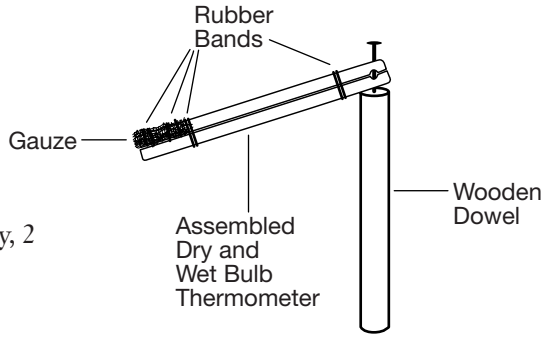
Build Your Own Sling Psychrometer

Introduction

In this activity, a sling psychrometer will be constructed and the relative amount of humidity in the air will be measured.

Concepts

- Relative humidity
- Water vapor



Materials

Beral-type pipet	Rubber bands, small, 4
Cotton gauze, 1″ × 1″	Thermometers, metal-backed, non-mercury, 2
Hammer	Wooden dowel, 6 inches, ½″ or larger
Nail with large head	

Safety Precautions

Be sure that the thermometers are securely attached to the wooden dowel before swinging. The instructor should inspect the assembled sling psychrometer prior to use. Be careful not to drop or break the thermometers. ***Wear protective eyewear.***

Assembly Procedure

1. Construct a wet-bulb thermometer by wrapping a small piece of cotton gauze around the bulb of one of the thermometers. Use two small rubber bands to secure the gauze to the wet-bulb thermometer. The other thermometer is the dry-bulb
thermometer.
2. Attach the two metal-backed thermometers together back-to-back using two small rubber bands. Place a rubber band at each end of the thermometers.
3. Slide both of the thermometers onto the nail through the hole used to hang the thermometers. Make sure the nail head is larger than the holes in the thermometer.
4. Hammer the nail carefully into the end of the wooden dowel rod. This step should be done by the teacher.

Sample Experiment

1. Use a Beral-type pipet and place a few drops of water on the gauze of the wet-bulb thermometer.
2. Place the dowel in your hand and slowly rotate the thermometers around the nail. The spinning motion will accelerate the evaporation rate of the water.
3. Spin the thermometers on the sling psychrometer for thirty seconds or until the wet-bulb thermometer drops to a point where it remains constant.
4. After the time has elapsed, immediately record the temperature of both thermometers. Determine the difference between the dry-bulb and wet-bulb thermometers. Use the Relative Humidity Table to determine the relative amount of humidity in the air.

Publication No. 10301
061616

Relative Humidity Table

Dry Bulb Temp. (°F)	Difference between dry bulb and wet bulb (measured in degrees Fahrenheit)														
	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°
64	95	90	84	79	74	70	65	60	56	51	47	43	38	34	30
66	95	90	85	80	75	71	66	61	57	53	48	44	40	36	32
68	95	90	85	80	76	71	67	62	58	54	50	46	42	38	34
70	95	90	86	81	77	72	68	64	59	55	51	48	44	40	36
72	95	91	86	82	77	73	69	65	61	57	53	49	45	42	38
74	95	91	86	82	78	74	69	65	61	58	54	50	47	43	39
76	96	91	87	82	78	74	70	66	62	59	55	51	48	44	41
78	96	91	87	83	79	75	71	67	63	60	56	53	49	46	43
80	96	91	87	83	79	75	72	68	64	61	57	54	50	47	44
82	96	92	88	84	80	76	72	69	65	61	58	55	51	48	45
84	96	92	88	84	80	76	73	69	66	62	59	56	52	49	46
86	96	92	88	84	81	77	73	70	66	63	60	57	53	50	47
88	96	92	88	85	81	77	74	70	67	64	61	57	54	51	48
90	96	92	89	85	81	78	74	71	68	65	61	58	55	52	49
92	96	92	89	85	82	78	75	72	68	65	62	59	56	53	50
94	96	93	89	85	82	79	75	72	69	66	63	60	57	54	51

Discussion

Water vapor is the gaseous, invisible, form of water in the atmosphere. It is better known as humidity. When the air in the atmosphere contains a large amount of water, the air feels very humid and when the air is relatively void of water vapor, air feels very dry. If air holds the maximum amount of moisture, dew or frost will be present and/or small droplets will begin to form as clouds. As the clouds become saturated with water droplets, they will become too dense to hold all of the droplets and they will start to fall towards the Earth's surface in the form of rain or snow. This is known as 100% humidity.

A sling psychrometer can be used to measure the relative humidity of the air. Relative humidity is the percentage of moisture air is holding compared to the maximum it can hold. When water in the air evaporates, a certain amount of heat is required to convert the air into water vapor. Therefore, a cooling effect takes place when evaporation occurs. A sling psychrometer consists of two thermometers; a dry-bulb and a wet-bulb. The dry-bulb thermometer takes the reading of the surrounding air while the wet-bulb thermometer records the amount of cooling that is required for the water to evaporate at that specific temperature. If the air is very humid, the differences between the dry-bulb and wet-bulb thermometers will not be large because there is little evaporation. However, if the air is arid or dry, a large amount of evaporation takes place (which causes a cooling effect on the wet-bulb thermometer) and the differences between the two thermometers will be great.

To use the Relative Humidity Table, first find the temperature difference between the dry- and wet-bulb thermometers. Locate this value on the Relative Humidity Table. Now use this value and the final temperature of the dry-bulb thermometer to obtain the relative humidity reading.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
- Evidence, models, and explanation
- Constancy, change, and measurement

Content Standards: Grades 5–8
- Content Standard A: Science as Inquiry
- Content Standard B: Physical Science, properties and changes of properties in matter
- Content Standard D: Earth and Space Science, structure of the Earth system
- Content Standard E: Science and Technology

Content Standards: Grades 9–12

Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter
Content Standard D: Earth and Space Science, geochemical cycles
Content Standard E: Science and Technology

Reference

Bonnet, R. L.; Keen, G. D. *Earth Science—49 Science Fair Projects;* TAB Books, USA, 1990; pp 124–126.

Materials for *Build Your Own Sling Psychrometer* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP5406	Metal-Backed Thermometer

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.