

## 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

### 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

YouTube Videos:



## Mixture — 5th Grade Lesson Guide

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- "Physical and Chemical Changes for Kids" - Simple explanation with cooking examples: [https://www.youtube.com/watch?v=37pir0ej\\_SE](https://www.youtube.com/watch?v=37pir0ej_SE)
  - "Bill Nye Chemical Reactions" - Engaging demonstration of how cooking involves chemistry: <https://www.youtube.com/watch?v=GEkHJwUb0xU>