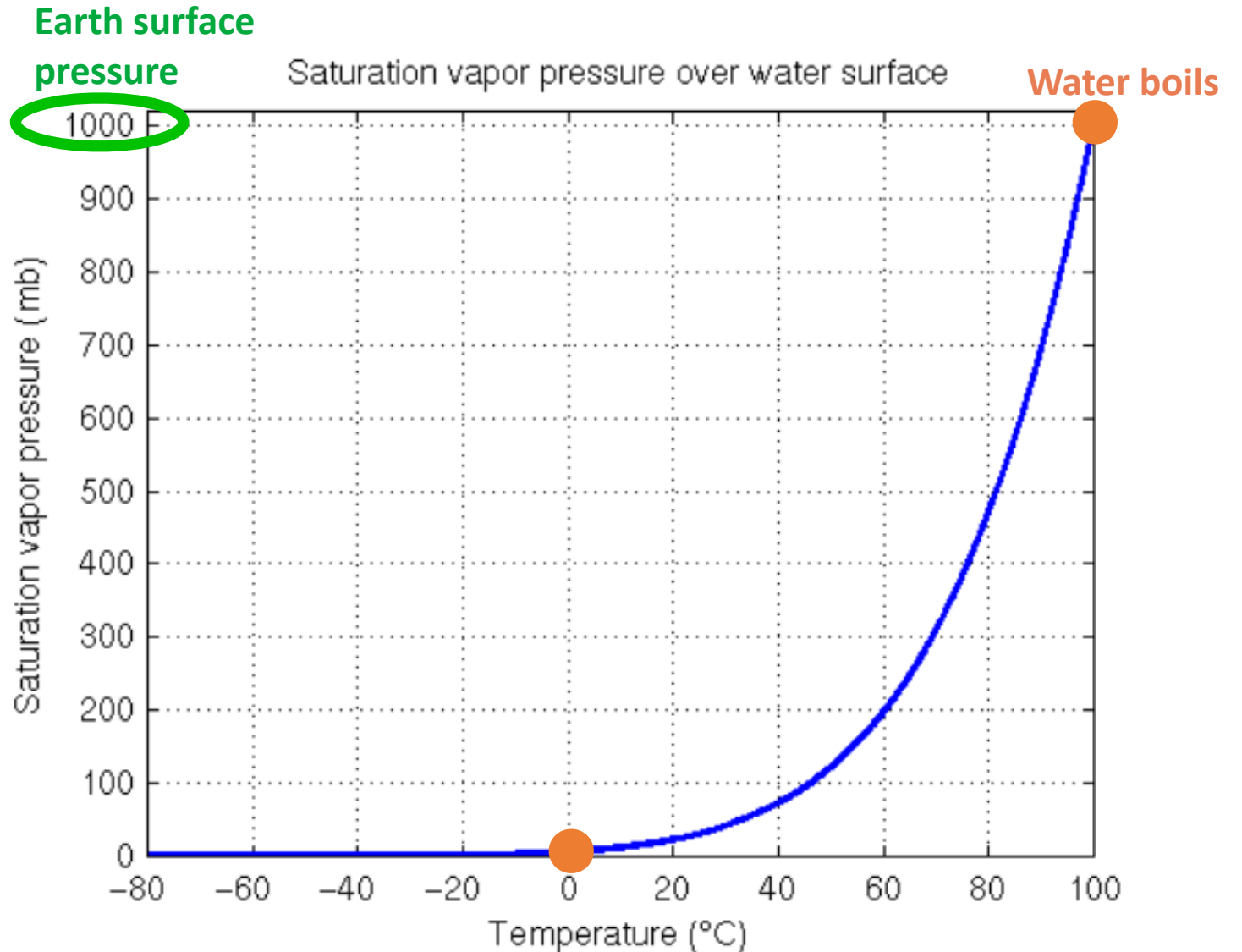# Global Warming
Lecture 1.2
