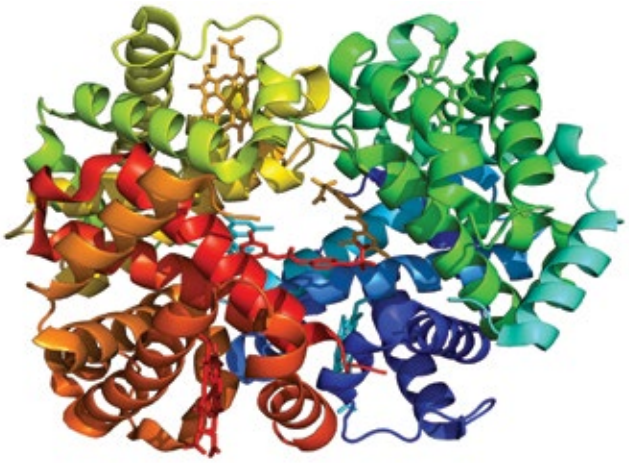
Chapter 6: Meat, Fish, Poultry & Eggs

Protein Connection

Did you know that protein can be found in every living cell?



Protein is one of the three **macronutrients** our body needs in large amounts to survive. The other two necessary macronutrients are carbohydrates and fats. Protein is necessary for a healthy body. It is important for many reasons including the building and repair of body tissues, body regulation processes, muscle contraction, and energy. However, consuming too much protein can cause extra stress for some of our organs, like the kidneys.

Since protein consumption is needed for muscle growth and maintenance, very active individuals may need to slightly increase the protein in their diet. New muscle growth can only occur when protein synthesis (the making of new proteins) exceeds the protein breakdown of food. You will learn more about the relationship between protein and muscles in *Food Lab Explorations Part II* of this chapter.

The chemical structure of protein is unique, making it different from carbohydrates and fat. Like carbohydrates and fat, proteins contain carbon, hydrogen, and oxygen; however, unique to protein, they also contain nitrogen.

The building blocks of proteins are called ***amino acids***. Once consumed, protein is broken down into amino acids and absorbed by the digestive system. Amino acids can then be reused to make new proteins that can maintain muscles, bones, blood, and organs. Our bodies use 22 different amino acids to make protein. Some amino acids are considered essential. ***Essential amino acids***, also called ***limiting amino acids***, cannot be made by the body and must be obtained from our diet. The nine essential amino acids are Phenylalanine, Methionine, Isoleucine, Valine, Leucine, Tyrptophan, Threonine, Histidine, and Lysine. All 22 amino acids are needed to make a protein. Not consuming enough of the essential amino acids may result in limited protein

Animal sources including meat, poultry, fish, eggs, and dairy are called "Complete Proteins" and contain all the essential amino acids our bodies can't make.

synthesis. You will learn more about amino acids and protein synthesis in *Food Lab Explorations Part I* of this chapter.

There are some foods that have ***complete proteins***. Complete proteins have all of the essential amino acids our bodies can't make. Animal sources including meat, poultry, fish, eggs, and dairy contain all the essential amino acids. Plant sources of protein including beans, nuts, grains, and seeds can provide us with some of the essential amino acids, but not all. You can combine two or more plant-based foods to create a complementary protein. ***Complementary proteins*** work together to provide our bodies with the essential amino acids needed to form a complete protein. You should be careful to choose the right combination of foods. For example, combining legumes (e.g. beans) with grains, nuts, or seeds will make complementary proteins.

Protein is necessary for life. We need to make sure we consume enough to keep our bodies healthy. Consuming a variety of both plant and animal sources is recommended for optimal health. The unique characteristics of protein make it essential for our body to function properly. Let's find out exactly what proteins look like!

Think About It

Food Explorations Lab I

1. Provide three (3) reasons why having protein in our diet is important.

Multiple answers possible

a. Building and maintaining muscle

b. Maintain bones

c. Maintain organs

2. The building blocks of proteins are called amino acids.

3. The amino acids we must get from our diet are called essential.

4. Two proteins that must be eaten together in order to have all essential amino acids are called complementary.

Food Explorations Lab II

1. Explain why protein consumption is important for our muscles.

To build and repair muscles

2. More protein in the diet is needed by an active (active/inactive) person.

3. For muscle growth, protein synthesis must be greater (greater/less) than protein breakdown.

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:* **Agr**	*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:* _____

