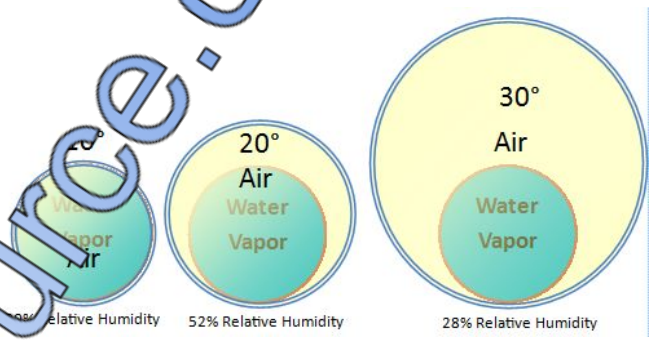
Name: _____

Relative Humidity and Dew Point Lab

Weather is the present state of the atmosphere. Factors that determine the type of weather the world will have are: air pressure, wind, temperature and the air's humidity. The water cycle forms the basis of our weather and the interactions of air and water. The sun provides the energy for it.

The warmer air is, the more volume it has and therefore can hold more water vapor. Humidity is the amount of water vapor in the air. Humidity changes daily because air temperature changes daily. As air slows down and changes from warm to cold, condensation of the water vapor can occur.



Meteorologists can use relative humidity to help predict weather. Relative Humidity is the measurement of how much water air is holding compared to how much water it can hold at specific temperatures. When the air can't hold any more water it is considered to be saturated and we say that there is 100% humidity. The dew point is the temperature at which saturated air condensates.

To find the relative humidity of the air, you can use a psychrometer. A psychrometer compares the temperature of a normal thermometer and a thermometer with a wet cotton ball attached to its bulb. You take the psychrometer outside and swing it in a circle for about three minutes. As you are swinging the psychrometer the dry thermometer bulb will measure the actual temperature and as the wet cotton ball starts to dry, heat from the thermometer will be drawn out. The more moisture in the air (humidity), the slower the wet bulb will dry. You can see how this works by adding a drop of rubbing alcohol onto the back of your hand and blowing on it. Lets try it.

1. **What happens when you blow on the rubbing alcohol?**

2. **In your own words explain what is happening scientifically.**

It's time to now discover the relative humidity outside of the classroom. We are going to use a psychrometer. To do this we are going to soak the cotton ball (wet bulb) in water. We are going to swing the psychrometer around for no longer than three minutes and we will check the dampness of the cotton ball every minute. Once the wet bulb temperature stops falling we will stop and answer question 3 and 4.

3. **What is the wet bulb temperature?**

4. **What is the dry bulb temperature?**

In order to calculate the relative humidity we need to know the value of the wet bulb depression. The depression of the wet bulb is the value difference of temperature between the wet bulb and the dry bulb.

5. **What is the numerical value of the wet bulb depression?**

6. **Using the chart below, determine what the value of the outdoor relative humidity is.**

Dry-Bulb Temp in ℃	Wet-Bulb Depression															
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
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
31	100	93	86	80	74	68	62	57	51	46	41	37	32	28	23	19
32	100	93	87	80	74	68	63	57	52	47	42	40	35	32	26	23
33	100	93	87	81	75	69	63	58	53	48	43	42	37	34	28	25
34	100	93	87	81	75	69	64	59	54	49	44	43	38	35	29	26

7. **Hypothesise whether the relative humidity indoors is higher, lower or the same compared to the outdoor humidity. Describe why you think that will be the case.**

8. **Using the psychrometer, determine the relative humidity of the classroom.**

9. **Was your hypothesis correct?**

Another aspect of understanding weather is understanding the dew point. The dew point is the temperature at which air that is saturated begins to condensate and change water vapor back into water. To understand this better go to the following website: http://www.dpcalc.org/ You will see a dew point calculator. First make sure you have the "Dew Point" selected. Next, match the temperature slider with the same temperature you got for the outside dry bulb temperature and change the %RH slider until it matches the percent of the outdoor relative humidity.

10. **What is the current dew point for out doors?**

11. **Following the same procedure, what is the current dew point for indoors?**

12. **Look off to the right of the website and you will notice the relationship between humidity, dew point and the risk of mold. What happens to the mold risk as humidity goes up?**

13. **Why do you think that is?**

Now let's do a science experiment to see how close we are in determining the actual dew point using a psychrometer and a dew point calculator. You are going to cause water vapor in the air to condensate. Fill a beaker about half way with water. Place a thermometer inside the water. Slowly add ice to the water. When you see moisture on the side of the container, the dew point has been reached.

