Rural Training Center – Thailand (RTC-TH)

REEEPP



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.

© 2005, rev. 2009,

Weather Observing: Measuring Relative Humidity



[©] 2005, rev. 2009,



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



© 2005, rev. 2009,



This is an English Language Training module of REEPP

Rural Environmental Education Enhancement Pilot Program presented by

The Rural Training Center-Thailand

E-mail: rtc2k5@gmail.com

www.neighborhoodlink.com/org/rtcth

© 2005, rev. 2009,







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.





is another word for Moisture water. It can be a liquid, solid, or a gas.





Vapor

Water

Ice

2005. rev. 2009. G.K.Lee & S.Lee

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



© 2005, rev. 2009, G.K.Lee & S.Lee

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

Temperature Scales

Wet Bulb
Thermometer







Water Bottle

Taking the Measurements

Step 1:

Read and write down the dry bulb temperature.

 $(31^{\circ}C)$





[©] 2005, rev. 2009,

	Student Cloud Observation On-Line Report Form (REEEPP Version)												
eds	01 (c)(3) non cational erg	nization	Po Box 8042,	Van Nuys, CA stemsscience o	91409-80	142		Е	mail	narthes	Phone:	(818) 3 co@vab	43-2363 100.com
C	Community-based Environmental Education for Families and Sustainable Neighborhoods												
D	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												0.86 E □ Aqua UT +7
						_							
С	CLOUD OBSERVATIONS (Required)												
Н	If more than one cloud layer exists, check the boxes to show the clouds are present. Cloud Cover												
	Cloud	Clo	ud Type					-					
Ľ	leight			Transparent	Iransius	:em	Upaque	_			a Fa Cloud		
	I E - L				+		+	-			rksheet to n ns and calc		
l	High		rrocumulus		+		+	-			k the box b		
⊢			rrostratus				+	-	* 1118	an unec	A. IIIE DUX D	uluw	
М	iddle		tocumulus		+		+	-		Overca	et (95-100	96]	
⊢			tostratus				+	-					
ı			umulonimbus				+	-	☐ Mostly cloudy (50-95%)				
ı		_	umulus				+	_	_	_	- ' '		
ı	Low	_	ratocumulus		-					☐ Partly cloudy (5-50%)			
ı			ratus										
ı		_	mbostratus				+	-	☐ Clear (0-5%)				
Ļ		ΠF								_	_		_
С			(This is option	onal.)		_							
1	Can you high int sky	o the	☐ Yes, go to t ☐ No, why?	2 ☐ Sky is o			Any natural looking circus clouds		☐ Cirrus ☐ Cirrocumulus ☐ Cirrocumulus ☐ Cirrostratus				Go to #5
2	contra	Can you see any No, why?		□ None present □ Sky is overcast □ Too many clouds		4	in sky with the persistent contrails?		Make a fist to block out			□ Yes □ No	
3				Count?		5	Estimate % sk	ke or	wered	byper	sistent contr	ais	
	& co.		☐ Persistent		Go to #4	Ľ		-4 m		-1 pain			
G			SERVATION	NS									
I			Cover				easuremen	ts					
	s No		Required)	Precipitation			lmm □ in	Win	4 1	Speed		_	☐ mph
_	☐ Sn			Temperature			1*C □*F		_ []	Sirectio			☐ Mag
		nding	water	Relative		_	□ 'C □ 'F				metric Pres		
	□ Mu	ddy		Humidity	Dry							Trend	d

Report the Dry Bulb Temperature on this part of the form





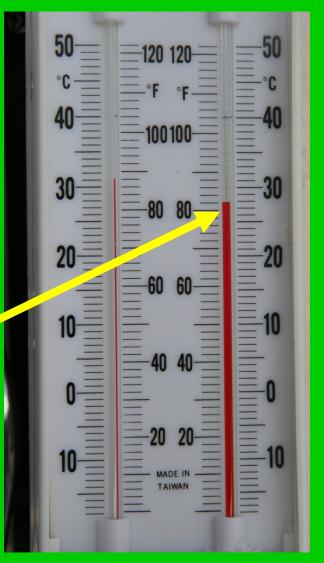
© 2005, rev. 2009.

