ScienceCube

The water is freezing!

Learning Objectives

Observing Temperature Changes and State Changes When Cooling Water.

Should I think about it?

How does the temperature change over time when cooling a test tube filled with water?

Learning Content

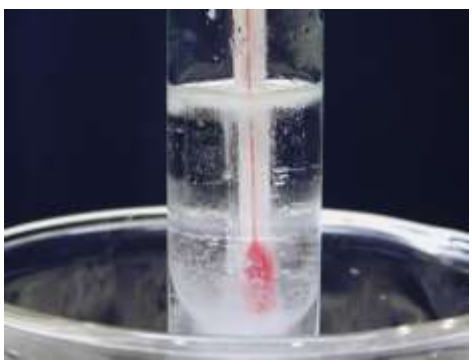
1. Changes When Cooling Water

1) Before the water freezes

- There is little to no change.

2) When water begins to freeze

- It starts freezing from the outer surface of the test tube and gradually freezes towards the center.



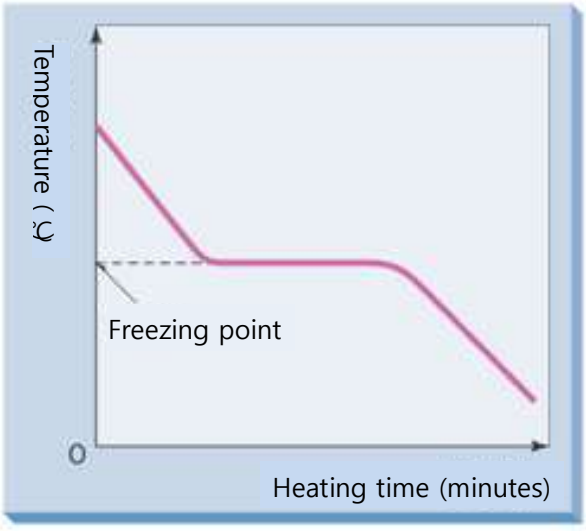
3) When the water is completely frozen

- The entire test tube is completely frozen to the center.

- Cooling water turns it into a solid state called ice.

2. Temperature and State Changes When Cooling Water

1) Temperature Changes: Before the water freezes, the temperature of the water continuously decreases as it is cooled. Once the water begins to freeze, the temperature remains constant even with continued cooling.



2) State Changes: If water continues to be cooled, it turns into solid ice. This process is referred to as "freezing."

3. Temperature Sensor

- Can measure temperatures between -50℃ and 180℃.

- The sensor tip contains a component whose resistance changes with temperature, and this change is displayed as the measurement value.

- Made of stainless steel.

Experimental Activities

Materials Needed

Interface, Science# program (smart device), temperature sensor, 1000mL beaker, one test tube, stand, 2 clamp holders, salt, ice, spatula

