Rural Training Center – Thailand (RTC-TH)

REEEPP

FOCUS

An innovative, non-traditional community-based environmental education program integrating math, science, geography, English language, and technology lessons for environmental stewardship using interactive experiential learning in outdoor settings at Ban Na Fa Elementary School, Nan Province, Thailand.

Weather Observing: Measuring Relative Humidity

This lesson was originally created when the RTC-TH was a program of ESSI (Earth Systems Science, Inc.), a California educational non-profit organization co-founded by Gregory Lee. In 2006, the RTC-TH was co-founded by Gregory and Saifon Lee as a separate organization.

This is an English Language Training module of

REEEPP

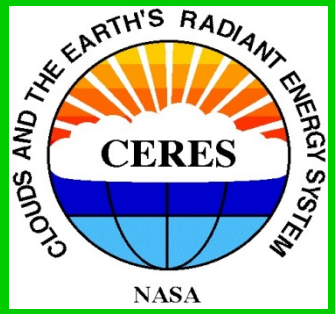
Rural Environmental Education Enhancement Pilot Program

presented by

The Rural Training Center-Thailand

E-mail: rtc2k5@gmail.com

www.neighborhoodlink.com/org/rtcth



The RTC-TH developed this lesson as part of the NASA CERES S'COOL Project component of REEPP

Relative Humidity

is the amount of ***moisture*** in the ***air*** compared to how much moisture could be in the air IF the air was holding all the moisture it could hold.

Moisture is another word for water.

It can be a liquid, solid, or a gas.

Water

Ice

Vapor

Water vapor is a gas.

Water vapor is moisture in the air.
It can be used to make clouds.

A gas has no shape,

A gas takes the shape of the container that holds it.

and you cannot see a gas.

Air is a gas.

The moisture forming on this container came from the water vapor in the air.

Measuring Relative Humidity

You must have:

- A hygrometer
- A Relative Humidity Chart

A hygrometer

is a tool to measure relative humidity

Many English words in science come from Latin or Greek language.

hygro = water

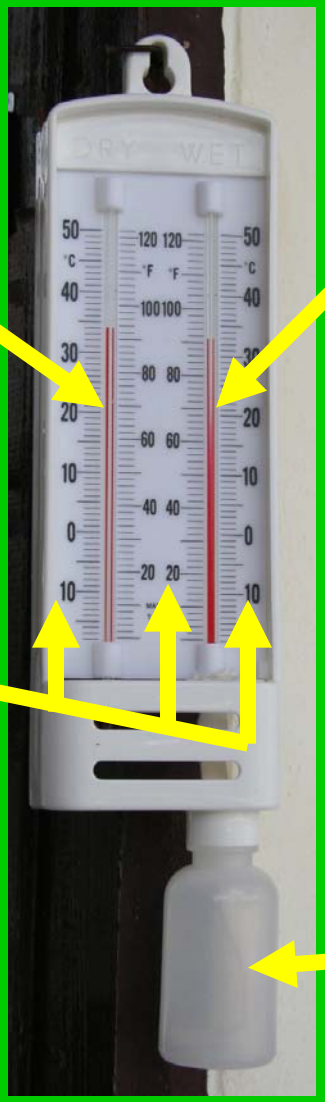
meter = to measure

A hygrometer is a tool to measure water in the air.

The Parts of a Hygrometer

Dry Bulb Thermometer

Wet Bulb Thermometer



Temperature Scales

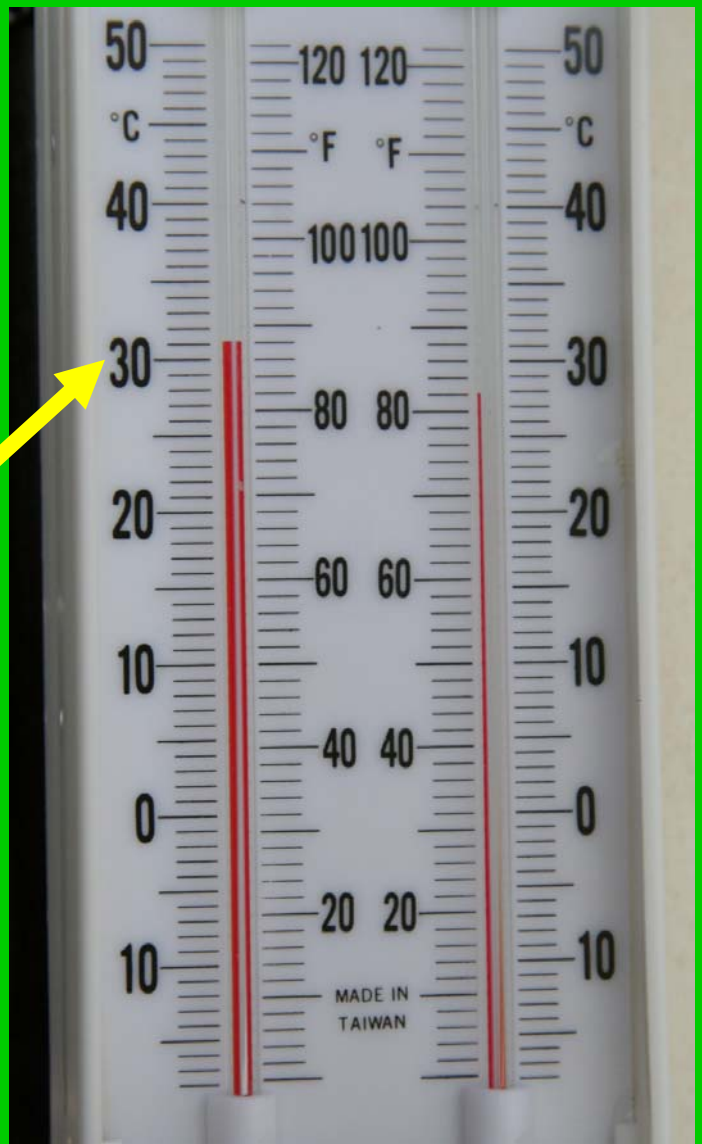
Water Bottle

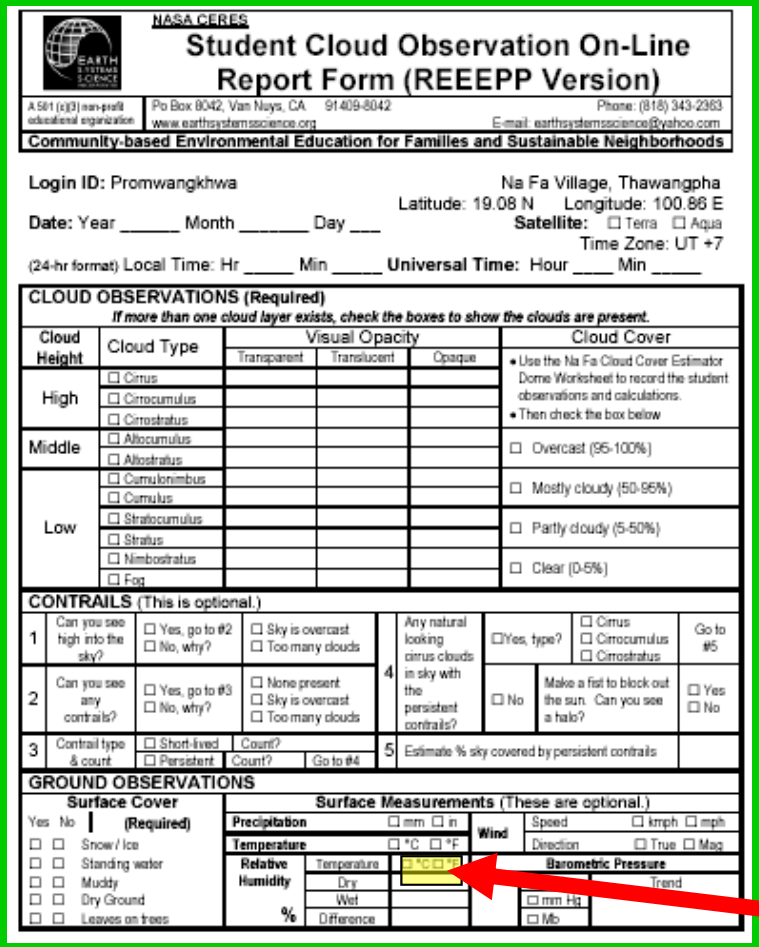
Taking the Measurements

Step 1:

Read and write down the dry bulb temperature.

(31ºC)





NASA CERES

Student Cloud Observation On-Line Report Form (REEEPP Version)

A 501 (c)(3) non-profit educational organization

Po Box 8042, Van Nuys, CA 91409-8042 Phone: (818) 343-2363
www.earthsystemsscience.org E-mail: earthsystemsscience@yahoo.com

Community-based Environmental Education for Families and Sustainable Neighborhoods

Login ID: Promwangkhwa — Na Fa Village, Thawangpha
Latitude: 19.08 N Longitude: 100.86 E
Date: Year _____ Month _____ Day ___ **Satellite:** ☐ Terra ☐ Aqua
Time Zone: UT +7
(24-hr format) Local Time: Hr _____ Min _____ **Universal Time:** Hour ____ Min _____

CLOUD OBSERVATIONS (Required)

If more than one cloud layer exists, check the boxes to show the clouds are present.

Cloud Height	Cloud Type	Visual Opacity: Transparent	Translucent	Opaque
High	☐ Cirrus			
	☐ Cirrocumulus			
	☐ Cirrostratus			
Middle	☐ Altocumulus			
	☐ Altostratus			
Low	☐ Cumulonimbus			
	☐ Cumulus			
	☐ Stratocumulus			
	☐ Stratus			
	☐ Nimbostratus			
	☐ Fog			

Cloud Cover

- Use the Na Fa Cloud Cover Estimator Dome Worksheet to record the student observations and calculations.
- Then check the box below

☐ Overcast (95-100%)
☐ Mostly cloudy (50-95%)
☐ Partly cloudy (5-50%)
☐ Clear (0-5%)

CONTRAILS (This is optional.)