Taking the Measurements

Step 2:

Read and write down the wet bulb temperature.

 $(28^{\circ}C)$







^o 2005, rev. 2009,

П	Student Cloud Observation On-Line													
	₩ _{EA}	RTH											e	
	100	t⇔C£		₹	eport	For	n	(REE	Е	PP	Ve	ersion)		
ASI1 (s)(3) nan-yeelik Po Box 8042, Van Naya, CA 91409-8042 Phone: (818) 343-2363 educational eganisation www.earthsystemssolience.org E-mail: earthsystemssolience@yeahoo.com											43-2363			
Co	Community-based Environmental Education for Familles and Sustainable Neighborhoods													
	Login ID: Promwangkhwa Na Fa Village, Thawangpha Latitude: 19.08 N Longitude: 100.86 E Date: Year Month Day Satellite: □ Tera □ Aqua												0.86 E □ Aqua	
	Time Zone: UT +7 (24-hr format) Local Time: Hr Min Universal Time: Hour Min													
CI	CLOUD OBSERVATIONS (Required) If more than one cloud layer exists, check the boxes to show the clouds are present.													
	Cloud		ud Type	Π		isual O				I		Cloud Cover		
н	leight			Ī	ransparent	Transluc	ænt	Opaqu	e	• Use the Na Fa Cloud Cover Estima				
				L			_	-				rksheet to record th ons and calculations		
l '	High		mocumulus	⊢				+-				ons and dalculations ok the box below		
Ь.			rrostratus tocumulus	⊢			_	+-		-				
М	iddle	☐ Altostratus		Н				+-			☐ Overcast (95-100%)			
г			ımulonimbus							_ ,	Months	cloudy (50-95%)		
ı			☐ Cumulus								wusiiy	clocally (au-sow)		
ı	Low		☐ Stratocumulus					-						
ı		□ St	ratus mbostratus	⊢			_	+-				, (,		
ı		□ Fe		⊢				+-			Clear (D-5%)		
C	ONTRA		(This is optic	ons	d.)					_				
1	Can yo high int	u see to the	☐ Yes, go to #	\neg	☐ Sky is ow ☐ Tooman			Any natural looking cirrus clouds]Yes, t	уре?	☐ Cirrus ☐ Cirrocumulus ☐ Cirrostratus	Go to	
2	Can you see			☐ Too man	one present ky is overcast oo many clouds		in sky with the persistent contrails?] No		a fist to block out un. Can you see o?	□ Yes □ No		
3			☐ Short-fived ☐ Persistent			So to #4	5	Estimate %	sky o	overed	byper	sistent contrails		
G			SERVATION			20 IU P4	_						\vdash	
Ĕ			Cover	Ī		Surface	M	easureme	nts	(Thes	se ar	e optional.)	-	
Ye	s No	(15)	tequired)	Pr	ecipitation			lmm □ in			Speed		□ mph	

Report the Wet Bulb Temperature on this part of the form





© 2005, rev. 2009.

Do some arithmetic.

