

Energy Services Engineer

Build Smarter, Save More

A Middle School Lesson Plan on Energy Efficiency

Duration: 45 Minutes

Students become Energy Inspectors and investigate how homes and buildings can reduce wasted energy. Working in teams, they place thermometers in and around a model building, use visual inspection cards to identify problem spots, and redesign the structure with insulation upgrades — mirroring the real workflow of Energy Services Engineers.

Students Will Be Able To:

- Identify common sources of energy waste in buildings through visual inspection and temperature readings.
- Measure and record temperature differences inside and outside a model building using standard thermometers.
- Use a visual inspection checklist to locate drafts, gaps, and weak insulation points.
- Recommend and apply insulation and design improvements to reduce energy loss.
- Demonstrate professional teamwork, problem-solving, and data-driven decision-making.
- Identify the core role, responsibilities, and career outlook of an Energy Services Engineer.

Career Spotlight: Solar PV Installer

- **Role & Responsibilities:** Conduct energy audits on homes and commercial buildings. Analyze insulation, HVAC systems, windows, and appliances to identify inefficiencies. Develop energy improvement plans and verify the impact of upgrades through before-and-after measurement.
- **Education:** A Bachelor's Degree in Mechanical or Electrical Engineering, Building Science, or Environmental Studies is common. Some entry-level roles accept an Associate's Degree or technical certification.
- **Experience & Training:** Entry-level roles require 1-2 years of experience in construction, HVAC, or facilities. Certifications such as the Certified Energy Auditor (CEA) or BPI Building Analyst credential are highly valued in advanced roles. solar certification (like the NABCEP Associate Credential), and safety training.
- **Salary Range:** Entry-level pay is typically \$48,000–\$65,000 per year. Senior Energy Engineers and Program Managers range from \$75,000–\$110,000 annually.
- **Career Outlook:** Employment growth is strong, estimated at 11–14% over the next decade, driven by building electrification, green building standards, and corporate sustainability mandates.

Materials List

Energy Services Slide Deck

Student worksheet

NEED Energy House: <https://www.need.org/product/energy-house/>

If unable to purchase above kit, purchase supplies below:

- 1 box
- Bubble wrap insulation
- Cotton batting insulation
- Paper wadding insulation
- Aluminum foil
- Caulking
- Weatherstripping
- 1 Roll of packing tape
- 1 Sheet of poster board
- 2 Digital thermometer
- 1 Sheet of transparency paper
- Ice bag
- Tape, scissors, glue
- Heat source (lamp etc)

How Measurement Works: Students place one thermometer inside the sealed model building and hold a second thermometer close to each outside wall surface. A smaller difference between inside and outside temperature means less heat is escaping — better insulation. Visual inspection (looking for gaps, thin spots, and uncovered openings) rounds out the audit just like professionals use blower door tests and visual checklists in real buildings.

Prerequisite:

Prior to this lesson, (about a week prior) , students should build the NEED Energy House after creating a plan to build the most efficient home. Once homes have been built they will then act as Energy Services Engineers to inspect the model building and find where the energy is being wasted and redesign it to be more efficient.

If this task is done in small groups, students can “inspect and audit” another group’s building and supply recommendations for them to be able to improve.

1. Opening: Where does Energy Go? (5 Minutes)

Step	Teacher Script	Teacher Notes
1. Introduce the Role	<i>"Today, you are Energy Services Engineers. Your job is to inspect a model building, find where energy is being wasted, and redesign it to be more efficient — just like professionals who audit real homes and businesses every day."</i>	Goal: Hook students with a real-world role. Show the occupational video clip for Energy Services / Energy Auditor careers if available.
2. Essential Questions	<p><i>Before we start: Where do you think homes lose the most energy?</i></p> <p><i>Turn & Talk: Discuss with your partner — what parts of a building might let heat escape? What clues could you use to find energy waste without tearing down walls?"</i></p>	Facilitation: Lead a 2–3 minute discussion. Elicit answers around windows, doors, walls, roofs, and gaps. Introduce the two-thermometer method and the Visual Inspection Card as the tools the class will use today — connecting to how real auditors use checklists and temperature probes.