1	Can you see high into the sky?	☐ Yes, go to #2 ☐ No, why?	☐ Sky is overcast ☐ Too many clouds	4	Any natural looking cirrus clouds in sky with the persistent contrails?	☐ Yes, type?	☐ Cirrus ☐ Cirrocumulus ☐ Cirrostratus	Go to #5
2	Can you see any contrails?	☐ Yes, go to #3 ☐ No, why?	☐ None present ☐ Sky is overcast ☐ Too many clouds			☐ No	Make a fist to block out the sun. Can you see a halo?	☐ Yes ☐ No
3	Contrail type & count	☐ Short-lived ☐ Persistent	Count? Count? Go to #4	5	Estimate % sky covered by persistent contrails			

GROUND OBSERVATIONS

Surface Cover

Yes	No	(Required)
☐	☐	Snow / Ice
☐	☐	Standing water
☐	☐	Muddy
☐	☐	Dry Ground
☐	☐	Leaves on trees

Surface Measurements (These are optional.)

Precipitation ☐ mm ☐ in
Temperature ☐ °C ☐ °F
Relative Humidity: Temperature ☐ °C ☐ °F; Dry; Wet; Difference; %
Wind: Speed ☐ kmph ☐ mph; Direction ☐ True ☐ Mag
Barometric Pressure: ☐ mm Hg ☐ Mb; Trend

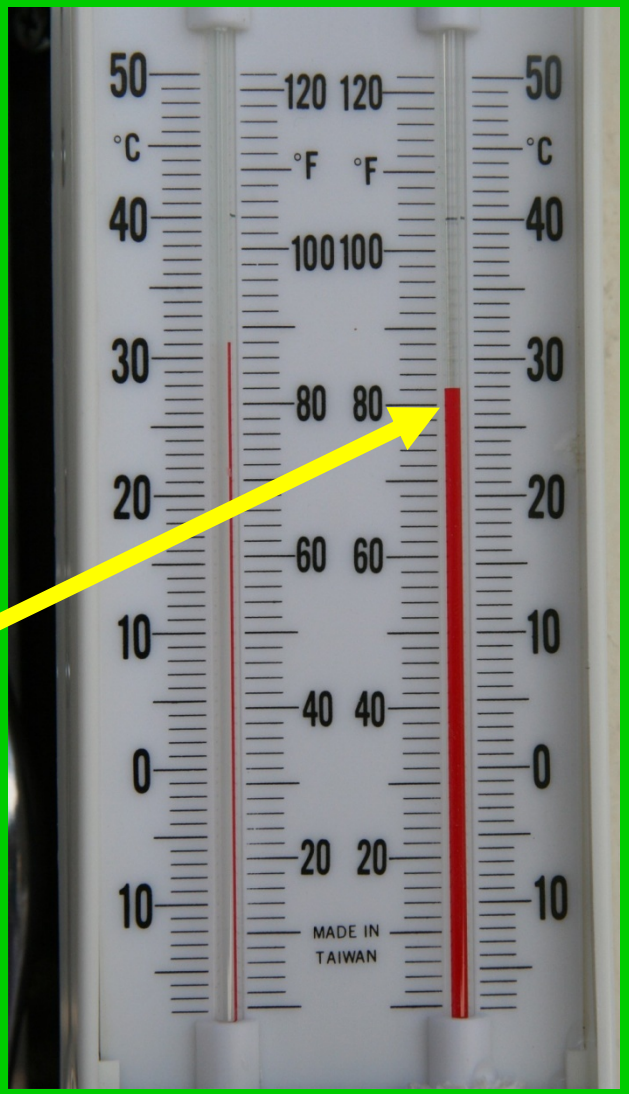
Report the Dry Bulb Temperature on this part of the form

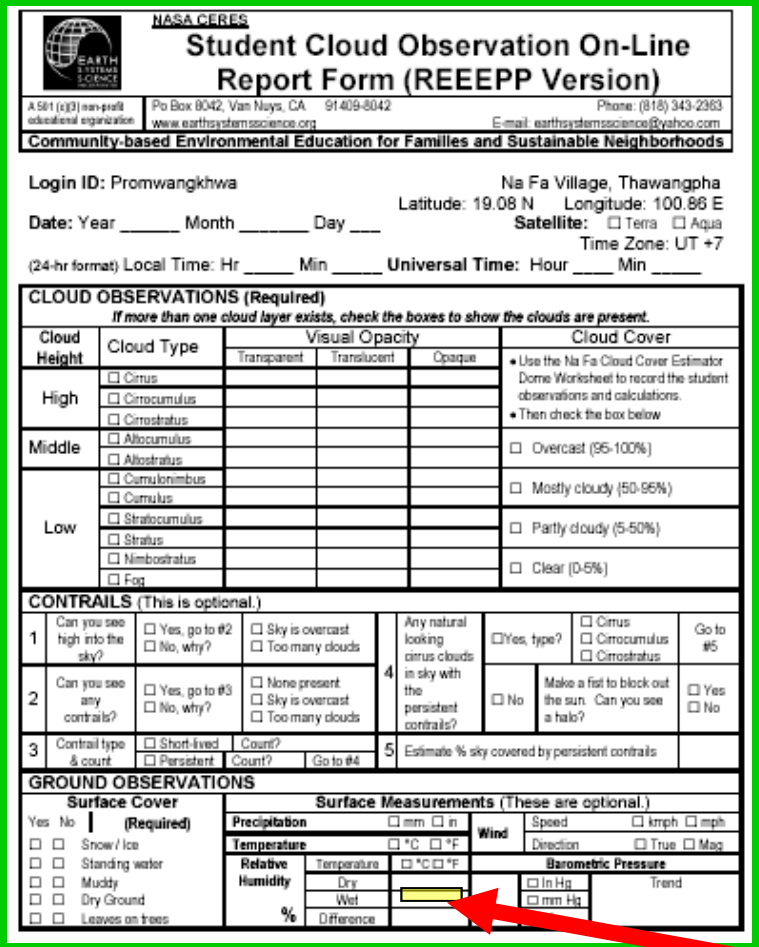
Taking the Measurements

Step 2:

Read and write down the wet bulb temperature.

(28ºC)





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	☐ Stratocumulus			
	☐ Stratus			
	☐ Nimbostratus			
	☐ Fog			

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3	Contrail type & count	☐ Short-lived ☐ Persistent	Count? Count?	Go to #4	5	Estimate % sky covered by persistent contrails		

GROUND OBSERVATIONS

Surface Cover

Yes	No	(Required)
☐	☐	Snow / Ice
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☐	☐	Muddy
☐	☐	Dry Ground
☐	☐	Leaves on trees

Surface Measurements (These are optional.)

Precipitation ☐ mm ☐ in

Temperature ☐ °C ☐ °F

Wind Speed ☐ kmph ☐ mph

Direction ☐ True ☐ Mag

Relative Humidity %

	Temperature ☐ °C ☐ °F
Dry	
Wet	
Difference	

Barometric Pressure

☐ In Hg ☐ mm Hg

Trend

Report the Wet Bulb Temperature on this part of the form

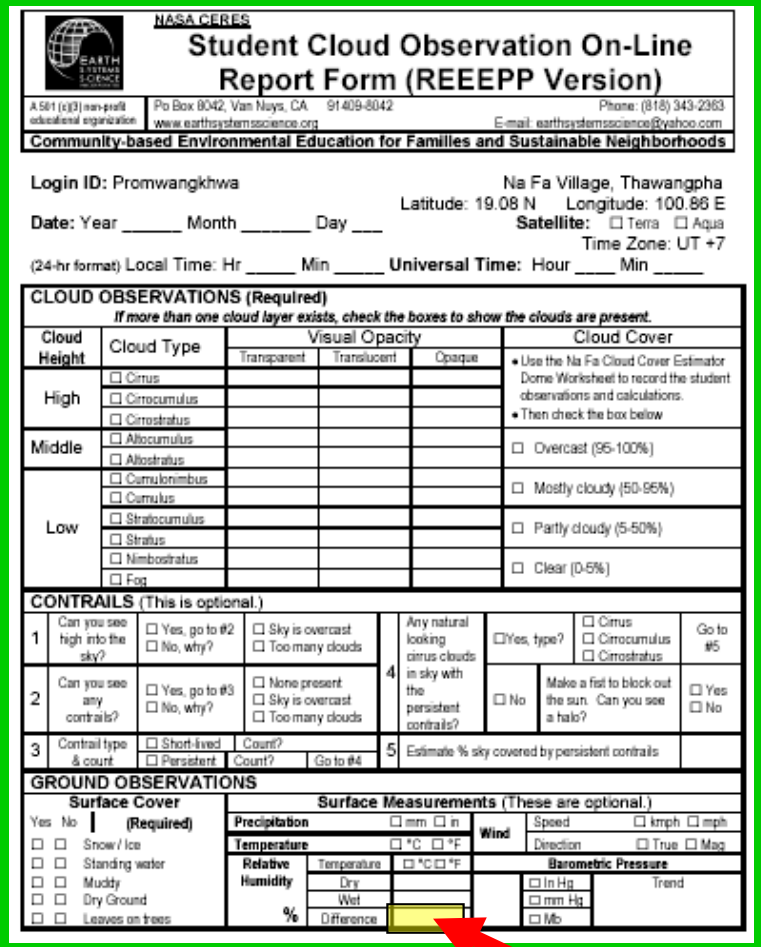
Do some arithmetic.

Step 3: Subtract the wet bulb temperature from the dry bulb temperature. Write it down

31ºC Dry

-28ºC Wet

3ºC Difference



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3	Contrail type & count	☐ Short-lived ☐ Persistent	Count? Count?	5	Estimate % sky covered by persistent contrails			

Go to #4

GROUND OBSERVATIONS

Surface Cover

Yes	No	(Required)
☐	☐	Snow / Ice
☐	☐	Standing water
☐	☐	Muddy
☐	☐	Dry Ground
☐	☐	Leaves on trees

Surface Measurements (These are optional.)

