Propane_heater_4 PS3 2

Physical Science | 5E Lesson Plan

5th Grade

Core Science Concepts

- Heat energy transfer and radiation – The bright orange glow and perforated panels demonstrate how heat from a combustion source (propane heater) radiates outward through designed materials, making thermal energy visible through light emission
- Light as a form of energy – The intense orange-red color shows how heat energy converts to visible light, which travels outward and can be observed from a distance
- Properties of materials and heat conduction – The perforated metal design reveals how different materials allow heat and light to pass through at different rates, affecting how energy is distributed…

Lesson Overview

- Grade Level: Fifth Grade
- Subject: Science (Physical Science)
- Time Allotment: Two 45-minute sessions (90 minutes total)
- NGSS Standards:
  - 5-PS3-1: Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
  - 5-PS1-3: Make observations and measurements to identify materials based on their properties.

Learning Objectives

Students will be able to:
1. Identify heat and light as forms of energy that can be observed and measured.
2. Explain how heat energy is produced and travels from one place to another.
3. Describe how different materials allow heat and light to pass through or block them based on their properties.
4. Make observations and predictions about how energy changes form (heat !' light).

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1. ENGAGE

Objective: Capture student interest and activate prior knowledge about heat and light energy.

Materials:
- Printed color copies or digital display of the propane heater photograph (1 per student or 1 for class display)
- Chart paper or whiteboard
- Markers

Activity:

1. Display the photograph large and prominently (projected on board or printed posters). Do NOT explain what it is yet.

2. Ask these discovery questions (allow 30-45 seconds of think time between each):
   - "What do you notice about the colors in this picture? Where do you see orange and red?"

- "Why do you think something would glow orange like that? What do you think caused it?"
- "If you could touch the orange parts, what do you predict they would feel like?"
- "Where do you think the heat energy is going? Can you see it moving anywhere?"

3. Activate prior knowledge:
- "Raise your hand if you've ever felt heat from a campfire or a sunny window. What form of energy makes you feel that warmth?"
- "Have you ever noticed that a lightbulb gets hot? Why do you think that happens?"

4. Create a class Wonder Wall: On chart paper, write: "We wonder..." and collect 3-4 student questions about the photograph. Pin it visibly for the lesson. Examples: "Does orange mean it's the hottest part?" "How does heat make light?"

Transition: "Today, we're going to investigate how energy travels as heat and light, and why we can see it glowing in this picture."

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2. EXPLORE

Objective: Students investigate how heat and light energy behave through hands-on experimentation.

Materials (per small group of 3-4 students):
- 1 heat source: incandescent lamp (75-100W) with shade removed, OR a desk lamp with warm-white LED bulb (safer alternative)
- Heat-safe thermometers (3 per group)
- Stopwatch or timer (phone or classroom timer)
- 3-4 different material samples (index cards, aluminum foil, plastic wrap, dark construction paper, tissue paper) – 5" × 5" squares
- Tape
- Data recording sheet (provided below)
- Safety goggles (1 per student)

Safety Note: Teacher demonstrates lamp handling before groups begin. Lamps should be on stable, flat surfaces away from water and paper. Incandescent bulbs get very hot—no touching.

Activity – Hands-On Investigation:

1. Setup (Teacher-Led Demo first – 3 minutes):
- Teacher shows all students where to place thermometers safely around a heat source without touching it.
- Explain: "We're going to see how heat and light travel from this lamp, and which materials allow heat and light to pass through best."

2. Student Investigation (15-20 minutes):
- Each group receives one thermometer to place 6 inches away from the lamp in a clear area.
- Round 1 (No barrier): Turn on the lamp. Record the starting temperature. Wait 3 minutes. Record temperature again. Observe any light reaching the thermometer.
- Round 2 (With barriers): One group member tapes different materials (one at a time) between the lamp and the thermometer, 6 inches away.
- For each material, record:
  - Can you see the light through it? (Yes/No, and describe color if yes)

- Does the thermometer temperature rise? (Yes/No)
- How much did it rise in 3 minutes?
- Observation: Have students predict which material will show the most heat transfer and which will show the least.

