WET AIR

TOPIC:

Measuring Humidity

INTRODUCTION:

On summer days we naturally feel warm or hot. But on some days it seems much hotter than others, even though the actual temperature is the same as previous days. This is because of humidity—the amount of moisture in the air. The more humid the air, the less sweat can evaporate from our body surface. Because the evaporation of sweat keeps us cool on hot days, conditions of high humidity make us feel hot, sweaty, and uncomfortable. In this experiment you will measure relative humidity—that is, the percentage of water vapor in the air relative to air totally saturated (100%) with water vapor. You will do this using wet and dry thermometers, which together make an instrument called a hygrometer.

TIME NEEDED:

20 minutes to construct the hygrometer
5 minutes each day for one week
1 hour to analyze results

MATERIALS:

2 identical thermometers (-10–110°C)
ring stand with two clamps
material to act as wick (*e.g.*, hollow shoelace, small piece of cheesecloth or muslin)
small rubber band
small glass jar (such as empty baby food or jelly jar)
calculator
water jug

Safety Precautions

Please click on above link to view our safety guidelines.

PROCEDURE:

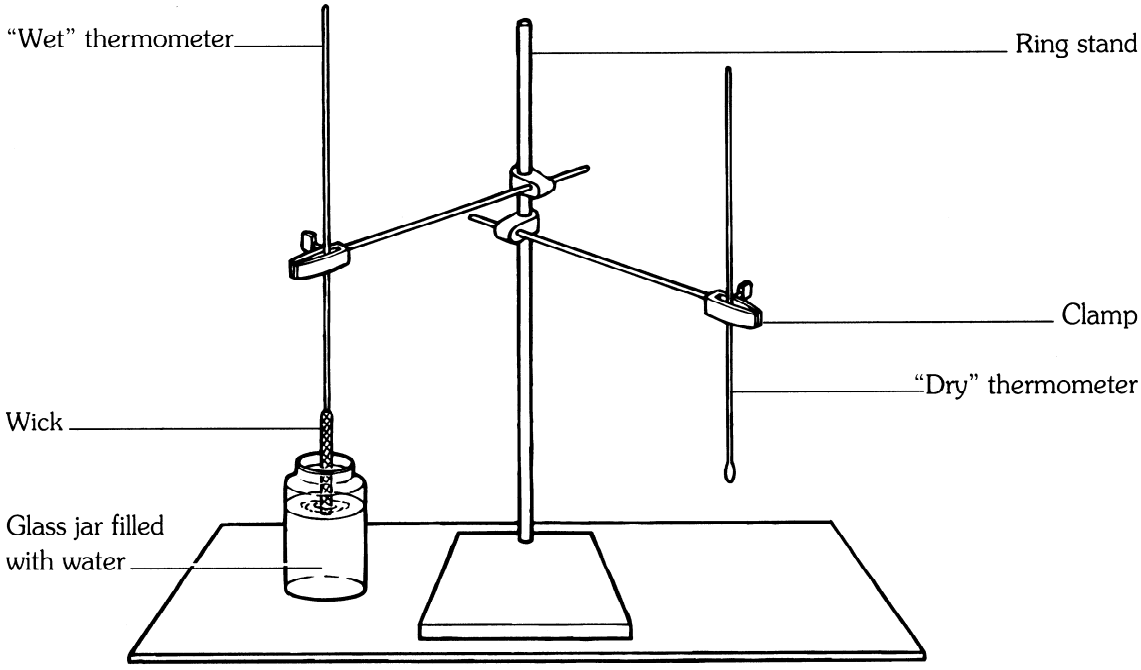
Assembling the hygrometer

1. Attach the two clamps to the ring stand at 90° angles to each other, approximately 45 cm above the table or bench.
2. Attach a wick of hollow shoelace, or a rolled-up piece of cheesecloth or muslin, approximately 10 cm long, over the bulb of one of the thermometers. Hold it in place by looping the small rubber band several times around it and the bulb of the thermometer.
3. CAREFULLY position this thermometer inside the clamp (bulb end down) and GENTLY tighten the clamp until the thermometer is held firmly in place.
4. Repeat step 3 with the other thermometer and the other clamp.
5. Put the glass jar below the thermometer with the wick. Adjust the height of this thermometer so that it goes inside the jar to the point where the wick touches the bottom of the jar.
6. Fill the glass jar with water from the faucet. At the same time, make sure the entire wick is wet.
7. Both thermometers, one with a wick inside a jar of water and one with no wick, will act as the hygrometer. Leave the hygrometer in place until the following day.

