

REGENTS Biology

Carbohydrates

Carbohydrates:

Energy molecules

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Carbohydrates

- Composed of carbon, hydrogen, and oxygen in a ratio of one oxygen and $(CH_2O)_n$ ($n = \#$ of CH_2O units in the chain)
- Building block molecules = **sugars**

sugar - sugar - sugar - sugar - sugar

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Carbohydrates

- Function:**
 - quick energy
 - energy storage
 - structure
 - cell wall in plants
- Examples**
 - sugars
 - starches
 - cellulose (cell wall)

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Sugars = building blocks

- Names for sugars usually end in **-ose**
- Glucose** = plays a central role as an energy source for organisms (monosaccharide)
- Fructose** = fruit sugar (monosaccharide)
- Sucrose** = table sugar (disaccharide)
- Maltose** = malt sugar (disaccharide)

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Building carbohydrates

- Synthesis**
 - 1 sugar = monosaccharide
 - 2 sugars = disaccharide

glucose glucose maltose

mono = one
saccharide = sugar
di = two

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Building carbohydrates

- Synthesis**
 - 1 sugar = monosaccharide
 - 2 sugars = disaccharide

glucose + fructose → sucrose (table sugar) + H₂O

How sweet it is!

BIG carbohydrates

- Polysaccharides are longer carbohydrate molecules**
 - large carbohydrates**
 - starch**
 - energy storage in most green plants
 - potatoes
 - glycogen**
 - energy storage form of glucose in animals
 - in liver & skeletal muscles
 - cellulose**
 - structure in plants
 - cell walls
 - chitin** (nitrogen containing polysaccharide)
 - structure in arthropods & fungi
 - exoskeleton

poly = many

Building BIG carbohydrates

glucose + glucose + glucose... = polysaccharide

- starch (plant)**
 - energy storage
 - glycogen (animal)

(a) Starch: Chloroplast, Starch, Amylose, Amylopectin, 1 μm

(b) Glycogen: Mitochondrion, Glycogen granules, Glycogen, 0.5 μm

Digesting starch vs. cellulose

starch easy to digest

cellulose hard to digest

Cellulose

- Cell walls in plants**
 - herbivores can digest cellulose most carnivores cannot digest cellulose because they are missing an important enzyme
 - that's why they eat meat to get their energy & nutrients
 - cellulose = roughage
 - stays undigested
 - keeps material moving in your intestines

Different Diets of Herbivores

Cow
can digest cellulose well; no need to eat other sugars

Gorilla
can't digest cellulose well; must add another sugar source, like fruit to diet

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Helpful bacteria

- How can cows digest cellulose so well?
 - BACTERIA** live in their stomachs & help digest cellulose-rich (grass) meals

Intestine, 1 Rumen, 2 Reticulum, 3 Omasum, 4 Abomasum, Esophagus

Eeew... Chewing cud?

What happens to carbohydrates that we eat

- In the body, carbs provide energy for working muscles, provide fuel for the central nervous system, enable fat metabolism, and prevent proteins from being used as energy.
- It is broken down into smaller units of sugar in the stomach and small intestine and are absorbed and then enter the bloodstream where they travel to the liver.
- Additional info at <http://www.extension.iastate.edu/humansciences/content/carbohydrate>

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Chemical energy
- Carbohydrates
- Fats
- Others

Chemical waste
- Carbon dioxide
- Water

ATP
- body's "energy currency"

Heat

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What is ATP

- Chemical energy is stored in biological molecules and can be converted to other forms of energy when needed.
- The most important biological molecule that provided chemical energy is called Adenosine triphosphate or ATP
 - It is a multipurpose storehouse of chemical energy that can be used by cells in a variety of reactions
 - It is the most abundant energy-carrier molecule in cells and is found in all types of organisms.

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What is ATP?

ATP = Adenosine + Energy + P_i + Energy + P_i + Energy + P_i

Adenosine - P - P + Energy from Glucose + P

ADP

Adenosine - P - P - P

ATP

Lots of energy (originally from glucose) is