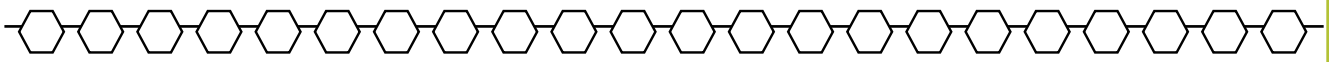
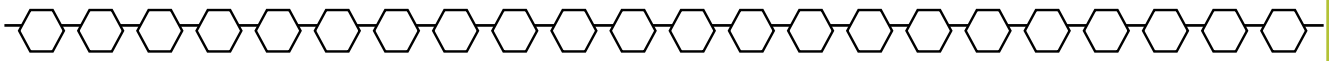
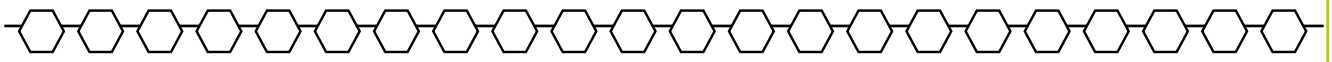
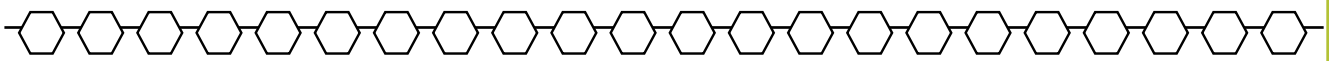
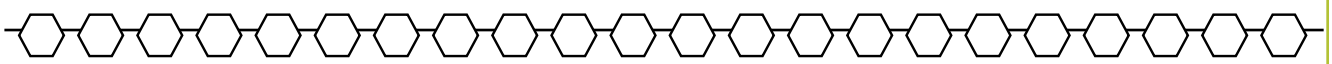
1. If you determine you are missing an amino acid, write the word "missing" beside the bead color. When you are constructing your protein strand, use a clear bead to present the "missing" amino acid.

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, Aspatric 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
Glu Val Ala Ser Ile Asp Try Lys Leu Phe Cys — Arg Gin Gly Met Pro Thr Tyr SeCys Pyl Ply  **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):** _____

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).

Food Explorations Lab II:
Synthesizing Muscles

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

In this investigation, you will match models of arm muscles to individuals who have varying dietary protein needs. You will determine dietary protein needs using information provided for each individual.

Lab Objectives

In this lab, you will learn how to…

1. Determine factors that can promote or hinder the synthesis of muscle (protein) in the body.

2. Identify the protein intake necessary for an individual based on his/her weight and exercise regimen.

Lab Question

Which of the following factors will promote muscle (protein) synthesis? (Circle your answer.)

(Exercise) (Adequate Protein Intake) Low Protein Intake High Protein Intake

Predictions: I predict the following factors will promote muscle (protein) synthesis:

_____ and _____ because….

Observations of Muscle Synthesis

MATERIALS

1 arm with 3 rubber bands
1 arm with 5 rubber bands
1 arm with 6 rubber bands
1 arm with 10 rubber bands
Calculators

PROCEDURE

In this investigation you will use "arms" your teacher has made to demonstrate muscle (protein) synthesis and strength.

1. Read each case study below carefully.

Case Study A - Johnny

Johnny is a male who is 5 feet 8 inches tall, weighs 70 kg, and eats 2,400 calories per day. He is an honors student, gets plenty of exercise and eats an adequate amount of protein (60 grams per day). For Johnny's arm, add 1 rubber band per 10 grams of protein eaten per day.

Case Study B - Sandra

Sandra is a female who is 5 feet tall, weighs 45 kg, and eats 1,600 calories. She gets adequate exercise, but does not eat a lot of protein from meat or plant sources (about 30 grams of protein per day). For Sandra's arm, add 1 rubber band per 10 grams of protein eaten each day.

Case Study C - Mary

Mary is a female who is 5 feet 3 inches tall, weighs 54.5 kg and eat 2,000 calories per day. She is on the swimming team at her high school and gets a lot of exercise by attending team practice 4 times per week for 2 hours each day. Mary eats lots of protein, about 200 grams per day to be exact! For Mary's arm, add 1 rubber band per 20 grams of protein eaten in one day.

Case Study D - Michael

Michael is a male who is 5 feet 10 inches tall, weighs 73 kg, and eats 3,000 calories per day. He wants to gain more muscle mass, but does not have time to exercise. Instead, he eats extra protein every day (300 grams/day). For Michael's arm, add 1 rubber band per 60 grams of protein eaten in one day.

2. Complete Table A to determine the number of muscle strands (rubber bands) needed for each case study.

Table A: Muscle Strand Calculations

Case Study	# Rubber Bands/Grams Protein	Total Grams Protein Eaten/Day	Total # Rubber Bands
Johnny Case Study A	1 rubber band per 10 grams protein eaten per day	60 g	6
Sandra Case Study B	1 rubber band per 10 grams protein eaten per day	30 g	3
Mary Case Study C	1 rubber band per 20 grams protein eaten per day	200 g	10
Michael Case Study D	1 rubber band per 60 grams protein eaten per day	300 g	5

3. Match the case study to the correct arm.

4. Gently pull the rubber bands to make each arm bend toward each other and contract. This movement represents the action of the biceps.

