ESCI 1010 Lab 3
Atmospheric Moisture

Before Lab: Review pages 112-125 in your Weather and Climate textbook. Pay special attention to the section entitled "Water's Changes of State", the terms relative humidity and dew point, and the sling psychrometer, wet-bulb temperature, and dry-bulb temperature discussion on pages 123-125.

Summary: This lab will give you hands-on experience collecting data that can be used to determine two key moisture variables that are often used by meteorologists and climatologists—the relative humidity and the dew point. By the end of the lab, you should be familiar with how to use a sling psychrometer to determine the relative humidity and the dew point, the relationship between relative humidity and dew point, and the heat exchanges taking place as water changes phase.

LAB EXERCISE

1. Note Figure 5-3 on page 114 in your textbook. Using that figure, fill in the following table

Water's Phase Change	Heat (released or consumed)
Ice → Water (liquid)	
Water (liquid) → Ice	
Ice → Water Vapor	
Water Vapor → Water (liquid)	
Water Vapor → Ice	
Water (liquid) → Water Vapor	

2. Using a sling-psychrometer, you will go outside and take measurements of the wet-bulb and dry-bulb temperature in order to determine the relative humidity and the dewpoint:

- Dip the sock, located on one of the thermometers, into the container of water provided in lab.
- Go outside and have one person in your group sling the psychrometer around (as demonstrated by your lab instructor) with the other keeping time.
- Sling the psychrometer for one minute, and look at the readings on the thermometers.
- Sing the psychrometer for another 30 seconds, and determine if there has been any change in the wet-bulb or dry-bulb readings. If there is no change, you may stop and record your values. If the reading has changed, the repeat this step by slinging the psychrometer for another 30 seconds and check the values again. Record your dry-bulb and wet-bulb temperatures in the table on the next page under "Your Group."
- Once you are back in the lab, your instructor will ask for the wet-bulb and dry-bulb temperatures from each group and those values will be noted on the board.
- Compute a class average for the wet-bulb and dry-bulb temperatures and record those values in the table on the next page under "Class Average."

	Your Group	Class Average
Wet-bulb Temperature (°F)		
Dry-bulb Temperature (°F)		

3. Were all group observations within a degree or two of the class average? Why might you expect differences?

4. Unless the air outside is completely saturated, the wet-bulb temperature likely declined as the psychrometer was slung. Why does the temperature of the wet-bulb go down when the air is not saturated (hint: remember heat exchanges when water changes state from question 1; refer back to the textbook on page 123-125)?

5. Using the wet-bulb and dry-bulb temperatures you recorded in the table above, the relative humidity can be determined, but first you must calculate a variable known as the wet-bulb depression. It is computed by subtracting the wet-bulb temperature from the dry-bulb temperature (i.e. dry-wet). Compute the wet-bulb depression using the "Class Average" data you recorded in the table above.

6. Think about low wet-bulb depression values vs. high wet-bulb depression values as they relate to the air saturation. Is the air closer to saturation when you see low values or high values?

7. Find the relative humidity. Use your computed wet-bulb depression value from question 5 above, the "Class Average" data in the table above, and Table 1 on page 5 of this lab. You may need to interpolate between the values in Table 1.

8. Use the value for relative humidity you found in question 7 above, the "Class Average" data in the table above, and Table 2 on page 6 of this lab to find the dew point temperature. Once again, you may need to interpolate between the values in Table 2.

9. If the wet-bulb temperature is 19°F and the dry-bulb temperature is 23°F, find the relative humidity and the dew point using Tables 1 and 2 on pages 5 and 6 of this lab.

10. If the wet-bulb temperature is 78°F and the dry-bulb temperature is 105°F, find the relative humidity and the dew point using Tables 1 and 2 on pages 5 and 6 of this lab.