14. **What was the dew point temperature based on your experiment?**

15. **Why does the water vapor condensate when the dew point is reached?**

16. **What is the value of the difference between the dew point from the experiment and the dew point from the dew point calculator based on your psychrometer readings?**

17. **What do you think happens if the dew point is 0℃ or lower?**

Relative Humidity and Dew Point Lab Instructions and Materials

1. Materials
    a. Sling Psychrometer, cotton balls, a computer, projector, ice cubes, beakers or glass jars, thermometers
        i. If you don't have a sling psychrometer you can easily make one with thermometers. Before I had a sling psychrometer I just tied string to the ends of the thermometers and had another student swing it around as I swung mine around. It will work fine. In fact I used to have all the students in groups make one, but we broke way too many thermometers as they crashed into each other or let go of the string.
    b. I have the students read the first four paragraphs and then asked random students questions about what they read. I prefaced their reading with the fact that I was assessing their ability to read science. As students answer individual questions about the reading, I use whole class discussion.
        i. Discussion questions I used were:
            1. What is a psychrometer?
            2. What is relative humidity?
            3. What is the dew point?
            4. What is the relationship between the volume of air, amount of moisture and temperature?
            5. What would it be like to be in a location with 100% humidity?
            6. Why would a wet bulb dry slower or not dry at all if the humidity was high?
    c. Throughout the rest of the lab I pause after each section discussing some of the answers that you can find below.
    d. I use online weather sites such as "intellicast.com" to show the real humidity level for the town. Most likely there will be some discrepancies between your psychrometers and what your local weather station pick up, but I discuss that locations, even close locations can change the humidity and dew point levels. Sometimes I get a class that is lucky and our data matches the weather station's and that is always a good feeling.

Relative Humidity and Dew Point Lab Answers, Insights and Teacher Reflection

1. What happens when you blow on the rubbing alcohol?
    a. Students should get a cooling sensation. If you don't want to use rubbing alcohol you can use hand sanitizer and get the same results.

2. In your own words explain what is happening scientifically.
    a. The faster a liquid evaporates the colder the feel. This is due to the fact that evaporating material draws heat from the surface so as the alcohol evaporated it litteral drew heat out of their hands.
    b. I use liquid nitrogen as an example and extension. They have all seen movies where somebody or something is frozen when touched by liquid nitrogen. They don't realize that the liquid nitrogen isn't necessarily cold, it is the quickness of evaporation and drawing all of the heat out of an object that causes the object to freeze.

3. **What is the wet bulb temperature?**
    a. This will vary throughout the day and even in different locations. If you are standing on grass and it is in the morning, you are going to be having more evaporation occurring and therefore a little more humidity than you might later on in the day.

4. **What is the dry bulb temperature?**
    a. This will vary due to your current temperatures.
5. **What is the numerical value of the wet bulb depression?**
    a. The wet bulb depression is calculated by subtracting the wet bulb temperature from the dry bulb temperature.

6. **Using the chart below, determine what the value of the outdoor relative humidity is**
    a. After calculating the wet-bulb depression students will move down vertically until they meet the horizontal dry-bulb temperature. This will give them the relative humidity.
    b. After they calculate the relative humidity, I ask the question to the whole class, "So what does this percentage relative humidity actually mean?"
7. **Hypothesise whether the relative humidity indoors is higher, lower or the same compared to the outdoor humidity. Describe why you think that will be the case.**
    a. This will almost always come out more humid in the classroom. In my room now though it tends to come out less humid. Maintenance added anti humidity something or others that dry the air out.
    b. If students hypothesize more humid indoors, this spawns a great discussion as to why. It is because people are constantly breathing out moisture as well as perspiring causing humidity.
8. **Using the psychrometer, determine the relative humidity of the classroom.**
    a. We just do the experiment one more time, but this time indoors.
9. **Was your hypothesis correct?**
    a. Simple yes or no suffices.
10. **What is the current dew point for out doors?**
    a. I use the dew point calculator on the internet via a projector. The nice thing is is a student can make up this lab using the online version if they are absent during the class time of the lab.
    b. The answer will be based on your relative humidity and dry bulb temperatures.
11. **Following the same procedure, what is the current dew point for indoors?**
    a. The answer will be based on your relative humidity and dry bulb temperatures.
12. **Look off to the right of the website and you will notice the relationship between humidity, dew point and the risk of mold. What happens to the mold risk as humidity goes up?**
    a. This is a great stopping point, to discuss the relationship between temperature, humidity, dew point and mold.
13. **Why do you think that is?**
    a. Thinking question and part of the discussion.
14. **What was the dew point temperature based on your experiment?**
    a. This will vary by class hour.
15. **Why does the water vapor condensate when the dew point is reached?**
    a. When the dew point is reached the air no longer has the volume to hold onto the water. Remember the warmer the air the more water it can hold because it has greater volume.
    b. I mention a sponge at about here as well. Sponge represents the air. As the volume decreases (me squeezing a sponge), the more likely water will leave the sponge.
16. **What is the value of the difference between the dew point from the experiment and the dew point from the dew point calculator based on your psychrometer readings?**
    a. This is to compare how close the psychrometer help determine dew point and the actual readings from the ice in water experiment.
17. **What do you think happens if the dew point is 0℃ or lower?**
    a. This is a thinking question that I let groups discuss.
    b. If the dew point is lower than 0℃ we get frost instead of dew.