Dry Bulb Temperature (°C)	Temperature Difference (dry bulb – wet bulb, °C)									
	1	2	3	4	5	6	7	8	9	10
10	88	77	66	55	44	34	24	15	6	–
11	89	78	67	56	46	36	27	18	9	–
12	89	78	68	58	48	39	29	21	12	–
13	89	79	69	59	50	41	32	22	15	7
14	90	79	70	60	51	42	34	25	18	10
15	90	81	71	61	53	44	36	27	20	13
16	90	81	71	63	54	46	38	30	23	15
17	90	81	72	64	55	47	40	32	25	18
18	91	82	73	65	57	49	41	34	27	20
19	91	82	74	65	58	50	43	36	29	22
20	91	83	74	67	59	53	46	39	32	26
21	91	83	75	67	60	53	46	39	32	26
22	91	83	76	68	61	54	47	40	34	28
23	92	84	76	69	62	55	48	42	36	30
24	92	84	77	69	62	56	49	43	37	31
25	92	84	77	70	63	57	50	44	39	33

Table 1- Relative humidities as a function of temperature and wet and dry bulb temperature difference (for use with 1st activity, calculating relative humidity)

- Blow the fan on the thermometers until the temperature stops falling
- Write down the temperature on both thermometers
- Subtract the temperature on the wet thermometer from that of the dry one.
- Use table 1 to figure out the relative humidity

There are many different ways to measure water vapor in the atmosphere, the most common include dew point and wet bulb temperatures, relative humidity, partial pressure and mixing ratio. The following definitions and relationships will prove useful in the 2nd activity:

- T_d (dew point temperature): the temperature at which a parcel of air would condense, also called the saturation point
- T_w (wet bulb temperature): the temperature a parcel of air would have if cooled to saturation by evaporation of water into it (the wet bulb temperature is the temperature the parcel would have if it reached saturation by addition of water vapor, since this additional water vapor would evaporate and cool the parcel). Usually between the actual temperature and the dew point.
- p_v (partial pressure of water vapor): the pressure water vapor would have if it alone occupied the same volume as the parcel of air
- q_v (mixing ratio): the ratio of water vapor mass per kilogram of dry air in any given parcel of air (g water vapor/ kg dry air)
- RH (relative humidity): ratio of partial pressure of water vapor to the saturated vapor pressure* of water at that temperature, expressed as a percent

$$\frac{p_v}{p_v^*} \times 100\%$$

*Saturated vapor pressure (p_v^*) is the vapor pressure needed in the parcel of air to reach saturation (RH = 100%), or the point at which the water will condense because the air parcel can't 'hold' any more water vapor. It is dependent on the temperature of the air only and can be calculated using table 2. Also note that because of this relationship, the dew point temperature in table 2 will correspond with the actual vapor pressure of the air, while the temperature itself will correspond to the saturation vapor pressure.

Saturation vapor pressure as a function of air temperature	
Air temperature (degrees C)	Saturation vapor pressure (mb)
2	6.9
4	8.4
7	10.2
10	12.3
13	14.8
16	17.7
18	21
21	25
24	29.6
27	35
29	41
32	48.1
35	56.2
38	65.2
41	76.2
43	87.8
46	101.4
49	116.8
52	134.2

Table 2 – Saturation vapor pressure as a function of air temperature

1. Temperature = 29°C. Dew point = 13°C.
What are the vapor pressure, saturation vapor pressure, and relative humidity?

Actual vapor pressure of air (p_v) = 14.8mb (corresponds to T_d = 13°C in Table 2)
Saturation vapor pressure (p_v^*) = 41mb (corresponds to T = 29°C in Table 2)
Relative Humidity (RH) = $\frac{p_v}{p_v^*} \times 100\% = \frac{14.8mb}{41mb} \times 100\% = .36 \times 100\% = 36\%$

2. Dew point = 10°C. Relative humidity = 50%.
What are the vapor pressure, saturation vapor pressure, and air temperature?

Actual vapor pressure of air (p_v) = 12.3mb (corresponds to T_d = 10°C in Table 2)
Use RH and p_v to find saturation vapor pressure:

$$\frac{50\%}{100\%} = 0.5 = \frac{p_v}{p_v^*} = \frac{12.3mb}{p_v^*} \rightarrow p_v^* = \frac{12.3mb}{0.5} = 24.6mb$$

Air Temperature ≈ 20°C (round from nearest corresponding p_v^* in Table 2)

3. Saturation vapor pressure is 35mb. Dew point = 10°C.
What are the air temperature, vapor pressure, and relative humidity?

Air Temperature = 27°C (corresponds to p_v^* = 35mb in Table 2)
Vapor Pressure (p_v) = 12.3mb (corresponds to T_d = 10°C in Table 2)
RH = $\frac{12.3mb}{35mb} \times 100\% = 35\%$

4. Find the relative humidity of two cities:

a. City A has an actual vapor pressure of 6mb and a saturation vapor pressure of 41mb.

   RH = $\frac{6mb}{41mb} \times 100\% = 14.6\%$

b. City B has an actual vapor pressure of 6mb also, but a saturation vapor pressure of 18mb.

$$\text{RH} = \frac{6mb}{18mb} \times 100\% = 33.3\%$$

c. Which city has a higher surface temperature? How can you tell?

City A has a higher surface temperature because it has a higher saturation vapor pressure.

5. Pheonix has a surface temperature of 35^{o}C and RH of 15% while Fairbanks has a surface temperature of 4^{o}C and RH of 80%. Which of these cities has a higher water vapor content? (hint: make sure to calculate it, don't just trust your instinct)

Phoenix:

$p_v^* = 56.2\text{mb}$

$$\frac{p_v}{p_v^*} = \frac{RH}{100\%} = 0.15 = \frac{p_v}{56.2mb} \rightarrow p_v = 56.2mb \times 0.15 = 8.43mb$$

Fairbanks:

$p_v^* = 8.4\text{mb}$

$p_v = 8.4mb \times 0.8 = 6.72mb$ (using same calculation as in Phoenix)

Therefore, Pheonix actually has a higher moisture content than Fairbanks even though it has a lower relative humidity.

This is also why it feels very dry in houses during winter; the air gets warmed up but no moisture is added, hence the numerator in the RH fraction remains the same while the denominator increases, reducing the relative humidity.