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

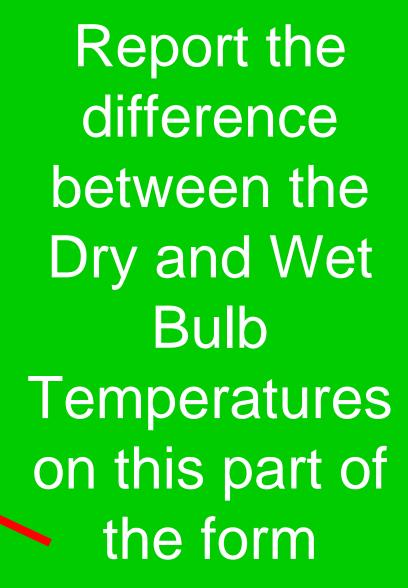
31°C Dry

-28°C Wet

3°C Difference



	Student Cloud Observation On-Line Report Form (REEEPP Version)												
A 501 (c)(3)		Po Box 8042,	Van Nuys, CA	91409-80	142					$\overline{}$	Phone: (818) 3		
Commi			stemsscience.c	rg ducation	to	r Eamillac	and	Cal	i: earthsy	stem olde	sscience@yah	moo.com	
Community-based Environmental Education for Families and Sustainable Neighborhoo Login ID: Promwangkhwa Na Fa Village, Thawangpi Latitude: 19.08 N Longitude: 100.86 Date: Year Month Day Satellite: ☐ Term ☐ Latitude:											igpha 0.86 E 1 Aqua UT +7		
(24-hr fo	(24-hr format) Local Time: Hr Min Universal Time: Hour Min												
CLOU	CLOUD OBSERVATIONS (Required) If more than one cloud layer exists, check the boxes to show the clouds are present.												
Cloud	Cla	ud Type		Visual O	pa	city Cloud Cover							
Height	Cit	uu Type	Transparent	Transluc	zent	Opaqu	IE .	۰۱	lse the N	la Fa	Cloud Cover E	stimator	
								Dome Worksheet to record the student					
High		irrocumulus				-		observations and calculations. Then check the box below					
		irrostratus				-	_	•	nen cnec	2K 10K	DOX DEIDM		
Middle		tocumulus				-	_		Overca	est (S	6-100%)		
Ь——		ltostratus				+-	_	_		_			
l		umulonimbus umulus		+		+-	_		Mostly	clou	dy (50-95%)		
l		ratocumulus				+	-	_					
Low		ratus				$\overline{}$			☐ Partly cloudy (5-50%)				
l		imbostratus				+-							
l	ΠF			1		+-		☐ Clear (0-5%)					
CONT		(This is option	nnal i										
1 high	you see into the ky?	☐ Yes, go to #			Γ	Any natural looking circus clouds		□ Cirrus □ Cirrosumulus □ Cirrostratus					
2 :	n you see		Sky is overcast ☐ Too many clouds		4	in sky with the persistent contrails?		Make a fist to block of the sun. Can you se a halo?				□ Yes □ No	
	rail type count	☐ Short-fived ☐ Persistent	Count?	Go to #4	5	Estimate %	sky oc	work	od by per	sister	nt contrails		
		SERVATIO			_								
	ırface			Surface	M	easureme	nts	(Tb	ese are	е ор	tional.)		
Yes No	0	Required)	Precipitation			ımm □ in	Win		Speed		□ kmph	□ mph	
			Temperature]*C □*F		GÍ	Directio		☐ True	☐ Mag	
		water	Relative		e	□ *C □ *F					ic Pressure		
			Humidity	Dry	4			T		Д	Trend	i	







2005, rev. 2009.

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. (31°C)

% 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%.

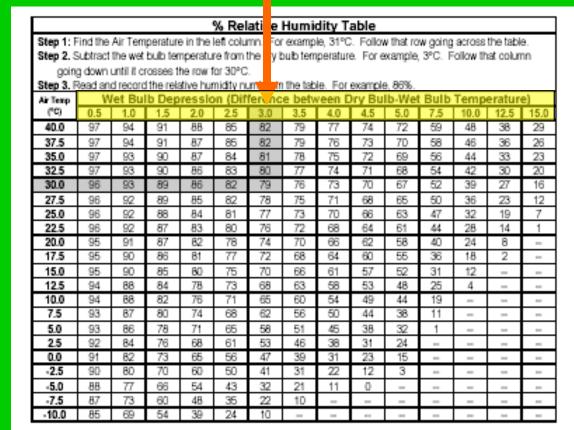
Air Tem	P													e)	
(°C)	0	.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.5	10.0	12.5	15.0
40.0	- 5	97	94	91	88	85	82	79	77	74	72	59	48	38	29
37.5	- 5	97	94	91	87	85	82	79	76	73	70	58	46	36	26
35.0	9	97	93	90	87	84	81	78	75	72	69	56	44	33	23
32.5	- 5	97	93	90	86	83	80	77	74	71	68	54	42	30	20
30.0	- 5	36	93	89	86	82	79	76	73	70	67	52	39	27	16
27.5	9	36	92	89	85	82	78	75	71	68	65	50	36	23	12
25.0	9	36	92	88	84	81	77	73	70	66	63	47	32	19	7
22.5	9	96	92	87	83	80	76	72	68	64	61	44	28	14	1
20.0	- 5	35	91	87	82	78	74	70	66	62	58	49	24	8	-
17.5	- 5	35	90	86	81	77	72	68	64	60	55	36	18	2	-
15.0	9	35	90	85	80	75	70	66	61	57	52	31	12	-	-
12.5	- 5	14	88	84	78	73	68	63	58	53	48	25	4		-
10.0	- 5	14	88	82	76	71	65	60	54	49	44	19	-	-	-
7.5	- 5	93	87	80	74	68	62	56	50	44	38	11		-	-
5.0	9	33	86	78	71	65	58	51	45	38	32	1	-	-	-
2.5	9	12	84	76	68	61	53	46	38	31	24	-	-		-
0.0	- 5	91	82	73	65	56	47	39	31	23	15	I	-	-	I
-2.5	8	90	80	70	60	50	41	31	22	12	3	I	-	-	-
-5.0	- 8	38	77	66	54	43	32	21	-11	0		I	-	-	I
-7.5	- 8	37	73	60	48	35	22	10	-	-	-	ı	-	-	-
-10.0		15	69	54	39	24	10		-			-	-	-	-