Precipitation ☐ mm ☐ in

Temperature ☐ °C ☐ °F

Relative Humidity %

Temperature	☐ °C ☐ °F
Dry	
Wet	
Difference	

Wind Speed ☐ kmph ☐ mph

Direction ☐ True ☐ Mag

Barometric Pressure

☐ In Hg ☐ mm Hg ☐ Mb

Trend

Report the difference between the Dry and Wet Bulb Temperatures on this part of the form

Relative Humidity Chart

To use this chart, you need to know:

- the dry bulb temperature (air temperature)
- the difference between the dry and the wet bulb temperatures

Using the Chart

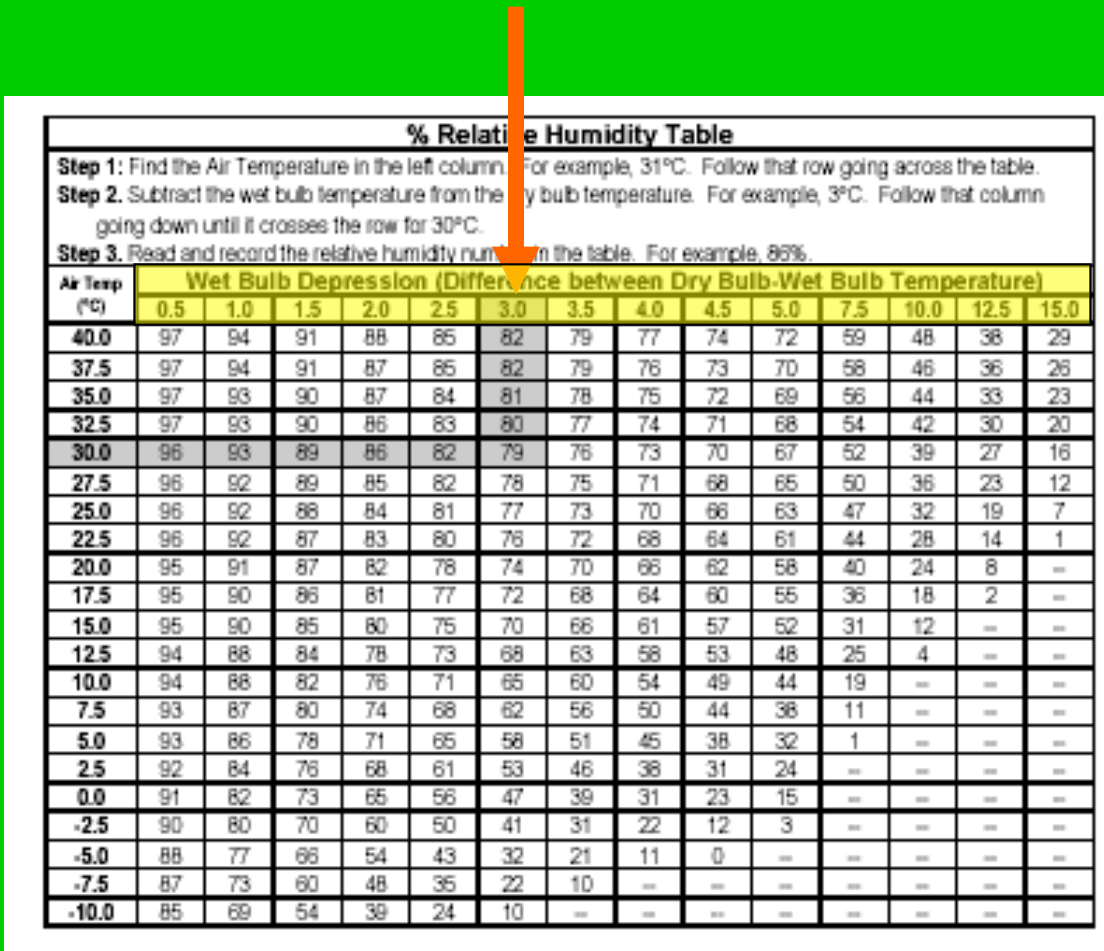
Step 1: Find the dry bulb temperature in the left column. (31ºC)

% Relative Humidity Table

Step 1: Find the Air Temperature in the left column. For example, 31°C. Follow that row going across the table.
Step 2. Subtract the wet bulb temperature from the dry bulb temperature. For example, 3°C. Follow that column going down until it crosses the row for 30°C.
Step 3. Read and record the relative humidity number in the table. For example, 86%.

Air Temp (°C)	Wet Bulb Depression (Difference between Dry Bulb-Wet Bulb Temperature)													
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.5	10.0	12.5	15.0
40.0	97	94	91	88	85	82	79	77	74	72	59	48	38	29
37.5	97	94	91	87	85	82	79	76	73	70	58	46	36	26
35.0	97	93	90	87	84	81	78	75	72	69	56	44	33	23
32.5	97	93	90	86	83	80	77	74	71	68	54	42	30	20
30.0	96	93	89	86	82	79	76	73	70	67	52	39	27	16
27.5	96	92	89	85	82	78	75	71	68	65	50	36	23	12
25.0	96	92	88	84	81	77	73	70	66	63	47	32	19	7
22.5	96	92	87	83	80	76	72	68	64	61	44	28	14	1
20.0	95	91	87	82	78	74	70	66	62	58	40	24	8	--
17.5	95	90	86	81	77	72	68	64	60	55	36	18	2	--
15.0	95	90	85	80	75	70	66	61	57	52	31	12	--	--
12.5	94	88	84	78	73	68	63	58	53	48	25	4	--	--
10.0	94	88	82	76	71	65	60	54	49	44	19	--	--	--
7.5	93	87	80	74	68	62	56	50	44	38	11	--	--	--
5.0	93	86	78	71	65	58	51	45	38	32	1	--	--	--
2.5	92	84	76	68	61	53	46	38	31	24	--	--	--	--
0.0	91	82	73	65	56	47	39	31	23	15	--	--	--	--
-2.5	90	80	70	60	50	41	31	22	12	3	--	--	--	--
-5.0	88	77	66	54	43	32	21	11	0	--	--	--	--	--
-7.5	87	73	60	48	35	22	10	--	--	--	--	--	--	--
-10.0	85	69	54	39	24	10	--	--	--	--	--	--	--	--

Step 2: Find the difference between the dry and wet bulb temperature in the row at the top of the chart. (3ºC)



% Relati e Humidity Table

Step 1: Find the Air Temperature in the left column. For example, 31°C. Follow that row going across the table.
Step 2. Subtract the wet bulb temperature from the y bulb temperature. For example, 3°C. Follow that column going down until it crosses the row for 30°C.
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40.0	97	94	91	88	86	82	79	77	74	72	59	48	38	29
37.5	97	94	91	87	86	82	79	76	73	70	58	46	36	26
35.0	97	93	90	87	84	81	78	75	72	69	56	44	33	23
32.5	97	93	90	86	83	80	77	74	71	68	54	42	30	20
30.0	96	93	89	86	82	79	76	73	70	67	52	39	27	16
27.5	96	92	89	85	82	78	75	71	68	65	50	36	23	12
25.0	96	92	88	84	81	77	73	70	66	63	47	32	19	7
22.5	96	92	87	83	80	76	72	68	64	61	44	28	14	1
20.0	95	91	87	82	78	74	70	66	62	58	40	24	8	--
17.5	95	90	86	81	77	72	68	64	60	55	36	18	2	--
15.0	95	90	85	80	75	70	66	61	57	52	31	12	--	--
12.5	94	88	84	78	73	68	63	58	53	48	25	4	--	--
10.0	94	88	82	76	71	65	60	54	49	44	19	--	--	--
7.5	93	87	80	74	68	62	56	50	44	38	11	--	--	--
5.0	93	86	78	71	65	58	51	45	38	32	1	--	--	--
2.5	92	84	76	68	61	53	46	38	31	24	--	--	--	--
0.0	91	82	73	65	56	47	39	31	23	15	--	--	--	--
-2.5	90	80	70	60	50	41	31	22	12	3	--	--	--	--
-5.0	88	77	66	54	43	32	21	11	0	--	--	--	--	--
-7.5	87	73	60	48	35	22	10	--	--	--	--	--	--	--
-10.0	85	69	54	39	24	10	--	--	--	--	--	--	--	--

Using the Chart

Step 3: Read across the row and down the column to find the % relative humidity.

(79%)

% Relati e Humidity Table

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[illegible]	[illegible]	94	91	87	86	82	79	76	73	70	58	46	36	26
35.0	97	[illegible]	[illegible]	87	84	81	78	75	72	69	56	44	33	23
32.5	97	93	90	[illegible]	[illegible]	[illegible]	77	74	71	68	54	42	30	20
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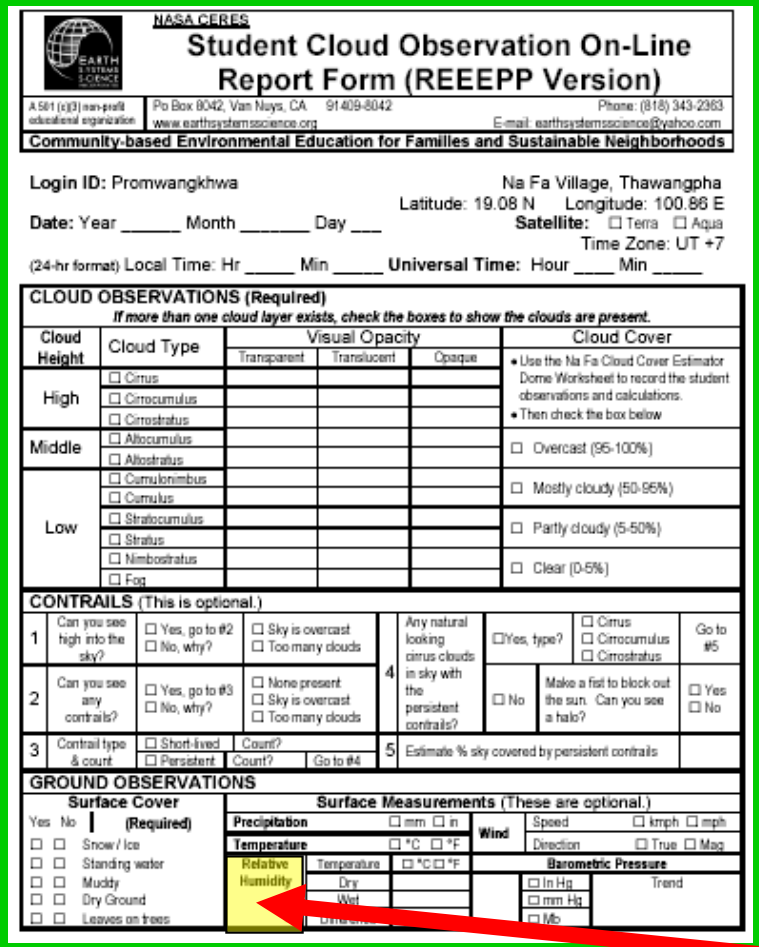

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3	Contrail type & count	☐ Short-lived Count? ☐ Persistent Count?	Go to #4	5	Estimate % sky covered by persistent contrails		

GROUND OBSERVATIONS

Surface Cover

Yes	No	(Required)
☐	☐	Snow / Ice
☐	☐	Standing water
☐	☐	Muddy
☐	☐	Dry Ground
☐	☐	Leaves on trees

Surface Measurements (These are optional.)