5. While one person bends the arm, another student should gently pull in the opposite direction on the top part of the arm to allow the "bicep" to relax. This demonstrates the action of the triceps.

6. Order each case study by level of tension you feel in each muscle (1= strongest tension; 4=weakest tension) in the "Muscle Tension" column of Table B.

7. Calculate how many calories from protein each individual is consuming. To find the calories each individual is consuming, multiple the number grams of protein eaten by 4. Record your findings under calories in the "Protein Intake" column in Table B. There are 4 calories in every gram of protein.

8. A healthy adult should consume 0.8 g of protein per kg of body weight per day. Calculate each individual's protein requirement. Record your findings in the grams column under "Protein Requirement" in Table B.

9. Based on the calculated protein requirement of each person, find the number of calories from protein. To find the calories each individual is consuming, multiple the number grams of protein eaten by each person by 4. Record your findings under calories in the "Protein Requirement" column in Table B. There are 4 kcal in every gram of protein.

10. Compare each person's protein intake (grams protein and calories) to the protein requirement. Is the protein intake high, adequate, or low? Record your findings under the "Protein Adequacy" column in Table B.

Table B: Calculating Protein Needs

Case Study	Muscle Tension	Protein Intake		Protein Requirement		Protein Adequacy (circle answer)
		Grams	Calories	Grams	Calories	
Johnny Case Study A	2	60	240	56	224	HIGH **(ADEQUATE)** LOW
Sandra Case Study B	4	30	120	36	144	HIGH ADEQUATE **(LOW)**
Mary Case Study C	1	200	800	44	176	**(HIGH)** ADEQUATE LOW
Michael Case Study D	3	300	1,200	58	232	**(HIGH)** ADEQUATE LOW

Conclusion:

1. Is each individual consuming adequate protein? Calculate % protein consumed for each individual. A healthy adult should consume 10-35% of their calories from protein (approximately 0.8g/kg). Divide calories from protein by total calories the person eats, then multiply by 100.

$$\textit{Example:} \quad \frac{\text{140 calories protein}}{\text{1,400 total calories}} \times 100 = 10\%$$

Protein intake is adequate. However, a slight decrease in dietary protein will result in inadequate overall protein intake.

Johnny: 10% - Adequate

Sandra: 7.5% - Low

Mary: 40% - High

Michael: 40% - High

2. Based only on the level of tension you felt in each arm, which people appear to have an adequate intake of protein? Explain your response.

Johnny seemed to have an adequate intake of protein because it was not too hard or too easy to contract his arm.

3. Describe how the calculations for daily protein intake compared to the tension in the muscle models.

The calculations for daily protein intake increase as tension increases in the muscle models.

4. Which individual required the most protein in their diet? Which individual required the least protein in their diet? Explain.

   Michael, because he is the largest student in size. Even though he does not exercise a lot, his basic requirement is still higher than the very active Johnny because he is larger in size.

   Sandra because she is the smallest student in size. Although she gets adequate exercise, she is smaller than the other students and is not an athlete.

5. For each individual, compare his/her protein intake to the protein synthesis (muscle tension). Describe the relationship in each case and explain reasons for that relationship.

   Johnny: He consumed adequate protein with some tension in the muscle model. Some protein synthesis occurred because he balanced protein and exercise.

   Sandra: She did not consume enough protein with little tension in the muscle model, but less protein synthesis occurred because she did not balance protein intake and exercise.

   Mary: She consumed adequate protein with more tension in the muscle model. More protein synthesis occurred because she balanced protein intake with exercise.

   Michael: He consumed a lot of protein with some tension in the muscle model, but less protein synthesis occurred than for others like Mary because he did not exercise.

6. Provide an explanation for Mary and Michael about the consequences of including too much protein in their diets.

The extra protein will be converted to fat for storage.

7. What advice would you give Michael on a better way to increase his muscle mass?

Michael should exercise and consume less protein.

8. Summarize the factors that have an impact on an individual's protein requirements. Compare and contrast your answer to your original response to the lab question.

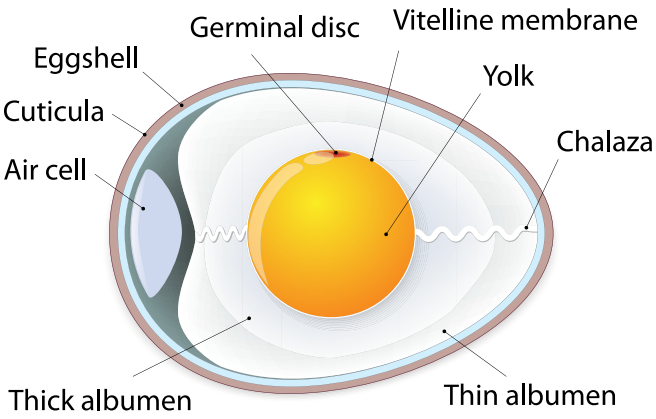
Level of exercise, Body size (i.e. weight, height)

Foaming Bonds

Did you know that eggs can be used to create foam?