Student Data Recording Sheet:

Material	Light Visible?	Light Color (if yes)	Temp Start	Temp After 3 min	Temp Change
None	Yes	Orange/yellow	___	___	___
Index card			___	___	___
Aluminum foil			___	___	___
Plastic wrap			___	___	___
Tissue paper			___	___	___

Teacher Role:
- Circulate and ask guiding questions (do NOT answer):
  - "What do you notice about the temperature? Is it going up or staying the same?"
  - "Can you describe what you see when you look through that material at the light?"
  - "Why do you think some materials let more heat through than others?"
- Ensure thermometer placement is consistent across trials.
- Remind students to record observations in their own words, including predictions about what they think is happening.

Expected Student Outcomes:
- Students observe that light can pass through some materials (transparent/translucent ones) and is blocked by others.
- Students measure that heat increases near the source, but the rate of increase differs depending on materials.
- Students make a connection: light and heat travel as energy, and materials have different properties that affect how energy passes through them.

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3. EXPLAIN

Objective: Introduce formal vocabulary and explain the science concepts students discovered.

Materials:
- Chart paper or whiteboard
- Markers
- Student observation sheets from Explore
- Photograph displayed again
- Index cards with vocabulary (prepared in advance)

Activity:

1. Group Share-Out (5 minutes):
   - Ask each group to share ONE surprising observation from their investigation.
   - Record responses on chart paper under "What We Discovered About Heat and Light."
   - Look for patterns: "I notice many groups found that _____ material allowed the most light through."

2. Teacher-Led Explanation (10 minutes):

Introduce these key vocabulary terms:

Term	Student-Friendly Definition
Energy	The power to make things move, change, or produce light and heat. Energy can't be made or destroyed—it just changes form.
Heat Energy	A form of energy that makes things feel warm. Heat always travels from hot places to cooler places.
Light Energy	A form of energy we can see. It travels in straight lines outward from a source, like that lamp.
Radiation	The way heat and light travel outward from a source, like warmth from a fire reaching your face even though you're not touching it.
Transparent/Translucent	Transparent = you can see clearly through it. Translucent = you can see light through it, but it's fuzzy or colored.

3. Connect Back to the Photograph (3-4 minutes):
- Display the heater photo again.
- "Look at the orange glow. That's heat energy that's so hot it's turning into light energy—that's why we see that bright orange color. The perforated metal design lets that heat and light escape outward, like what happened with your thermometer."
- Point out the darker areas: "See how some parts are darker? That's where less light is escaping. The metal itself has properties that affect how heat and light move through it."

4. Check for Understanding:
- Ask 2-3 quick-answer questions:
  - "If heat and light traveled through aluminum foil in your experiment, why?" (Possible answer: It's reflective/shiny and thin.)
  - "Why did the tissue paper let some orange light through but the cardboard didn't?" (Possible answer: Different materials have different properties.)
  - "In the photograph, what form of energy are we actually seeing—heat or light?" (Answer: Light, but it's caused by heat energy creating a bright glow.)

Vocabulary Wall: Post the 5 vocabulary terms visibly for reference throughout the lesson and beyond.

Expected Student Outcomes:
- Students understand that heat and light are both forms of energy.
- Students can explain that materials have properties that affect how energy passes through or bounces off them.
- Students connect their hands-on observations to the photograph and understand that the orange glow is heat energy converting to visible light.

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4. ELABORATE

Objective: Students apply understanding to a new, real-world context and deepen their learning.

Materials:
- 5-6 household items with different properties (clear glass jar, frosted glass, plastic bottle, dark cloth, white cloth, aluminum foil)
- A strong flashlight or small LED light source
- Dark room or shaded area (closet, corner with windows covered)

- Student worksheet: "Energy Detective Challenge" (provided below)
- Colored pencils or markers

Activity – Real-World Application:

Scenario: "A family wants to design a better lampshade that lets light shine through but protects them from getting burned by heat. They're testing materials to see which ones are best. You're the design team!"

1. Exploration (10 minutes):
   - Place the light source in the dark area.
   - One student holds the thermometer near each material while another holds it in front of the light.
   - Test 3-4 materials from the household collection.
   - Record observations on the worksheet: Which material blocks the most heat? Which lets the most light through? Which would make the best lampshade?

2. Design Challenge (5 minutes):
   - Students draw or describe their ideal lampshade material using what they learned.
   - Justification: "I would use _____ because..."
   - Share designs with a partner and explain their energy reasoning.

