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# Build Your Own Weather Station

## Building a Psychrometer

### Background

Air is made of gas particles that are constantly moving. Warm air particles move rapidly; cold air particles move more slowly. When air is warm, the distance between the particles is greater than when air is cold.

Water can exist in all three states on this planet. It has a tendency to evaporate when left sitting for too long. In the gaseous form it is called water vapor. You can't see it in the air or as it leaves a boiling pot or tea kettle. Look at the jet of steam coming from a tea kettle. If the kettle has a whistle top, you'll notice that closest to the opening, you can't see anything. That's the water vapor! A little farther out, you see the white cloud we like to call steam. It's really condensed water vapor (sort of like a cloud).



Water vapor particles can move freely between air particles. At higher temperatures, when air particles are farther apart and moving faster, a lot of water vapor particles can fit in between. At lower temperatures, when air particles are closer together and moving slower, less water vapor particles can fit between the spaces, so they have to "band together," or condense. There's your white cloud above the tea kettle.

The amount of water vapor actually in air as opposed to how much the air is capable of holding is called relative humidity. If the weather report says, "The relative humidity is 72%," that really means that the air (at that temperature) is holding 72% of its actual capacity. The hotter it gets, the more water can fit into the spaces between air particles.

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A psychrometer or a hygrometer is used to measure relative humidity. A wet-bulb/dry-bulb hygrometer actually measures how fast air will let water evaporate into it. Evaporation is a cooling process. A wet surface covering the bulb end of a thermometer will cool as water evaporates from it into the air. The drier the air, the faster the evaporation and the cooler the wet bulb will become. The wetter the air, the slower water will evaporate into it and the wet bulb's temperature is not lowered as much.

### Materials

- 2 alcohol-filled air thermometers (they must read exactly the same temperature when placed side by side out of direct sunlight)
- clear packing tape
- cotton shoelace (the hollow type)
- 1- or 2-liter bottle (label removed)
- water (distilled is best but tap will do)
- thread
- awl
- relative humidity chart

### Procedure

Read all [Precautions](#) before beginning this activity.

1. Punch a hole in the side of the bottle about an inch from the bottom. Heating the awl will make a perfect hole. The same thing can be done with a hot nail held with tongs. Use great caution when doing this so you don't burn yourself or others. When you've made the hole, place the hot object in cold water.
2. Be sure the tips are cut off the shoestring. Cut about 2 inches of shoestring and slip it over the bulb of one of the thermometers. Carefully tie it in place with thread.
3. Cut a small piece of packing tape. Position the bulb of the shoestringed thermometer about 1/8 inch over the hole. Be sure the top of the thermometer is aligned with the top of the bottle. Tape the thermometer to the bottle. Tape the other thermometer parallel to the first one and about 1/4 inch away. Put a strip of tape around the bottle and both thermometers to make sure they don't fall off.
4. Push the shoelace through the hole. Put room temperature water in the bottle until it reaches just below the hole.
5. Wait 5 to 10 minutes and read both thermometers. There will be a difference in the two. Use the chart

below to calculate the relative humidity.

6. Keep a record of the daily humidity for a few weeks. Next to your entries, describe the way you feel on those days.
7. The dry-bulb temperature can also be used to record the air temperature!

Air Temp.	Difference between wet- and dry-bulb readings in degrees F														
(Dry Bulb)	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35
20	85	70	55	40	26	12									
25	87	74	62	49	37	25	13	1							
30	89	78	67	56	46	36	26	16	6						
35	91	81	72	63	54	45	36	29	19	10					
40	92	83	75	68	60	52	45	37	29	22					
45	93	86	78	71	64	57	51	44	38	31					
50	93	87	80	74	67	61	55	49	43	38	10				
55	94	88	82	76	70	65	59	54	49	43	19				
60	94	89	84	78	73	68	63	58	53	48	26	5			
65	95	90	85	80	75	70	66	61	56	52	31	12			
70	95	90	86	81	77	72	68	64	59	55	36	19	3		
75	96	91	86	82	78	74	70	66	62	58	40	24	9		
80	96	91	87	83	79	75	72	68	64	61	44	29	15	3	
85	96	92	88	84	80	76	73	69	66	62	46	32	20	8	
90	96	92	89	85	81	78	74	71	68	65	49	36	24	13	3
95	96	93	89	85	82	79	75	72	69	66	51	38	27	17	7
100	96	93	89	86	83	80	77	73	70	68	54	41	30	21	12
105	97	93	90	87	83	80	77	74	71	69	55	43	33	23	15
110	97	93	90	87	84	81	78	75	73	70	57	46	36	26	18
115	97	94	91	88	85	82	79	76	74	71	58	47	37	28	21

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