Build Your Own Weather Station

In this exploration, students will create a weather station by building a psychrometer in order to measure the relative humidity of their climate, and record their observations of changes in the daily humidity over time. In addition, students will compare their observations with a relative humidity chart, and hypothesize why warmer air is capable of holding more moisture than cool air.

Driving Questions

- How does the uneven heating of Earth's surface cause changes in humidity?

Material

- Two air thermometers (that read the same temperature when placed side by side out of direct sunlight)
- Clear packing tape
- Cotton shoelace (the hollow type)
- One- or two-liter bottle (label removed)
- Water (distilled is best but tap will do)
- Thread
- Awl or nail
- Relative humidity chart
- Student copies of:
    - Relative Humidity Chart
    - Weather Station Instructions (see Step 1 to decide how many copies)
- Teacher Guide

Key Vocabulary

- Humidity
- Weather
- Psychrometer

Engage - Class Brainstorm

1. Write the question below on the board. Ask the class to discuss the question and and share responses as a group. Jot their thoughts down on chart paper or on the board:

    Why does it feel hotter on days with high humidity than on days with low humidity?

Explore - Design Procedure

1. Decide how you want to run the simulation. You can put students in small groups of 3-4 and provide each with a set of psychrometer materials and 1 page of Simulation Instructions, ***OR*** you can do the demonstration yourself for the whole class and provide each individual student a copy of the Simulation Instructions.

2. Conduct the Psychrometer Simulation first, and use the discussion questions included in the instructions to check for student understanding around the concept of humidity indicating changes in the amount of water vapor in the atmosphere.

Explain - Daily Temperature Examination

1. Provide each student with a copy of the Relative Humidity Chart, and Daily Temperature Sheet. Review the task as explained on the Psychrometer Simulation Instructions.

2. Have students fill out the table on the Daily Temperature Sheet, using the Relative Humidity Chart to support their inferences.

Elaborate - Student Analysis Sheets

1. Based on the table they filled out, give students time to finish the questions on the Analysis Sheet to explain their responses.

2. Use student responses to guide a whole class discussion about their results.

Evaluate

1. Use student responses on Analysis Sheets to gauge student understanding of humidity and the role of water vapor in regulating the Earth's climate.

Psychrometer Simulation - Instructions

Meteorologists study weather processes, solar radiation and its effects. To monitor the weather, meteorologists use specialized instruments that measure rainfall, wind speed and direction, humidity, and atmospheric pressure. In this procedure, we will be designing our own **psychrometer** to measure the amount of water vapor in the atmosphere known as relative humidity.

Humidity is measured by the amount of water vapor that can saturate the air at a given temperature. **Relative humidity** is the **ratio** of the amount of moisture in the air to the maximum amount of moisture the air *could* have. A relative humidity of 50% at a given air temperature means the atmosphere is “half-full” of water vapor. In this exploration we will use our personally designed instrument to collect and analyze data on the amount of water vapor in the atmosphere.

Procedures

Step 1 - Poke a hole in the side of the bottle about an inch from the bottom. Heating the awl will make a perfect hole. Use caution when doing this so you don't burn yourself or others. When you've made the hole, cool the hot object in cold water.

Step 2 - Cut the tips off the shoestring. Cut about two inches of shoestring and slip it over the bulb of one of the thermometers. Carefully tie it in place with thread.