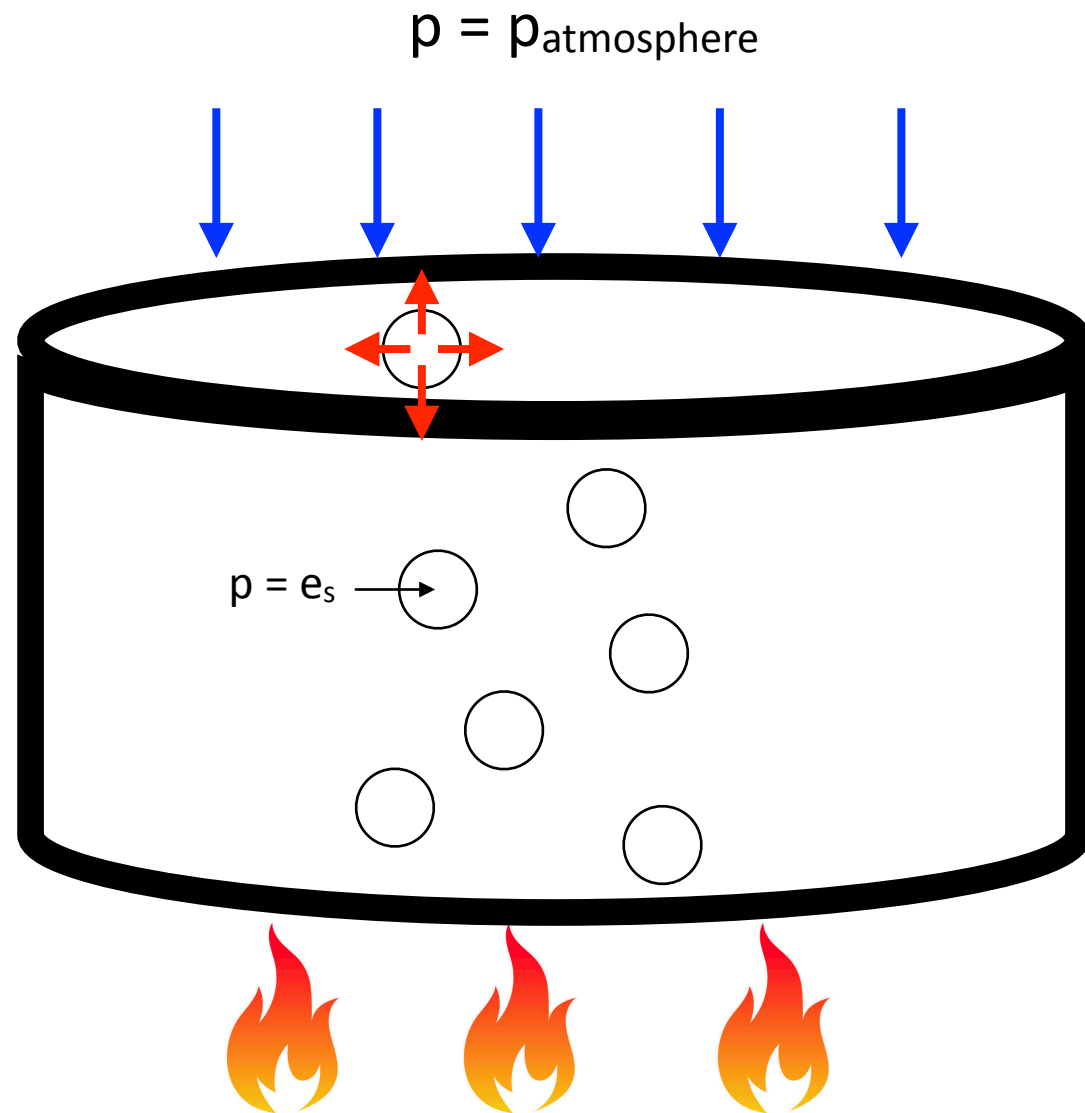# Heat Stress Death