Precipitation ☐ mm ☐ in

Temperature ☐ °C ☐ °F

Relative Humidity — Temperature ☐ °C ☐ °F; Dry; Wet

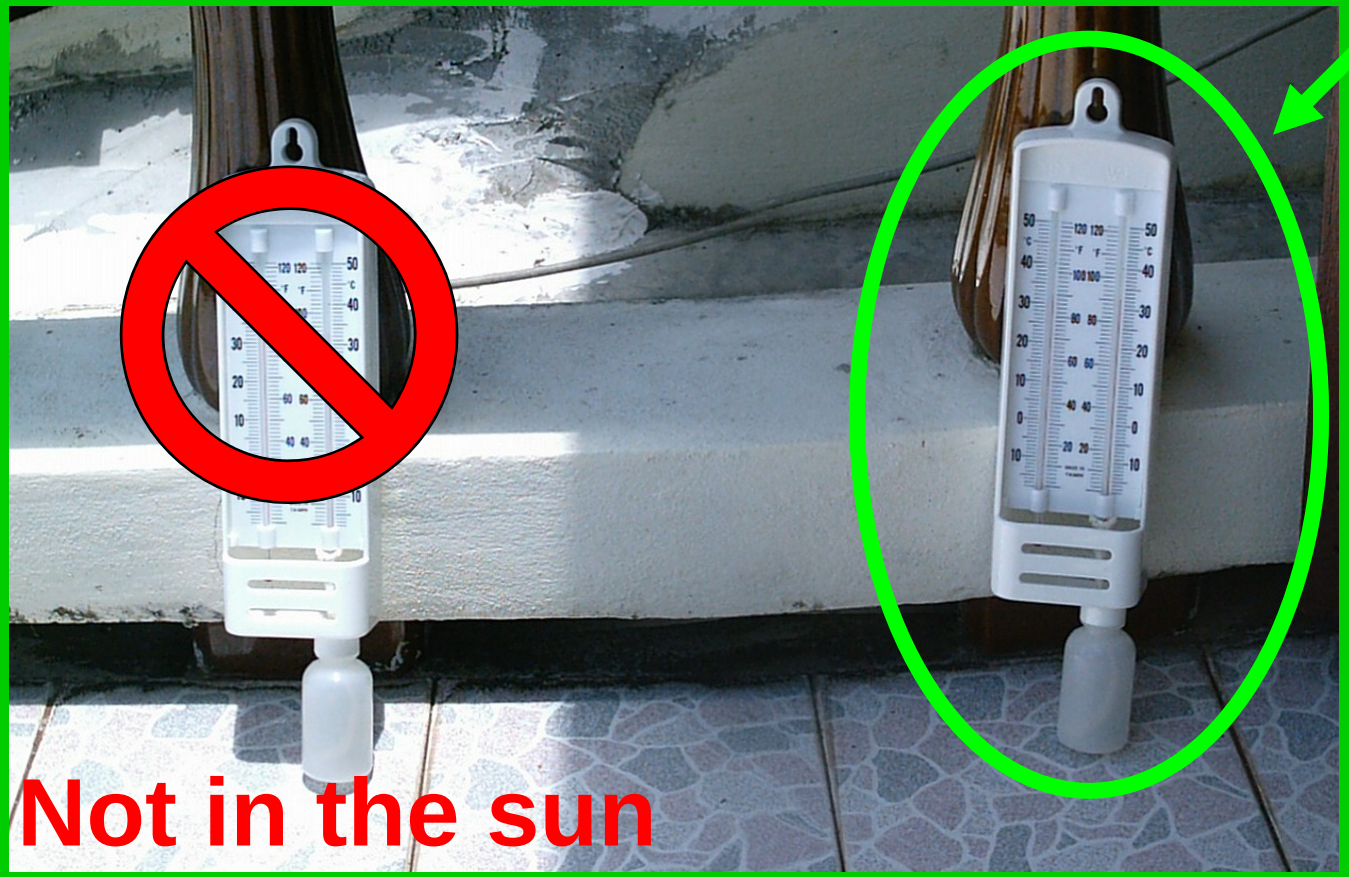
Wind — Speed ☐ kmph ☐ mph; Direction ☐ True ☐ Mag

Barometric Pressure ☐ In Hg ☐ mm Hg ☐ Mb; Trend

Report the % relative humidity on this part of the form

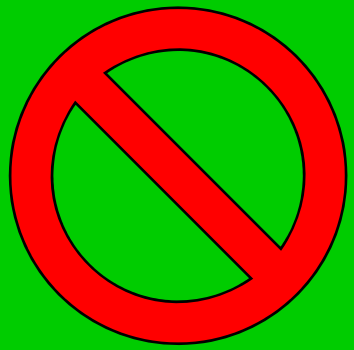
Important Notes

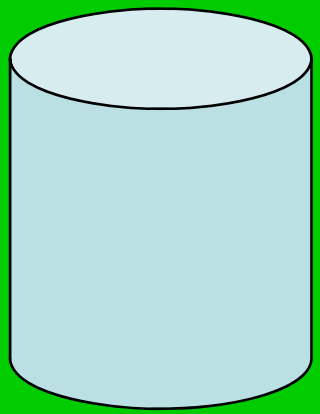
Keep the hygrometer in the shade

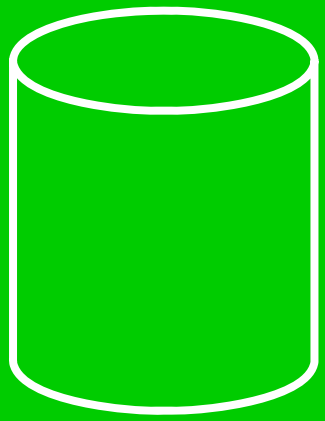


Important Notes

Keep water
in the bottle







Important Notes

Keep the hygrometer at the proper height (1.5 m above the ground)

Can you name the parts of the hygrometer?

Try to answer these questions.

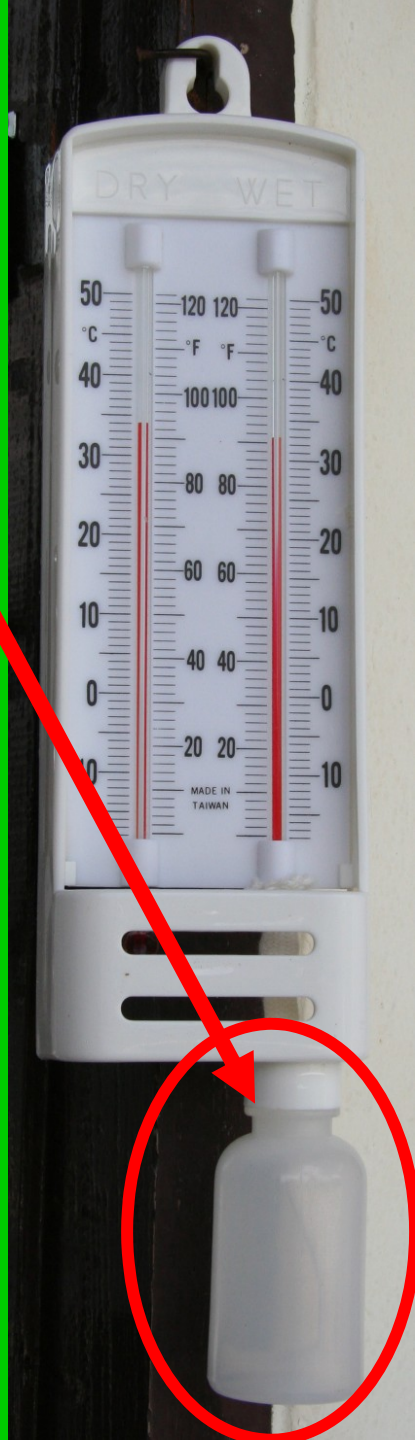
What is this?