Measuring humidity

8. At noon, or early afternoon, of the following day, read the temperature of the thermometer

without the wick. Record this in the column marked "Dry" in the Data Table. Read the temperature of the thermometer with the wick. Record this in the column marked "Wet."



9. At the same time, record your prediction of humidity level (*e.g.*, "dry," "slightly humid," or "very humid") in the Data Table.
10. Repeat steps 8 and 9 at the same time each day for the following six days. Check that the glass jar remains filled with water.

DATA TABLE

Day	Prediction	Dry °C	Wet °C	Difference °C	Relative humidity
1					
2					
3					
4					
5					
6					
7					

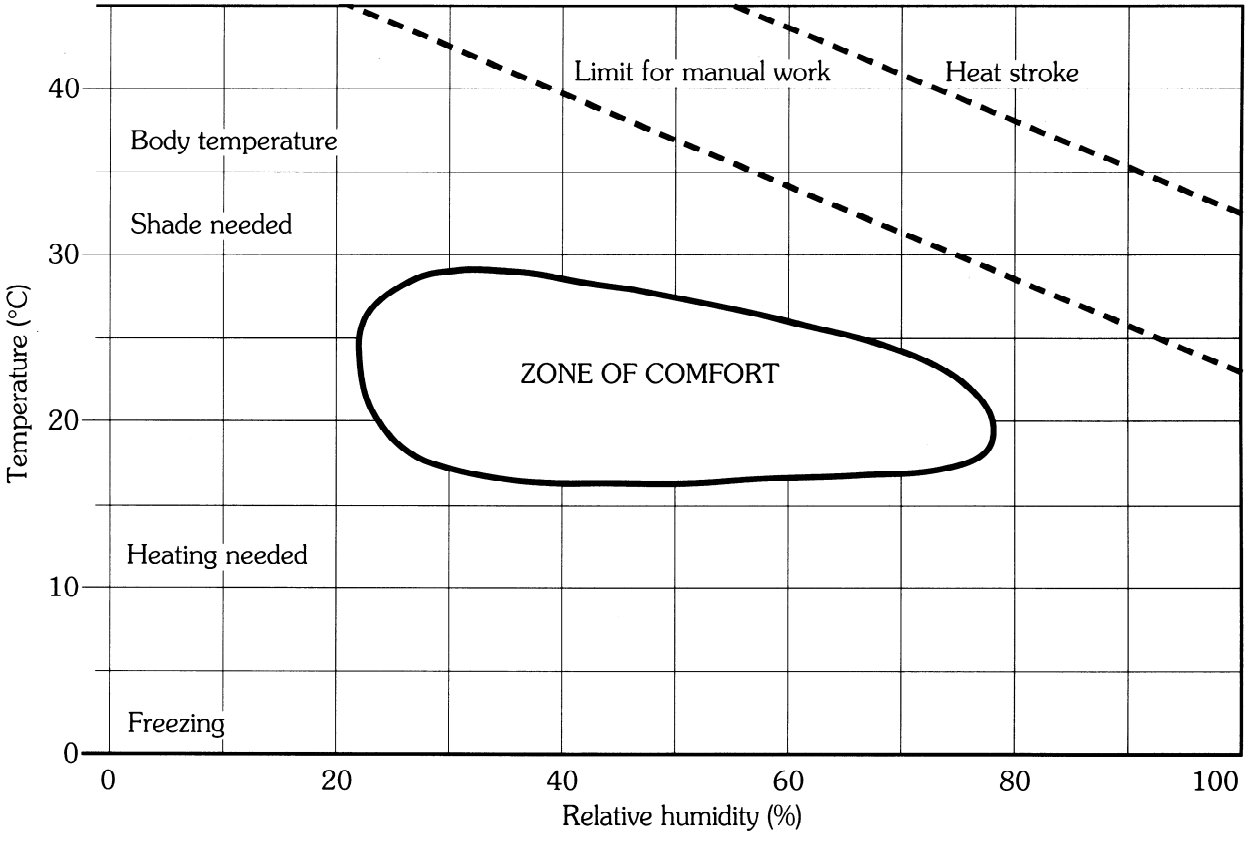
ANALYSIS:

1. Which are higher—the temperatures recorded by the wet thermometer or the dry?
2. Explain your answer to 1. (Clue: when sweat evaporates from the skin, it cools the body down.)
3. Calculate the difference between the temperatures recorded by the wet and dry thermometers. Record these values in the column marked "Difference."
4. Now determine the relative humidity for each day of the experiment, using the table of values on the following page.

a) Read down the table until you find the temperature recorded by the dry thermometer on that day.

b) Then read across the top until you reach the line indicating the difference you recorded between the wet and the dry thermometers. The percentage in that box will be the relative humidity for that day.