The many components of eggs allow them to be very versatile. An egg consists of a shell, albumen, chalazae, membranes, and yolk. Each of these parts serve a specific purpose. Together, however, they provide us with a nutritious source of protein, fat, and vitamins and minerals.

Eggs contain ***lecithin***, a substance in egg yolk that can help form ***emulsions***. An emulsion is a mixture of two normally immiscible liquids, like oil and water. Without an emulsifier, like lecithin, the two liquids would separate. You can find emulsions in foods like mayonnaise.



The albumen, which is also known as egg white, can be beaten to form foams, also known as a ***colloidal dispersion***. Colloidal dispersions represent a type of emulsion that occurs when a gas (air) is dispersed throughout a liquid (egg white) forming a uniform mixture. As eggs are beaten, peaks form because the protein begins to untangle and stretch, forming the foam. Factors that affect egg foams include temperature, fat, salt, acid, and sugar.

Eggs beaten at room temperature whip more easily than those at refrigerator temperature due to a lower ***surface tension***. The tension created by molecules being pulled from the surface to the rest of the fluid is called surface tension. Fat interferes with foam formation because it does not readily bond with other molecules. Salt decreases the volume while increasing the whipping time. Like salt, acids increase whipping time. The end result is a stiff large volume. Many times an acid is added to the egg whites before whipping. Sugar will increase the whipping time by hindering egg protein coagulation. It will, however, produce a satiny appearance if added slowly.

Egg foams are used in a variety of products including soufflés, meringues, omelets, and angel food cake. Its unique characteristics produce light and airy products that are enjoyed by many. However, one mistake in the process may result in an undesirable product, possibly due to a decrease in stability. Whipped eggs that are stable will stay in a foamy state and appear firm with small air cells. On the other hand, an unstable whipped egg may appear to be liquid with large, foamy air cells.

Eggs can experience both chemical and physical changes. ***Chemical changes*** involve two or more molecules interacting to form new molecules. When you cook an egg, breaking bonds within, you have made a chemical change. You cannot reverse this process. ***Physical changes*** rearrange molecules, but do not change internal structure. When you whip egg whites, you have rearranged the molecules with the air being forced into the egg white. You will observe examples of these changes in *Food Lab Explorations Lab I* of this chapter.

Eggs are very versatile. They can be used alone, or in combination with other foods to provide a good source of protein. Let's see what they can do!

Think About It

Food Explorations Lab

1. A colloidal dispersion is formed when a _____gas_____ and a _____liquid_____ are uniformly mixed.

2. The part of the egg needed to create a colloidal dispersion with air is the _____albumen_____.

3. Another term for a colloidal dispersion is a(n) _____emulsion_____.

Food Explorations Lab III:
Foam Formulations

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

This investigation is in two parts. In Part A, you will make observations of an egg's parts and diagram its anatomy. You will then form a colloidal dispersion (a foam) with the egg white and become familiar with its appearance as the whisking time increases. In Part B, your class will determine the effects of different substances on the stability of the egg white foam.

Lab Objectives

In this lab, you will learn how to…

1. Diagram the anatomy of an egg and make observations of its parts.

2. Form colloidal suspensions from the egg white.

3. Determine the effects of substances on the stability of egg white foams.

Lab Safety: Before beginning ANY investigation you should put on your safety goggles and apron. It is important to avoid getting chemicals on your hands. Always wash your hands following completion of an investigation. When handling food, you should also wash your hands prior to beginning an investigation. *Raw egg material is not safe for consumption; do not eat any of the foams in your investigation.*

Lab Question

Which of the following will increase the stability (firmness) of egg white foams? (Circle your answer.)

Sugar Acid Salt Agitation Time Fat

Predictions: I predict the following substance(s) will increase the stability of egg white foam _____ because…

PART A: Observation of Egg Anatomy & Stages of Foam Formation

MATERIALS

1 egg
1 egg separator
2 small glass or steel bowls
1 paper plate
1 whisk or electric mixer
1 kitchen timer or stopwatch

PROCEDURE

1. Break your egg and separate the egg white from the egg yolk. Tap the egg lightly against the bowl to create a crack. Hold the egg separator over the small bowl. Using your fingers, pull apart the shell and dump the egg contents into the egg separator. The egg white should fall into the bowl with **gentle** shaking while the egg yolk stays in the egg separator. Be careful not to break the egg yolk. **Be sure no egg yolk mixes with your egg white.**

2. Once your egg whites have been prepared, you are ready to begin. Using the diagram found in the reading *Foaming Bonds* as a guide, describe your *visual* observations of the egg white, egg yolk, and eggshell in Table A under the column labeled "Physical Properties."