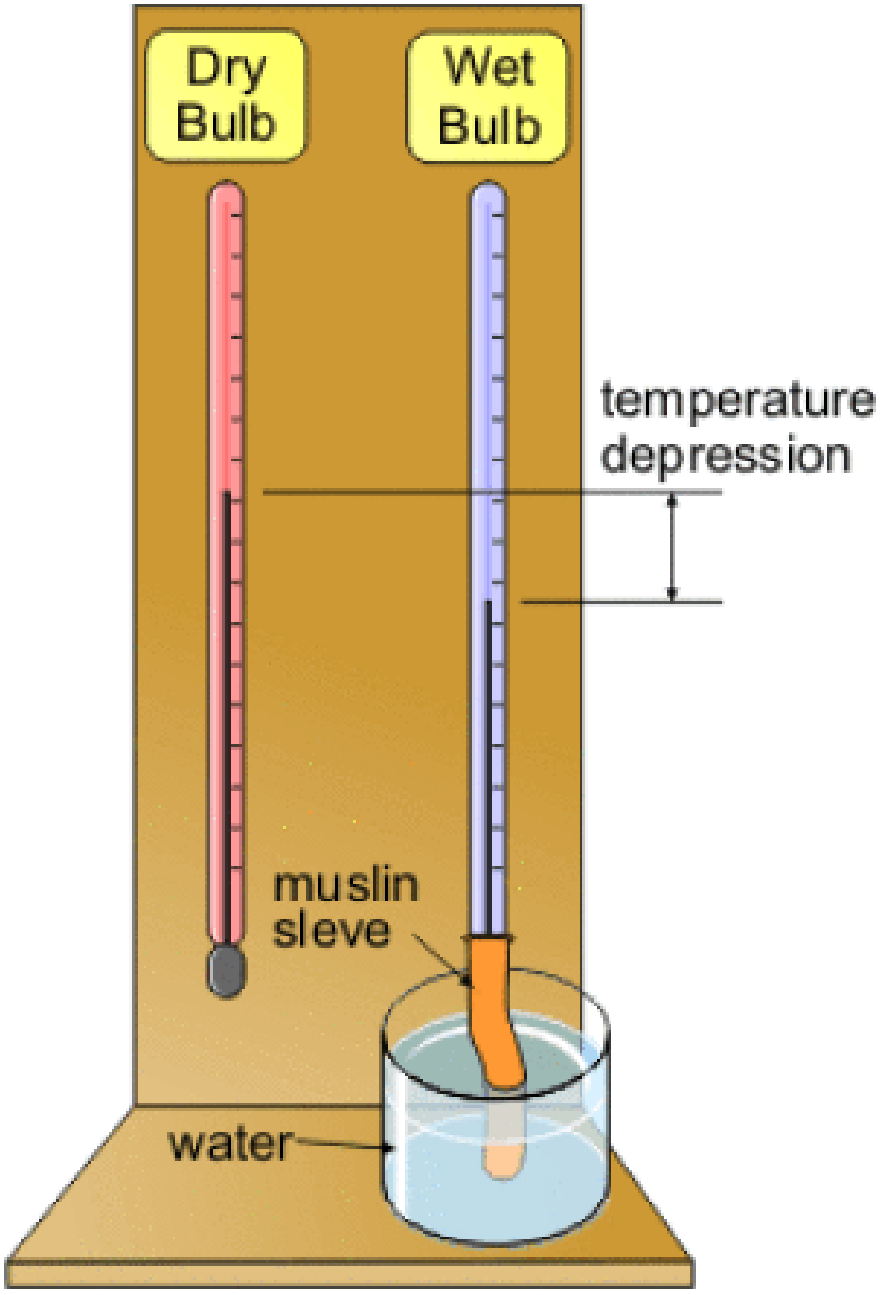
Step 3 - Cut a small piece of packing tape. Position the bulb of the shoe-stringed thermometer about 1/8 inch over the hole. Be sure the top of the thermometer is aligned with the top of the bottle. Tape the thermometer to the bottle. Tape the other thermometer parallel to the first one and about 1/4 inch away. Put a strip of tape around the bottle and both thermometers to make sure they don't fall off.

Step 4 - Push the shoelace through the hole. Put room-temperature water in the bottle until it reaches just below the hole.

Step 5 - Wait 5 to 10 minutes, and read both the dry and wet thermometers. Record the temperature difference of both thermometers in the Student Analysis table. Use the Relative Humidity Chart to calculate the relative humidity.

Step 6 - Keep a record of the daily humidity for a few weeks. Next to your entries, describe the way you feel on those days.

