# Title: Dew you get the point?

# Team:

## **OBjective**

Use the lab instructions to set up conditions such that dew (condensation) will form on the outside of a metal bowl. Using the data gathered in the experiment, establish the relationship between relative humidity and dew point.

## **Safety discussion**

The team will be handling water, ice and a thermometer. Look around the work area to ensure it is free of tripping hazards and discuss how to avoid creating slip hazards when handling the water and ice.

## **Human PErformance Tools**

* **HOLD POINT** – designates that the group cannot proceed past this step without specific instructions from the Instructor(s).
* **Place Keeping** – When starting an instruction step circle the number, when the step has been completed put a slash through the circle.

## **EQUIPMENT**

* Ice
* Stainless Steel Bowl
* Wooden Bowl
* Water
* Paper
* Pen
* Thermometer
* Wooden Spoon
* Rags
* Stop Watch

## **INSTRUCTIONS**

NOTE: The first part of the experiment will be performed in the classroom.

1. **HOLD POINT** – Instructor will lead a short discussion on Dew Point and Relative Humidity.

***Relative humidity****tells us how much water vapor is in the****air****, compared to how much it could hold at that temperature. It is shown as a percent. For example, a* ***relative humidity****of 50 percent means the****air****is holding one half of the water vapor it can hold.*

***Dew point*** *indicates the amount of moisture in the air.* ***Dew point temperature*** *is defined as the temperature to which the air would have to cool (at constant pressure and constant water vapor content) in order to reach saturation.*

1. Assign one team member to record the data on the Data Sheet.
2. Using a thermometer determine the average temperature of the room to at least one decimal point by taking three 30 sec. temperature readings.
3. Fill the metal bowl about ½ full with water.
4. Using a thermometer determine the average temperature of the water in the bowl to at least one decimal point by taking three 30 sec. temperature readings.
5. Leave the thermometer in the metal bowl of water and add a small amount of ice to the water, stir and perform the following:
	1. Start timing with the stop watch.
	2. When a thin film of water droplets form on the outside of the metal bowl (condensation), record the time and the water temperature.
	3. If the ice melts and condensation has not formed, then add another small amount of ice.
6. Empty the ice / water mixture from the metal.
7. Fill the wooden bowl about ½ full with water.
8. Determine the average temperature of the water in the bowl.
9. Leave the thermometer in the wooden bowl of water and add a small amount of ice to the water, stir and perform the following:
	1. Start timing with the stop watch.
	2. When a thin film of water droplets form on the outside of the wooden bowl (condensation), record the time and the water temperature.
	3. If the ice melts and condensation has not formed, then add another small amount of ice.
10. **HOLD POINT** – Instructor will lead a short discussion on Dew Point, Thermal Conductivity, Heat Capacity and findings.

*When the dew point temperature and air temperature are equal, the air is said to be saturated. Dew point temperature is NEVER GREATER than the air temperature.*

*Since your body uses perspiration to help keep you cool, too much moisture in the air does not allow efficient heat removal since the surrounding air can only take in a limited amount of moisture.*

*Thermal Conductivity is the ability of a material to conduct heat. For example:*

* *Thermal Conductivity of Stainless Steel (304) at 680F is 8.32 BTU/ft-hr-0F*
* *Thermal Conductivity of White Pine at 770F is 0.07 BTU/ft-hr-0F*

*Meaning that metal is a better conductor of heat than wood.*

*Heat Capacity is the energy (BTU) needed to raise the temperature of an object 10F. For example:*