A) Dry Bulb Thermometer

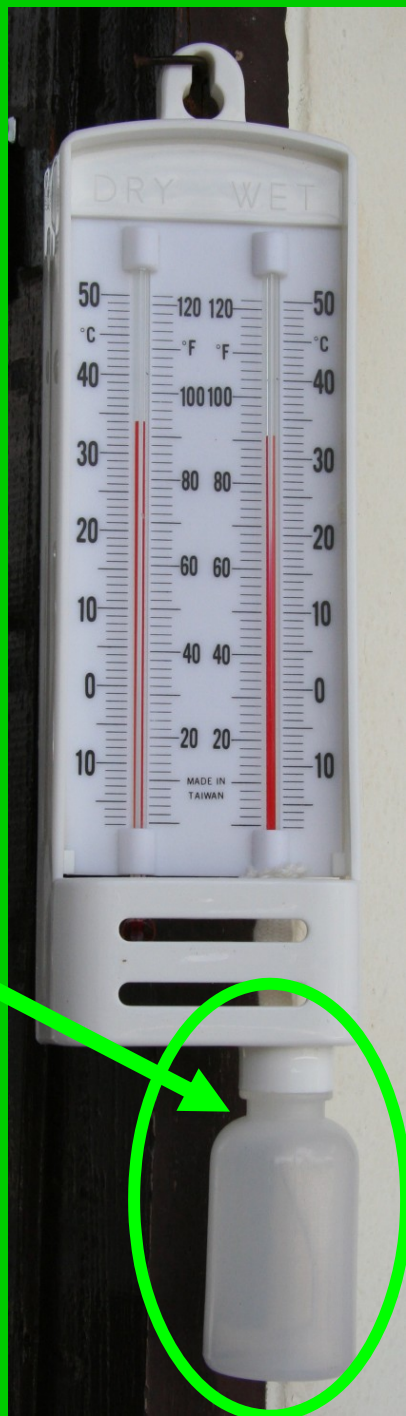
B) Wet Bulb Thermometer

C) Water Bottle

D) Temperature Scales



C) It is the water bottle.



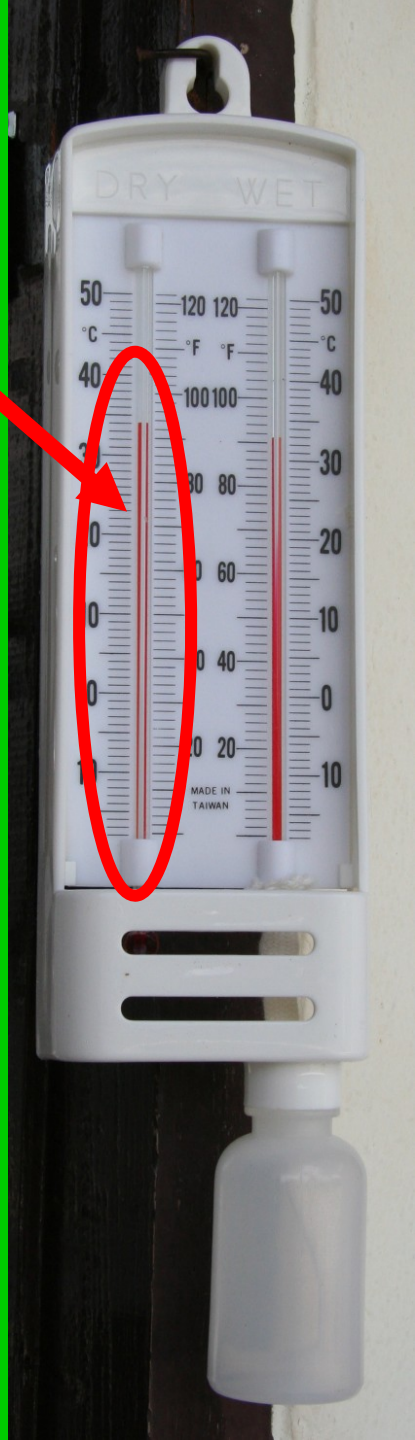
What is this?

A) Dry Bulb Thermometer

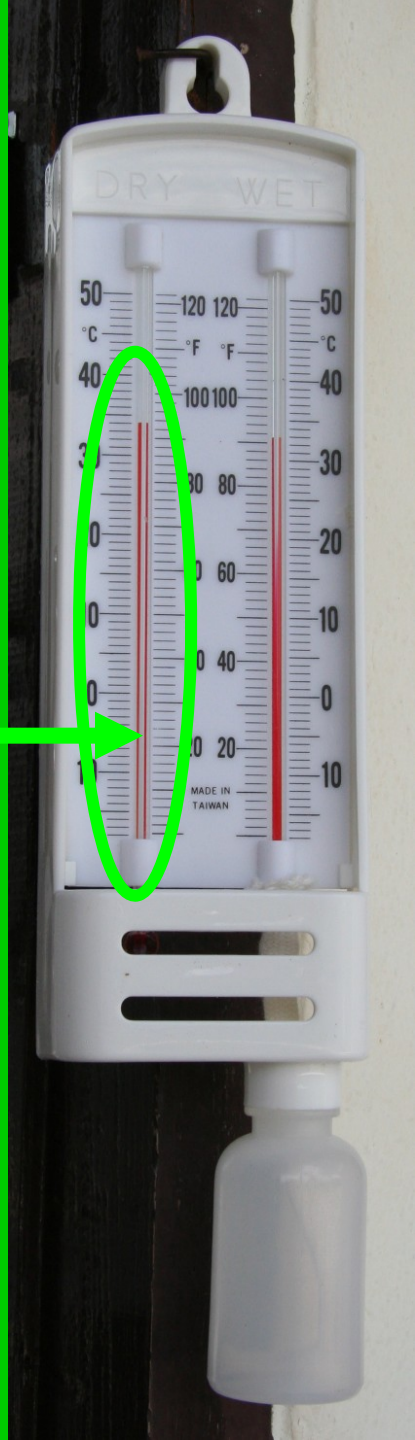
B) Wet Bulb Thermometer

C) Water Bottle

D) Temperature Scales



A) It is the dry bulb thermometer.



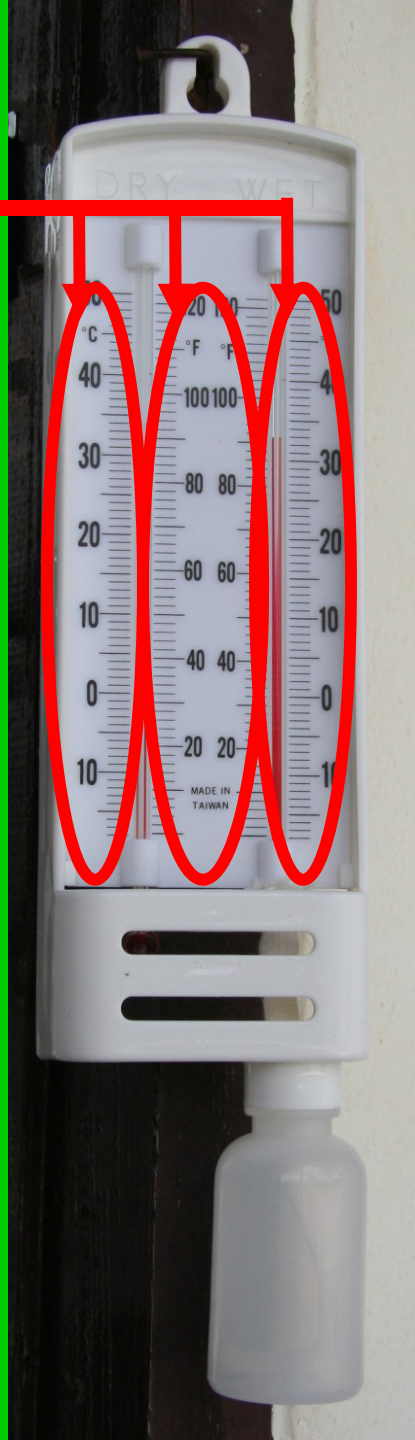
What are these?

A) Dry Bulb Thermometer

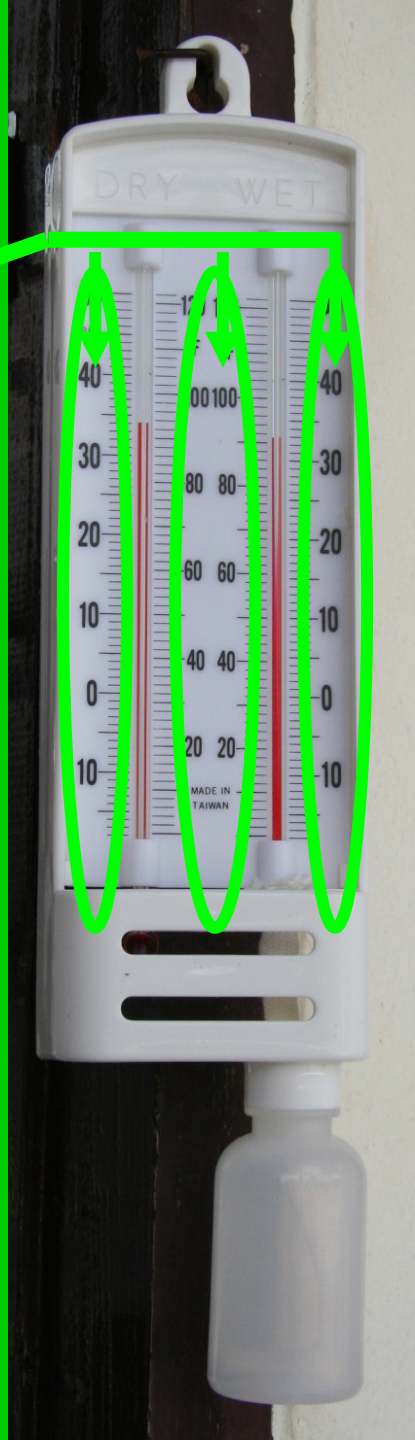
B) Wet Bulb Thermometer

C) Water Bottle

D) Temperature Scales



D) They are the temperature scales .



What is this?