Psychrometer Visualization - Teacher Copy



Daily Temperature Sheet

Why does it feel hotter on days when there is more water vapor in the atmosphere?
Hypothesis: _____ _____ _____ _____ _____ _____

Day 1		
Dry Thermometer (F°)	**Wet Thermometer (F°)**	**~Relative Humidity (%)**

1. How does the atmosphere feel? How do you feel?

_____
_____
_____
_____

Day 2		
Dry Thermometer (F°)	**Wet Thermometer (F°)**	**~Relative Humidity (%)**

2. How does the atmosphere feel? How do you feel?

_____
_____
_____
_____

Daily Temperature Sheet (Continued..)

Day 3		
Dry Thermometer (F°)	**Wet Thermometer (F°)**	**~Relative Humidity (%)**

3. How does the atmosphere feel? How do you feel?

_____

_____

_____

_____

Day 4		
Dry Thermometer (F°)	**Wet Thermometer (F°)**	**~Relative Humidity (%)**

4. How does the atmosphere feel? How do you feel?

_____

_____

_____

_____

Day 5		
Dry Thermometer (F°)	**Wet Thermometer (F°)**	**~Relative Humidity (%)**

5. How does the atmosphere feel? How do you feel?

_____

_____

_____

_____

Student Analysis Sheet

1. What do you notice about the relative humidity when the dry-bulb temperature and the wet-bulb temperature are the same (0 difference)?

2. What do you notice about the relative humidity as temperatures increase when the dry-bulb temperature and the wet-bulb temperature differ by 7 degrees?

3. What do you notice about the relative humidity as temperatures increase when the dry-bulb temperature and the wet-bulb temperature differ by 14 degrees?

4. Why do you think there is a difference in the relative humidity between higher temperatures and lower temperatures? In other words, as air temperature increases, why do you think the air can hold more water? Explain your reasoning.

Relative Humidity Chart (%)

Dry-bulb Temp (F°)	Difference Between Dry-bulb and Wet-bulb Temperatures (F°)														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
40°	*100*	*92*	*84*	*76*	*68*	*62*	*54*	*46*	*38*	*32*	*24*	*16*	*8%*	*4%*	*0%*
45°	*100*	*93*	*86*	*78*	*71*	*64*	*57*	*51*	*44*	*38*	*31*	*25*	*18*	*12*	*6%*
50°	*100*	*93*	*87*	*80*	*74*	*67*	*61*	*55*	*49*	*43*	*38*	*32*	*27*	*21*	*16*
55°	*100*	*94*	*88*	*82*	*76*	*70*	*65*	*59*	*54*	*49*	*43*	*38*	*33*	*28*	*23*
60°	*100*	*94*	*89*	*83*	*78*	*73*	*68*	*63*	*58*	*53*	*48*	*43*	*39*	*34*	*30*
65°	*100*	*95*	*90*	*85*	*80*	*75*	*70*	*66*	*61*	*56*	*52*	*48*	*44*	*39*	*35*
70°	*100*	*95*	*90*	*86*	*81*	*77*	*72*	*68*	*64*	*59*	*56*	*51*	*48*	*44*	*40*
75°	*100*	*96*	*91*	*86*	*82*	*78*	*74*	*70*	*66*	*62*	*58*	*54*	*51*	*47*	*44*
80°	*100*	*96*	*91*	*87*	*83*	*79*	*75*	*72*	*68*	*64*	*61*	*57*	*54*	*50*	*47*
85°	*100*	*96*	*92*	*88*	*84*	*80*	*77*	*73*	*70*	*66*	*63*	*59*	*56*	*53*	*50*
90°	*100*	*96*	*92*	*89*	*86*	*81*	*78*	*74*	*71*	*68*	*65*	*61*	*58*	*55*	*52*
95°	*100*	*96*	*93*	*89*	*86*	*82*	*79*	*76*	*72*	*69*	*66*	*63*	*60*	*57*	*54*
100°	*100*	*97*	*93*	*89*	*86*	*83*	*80*	*77*	*73*	*71*	*68*	*65*	*62*	*59*	*56*
105°	*100*	*97*	*93*	*90*	*87*	*84*	*81*	*78*	*75*	*72*	*69*	*66*	*64*	*61*	*58*