3. Draw a diagram of your egg's anatomy in the space provided. Neatly label the following in your diagram: outer membrane, inner membrane, shell, yolk, vitelline (yolk) membrane, air cell, chalazae, and albumen (egg white).

4. Using your whisk, beat the egg white in a small bowl. Whisk the egg white until it becomes foamy (i.e. foam on a recently poured carbonated drink). This is the "no peaks" stage. Use the timer to record how long it takes to reach this stage. Record the time and your observations of the foam in Table B under the column labeled "Appearance of Foam."

5. Repeat Step 5 for each of the following:

a. *Soft Peaks*: Beat until egg whites form peaks that bend slightly at the tips. The foam should be shiny and moist. Record the time it takes to reach this stage and your observations of the foam in Table B.

b. *Stiff Peaks*: Beat the egg white until the foam no longer slips when the bowl is tilted. Record the time it takes to reach this stage and your observations of the foam in Table B.

c. *Overbeaten*: Beat the egg white until the foam begins to break down and become grainy. Liquid may begin to drain from the foam. Record the time it takes to reach this stage and your observations of the foam in Table B.

Table A: Physical Properties of Eggs

	Physical Properties
Egg White	Clear liquid
Egg Yolk	Thick, yellow liquid
Egg Shell	White and thin

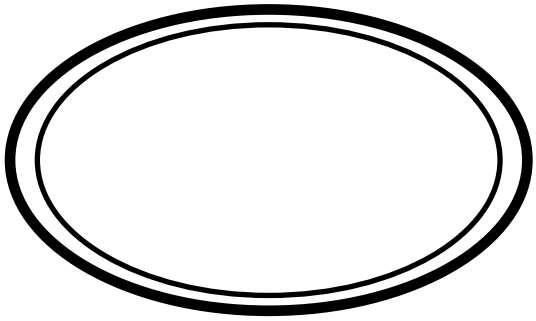
Egg Anatomy Diagram


Table B: Egg White Whisking Observations

Stages	Time to Stage (Minutes)	Appearance of Foam
No Peaks (Frothy)	2-3 minutes	Bubbly, frothy, lots of bubbles
Soft Peaks	3-6 minutes	The peaks fall back down after being formed
Stiff Peaks	2-3 minutes	The peaks stand up straight after being formed
Overbeating	>3 minutes	Grainy and dull

Conclusion:

1. Describe how the color of the egg white changed as it moved from frothy to stiff peaks.

Clear to white

2. As you continued to beat your egg white, what happened to the volume of the foam?

Volume increased

3. As you continued to beat your egg white, how did the stability (firmness) of the foam change?

Stability increased until overbeaten stage when egg white foam begins to breakdown.

4. Were the observed changes in the egg (liquid to foam) chemical or physical? Explain.

They were physical changes because the molecules were rearranged.

PART B: Observation of Foam Emulsions

Your teacher will begin by assigning each group 1 treatment.

Assignment A: Sugar

Assignment B: Acid

Assignment C: Fat

Assignment D: Salt

MATERIALS

⅛ cup (2 tablespoons) of egg white
1 small glass or steel bowl
1 whisk or electric mixer
1 rubber spatula
1 kitchen timer or stopwatch
1 set measuring spoons
assigned treatment
1 funnel
1 10- or 25-mL graduated cylinders
ruler

Obtain your assignment from you teacher. Record your group's assignment/treatment (sugar, acid, fat, or salt) below.

My group's treatment is: _____

Predictions: Predict what will happen when you add your assigned treatment to the egg white. Will your treatment increase or decrease the egg white foam stability (firmness)? Why?

PROCEDURE

1. Using your whisk, beat the egg white. Whisk your new egg white until it becomes foamy or reaches the *no peak stage* (i.e. foam on a recently poured carbonated drink).

2. Once your egg white has become foamy, add your treatment.

   - Assignment A: *Treatment = Sugar* – Add 1 teaspoon sugar to the frothy foam.
   - Assignment B: *Treatment = Acid* – Add ¼ tablespoon acid to the frothy foam.
   - Assignment C: *Treatment = Fat* – Add ¼ teaspoon of oil to the frothy foam.

- Assignment D: *Treatment* = *Salt* – Add ¼ teaspoon salt to the frothy foam.

3. Continue to beat your egg white for 10-15 minutes or until soft peaks are obtained. Record your *visual* observations in Table A under the column labeled "Treatment." Be sure to describe the texture of the foam.

4. Using a rubber spatula, push the egg white foam into a funnel and flatten the top so it is level. Plug the bottom of the funnel with your thumb to ensure no liquid escapes.