A) Dry Bulb Thermometer

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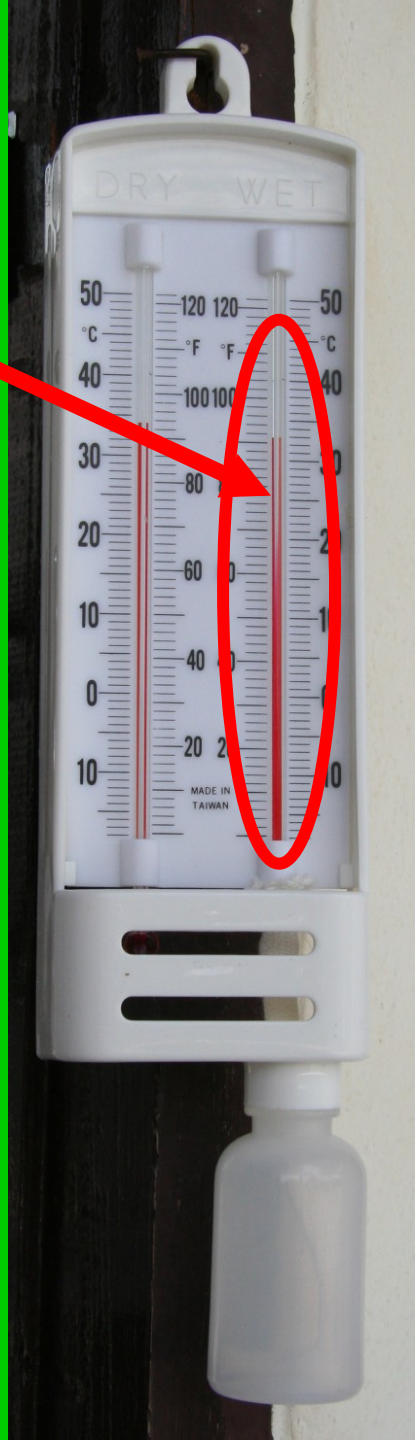
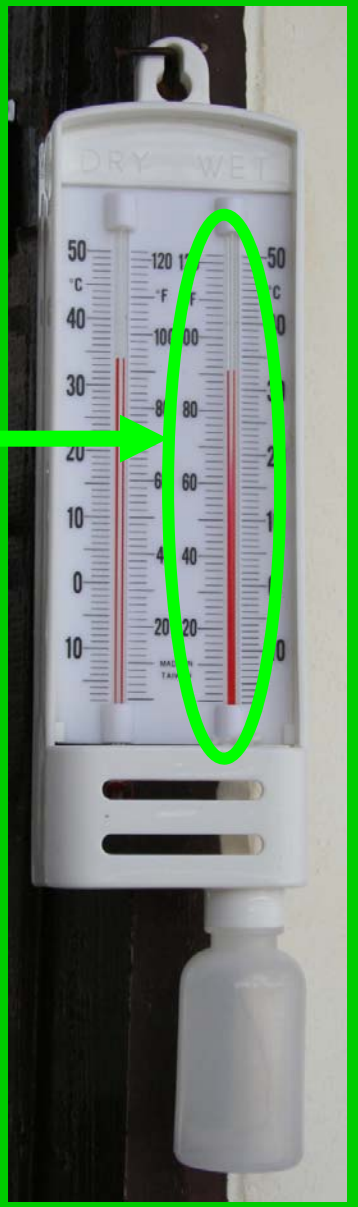
C) Water Bottle

D) Temperature Scales



B) It is the wet bulb thermometer.



Do You Know How to Measure Relative Humidity?

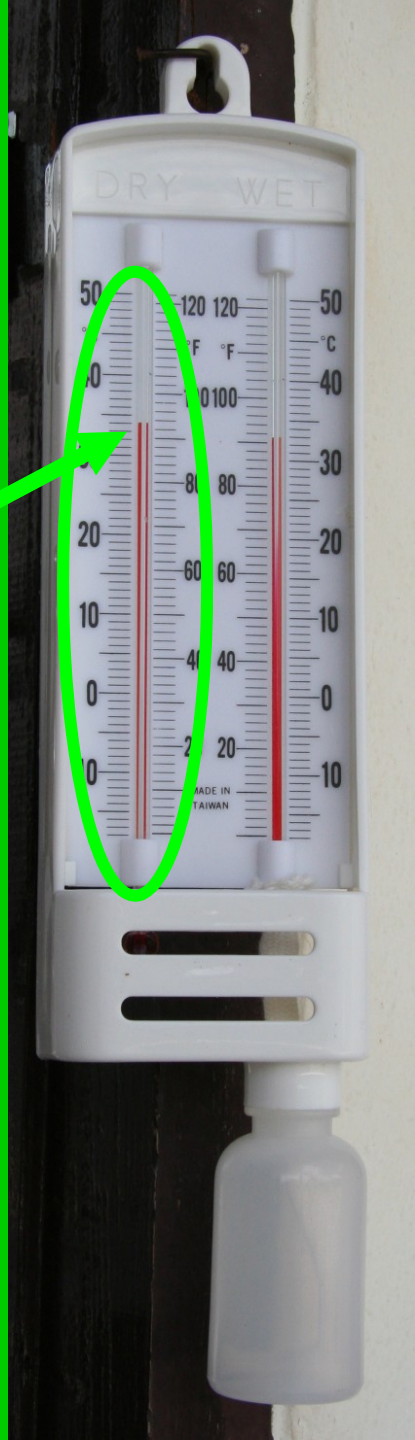
Try to answer the following questions.

What is the first step?

A) Read the wet bulb temperature

B) Read the dry bulb temperature

B) The first step is to read the dry bulb temperature.



What is the second step?

A) Read the wet bulb temperature

B) Read the dry bulb temperature

A) The second step is to read the wet bulb temperature.

What is the third step?

A) Use the chart

B) Subtract the wet bulb temperature from the dry bulb temperature

Do some arithmetic.

B) Subtract the wet bulb temperature from the dry bulb temperature. Write it down

What is the fourth step?

A) Subtract the wet bulb temperature from the dry bulb temperature

B) Use the chart

B) Use the chart.

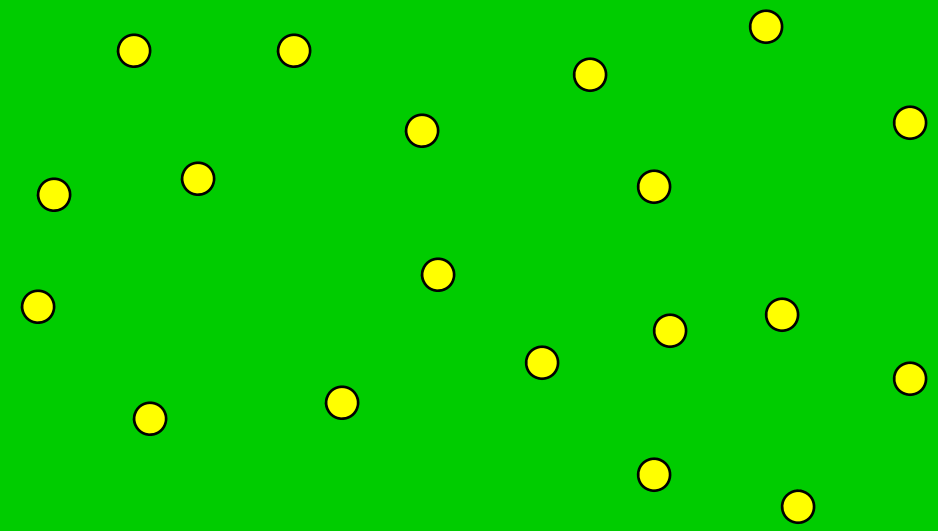
Use the dry bulb temperature and the difference between wet and dry bulb temperatures to look up the % relative humidity in the chart.

Do you want to learn more?

Here is more information about relative humidity.

Air Temperature Affects Relative Humidity

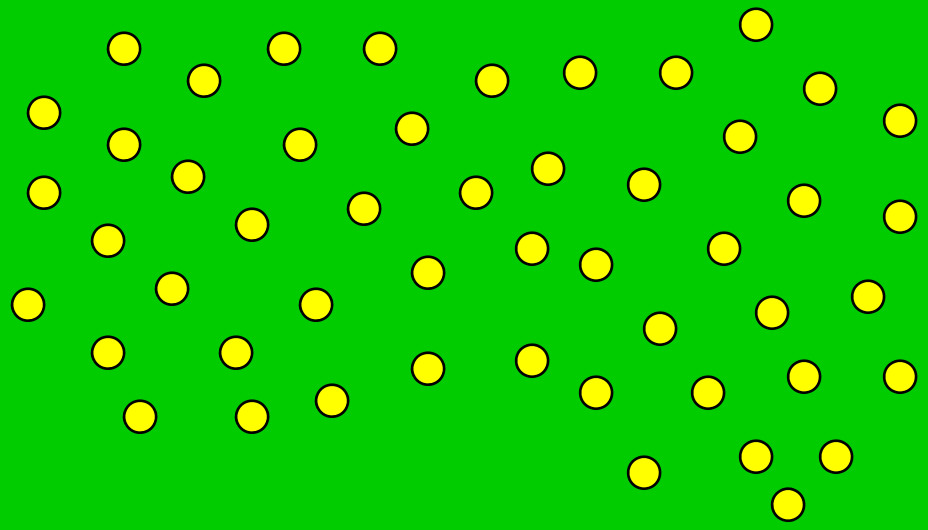
Warm air can have a lower relative humidity than cool air



