

TO THINK ABOUT:

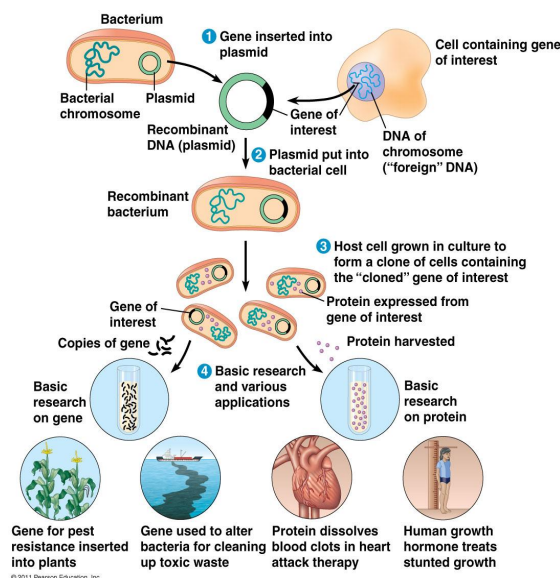
- DNA cloning yields multiple copies of a gene or other DNA segment
- DNA technology allows us to study the sequence, expression, and function of a gene
- The practical applications of DNA technology affect our lives in many ways
- The potential benefits and concerns of developing transgenic and genetically modified organisms for human purposes
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READ:

- Chapter 20

KEY TERMS: Here is a list of key terms and concepts you will hear about and see during the chapter readings. Get to know them!

<i>Biotechnology</i>	<i>Plasmids</i>	<i>Knock out genes</i>	<i>Ex vivo / In vivo</i>
<i>Recombinant DNA</i>	<i>Transformation / Transgenic</i>	<i>Cloning</i>	<i>Genetically Modified Organism (GMO)</i>
<i>Genetic Engineering</i>	<i>Genomic library</i>	<i>Nuclear transplantation</i>	<i>Genetic profile</i>
<i>DNA cloning</i>	<i>Polymerase chain reaction (PCR)</i>	<i>Restriction fragment length polymorphism (RFLP)</i>	<i>Short tandem repeats (STR)</i>
<i>Restriction enzymes</i>	<i>Gel electrophoresis</i>	<i>Single nucleotide polymorphism (SNP)</i>	<i>Genomics</i>
<i>Restriction site</i>	<i>Southern Blotting</i>	<i>Gene therapy</i>	<i>Proteomics</i>
<i>Sticky ends</i>	<i>DNA sequencing</i>		<i>Bioinformatics</i>
<i>Vector</i>	<i>DNA microarray</i>		



QUESTIONS FOR YOUR BILL:

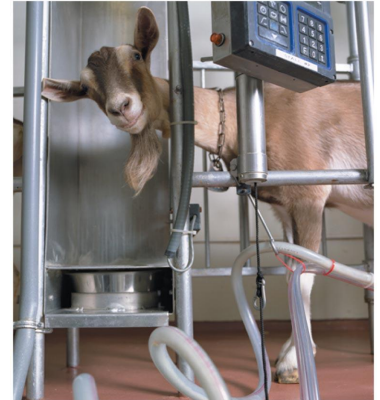
Recombinant DNA Technology

1. Define the following terminology: *biotechnology*, *genetic engineering*, *recombinant DNA*, *gene cloning*,
2. Describe the natural function of *restriction enzymes* and explain how they are used in *recombinant DNA* technology.
3. Using a drawing to explain how the creation of *sticky ends* on the *restriction fragments* by restriction enzymes is useful in producing a recombinant DNA molecule.
4. Make a cartoon strip that outlines and explains step-by-step the procedures for *engineering and cloning* a eukaryotic gene (such as human insulin or human growth hormone) in a bacterial plasmid.
5. Explain the rationale for including a gene for *antibiotic resistance* and a gene that codes for a *hydrolytic enzyme* (such as PGAL or arabinose in pGLO) in the plasmid.

6. Explain the purpose of the polymerase chain reaction (PCR). Why is it useful?
7. Explain the function of the following in PCR
 - a. Taq polymerase
 - b. primers.
 - c. thermal cyclers.
8. Explain what happens during each phase of a PCR cycle, and the temperature at which each phase occurs:
 - a. Denaturation.
 - b. Annealing.
 - c. Elongation.
9. Create a cartoon strip that outlines and explains step-by-step how to run a *gel electrophoresis* to analyze a series of DNA samples.
10. Where will the smallest fragments of DNA be found on a gel after it runs? Where will the largest fragments be found? How is the size of a particular fragment determined?

