

# Year 11 Physics - Lesson Plan 1/3

## Thermodynamics: Particles, Temperature Energy Flow

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Based on NSW Stage 6 Syllabus (Module 3)

### Lesson Overview

- **Lesson Title:** Thermodynamics: Relating Particles, Temperature, and Energy Transfer
- **Duration:** 60 minutes
- **Focus Inquiry Question:** How are temperature, thermal energy, and particle motion related? (Introduction to Q3: direction of energy transfer)

### Syllabus Alignment Knowledge Nodes Targeted

- **Outcomes:** PH11-10, PH11/12-3 (Conduct Invest.), PH11/12-7 (Communicate)
- **Content:** ACSPH018, ACSPH016, ACSPH022 (conceptual intro)
- **Knowledge Nodes:** N1 (Temp/KE Relation), N4 (Transfer Mechanisms), N2 (Thermal Equilibrium - Concept)

### Student Learning Objectives (Aligned with Nodes)

Students will be able to:

- Explain the relationship between temperature and the average kinetic energy of particles (N1 - Understand).
- Identify and describe conduction, convection, and radiation with examples (N4 - Understand).
- Explain conduction in solids using the particle model (N4 - Understand).
- Define thermal equilibrium conceptually as no net energy transfer (N2 - Understand).
- Predict the direction of heat flow based on temperature differences (Links N1, N2, Inquiry Q3).

**Literacy** Define temperature, thermal energy, conduction, convection, radiation, thermal equilibrium precisely (N1, N4, N2).

**Numeracy** Qualitatively interpret particle energy distributions/visualisations (N1).

### Lesson Structure & Activities

#### Introduction (10 mins)

- **Teacher Activity:** Display Inquiry Questions 1, 2, 3. State focus on Q1. Engage with prompt: "Metal vs wood chair feeling cold/warm". Facilitate brief discussion. Introduce Thermodynamics scope. Provide historical (Steam Engine) and future (Climate/IT) context. Define core terms on board/slide: Temperature (Avg KE), Thermal Energy (Total KE+PE), Heat (Transfer of TE). [N1 Definitions]

- **Student Activity:** Note Inquiry Questions. Participate in discussion. Record key definitions from board/slide (support via Worksheet 1).
- **Pedagogy Focus:** Contextualization (Motivation), Activate Prior Knowledge, Core Terminology (Literacy N1).

### Exploration (30 mins)

- **Teacher Activity:** Conduct/Show Demo/Simulations (See Activity Sheet 1 for details):
  - Conduction (N4): Heat metal rod, explain particle vibration transfer.
  - Convection (N4): Show video/sim of convection currents, explain density changes.
  - Radiation (N4): Use IR camera/heat lamp/sim, explain EM wave transfer. Link to user prompt: hot metal radiating heat and light.

Guide PhET Simulation "Energy Forms and Changes" exploration (link on Activity Sheet 1). Focus on particle view vs. temperature (N1). Introduce Equilibrium concept (N2) - what happens when hot/cold objects touch? Discuss direction of flow (Inquiry Q3 link).

- **Student Activity:** Observe demos/sims, explain using particle model (N1, N4). Use PhET simulation on laptops, guided by Worksheet 1 prompts. Discuss equilibrium concept. Complete relevant parts of Worksheet 1.
- **Pedagogy Focus:** Active Learning (Observation/Prediction), Multimodal Input (Demo/Sim), Visualising Microscopic Processes (N1, N4), Guided Inquiry (N2). Cognitive Science: Dual Coding, reducing load via visualisation.
- **ICT Integration:** PhET Simulation.

### Consolidation (20 mins)

- **Teacher Activity:** Lead class discussion summarising N1, N4. Explicitly address metal/wood chair question using conduction/conductivity concept (N4). Reiterate equilibrium concept (N2) and direction of heat flow. Distribute Worksheet 1 for completion. Distribute #MarkSense Quiz 1.
- **Student Activity:** Participate in discussion, complete Worksheet 1 (definitions, explanations for N1, N4, N2 concept). Complete #MarkSense Quiz 1 (end of class or homework).
- **Pedagogy Focus:** Concept Consolidation, Linking Micro-Macro, Formative Assessment.

### Resources Required

- Teacher demonstrations materials (metal rod, heat source, etc. - See Activity Sheet 1) OR Simulation/Video access.
- Student laptops with internet access.
- PhET Simulation links (on Activity Sheet 1).
- Worksheet 1 (separate PDF).
- #MarkSense Quiz 1 (included on Worksheet 1 PDF).
- Projector/Whiteboard.

## Assessment

- **Formative:** Teacher observation of student participation in discussions and simulation use. Review of Worksheet 1 responses. Analysis of #MarkSense Quiz 1 results.

## Differentiation

- **Support:** Provide sentence starters for explanations on worksheet. Pair students for simulation exploration. Pre-teach key vocabulary.
- **Extension:** Ask students to research specific thermal conductivity values and explain differences. Challenge students to explain convection in weather patterns.