Saturation Vapor Pressure e_s

Maximum amount of water that air can hold

Any extra amount would condense out

Exponentially: larger increase when the temperature is high

Saturation vapor pressure over water surface

Why water boils when e_s is equal to atmospheric pressure

$p = p_{atmosphere}$

$p = e_s$

Relative Humidity

Percentage of the saturation vapor pressure that the actual water vapor pressure:

Actual water vapor pressure

$$RH = \frac{e}{e_s} \times 100\,\%$$

Saturation water vapor pressure

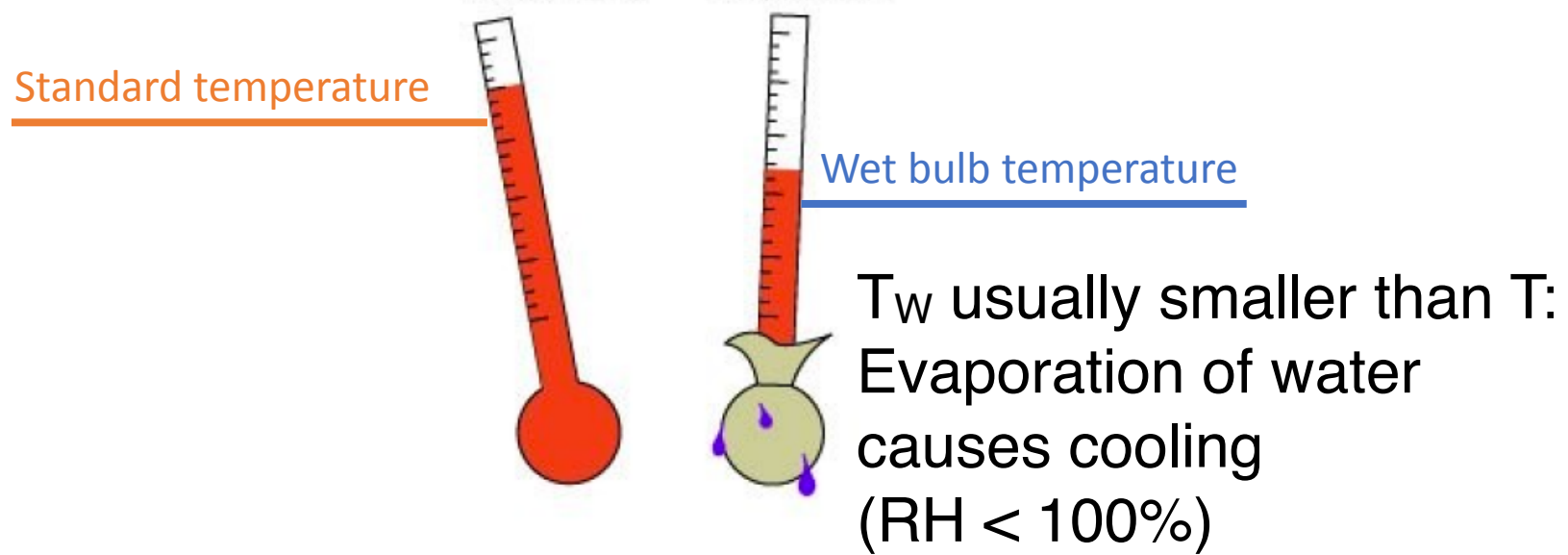# Relative Humidity

Percentage of the saturation vapor pressure that the actual water vapor pressure:

Actual water vapor pressure
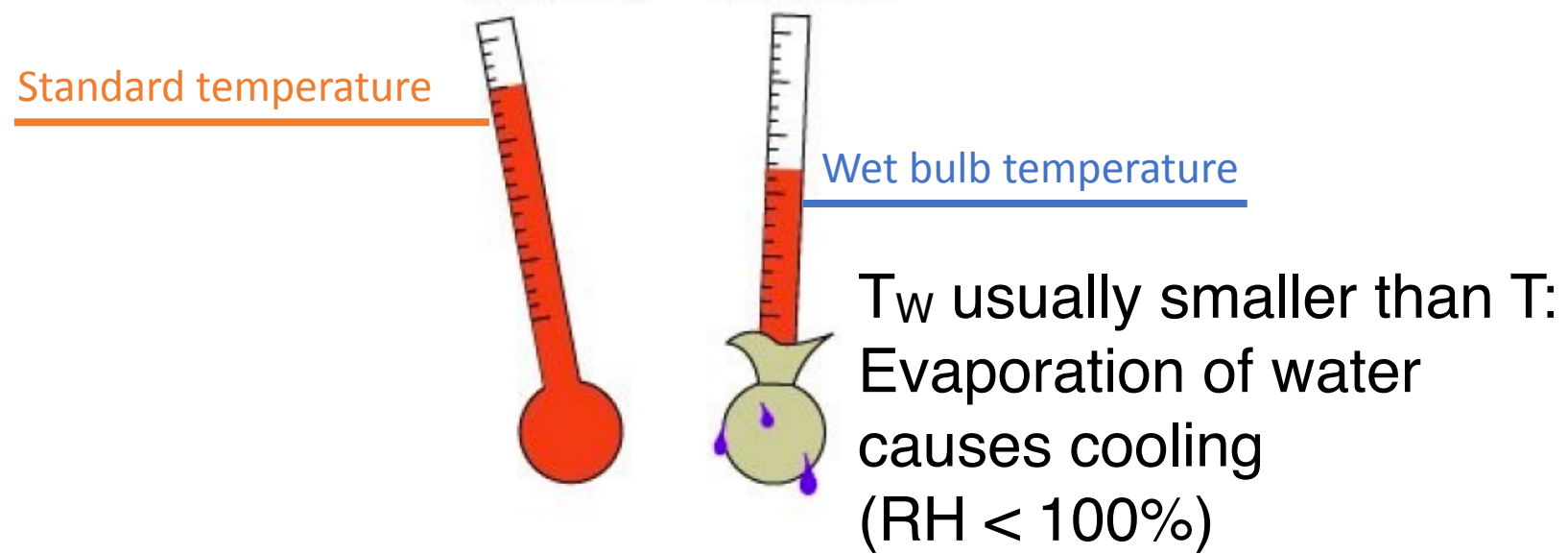
$$RH = \frac{e}{e_s} \times 100 \, \%$$

