



## Solar Water Heating Workshop – Lesson Plan

Solar water heating uses the sun's energy to produce hot water for homes, schools, and industrial applications. By capturing solar heat through specially designed vacuum tube collectors within fully automated closed-loop glycol systems, these technologies significantly reduce the need for electricity or gas, lowering both energy costs and carbon emissions.

Despite being one of the most efficient and practical renewable energy solutions available today, a lack of awareness has led to limited adoption. As a result, the majority of residential, commercial, and industrial water heating is still powered by fossil fuels.

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**Duration: 75 minutes**

**Audience: Students in Grades 6 to 12**

**Objective:**

Students will explore how energy from the sun can be used to heat water in everyday life. Through an interactive, hands-on experiment, they will investigate how solar water heating systems work, develop critical thinking and problem-solving skills, and connect renewable energy concepts to real-world applications.

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### 1. Introduction to Solar Thermal (5 minutes)

**Objective:** Introduce the concept of solar thermal energy

**Content:**

- Difference between solar thermal vs solar PV
- Basic idea: converting sunlight → heat
- Real-world applications (water heating, industry, buildings)

**Teaching Method:**

- Short presentation + visual images
  - Ask a quick question: “Where do we use hot water daily?”
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### 2. Water Heating Basics (5 minutes)

**Objective:** Understand how water is heated and energy is calculated

**Content:**

- Concept of heat energy ( $Q = m \cdot c \cdot \Delta T$  – no need to go deep unless advanced group)
- Energy consumption in traditional water heating
- Why water heating is a major energy use



**Teaching Method:**

- Simple explanation + real-life example (home or school)
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**3. How solar water heaters work (10 minutes)**

**Objective:** Understand the most reliable commercialized technology in solar water heating: evacuated tube, closed loop glycol systems

**Content:**

- Flat Plate Collectors
- Evacuated Tube Collectors (focus)
- Active vs Passive systems
- Storage tanks

**Teaching Method:**

- Show real components or images
  - Bring a demo vacuum tube
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**4. Experiment: Vacuum Tube Collector Calorimetry (40 minutes)**

**Objective:** Hands-on understanding of heat gain and efficiency

**Activity:**

Students measure how much energy is gained from the sun

**Steps:**

1. Measure initial water volume and temperature
2. Expose vacuum tube collector to sunlight or G-BMG artificial sun light
3. Measure temperature increase over time
4. Record:
  - Time
  - Temperature
  - Volume of water
5. Calculate heat gained using:

$$Q = m * C_p * \Delta T$$

**Discussion Points:**



- Why temperature increases
- Effect of sunlight intensity
- Real system efficiency

**Materials Needed:**

- Vacuum tube collector (demo unit)
  - Thermometer
  - Measuring container
  - Stopwatch
  - Data sheet
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**5. Worksheets / Group Activity (10 minutes)**

**Objective:** Reinforce learning

**Activities:**

- Simple calculation (energy gained)
- Concept questions:
  - Why vacuum tubes are efficient?
  - Where can we use this system?
- Optional:
  - Estimate cost savings

**Teaching Method:**

- Small groups (3 - 4 students)
  - Instructor walks around
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**6. Summary & Wrap-Up (5 minutes)**

**Objective:** Consolidate learning

**Content:**

- Key takeaways:
  - Solar thermal = efficient & practical
  - Water heating = major energy use

**Vacuum tubes = high performance**