**AP Biology Exploration Study Guide**: Molecular Genetics #3

Unit 5 Biotechnology

**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

**Online Tasks**:

* Complete the masteringbiology.com activities for CH 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!

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

**Questions for study:**

**Recombinant DNA Technology**

1. Define the follow 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 drawing 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 **(\*this will be done AFTER this unit in 2019).**
6. Explain the purpose of the polymerase chain reaction (PCR).  Why is it useful?
7. Explain the function of the following in PCR
8. Taq polymerase
9. primers.
10. thermal cycler.
11. Explain what happens during each phase of a PCR cycle, and the temperature at which each phase occurs:
12. Denaturation.
13. Annealing.
14. Elongation.
15. Explain step-by-step how to run a *gel electrophoresis* to analyze a series of DNA samples.
16. 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? (think- standard curve!)

**Biotechnology Products**

1. Distinguish between a transgenic animal and a cloned animal.
2. Describe how *nuclear transplantation* was used to produce Dolly, the first cloned sheep.
3. Explain why cloned animals are so likely to have *defects*.
4. Distinguish between *reproductive cloning* and *therapeutic cloning*.
5. What is *pharming*, how is it done, and what are its advantages over more conventional biotechnology approaches?
6. Createa t-chart that lists the benefits and drawbacks to genetic modification of organisms.

**Gene Therapy**

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

**Genomics**

1. Distinguish between the *genome* and the *proteome* of a cell.
2. What was the purpose of the Human Genome Project? What is the goal of functional genomics?
3. Summarize the difference between a short tandem repeat and a transposon.
4. How does short tandem repeats (STR) profiling produce a DNA fingerprint?
5. What is the purpose of a DNA “library”?  How can specific genes be retrieved from a DNA library?
6. What is a genomic library?
7. Explain why we would want to determine the base sequence of a piece of DNA.
8. How has sequencing technology advanced since the development of the process by Fred Sanger?  Give an example.
9. Explain the relationship between single nucleotide polymorphisms (“SNPs”) and restriction fragment length polymorphisms (“RFLPs”)?  How are they caused and why do they matter?
10. Explain how the use of microarrays and bioinformatics aids in the study of genomics and proteomics.
11. What are the goals of proteomics and bioinformatics?
12. 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.

**Argumentative**

1. As a consumer, 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?

**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](http://www.phschool.com/science/biology_place/biocoach/red/intro.html)
* Utah Learn Genetics: [Virtual Lab – Gel Electrophoresis](http://learn.genetics.utah.edu/content/labs/gel/)
* Utah Learn Genetics: [Virtual Lab – Polymerase Chain Reaction (PCR)](http://learn.genetics.utah.edu/content/labs/pcr/)
* Utah Learn Genetics: [Transgenic Mice](http://learn.genetics.utah.edu/content/tech/transgenic/)
* Utah Learn Genetics: [Gene Therapy](http://learn.genetics.utah.edu/content/tech/genetherapy/)
* Utah Learn Genetics: [Cloning](http://learn.genetics.utah.edu/content/tech/cloning/)
* DNA Learning Center Online Lab: [Bacterial Transformation](http://labcenter.dnalc.org/labs/transformation/transformation_d.html)
* DNA Learning Center Online Lab: [DNA Fingerprinting](http://labcenter.dnalc.org/labs/dnafingerprintalu/dnafingerprintalu_d.html)
* DNA Learning Center Online Lab: [Restriction Analysis](http://labcenter.dnalc.org/labs/restrictionanalysis/restrictionanalysis_d.html)
* NCBI ([National Center for Biotechnology Information](http://www.ncbi.nlm.nih.gov/))
* Utah Learn Genetics: [Virtual Lab – DNA Microarray](http://learn.genetics.utah.edu/content/labs/microarray/)
* Scitable by Nature: [Genomics](http://www.nature.com/scitable/topic/genomics-19)
* National Genome Research Institute – [Human Genome Project](http://www.genome.gov/18016863)
* National Genome Research Institute – [Home Genome Project – In Depth](http://www.genome.gov/10001772)
* National Center for Biotechnology Information (NCBI) – [Bioinformatics Fact Sheet](http://www.ncbi.nlm.nih.gov/About/primer/bioinformatics.html)
* National Center for Biotechnology Information (NCBI) – [Genome Mapping Fact Sheet](http://www.ncbi.nlm.nih.gov/About/primer/mapping.html)
* National Center for Biotechnology Information (NCBI) – [SNPs](http://www.ncbi.nlm.nih.gov/About/primer/snps.html)
* Sumanas, Inc. Animation – [Creating a DNA Library](http://www.sumanasinc.com/webcontent/animations/content/dnalibrary.html)
* DNA Learning Center – [Knockout Genes](http://www.dnalc.org/view/897-Gene-knockout-in-mice.html)

Lectures

* Bozeman Biology’s “[Molecular Biology](http://www.youtube.com/watch?v=yYIZgS-L5Sc)” video.