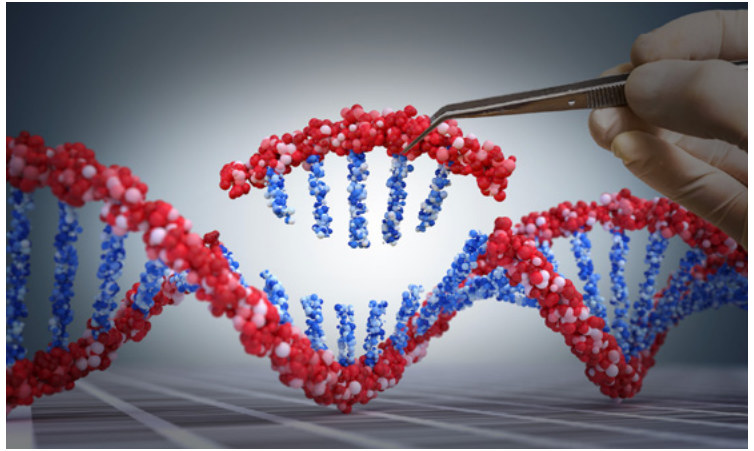


Genetic Technologies

- 7.1 [The Human Genome](#)
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End of Chapter Questions

Simple Review Questions

7.1 The Human Genome

1. How many genes does a human have?

2. What is an SNP?

7.2 Inherited Diseases and Genetic Testing

3. What is a pedigree?

4. Explain what a carrier of a disease is.

7.3 Cancer: A Genetic Disease

5. Is cancer usually the result of a single genetic mutation?



6. What does it mean for a cancer to have metastasized?

7. What are some of the most important cancer-related environmental risk factors?

8. How is the loss of ozone from Earth's atmosphere related to skin cancer?

7.4 DNA Technology and Genetic Engineering

9. What is a genetically modified organism?

10. Use examples to describe how genetically modified organisms are useful to humans.

11. Explain how a mammal is cloned.

7.5 Case Study: Genetically Engineered Mosquitoes

12. Explain how genetically engineered "friendly male" mosquitoes can help address mosquito-borne diseases.



13. Why might it be better to develop mosquitoes that are resistant to diseases such as malaria than to drastically decrease mosquito populations?

7.6 Methods in Genetic Engineering: Genome Editing with CRISPR-Cas9

14. What does the CRISPR-Cas9 technology allow scientists to do?

7.7 Concerns About DNA Technology

15. Describe some of the safety, social, and ethical concerns that relate to genetically modified crops.

(CLICK TO CHECK YOUR ANSWERS)

Challenging Review Questions

7.1 The Human Genome

16. Does all your DNA code for proteins?

17. Explain how studying SNPs could help scientists identify genes that are related to specific human diseases.



7.2 Inherited Diseases and Genetic Testing

18. The allele for Tay-Sachs disease behaves as a recessive. A couple would like to know if their children are at risk for the disease and go in for genetic testing. The test reveals that one of them is a carrier of Tay-Sachs but the other is not. Is this couple at risk of having an affected child?

19. The allele for Tay-Sachs disease behaves as a recessive. A couple would like to know if their children are at risk for the disease. Both are carriers of Tay-Sachs. Are their children at risk of being affected by Tay-Sachs disease?

7.3 Cancer: A Genetic Disease

20. Cancer is caused by “genes gone awry”—yet cancer is not usually an inherited genetic condition. Explain why.

21. Are older people or younger people more likely to develop cancer? Defend your answer.

22. What are some factors that could make certain people more likely to develop cancer than others?

23. Explain how the chlorofluorocarbons (CFCs) in refrigerants and aerosol sprays affect Earth’s ozone layer. Have international agreements to phase out the use of CFCs helped restore the ozone layer?



24. Australia has one of the highest skin cancer rates in the world. Scientists believe that two factors behind this are the high UV radiation levels present there and the popularity of tanning. Explain how these factors could lead to unusually high skin cancer rates.

7.4 DNA Technology and Genetic Engineering

25. How can genetic engineering help humans adapt to global warming and climate change?

26. How might genetic engineering affect the human diet in the future?

7.5 Case Study: Genetically Engineered Mosquitoes

27. Describe three different genetically engineered mosquitoes and the advantages of each in helping to control mosquito-borne diseases such as malaria.

7.6 Methods in Genetic Engineering: Genome Editing with CRISPR-Cas9

28. How does the CRISPR-Cas9 genome editing technology work?

29. Are there any ethical concerns regarding the use of CRISPR-Cas9 technology?



7.7 Concerns About DNA Technology

30. What is a “superweed”? Explain the benefits and dangers of genetically engineered crops that are resistant to herbicides.

