Propane_heater_4 PS3 2

Physical Science | 5E Lesson Plan

2nd Grade

Core Science Concepts

- Heat Energy: The heater produces and radiates thermal energy (heat) outward, warming objects and air around it.
- Light Energy: The glowing coils emit visible light (the bright orange-red glow), which is a form of energy traveling in straight lines.
- Material Properties: The metal coils and mesh screen have properties (conducting heat, reflecting light, durability) that make them suitable for a heater's purpose.
- Energy Transformation: Electrical energy is converted into heat and light energy when the heater is turned on.…

Lesson Overview

- Grade Level: Second Grade
- Subject: Science (Physical Science)
- Time Allotment: Two 45-minute sessions (90 minutes total)
- NGSS Standards:
  - 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.
  - 2-PS1-4: Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Learning Objectives

Students will be able to:
1. Observe and describe how heat and light energy travel from a heat source.
2. Identify materials that conduct (transfer) heat well and materials that do not.
3. Explain why certain materials are chosen to make heaters based on their properties.
4. Construct a simple argument using evidence that heat can change materials in different ways.

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1. ENGAGE

Objective: Activate curiosity about heat and light energy using the photograph of the glowing heater.

Materials:
- Photograph of the propane heater displayed on a projector or large screen
- Chart paper and markers
- Optional: A safe, LED glow stick or flashlight (do NOT use an actual heater in this phase)

Activity:

1. Display the Photo: Show the photograph large enough for all students to see. Draw attention to the bright orange-red glow.

2. Guiding Discussion Questions:

- "What do you see in this picture? What colors do you notice?" (Students should observe the bright orange, red glow and dark areas.)
- "How do you think this object feels if you put your hand near it?" (Students should infer it would feel hot or warm.)
- "What is making it glow like that? What is that orange color?" (Students may say "fire," "electricity," "heat," or "light." Accept all answers.)
- "Have you ever felt heat from something at home? Tell me about it." (Personal connection: sun, oven, heater, campfire, blanket.)

3. Wonder Prompt:
- Display: "I wonder... What makes the coils glow orange-red? What travels from hot things to make us feel warm?"
- Have students turn to a partner and share their wondering. Record 3-4 student wonderings on chart paper.

4. Class Prediction:
- Ask: "Do you think the metal coils are hot or cold? Why do you think that?" Write predictions on the chart.

Transition: Now we're going to explore heat and light for ourselves with safe activities that will help us understand how this heater works.

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2. EXPLORE

Objective: Students investigate heat transfer through hands-on activities and discover which materials conduct heat well.

Materials:
- Warm (not hot) water in a bowl or tub (approximately 110°F / 43°C — comfortable to touch but noticeably warm)
- Metal spoon
- Plastic spoon
- Wooden spoon
- Cloth strips or paper towels
- Timer or classroom clock
- Small objects: metal washer, plastic bead, wooden bead
- Recording sheet with simple drawings or checkboxes (provided below)
- Optional: Thermometers (if available)

Activity: Heat Conduction Investigation

Step-by-Step Student Directions:

1. Setup: Each small group receives one bowl of warm water and three spoons (metal, plastic, wood).

2. Prediction: Before placing spoons in water, students draw which spoon they think will feel hottest after 2 minutes. Use the recording sheet.

3. Testing (2-minute duration):
- Students place all three spoons in the warm water at the same time.
- Set a timer for 2 minutes.
- Students sit quietly and wait (no touching yet).

4. Observation:
- After 2 minutes, students use a cloth strip to carefully touch the handle end of each spoon (away from the bowl).

- Students record which spoon felt warmest, lukewarm, and coolest on their recording sheet (using faces: Ø=Þ hot, Ø=Þ warm, Ø=Þ cool).

5. Data Collection:
- Students repeat with metal, plastic, and wooden beads placed on a plate near the warm water. Do they heat up the same way? Record observations.

