

Teacher Guide: From Gene to Protein Web Quest

ACTIVITY OVERVIEW

Abstract:

Students navigate the *Basics and Beyond* module to complete a web quest to learn about how proteins are made using the instructions contained in genes.

Module:

Basics and Beyond

Prior Knowledge Needed:

None.

Key Concepts:

DNA, gene, transcription, translation, amino acids

Materials:

Computers with Internet access, student handouts

Appropriate For:

Ages: 12 - 18

USA grades: 7 - 12

Prep Time:

15 minutes

Class Time:

30 minutes

Activity Overview Web Address:

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=proteinquest>

Other activities in the *Basics and Beyond* module can be found at:

<http://gslc.genetics.utah.edu/teachers/tindex/>

Teacher Guide: From Gene to Protein Web Quest

TABLE OF CONTENTS

	<u>Page</u>
Pedagogy	1
A. Learning Objectives	
B. Teaching Strategies	
Additional Resources	1-2
A. Activity Resources	
Materials	2
A. Detailed Materials List	
Standards	2-3
A. U.S. National Science Education Standards	
B. AAAS Benchmarks for Science Literacy	
C. Utah Secondary Science Core Curriculum	
Teacher References	4
A. From Gene to Protein - Answer Key	
Student Pages	
• From Gene to Protein Web Quest	S-1

Teacher Guide: From Gene to Protein Web Quest

I. PEDAGOGY

A. Learning Objectives

- Students will learn how proteins are assembled using the instructions contained in genes.
- Students will learn the specific steps of transcription and translation.
- Students will apply what they know about transcription and translation to explain the process, given an example organism and protein product.

B. Teaching Strategies

1. Timeline

- 2-3 weeks before activity:
 - Reserve a computer lab with Internet access
- 1 day before activity:
 - Make copies of the student page (S-1), one for each student
- Day of activity:
 - Take students to the computer lab and pass out student handouts for them to complete

2. Classroom Implementation

- Hand out the *From Gene to Protein* web quest (student page S-1)
- Bring your class to the computer lab and have them log on to: <http://gslc.genetics.utah.edu/> and click on the *Basics and Beyond* module.
- Instruct your students to use this module to answer the questions on the *From Gene to Protein (page S-1)* web quest.

3. Assessment Suggestions

- Use the completed web quest as an assessment.

4. Extensions

- See Additional Resources for more activities covering basic genetics.

II. ADDITIONAL RESOURCES

A. Activity Resources linked from the online Activity Overview at:

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=proteinquest>

- Website: Classroom Activities Index: *Basics and Beyond* - Online and Print-and-Go™ activities covering basic genetics.

Teacher Guide: From Gene to Protein Web Quest

III. MATERIALS

A. Detailed Materials List

- Computers with Internet access
- Student handout (S-1) - one per student

IV. STANDARDS

A. U.S. National Science Education Standards

Grades 5-8:

- Content Standard C: Life Science - Reproduction and Heredity; every organism requires a set of instructions for specifying traits.
- Content Standard C: Life Science - Reproduction and Heredity; hereditary information is contained in genes.

Grades 9-12:

- Content Standard C: Life Science - The Cell; cells store and use information to guide their functions. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.
- Content Standard C: Life Science - The Molecular Basis of Heredity; in all organisms, the instructions for specifying the characteristics of the organisms are carried in DNA

B. AAAS Benchmarks for Science Literacy

Grades 9-12:

- The Living Environment: Heredity - the information passed from parents to offspring is coded in DNA molecules.
- The Living Environment: Cells - within every cell are specialized parts for the transport of materials, energy transfer, protein building, waste disposal, information feedback, and even movement. In addition, most cells in multicellular organisms perform some special functions that others do not.
- The Living Environment: Cells - the work of the cell is carried out by the many different types of molecules it assembles, mostly proteins. Protein molecules are long, usually folded chains made from 20 different kinds of amino-acid molecules. The function of each protein molecule depends on its specific sequence of amino acids and the shape the chain takes is a consequence of attractions between the chain's parts.
- The Living Environment: Cells - the genetic information encoded in DNA molecules provides instructions for assembling protein molecules. The code used is virtually the same for all life forms.

Teacher Guide: From Gene to Protein Web Quest

C. Utah Secondary Science Core Curriculum

Biology (9-12)

STANDARD IV: Students will understand that genetic information coded in DNA is passed from parents to offspring by sexual and asexual reproduction. The basic structure of DNA is the same in all living things. Changes in DNA may alter genetic expression.