Student Worksheet: "Energy Detective Challenge"

Material	Light Passes Through?	How Bright? (1-5 stars)	Feels Warm Behind It?	Best for Lampshade? Why or Why Not?

Design Your Lampshade:
Draw or describe the best material to use. Label the light, heat, and material.
Explain why: "This material is best because _____."

Teacher Role:
- Facilitate small-group rotations if needed.
- Prompt thinking: "Is letting light through enough, or do we also need to think about protecting people from heat?"
- Encourage students to use vocabulary from Explain phase (transparent, heat, light, radiation).

Expected Student Outcomes:
- Students recognize that real-world engineering problems require thinking about multiple properties of materials.
- Students apply heat and light concepts to solve a design problem.
- Students articulate that the best lampshade balances letting light through while controlling heat.

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5. EVALUATE

Objective: Assess student understanding of heat energy, light energy, and material properties.

Formative Assessment (Throughout Lesson):
- Explore Phase: Observation of group data collection and accuracy of thermometer readings and light observations.

- Explain Phase: Listen to student answers during share-out and check-for-understanding questions. Note who can explain material properties affecting energy transfer.
- Elaborate Phase: Review design choices and justifications—do they reference heat, light, or material properties?

Summative Assessment – Exit Ticket (5 minutes):

Distribute a one-page exit ticket. Students answer:

1. Draw and Label: "Draw the heater from the photograph. Show where heat energy is traveling and where light energy is traveling. Use arrows."

2. Short Answer (3-5 sentences):
   - "Why do you think the metal in the heater is perforated (has holes in it)? What form of energy escapes through those holes?"

3. Scenario Application:
   - "Your classroom windows let in a lot of heat from the sun, and it makes the room very warm. Based on what you learned, what material property would you look for in a window covering to block heat but still let some light in? Explain your thinking."

Success Criteria for Student Understanding:

' Meets Standard:
- Clearly identifies heat and light as forms of energy in drawings and explanations.
- Explains that materials have properties affecting how energy passes through.
- Connects observations to the photograph accurately.
- Uses at least 2 vocabulary terms correctly (energy, heat, light, transparent, radiation).

' Approaching Standard:
- Identifies heat or light but may confuse them.
- Recognizes material differences but incomplete explanation of why.
- Makes some connection to photograph.
- Uses vocabulary but may need prompting for accuracy.

' Beginning Standard:
- Limited distinction between heat and light.
- No connection between material properties and energy transfer.
- No reference to photograph concepts.

How to Determine if Learning Objectives Were Met:

- Objective 1 (Identify heat/light as energy): Exit ticket drawing and scenario answers show clear differentiation.
- Objective 2 (Explain heat/light travel): Arrows and descriptions in exit ticket drawing demonstrate understanding of energy movement.
- Objective 3 (Describe material properties): Window covering question and Elaborate design choices show transfer of material property concepts.
- Objective 4 (Observe energy transformation): Connections to the photograph throughout the lesson (especially exit ticket Q2) show students understand heat!'light conversion.

Differentiation

Extension Activities

1. Energy Scavenger Hunt at Home:
   - Assign homework: "Find 5 things in your home that produce light or heat energy (or both). Draw them and label whether they create light, heat, or both. Bring your list back to school."
   - Follow-up discussion: Create a class chart of student-found examples and discuss energy transformation in everyday objects (toaster, lamp, oven, etc.).

2. Model a Heat House:
   - Materials: Shoebox, aluminum foil, black paper, clear plastic wrap, tape, small thermometer.
   - Challenge: "Build a small 'house' using different materials. Place a heat source outside and measure temperature inside. Which material setup keeps the most heat inside (or outside)?"
   - Connect to real-world: Discuss why buildings are designed differently in hot vs. cold climates.

3. Technology Connection – Thermal Imaging Virtual Exploration:
   - If accessible, show students thermal imaging camera footage or online thermal images of homes/objects showing heat distribution.
   - Ask: "Why do you think some areas are bright red/orange and others are blue? What does that tell us about energy transfer?"
   - Discussion: "If we could see heat the way this camera does, what would our classroom look like? Where would we see the most heat?"