2. Hands-On Activity: Solar Panel Angle Efficiency Experiment (30 Minutes)

Objective: Students use thermometers and a visual inspection checklist to find where their model building loses heat, apply insulation upgrades, and re-measure to confirm improvement — mirroring the real workflow of an Energy Services Engineer.

Step	Teacher Script	Teacher Notes
1. Setup & Materials Check	<i>"Each team has a model building from last week, a heat source, two thermometers, insulation materials, and a Visual Inspection Card. Place the heat source and one thermometer inside your building, then close all the openings. This thermometer reads the indoor temperature. Your second thermometer will measure how warm each outside wall feels — warmer outside means heat is escaping through that surface."</i>	<p>Preparation: Pre-cut a small flap or hole in each box to slide the inside thermometer in, then tape shut. Lamps or hand warmers both work well.</p> <p>Thermometer Use: Hold the outside thermometer flat against each wall surface for 15–20 seconds before reading. This measures conductive heat loss through that surface.</p> <p>Safety: Lamps get hot — do not touch the bulb. Hand warmers are safe but remind students not to open the packet.</p>

2. Visual Inspection	<p><i>"Before you take any temperature readings, do a visual inspection first — just like a real energy auditor. Look at your building from the outside. Can you see any gaps, holes, thin spots, or uncovered openings? Mark each problem you find on your Visual Inspection Card using the color code: Red = gap or hole, Yellow = thin material, Green = looks well-sealed."</i></p>	<p>This step builds the observation skills that real auditors use before running any instruments. Circulate and prompt students: 'Where would cold air sneak in on a real house?' Connect to real examples: door sweeps, caulking, window weatherstripping.</p>
3. Baseline Temperature Readings	<p><i>"Wait two minutes for the building to warm up. Then read your inside thermometer and record it. Next, hold the outside thermometer against each surface — front wall, back wall, left wall, right wall, roof, and any window or door cutout — for 15 seconds, and record each reading in Trial 1 of your table. Calculate the temperature difference for each surface: Inside Temp minus Outside Surface Temp. A smaller difference means better insulation."</i></p>	<p>Procedure Focus: Remind students to re-read the inside thermometer at the start of each new trial — the heat source keeps the inside temperature fairly stable but it may drift slightly.</p> <p>Key Concept: Outside surface temperature rising toward the inside temperature = heat escaping. Students are measuring the temperature differential, not the absolute temperature.</p>
4. Identify Weak points	<p><i>Study your data and your Visual Inspection Card together. Which surfaces had the smallest temperature difference — meaning the most heat is getting through? Do those match the problem spots you marked visually? Circle your top two weak points. These become your priority upgrade areas — just like the findings section of a real energy audit report."</i></p>	<p>Assessment: Circulate and check that students correctly connect small temperature differential = high heat loss. The goal is for students to triangulate: visual findings + temperature data = informed recommendation. This mirrors professional audit methodology.</p>
5. Apply Upgrades	<p><i>"Now redesign your building. Apply insulation materials to your weak-point areas. You might line a wall with foam, cover a window gap with foil, or add a cotton batting layer to the roof. Think about which material works best for each location and why — is the problem a gap (air leakage) or thin material (conductive loss)?"</i></p>	<p>Differentiation: Challenge advanced groups to calculate a percentage improvement: (Before Difference – After Difference) / Before Difference × 100.</p> <p>Tip: Aluminum foil blocks radiant heat; foam and batting block conductive heat. Let students discover which works better on which surface.</p>