Air molecules

Air Temperature Affects Relative Humidity

Cool air can have a higher relative humidity than warm air

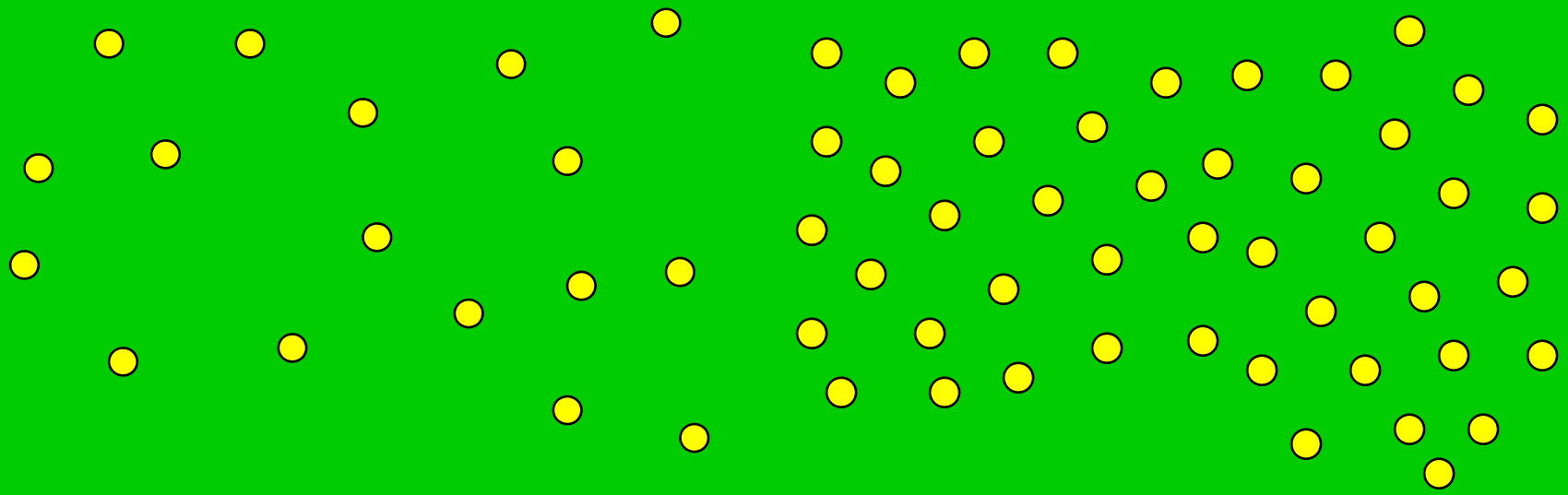


Air molecules

Can you see the difference?

Warm air

Cool air



Air molecules

This is why warm air can hold more moisture.

Warm air has more space to hold water molecules.

It takes more water molecules to fill the warm air.

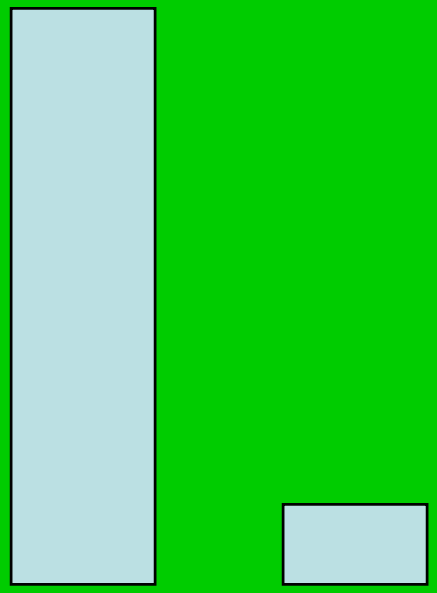
This is why cool air holds less moisture.

Cool air has less space to hold water molecules

It takes less water molecules to fill cool air.

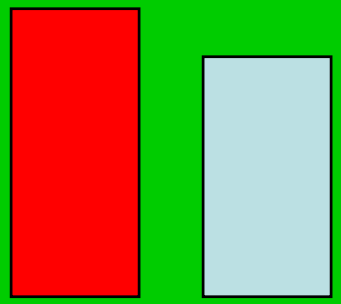
The Time of Day Affects Relative Humidity

It is highest early in the morning just before sunrise.



It is lowest in the afternoon, about 2-3 pm.

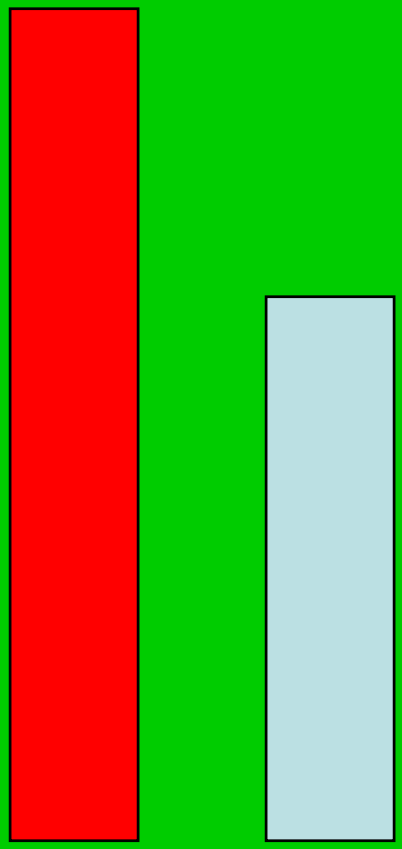
Why?



Temp Moisture

RH = 90%

The temperature is lowest early in the morning before sunrise, and cool air can hold less water, making it easier for the water vapor to fill the air.

