An Exploration of DNA Concepts Activity
Participant Guide

Description and Estimated Time to Complete

This activity is one of two activities in the *Overview of DNA Learning Module*. This activity provides further exploration into DNA concepts and DNA's significance as the genetic material. This information should help you to better understand how microsystems are used in the exploration of DNA and how this information is used in the design of new microsystems for the medical fields.

If you have not review the Overview of DNA primary knowledge unit, you should consider reading it prior to starting this activity.

Estimated Time to Complete
Allow approximately 1 hour

Introduction

Deoxyribonucleic acid (DNA) is a long polymeric molecule found in most cells that functions as the carrier of genetic information. The information carried in the linear sequence of bases in DNA defines an organism. Changes in the linear sequence, sometimes called mutations or polymorphisms, can be used to explain differences between individuals and diagnose diseases such as cancer.

Past and current studies of DNA identify how DNA can be used in biomedical applications. Such applications include the following:

- Improve diagnosis of a disease
- Test the best treatment options for a disease
- Execute rational drug design
- Create custom drugs
- Utilizing DNA in gene therapy

Activity Objectives and Outcomes

Activity Objectives

- Describe the structure and function of DNA

Activity Outcomes
Upon completion of this activity, you will be able to describe the DNA double helix, how it is copied, and to understand its significance as genetic material.

Activity – An Exploration of DNA Concepts

1. Go to http://www.dnai.org
   Complete the "Code" tutorial

2. Go to http://www.dnai.org
   Complete the "Manipulation" tutorial

3. Go to http://www.dnai.org
   Complete the "Genome" tutorial

4. Go to http://www.dnai.org
   Complete the "Applications" tutorial

5. Answer the Post-Activity Questions.

Post-Activity Questions / Answers

"Code"

1. How do the 4 bases (A, T, C, G) fit together in the DNA double helix?

2. Watch the video on "Copying the Code". What is helicase?

3. Watch the video on Translation with the "Reading the Code" section. Why is the ribosome referred to as a molecular machine?

4. What are histones and what is their function within the cell?

5. What is an operon?

"Manipulation"

1. What is transformation?

2. What is a restriction enzyme?

3. How are pieces of DNA that have been cut with a restriction enzyme pasted back together?

4. What methods of large scale analysis of DNA are described?

5. View the descriptions of DNA microarrays and GeneChips™. Are these large scale analysis methods examples of BioMEMS?

"Genome"

1. What is a consensus sequence?
2. How are gene density and GC content of DNA related?
3. What is a chromosome?
4. How much DNA is inside every nucleus in our cells?
5. Who headed the private Human Genome Sequencing Project?

"Applications"

1. What is the technique of DNA fingerprinting?
2. What DNA variation did Alec Jeffreys examine in his initial DNA fingerprints?
3. What DNA source has been used to construct a maternal lineage map?
4. What technique does the FBI currently use for DNA profiling?
5. How are DNA segments separated for analysis of STRs?

Matching Activity

Answer	Description		Match
	Small proteins that interact with DNA to aid in packaging the DNA		**A.** 6 feet
	Devices used to detect DNA presence and activity		**B.** hydrogen
	The amount of DNA inside every nucleus in our cells		**C.** Gene density
	The DNA variation that Alec Jeffreys examined in his initial DNA fingerprints		**D.** chromosome
	The types of bonds that bind together nitrogenous bases		**E.** Transformation
	A protein that cuts at specific sites on a DNA molecule		**F.** Histones
	The thread-like packaging of DNA molecules		**G.** Operon
	Technique used by the FBI for DNA profiling		**H.** VNTRs
	A protein that unwinds the DNA double helix during replication.		**I.** mtDNA
	The genetic alteration of a bacterial cell by introduction of DNA from another cell		**J.** DNA microarrays
	The percentage of nitrogenous bases in a DNA molecule that are either guanine or cytosine		**K.** Restriction enzyme
	DNA source used to construct a maternal lineage map		**L.** Ribosome
	Nucleotide sequences that are common to or similar in regulatory regions of DNA		**M.** helicase
	A functional unit of transcription and genetic regulation found in prokaryotic organisms		**N.** GC content
	Increases the GC content of DNA		**O.** STRs
	Locks around the mRNA during replication to translate the genetic information in the mRNA into a string of amino acids		**P.** Consensus sequences

Summary

DNA is the genetic material with the genetic information stored in the linear array of nitrogenous bases. The DNA molecule is composed of the sugar deoxyribose, phosphate groups, and the nitrogenous bases. The molecular structure is a double-stranded helix with the sugar and phosphate groups forming the ladder and the nitrogenous bases forming the steps of the ladder. DNA replication is a complex process that requires many enzymes and proteins, and follows a semiconservative model for replication.

References

1. DNA Interactive: Dolan DNA Learning Center. Cold Spring Harbor Laboratory. http://www.dnai.org
2. Overview of DNA: SCME Primary Knowledge Unit

Disclaimer

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