© 2005, rev. 2009,

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







© 2005, rev. 2009,

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

(79%)

% 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 public temperature. For example, 3°C. Follow that column aging down until it crosses the row for 30°C.

tep 3. Read and record the relative humidity num in the table. For example, 86%.

ı	atep a. r	veau an	a recard	ine rea	anve un	meany n	-114 41	TIPE REL	ec. POI	example	9,0036.				
	Air Temp	W	let Bul	lb Dep	ressio	on (Dif	fer. nc	e betv	veen D	ry Bu	lb-Wet	Bulb	Temp	eratur	e)
ı	(°C)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	49	4.5	5.0	7.5	10.0	12.5	15.0
J	40.0	97	94	91	88	85	82	79	77	74	72	59	48	38	29
1	21.00	97	94	91	87	85	82	79	76	73	70	58	46	36	26
ı	35.0	97	200	9	87	84	81	78	75	72	69	56	44	33	23
ı	32.5	97	93	90	Dia.	63		77	74	71	68	54	42	30	20
	30.0	96	93	89	86	82	79	76	73	70	67	52	39	27	16
ı	27.5	96	92	89	85	82	78	75	71	68	65	50	36	23	12
ı	25.0	96	92	88	84	81	77	73	70	66	63	47	32	19	7
ı	22.5	96	92	87	83	80	76	72	68	64	61	44	28	14	1
ı	20.0	95	91	87	82	78	74	70	66	62	58	40	24	8	1
ı	17.5	95	90	86	81	77	72	68	64	60	55	36	18	2	-
ı	15.0	95	90	85	80	75	70	66	61	57	52	31	12		I
ı	12.5	94	88	84	78	73	68	63	58	53	48	25	4	-	I
ı	10.0	94	88	82	76	71	65	60	54	49	44	19	-	-	1
ı	7.5	93	87	80	74	68	62	56	50	44	38	11			i
ı	5.0	93	86	78	71	65	58	51	45	38	32	1	-		I
ı	2.5	92	84	76	68	61	53	46	38	31	24	I		-	I
ı	0.0	91	82	73	65	56	47	39	31	23	15	I	-	-	I
	-2.5	90	80	70	60	50	41	31	22	12	3	I		-	I
	-5.0	88	77	66	54	43	32	21	-11	0		1			I
	-7.5	87	73	60	48	35	22	10	1	-	-	ı	-	-	I
ı	-10.0	85	69	54	39	24	10	-	-		-	-	-	-	-





