ScienceCube

The water is boiling!

Learning Objectives Observing Temperature Changes and State Changes When Heating Water.

Should I think about it? How does the temperature change over time when heating a flask filled with water??

Learning Content

1. Changes When Heating Water

1) Before Water Boils

- Small bubbles start to form at the bottom of the flask.
- As the temperature rises, bubbles detach from the bottom and rise to the surface of the water.
- As the temperature rises further, steam begins to form, and many bubbles rise to the surface of the water.

2) When Water Begins to Boil

- Steam continues to form, and large bubbles form at the bottom of the flask and rise to the surface.
- The movement of the bubbles becomes very vigorous.

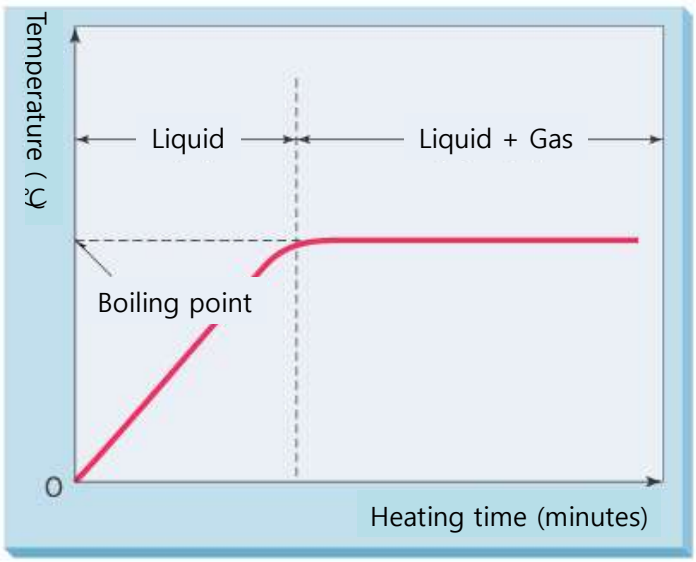
Boiling kettle

3) While Water is Boiling

- The appearance is similar to when the water first begins to boil.
- Large bubbles form at the bottom of the flask and quickly rise to the surface.

2. Temperature and State Changes When Heating Water

1) Temperature Changes: Before the water boils, the temperature of the water continues to rise as it is heated. Once the water boils, the temperature does not rise and stays constant around 100℃..



2) State Changes: If water continues to be heated, it changes into a gaseous state, which is called steam. This process is referred to as "boiling."

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.

4. Humidity Sensor

- The sensor is housed in a plastic case with air holes, allowing air to circulate and the sensor to detect humidity in the air. For accurate measurements, ensure there is no slight breeze around the sensor.
- Since the sensor detects humidity in slowly moving air, it takes some time to reach a stable value without fluctuations.

- However, it quickly approaches the measured value, making it very useful for observing immediate changes.

Experimental Activities

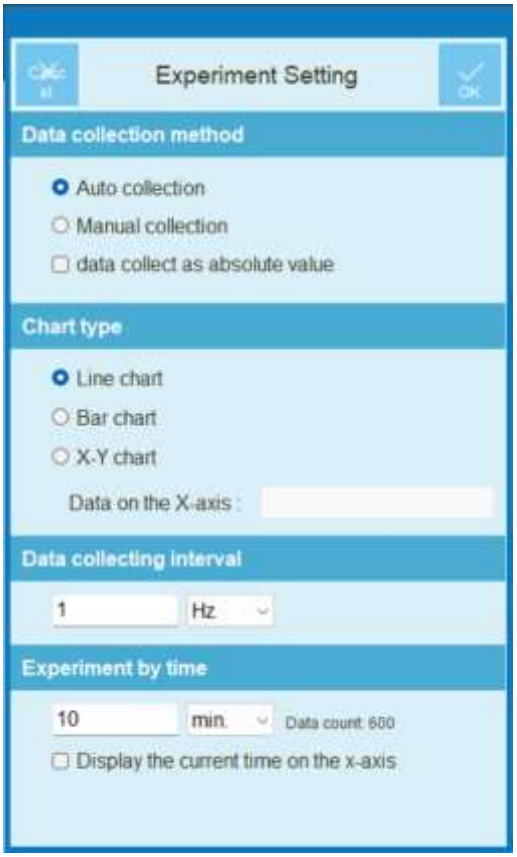
Materials Needed

Interface, Science# program (smart device), temperature sensor, humidity sensor, stand (with clamp holder), boiling stones, 250mL Erlenmeyer flask with side arm, 9-hole rubber stopper, tripod, alcohol lamp, lighter

