Making Connections

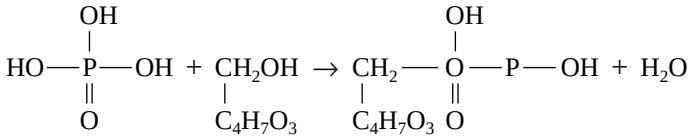
10. (Sample answer) Paper or Plastic Bags
    Paper:
    Advantages—made from renewable resources, e.g., wood fibres; biodegradable and is decomposed in a short time, releasing the atoms and molecules to be recycled; strong; can be reused in many applications, e.g., wrapping parcels, book covers. Disadvantages—can rip easily; becomes soggy when wet; not waterproof.
    Plastic:
    Advantages—strong and flexible; waterproof; can be reused in many applications, e.g., as garbage bags; less bulky than paper bags when folded for storage; low cost. Disadvantages—made using nonreusable resources; not readily decomposed; takes up landfill sites.
11. (a) The acetylated amino group contains a polar carbonyl group that is capable of forming strong hydrogen bonds with the hydroxyl groups in the polymer. Chitin molecules, being similar to cellulose, are linear and the inter-chain hydrogen bonds pack the polymer chains tightly together, giving the molecule strength and rigidity.
    (b) Strong and rigid, insoluble in water (large size) or nonpolar solvents (abundance of polar groups).
    (c) Highly suitable as protective covering because of its structural strength and its insolubility in water and nonpolar solvents.

2.6 NUCLEIC ACIDS

PRACTICE

(Page 131)

Understanding Concepts

1. Deoxyribonucleic acid. It carries the genetic information codes for the sequence of amino acids in protein synthesis.
2. A phosphate group, a five-carbon sugar called ribose, and a nitrogenous base which contains an amino group.
3. (a) Covalent bonds: formed from condensation reactions between the hydroxyl groups of the phosphate on one nucleotide and the ribose of another nucleotide, forming a ribose–phosphate backbone.
   (b) Hydrogen bonds: formed between the NH groups and the C=O groups of the nitrogenous bases from adjacent strands.
4. 

   phosphoric acid deoxyribose
5. Its structure allows it to be flexible and coiled into tertiary structures to be stored in the nucleus of the cell. The nucleotides are paired specifically (AT and CG), requiring that one strand in the double helix is an exact opposite copy of the other strand. When each strand is replicated, a new opposite strand identical to its original partner is produced. This mechanism allows the genetic information to be copied and distributed to other cells.
6. (a) Heat, change in pH, and high-energy radiation (e.g., gamma rays, beta rays, X rays, and UV light).
   (b) Any change in the DNA sequence causes a change in the sequence of amino acids synthesized in its designated protein. The change in amino sequence results in the synthesis of a different protein or no protein at all; the faulty or absent protein causes a faulty or absent cell function.

SECTION 2.6 QUESTIONS

(Page 132)

Understanding Concepts

1. (a) adenine, guanine, thymine, cytosine
   (b) Similarities: They all contain a phosphate group, a ribose, and a nitrogenous base. All four bases are ring structures of carbon and nitrogen, and contain NH groups. They differ in the nitrogenous bases, with A and G having two rings joined together and C and T having a single ring.
2. RNA is ribonucleic acid. It is similar to DNA and is also involved in protein synthesis. The ribose unit in RNA contains an extra OH group in place of one of the H atoms.

3. The helical structure allows the DNA molecule more flexibility and the capability of coiling to be stored in a smaller space, the nucleus. This structure also allows the DNA molecule to readily uncoil and be replicated. A linear fibrous structure would give more structural strength, not needed in DNA function, and restrict flexibility.
4. (a) Hydrogen bonding between groups in different sections of the same DNA strand produces the helical or pleated-sheet secondary structure of a single strand of DNA.
   (b) Hydrogen bonding between groups on adjacent strands holds the two strands together, forming a double helix.
5. Changes in DNA sequence alters its structure, and also alters the sequence of the amino acids in proteins it is coded to synthesize in the cell. This leads to synthesis of incorrect proteins or no proteins; if the missing protein or the faulty section of the protein is essential to cell function, the organism cannot function properly.
6. Since the number of A = the number of T, and the number of C = the number of G, one might conclude that A and T are always paired, and C and G are always paired.

Applying Inquiry Skills

7. (Sample answers) If each amino acid is coded by 1 nucleotide: 4 nucleotides can code for only 4 amino acids. If each amino acid is coded by 2 nucleotides, we can have AA, AC, AG, AT; CA, CC, CG, CT; GA, GC, GG, GT; TA, TC, TG, TT: total 16 amino acids. Numerically, $4^2 = 16$ combinations, not enough to code for 20 amino acids. If each amino acid is coded by 3 nucleotides, list all combinations beginning with A: AAA, AAC, AAG, AAT; ACA, ACC, ACG, ACT; AGA, AGC, AGG, AGT; ATA, ATC, ATG, ATT; (total 16 combinations). Repeat list combinations beginning with C, then G, then T. Total: $16 \times 4 = 4^3 = 64$ combinations. Therefore, 3 nucleotides assigned per amino acid can code for at least 20 amino acids.

Making Connections

8. (a) Proteins: amino groups and carboxyl groups (carbonyl and hydroxyl groups). Carbohydrates: hydroxyl groups and carbonyl groups. Nucleic acids: hydroxyl groups, amino groups, carbonyl groups.
   (b) All form hydrogen bonds between the functional groups listed in (a).
   (c) In all the helical structures of these polymers, monomers are linked by strong covalent bonds, giving the polymers stability. Proteins, starch, glycogen, DNA, and RNA are all flexible and mobile in the organism, enabling each polymer to function where needed: proteins such as enzymes where needed, starch and glycogen transported for energy storage or release, and DNA and RNA to replicate or to sites of protein synthesis in the cell.
9. To find out the circuit protected by each fuse, remove the fuses, one at a time, and determine which electrical outlet or electrical appliance no longer functions. (For example, if fuse #1 is removed, and the kitchen outlets and refrigerator are turned off, then fuse #1 must control the circuit for the kitchen and refrigerator.)
10. Minimize time spent in the Sun; wear protective clothing such as hats, long-sleeved shirts, long pants; wear sunscreen; do not use tanning lights.

2.7 FATS AND OILS

PRACTICE

(Page 136)

Understanding Concepts

1. $CH_3(CH_2)_7CH=CH(CH_2)_7COOCH_2$
   $CH_3(CH_2)_7CH=CH(CH_2)_7COOCH$
   $CH_3(CH_2)_7CH=CH(CH_2)_7COOCH_2$
2. As corn oil is a liquid at room temperature, it is likely to contain unsaturated fatty acids. A hydrogenation process to add hydrogen atoms to the carbon–carbon double bonds may be necessary to change corn oil into a saturated fat with a melting point above that of ordinary room temperature.
3. $CH_3(CH_2)_{16}COO-CH_2$
   $CH_3(CH_2)_{16}COO-CH + 3\,NaOH \rightarrow 3\,CH_3(CH_2)_{16}COONa + \text{glycerol}$
   $CH_3(CH_2)_{16}COO-CH_2$
   sodium stearate
   (soap: Na^+ salt of fatty acid)