* *It takes ~ 0.1 BTU to raise Stainless Steel by 10F*
* *It takes ~ 0.2 BTU to raise wood by 10F*
1. Move the experiment outside.
2. Using a thermometer determine the average outside temperature to at least one decimal point by taking three 30 sec. temperature readings.
3. Fill the metal bowl about ½ full with water.
4. Using a thermometer determine the average temperature of the water in the bowl to at least one decimal point by taking three 30 sec. temperature readings.
5. Leave the thermometer in the metal bowl of water and add a small amount of ice to the water, stir and perform the following:
	1. Start timing with the stop watch.
	2. When a thin film of water droplets form on the outside of the metal bowl (condensation), record the water temperature.
	3. If the ice melts and condensation has not formed, then add another small amount of ice.
6. Answer the following questions:
	1. Was there a difference in dew point temperature in the classroom between the metal and wooden bowl?
	2. Was there a difference in time for the dew point to be reached in the classroom between the metal and wooden bowl?
	3. Was there a difference in dew point temperature between the classroom and outside?
	4. Was there a difference in time for the dew point to be reached in the classroom and outside?
7. Using Data Sheet 2 and the graph for Air Temperature (°F) vs. Dew Point Temperature (°F) determine the Relative Humidity for the classroom and outside experiments.
8. Using Data Sheet 2 and the data table provided, calculate the Difference in Dew Point Temperature for the Relative Humidity bands provided.
9. Using the data gathered and the information on Data Sheet 2, develop a hypothesis that relates average temperature, relative humidity and the dew point.
10. **HOLD POINT** – Instructor will lead a short discussion on Dew Point, Relative Humidity, hypothesis and conclusions.

*If the air cools, moisture must be removed from the air and this is accomplished through condensation. This process results in the formation of tiny water droplets that can lead to the development of fog, frost, clouds, or even precipitation. 50 – 600F is comfortable for most people.*

*A high relative****humidity****implies that the****dew point****is closer to the current air temperature. A relative****humidity****of 100% indicates the****dew point****is equal to the current temperature and that the air is maximally saturated with water. For example,*

* *On a 500F day with 50% RH the DPT would be 340F. This means that air temperature would have to be cooled down to < 340F to form dew.*
* *On a 700F day with 50% RH the DPT would be 520F. Thus as temperature increases DPT increases for a constant RH.*
* *If temperature were 1000F @ RH 50% DPT = 900F*

*Though not exact a good thumb rule is*

*Dew Point Temperature = Temperature – (Relative Humidity/5)*

**DATA SHEET 1**

|  |
| --- |
| CLASSROOM DATA METAL BOWL |
| Temperature Room (0F) | Temperature Water (0F) | Dew Point Temperature (0F) |
|  |  |  |
|  |  |
|  |  |
| Average Temperature Room (0F) | Average Temperature Water (0F) | Time to Reach Dew Point (sec.) |
|  |  |  |
| CLASSROOM DATA WOODEN BOWL |
| Temperature Room (0F) | Temperature Water (0F) | Dew Point Temperature (0F) |
|  |  |  |
|  |  |
|  |  |
| Average Temperature Room (0F) | Average Temperature Water (0F) | Time to Reach Dew Point (sec.) |
|  |  |  |
| OUTSIDE DATA METAL BOWL |
| Temperature Outside (0F) | Temperature Water (0F) | Dew Point Temperature (0F) |
|  |  |  |
|  |  |
|  |  |
| Average Temperature Outside (0F) | Average Temperature Water (0F) | Time to Reach Dew Point (sec.) |
|  |  |  |

**DATA SHEET 2**



Relative Humidity in the Room Metal Bowl \_\_\_\_\_\_ %

Relative Humidity in the Room Wooden Bowl \_\_\_\_\_\_ %

Relative Humidity Outside \_\_\_\_\_\_ %

Using the table below calculate the difference in Dew Point Temperature (ΔDPT) for each of the Relative Humidity (RH) bands provided. Calculate an average for the difference in Dew Point Temperature (Average ΔDPT). Table on the left is only for reference.

|  |  |  |
| --- | --- | --- |
| RH Band | DPT | ΔDPT |
| 100% - 90% | 1000F – 970F |  |
| 90% - 80% | 970F – 930F |  |
| 80% - 70% | 930F – 880F |  |
| 70% - 60% | 880F – 830F |  |
| 60% - 50% | 830F – 780F |  |
| 50% - 40% | 780F – 710F |  |
| 40% - 30% | 710F – 620F |  |
| 30% - 20% | 620F – 520F |  |
| 20% - 10% | 520F – 340F |  |
| Average ΔDPT |  |