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Atmospheric Moisture

Dew Point and Relative Humidity

Some helpful words…

Dew Point - Temperature at which air becomes saturated with water vapor and condensation occurs.

Absolute Humidity - The actual mass (grams) of water vapor in the air.

Relative Humidity - How close air is to saturation (100%) at a given temperature.

Saturated - When air is full of the water vapor it can hold.

Condensation - When water vapor turns in a liquid.

Dew Point vs. Relative Humidity

Identify each statement as relating to dew point (DP) or relative humidity (RH).

DP _____ measured as a temperature

RH _____ how much water vapor in the air compared to what the air can hold

RH _____ written as a percentage

DP _____ temperature of the air at which water vapor will condense

RH _____ at 100% when air is full of the water vapor it can hold

RH _____ changes when the air temperature changes

DP _____ always lower in the desert

RH _____ increase when temperature decreases

DP _____ can never be higher than the air temperature

DP _____ often lower when its cold out

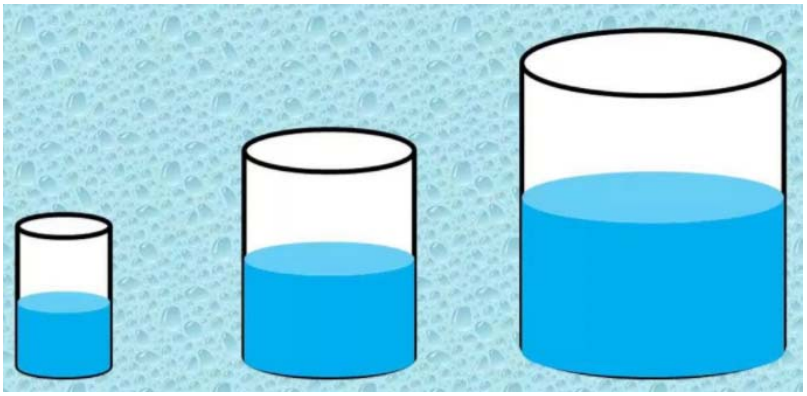
RH _____ usually higher in the morning than in the afternoon

DP _____ has a high value when it feels really humid and uncomfortable

RH _____ can be the same from day to day even if the amount of water vapor changes

Visualizing DP and RH

You can think of the air as being like a container that holds water. The 3 containers below represent samples of air at 3 different temperatures. Each container is filled with some water, which represents water vapor in the air .



1 2 3

Questions – Visualizing DP and RH

1. Which container represents the warmest air? 3

2. If the temperature of the containers *(air samples)* were to decrease, what would happen to their sizes? DECREASES

3. Which container represents air with the highest dew point? 3

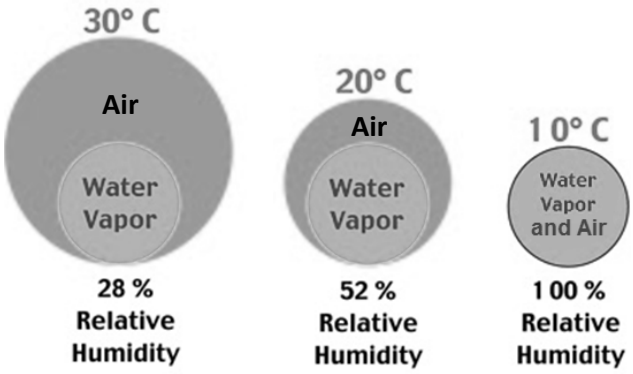
4. What is the relative humidity of each "air" sample? 50%

5. If more water was added to the "air samples", which would become saturated first? 1

6. When air becomes saturated with water vapor, what could happen? CONDENSATION OF WATER VAPOR

Understanding DP and RH

The diagram to the right shows an air sample at 3 different temperatures. The size of the air sample shows its capacity to hold the water vapor circle.



