**Sling Psychrometer Lab**

**Water vapor** is the invisible, gaseous form of water that hangs around in our atmosphere along with liquid water (cloud droplets, rain drops) and ice water (snow, hail, and sleet). When the air contains abundant water vapor, we say the air feels humid; when the air has very little water vapor in it, we say the air feels dry or arid. In the driest deserts, the volume of water vapor present in the air can be nearly 0 while in tropical rainforests; water vapor can occupy as much as 4% of the air’s volume. Although the amount of water vapor changes over distance and time, it is always measurable.

**Humidity**, when simply expressed as a measure of how much water vapor is present at a given temperature is called **absolute humidity**. On warm, humid days, we sense this by observing how muggy or sticky the air feels. Water or sweat from your skin cannot evaporate easily because the air already carries much water vapor. More commonly, though humidity is reported as **relative humidity**. For a given temperature, relative humidity is expressed as a percentage of how much moisture the air actually contains relative to how much moisture the air could contain. In other words, air like a sponge, could “absorb” that much volume of water.

For example, at 30 degrees C (86 degrees F), warm air can hold a maximum of 26 g/m3 of water. If, in our example, that much water was indeed present, the air would be ‘filled’ with water vapor and no more evaporation could take place. At this point, the air becomes **saturated**, condensation begins to take place, and water droplets form on tiny particles n the air or on cool surfaces along the ground. The temperature at which the air becomes saturated with water vapor is called the **dew point**. In our examples, 30 degrees C is the dew point and relative humidity is 100% because the air is holding all the moisture it can. If the same air only contains 13 g/m3, the relative humidity would be 50%. When the air temperature cools to the dew point, dew, fog and clouds can form. Frost forms when the air temperature is low enough that the water vapor turns directly into ice.

**Pre-Lab – answer on *your* sheet**

1. Compare the humidity between a summer day in Miami, Florida with that of Phoenix, Arizona. Which city would you predict would have a higher humidity? Why?
2. Define the following terms:
   1. Humidity:
   2. Relative humidity:
3. The same air as described above now contains 6.5g/m3.
   1. What is the relative humidity now?
   2. How would this air feel on your skin compared to 50% relative humidity?
   3. How would your skin feel if the same air cooled to the dew point?

**How it works**

1. When water evaporates, heat is required to change water into water vapor. As a result, evaporation has a definite cooling effect. Think about how you feel when you get out of a pool on a warm day. The ‘chilled’ feeling is the cooling effect of water evaporating from your skin.
2. Warm air holds more moisture than cool air. In fact, air at near room temperature, 20 degrees C or 68 degrees F, holds twice as much water vapor as air at 10 degrees C or 50 degrees F. That is why during sticky summer days, a sudden drop in temperature often brings welcome relief from the high humidity.

**What to do:**

1. Wet the cloth covering one the end of one thermometer and squeeze out the excess moisture.
2. Make sure that both thermometers are securely attached to the backing device, then carefully whirl the two thermometers in the air for about 30 seconds.
3. Immediately after whirling, record the temperatures indicated on both thermometers.
4. The difference between the readings on the wet and dry bulb thermometers is a measure of the amount of heat energy that is needed at the wet-bulb temperature to produce air saturated with water vapor. This measure is termed wet-bulb depression.

**Investigation 1: Dew Point**

1. To determine the dew point temperature, find the dry-bulb or air temperature along the left column of the Dew Point Chart (Figure 1). Write down this number on the worksheet.

2. Next, find the vertical column that corresponds to the wet-bulb depression (difference between dry-bulb and wet-bulb temperatures.

3. Record this value on your worksheet.

4. Follow the row containing the dry-bulb temperature until you reach the intersection of the column containing the wet-bulb depression. This value is the dew point.

5. Record the result on your worksheet.

**Investigation 2: Relative Humidity**

1. Using the Relative Humidity Chart (Figure 2) follow the row containing the dry-bulb temperature until you reach the intersection of the column containing the web-bulb depression.
2. The resulting value is the relative humidity. Record the result on your worksheet.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Location** | **Dry-Bulb Temperature** | **Wet-Bulb Temperature** | **Wet-Bulb Depression**  ***(dry bulb temp – wet bulb temp)*** | **Dew Point (from Chart)** | **Relative Humidity (from Chart)** |
| Classroom | °C | °C | °C | °C | % |
| Inside: | °C | °C | °C | °C | % |
| Outside: | °C | °C | °C | °C | % |

Student Sheet Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Pre-Lab**

1. Compare the humidity between a summer day in Miami, Florida with that of Phoenix, Arizona. Which city would you predict would have a higher humidity? Why?
2. Define the following terms:
   1. Humidity:
   2. Relative humidity:

**Data Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Location** | **Dry-Bulb Temperature** | **Wet-Bulb Temperature** | **Wet-Bulb Depression**  ***(dry bulb temp – wet bulb temp)*** | **Dew Point**  **(from Chart)** | **Relative Humidity (from Chart)** |
| Classroom | °C | °C | °C | °C | % |

**Post-Lab**

1. Why does the temperature decrease on the wet-bulb thermometer?
2. What does it mean if the water does not evaporate from the wet-bulb thermometer?
3. Can a sling psychrometer be used when the temperature is below freezing? Why or why not?
4. What did you learn from this lab?