© 2005, rev. 2009,

	NASA CERES Student Cloud Observation On-Line Report Form (REEEPP Version) A501 ((3) (10) - 10-10 (10) (10) (10) (10) (10) (10) (10) (1														
edu	cational org	anization	www.earthsy:	stem	sscience.org					E-mail:	earths	stemsscience@yah	00.00m		
Co	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														
C	CLOUD OBSERVATIONS (Required) If more than one cloud layer exists, check the boxes to show the clouds are present.														
	Cloud		ud Type			isual O				T		Cloud Cover			
Н	leight		,,	Transparent Transluc				Opaqu	e	Use the Na Fa Cloud Cover Estimator					
Ι.				⊢				-				rksheet to record th ons and calculations			
ľ	High		☐ Cirrocumulus ☐ Cirrostratus					+-				ons and dalculations ok the box below			
_			tocumulus	⊢			_	+-	_						
Mi	iddle		☐ Altostratus					+-			Overca	st (95-100%)			
г			Cumulonimbus								Months	olough JED DEMA			
ı			☐ Cumulus								☐ Mostly cloudy (50-95%)				
ı	Low		☐ Stratocumulus			☐ Partly cloudy (5-50			doudy (5-50%)						
1		□ St		⊢				+			a runjudaj (o-odn)				
ı			mbostratus	⊢			_	+-	_		Clear (D-5%)			
C	ONTRA		(This is optic	ona	1)					_					
1	Can yo high int	u see to the	☐ Yes, go to #	12	☐ Sky is ow ☐ Tooman			Any natural looking cirrus clouds		□Yes, t	урю?	☐ Cirrus ☐ Cirrocumulus ☐ Cirrostratus	Go to		
2	Can you any contra	n you see			☐ None present ☐ Sky is overcast ☐ Too many clouds		4		Γ	□No		a fist to block out un. Can you see	□ Yes □ No		
3		type	☐ Short-fived	Co	Count?	So to #4	5	Estimate %	sky (overed	byper	sistent contrails			
G	& count Persistent Count? Go to #4 Seminate to Say Covered by Persistent Contrars GROUND OBSERVATIONS														
-	Surface Cover Surface Measurements (These are optional.)														
Yes	s No			Pro	ecipitation			lmm □ in			Speed		□ mph		

Report the % relative humidity on this part of the form

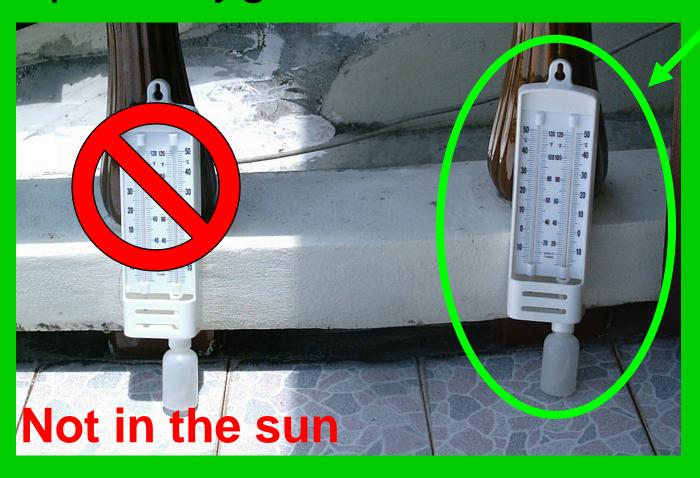




2005, rev. 2009.

Important Notes

Keep the hygrometer in the shade



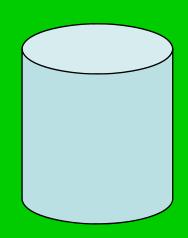


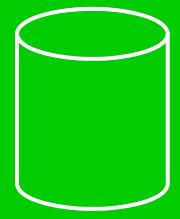
[©] 2005, rev. 2009,

Important Notes

Keep water in the bottle











2005, rev. 2009,

Important Notes

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





Too Low

Can you name the parts of the hygrometer?

Try to answer these questions.





2005, rev. 2009.

What is this?

- A) Dry Bulb Thermometer
- B) Wet Bulb Thermometer
- C) Water Bottle
- D) Temperature Scales







C) It is the water bottle.





© 2005, rev. 2009,

What is this?

- A) Dry Bulb Thermometer
- B) Wet Bulb Thermometer
- C) Water Bottle
- D) Temperature Scales







A) It is the dry bulb thermometer.

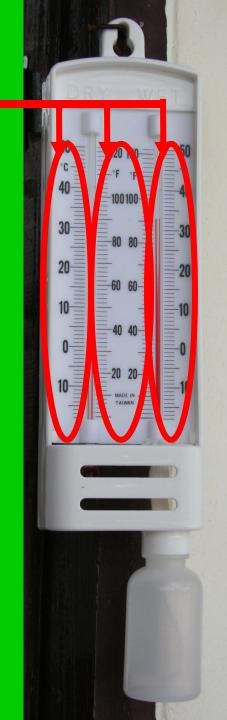




2005, rev. 2009,

What are these?