Biotechnology Products

11. Distinguish between a transgenic animal and a cloned animal.
12. Create a series of drawings and use your drawings to describe how *nuclear transplantation* was used to produce Dolly, the first cloned sheep.
13. Explain why cloned animals are so likely to have *defects*.
14. Distinguish between *reproductive cloning* and *therapeutic cloning*.
15. What is *pharming*, how is it done, and what are its advantages over more conventional biotechnology approaches?
16. Create a t-chart that lists the benefits and drawbacks to genetic modification of organisms.



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Gene Therapy

17. Describe the methods that are being used to introduce genes in human beings for gene therapy.
18. Discuss an example of ex vivo and of in vivo gene therapy.

Genomics

19. Distinguish between the *genome* and the *proteome* of a cell.
20. What was the purpose of the Human Genome Project? What is the goal of functional genomics.
21. Summarize the difference between a short tandem repeat and a transposon.
22. How does short tandem repeats (STR) profiling produce a DNA fingerprint?
23. What is the purpose of a DNA "library"? How can specific genes be retrieved from a DNA library?
24. What are the differences between a genomic library and cDNA library?
25. Explain why we would want to determine the base sequence of a piece of DNA.
26. What are dideoxynucleotides? Why are they used in DNA sequencing?
27. Explain how the Sanger sequencing method works.
28. How has sequencing technology advanced since the development of the process by Fred Sanger? Give three examples.
29. Explain the relationship between single nucleotide polymorphisms ("SNPs") and restriction fragment length polymorphisms ("RFLPs")? How are they caused and why do they matter?
30. Outline the steps involved in "knocking out" a gene in a bacterium and in an animal. What are the uses for these methods?
31. What is the purpose of a microarray? Give an example of a real-world application of microarray analysis.
32. Explain how the use of microarrays and bioinformatics aids in the study of genomics and proteomics.
33. What are the goals of proteomics and bioinformatics?
34. Give three examples of things that the biotechnology revolution has allowed us to do that couldn't have been done at a prior point in human history.

You will most likely need to do a bit of research to answer these questions:

35. From a legal standpoint, how much information do you have a right to know about the genetically engineered nature of the food you eat and the products that you consume?
36. From a legal standpoint, how much information do other people and entities have the right to know about your genome?
37. From a legal standpoint, what sorts of genetically engineered technologies are individuals allowed to copyright?
38. From a legal standpoint, what constraints are placed on the scientific establishment with regard to altering the genetic material of organisms?

This one is for your own consideration:

39. Consider the answers to the last five questions. From a personal moral/ethical standpoint, how do you feel about those answers?

SUPPLEMENTARY RESOURCES: Click the links below for more information to help you learn more about this lesson.

Interactives

- **Pearson's BioCoach Activity:** [Restriction Enzyme Digestion of DNA](#)
- Utah Learn Genetics: [Virtual Lab – Gel Electrophoresis](#)
- Utah Learn Genetics: [Virtual Lab – Polymerase Chain Reaction \(PCR\)](#)
- Utah Learn Genetics: [Transgenic Mice](#)
- Utah Learn Genetics: [Gene Therapy](#)
- Utah Learn Genetics: [Cloning](#)
- DNA Learning Center Online Lab: [Bacterial Transformation](#)
- DNA Learning Center Online Lab: [DNA Fingerprinting](#)
- DNA Learning Center Online Lab: [Restriction Analysis](#)
- NCBI ([National Center for Biotechnology Information](#))
- Utah Learn Genetics: [Virtual Lab – DNA Microarray](#)
- Scitable by Nature: [Genomics](#)
- National Genome Research Institute – [Human Genome Project](#)
- National Genome Research Institute – [Home Genome Project – In Depth](#)
- National Center for Biotechnology Information (NCBI) – [Bioinformatics Fact Sheet](#)
- National Center for Biotechnology Information (NCBI) – [Genome Mapping Fact Sheet](#)
- National Center for Biotechnology Information (NCBI) – [SNPs](#)
- Sumanas, Inc. Animation – [Creating a DNA Library](#)
- DNA Learning Center – [Knockout Genes](#)

Lectures

- Bozeman Biology's "[Molecular Biology](#)" video.