31. Write an imaginary letter to your grandfather telling him about genetically engineered organisms. Tell him why the development of this technology could result in many practical applications. Also tell him about the potential dangers of this technology. Are you more excited or more worried about the possible consequences of DNA technology?

(CLICK TO CHECK YOUR ANSWERS)

Apply & Discuss Questions

32. Artemisinin is a powerful antimalaria drug. Unfortunately, it is expensive and in short supply because it must be extracted from the leaves of the sweet wormwood tree, a rare plant with a very limited distribution. As a result, many of the populations that suffer most from malaria cannot afford artemisinin. Could DNA technology be used to address this problem?



33. Does this cartoon make you excited about DNA technologies or worried about it? If you were a lawmaker, what constraints would you place on DNA technology? Should there be different rules regarding applying DNA technology to humans and applying it to other species?



(CLICK TO CHECK YOUR ANSWERS)



End of Chapter Solutions

Simple Review Solutions

1. Humans have a total of about 19,000 genes.
3. A *pedigree* is a family tree that shows which relatives are affected by genetic disease.
5. A mutation in a single gene is not enough to produce cancer—mutations in many important genes are required.
7. Environmental factors that increase cancer risk include smoking, diet, radiation, ultraviolet light, chemicals, and infection by certain viruses and bacteria.
9. A genetically modified organism, or GMO, is an organism whose DNA has been changed through genetic engineering.
11. Cloning is done through a process called nuclear transplantation, in which the nucleus of a cell from the animal being cloned is placed in an egg cell that has had its own nucleus removed. The resulting embryo is then implanted in a surrogate mother.
13. The advantages of this approach are that wiping out mosquito populations is not necessary and unintended consequences are less likely.
15. Although DNA technology has been the source of great excitement, it has also given rise to serious concerns. Could scientists accidentally release a deadly bacteria or virus? Are transgenic plants and animals safe to eat? Are transgenic crops damaging the environment and giving rise to dangerous “superweeds”? Also, which DNA technologies could one day be applied to humans, and how will this impact our society and culture? Finally, who will have access to DNA technologies?

Challenging Review Solutions

17. Scientists can look for SNPs that are unique to people who share a certain disease or condition. Such SNPs would likely be found within genes that are related to that disease or condition.
19. Yes. There is a $\frac{1}{4}$ chance their child would inherit two recessive disease alleles and suffer from Tay-Sachs disease.
21. Cancer occurs as a result of mutations in many of the key genes that control cell division. Older people are more likely to develop cancer than younger people because mutations have had more time to build up in their cells.
23. The chlorine in CFCs speeds up the breakdown of ozone, causing it to become depleted. An international agreement to phase out the use of CFCs has succeeded in shrinking the ozone hole. This is considered one of the world’s major environmental successes.
25. A lot of effort is currently going towards developing genetically engineered plants that are resistant to drought and high temperatures, both of which have worsened with global warming.



27. The British company Oxitec has developed genetically engineered “friendly male” mosquitoes. These males mate normally with females, but they have special genes that cause their offspring to die as larvae, so that they never grow to become biting adults. A group at Imperial College London has developed a “gene drive” that spreads female infertility in mosquitoes. Both of these have the potential to reduce mosquito populations. Groups at the University of California, Irvine, and the University of California, San Diego, are developing genetically engineered mosquitoes with high activity in the part of the immune system that fights the malaria parasite. These mosquitoes are resistant to malaria and will not transmit the disease to humans.

29. A big unanswered question is, what limits should be placed on editing the human genome? Although most people agree that using a technology such as CRISPR-Cas9 to treat disease is reasonable, people disagree about whether other uses are ethical. For example, is it ethical to use genes to improve or “enhance” human traits? Many people also favor a ban on the use of genetic technologies in human eggs and sperm, where they would produce genetic changes that would then be passed from one generation to the next.

31. Dear Grandpa, A genetically engineered organism is one whose DNA has been changed through technology. Many genetically engineered organisms have practical applications. Examples include *E. coli* that produce human insulin, plants that can grow under difficult conditions—for example, in unusually salty soils or during times of drought and high temperatures, and animals that can be used to study human diseases. Although this sounds good so far, there are potential dangers as well. Some people worry about the accidental release of deadly bacteria or viruses. Others worry that genetically engineered plants and animals are dangerous to human health, or that they will damage the environment, for example by spreading their genes to native populations. Finally, some scary things could happen if DNA technologies are used on humans.

Apply & Discuss Solutions

33. Answers will vary, but this is an important question!

