

Measuring Humidity

Relative humidity is a measurement used to describe water vapor in the air. In general, it expresses how close the air is to saturation. In this lab, you will use a psychrometer and a data table to determine the relative humidity of air.

Problem How can relative humidity be determined?

Materials

- calculator
- water at room temperature
- psychrometer

Alternative materials for psychrometer:

- 2 thermometers
- cotton gauze
- paper fan
- string

Skills Observing, Measuring, Analyzing Data, Calculating

Procedure

Part A: Calculating Relative Humidity from Water Vapor Content

1. Use Data Table 1 to record your measurements.
2. Relative humidity is the ratio of the air's water vapor content to its water vapor capacity at a given temperature. Relative humidity is expressed as a percent.

$$\text{Relative humidity (\%)} = \frac{\text{Water vapor content}}{\text{Water vapor capacity}} \times 100\%$$

3. At 25°C, the water vapor capacity is 20 g/kg. Use this information to complete Data Table 1.

DATA TABLE 1 Relative Humidity Determination Based on Water Vapor Content

Air temperature (°C)	Water Vapor Content (g/kg)	Water Vapor Capacity (g/kg)	Relative Humidity (%)
25	5	20	25
25	12		
25	18		

Part B: Determining Relative Humidity Using a Psychrometer

4. A psychrometer consists of two thermometers—a wet-bulb thermometer and a dry-bulb thermometer. The wet-bulb thermometer has a cloth wick that is wet with water and spun for about 1 minute. Relative humidity is determined by calculating the difference in the temperature reading between the dry-bulb temperature and the wet-bulb temperature and using Data Table 2. For example, suppose a dry-bulb temperature is measured as 20°C, and a wet-bulb temperature is 14°C. Read the relative humidity from Data Table 2.

5. If a psychrometer is not available, construct a wet-bulb thermometer by tying a piece of cotton gauze around the end of a thermometer. Wet it with room-temperature water, and fan it until the temperature stops changing.
6. Make wet-bulb and dry-bulb temperature measurements for the air in your classroom and the air outside. Use Data Table 3 to record your measurements. Use your measurements and Data Table 2 to determine the relative humidity inside and outside.

DATA TABLE 2 Relative Humidity (percent)

Dry-Bulb Temperature (°C)	Depression of Wet-Bulb Temperature (Dry-Bulb Temperature – Wet-Bulb Temperature = Depression of the Wet Bulb)																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
-20	28																					
-18	40																					
-16	48	0																				
-14	55	11																				
-12	61	23																				
-10	66	33	0																			
-8	71	41	13																			
-6	73	48	20	0																		
-4	77	54	43	11																		
-2	79	58	37	20	1																	
0	81	63	45	28	11																	
2	83	67	51	36	20	6																
4	85	70	56	42	27	14																
6	86	72	59	46	35	22	10	0														
8	87	74	62	51	39	28	17	6														
10	88	76	65	54	43	33	24	13	4													
12	88	78	67	57	48	38	28	19	10	2												
14	89	79	69	60	50	41	33	25	16	8	1											
16	90	80	71	62	54	45	37	29	21	14	7	1										
18	91	81	72	64	56	48	40	33	26	19	12	6	0									
20	91	82	74	66	58	51	44	36	30	23	17	11	5	0								
22	92	83	75	68	60	53	46	40	33	27	21	15	10	4	0							
24	92	84	76	69	62	55	49	42	36	30	25	20	14	9	4	0						
26	92	85	77	70	64	57	51	45	39	34	28	23	18	13	9	5						
28	93	86	78	71	65	59	53	47	42	36	31	26	21	17	12	8	2					
30	93	86	79	72	66	61	55	49	44	39	34	29	25	20	16	12	8	4				
32	93	86	80	73	68	62	56	51	46	41	36	32	27	22	19	14	11	8	4			
34	93	86	81	74	69	63	58	52	48	43	38	34	30	26	22	18	14	11	8	5		
36	94	87	81	75	69	64	59	54	50	44	40	36	32	28	24	21	17	13	10	7	4	
38	94	87	82	76	70	66	60	55	51	46	42	38	34	30	26	23	20	16	13	10	7	5
40	94	89	82	76	71	67	61	57	52	48	44	40	36	33	29	25	22	19	16	13	10	7

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DATA TABLE 3 Relative Humidity Determinations Using Dry- and Wet-Bulb Thermometers

	Inside	Outside
Dry-bulb temperature (°C)		
Wet-bulb temperature (°C)		
Differences between dry-bulb and wet-bulb temperatures (°C)		
Relative humidity (%)		

Analyze and Conclude

1. Comparing and Contrasting How do the relative humidity measurements for inside and outside compare? Why are your determinations similar or different?

2. Applying Concepts Explain the principle behind using a psychrometer to determine relative humidity.

3. Applying Concepts Suppose you hear on the radio that the relative humidity is 90 percent on a winter day. Can you conclude that this air contains more moisture than air on a summer day with a 40 percent relative humidity? Explain why or why not.

4. Applying Concepts Why is a cool basement often damp in the summer?
