

Weather Factors • *Laboratory Investigation*

# Using a Psychrometer to Determine Relative Humidity

## Pre-Lab Discussion

Even without rain, the air can be very wet because it contains invisible water vapor. The amount of water vapor in the air is known as humidity. As air gets warmer, it can hold more moisture. Meteorologists usually speak of relative humidity—the amount of water vapor in the air compared to the maximum amount that air can hold at a particular temperature.

You can measure relative humidity with a psychrometer, an instrument consisting of two thermometers. One thermometer has a dry bulb, and one has a wet bulb. A piece of wet cloth surrounds the bulb of the wet-bulb thermometer. When the wet bulb is exposed to air, water in the cloth evaporates, just as it does from wet clothing. Water evaporation requires heat energy, so it cools the wet bulb.

In this investigation, you will construct a sling psychrometer and use it to measure the relative humidity of the classroom.

1. What is the difference between humidity and relative humidity?

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2. Would you expect the temperature of the wet-bulb thermometer to be higher on a humid day or on a dry day? Explain your answer.

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**Weather Factors** • *Laboratory Investigation***Using a Psychrometer to Determine Relative Humidity** *(continued)***Problem**

How can you use a psychrometer to find the relative humidity of the classroom?

**Materials** *(per group)*

2 identical thermometers

strip of gauze, 10 cm

piece of thread, 20 cm

piece of cardboard, approximately 20 cm × 30 cm

water at room temperature



transparent tape

bucket

small plastic cup

plastic dropper

large index card

**Safety**   Review the safety guidelines in Appendix A in your textbook.

Handle the thermometer carefully. If it breaks, tell your teacher. Do not pick up broken glass.

**Procedure**

1. Wrap the gauze around the bulb of one thermometer, and tie it in place with the thread.
2. Tape the thermometers side by side with the two bulbs extending over the edge of the cardboard. See Figure 1.

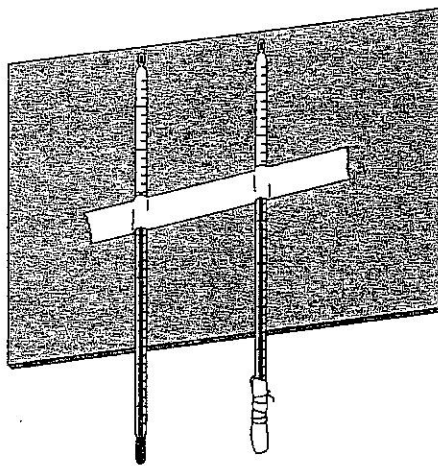


Figure 1

3. Scoop some water from the bucket into a small plastic cup. Use this water and the plastic dropper to wet the gauze thoroughly.

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4. Hold up the cardboard in the air. Carefully fan the thermometer bulbs with the index card until the temperature of the wet-bulb thermometer stops dropping. Predict the difference in temperatures between the two thermometers. Explain your reasoning.

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Read the temperatures on both thermometers. Record these numbers in the data table next to the sample data. Calculate the difference between the two readings.

5. Find the relative humidity in Data Table 1 below, using the temperature difference between the dry bulb and the wet bulb. Express relative humidity as a percentage. For example, suppose the dry-bulb reading is 21°C and the wet-bulb reading is 15°C. The difference is 6°C. The number on the table where the row of the dry-bulb reading (21) and the column of the difference (6) intersect shows the relative humidity (53%). These numbers are included in Data Table 2 as sample data. Record your own data next to them.

**Data Table 1: Relative Humidity (%)**

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

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**Using a Psychrometer to Determine Relative Humidity** (continued)**Observations**

Data Table 2

	<i>Sample Data</i>	<i>Your Data</i>
<i>Dry-bulb reading</i>	21°C	
<i>Wet-bulb reading</i>	15°C	
<i>Difference</i>	6°C	
<i>Relative Humidity</i>	53%	

1. Which of the two thermometers measures the air temperature?

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2. What is the relative humidity in your classroom?

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**Analyze and Conclude**

1. What is the relationship between evaporation and the wet-bulb temperature?

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\_\_\_\_\_

2. Explain your answer to question 1 in terms of energy.

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3. What is the relationship between evaporation and relative humidity?

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4. Predict the difference between the dry-bulb and wet-bulb readings when the relative humidity is 100 percent. Explain your answer.

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5. Predict how the relative humidity inside your classroom compares with the relative humidity outdoors. How could you test your prediction?

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**Critical Thinking and Applications**

1. Does the air in your classroom tend to be moist, dry, or somewhere in between? Give a reason for your answer.

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2. Would you feel more comfortable in a desert where the temperature is 35°C or in a rain forest where the temperature is 35°C? Give a reason for your answer.

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3. How can you tell, without using a psychrometer, whether the air is moist or dry?

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4. Why does running a dehumidifier in your home during the summer help make you feel more comfortable?

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5. Antarctica is the coldest place on Earth. Explain why the parts of Antarctica not covered by glaciers are a frigid desert.

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