1. At what temperature can this air sample hold the most water vapor?

   30°C

2. At what temperature is the air saturated?

   10°C

3. What is the dew point for this air sample?

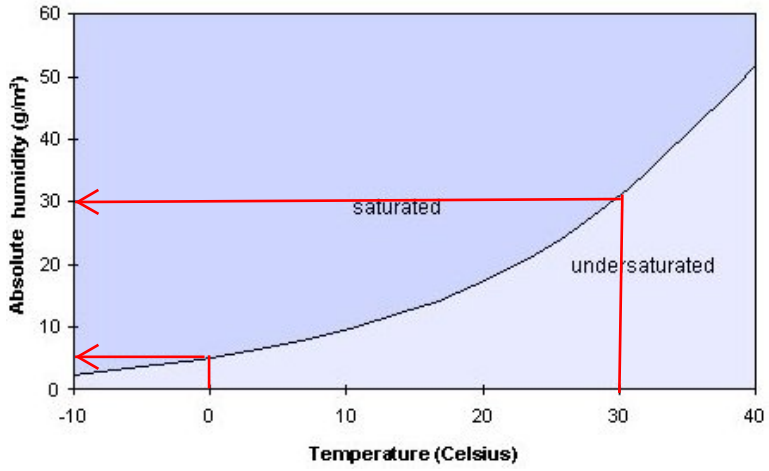
   10°C

4. At what temperature is there the greatest chance of precipitation?

   10°C

Understanding DP and RH

The graph to the right shows the relationship between air temperature and absolute humidity. In other words, it shows how much total water vapor air can have in it at different temperatures.



1. What are the units for absolute humidity on this graph? g/m^3
2. What does the curve in the graph represent? Saturation (100% RH)
3. About how much water vapor will saturate air at 0°C? ~5g 30°C? ~30g
4. If the curve represents air that is at 100% relative humidity (saturated), about how much water vapor is needed for 50% relative humidity at 20°C? ~7g 40°C? ~25g
5. How can relative humidity be misleading when describing how much water vapor is in the air? RH depends on the temp of the air, not the actual amount of water vapor the air is holding.

Dew Point Chart

Dewpoint (°C)

Dry-Bulb Temperature (°C)	Difference Between Wet-Bulb and Dry-Bulb Temperatures (C°)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
−20	−20	−33														
−18	−18	−28														
−16	−16	−24														
−14	−14	−21	−36													
−12	−12	−18	−28													
−10	−10	−14	−22													
−8	−8	−12	−18	−29												
−6	−6	−10	−14	−22												
−4	−4	−7	−12	−17	−29											
−2	−2	−5	−8	−13	−20											
0	0	−3	−6	−9	−15	−24										
2	2	−1	−3	−6	−11	−17										
4	4	1	−1	−4	−7	−11	−19									
6	6	4	1	−1	−4	−7	−13	−21								
8	8	6	3	1	−2	−5	−9	−14								
10	10	8	6	4	1	−2	−5	−9	−14	−28						
12	12	10	8	6	4	1	−2	−5	−9	−16						
14	14	12	11	9	6	4	1	−2	−5	−10	−17					
16	16	14	13	11	9	7	4	1	−1	−6	−10	−17				
18	18	16	15	13	11	9	7	4	2	−2	−5	−10	−19			
20	20	19	17	15	14	12	10	7	4	2	−2	−5	−10	−19		
22	22	21	19	17	16	14	12	10	8	5	3	−1	−5	−10	−19	
24	24	23	21	20	18	16	14	12	10	8	6	2	−1	−5	−10	−18
26	26	25	23	22	20	18	17	15	13	11	9	6	3	0	−4	−9
28	28	27	25	24	22	21	19	17	16	14	11	9	7	4	1	−3
30	30	29	27	26	24	23	21	19	18	16	14	12	10	8	5	1

1. Dry-Bulb = 22°C

   Difference = 4°C

   Dew Point = 16°C

2. Dry-Bulb = 6°C

   Wet-Bulb = 2°C

   Dew Point = -4°C

3. Dry-Bulb = 12°C

   Difference = 7°C

   Dew Point = -5°C

4. Dry-Bulb = 10°C

   Wet-bulb = 7°C

   Dew Point = 4°C

Relative Humidity Chart

Relative Humidity (%)

Dry-Bulb Temperature (°C)	Difference Between Wet-Bulb and Dry-Bulb Temperatures (C°)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
−20	100	28														
−18	100	40														
−16	100	48														
−14	100	55	11													
−12	100	61	23													
−10	100	66	33													
−8	100	71	41	13												
−6	100	73	48	20												
−4	100	77	54	32	11											
−2	100	79	58	37	20	1										
0	100	81	63	45	28	11										
2	100	83	67	51	36	20	6									
4	100	85	70	56	42	27	14									
6	100	86	72	59	46	35	22	10								
8	100	87	74	62	51	39	28	17	6							
10	100	88	76	65	54	43	33	24	13	4						
12	100	88	78	67	57	48	38	28	19	10	2					
14	100	89	79	69	60	50	41	33	25	16	8	1				
16	100	90	80	71	62	54	45	37	29	21	14	7	1			
18	100	91	81	72	64	56	48	40	33	26	19	12	6			
20	100	91	82	74	66	58	51	44	36	30	23	17	11	5		
22	100	92	83	75	68	60	53	46	40	33	27	21	15	10	4	
24	100	92	84	76	69	62	55	49	42	36	30	25	20	14	9	4
26	100	92	85	77	70	64	57	51	45	39	34	28	23	18	13	9
28	100	93	86	78	71	65	59	53	47	42	36	31	26	21	17	12
30	100	93	86	79	72	66	61	55	49	44	39	34	29	25	20	16

