

Dew Point Temperature

On hot summer days, you may notice water droplets forming on the outside of a glass of ice water. It is commonly said that the glass is “sweating.” Since the glass cannot actually sweat, the liquid on the glass must come from the air outside the glass. This liquid forms by the condensation of water vapor that is near the surface of the glass. The air next to the cold glass has been cooled to the *dew point* or *dew point temperature*. The dew point temperature is the temperature to which air would have to be cooled to become saturated. Once the air is saturated, the water vapor condenses to form a liquid. The same process occurs when dew forms on the lawn.

In this experiment you will use an EasyTemp temperature probe to make two investigations. In the first you will measure the temperature of air next to a can of ice water to see if it is colder than room temperature. In the second investigation, you will determine the dew point temperature of the air in the classroom. You will do this by slowly adding ice to water and watching for condensation to form on the outside of the container. Throughout this process you will continuously record the temperature of the water. When condensation first forms on the container, the temperature of the water is the dew point temperature.

OBJECTIVES

In this experiment, you will

- Compare room temperature to the temperature of air next to a can of ice water.
- Record the temperature of water while ice is slowly added.
- Observe the formation of condensation.
- Determine the dew point temperature.

MATERIALS

TI-84 Plus or TI-84 Plus Silver Edition
graphing calculator
Vernier EasyTemp
Vernier EasyData application
shiny, metal can

plastic spoon
ice cubes and ice chips
ring stand
paper towels
room temperature water

PRE-LAB QUESTIONS

1. To determine the dew point temperature, you will slowly add small pieces of ice to room temperature water. After each piece is added, you will wait for the ice to melt. Throughout this process, you will graph the temperature of the water. Draw a rough sketch of what the temperature *vs.* time graph will look like while the ice melts.
2. In the experiment you will continue to collect temperature data after the small pieces of ice have melted. Draw a rough sketch of what the temperature *vs.* time graph will look like after the ice has melted.

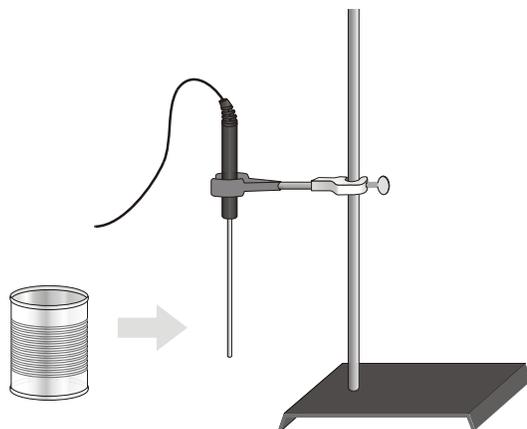


Figure 1

PROCEDURE

Part I Measure the Temperature of the Air Next to a Can of Ice Water

1. Turn on your TI-84 Plus (or TI-84 Plus Silver Edition) graphing calculator and make sure that it is on the home screen. Plug the EasyTemp probe into the USB port of the graphing calculator. The EasyData application will automatically start and the Main screen will be displayed.
2. Use a utility clamp to suspend the EasyTemp probe on a ring stand as shown in Figure 1. The end of the EasyTemp probe should be about 1 cm above the tabletop.
3. Set up the data collection.
 - a. Select **File** from the Main screen, and then select **New**.
 - b. Select $\left[\text{Setup}\right]$ from the Main screen.
 - c. Select **Time Graph....**
 - d. Select $\left[\text{Edit}\right]$.
 - e. Press $\left[\text{CLEAR}\right]$ on the calculator and type **10** as the time between samples in seconds. Select $\left[\text{next}\right]$.
 - f. Press $\left[\text{CLEAR}\right]$ on the calculator and type **90** as the number of samples. Select $\left[\text{next}\right]$. The length of the data collection will be 900 seconds (15 minutes).
 - g. Confirm that time graph settings are correct. Select $\left[\text{OK}\right]$.
4. Read the room temperature displayed at the top of the calculator screen. Record it in your data table.
5. Place 5 or 6 ice cubes in the metal can, fill it with water, and place it away from the EasyTemp probe.
6. Select $\left[\text{Start}\right]$ to begin data collection. Wait 30 seconds and then place the can about 1 mm from the tip of the EasyTemp probe. Do not touch the probe to the can.
7. Watch the outside of the can. When condensation forms on the can, select $\left[\text{Stop}\right]$.
8. A graph of temperature vs. time will be displayed. Use $\left[\text{D}\right]$ to examine data points along the curve. As you move the cursor right or left, the time (X) and temperature (Y) values of each

data point are displayed above the graph. Move the cursor all the way to the right side of the graph and record the temperature value in your data table.

9. Sketch the graph as directed by your teacher.
10. Empty the can and dry the outside.

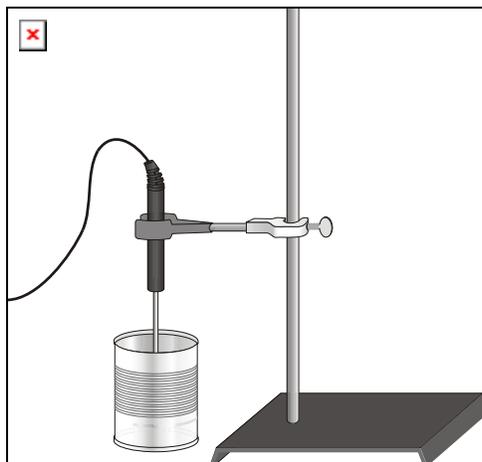


Figure 2

Part II Determine the Dew Point Temperature

11. Fill the dry can half full with room temperature water.
12. Lower the EasyTemp probe into the water (to about 1 cm from the bottom) as shown in Figure 2.
13. Select **(Main)** to return to the Main screen. Monitor the temperature of the water. Once the temperature is stable, go to Step 14.
14. Select **(Start)** to begin data collection. Wait about 30 seconds and then add a spoonful of ice chips to the water. Stir the water while the ice melts. After the ice has melted wait, continue to stir the water for about 10 seconds.
15. Add another spoonful of ice chips and again stir the water until it melts. Again wait about 10 seconds after the ice has melted. Observe the can to see if water has condensed on the outside.
16. Repeat Step 15 until you observe condensation. Once condensation can be observed, select **(Stop)**.
17. A graph of temperature *vs.* time will be displayed. Move the cursor all the way to the right side of the graph. The temperature displayed is the dew point temperature. Write it down in your data table.
18. Sketch the graph as directed by your teacher.

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19. When you have completed Part II, select **Main** to return to the Main screen. Select **Quit** from the Main screen. Select **Exit** to exit the EasyData application.

DATA

Part I	
Room Temperature (°C)	
Air Temperature Close to the Can of Ice Water (°C)	

Part II	
Dew Point Temperature (°C)	

PROCESSING THE DATA

1. Compare the room temperature to the temperature of the air next to the can of ice water. How much colder was this air than room temperature?

2. Compare the room temperature, the temperature of the air next to the can, and the dew point temperature.

EXTENSIONS

1. Repeat Part II of this experiment four more times and determine the average dew point temperature.
2. Collect results from other lab groups and determine the average dew point temperature.
3. Repeat the experiment outside and compare the dew point temperature of the outside air to that of the inside air. Explain any differences.