Objective 3: Explain how the structure and replication of DNA are essential to heredity and protein synthesis.

- c. Summarize how genetic information encoded in DNA provides instructions for assembling protein molecules.

V. CREDITS

Activity created by:

Molly Malone, Genetic Science Learning Center

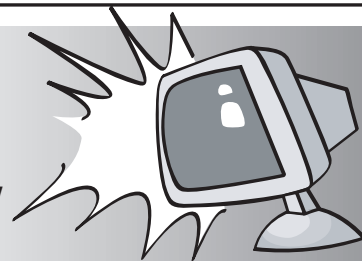
Pete Anderson, Genetic Science Learning Center (illustrations)

Funding:

A Howard Hughes Medical Institute Precollege Science Education Initiative for Biomedical Research Institutions Award (Grant 51000125)



From Gene to Protein- Answer Key



Log on to <http://gslc.genetics.utah.edu/units/basics/>. Explore this module to find the answers to the questions below.

1. What are the base-pairing rules for DNA?

Guanine (G) binds with Cytosine (C)

Adenine (A) binds with Thymine (T)

2. How is DNA replicated?

The rungs of the DNA ladder split down the middle and the uprights pull apart. New bases are matched up to the exposed bases on each upright.

3. The two-step process by which cells read a gene and produce a string of amino acids that will eventually become a protein is called:

Transcription and Translation

4. Transcribe and Translate a Gene.

How is mRNA different from DNA? (Hint read the side-bar on this page for help)

In mRNA the base Uracil (U) replaces the base Thymine (T)

What is the correct starting position for translation?

AUG

Write the amino acids used to assemble your protein in order below.

Methionine, Leucine, Aspartic Acid, Valine, Phenylalanine,
Where does translation take place?

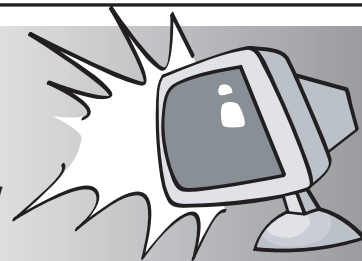
In the ribosome of the cell.

5. Once assembled, what is the key to a protein's unique function?

The manner in which proteins fold is the key to their function.



From Gene to Protein- Answer Key



Log on to <http://gslc.genetics.utah.edu/units/basics/>. Explore this module to find the answers to the questions below.

6. Explain What Makes a Firefly Glow using all of the words below:

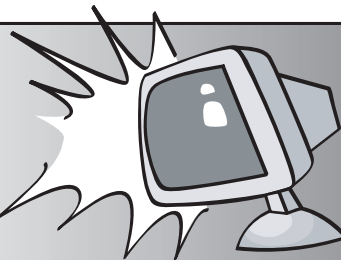
RNA Polymerase	LUC gene	Transcription	mRNA
Luciferase Enzyme	Ribosome	Translation	Amino Acids
Three dimensional	Luciferin	Oxyluciferin	
Functional Luciferase Enzyme			

Example Answer:

RNA Polymerase makes an mRNA copy of the LUC gene. This is called transcription. The LUC gene contains directions for assembling the luciferase enzyme. The newly transcribed mRNA travels from the nucleus to the ribosome where the mRNA copy for the LUC gene is read and the proper amino acids are assembled to make up the luciferase enzyme. This is known as translation. The assembled amino acid chain must bend and fold into a three dimensional shape before it can become a functional luciferase enzyme. In the cell, the newly-made enzymes bind to a chemical called Luciferin to form a complex called Oxyluciferin. This reaction requires energy and gives off the light which makes a firefly glow.



From Gene to Protein



Log on to <http://gslc.genetics.utah.edu/units/basics/>. Explore this module to find the answers to the questions below.

1. What are the base-pairing rules for DNA?
2. How is DNA replicated?
3. The two-step process by which cells read a gene and produce a string of amino acids that will eventually become a protein is called:

_____ and _____

4. Transcribe and Translate a Gene.

How is mRNA different from DNA? (Hint read the side-bar on this page for help)

What is the correct starting position for translation?

Write the amino acids used to assemble your protein in order below.

Where does translation take place?

5. Once assembled, what is the key to a protein's unique function?
6. Explain What Makes a Firefly Glow using all of the words below:

RNA Polymerase	LUC gene	Transcription	mRNA
Luciferase Enzyme	Ribosome	Translation	Amino Acids
Three dimensional	Luciferin	Oxyluciferin	
Functional Luciferase Enzyme			