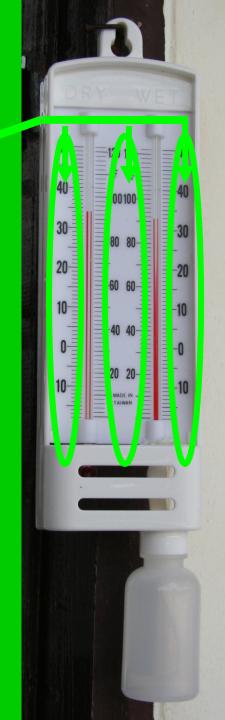
- A) Dry Bulb Thermometer
- B) Wet Bulb Thermometer
- C) Water Bottle
- D) Temperature Scales





© 2005, rev. 2009, G.K.Lee & S.Lee D) They are the the temperature scales.





What is this?

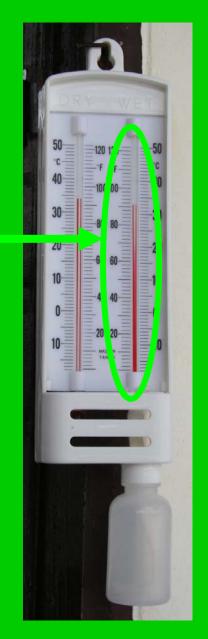
- A) Dry Bulb Thermometer
- B) Wet Bulb Thermometer
- C) Water Bottle
- D) Temperature Scales





© 2005, rev. 2009, G.K Lee & S. Lee

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.



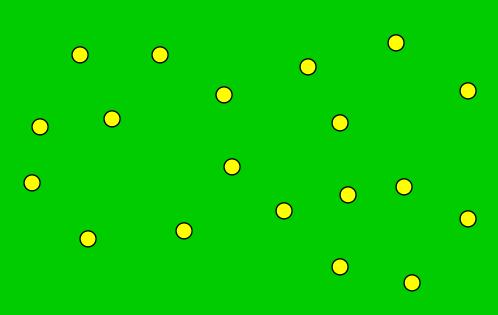
Do you want to learn more?

Here is more information about relative humidity.



Air Temperature Affects Relative Humidity

Warm air can have a lower relative humidity than cool air



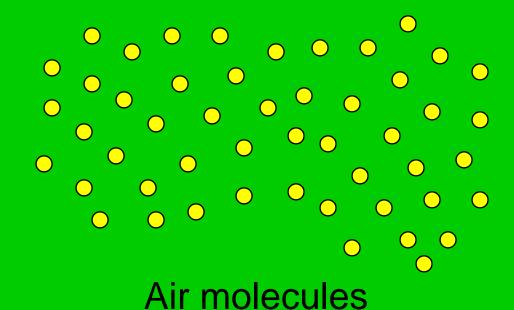






Air Temperature Affects Relative Humidity

Cool air can have a higher relative humidity than warm air



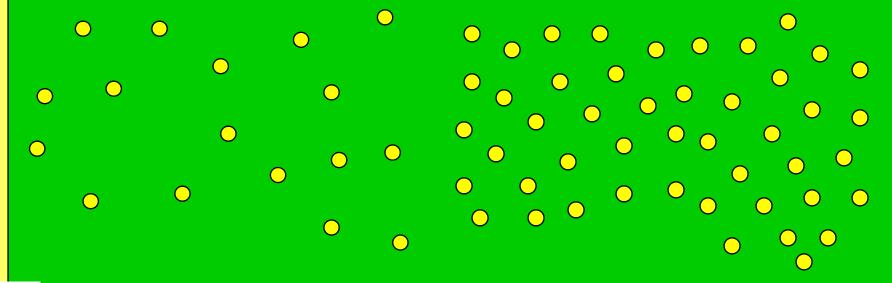




Can you see the difference?

Warm air

Cool air





Air molecules

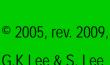


This is why warm air can hold more moisture.

