c) These vaccines are prepared from living bacteria or viruses. Scientists have selected strains whose power to cause disease has been lost. *Attenuated vaccine*

Assisted Reproduction (*pages 420 to 424*)

8. *a)* What is assisted reproduction? *Assisted reproduction is defined as all medical procedures that facilitate the union of an ovum and spermatozoon for the purposes of achieving fertilization.*

b) What is it used for? *It helps infertile or sterile couples to conceive a child.*

9. Associate one or more of the following procedures with the statements that follow:

- Hormonal treatment
- Artificial insemination
- *In vitro* fertilization
- Intracytoplasmic sperm injection

a) A specialist deposits the spermatozoa in the woman's uterus. *Artificial insemination*

b) In the laboratory, a specialist puts an ovum in contact with several thousand spermatozoa. In vitro *fertilization*

c) A specialist implants embryos in the woman's uterus. In vitro *fertilization, intracytoplasmic sperm injection*

d) This treatment is used to correct ovulation problems, or it is used in conjunction with artificial insemination or *in vitro* fertilization. *Hormonal treatment*

e) Fertilization takes place in the laboratory. In vitro *fertilization, intracytoplasmic sperm injection*

f) In the laboratory, a spermatozoon is inserted directly into an ovum. *Intracytoplasmic sperm injection*

g) A preimplantation diagnosis can be performed on embryos In vitro *fertilization, intracytoplasmic sperm injection*

10. Put the stages of *in vitro* fertilization in the right order.

1) Implantation of selected embryos
2) Collection of ova
3) Fertilization in the laboratory
4) Administration of a hormonal treatment to the woman
5) Growth of embryos
6) Collection and treatment of semen
7) Selection of embryos to implant

Answer: 4, 6, 2, 3, 5, 7, 1. On page 423 of the student textbook, fertilization in the laboratory (3) and growth of embryos (5) were combined.

Cell Cultures (*pages 425 to 427*)

11. *a)* What is cell culture? *A cell culture is a process by which cells are reproduced outside their natural environment i.e. outside the organism they originate from.*

b) What kinds of cells can be cultivated? *Unicellular micro-organisms, such as bacteria and yeast, or cells from multicellular organisms, such as plants and animals, can be cultivated.*

c) Name two applications of cell culture. *This technique helps researchers to understand how cells work. It is also used in the testing of medication and beauty products, and verifying the toxicity of chemical products. Cultivated cells are also instrumental in the production of certain vaccines. Furthermore, cell*

cultures can produce tissues such as skin used in grafts for burn victims. They can also be used to diagnose illnesses or assess a certain type of leukemia.

d) What is the advantage of cultivating cells from cancerous tumours rather than from normal cells? *Cancer cells have an infinite capacity to divide themselves.*

12. Culture media are instrumental in the growth and survival of cultivated cells.

a) What should a culture medium contain? *A culture medium should contain everything the cells need to grow normally.*

b) Why must cultivated cells be transferred frequently into new culture media? *Cells must be transferred frequently to new culture media because the medium becomes depleted as the cells use up the nutrients.*

13. Cell culture requires a recreation of the conditions of the cell environment.

a) Why are these conditions reproduced in the laboratory? *These conditions are reproduced to encourage the normal growth and reproduction of cells.*

b) Give three examples of these conditions. *Temperature, pressure, humidity, pH*

14. Why is it important to work in a sterile environment? *Working in a sterile environment helps to prevent contamination of the cultivated cells.*

Genetic Transformation (*pages 428 to 430*)

15. *a)* What does the term "GMO" mean? *GMO means "genetically modified organism."*

b) What is the definition of a GMO? *A GMO is a living organism whose genetic material has been modified by the introduction of one or more foreign genes with a view to imparting new characteristics to the organism.*

16. *a)* What is the purpose of modifying an organism's genes to create a GMO? *An organism's genes are modified to provide it with new and improved characteristics that might be beneficial to humans.*

b) Give two examples of GMO applications. *Various answers: e.g. obtaining plants that are more resistant to stress, insects and parasites and that tolerate herbicides; delay the ripening of a food; increase the nutritional value of a food; produce medication, biodegradable plastics and biofuels*

17. *a)* What is the name of the process that consists in inserting into the organism a gene that is foreign to it? *Transgenesis*

b) Put the stages of this process in the right order.

1) Insertion of the gene of interest into the cells of the organism to be modified
2) Selection of the organisms in which the genetic modification has worked
3) Extraction of the gene of interest from the donor organism
4) Identification of a significant characteristic (or gene of interest) in a donor organism, and locating the gene responsible for this characteristic in its DNA

Answer: 4, 3, 1, 2

Ethical Questions Raised by Biotechnology (*page 430*)

18. Explain why assisted reproduction raises ethical questions. *The intervention of science in life's origins makes it contentious. Objections may be founded in religion, but they may also be made from a strictly moral point of view. The possibility of making a preimplantation diagnosis on an unborn child can give rise to certain forms of racism or sexism. Furthermore, the health problems and costs associated with multiple pregnancies and premature births cannot be ignored.*

19. Name two fears elicited by the creation of GMOs. *Genes introduced into certain plants can accidentally spread to other species and cause undesirable consequences. The introduction of a foreign gene into a food can cause allergic reactions. Genetically modified variations that are stronger and more resistant can cause traditional varieties to disappear.*