Connection to the Photo:
- Ask: "In the heater picture, the metal coils glow. Do you think metal is good at holding heat and getting hot? What did we just discover?"

Teacher Role:
- Circulate to ensure water is appropriately warm (safe but clearly warm to touch).
- Ask guiding questions: "Which spoon's handle got hot first? Why do you think that happened?"
- Do NOT provide the answer — let students observe and wonder.
- Manage timing so all groups finish within the phase.

Expected Student Outcomes:
- Students discover that metal conducts (transfers) heat fastest.
- Plastic and wood conduct heat more slowly.
- Students record their observations with drawing, words, or teacher-scribed notes.

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3. EXPLAIN

Objective: Formalize understanding of heat transfer, energy, and material properties using student-discovered evidence.

Materials:
- Chart paper with predictions from Engage phase
- Three spoons (metal, plastic, wood) from Explore activity
- Picture cards of heat sources: sun, fire, heater, stove, blanket
- Vocabulary anchor chart (see below)

Activity:

1. Share Out (5 minutes):
- Invite 2-3 groups to share their findings: "Which spoon got hot the fastest? Which was slowest?"
- Create a simple bar graph or tally chart on the board showing results across groups.
- Ask: "Why do all groups get the same answer about metal?"

2. Introduce Key Vocabulary (8-10 minutes):
- Write each term on the anchor chart with a picture or simple diagram.

3. Make Connections (5 minutes):
- Point back to the photograph: "The heater has metal coils on the inside. Now we understand why! Metal gets hot quickly and spreads that heat. The metal glows orange because it is SO hot."
- Show picture cards of heat sources and ask: "Which of these give off heat? Which give off light? Can something give off both?"

4. Check for Understanding:

- Ask individual students: *"If I want to make a spoon get hot quickly, what material should I use?" (Metal)
- "If I want to keep my hands warm and NOT burn them, what material would I wrap around a hot pot?" (Wood, cloth, plastic)

Vocabulary:

Term	Student-Friendly Definition
Heat	Energy that makes things warm. It moves from hot things to cooler things.
Conduct (or Conducts)	To let heat travel through something. Metal conducts heat really well and really fast.
Material	What something is made of — like metal, plastic, wood, cloth, or rubber.
Energy	The power to make things happen or change. Heat and light are kinds of energy.
Light	Energy that we can see. It travels in straight lines from bright things.

Expected Student Outcomes:
- Students understand that different materials conduct heat at different speeds.
- Students can explain why metal is used in heaters (it conducts heat well).
- Students know heat is energy that moves from hot to cold objects.

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4. ELABORATE

Objective: Students apply understanding by designing a "heat keeper" and exploring reversible vs. irreversible changes.

Materials:
- Small objects: ice cubes, chocolate chip, crayon, butter, clay
- Plastic bags or aluminum foil
- Cloth scraps, bubble wrap, newspaper
- Metal pan, wooden board, plastic plate, cloth
- Warm water (same as Explore phase)
- Recording sheet with boxes for "Can Change Back?" and "Cannot Change Back"
- Timer

Activity: Part 1 — Design a Heat Keeper (10 minutes)

1. Challenge: "We know metal conducts heat fast. But what if we want to KEEP something warm WITHOUT letting the heat escape? What material would we wrap around it?"

2. Design Task:
   - Show students ice cubes, a warm water bowl, and materials (cloth, bubble wrap, foil, newspaper).
   - Ask: "Which material would keep ice from melting the longest? Why?"
   - Students predict and vote with thumbs (cloth, bubble wrap, foil, newspaper).
   - Choose one prediction to test together: Wrap ice in the voted material and another ice cube unwrapped. Check every 2 minutes. Which melts first?

3. Debrief: "The material that melts slowly keeps heat OUT. It doesn't conduct heat well. We call materials like this insulators."