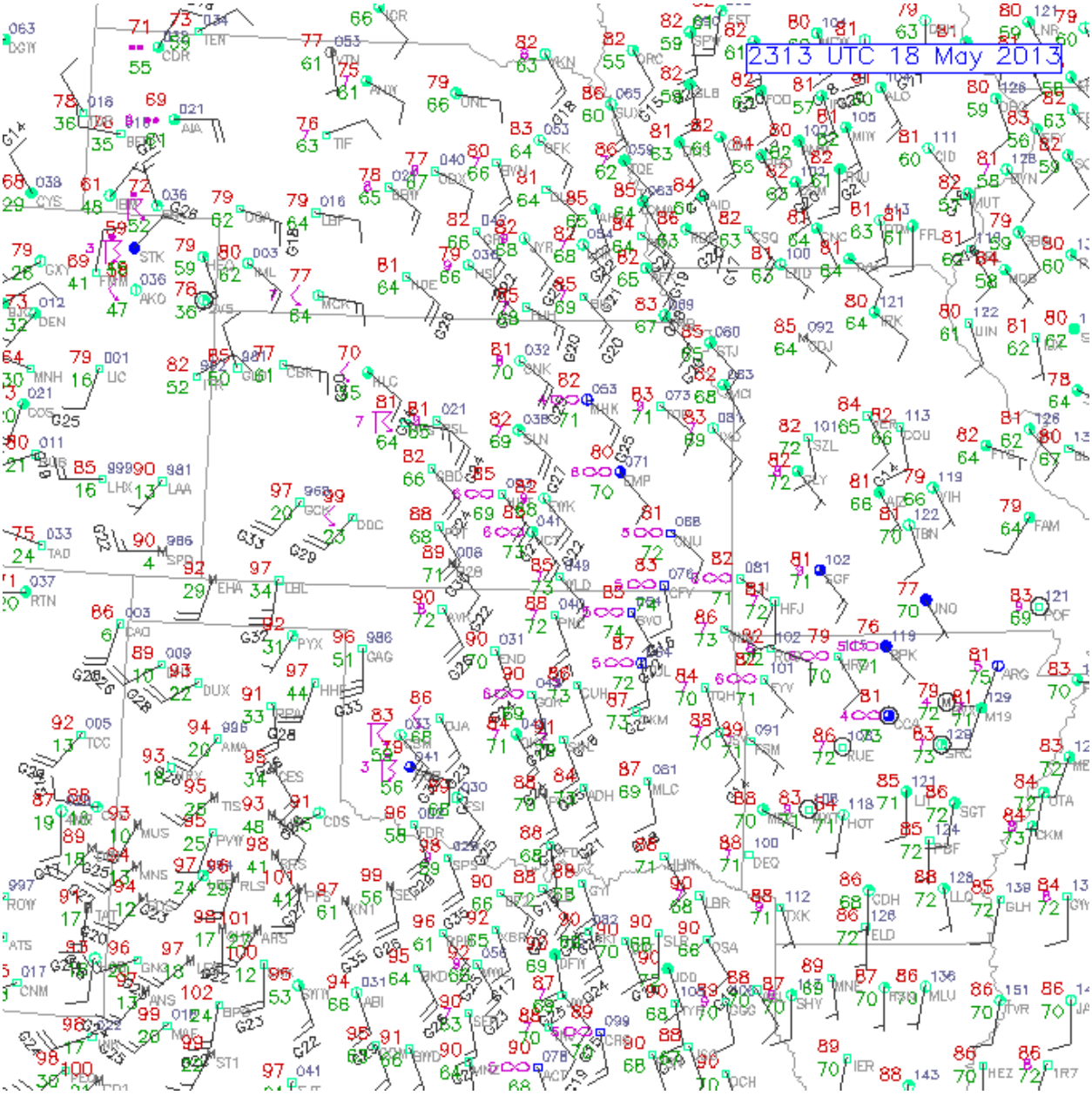
11. Your lab instructor will show you the current relative humidity and dew point data from our WeatherBug station at Johnson Hall. You can find this information in the WeatherBug app for the iPhone and Android as well as from weather.weatherbug.com. Compare the relative humidity and dew point you computed with our WeatherBug station at Johnson Hall. Are there any differences? Why might there be differences?

12. Note Figure 5-11 in your textbook on page 122. This figure illustrates the typical behavior of both temperature and relative humidity during the day. When is the relative humidity highest? When it is the lowest? Why does relative humidity typically behave like this?

13. Keep your answer to question 12 in mind. Note the temperature, dew point, and relative humidity values in the table below for two different times during the same day. Has the amount of moisture in the air changed from morning to afternoon? What variable did you use to answer this question? Why did you use that variable?

