

Carbohydrates

Carbohydrates

- A simple sugar or a molecule composed of two or more sugar units
- Contains C,H,O in 1:2:1 ratio
- The most abundant biological molecule
- the body's most important source of energy
- the human body is not able to make these chemicals by itself - you rely on plants (potato, bread, rice, corn, fruit)
- Used as structural materials by the cell, transports and stores energy
- Three classes: monosaccharides, oligosaccharides and polysaccharides

Monosaccharides

- Single molecule of sugar (simplest carbohydrate)
- One sugar unit that has at least two -OH groups and a carbonyl group (an aldehyde or ketone)
- Backbone of 5 or 6 carbon atoms
- Many are isomers, which have the same chemical formula with a different arrangement of atoms
- Ex/ glucose, galactose, and fructose (see Fig. 6 on p.29)
- Monosaccharides are sweet tasting and dissolve readily in water (where they form a ring structure)

Oligosaccharides

- A short chain of two or three sugar units covalently bonded through glycosidic linkages
- they are formed by a process called dehydration synthesis
 - a hydroxyl group (-OH) is removed from one monosaccharide
 - a hydrogen (-H) atom is removed from another monosaccharide
 - these form a water molecule that is extracted from the monosaccharides which allows them to bond together
- Disaccharides include: lactose (present in milk, made of glucose and galactose), sucrose (table sugar, made of glucose and fructose) and maltose (created from breakdown of starch, two glucose molecules)

Polysaccharides

- A straight or branched chain of sugar units
- Starch, cellulose and glycogen are three different polysaccharides made from glucose (see Fig.11, p.32)
- Starch is a large carbohydrate composed of many sugar molecules linked into long, branching chains
- plants store excess sugar molecules as starch in roots and stems
- when plants need energy the starches are broken down into simple sugar molecules which are used by the cells
- Cellulose is used as a structural material in cell walls (cannot be digested by humans, but provides a source of energy for herbivores)

- In humans, cellulose is important because it holds water and aids in the elimination of solid waste
- Glycogen is the sugar storage molecule in animals (found in liver and muscle tissues)
- When blood sugar levels fall, the liver cells break down glycogen and release glucose units to the blood stream
- When you exercise, the muscle cells tap into their glycogen stores
- Chitin is the main structural material in external skeletons (Fig.13, p.34)
- Plants store the sun's energy in the form of glucose or other carbohydrates (enzymes in the chloroplast assemble the glucose units)

Lipids

Lipids

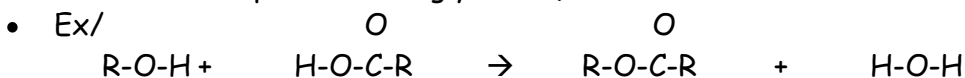
- Fats, phospholipids, oils and waxes (all have fatty acid components)
- Dissolve in one another but not as readily in water
- like carbohydrates, lipids supply energy to the cells of the body
- unlike carbohydrates, lipids are difficult for the body to break down
- Functions as a reservoir of stored energy, structural material and other products (like surface coatings)

Fatty Acids

- Contain up to 36 carbon atoms in its backbone, a carboxyl group (-COOH) at one end and hydrogen atoms occupying most of the remaining bonding sites
- Unsaturated contain one or more double bonds in carbon backbone
- Because of weak intermolecular forces, these tend to be liquid at room temperature and in the body (ex/ plant oils)
- Saturated contain only single bonds (saturated with hydrogen atoms)
- Intermolecular forces are much stronger, so these tend to be firmer (ex/ lard and butter) and are associated with heart disease

Neutral Fats (triglycerides)

- Butter, lard and oils
- Body's most abundant lipid and richest source of energy (yields more than twice the amount of carbohydrates)
- Aids in the absorption of vitamins, insulates the body and protects delicate organs
- Fatty acid tail attached to a backbone of glycerol (see Fig.16, p.35)
- Energy is released when bonds are broken and fats have more covalent bonds than carbohydrates
- The adipose tissue in vertebrates store triglycerides as fat droplets
- Ester linkage occurs when an alcohol reacts with a carboxylic acid (glycerol and three fatty acids react to produce a triglyceride)



- See Fig.19 on p.37

Phospholipids

- Has two fatty acid tails and a hydrophilic head (with a phosphate group)
- Main component of the two lipid layers of cell membranes
- The heads (polar) dissolve in the cellular fluid and the surroundings, and the tails (nonpolar) sandwiched between the two (see Fig.20 on pg.38)

Sterols

- Lipids with no fatty acid tails
- Have a rigid backbone of four fused-together carbon rings
- Structural components of eukaryotic cell membranes (ex/cholesterol)
- See Fig.23 on p.39
- Precursor of steroid hormones (testosterone and estrogen)
- Bile salts and vitamin D are derived from cholesterol is one of the chemicals used by your body to make certain hormones
- has been associated with heart disease and circulatory problems
- if cholesterol forms with other fats, it can form plaque that may block vessels

Waxes

- Long chains of fatty acids linked to long chain alcohols or carbon rings
- Firms substances (beeswax) and repel water (cuticles of plants) (see p.39)