5. Keeping the bottom of the funnel plugged, hold the base of the funnel next to the top of a counter or table. Stand a ruler upright on the counter and use it to measure the height of the foam. Record your results in Table B under the column "Treatment."

6. Place the funnel in a graduated cylinder and allow it to sit for 5 minutes. Record the volume of any fluid that drained into the cylinder in Table B.

7. Share the data with the other student groups and complete Table B using their data.

Table A: Egg White Treatment Observations

	TREATMENT	
Egg White Formation	**Sugar**	Smooth, shiny, white
	Acid	Smooth, porous, liquidy
	Fat	Very liquidy, yellow, small amount of foam on the surface
	Salt	Very white, foamy mixture (more than acid) and very liquidy

Table B: Foam Property Treatment Observations

	TREATMENT	
Foam Height (cm)	**Sugar**	14.5 cm
	Acid	10 cm
	Fat	3 cm
	Salt	2 cm
Foam Leakage (mL)	**Sugar**	25 mL
	Acid	30 mL
	Fat	36 mL
	Salt	40 mL

TEACHER'S NOTE: Numbers in the above tables are estimates only. Student values may vary.

Conclusion:

1. Explain what foams are and how they form.

Foams are a colloidal dispersion of air in egg white. They are formed when the egg white is beaten, forcing air between the liquid molecules.

2. What two states of matter make up a foam?

Solid and liquid

3. As a class, discuss observations of each group and complete Table C.

Table C: Foam Treatment Observations

		OBSERVATIONS
Sugar	Foam Height (cm)	
	Foam Leakage (mL)	
Acid	Foam Height (cm)	
	Foam Leakage (mL)	
Fat	Foam Height (cm)	
	Foam Leakage (mL)	
Salt	Foam Height (cm)	
	Foam Leakage (mL)	

4. Which substance(s) increased the volume of egg white foams?

Sugar

5. Which substance(s) increased the stability of egg white foams?

The addition of acid and sugar.

6. Were the observed changes in the egg white chemical or physical? Explain.

They were physical because even though a foam was formed, there was still no change in internal structure.

Investigating Your Health:
Healthy Proteins

Name: _____

Objective: Investigate lean sources of protein by comparing different kinds of ground meat and their nutritional composition (e.g. grams of fat per serving).

Meat, fish, and poultry are members of the protein group and provide important nutrients for your body including protein, B vitamins, vitamin E, iron, zinc, and magnesium. ***Proteins*** are large molecules made of one or more long amino acid chains. The protein you eat is important for your muscles, bones, skin, and blood. When choosing meat, fish, and poultry products it's important to pay attention to the fat content. You should pick lean (low in fat) sources. Ground beef should say extra lean or at least 90% lean. Choose skinless chicken, or take the skin off before you eat it. Pick low fat lunch meats like lean ham, turkey, or roast beef instead of bologna or salami. Choosing meats with no breading will reduce the amount of calories you eat. Breaded meat (e.g. chicken nuggets) also soaks up more fat while it is being fried. Fatty meats have higher amounts of saturated fat and can raise your blood cholesterol. Fatty meats also have more calories. You should try to limit or avoid fatty meats. You can do this by choosing or preparing meat that is grilled or baked without breading or extra fat. Eat 5-6 ounces of protein from multiple sources every day for good health! For protein, we want the right amount, not too little and not too much. See below for some examples. Use the *Try This at Home* recipe to make a meal with healthy proteins!

Approximate Weights		
MEAT	1 small steak	3 ½ - 4 ounce equivalents
	1 small lean hamburger	2-3 ounce equivalents
FISH	1 can of tuna, drained	3-4 ounce equivalents
	1 salmon steak	4-6 ounce equivalents
POULTRY	1 small chicken breast half	3 ounce equivalents

PART A: Comparing Meats

1. Go to the grocery store and look at the Nutrition Facts Label of 73% ground beef, 93% lean ground beef, and 93% lean ground turkey. If you are unable to go to the grocery store, use the handout provided by your teacher or access the nutrient database on USDA's website: http://ndb.nal.usda.gov/ndb/search/list. Complete the Nutrition Facts Labels below.

