CHAPTER 24

Metabolism consists of the chemical reactions which keep us alive. Metabolism is broken down into **catabolism**, which provides energy, and **anabolism**, the building and repairing of the system. **Respiration** involves the chemical reactions of oxygen to form carbon dioxide, water and energy.

24.1 ATP: Universal Energy Currency

Adenosine triphosphate (ATP) consists of an adenine molecule attached to ribose with three phosphate residues (see Figure 24.2, page 676.) The phosphates are connected to each other by splitting out molecules of water. ADP (adenosine diphosphate) is similar to ATP but only has two phosphate residues, while AMP (adenosine monophosphate) has only one phosphate residue. Each of these molecules can be interconverted. Energy is absorbed when ADP is converted to ATP, and energy is released when ATP is converted to ADP. Therefore, ATP is sometimes called the energy currency of the cell (see Figure 24.4, page 677.)

24.2 Digestion and Absorption of Major Nutrients

In Stage I of catabolism, each category of food is broken down into simpler molecules which may be absorbed through the intestinal walls (see Figure 24.5, page 679.) In all cases, the chemical reaction involved is hydrolysis.

Carbohydrate digestion begins in the mouth where α-amylase attacks the α-glycosidic linkages of starch, resulting in the production of dextrins, maltose and glucose (see Figure 24.8, page 681.) Digestion continues in the small intestines where enzymes further break down the dextrins to maltose. The enzyme maltase then breaks down maltose to glucose. Sucrase breaks down sucrose to glucose and fructose, and lactase breaks down lactose to glucose and galactose. The end products of carbohydrate digestion are glucose, fructose and galactose.

Digestion of proteins begins in the stomach where pepsin and hydrochloric acid begins to denature the proteins and hydrolyze peptide linkages. This action continues in the small intestine where additional enzymes (see Figure 24.12, page 683) ultimately break down the proteins into amino acids which can then be absorbed (see Figure 24.9, page 682.)

The digestion of lipids begins in the small intestine. Since the lipids are not water soluble they tend to accumulate into globules, and first must be emulsified by bile salts, a natural "soap." This action speeds the breakdown of the lipids by lipase, which hydrolyzes the esters of the triglycerides to diglycerides, monoglycerides, fatty acids and glycerol (see Figure 24.13, page 684.)

The fatty acids and monoglycerides are absorbed by simple osmosis (**passive transport**) while the monosaccharides and amino acids require energy (**active transport**.)

24.3 Overview of Stage II of Catabolism

In stage II of catabolism, the simple sugars, fatty acids and amino acids produced in stage I are broken down by specific metabolic pathways to form a common end product, acetyl-coenzyme A (acetyl-CoA, see Figure 24.16, page 685.) Acetyl-CoA is the starting material for the synthesis of triglycerides, phospholipids, cholesterol, steroids and ketone bodies. Acetyl-CoA may also be oxidized to carbon dioxide in the Krebs cycle of stage III of catabolism (see Figure 24.18, page 686.)

24.4 The Krebs Cycle - skim

24.5 Cellular Respiration - skip

The cyanide ion is an irreversible inhibitor of the enzyme cytochrome oxidase, which is necessary in cellular respiration. Cyanide ion is extremely toxic since it can exert its poisonous effect immediately. Cyanide is also found covalently bonded in amygdalin, a substance found in pits of apricots and bitter almond. Amygdalin was sold as a cure for cancer in the product Laetrile. Laetrile was never sold in this country, but many people traveled to Mexico for Laetrile treatment.

24.6 Muscle Power

Much of the energy in ATP is used for muscle contraction.