Time	Temperature (°F)	Dew Point (°F)	Relative Humidity (%)
7 a.m.	71	70	97
5 p.m.	100	70	38

14. Draw isodrosotherms (lines of equal dew point) at 10°F intervals starting at 70°F on the map below (i.e., draw 70°F, 60°F, 50°F, 40°F, etc. lines). Remember the dew point is the value in the lower-left of the station model plot, and that a 50°F isodrosotherm will separate dew points above 50°F from those below 50°F (40°F separates dew points above 40°F from those below 40°F and so on).



15. On the map above, circle the highest dew point gradient.

Temperature (°F) \ Wet-Bulb Depression (°F)	0	5	10	15	20	25	30	35	40	45	50
-10	100	0	0	0	0	0	0	0	0	0	0
-5	100	0	0	0	0	0	0	0	0	0	0
0	100	0	0	0	0	0	0	0	0	0	0
5	100	0	0	0	0	0	0	0	0	0	0
10	100	4	0	0	0	0	0	0	0	0	0
15	100	19	0	0	0	0	0	0	0	0	0
20	100	31	0	0	0	0	0	0	0	0	0
25	100	41	0	0	0	0	0	0	0	0	0
30	100	49	1	0	0	0	0	0	0	0	0
35	100	55	13	0	0	0	0	0	0	0	0
40	100	60	23	0	0	0	0	0	0	0	0
45	100	64	31	1	0	0	0	0	0	0	0
50	100	68	38	11	0	0	0	0	0	0	0
55	100	70	44	19	0	0	0	0	0	0	0
60	100	73	48	26	5	0	0	0	0	0	0
65	100	75	52	32	13	0	0	0	0	0	0
70	100	77	55	36	19	3	0	0	0	0	0
75	100	78	58	40	24	10	0	0	0	0	0
80	100	79	61	44	29	15	3	0	0	0	0
85	100	80	63	47	33	20	8	0	0	0	0
90	100	81	65	50	36	24	13	3	0	0	0
95	100	82	66	52	39	28	17	8	0	0	0
100	100	83	68	54	42	31	21	12	4	0	0
105	100	84	69	56	44	33	24	15	8	1	0
110	100	84	70	57	46	36	27	18	11	5	0
115	100	85	71	59	48	38	29	21	14	8	2
120	100	85	72	60	49	40	31	24	17	11	5

Table 1. Table of relative humidity values with associated temperature (the dry-bulb temperature) and the wet-bulb depression (dry-wet) values.

Temperature (°F)	Relative Humidity (%)										
	5	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
-10	-62	-51	-40	-33	-28	-23	-20	-17	-14	-12	-10
-5	-59	-47	-36	-29	-23	-19	-15	-12	-10	-7	-5
0	-55	-43	-31	-24	-19	-14	-11	-7	-5	-2	0
5	-51	-40	-27	-20	-14	-10	-6	-3	0	3	5
10	-47	-36	-23	-15	-9	-5	-1	2	5	8	10
15	-44	-32	-19	-11	-5	0	4	7	10	13	15
20	-40	-28	-15	-6	0	5	8	12	15	18	20
25	-36	-24	-10	-2	4	9	13	17	20	23	25
30	-33	-20	-6	2	9	14	18	21	25	28	30
35	-29	-16	-2	7	13	18	23	26	30	32	35
40	-25	-12	2	11	18	23	27	31	34	37	40
45	-22	-8	6	15	22	28	32	36	39	42	45
50	-18	-4	11	20	27	32	37	41	44	47	50
55	-15	-1	15	24	31	37	41	45	49	52	55
60	-11	3	19	28	36	41	46	50	54	57	60
65	-8	7	23	33	40	46	51	55	59	62	65
70	-4	11	27	37	45	51	55	60	64	67	70
75	0	15	31	41	49	55	60	65	68	72	75
80	3	19	35	46	53	60	65	69	73	77	80
85	7	22	39	50	58	64	69	74	78	82	85
90	10	26	44	54	62	69	74	79	83	87	
95	14	30	48	59	67	73	79	84	88		
100	17	34	52	63	71	78	84	88			
105	21	37	56	67	76	83	88				
110	24	41	60	71	80	87					
115	27	45	64	76	85						
120	31	49	68	80	89						

Table 2. Table of dew point values with associated temperature (the dry-bulb temperature) and the relative humidity values.