73% Ground Beef	93% Lean Ground Beef	93% Lean Ground Turkey
Nutrition Facts	**Nutrition Facts**	**Nutrition Facts**
Serving Size _____	**Serving Size** _____	**Serving Size** _____
Calories _____	**Calories** _____	**Calories** _____
Total Fat _____	**Total Fat** _____	**Total Fat** _____
Sodium _____	**Sodium** _____	**Sodium** _____
Total Carbohydrates _____	**Total Carbohydrates** _____	**Total Carbohydrates** _____
Dietary Fiber _____	Dietary Fiber _____	Dietary Fiber _____
Sugars _____	Sugars _____	Sugars _____
Protein _____	**Protein** _____	**Protein** _____
Vitamin A ____% Vitamin C ____%	Vitamin A ____% Vitamin C ____%	Vitamin A ____% Vitamin C ____%
Vitamin E ____% Calcium ____%	Vitamin E ____% Calcium ____%	Vitamin E ____% Calcium ____%
Iron ____% Thiamin ____%	Iron ____% Thiamin ____%	Iron ____% Thiamin ____%
Niacin ____% Folate ____%	Niacin ____% Folate ____%	Niacin ____% Folate ____%
Vitamin B_{12} ____% Zinc ____%	Vitamin B_{12} ____% Zinc ____%	Vitamin B_{12} ____% Zinc ____%
Magnesium ____%	Magnesium ____%	Magnesium ____%

TEACHER'S NOTE: Regardless of the source used to obtain the food labels, students should seek labels that use identical serving sizes. If students choose meat with different serving sizes listed on the label, they will need to mathematically standardize each label before comparing them. To standardize serving size across nutrition labels, students will need to convert each serving size into the same value (cups, tablespoons, etc.). Students will then need to convert all fractions to a decimal. Finding the largest decimal, the students will then divide it by one of the others. Multiply each number in the nutrition facts label using this answer. For example: ¾ = .75, .75 ÷ .5 = 1.5. Repeat these steps with the other labels. Please reference the Sample Nutrition Facts Standardization Worksheet found at www.foodmaster.org.

2. Before you begin, compare the serving size for each label. If the serving sizes are different, use the space below to standardize each label so that you can compare their nutritional content. Ask your teacher for help if you have to standardize your labels.

73% Ground Beef

Nutrition Facts

Serving Size	_____
Calories	_____
Total Fat	_____
Sodium	_____
Total Carbohydrates	_____
Dietary Fiber	_____
Sugars	_____
Protein	_____

Vitamin A	____%	Vitamin C	____%
Vitamin E	____%	Calcium	____%
Iron	____%	Thiamin	____%
Niacin	____%	Folate	____%
Vitamin B_{12}	____%	Zinc	____%
Magnesium	____%		

93% Lean Ground Beef

Nutrition Facts

Serving Size	_____
Calories	_____
Total Fat	_____
Sodium	_____
Total Carbohydrates	_____
Dietary Fiber	_____
Sugars	_____
Protein	_____

Vitamin A	____%	Vitamin C	____%
Vitamin E	____%	Calcium	____%
Iron	____%	Thiamin	____%
Niacin	____%	Folate	____%
Vitamin B_{12}	____%	Zinc	____%
Magnesium	____%		

93% Lean Ground Turkey

Nutrition Facts

Serving Size	_____
Calories	_____
Total Fat	_____
Sodium	_____
Total Carbohydrates	_____
Dietary Fiber	_____
Sugars	_____
Protein	_____

Vitamin A	____%	Vitamin C	____%
Vitamin E	____%	Calcium	____%
Iron	____%	Thiamin	____%
Niacin	____%	Folate	____%
Vitamin B_{12}	____%	Zinc	____%
Magnesium	____%		

3. Compare the Nutrition Facts Labels of the 93% Lean Ground Beef and the 93% Lean Ground Turkey label. What is similar? What is different?

They are very similar. Both meats have the same grams of fat per 4 ounce serving. However, the ground beef has slightly more calories, protein, and iron than the ground turkey, and the ground turkey has more sodium.

4. Compare the Nutrition Facts Label for the 93% Lean Ground Beef to the 73% Ground Beef label. What is similar? What is different?

The 73% ground beef has double the calories and over triple the amount of fat with less protein and iron than the 93% ground beef.

5. Compare the three Nutrition Facts Labels. Which protein source is a healthier option? Why?

The 93% ground beef is the healthier option. Although it has more calories compared to the ground turkey, the calories are primarily derived from lean protein (the fat content is the same). Additionally, the lean beef is lower in sodium and higher in iron compared to the ground turkey. In comparison with the 73% ground beef, the lean beef also has fewer calories, less fat, more protein, and more iron.

TEACHER'S NOTE: Students may assume the ground turkey will be the best option. However, students should find that the lean ground beef is a healthier option after comparing the Nutrition Facts Labels.

Investigating Your Health:

Extraordinary Eggs

Name: _____

Objective: Investigate eggs by researching the nutrient amounts in each part of an egg.

Eggs are one of the highest quality proteins you can buy. They are also very inexpensive. There are many different ways to eat eggs including scrambled, hard-boiled, over easy, and sunny side up! Eggs are also an ingredient in many recipes including cakes, cookies, breads, pudding, mayonnaise, etc.