Experiment Procedure

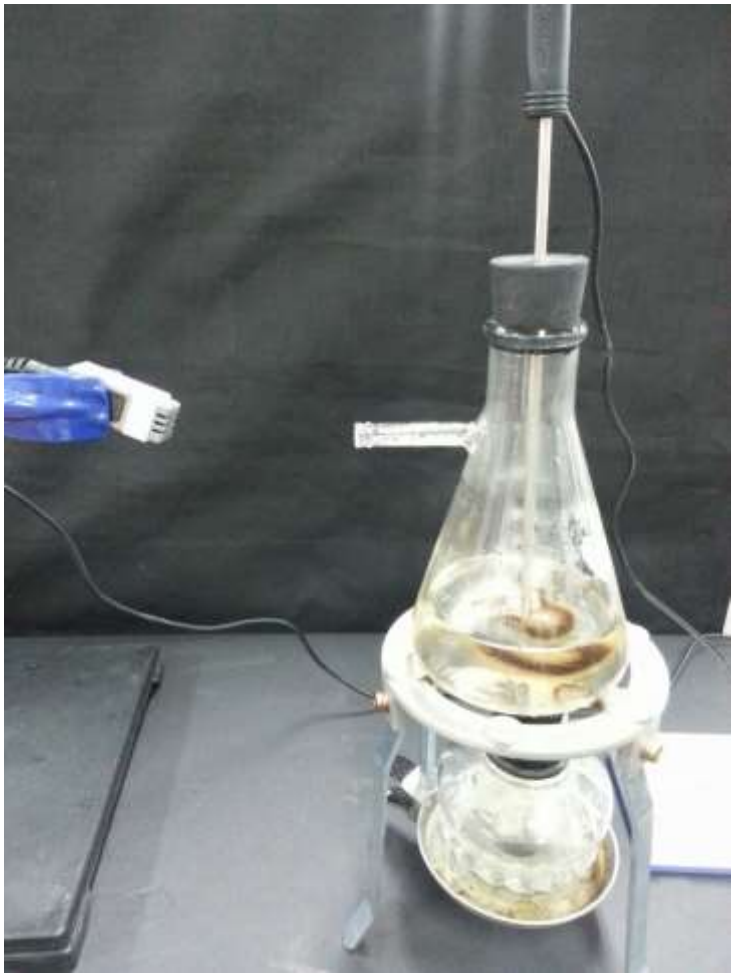
Preparing the Equipment

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



Conducting the Experiment

1. Place boiling stones in the Erlenmeyer flask, fill it with approximately 150mL of water, and place it on the tripod.
2. Adjust the wick length of the alcohol lamp and place it under the tripod.
3. Insert the temperature sensor into the rubber stopper and seal the mouth of the flask with the rubber stopper. Ensure that the temperature sensor does not touch the bottom or sides of the flask and is inserted 2-3cm into the water.
4. Secure the humidity sensor in the clamp holder and adjust its position to face the side arm of the flask from about 10cm away.



5. Press the button  to start measuring temperature and humidity..

6. Use the lighter to ignite the alcohol lamp, heat the water, and observe and record the changes in the water in the flask.

Experimental contents

1. Write down the observations regarding the state changes of the water in the Erlenmeyer flask besides temperature when heating the water.

Size of bubbles	
Amount of bubbles	
Place where bubbles form	

2. Plot the temperature and humidity changes over time as the water in the flask is heated.

Experimental results

1. Based on the experiment results, describe the temperature and state changes when heating water..

2. Water can turn into a gaseous state (steam) without heating. Find examples of this in daily life.