5. Record this figure in the Data Table in the column marked "Relative humidity." Repeat this step for the other six days.
6. Did your predictions match the relative humidity for each day? The higher the relative humidity, the more uncomfortable you should feel, depending on the temperature.
7. Look at the graph below. Plot the temperature (recorded by the dry thermometer) against the relative humidity for the seven days. Label each plot mark with the number of the day.



8. Did any of the days' recordings fall into the "zone of comfort"? Did these days coincide with favorable predictions on your part?

OUR FINDINGS:

Click on above link to see what we found.

RELATIVE HUMIDITY TABLE

DIFFERENCE BETWEEN WET AND DRY BULB READINGS (°C)

DRY BULB TEMPERATURE (°C)

	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18
10	94	88	82	77	71	65	60	54	49	44	39	34	29	24	19	14	9	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	94	88	83	77	72	66	61	56	51	46	41	36	31	26	22	17	13	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	94	89	83	78	73	68	63	57	53	48	43	38	34	29	24	20	16	11	7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	95	89	84	79	74	69	64	59	54	49	45	40	36	31	27	23	18	14	10	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	95	90	84	79	74	70	65	60	56	51	47	42	38	33	29	25	21	17	14	9	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	95	90	85	80	75	71	66	61	57	52	48	44	40	36	31	27	24	20	16	12	8	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-
16	95	90	85	81	76	71	67	62	58	54	50	46	41	37	34	30	26	22	18	15	11	8	4	1	-	-	-	-	-	-	-	-	-	-	-	-
17	95	90	86	81	77	72	68	64	59	55	51	47	43	39	35	32	28	24	21	17	14	10	7	4	1	-	-	-	-	-	-	-	-	-	-	-
18	95	91	86	82	77	73	69	65	60	56	52	49	45	41	37	34	30	27	23	20	16	13	10	7	4	-	-	-	-	-	-	-	-	-	-	-
19	95	91	86	82	78	74	70	65	61	58	54	50	46	43	39	35	32	29	25	22	19	15	12	9	7	3	-	-	-	-	-	-	-	-	-	-
20	96	91	87	83	78	74	70	66	62	59	55	51	48	44	41	37	34	30	27	24	21	18	15	12	9	6	3	-	-	-	-	-	-	-	-	-
21	96	91	87	83	79	75	71	67	63	60	56	52	49	46	42	39	35	32	29	26	23	20	17	14	11	8	6	3	-	-	-	-	-	-	-	-
22	96	92	87	83	79	76	72	68	64	61	57	54	50	47	44	40	37	34	31	28	25	22	19	16	13	11	8	5	3	-	-	-	-	-	-	-
23	96	92	88	84	80	76	72	69	65	62	58	55	51	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5	3	-	-	-	-	-	-
24	96	92	88	84	80	77	73	69	66	62	59	56	52	49	46	43	40	37	34	31	28	26	23	21	18	15	12	10	7	5	3	-	-	-	-	-
25	96	92	88	84	81	77	74	70	67	63	60	57	54	50	47	44	41	38	36	33	30	27	25	22	19	17	14	12	10	7	5	3	-	-	-	-
26	96	92	88	85	81	78	74	71	67	64	61	58	55	51	49	46	43	40	37	34	32	29	26	24	21	19	16	14	12	9	7	5	3	-	-	-
27	96	92	89	85	82	78	75	71	68	65	62	59	55	52	50	47	44	41	38	36	33	30	28	25	23	21	18	16	14	11	9	7	5	3	-	-
28	96	93	89	85	82	79	75	72	69	65	62	59	56	53	51	48	45	42	40	37	34	32	29	27	25	22	20	18	15	13	11	9	7	5	3	1
29	96	93	89	86	82	79	76	72	69	66	63	60	57	54	52	49	46	43	41	38	36	33	31	28	26	24	21	19	17	15	13	11	9	7	5	3
30	96	93	89	86	83	79	76	73	70	67	64	61	58	55	52	50	47	44	42	39	37	34	32	30	27	25	23	21	19	17	15	13	11	9	7	5
31	96	93	90	86	83	80	77	73	70	67	64	62	59	56	53	51	48	45	43	41	38	36	33	31	29	27	24	22	20	18	16	14	12	10	8	7
32	97	93	90	86	83	80	77	74	71	68	65	62	60	57	54	52	49	46	44	42	39	37	35	32	30	28	26	24	22	20	18	16	14	12	10	8
33	97	93	90	87	83	80	77	74	71	69	66	63	60	58	55	52	50	47	45	43	40	38	36	34	31	29	27	25	23	21	19	17	15	14	12	10
34	97	93	90	87	84	81	78	75	72	69	66	64	61	58	56	53	51	48	46	44	41	39	37	35	33	30	28	26	24	23	21	19	17	15	13	12
35	97	93	90	87	84	81	78	75	72	70	67	64	61	59	56	54	51	49	47	44	42	40	38	36	34	32	30	28	26	24	22	20	18	17	15	13
36	97	94	90	87	84	81	78	76	73	70	67	65	62	60	57	55	52	50	48	45	43	41	39	37	35	33	31	29	27	25	23	21	20	18	16	15
37	97	94	91	87	85	82	79	76	73	70	68	65	63	60	58	55	53	51	48	46	44	42	40	38	36	34	32	30	28	26	24	23	21	19	18	16
38	97	94	91	88	85	82	79	76	74	71	68	66	63	61	58	56	54	51	49	47	45	43	41	39	37	35	33	31	29	27	26	24	22	20	19	17
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40	97	94	91	88	85	82	80	77	74	72	69	67	64	62	60	57	55	53	51	48	46	44	42	40	38	37	35	33	31	29	28	26	24	23	21	20