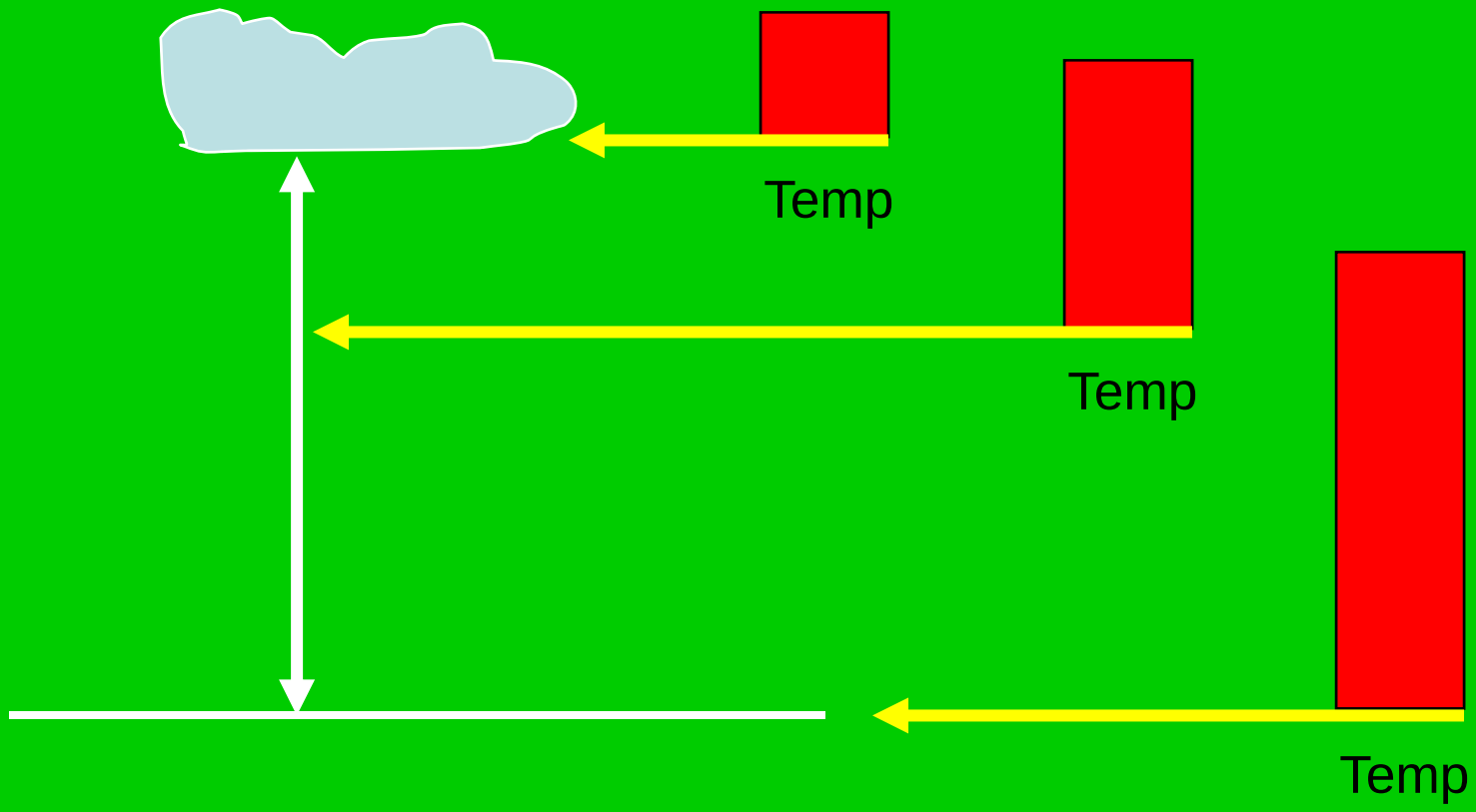


Temp Moisture

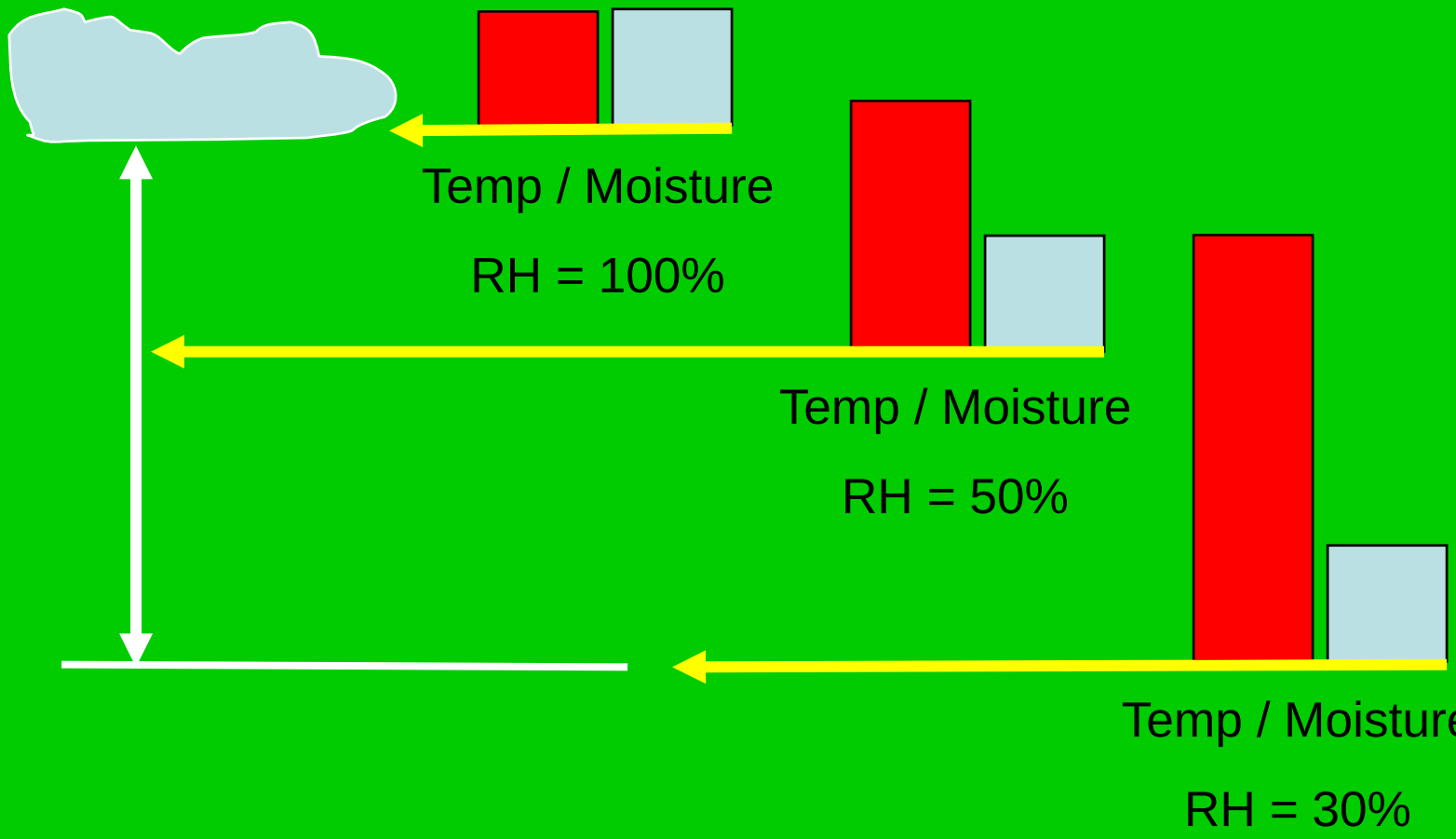
RH = 75%

In the afternoon the temperature is highest, and warm air can hold more water, making it harder for water vapor to fill the air.

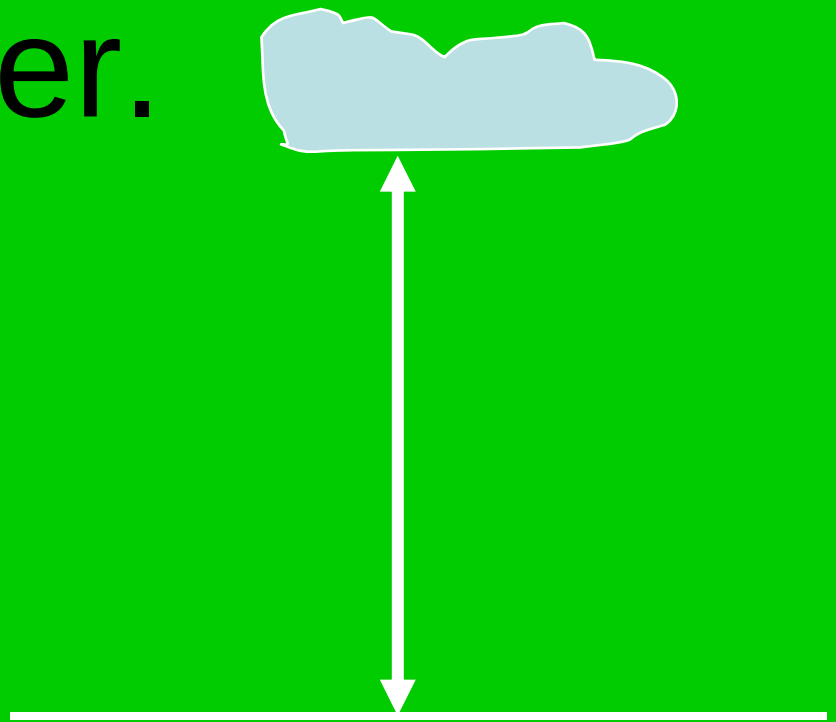
The temperature gets lower as you go higher above the ground.



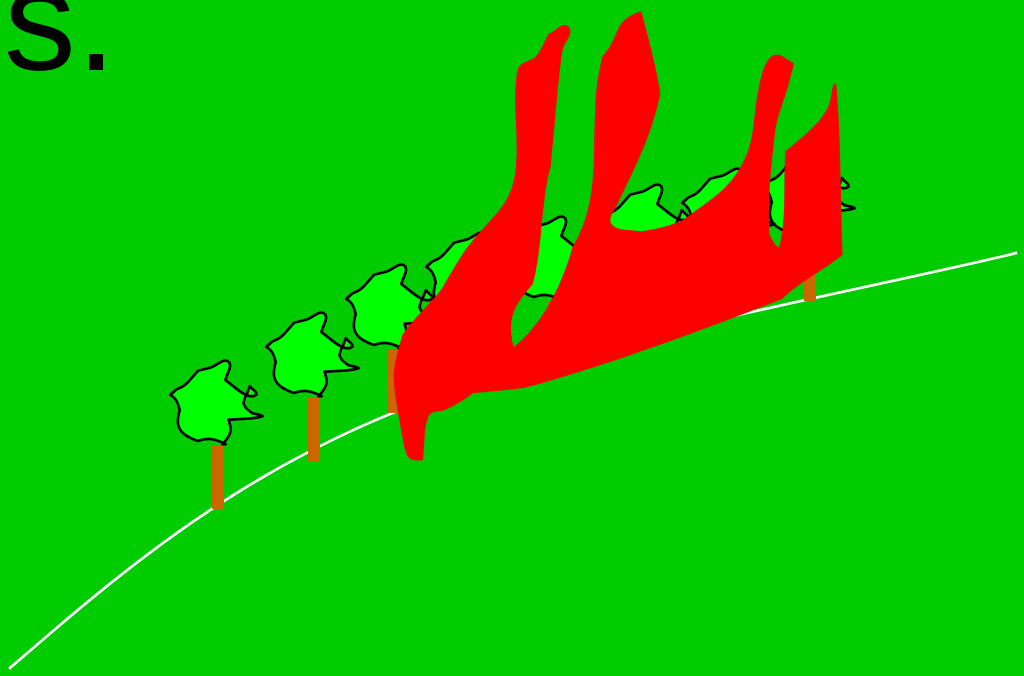
So the relative humidity gets higher as you go higher above the ground.



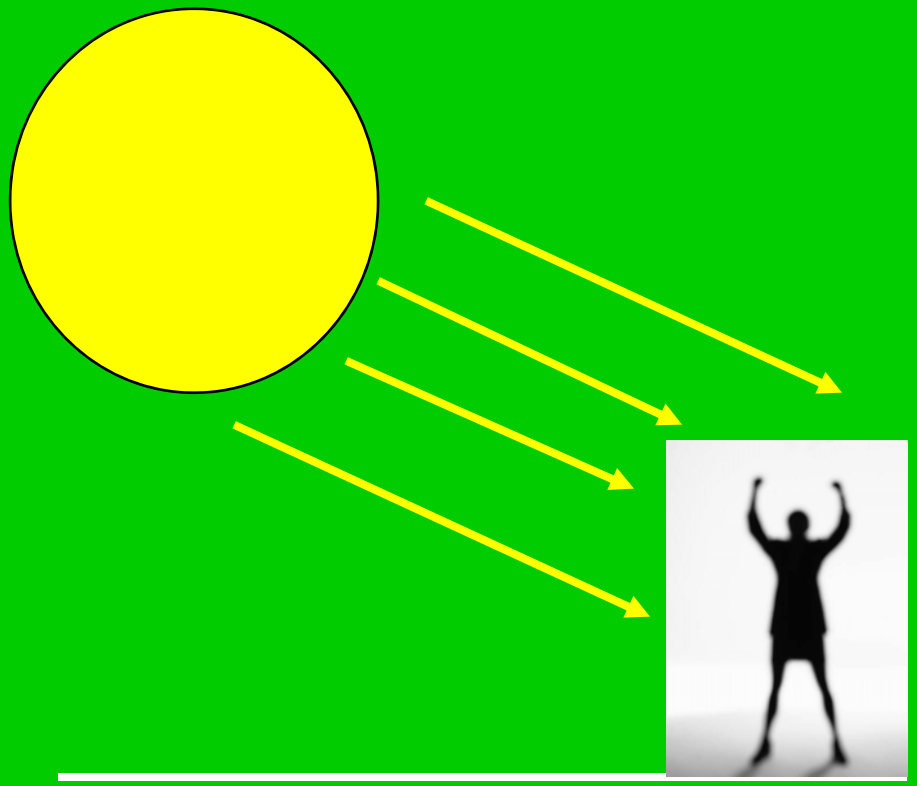
Knowing the relative humidity can tell you the height of a low cloud layer.



Knowing the relative humidity can warn you when it is dry enough for forest fires.



High temperatures and high relative humidity…



…can make it dangerous to work outside.

Knowing the relative humidigy can tell you how fast rice or corn will dry.

In summer 2005, the RTC-TH and ESSI donated a hygrometer to Na Fa Elementary School

It was put into service, 5 Aug 2005.

A relative humidity reference chart was put on the bulletin board.

RTC-TH

Rural Training Center-Thailand

is dedicated to providing community-based environmental education for the self-sufficiency and sustainability of small rural family farms

The RTC-TH was created to honor the memory of Mr. Tang Suttisan, a father, a farmer, and a man who valued education and used it in starting his family farm

REEEPP

Rural Environmental Education Enhancement Pilot Program

An innovative, non-traditional community-based environmental education program integrating math, science, geography, English language, and technology lessons for environmental stewardship using interactive experiential learning in outdoor settings at Ban Na Fa Elementary School, Nan Province, Thailand..

The End