ScienceCube

Effect of Insulation

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1. **Identify materials that can effectively block the transfer of heat.**
2. **Examine and explain the characteristics of efficient insulation materials.**

Fundamental Concept

1. Insulation

(1) Insulation: Preventing heat from passing between objects.

(2) Insulating Materials: Substances that hinder the transfer of heat.

(3) Types of Insulating Materials

- Materials containing air that does not conduct heat well: cotton, fabric, Styrofoam.
- Solids that do not conduct heat well: leather, plastic, wood, stone, etc.

2. Insulation in Our Daily Lives

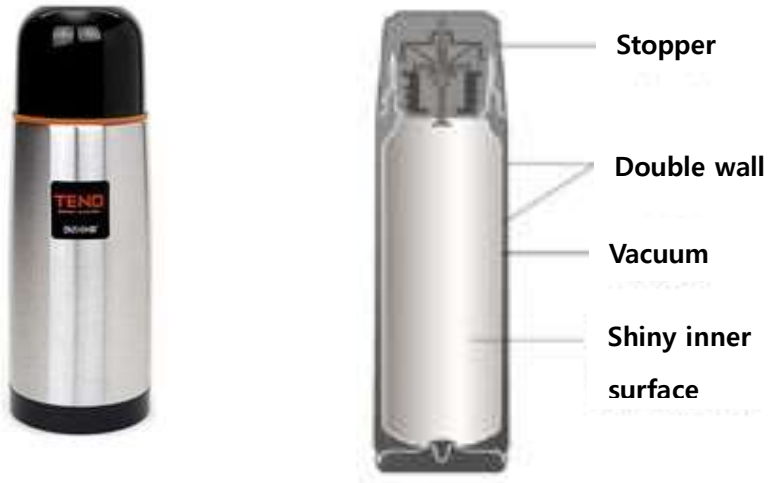
(1) Insulation in Houses

- To maintain a comfortable indoor temperature, heat should not escape in winter, and external heat should not enter in summer.
- Constructing double walls filled with Styrofoam or foam concrete, and using double-glazed windows.
- In winter, sealing window gaps and using curtains.

(2) Thermos

- Cap: Usually made of plastic, which does not conduct heat well.

- Double Walls: A gap between the inner and outer walls prevents conduction and convection. Since there is no material to transfer heat between the walls, conduction and convection do not occur..



Experiment

Materials Needed

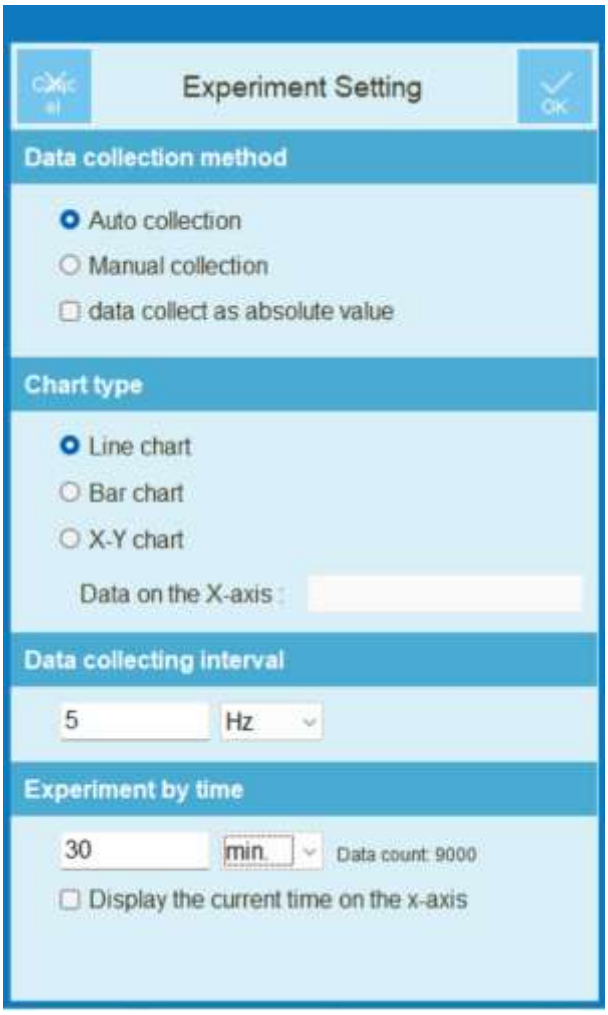
Interface, Science# Program, 3 temperature sensors, newspaper, cotton, sand, test tubes, 3 rubber stoppers, three 500 mL beakers, black foam board, cellophane tape, graduated cylinder.

Preparation of Experimental Apparatus

1. Place three test tubes in the center of three beakers and fill the space between the beakers and test tubes with newspaper, cotton, and sand, respectively
2. Cover the test tubes with black foam board with holes to fit the test tubes and secure with cellophane tape.
3. Insert the temperature sensors into the rubber stoppers. (Ensure the sensor does not touch the bottom of the test tubes when the stopper is in place.)
4. Pour 20 mL of hot water into each test tube.

Interface Setup

1. Run the Science# program.
2. Connect the three temperature sensors to the interface..
3. Click to set up the experimental environment as shown below, or click to automatically set up.



4. Seal the test tubes with the rubber stoppers containing the temperature sensors.

Data Collection

1. Click  to start data collection.
2. End data collection after a set period of time.

Data Analysis

Recording Data

1. Plot and compare the temperature changes of the water in each test tube over a set period of time. (If the initial values of the graph are not the same, you can align the starting points by entering an appropriate B value in [Analysis] - Y-axis transformation.)

2. Record the temperature changes of the water in each test tube in the following table and calculate the temperature difference.

Category	Initial Temperature (℃)	Final Temperature (℃)	Temperature Difference (℃)
Cotton			

Newspaper			
Sand			

Data Application

1. List the materials around the test tubes in order from the smallest temperature change to the largest.

2. Identify which material (newspaper, cotton, sand) effectively blocked heat transfer.

3. Examine and summarize the characteristics of efficient insulating materials.