

**Subject Area:** Science - Nature of Matter  
**Unit Title:** Heat and Temperature Experiment  
**Grade Level:** 5th Grade  
**Lesson Number:** 1 of 8

**Duration:** 8 Weeks (45-minute sessions)  
**Date:** Ongoing  
**Teacher:** To be assigned  
**Room:** Science Laboratory

## Curriculum Standards Alignment

### Content Standards:

- PS3.1 - Understand and explain that energy cannot be created or destroyed but can be transferred from one form to another
- PS3.2 - Measure and graph quantities to provide evidence that the transfer of thermal energy occurs between objects
- PS3.3 - Apply scientific principles to design, construct, and test a device that minimizes or maximizes thermal energy transfer

### Skills Standards:

- Planning and carrying out investigations to answer questions or test solutions
- Analyzing and interpreting data to derive meaning
- Using mathematics and computational thinking to analyze data
- Constructing explanations and designing solutions based on evidence

### Cross-Curricular Links:

- Mathematics: Data collection, graphing, and analysis
- Technology: Digital tools and simulations
- Language Arts: Scientific writing and communication

## Essential Questions & Big Ideas

### Essential Questions:

- How does heat energy transfer between objects of different temperatures?
- What is the relationship between heat and temperature?
- How can we measure and track temperature changes in a controlled experiment?
- Why is understanding heat transfer important in our daily lives?

### Enduring Understandings:

- Heat is a form of energy that transfers from warmer to cooler objects
- Temperature is a measure of the average kinetic energy of particles in matter
- Heat transfer continues until thermal equilibrium is reached
- Scientific investigations require careful measurement and systematic observation

## Pre-Lesson Preparation

### Room Setup:

- Arrange laboratory tables into 6 group stations
- Set up safety equipment station with goggles, gloves, and first aid kit
- Prepare digital projection system for PhET simulation demonstration
- Position thermometer storage and calibration station
- Set up hot water heating station with electric kettle and cooling area

### Technology Needs:

- Computer with internet access for PhET simulation
- Digital projector and screen
- 6 tablets/laptops for student group data collection
- Digital thermometers (one per group)
- Document camera for demonstration purposes

### Materials Preparation (per group):

- 2 graduated cylinders (250ml capacity)
- 2 thermometers (digital and analog)
- Hot water heating system
- Ice bath for cold water
- Data recording sheets and clipboards
- Safety goggles and heat-resistant gloves
- Stopwatch or timer
- Graph paper and plotting materials

## Safety Considerations

### Critical Safety Protocols:

- Establish clear procedures for handling hot water (maximum 50°C)
- Require safety goggles and heat-resistant gloves during experiments
- Review emergency procedures and location of safety equipment
- Establish clear spillage cleanup protocols
- Maintain clear pathways between experimental stations
- Post visible safety reminders and emergency contact information

## Detailed Lesson Flow

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### Pre-Class Setup (15 mins before)

- Heat water to exactly 50°C
- Prepare ice bath for cold water (10°C)
- Distribute materials to group stations
- Test all digital thermometers
- Load PhET simulation on devices

### Bell Work / Entry Task (5-7 mins)

- Students complete temperature prediction worksheet
- Record initial thoughts about heat vs. temperature
- Review safety protocols in laboratory notebook

### Opening/Hook (10 mins)

- Demonstrate dramatic temperature change using hot and cold water
- Lead discussion on everyday heat transfer examples
- Introduce key vocabulary through visual aids

### Engagement Strategies:

- Use real-time temperature readings for visual impact
- Connect to students' daily experiences
- Incorporate interactive questioning techniques

## Main Activity Sequence

### Direct Instruction (10 mins)

- Review experimental procedure and safety guidelines
- Demonstrate proper use of measurement tools
- Model data recording techniques
- Explain success criteria and expectations

### Guided Practice (20 mins)

- Students conduct temperature mixing experiments in groups
- Record temperature changes at 30-second intervals
- Create real-time graphs of temperature changes
- Document observations and initial conclusions

#### Differentiation Strategies:

- Provide scaffolded data sheets for different ability levels
- Offer visual aids for experimental steps
- Allow for digital or manual data recording options

## Assessment Strategies

### Formative Assessment:

- Observation of experimental technique and safety compliance
- Quality of data collection and recording
- Group participation and collaboration
- Understanding of key concepts through questioning

### Summative Assessment:

- Lab report completion with data analysis
- Graph interpretation and explanation
- Connection to real-world applications
- Written reflection on learning outcomes

## Closure and Extension Activities

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**Lesson Closure (5-7 mins):**

- Class discussion of experimental results
- Compare predictions with actual outcomes
- Address misconceptions and questions
- Preview next lesson's activities

**Extension Activities:**

- Design additional experiments with different variables
- Create digital presentations of findings
- Research real-world applications of heat transfer
- Develop mathematical models of temperature change

**Homework/Follow-up:**

- Complete data analysis worksheets
- Write preliminary conclusions
- Begin research for extended investigation

## Resources and References

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**Teacher Resources:**

- PhET Interactive Simulations ([phet.colorado.edu](http://phet.colorado.edu))
- NSTA Safety Guidelines for Science Laboratories
- Common Core Mathematics Standards Alignment Guide
- Digital Assessment Tools and Rubrics

**Student Resources:**

- Online Data Collection Templates
- Scientific Method Reference Guide
- Laboratory Safety Manual
- Graph Creation Software Tutorial