

Activity: Protein Structure and Function

DNA to Protein Overview

Instructor Guide

Notes to Instructor

This Activity will provide the participants with a better understanding of DNA and the information provided in the Primary Knowledge reading unit.

This activity is part of the *DNA to Protein Overview Learning Module*.

- Knowledge Probe (KP) or pre-test
- DNA to Protein Overview Primary Knowledge (PK)
- **Activity: Protein Structure and Function**
- Activity: Gene Transcription
- DNA to Protein Overview Assessment

Description and Estimated Time to Complete

This is one of two activities in the DNA to Protein Learning Module. This activity provides the processes and tasks for reviewing protein structure and function. This information is important in improving your understanding of how protein and MEMS work together in bioMEMS devices. If you have not reviewed the PK (reading unit), you should do so at this time.

Estimated Time to Complete

Allow approximately one hour

Introduction

Most of the properties of living organisms ultimately arise from a class of molecules known as proteins. Proteins are polymers composed of subunits known as amino acids. These linear polymers fold into specific three-dimensional structures with specific, unique functions. Amino acids dictate the structure of the protein. The linear sequence of information found within a gene in an organism's DNA dictates the order of amino acids.

The emerging field of proteomics is analyzing the complex range of protein expression within cells. Biologists use this information to create micro-sized protein arrays on chips. These arrays investigate both the interactions of the arrayed proteins with other proteins as well as their potential for chemical modification. These micro-sized protein arrays and their electronic interface are part of microsystems technology and a bioMEMS device.

This activity allows you to further your understanding of protein structure and its complexity.

Activity Objectives and Outcomes

Activity Objectives

- List the functions of proteins.
- Describe an application in which proteins are used in microsystems technology.
- Describe the Central Dogma of Biology.

Activity Outcomes

Upon completion of this activity you will have gained an understanding of the information flow within a biological system as an aid to understanding bioMEMS applications.

Activity: Protein Structure and Function

Description

This activity provides more in-depth information on proteins, their function and structure.

Procedure:

1. Step through the lesson “[What are Proteins?](http://learn.genetics.utah.edu/content/molecules/proteins/)” from Learn Genetics, University of Utah.
(<http://learn.genetics.utah.edu/content/molecules/proteins/>)
2. View the video “[What is a Protein?](https://youtu.be/qBRFIMcxZNM)” from the RCSB Protein DataBank.
(<https://youtu.be/qBRFIMcxZNM>)
3. Review the series of YouTube videos at this link:
<https://youtu.be/MI0OqAUzEXU?list=PL1AD35ADA1E93EB6F>
4. Answer the Post-Activity Questions. (You may need to do additional research to correctly answer the questions.) Be sure to list your source(s) to support your answers.

Activity: Post-Activity Questions / Answers

1. Name at least five (5) proteins classification by biological function?
Answer: Proteins are classified as enzymes, transport and storage proteins, movement proteins, immune protection proteins, regulatory function proteins, hormones and structural proteins.
2. Why does each protein have a unique chemical composition and structure?
Answer: Every protein has different numbers and kinds of the twenty available amino acids.
3. What are amino acids composed of?
Answer: carbon, hydrogen, oxygen and nitrogen.

4. What are the 4 types of R groups?
Answer: Nonpolar: hydrophobic, Polar: acidic, basic and uncharged.
5. What two methods of protein separation separate proteins by hydrophobicity?
Answer: Hydrophobic interaction and reverse phase chromatography.
6. What is a bioMEMS application in which the hydrophobicity characteristics of a protein might be advantageous?
Answers will vary. Judge the answer based on the participant's understanding of the following protein characteristic: Proteins tend to fold so that areas of the protein with hydrophobic regions are located in internal surfaces next to each other and away from the polar water molecules of the solution. Polar groups on the amino acid are called hydrophilic (water loving) because they will form hydrogen bonds with water molecules. (Chapter 2: Protein Structure. The Biotechnology Project)
7. Create your own graphic that illustrates the Central Dogma of Biology and briefly describe each step.
Answers and graphics should vary.

Summary

Deciphering the genetic code has allowed scientists to translate the sequence of DNA into the sequence of amino acids that comprise the primary structure of a protein or polypeptide. Protein structure is related to function, and proteins fulfill a wide diversity of functions within cells. Proteins are also an integral part of many diagnostic aids and devices.

References

1. Fundamentals of BioMEMs and Medical Microdevices. Steven S. Saliterman. Wiley Interscience. 2006.
2. Life: The Science of Biology, 8th edition. Sadava et.al. Freeman. 2007.
3. Bioinquiry, 3rd edition. Pruitt and Underwood. Wiley. 2006.
4. Genetics: From Genes to Genomes, Hartwell et.al., McGraw Hill. 2008.
5. Learn Genetics, Genetic Science Learning Center. University of Utah.
<http://learn.genetics.utah.edu>
6. The Biotechnology Project. Madison Area Technology College. Proteins Unit 1: Why Proteins?

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