ScienceCube

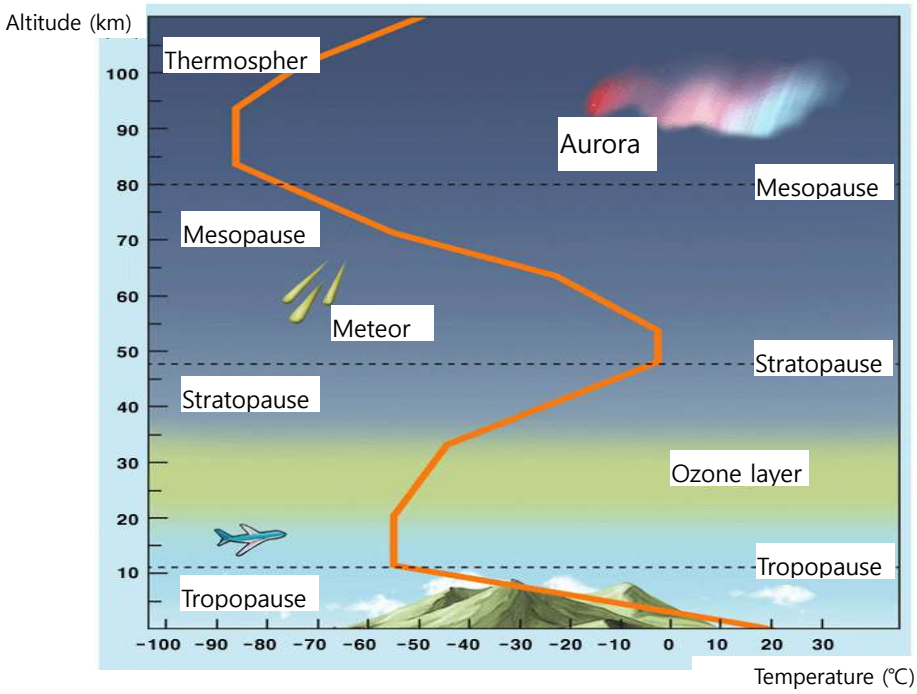
Temperature of Air According to Altitude

1. **Confirm how temperature changes with altitude in the troposphere through an experiment.**
2. **Divide the atmosphere based on temperature changes and explain the characteristics of each layer.**

Fundamental Concept

1. **Atmosphere**

The layer of air surrounding the Earth, extending from the surface to approximately 1,000 km in height.



2. **Characteristics of the Atmospheric Layers**

Layer	Height	Characteristics
Thermosphere	About 80~1,000 km	- The temperature increases with altitude. - The air is very thin, causing significant temperature differences between day and night. - Auroras occur, and the ionosphere exists.
Mesosphere	About 50~80 km	- The temperature decreases with altitude. - Convection occurs, but weather phenomena do not. - The lowest temperature (-90°C) in the atmosphere occurs here.
Stratosphere	About 11~50 km	- The temperature increases with altitude. → Because the ozone layer absorbs ultraviolet rays. - It is a stable layer and is used as an airplane flight path.
Troposphere	Surface~11 km	- The temperature decreases with altitude. - Contains about 80% of the total atmosphere. - Convection is active, and many weather phenomena occur due to the presence of water vapor.

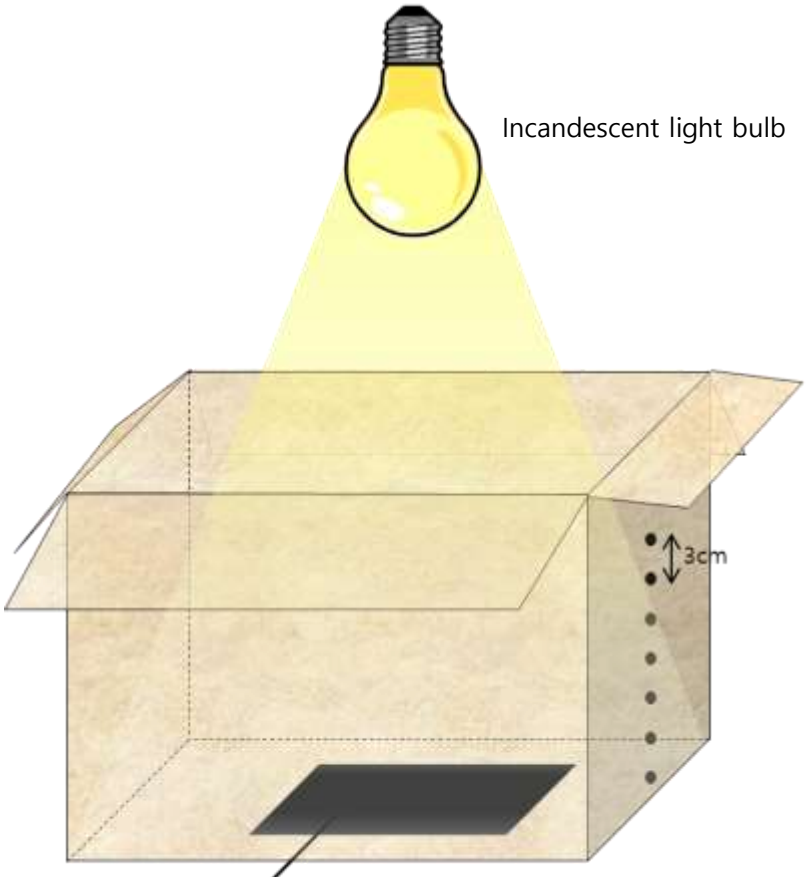
Experiment

Materials Needed

Interface, Science# Program, K-type thermocouple sensor, stand (incandescent lamp), paper box (A4 size), black copper plate, awl