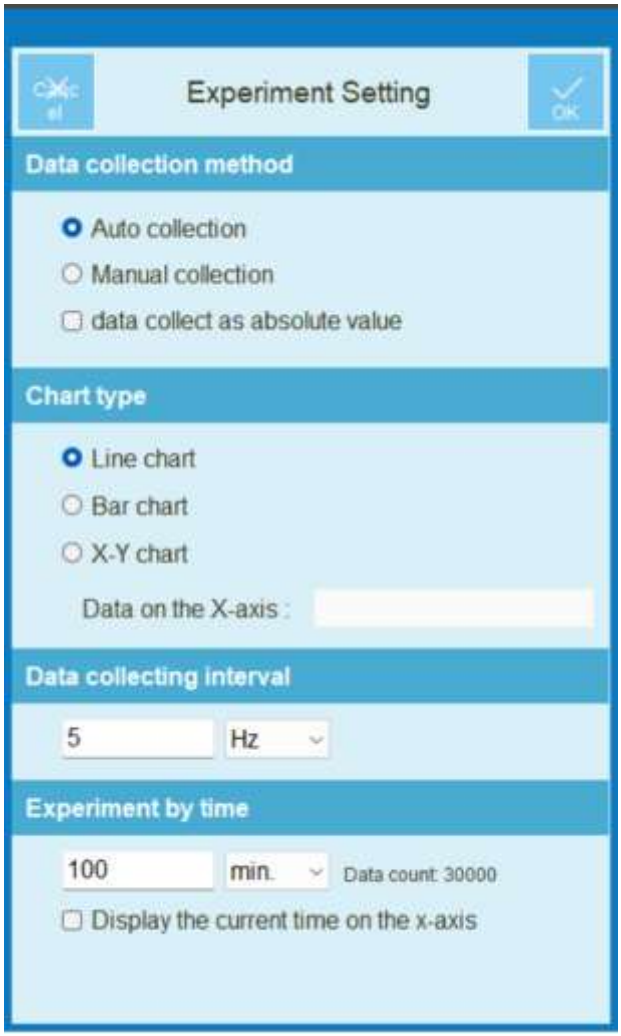
Experiment Procedure

Preparing the Equipment

1. Run the Science# program on the smart device and connect it to the powered interface via Bluetooth or cable.

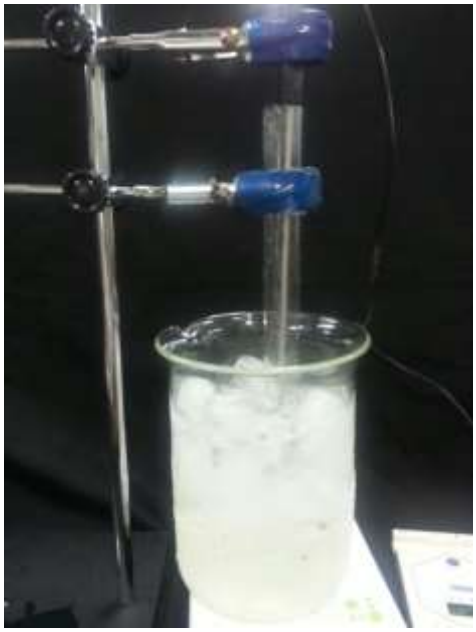
2. Connect the temperature sensor to the interface.

3. Press the button  on Science# to automatically set up the experimental environment as shown below.



Conducting the Experiment

1. Fill the 1000mL beaker with ice and salt, and stir with a spatula to mix. (Adding salt to the ice can lower the temperature further.)
2. Secure two clamp holders to the stand.
3. Fill the test tube with water up to 1/5 of its height (about 3cm from the bottom), place it in the beaker with ice, and secure it with a clamp.
4. Insert the temperature sensor into the water in the test tube, and secure it with a clamp. (Ensure that the temperature sensor does not touch the bottom or sides of the test tube.)



5. Press the button to measure the temperature of the water in the test tube.
6. If supercooling occurs during the temperature measurement, lightly tap the beaker to give a shock to the water in the test tube. This helps the water transition from the supercooled state to ice.
7. The experiment will automatically end after the set time.

**** Supercooling Phenomenon****

This refers to the phenomenon where water remains in a liquid state even when the temperature drops below 0℃ during the freezing process.

Experimental contents

1. Plot the temperature changes of the water in the test tube as it cools, and describe them in the table below.

[Graph]

[Table]

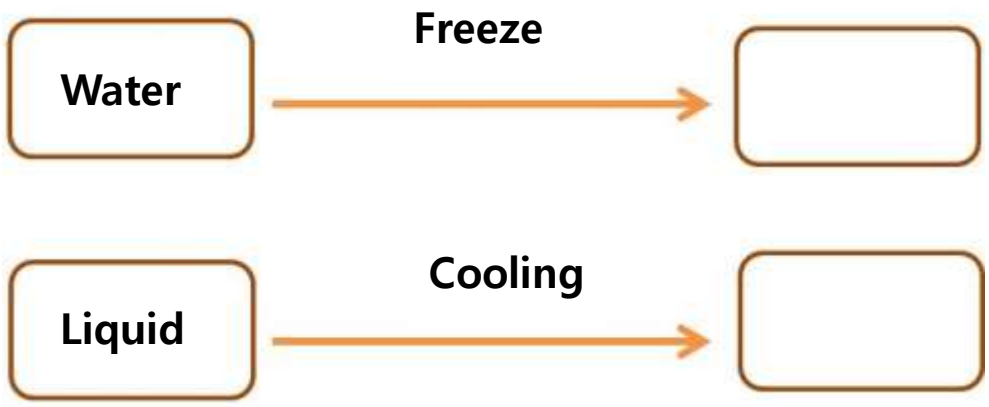
State	Temperature change
Before water freezes	
While water is freezing	
After water has frozen	

2. Write down the observations regarding the state changes of the water in the test tube besides temperature when cooling the water.

State	State change
Before water freezes	
While water is freezing	
After water has frozen	

Experimental results

1. The following sentences describe the state changes when cooling water. Fill in the blanks with appropriate words.



2. Why do we stir with a glass rod when adding salt to the ice while cooling water?

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