

Food Explorations Lab I: The Building Blocks

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

In this investigation, you will be constructing animal and plant proteins using beads to represent the amino acids. You will be asked to consider which proteins are complete proteins and, if not complete, which proteins are complementary.

Lab Objectives

In this lab, you will learn how to...

1. Describe the relationship of dietary protein and the health of major body systems.
2. Construct a model protein.
3. Identify complete and incomplete proteins.
4. Explain the effect of insufficient essential amino acids on the body's protein synthesis.
5. Explain the relevance of complementary proteins in a vegetarian diet.

Lab Question

Which of the following food sources are complete proteins (contain all essential amino acids)? (Circle your answer.)

Meat

Peanuts

White Rice and Beans

Toast

Predictions: I predict the following two foods are considered complete proteins:

1. _____ is a complete protein because _____

2. _____ is a complete protein because _____

Building Proteins

MATERIALS

- 4 bags of Amino Acids (colored beads)
- 4 Craft Pipe Cleaners

PROCEDURE

In this investigation you will be working with colored beads. Your group will be given 4 bags of beads, each a different color. Each colored bead will represent a single amino acid. The 22 amino acids and their abbreviations are listed on the following page. With direction from your teacher, create a key to determine which colored bead(s) represents each amino acid.

Amino Acid Bead-Color Key






Alanine Abbreviation: Ala Bead-Color: _____	Lysine Abbreviation: Lys Bead-Color: _____
Arginine Abbreviation: Arg Bead-Color: _____	Methionine Abbreviation: Met Bead-Color: _____
Asparagine Abbreviation: Asn Bead-Color: _____	Phenylalanine Abbreviation: Phe Bead-Color: _____
Aspartic Acid Abbreviation: Asp Bead-Color: _____	Proline Abbreviation: Pro Bead-Color: _____
Cysteine Abbreviation: Cys Bead-Color: _____	Serine Abbreviation: Ser Bead-Color: _____
Glutamine Abbreviation: Gln Bead-Color: _____	Threonine Abbreviation: Thr Bead-Color: _____
Glutamic Acid Abbreviation: Glu Bead-Color: _____	Tryptophan Abbreviation: Trp Bead-Color: _____
Glycine Abbreviation: Gly Bead-Color: _____	Tyrosine Abbreviation: Tyr Bead-Color: _____
Histidine Abbreviation: His Bead-Color: _____	Valine Abbreviation: Val Bead-Color: _____
Isoleucine Abbreviation: Ile Bead-Color: _____	Selenocysteine Abbreviation: Se-CYs Bead-Color: _____
Leucine Abbreviation: Leu Bead-Color: _____	Pyrrolysine Abbreviation: Pyl Bead-Color: _____

1. If you determine you are missing an amino acid, write the word "missing" beside the bead color. When you are constructing your protein strand, use a clear bead to present the "missing" amino acid.
2. Using a pipe cleaner to organize the amino acids in a primary structure (straight chain), create each food protein following this order: Histidine, Glutamic Acid, Valine, Alanine, Serine, Isoleucine, Asparagine, Tryptophan, Lysine, Leucine, Phenylalanine, Cysteine, Aspartic Acid, Arginine, Glutamine, Glycine, Methionine, Proline, Threonine, Tyrosine, Selenocysteine, and Pyrrolysine. Repeat this order once, so you have a total of 44 beads on your strand. In the preceding chart, number the amino acids in order of use from 1 to 22.

NOTE: After adding the first few amino acids bend the end of the pipe cleaner slightly to ensure the beads do not fall off.

3. Label the amino acids within each protein molecule below (see example below). When applicable, identify the location and name(s) of any missing amino acids.

Data:

Protein Molecule Drawings	
Example Protein	
<p>Glu Val Ala Ser Ile Asp Try Lys Leu Phe Cys — Arg Gin Gly Met Pro Thr Tyr SeCys Pyl Ply</p> 	
Missing Amino Acid(s): Aspartic Acid (Asp)	
Meat Protein	
	
Missing Amino Acid(s): _____	
Peanut Protein	
	
Missing Amino Acid(s): _____	
Toast Protein	
	
Missing Amino Acid(s): _____	
White Rice and Bean Protein	
	
Missing Amino Acid(s): _____	

Meat, Fish, Poultry & Eggs

Conclusion:

1. Compare and contrast the complete proteins constructed to the incomplete proteins constructed.

Peanuts and toast do not contain all the essential amino acids, and are therefore incomplete proteins. Meat contains all of the amino acids, and is therefore a complete protein. The combination of rice and beans contains all of the amino acids; this combination is considered a complementary protein.

2. In any proteins that were not complete, which amino acids were limiting?

Peanuts are missing methionine and tryptophan. Toast is missing lysine and isoleucine.

3. Describe which of the four food source(s) are considered complementary proteins.

Toast and peanuts are missing essential amino acids, while rice and beans are not. Rice and beans combine to make a complementary protein. If toast and peanuts were combined, they would also make a complementary protein.

Rice and beans are complementary proteins because they are each missing different amino acids. When combined, the missing amino acids are found in the other to make a complete protein.

4. Why should individuals consuming a plant-based diet (e.g. vegetarians) understand complementary sources of protein?

They should understand complementary proteins because our bodies need all 22 amino acids to complete necessary functions, including maintaining organs and bones, and promoting muscle growth and repair. Animal foods are the only source of complete proteins.

5. Describe the impact on the body's ability to make proteins if a person's diet is low in proteins containing essential amino acids.

If a person's diet is low in proteins containing the essential amino acids, the body is unable to make enough protein to support cell structure and growth.

6. Using examples of major body systems, explain the importance of consuming complete sources of protein for the body's health.

Consuming complete sources of protein is important to provide our bodies with all the essential amino acids. Without essential amino acids, our bodies will begin to breakdown tissues containing those amino acids for utilization (i.e. for energy).