6. Post Upgrade Readings	<p><i>Wait two minutes, then re-read the inside thermometer and all outside surfaces. Record in Trial 2. Compare your temperature differences before and after. Did the gap get bigger — meaning you kept more heat inside? Which upgrade made the biggest impact?"</i></p>	<p>Assessment: The team with the greatest increase in average temperature difference (inside vs. outside) wins the efficiency challenge. (<i>Think: The inside of the house should be much warmer in the winter than the cold wintry day outside if your insulation works well</i>)</p> <p>Encourage groups to explain why certain upgrades worked better than others — this is the verbal equivalent of writing an audit recommendation.</p>
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3. Closing & Review: Career Spotlight (10 Minutes)

Step	Teacher Script	Teacher Notes
1. Data Review & Discussion	<p><i>"Which surfaces lost the most heat before your upgrades? Did your visual inspection predict the same problem areas as your thermometer data? Which upgrade created the biggest temperature improvement — and why do you think that material worked for that surface?"</i></p>	<p>Review student data and lead a discussion on the two heat loss mechanisms students encountered: air leakage (gaps/holes — fixed by sealing) and conductive loss (thin walls — fixed by insulation). Connect to real building science vocabulary.</p>
2. Career Profile Wrap Up	<p><i>You've practiced the core skills of an Energy Services Engineer — visual inspection, temperature measurement, identifying problems, and recommending solutions. This is a fast-growing career with an estimated 11–14% job growth, driven by the push for greener, more efficient buildings across the country."</i></p>	<p>Wrap-Up: Review the career profile. Ask students what surprised them most about the role and how the hands-on challenge reflects real daily work. Connect to local examples — school buildings, homes, local businesses.</p>

Energy Efficiency Audit Challenge

Student Worksheet

Name: _____ Date: _____

Group Members: _____

Scenario:

You are an Energy Services Engineer. A local business owner wants to lower their heating and cooling bills. Your job is to inspect their model building using thermometers and a visual inspection checklist, find where energy is being lost, apply targeted insulation upgrades, and deliver a final recommendation — just like a real energy audit.

Part 1: Career Spotlight – Energy Services Engineer

You will use the information below to answer the final analysis questions.

Detail	Description
Role & Responsibilities	Conduct energy audits on homes and commercial buildings. Analyze insulation, HVAC systems, windows, and appliances to identify inefficiencies. Develop improvement plans and verify results through before-and-after measurement.
Education	Bachelor's Degree in Engineering, Building Science, or Environmental Studies. Some entry-level roles accept an Associate's Degree or technical certification.
Experience & Training	1–2 years in construction, HVAC, or facilities management. Certifications like Certified Energy Auditor (CEA) or BPI Building Analyst are valued for advancement.
Career Outlook	Estimated 11–14% growth over the next decade, driven by green building standards and corporate sustainability goals.
Salary Range	Entry-level: \$48,000–\$65,000/year. Senior roles and Program Managers: \$75,000–\$110,000/year.

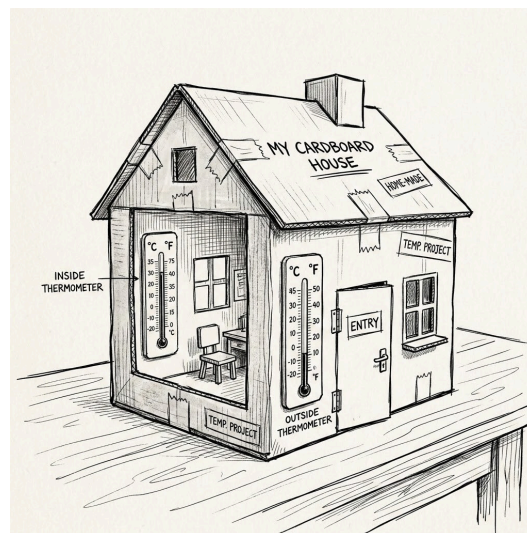
Part 2: Hands-On Challenge Procedure

Materials Check:

- Model building (cardboard box or NEED Energy Kit)
- Heat source: small desk lamp or hand warmer — placed inside the building
- 2 standard thermometers per group
- Insulation materials: foam scraps, cotton batting, bubble wrap, aluminum foil, felt
- Tape, scissors, rulers, colored markers
- This worksheet (including the Visual Inspection Card below)

A. Procedure

1. **Prepare the Model:** Assemble your building and place the heat source and one thermometer inside. Close all openings. Label each surface: Front Wall, Back Wall, Left Wall, Right Wall, Roof, Window/Door (if present).
2. **Visual Inspection:** Before taking any temperature readings, inspect the outside of your building. Look for gaps, holes, thin walls, and uncovered openings. Use the Visual Inspection Card (Part 3) to mark what you find using the color code.
3. **Wait & Warm Up:** Let the model sit with the heat source running for 2 minutes before taking any readings.
4. **Baseline Readings (Trial 1):** Read the inside thermometer and record it. Then hold the outside thermometer flat against each surface for 15 seconds and record the reading. Calculate the Temperature Difference (Inside Temp – Outside Surface Temp) for each surface. A smaller difference = more heat escaping through that surface.
5. **Identify Weak Points:** Look at your data and your Visual Inspection Card. Circle the two surfaces with the smallest temperature difference. These are your priority upgrade areas.
6. **Apply Upgrades:** Select insulation materials and apply them to your weak-point areas. Record what you used and where in the Notes column.
7. **Post-Upgrade Readings (Trial 2):** Wait 2 minutes, then re-read all surfaces. Record in Trial 2. Calculate the new Temperature Difference. Did the gap get larger — meaning you're keeping more heat inside?



B. Data Collection Table

Inside Temperature (read from thermometer inside building)	Trial 1: _____ °F	Trial 2: _____ °F
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Outside Surface Readings — hold thermometer against each surface for 15 seconds before recording.

Building Surface	Trial 1 Outside Temp °F	Trial 1 Difference*	Trial 2 Outside Temp °F	Trial 2 Difference*	Upgrade Applied / Notes
Front Wall					
Back Wall					
Left Wall					
Right Wall					
Roof					
Window / Door Gap					

** Temperature Difference = Inside Temp – Outside Surface Temp. A larger difference means better insulation (less heat escaping).*

As an Energy Services Engineer, what is your final recommendation to this client?

Part 3: Visual Inspection Card

Before taking temperature readings, inspect your building from the outside. Use the color code below to mark problem spots directly on the building diagram.

RED	YELLOW	GREEN	Color Code Key
Gap, hole, or open crack	Thin material or weak spot	Well-sealed, looks good	Mark each surface of your building diagram below with the matching color. Then answer the checklist.

Building Diagram — Label and Color-Code Each Surface:

[Draw your building here — label each wall and roof, mark problem spots with color code]

Visual Inspection Checklist:

	Inspection Item	What Did You Find?
☐	Are there any visible gaps or holes in the walls?	
☐	Is there anything covering the window or door openings?	
☐	Does the roof appear thick and sealed, or thin and open?	
☐	Are all the wall joints (corners) fully taped and sealed?	
☐	Is there any material that looks thinner than the rest?	

Part 3: Analysis and Conclusion

Answer the following questions based on your experiment and the Career Spotlight section.

- 1.** What two tools did your team use to find energy waste in the model building? Describe how each one worked.

- 2.** According to the Career Spotlight, what is the estimated employment growth for Energy Services Engineers over the next decade?

- 3.** Did your visual inspection predict the same weak spots as your thermometer data? Explain what matched and what surprised you.

- 4.** A client asks why they should spend money on insulation upgrades now. Using your data, write a one-paragraph justification explaining the long-term energy and cost savings.

- 5.** The Career Spotlight mentions that Energy Services Engineers conduct 'energy audits.' Based on your experiment, list two specific data points you would include in a real audit report and explain why each one matters.