Saturation water vapor pressure

Compare the amount of water vapor in these two atmosphere:
1. RH=50%, T=10 C; 2. RH=50%, T = 30 C.

Wet Bulb Temperature T$_W$

Standard temperature

Wet bulb temperature

T$_W$ usually smaller than T:
Evaporation of water
causes cooling
(RH < 100%)

What may happen when RH=100%?

Wet Bulb Temperature T$_W$

Standard temperature

Wet bulb temperature

T$_W$ usually smaller than T: Evaporation of water causes cooling (RH < 100%)

What may happen when RH=100%?   T$_W$ = T

Wet Bulb Temperature T_W
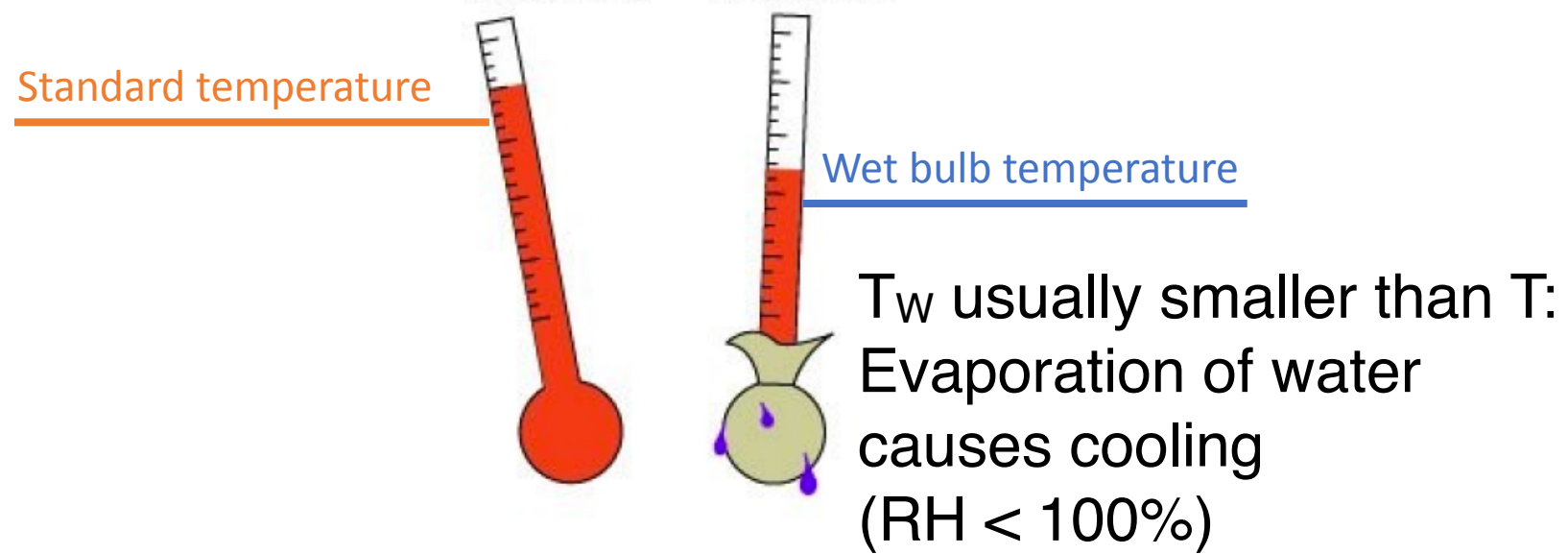
Standard temperature

Wet bulb temperature

T_W usually smaller than T:
Evaporation of water causes cooling
(RH < 100%)

What may happen when RH=100%? $T_W = T$

Human body cools by evaporating sweat. What if T_W reaches human body temperature?

