Thermal Energy

Physical Science | Lesson Guide

2nd Grade

Photo Description

This image shows an egg cooking on a dark pan over a blue flame on a stove. The egg white has turned from clear to solid white, while the yellow yolk in the middle stays runny. Heat from the flame below is making the egg change from raw to cooked.

Scientific Phenomena

Anchoring Phenomenon: Heat energy changes the properties of matter (specifically, egg proteins denature and solidify when exposed to thermal energy).

When heat from the flame travels to the pan and then to the egg, it causes the proteins in the egg white to break apart and bond in new ways. This physical and chemical change makes the clear, liquid egg white become solid and opaque. The yolk heats more slowly because it's thicker, so it may stay liquid longer. This is an everyday example of how thermal energy (heat) can permanently transform materials.

Core Science Concepts

* Heat and Temperature: Heat is energy that moves from hot things to cooler things. The flame is very hot and transfers heat to the pan and egg.

* States of Matter: Matter can exist as solids, liquids, or gases. The egg changes from a liquid (raw) to a solid (cooked) when heat is added.

* Energy Transfer: Thermal energy moves in a direction—from the hot flame !' to the pan !' to the egg. This is called heat transfer.

* Irreversible Changes: Once an egg is cooked, you cannot turn it back into a raw egg. This shows that some changes caused by heat are permanent.

Pedagogical Tip:

Use a sensory prediction strategy before showing the cooking process. Ask students, "If you could touch this raw egg, what would it feel like?" Then ask, "What do you think it will feel like after the heat touches it?" This activates prior knowledge and builds curiosity before the lesson begins.

UDL Suggestions:

Multiple Means of Engagement: Provide a raw egg and a cooked egg for students to observe and touch (with appropriate safety and hand-washing). Offer visual, tactile, and olfactory experiences. For students with sensory sensitivities, provide photos or drawings as alternatives to direct contact.

Multiple Means of Representation: Use both words and pictures to describe the egg cooking. Act out the changes: have students stand (liquid) and then "freeze" in place (solid) to show the change from raw to cooked.

Discussion Questions

1. What do you notice has changed about the egg after heat was added? (Bloom's: Remember | DOK: 1)

2. Why do you think the egg white turned from clear to white? (Bloom's: Analyze | DOK: 2)

3. If we could cool down the cooked egg, do you think it would turn back into a raw egg? Why or why not? (Bloom's: Evaluate | DOK: 3)

4. Where is the heat coming from, and how does it reach the egg? (Bloom's: Understand | DOK: 2)

Extension Activities

Activity 1: Cooking Sequence Cards
Provide three pictures showing an egg in different stages: raw, cooking, and fully cooked. Ask students to place them in order and explain what is happening at each stage using their new vocabulary.

Activity 2: Heat Source Exploration
Safely explore other heat sources in the classroom (a sunny windowsill, a lamp, warm water). Have students predict and test which sources are warm and which are cool. Create a class chart showing "Warm" and "Cool" heat sources.

Activity 3: Material Changes Hunt
Take students on a "material changes" walk through the school or home (with permission). Identify other examples of irreversible changes caused by heat: toast, melted butter, baked cookies, or heated playdough. Document with drawings and discuss why these changes are permanent.

NGSS Connections

Performance Expectation:
2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Disciplinary Core Ideas:
- 2-PS1.A: Different properties are suited to different purposes.
- 2-PS3.A: Heat can be produced in many ways and can move from one place to another.

Crosscutting Concepts:
- Energy and Matter: Energy can be transferred from one object to another.
- Cause and Effect: Simple cause-and-effect relationships exist in everyday situations (heat causes changes in materials).

Science Vocabulary

* Heat: Energy that makes things warm or hot.
* Thermal Energy: The energy that comes from heat and makes things warm.
* Cook: To use heat to change the way food looks and feels.
* Solid: Matter that has a definite shape and does not flow (like a cooked egg white).
* Liquid: Matter that flows and takes the shape of its container (like a raw egg).
* Irreversible Change: A change that cannot be undone or reversed.

External Resources

Children's Books:
- Heat by Robin Nelson (Lerner Publications) – Simple, illustrated introduction to heat and thermal energy
- The Egg by M.P. Robertson – A story-based exploration of eggs and transformation
- Cooking with the Sun by Beth and George Geiger – Demonstrates how heat from the sun cooks food

YouTube Videos:
- "States of Matter for Kids" by Science Kids – Clear, animated explanation of solids, liquids, and gases (~4 minutes)
  https://www.youtube.com/watch?v=iNj5IU1Ey2s

- "How Cooking Changes Food" by National Geographic Kids – Engaging video showing heat's effects on various foods (~5 minutes)
  https://www.youtube.com/watch?v=2TDDIBoXPNo