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

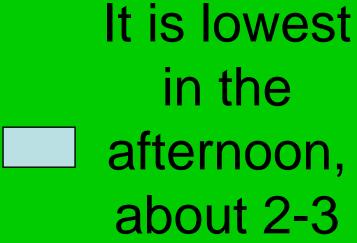
It takes less water molecules to fill cool air.





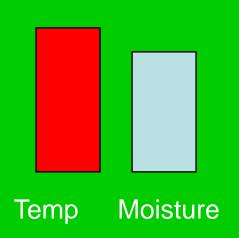
The Time of Day Affects Relative Humidity

It is highest early in the morning just before sunrise.





Why?



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.



2005, rev. 2009.

Temp Moisture

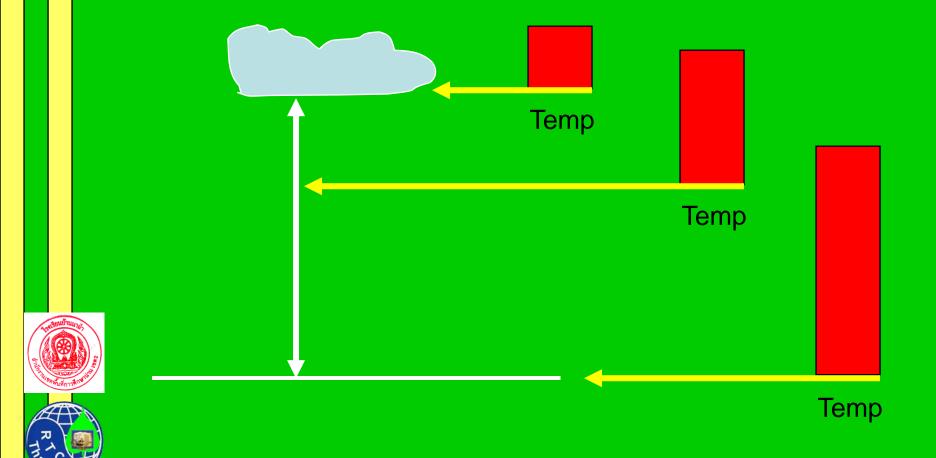
RH = 75%

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



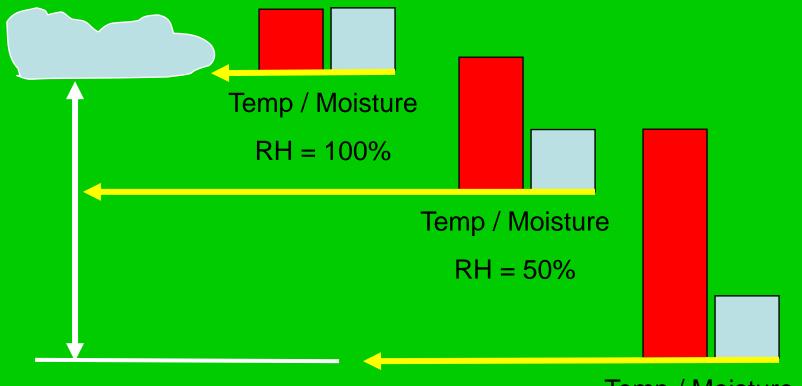
© 2005, rev. 2009,

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



2005, rev. 2009.

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





Temp / Moisture

RH = 30%

© 2005, rev. 2009,

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

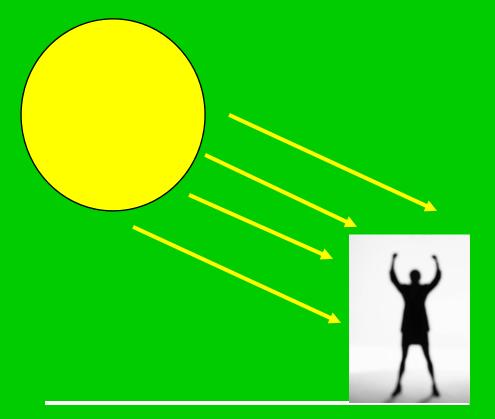


^o 2005, rev. 2009,

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



High temperatures and high relative humidity...



make it dangerous to work outside.





^o 2005, rev. 2009,

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





© 2005, rev. 2009, G.K Lee & S. Lee

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

© 2005, rev. 2009,

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





© 2005, rev. 2009,