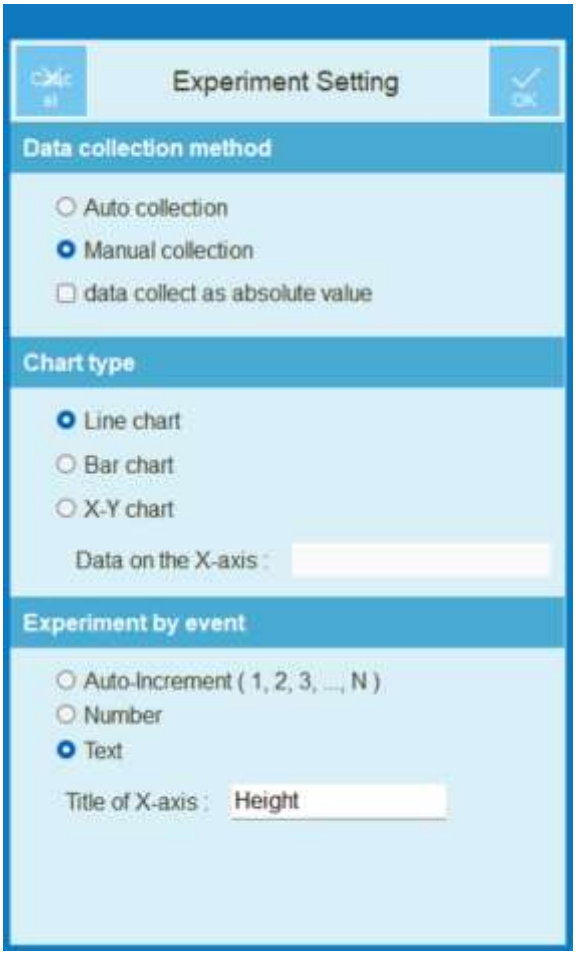
Preparation of Experimental Apparatus

1. Make 6 holes at 3 cm intervals on one side of the paper box from the bottom.
2. Place the black copper plate at the bottom of the paper box.
3. Position the incandescent lamp directly above the paper box.
4. Turn on the power to the incandescent lamp and heat the black copper plate for 10 minutes.



Interface Setup

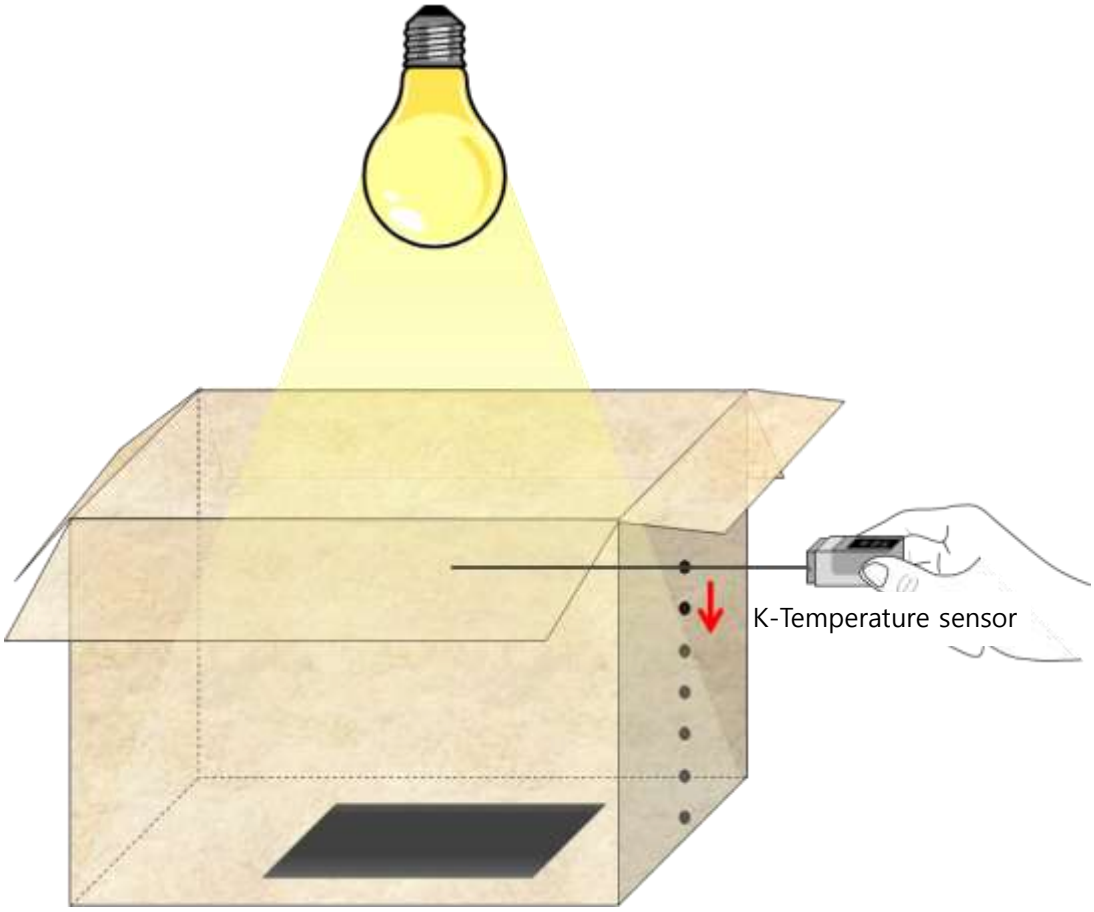
1. Run the Science# program
2. Connect the K-type thermocouple sensor to the interface.
3. Click to set up the experimental environment as shown below or click to automatically set up.