Activity: Part 2 — Reversible vs. Irreversible Changes (10 minutes)

1. Demonstration & Discussion:

- Show students items affected by heat:
  - Ice cube (melting with warm water)
  - Chocolate chip (softening with warm water)
  - Crayon (slightly softening with warm water)
  - Clay (warming up but not changing shape)

2. Sorting Activity:
- Ask: "If we take away the heat, does this come back to how it was? Or is the change permanent?"
- Can Change Back (Reversible): Ice melts !' freezes back. Chocolate softens !' hardens when cool.
- Cannot Change Back (Irreversible): Crayon melts into wax (does not go back to the crayon shape). Paper burns (cannot un-burn).

3. Recording:
- Students draw or sort pictures onto a two-column chart: "Changes Back" and "Does NOT Change Back."

Teacher Role:
- Guide student predictions before testing.
- Ask: "What do you notice? Is the change going back to how it started?"
- Allow students time to watch changes occur; avoid rushing.

Expected Student Outcomes:
- Students understand that some materials insulate (do not conduct heat).
- Students distinguish between reversible changes (can be undone by cooling) and irreversible changes (cannot be undone).
- Students apply this thinking to understand how materials protect us from heater burns.

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5. EVALUATE

Objective: Assess whether students met the learning objectives through formative and summative strategies.

Activity:

Formative Assessment (During Lesson):
- Observation Checklist: During Explore and Elaborate, note whether students:
  - Accurately record observations of which spoon conducts heat fastest
  - Use evidence to explain why certain materials are used in heaters
  - Can identify a reversible vs. irreversible change with at least 1 correct example
- Questioning: Use responses to guiding questions to gauge understanding.

Summative Assessment — Exit Ticket (5-7 minutes):

Administer at the end of Day 2. Provide a sheet with images and simple text or teacher read-aloud.

Exit Ticket Questions:

1. Draw and Explain: "Draw a spoon made of the material that gets hot FASTEST in warm water. Write or tell me why you chose that material."
- Success Criteria: Student identifies metal and provides a reason (e.g., "metal conducts heat," "metal gets hot fast").

2. Picture Matching: Show three images: (a) ice melting, (b) paper burning, (c) clay warming up. Ask: "Which one can change back to how it started? Circle it."
   - Success Criteria: Student circles the ice (reversible change).

3. Application Question: "If a heater has metal coils on the inside, what material would you use to cover the heater so people don't burn their hands?"
   - Success Criteria: Student suggests an insulating material (plastic, cloth, rubber) and gives a simple reason (e.g., "doesn't conduct heat," "keeps us safe").

Expected Student Outcomes:
- Meets Standard: Students answer 2-3 questions correctly with evidence-based reasoning.
- Approaching Standard: Students answer 1-2 questions with partial explanations or minimal evidence.
- Not Yet: Students struggle to connect materials to heat conduction or cannot identify reversible changes.

Differentiation

Extension Activities

1. Kitchen Heat Investigators:
   - At Home: Students (with family help) identify three items at home made of metal and three made of insulating materials. They record or draw these and bring findings back to class. Class creates a shared chart: "Metal Things in My Home" and "Insulating Things in Our Kitchens."
   - Connection: Reinforces understanding that material choice is purposeful in everyday objects (pot handles, oven mitts, aluminum foil).

2. Design a Safe Heater:
   - Activity: Provide students with craft materials (foam, cloth, plastic tubes, cardboard). Challenge them to design a protective cover for a pretend "hot heater." They must explain which materials they used and why (e.g., "I used cloth because it doesn't conduct heat, so it won't burn us").
   - Presentation: Students present designs to the class and justify material choices using evidence from the lesson.

3. Heat & Light in Nature:
   - Activity: Take students on a classroom or outdoor walk to identify natural sources of heat and light (sun, fire, animals, plants). Create a chart: "Things That Make Heat" and "Things That Make Light." Discuss: Can something do both? (Yes — the sun and fires.)
   - Connection: Broadens understanding of energy beyond human-made heaters to natural phenomena.
