SUMMARY OF CHAPTER 8

THE HUMAN ORGANISM AND BIOTECHNOLOGY

1. WHAT IS A BIOTECHNOLOGY?

- A biotechnology is a technology that is applied to living organisms or substances derived from living organisms in order to meet a need or a desire (p. 236).
- Traditional biotechnologies have been used since early human history (p. 237).
- Modern biotechnologies have been developed over the last three centuries (p. 239).

2. TRADITIONAL BIOTECHNOLOGIES

- Selective breeding increases the presence of desired traits within a population by bringing two specimens with one or more of the desired traits together to reproduce. This biotechnology leads to improved crop production and animal breeding, and thus produces new crop varieties and animal breeds that better meet human needs (p. 238).
- In food production, the use of bacteria, enzymes and yeast has led humans to turn milk into cheese and yogurt, grains into bread, and grapes into wine (p. 239).

3. MODERN BIOTECHNOLOGIES

- Modern biotechnologies are based on two principal methods: cell culture and genetic transformation.
  - Cell culture involves the multiplication of strain(s) of cells under controlled conditions (p. 239).
  - Genetic transformation involves the manipulation of genetic information or one or more genes of a living organism (p. 239).
- The process of culturing cells consists of at least four steps: 1) collection of sample from the environment of origin; 2) transfer of cells to an appropriate culture medium; 3) incubation of cells in favourable conditions; 4) growth of new cells (p. 241).
- The following parameters must be controlled in a culture medium: 1) water level; 2) nutrient composition; 3) mineral level; 4) oxygen and carbon dioxide levels; 5) temperature; 6) pH; 7) amount of light (p. 242).
- Culture media are usually liquid or solid. A liquid medium may also be called a broth. A solid medium is a broth containing a substance that has made it gelatinous (p. 242).
- Growth in a cell culture goes through four phases: 1) lag phase, or adaptation; 2) logarithmic (log) phase, a phase of division; 3) stationary phase; 4) death phase (p. 243).
- When lab technicians grow a cell culture, they keep all of the lab materials sterile. There are different methods of sterilization (p. 244).
- A GMO (genetically modified organism) is a living organism that has had its DNA modified through genetic transformation to provide it with traits it would not otherwise possess (p. 245).
- Genetic transformations generally follow the same six steps: 1) identification of a need or desire; 2) identification of a trait that meets the need or desire; 3) identification and isolation of the gene producing the desired trait; 4) replication of the gene; 5) transfer of the desired gene into the cells of the organism that is being modified; 6) culture of genetically modified cells (pp. 246–247).
- In cloning, the nucleus of an unfertilized egg is replaced with a nucleus from a cell of the organism to be cloned. Cloning produces a living organism genetically identical to another living organism (p. 247).

4. APPLICATIONS IN THE AGRO-FOOD INDUSTRY

- Genetic engineering researchers are currently working to develop genetically modified plants. Such research can improve crop yield by producing varieties resistant to herbicides, insects, viruses or rigours of climate or that have a longer shelf life. The goal may also be to improve a plant's nutritional qualities (p. 249).
- Large quantities of corn, soy and canola crops cultivated in Canada are already genetically modified (p. 250).
- Scientists are also working in the field of genetically modified animal species. Results of such research could include increases in growth rates, manure that is less harmful to the environment, production of milk with specific properties, etc. (p. 250).
- It is illegal in Canada to market a genetically modified animal (p. 250).
- Pasteurization is a process whereby food is heated for a time in order to destroy harmful microorganisms and thus prolong its shelf life (p. 251).

5. MEDICAL APPLICATIONS

- Immunity is the body's capacity to resist infectious agents that cause disease (p. 253).
- White blood cells defend the body in two ways:
  - by destroying infectious agents (p. 253)
  - by producing antibodies, which neutralize the infectious agents and the antigens they produce (p. 253)
- A vaccine is a prepared substance that is able to immunize an organism against one or more diseases (p. 254).
- A live vaccine is produced from attenuated cultures of the infectious agent (p. 255).
- An inactive vaccine is developed from antigens secreted by an infectious agent (p. 255).
- The government of Québec has established a vaccination schedule that it recommends for all of its citizens. The vaccines in this schedule are free of charge (p. 257).
- From a medical standpoint, a couple who cannot conceive a child after 12 months of sexual relations without the use of contraception is considered to be infertile (p. 258).
- Assisted reproduction refers to all medical procedures used to help women become pregnant (p. 258).
- Ovarian stimulation involves the use of medication to stimulate ovaries into developing one or more mature follicles and eggs in a single ovarian cycle (p. 258).
- For artificial insemination, semen is injected directly into the uterus on the day of ovulation (p. 259).
- In vitro fertilization begins with ovarian stimulation. The ova are taken at the moment of ovulation. A sperm sample also is collected. The ova are fertilized in a lab setting. After two to seven days of growth, the most developed embryos are transferred to the uterus (p. 259).
- The process of fertilization by microinjection resembles in vitro fertilization. The difference is that during fertilization in the lab, the physician injects the sperm cells directly into the ova with a microsyringe (p. 260).
- The body is made up of two types of cells: specialized cells and stem cells.
  - Specialized cells play specific roles in the human body. A specialized cell can only divide a limited number of times (p. 261).
  - A stem cell does not play any particular role in the human organism. It has the capacity, however, to divide many times and to transform into a variety of specialized cells (p. 262).

SUMMARY OF CHAPTER 8 (*CONTINUED*)

- Stem cells can be used to engineer replacement tissue and organs (p. 262).
- Ethical standards have been established regarding the use of stem cell cultures to ensure that the moral principles reflecting society's values are respected (p. 263).