Our Findings

II. WEATHER PROJECTS

2.002 Wet Air

1. Temperatures recorded by the dry thermometer are higher.
2. Water evaporated from the material surrounding the wet bulb thermometer. For evaporation to take place, heat was drawn from the bulb of the thermometer in order to give the water molecules sufficient kinetic energy to escape. This removal of heat from the bulb cooled the mercury contained within it, causing it to contract so that the length of the mercury column in the thermometer decreased. The wet bulb thermometer, therefore, recorded a lower temperature.
3. Results will vary. The difference in temperature between the two thermometers depends on the humidity. The more humid it is, the less water evaporation takes place from the wet bulb thermometer. This is because evaporation depends on the amount of water vapor in the air; the rate of evaporation is much slower when the air is saturated with water vapor.
4. Results will vary.
5. Results will vary.
6. Results will vary.
7. Results will vary.
8. Results will vary.

SPECIAL SAFETY NOTE TO EXPERIMENTERS

Each experiment includes a short list of special safety precautions that are relevant to that particular project. However, these do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely necessary that you read, copy, and remain mindful of the General Safety Precautions that follow this note.

Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following basic safety guidelines the *entire* time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note—The book assumes that you will read the safety precautions that follow, as well as those at the head of each experiment you are preparing to perform, and that you will *remember* them. Except in rare instances, these precautions will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE does not mean that you should be careless when simmering water or stripping an electrical wire. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it.

If you ever have a question about whether a procedure or material is dangerous, wait until you find out for sure that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARE:
—Clear all surfaces before beginning experiments
—Read the instructions before you start
—Know the hazards of the experiments and anticipate dangers

PROTECT YOURSELF:
—Follow the directions step-by-step; do only one experiment at a time
—Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eye wash, and first-aid kit
—Make sure there is adequate ventilation
—Do not horseplay
—Wear an apron and goggles
—Do not wear contact lenses, open shoes, loose clothing, or loose hair
—Keep floor and work space neat, clean, and dry
—Clean up spills immediately
—Never eat, drink, or smoke in laboratory or work space
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USE EQUIPMENT WITH CARE:
—Set up apparatus far from the edge of the desk
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs
—Don't use your mouth to pipette; use a suction bulb
—Clean glassware before and after use
—Check glassware for scratches, cracks, and sharp edges
—Clean up broken glassware immediately
—Do not use reflected sunlight to illuminate your microscope
—Do not touch metal conductors
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders

USING CHEMICALS:
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly

HEATING SUBSTANCES:
—Use goggles, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—Turn off hot plates, bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Have fire extinguisher on hand

GOING ON FIELD TRIPS:
—Do not go on a field trip by yourself
—Tell a responsible adult where you are going and maintain that route
—Know the area and its potential hazards, such as poison plants, deep water, and rapids
—Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold)
—Bring along a first-aid kit
—Do not drink water or eat plants found in the wild
—Use the buddy system; do not do outdoor experiments alone

FINISHING UP:
—Thoroughly clean your work area and glassware
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residue and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws

BE SAFETY CONSCIOUS AT ALL TIMES