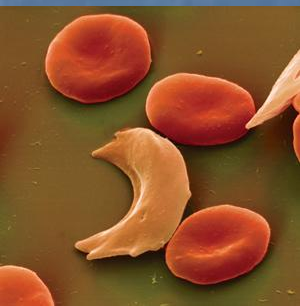
- Sources of protein:
 - Meat, milk, eggs, legumes



- Examples: (Proteins have many jobs)

- **Collagen** – building material in skin, ligaments, tendons, bones

- **Hemoglobin** – carries Oxygen in the blood



Important things to know about Proteins:

- Examples: (Proteins have many jobs)
 - Insulin – helps Glucose into cells
 - Antibodies – fight infections and diseases
 - Various protein fibers form muscle tissue and help blood clot
 - Enzymes – speed up chemical reactions in the body

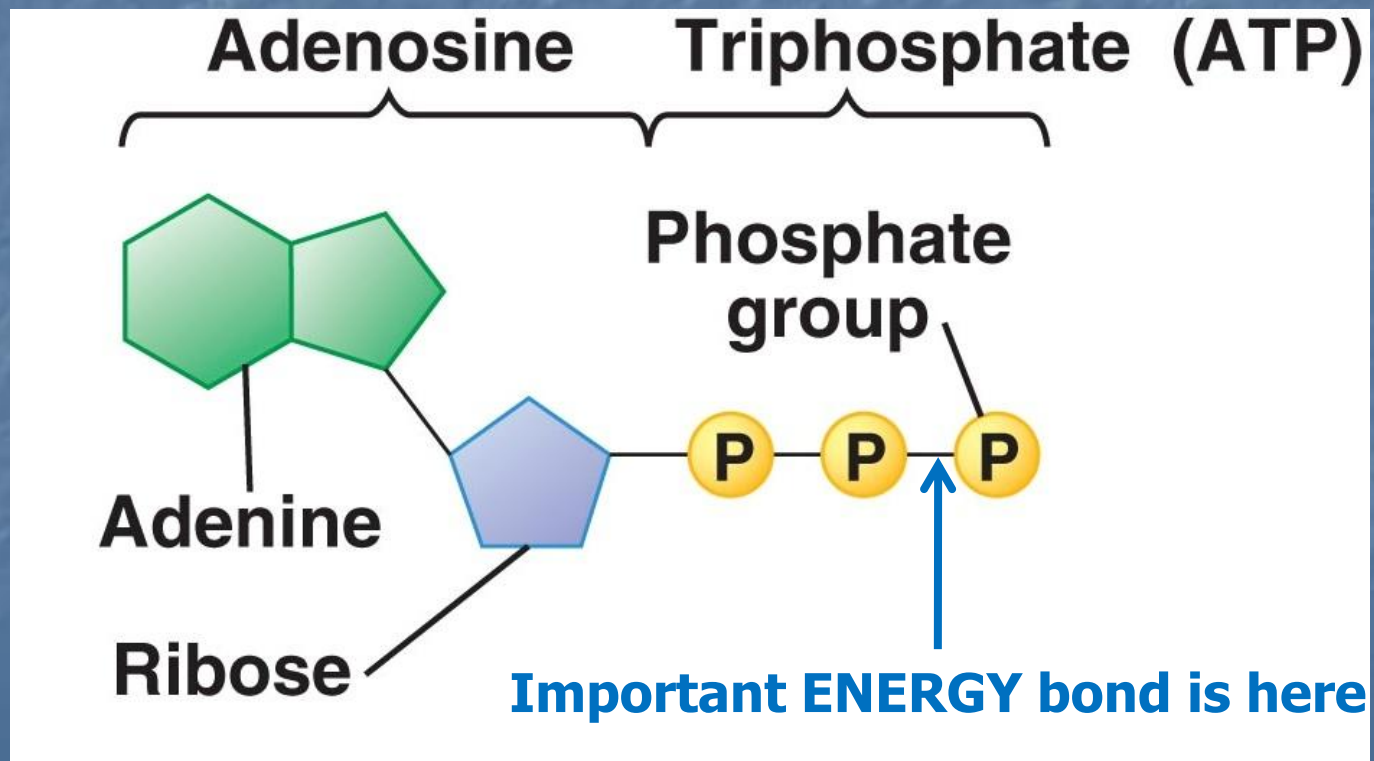
Let's Review the 4 biomolecules

Biomolecule	Monomer "BB"
Carbohydrate	Monosaccharide
Lipid	3 Fatty Acids & 1 Glycerol
Nucleic Acid	Nucleotide
Protein	Amino Acid

ATP (adenosine tri-phosphate)



- BUILDING BLOCK: a single nucleotide + 2 extra phosphate groups



Important things to know about **ATP**:

- Chemical Energy is stored in covalent bonds between **phosphate** groups
 - When the bond breaks, **energy is released**
- **FUNCTION**
 - carries Energy in cells
 - fuels most cellular activities (like \$1 of energy)



There are also molecules known as **AMP molecules** (adenosine **mono**phosphate) and **ADP molecules** (adenosine **di**phosphate).

Remember what your *pre*-fixes correspond to when we discuss biomolecules.