Mixture

Physical Science | Lesson Guide

5th Grade

Photo Description

This image shows pieces of fried cauliflower sitting on top of a fresh green salad with lettuce, cabbage, and carrots. The cauliflower has a golden, bumpy coating from being breaded and cooked in hot oil. The vegetables underneath are raw and crisp, showing different colors and textures.

Scientific Phenomena

The anchoring phenomenon here is chemical and physical changes in cooking. When the cauliflower was fried, multiple scientific processes occurred simultaneously. The high heat caused water molecules in the cauliflower to turn into steam (physical change), while proteins and starches in the breading underwent chemical reactions called the Maillard reaction, creating new compounds that give the golden color and crispy texture. Meanwhile, the raw vegetables maintain their original cellular structure and chemical composition.

Core Science Concepts

1. Physical vs. Chemical Changes: Cooking involves both types of changes - water evaporating is physical (can be reversed), while browning reactions are chemical (create new substances)

2. States of Matter: Heat energy transforms liquid water in food into water vapor (gas), demonstrating state changes

3. Heat Transfer: Thermal energy moves from the hot oil into the food through conduction, cooking it from outside to inside

4. Properties of Materials: Different materials (raw vegetables vs. cooked cauliflower) have different observable properties like texture, color, and temperature

Pedagogical Tip:

Use this image to have students create a T-chart comparing the properties of the raw vegetables versus the cooked cauliflower. This concrete comparison helps them understand that cooking creates measurable changes in materials.

UDL Suggestions:

Provide multiple ways for students to explore this concept: let them touch different textures (raw vs. cooked vegetables), smell different aromas, and use graphic organizers to categorize physical versus chemical changes they observe.

Zoom In / Zoom Out

1. Zoom In: At the molecular level, heat breaks down cell walls in the cauliflower, proteins unfold and reconnect in new ways, and starch molecules change structure to create the crispy coating.

2. Zoom Out: This meal represents part of a larger food system - the vegetables grew using energy from the sun, were harvested and transported, and now provide chemical energy (calories) to fuel human body systems.

Discussion Questions

1. What evidence do you see that the cauliflower went through both physical and chemical changes? (Bloom's: Analyze | DOK: 3)

2. How would you design an experiment to test whether cooking creates new substances? (Bloom's: Create | DOK: 4)

3. Why do you think the raw vegetables look and feel different from the cooked cauliflower? (Bloom's: Apply | DOK: 2)

4. What do you predict would happen if we tried to "uncook" the fried cauliflower? (Bloom's: Evaluate | DOK: 3)

Potential Student Misconceptions

1. Misconception: "Cooking just makes food hot"
   Reality: Cooking creates new substances through chemical reactions and changes the physical structure of materials

2. Misconception: "All changes in cooking can be undone"
   Reality: Physical changes like melting can be reversed, but chemical changes like browning cannot be undone

3. Misconception: "Raw and cooked foods are made of the same exact materials"
   Reality: Chemical reactions during cooking create entirely new compounds with different properties

Cross-Curricular Ideas

1. Math - Measurement & Data: Have students measure the temperature of hot oil, room-temperature raw vegetables, and the cooked cauliflower at different times. Create a line graph showing how temperature changes over time during cooking. This connects heat transfer to data visualization and helps students understand rates of change.

2. ELA - Descriptive Writing: Ask students to write detailed sensory descriptions comparing the raw salad to the cooked cauliflower without naming the foods. Include observations about color, texture, smell, and sound. This builds vocabulary for scientific properties while developing descriptive writing skills using a concrete subject they can observe.

3. Social Studies - Food & Culture: Research how different cultures prepare cauliflower and other vegetables. Create a chart showing various cooking methods (frying, steaming, roasting, raw) and discuss how available resources and cultural traditions influence food preparation. This connects food science to geography and cultural diversity.

4. Art - Color Theory & Texture: Have students create mixed-media artwork comparing the textures and colors of raw versus cooked foods. Use actual materials (sandpaper for crispy texture, silk for smooth raw vegetables) to represent different surfaces. This reinforces understanding of physical properties while exploring artistic expression.

STEM Career Connection

1. Food Scientist: Food scientists study how cooking changes foods and develop new recipes and cooking methods that are healthy and delicious. They test different ingredients, temperatures, and techniques to understand what happens when foods are prepared. Food scientists work in restaurants, food companies, and research labs to make sure food is safe and tasty. Average Salary: $65,000 - $75,000 per year

2. Nutritionist/Dietitian: Nutritionists study how different foods and cooking methods affect our bodies and health. They understand that cooking changes the nutrition in foods and help people choose healthy meals. They might work in schools, hospitals, or sports teams to help people eat well. Average Salary: $58,000 - $68,000 per year

3. Chemical Engineer: Chemical engineers use chemistry and physics to design better ways to cook, preserve, and process foods on a large scale. They figure out the best temperatures, timing, and methods to cook food efficiently for restaurants and food companies. They might invent new cooking equipment or improve how frozen foods are prepared. Average Salary: $105,000 - $120,000 per year

NGSS Connections

- Performance Expectation: 5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances
- Disciplinary Core Ideas: 5-PS1.B (Chemical Reactions), 5-PS1.A (Structure and Properties of Matter)
- Crosscutting Concepts: Cause and Effect, Energy and Matter
- Science Practices: Planning and Carrying Out Investigations, Analyzing and Interpreting Data

Science Vocabulary

* Chemical change: A process that creates new substances with different properties than the original materials
* Physical change: A process that changes how something looks or feels but doesn't create new substances
* Properties: Observable characteristics of materials like color, texture, temperature, or smell
* Heat transfer: The movement of thermal energy from warmer objects to cooler objects
* State of matter: Whether a substance exists as a solid, liquid, or gas
* Maillard reaction: A chemical process that happens when proteins and sugars are heated together, creating browning and new flavors

External Resources

Children's Books:
- What Is Matter? by Robin Johnson
- Chemical and Physical Changes by David Dreier
- Cooking by DK Eyewitness