 automatically set up

Data Collection

1. Click  to start data collection.
2. Insert the K-type thermocouple sensor into the top hole. Ensure the sensor remains horizontal to the bottom.



3. Click  and enter the height value (18 cm) from the bottom
4. Move the K-type thermocouple sensor to the next lower hole and repeat steps #2~#3 to measure the temperature at each hole.
5. Click  to stop data collection.

Data Analysis

Recording Data

1. Record the temperatures measured with the thermocouple sensor at different heights in the following table..

Height (cm)	3	6	9	12	15	18
Temperature (℃)						

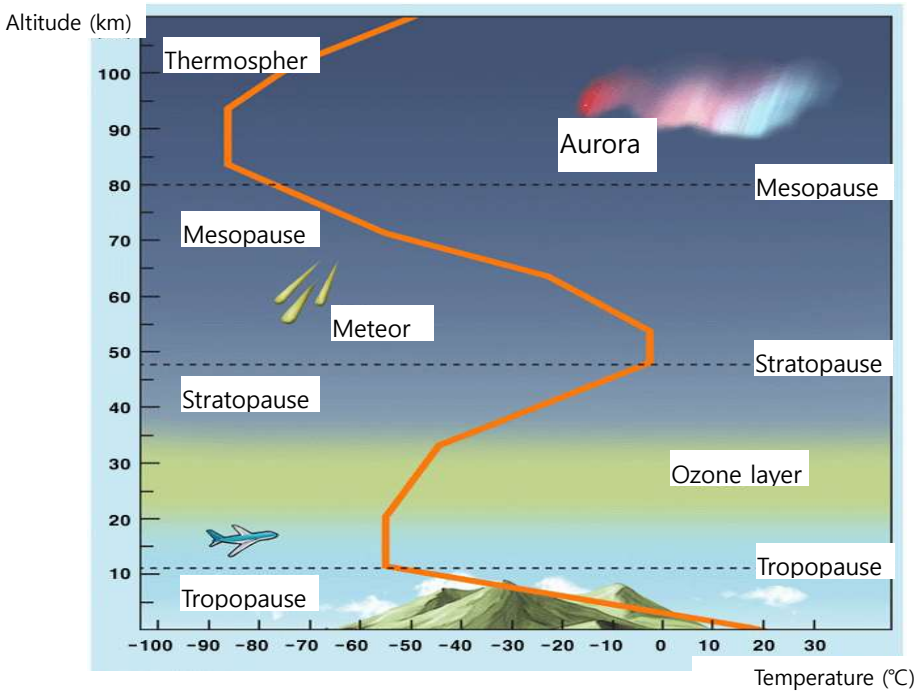
2. Rotate the temperature change graph obtained with the thermocouple sensor to match the x-axis and y-axis settings below and insert it appropriately

Data Application

1. Describe what the incandescent lamp and black copper plate represent in the experiment..

Incandescent Lamp	Black Copper Plate

2. The following shows the actual temperature change with altitude in the atmosphere



(1) Compare the actual atmosphere with the experimental data and write down the number of layers that can be distinguished

	Actual Atmosphere	Experimental Data
Distinguishable Layers		

(2) Identify the layers in the atmospheric structure that can be confirmed through the experimental data and explain why the temperature changes as observed in the experiment.

(3) Compare the actual atmosphere with the experimental data and explain the reasons for any differences..

Extended Activities

1. The atmosphere is divided into layers based on temperature changes. Describe the temperature changes in each layer and explain the reasons.

Layer	Reason
Troposphere	
Stratosphere	
Mesosphere	
Thermosphere	

2. Write the correct name of the atmospheric layer where the following phenomena occur.

a. Active mixing of air, and rain or snow falls.

b. The ozone layer absorbs ultraviolet rays, causing the temperature to rise with altitude.

c. Large temperature differences between day and night, and auroras appear over the polar regions.

d. Convection occurs, but there is little water vapor, so weather phenomena do not occur.

	a	b	c	D
Name