High quality proteins can help you build muscle and become stronger. The protein in one egg is about the same as one ounce of meat, fish, or poultry. You can buy whole eggs or egg whites in the grocery store, or you can separate an egg at home using an egg separator. A little over half the protein in an egg is in the white, and the rest is in the yolk. The ***yolk*** is the yellow part of the egg and is the major source for the vitamins and minerals in an egg. The eggshell color varies depending on the breed of hen that laid the egg; however, the nutritional quality is the same (i.e. brown vs. white eggs). Egg yolk color changes depending on the diet of the hen.

Eggs also provide a lot of vitamins, minerals, and other nutrients for a small amount of calories. Some of the vitamins and minerals that are in an egg are vitamins B_{12}, A, D, and E, folate, and riboflavin. Use the *Try This at Home* recipe to make a "fluffy" breakfast with eggs!

PART A: Egg Colors

1. Compare the nutrition information of brown eggs and white eggs. Use the handout provided by your teacher or access the nutrient database on USDA's website: http://ndb.nal.usda.gov/ndb/search/list. Complete the table below.

	White Egg	Brown Egg
Serving Size	1 egg	1 egg
Calories	70	70
Total Fat	4.5g	4.5g
Saturated Fat	1.5g	1.7g
Cholesterol	215mg	238mg
Sodium	65mg	79mg
Protein	6g	6.8g
Calcium	2%	2%
Vitamin A	6%	5%
Iron	4%	7%

2. Describe how the eggs differ in appearance.

The only difference in appearance is color.

3. Is there a significant difference in nutrition between white eggs and brown eggs? If yes, explain the better option.

Nutritionally, they may differ slightly in saturated fat, cholesterol, sodium, protein, Vitamin A, and iron content. Either one would be a good option.

PART B: Egg White or Egg Yolk

1. Research the nutrients in the egg white and the egg yolk in one large egg and complete the table below.

	Egg White	Egg Yolk
Calories	17 kcal	54 kcal
Total Fat	0g	4.5g
Saturated Fat	0g	1.5g
Cholesterol	0 mg	210 mg
Sodium	55 mg	8 mg
Protein	4g	3g
Folate	1.30 mcg	25 mcg
Vitamin D	0 IU	18 IU
Vitamin A	0 IU	245 IU
Phosphorus	5 mg	66.3 mg
Iron	0 mg	0.5 mg
Calcium	2 mg	22 mg
Potassium	54 mg	18 mg
Magnesium	4 mg	1 mg

TEACHER'S NOTE: Students can find the nutritional composition of eggs by using USDA's nutrient database (http://ndb.nal.usda.gov/ndb/search/list), or the labels provided.

2. What nutrients does the egg white have more of when compared to the egg yolk?

The egg white has more sodium, protein, potassium, and magnesium.

3. What nutrients does the egg yolk have more of when compared to the egg white?

The egg yolk has more calories, fat, and cholesterol, but also has more vitamins and minerals including folate, Vitamin D, Vitamin A, phosphorus, iron, and calcium

4. Why would a person choose egg whites instead whole eggs?

A person would choose egg whites because they are lower in calories, fat, and cholesterol without comprising the protein content.

TEACHER'S NOTE: In general, students should find that there is little nutritional difference between eggs of different colors, however there are significant nutritional differences between egg whites and egg yolks. The egg white contains most of the protein and little fat. The egg yolk contains protein, albeit less than the white, and is the major source of fat, vitamins and minerals.

TRY THIS AT HOME:

Turkey Quesadillas

Makes 3 servings

You will need:

6 (8-inch) whole-wheat flour tortillas
1 ½ cups vegetables
8 ounces cooked turkey (or other kind of meat)
1 cup shredded Monterey Jack cheese
½ cup salsa

INSTRUCTIONS:

1. Top one tortilla with ¼ cup of cheese, half the vegetables, and half the turkey.
2. Add another ¼ cup cheese and another tortilla.
3. Transfer to a skillet and cook each side for 4-5 minutes, or until tortillas are golden brown and the cheese has melted.
4. Remove from skillet and set aside to cool.
5. Enjoy!

TRY THIS AT HOME:

Fluffy Vegetable Omelet

Makes 1 serving

You will need:

2 eggs
1 tablespoon skim or low-fat milk
⅓ cup vegetable of choice
Salt and pepper (to taste)
Vegetable oil cooking spray

INSTRUCTIONS:

1. Beat egg with a fork and add milk.
2. Add vegetables to eggs and mix.
3. Spray a small frying pan with cooking spray.
4. Heat the frying pan over low heat.
5. Pour eggs into the frying pan. Cook until the eggs are no longer liquid. Slip spatula around the sides of the omelet and fold in half.
6. Cook for 2 minutes longer. Remove from the pan with the spatula.
7. Add salt and pepper to taste and enjoy!