

Science
Physical Science
Grades 6 and 8



Lesson Plans

"The Hot in the Cold"

Subject:

Physical Science: Thermal Energy

Level:

Grade 6 and 8

Abstract:

Students will conduct an experiment and collect data on the exchange of thermal energy. After gathering the data the students will use the Excel program to input their data in a table and graph where they will record temperatures to show thermal equilibrium. Students will then explain the difference between temperature, heat, and thermal energy in a lab report that they write using Microsoft Word.

Invitation:

Ask for 5-6 volunteers and have them stand really close together in a cluster formation. Tell them they are molecules in an ice cube. Have another student come and place a piece of string close around them. Ask the students to move within the string reminding them that they are water molecules in the **solid** state of matter called ice. Can they move very easily? Do they have much room to move? Are they putting out much ENERGY as they try to move?

Have another student labeled "fire" come over to the human ice cube and heat it up by enlarging the circle of string so that the ice molecules can move around with more freedom. What state are the water molecules in now? (**liquid**/water).

OPTIONAL: Have the "fire" student remove the string completely and allow the water molecules to go anywhere in the room to demonstrate the **gas** state of steam.

Situations:

Where: The activities in this lesson will occur in school, in the classroom and on computers in the computer lab.

When: This lesson will take place during science class at mid year.

How Long: This lesson will take between 5 to 7 days.

Tasks:

Task 1:

As a class, discuss which state of matter has more energy. Which is "hotter"? How do we measure this? Have students write down that **temperature** is a measure of kinetic energy and that **thermal energy** is the total kinetic energy of the particles that make up a substance. (See Tips 1 and 2.)

Task 2:

What is heat? Does an ice cube have heat? (Most kids will say "no".) Did the molecules in the ice cube demonstration move at all? Hand each student an ice cube and paper towel. What happens to the ice cube as you hold it? What happens to your hand? Have students write down their observations in their lab book. Discuss how your hand is warmer than the ice cube, but as you hold the ice cube it melts and your hand gets cold. Which has more energy, your hand or the ice cube? What happens to energy in each one as they come in contact? (The higher energy in your hand is being transferred to the ice cube, which increases its energy. As the molecules in the ice cube move faster as a result of energy transfer, it starts to melt). Have students write down that **heat** is the transfer of energy between objects that are of different temperatures. Reinforce the concept that even something that is cold to us has heat. It has molecules that are moving, they are just moving slower.

Task 3:

Discuss with students the ways in which energy is transferred. Demonstrate convection by showing a lava lamp or boiling a pot of water with tightly packed aluminum foil balls in it. Demonstrate conduction by attaching wooden matches or toothpicks with wax at equal intervals along a copper strip, keeping one end of the copper strip clear. Then, using tongs, hold the empty end of the copper strip over a candle flame making sure the matches/toothpicks are facing the floor. The matches/toothpicks should fall off in succession showing conduction. Finally walk the candle around and allow students to feel the heat coming off the flame. This is radiation. Have students complete the "Worksheet: Conduction, Convection, Radiation" attachment.

Task 4:

Students will conduct a simple lab to demonstrate the transfer of heat through water as it reaches thermal equilibrium. (See the "Worksheet: Finding Thermal Equilibrium" attachment.)

Task 5:

Students will record the data from their lab into an Excel program and graph their results. (See the "Step Sheet: Creating a Data Table and Charts" attachment.) The results from the hand graph and Excel spreadsheet/graph should agree.

Task 6:

Students will include a graph of their data in their Excel spreadsheet. (See the "Step Sheet: Creating a Graph in Excel" attachment.)

Task 7:

Students will write a lab report in Microsoft Word communicating the results of their lab. (See the "Worksheet: Writing a Lab Report," "Step Sheet: Creating a New Document," and "Step Sheet: Inserting a Graph from Excel" attachments.)

Interactions:

Full Class: The teacher will initiate discussions and demonstrations that convey the concepts of temperature, heat, and thermal energy as well as the ways in which heat is transferred. The teacher will provide instruction in how to write a lab report. The teacher will also guide instruction on Excel and Microsoft Word programs.

Partners: Students will work with one or more partners to conduct the experiment and collect data. Students may work together on the Excel program if computers are limited.

Individual: Students will participate in class discussions and activities. Each student will write their own lab report detailing the concepts of thermal energy, heat, and temperature.

Standards:

Heat (Thermal Energy) (Physical Science)

3a: Energy can be carried from one place to another by heat flow, or by waves, including water.

3c: Heat flows in solids by conduction and in fluids by conduction and by convection.

Investigation and Experimentation

7b: Select and use appropriate tools and technology to perform tests, collect data, and display data.

7c: Construct appropriate graphs from data and discuss relationships between variables.

7d: Communicate the steps and results from an investigation in written reports.

7e: Explain if evidence is consistent with a proposed explanation.

Assessment:

- Excel worksheet to determine validity of proper lab technique and data collection.
- "Rubric for Thermal Equilibrium Lab" for assessing the lab write up.

Tools:

- Microsoft Excel
- Microsoft Word
- film canisters
- thermometers
- stop watches
- hot and cold water
 - A hot plate can be used to heat the water. Tap water left in the refrigerator over night works fine.
- plastic tubs or 500 mL beakers

Project Tips and Alternatives:

Tip #1:

Students can keep a lab book for science, recording notes, lab information, etc.

Tip #2:

To demonstrate kinetic energy, show a book sitting still on a desk. This is potential energy. Push the book off the edge of the table to demonstrate kinetic energy. Another good example is water sitting behind a dam.

Attachments:

- "Worksheet: Conduction, Convection, Radiation"
- "Thermal Equilibrium Graph" Example
- "Worksheet: Finding Thermal Equilibrium"
- "Step Sheet: Creating a Data Table"
- "Step Sheet: Creating a Graph in Excel"
- "Worksheet: Writing a Lab Report"
- "Step Sheet: Creating a New Document"
- "Step Sheet: Inserting a Graph from Excel"
- "Rubric for Thermal Equilibrium Lab"

Web Resources – Content:

A list of [linked web resources](#) related to the content of this lesson can be found on the Lesson Page.

Web Resources – Excel:

A list of linked web [resources for Excel](#) can be found on the Excel Resources page.

Assistive Technology:

Please refer to the [Assistive Technology section](#) for information on methods and devices to help ensure that all students have access to the curricula in the least restrictive environment.