Section 18.4 Review Answers

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1. Studying the human genome offers the potential for developing drugs that are tailored not only to the expression of individual genes associated with particular disorders, but also to the unique genome of a patient. Studying the differences in gene expression among individuals can also help medical researchers understand why certain drugs work better in some people than in others, and why certain people experience side effects from medications.
2. A DNA microarray is a chip (usually a glass microscope slide or a polymer membrane) that contains a grid of thousands of cells. Each cell contains a nucleic acid sequence that can bind with one of the mRNA molecules transcribed during gene expression.

   A DNA microarray allows scientists to analyze the activity of thousands of genes at once. The results of a microarray allow scientists to pinpoint the genes that are responsible for particular functions or conditions, to study the interactions among genes, or to gather information about the relationship between environmental conditions and gene expression.

3. (a) Some of the issues that might be considered are: Who owns the genetic information? Should companies have the right to sell DNA information to other companies without the permission of the people who provided the samples? Should companies that use DNA in medical research be required to share the results of their work with the individuals, or communities, whose genetic information was used? Where is the boundary between public and private genetic property rights?

(b) Providing genetic information should be voluntary. Genetic information can provide medical benefits to many. Research should be funded so as to maximize benefit, for as many as possible. It is reasonable for companies to expect a return on their investment in genetic research. The outcome of the research should be widely available.

4. (a) Prior to approving the plant for use and human and livestock consumption, it should be demonstrated that it is safe and there are no short-term, nor long-term adverse effects resulting from its consumption. Testing on laboratory animals may not be conclusive in determining whether of not it is safe for human consumption. The benefits are that this transgenic carrot plant can be grown without the use of harmful pesticides.

(b) The advantages include that this plant can be grown without the use of harmful pesticides that may affect other organisms. The development of this plant was expensive, and this cost is passed on to the farmer. Genetically modified and organically grown foods are generally more expensive than non-modified crops that are treated with pesticides.

(c) Responses will reflect the student's beliefs on this issue. An example answer might be: Yes, consumers should be aware of what they are buying. Informed choices can only be made if the consumer is provided with the information upon which to base his/her decision. Arguments that could be made to support the other viewpoint include:

- If Health Canada and other similar agencies have policies to protect the public, then it should not be necessary to provide detailed information, other than labelling the product as being tested and approved for consumption by a reputable agency.
- Informing the public of the details of testing and approving consumer products could be costly, and may be difficult for the public to understand.

5. (a) During an ultrasound procedure, sound waves beyond the limit of human hearing are sent through the amniotic fluid. The sound waves bounce off the developing fetus and produce a cross-sectional image of the fetus. This image can reveal physical abnormalities, such as a missing limb, malformed heart, or cleft palate.

(b) In chorionic villi sampling, cells from the chorion can be removed and examined to determine their genetic information. This may reveal whether or not the fetus is at risk of developing a genetic abnormality.

6. A DNA probe consists of a molecule of DNA with a nucleic acid sequence that is complementary to a specific genetic marker sequence, "marked" with a radioactive or fluorescent chemical tag. DNA from the tissue sample is placed in a suspension with the DNA probe. If the DNA sample contains the gene of interest, the probe will bind to the marker sequence. Using the tag, researchers can verify the gene of interest and possible genetic abnormality, as genetic makers for many human genetic disorders have been identified.

7. Somatic gene therapy is aimed at correcting genetic disorders in somatic cells (cells that do not produce eggs or sperm). This therapy can improve the health of a patient; it does not prevent the disorder from being passed on to the patient's children. Germ-line therapy is used to modify the genetic information carried in egg and sperm cells. In theory, this kind of therapy could eliminate inherited genetic disorders. In reality, however, it could have many unforeseen effects on future generations. Human germ-line therapy research is currently banned in Canada and in many other countries.

Somatic gene therapy can be used in the treatment of cancer by inserting a gene that destroys cancer cells into somatic cells that are at risk of becoming a malignant cancer. Thus, the precancerous cells may be destroyed before cancer can develop. Similarly, by using germ-line therapy and inserting a gene that destroys cancer cells into germinal oogonial or spermatogonial cells whose family history show a risk of cancer, any precancerous cells may be destroyed before cancer can develop.