

name _____

Time Frame

2 class periods (45 minutes each)

Overview

In this lesson, students compare nutritional benefits of egg yolks and egg whites and determine the health benefits and nutrients of each. Students build understanding that both the egg yolk and egg white have unique chemical and physical properties and explore how and why eggs are used in different applications, such as cooking and baking.

Objectives

Students will:

- Identify the properties of proteins and amino acids
- Examine how egg whites and yolks are used in preparation methods
- Explain how chemical and physical reactions are used to cook and bake using eggs

Next Generation Science Standards

- **HS-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
 - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)

Materials

- Paper
- Sketch it Out! student handout
- Egg Preparation Chemistry student handout
- Optional Image: <https://biosocialmethods.isr.umich.edu/research-support/videos-tutorials/epigenetics-tutorial/>



Background Information

Proteins are macromolecules made of amino acids and they are coded by our genes. A gene is a segment of a DNA molecule that contains the instructions needed to make a protein. All of our cells contain the same DNA molecules, but each cell uses a different combination of genes to build the specific proteins it needs to perform its specialized functions. Proteins are more than 50% of the dry weight of most cells and are important in every cellular process. Proteins are folded into shapes and held by chemical bonds. Proteins can be classified according to their structure or function. Their three-dimensional shape is critical to its function. Eggs are a good source of protein. An egg's protein structure changes in different ways depending on how it is cooked. This makes eggs ideal for use in a variety of recipes and preparations.

Engage (15 minutes)

1. Ask students to write “proteins, eggs, cooking, baking” at the top of a sheet of paper.
2. Have them list as many terms, facts, ideas, concepts, definitions or experiences as they can in two minutes.
3. After two minutes have passed, have students turn to a partner and compare lists.
4. Ask each group to share one or two items they wrote down and write their ideas on the board. **Teacher Note: You may want to collect the lists to use as a pre-assessment of what the students recall and what critical ideas are missing.**

Explore (20 minutes)

1. Explain to students that eggs are a good source of protein, are prepared in many dishes and have a variety of applications in consumer products. The key to understanding how eggs are so versatile lies in understanding their protein structure.
2. Explain that there are 20 different amino acids that are the basic building blocks for proteins. They may already be in your body or in something you can eat, but all have a similar structure. If possible, show students an image of protein composed of amino acids. (An optional image is provided.)



3. Invite students to review the descriptions of different cooking methods in the **Sketching it Out!** handout. Each preparation method describes a different way to cook or prepare food with an egg.
4. For each method, ask students to first sketch out the method being described.
5. Next, ask students to predict what type of preparation is being described in each method. Present the three methods: **cooking**, **emulsification** and **mixing** to check their predictions. Each method describes a unique property eggs exhibit when manipulated for different recipes. Sometimes a completely new substance is formed with the egg and other times the egg is part of a mixture. Scientists describe these changes as **physical** and **chemical**.
6. Provide the following definitions that help describe the processes happening as the egg is prepared:
 - **Chemical change:** Any change that results in the formation of new chemical substances.
 - At the molecular level, chemical change involves making or breaking of bonds between atoms.
 - **Physical change:** Rearranges molecules but does not affect their internal structures.
7. Ask students to classify which cooking method is being explained and illustrated in each description as either a chemical or physical change.
8. Explain to students that no matter the preparation method, the protein structure changes in some way.

Explain (40 minutes)

1. Share with students a variety of images of foods in which eggs are a main ingredient, such as crème brulee, flan, Hollandaise sauce, Pavlova, mayonnaise, huevos rancheros, soufflé.
2. Invite students to briefly research each food item and identify which parts of the egg are being used: the yolk, the egg white or both.
3. Tell students that eggs are used in dishes everyone enjoys throughout the day, from hearty breakfasts to rich desserts. Chefs and home cooks use the properties of eggs to create delicious dishes. Using **Egg Preparation Chemistry** (and any other resources available in the classroom), guide students to use their learning about proteins, amino acids and bonding to describe how each dish uses a different preparation method.



Elaborate (20 minutes)

1. Explain to students that eating a variety of nutrient-dense foods which have more nutrients and fewer calories can provide energy and help the body function properly. Nutrient-dense foods may contain carbohydrate, protein, fat, vitamins, minerals and water which are nutrients essential for life and health. Choosing nutrient-dense foods like fruits, vegetables, whole grains, low-fat or fat-free milk products, seafood, lean meats, eggs, peas, beans, and nuts as part of a healthy eating pattern can nourish the body and keep them healthy.

Ask students to consider the nutrients in both parts of the egg and predict whether there are more nutrients in the egg white or egg yolk by displaying the major contents of each. Engage students in a discussion about the meaning of “nutrient-dense” and ask them to support their predictions with evidence.

- **Vitamins and minerals in egg yolk:**

- Vitamin D 4% DV*
- Vitamin A 8% DV
- Riboflavin (B2) 6% DV
- Niacin (B3) 4% DV
- Vitamin B6 4% DV
- Folate 6% DV
- Vitamin B12 15% DV
- Biotin (B7) 15% DV
- Pantothenic Acid (B5) 10% DV
- Phosphorus 6% DV
- Zinc 4% DV
- Selenium 15% DV
- Choline 25% DV
- 186 mcg lutein & zeaxanthin

- 50 kcal
- 2.5 g protein
- 4.5 g fat

- **Vitamins and minerals in egg white:**

- Riboflavin (B2) 10% DV
- Niacin (B3) 4% DV
- Biotin (B7) 6% DV
- Selenium 10% DV

- 15 kcal
- 3.5 g protein

2. Invite students to check their prediction by researching if egg whites have more nutrients than egg yolks. Also, to think about how to get the most nutrition from an egg. Ask students to research the health benefits of nutrients found in the egg white and egg yolks like protein, choline and carotenoids lutein and zeaxanthin.

Evaluate (5 minutes)

Collect student explanations included on *Egg Preparation Chemistry*.



Sketch it Out!

Directions: Using the descriptions below, sketch out what is happening in each egg preparation method below.

Preparation Method #1	Preparation Method #2	Preparation Method #3
<p>As the egg is cooked, the molecules vibrate. The bonds break and the proteins unravel. They form new bonds and the egg becomes a solid.</p>	<p>Some amino acids are attracted to water while others are repelled by water. Egg proteins include both types. When the egg is exposed to the air and part of it is in water the proteins uncurl and bond with each other. This holds the air bubbles in place. Even when you cook them the bubbles will stay intact.</p>	<p>Amino acids that repel and attract water are found in egg yolk. Since they have both types they can act as emulsifiers. This means the eggs in proteins can stick to the water and oil, making a uniform substance.</p>
Blank space for sketching	Blank space for sketching	Blank space for sketching



Egg Preparation Chemistry

Preparation Method	Description	Example and description of preparation in that dish
Cooking	When the egg is cooked the molecules vibrate. The bonds break and the proteins unravel. They form new bonds and the egg becomes a solid.	
Mixing	Some amino acids are attracted to water while others are repelled by water. Egg proteins include both types. When the egg is exposed to the air and part of it is in water, the proteins uncurl and bond with each other. This holds the air bubbles in place. Even when you cook them, the bubbles will stay intact.	
Emulsifier	Amino acids that repel and attract water are found in egg yolk. Since they have both types they can act as emulsifiers. This means the eggs in proteins can stick to the water and oil, making a uniform substance.	