1. Dry-Bulb = -4°C

   Difference = 2°C

   RH = 54%

2. Air Temp = 16°C

   Wet-Bulb = 10°C

   RH = 45%

3. Dry-Bulb = 20°C

   RH = 58%

   Dew Point = 12°C

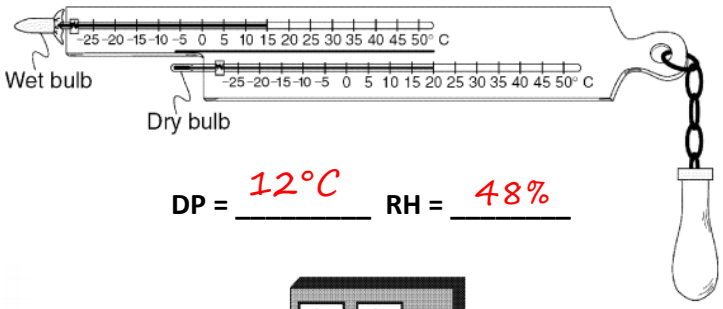
4. Dry-Bulb = 26°C

   Dew Point = 6°C

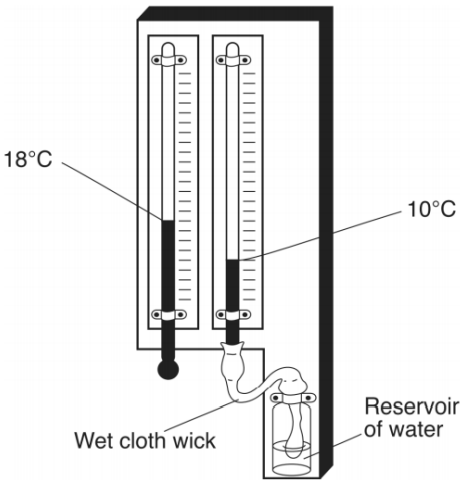
   RH = 57%

Psychrometers

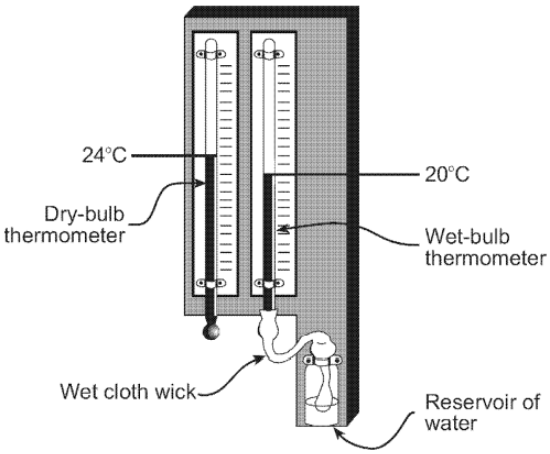
For each of the psychrometers, find the dew point and relative humidity.



DP = 12°C **RH =** 48%

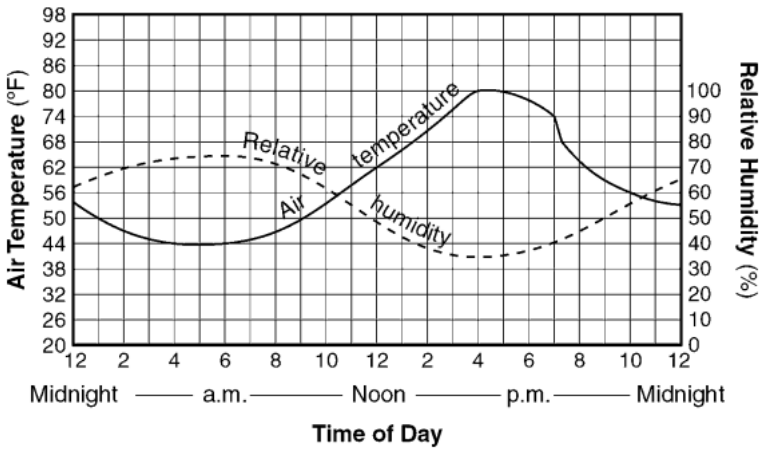


DP = 2°C **RH =** 33%



DP = 18°C **RH =** 69%

What's the relationship?



1. Use the graph to state the relationship between air temperature and relative humidity. As air temp increases, relative humidity decreases.

2. For the time represented by the graph, did the air temperature ever equal the dew point temperature and how do you know?

   NO, because the RH never reached 100%

Graph it!

Graph the relationships below.