Wet Bulb Temperature T_W

Standard temperature

Wet bulb temperature

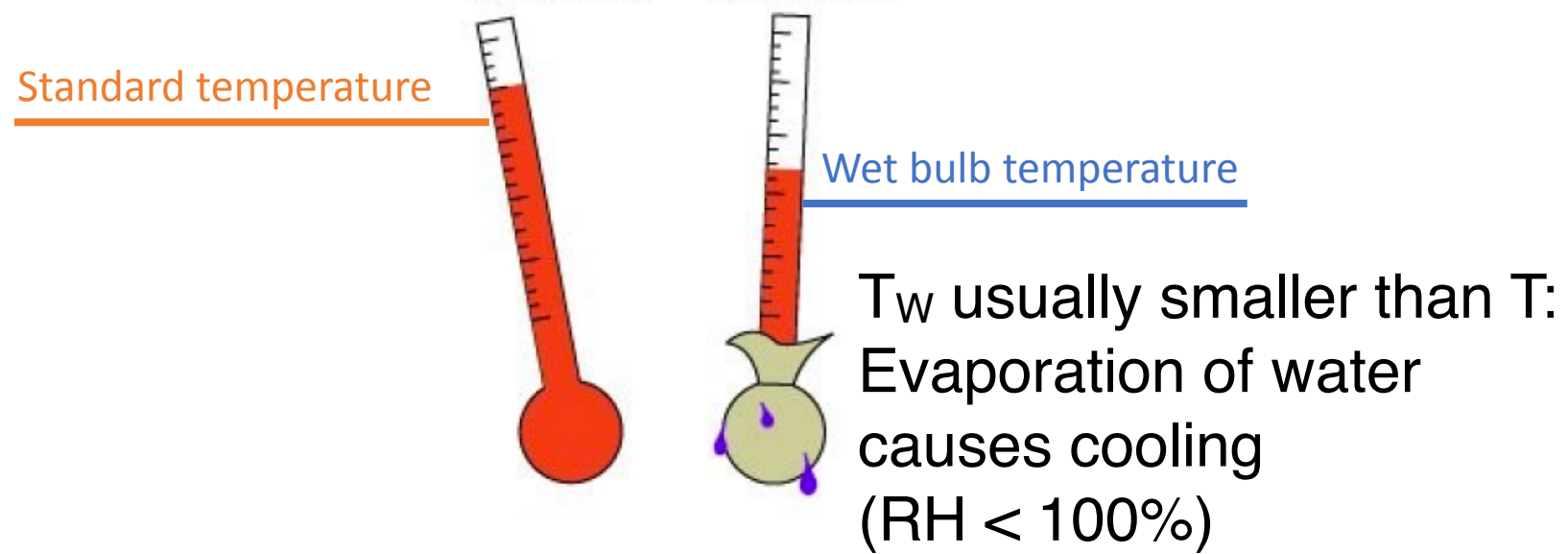T_W usually smaller than T:
Evaporation of water
causes cooling
(RH < 100%)

What may happen when RH=100%? $T_W = T$

Human body cools by evaporating sweat. What if T_W reaches human body temperature?

Human no longer be able to dump heat into environment - they would overheat and die in a few hours!

Percentage Change

New value

Old value

$$100 \times \frac{x_2 - x_1}{x_1} \%$$

Old value

Weight increased to 182 lbs from 168 lbs:

$$100 \times \frac{182 - 168}{168} \% = 8.3\%$$

He hit 39 home runs in 2019 and 29 in 2020:

$$100 \times \frac{29 - 39}{39} \% = -25.6\%$$

(Not required) How is T_W influenced by atmosphere temperature T, relative humidity RH, and air pressure p?

Try it and think!

Relative Humidity
by **Tim Brice** and **Todd Hall**

Enter a temperature, relative humidity and actual station pressure		wet-bulb	unit	dewpoint
Temperature:		**wet-bulb**	**unit**	**dewpoint**
95 ● Fahrenheit ○ Celsius ○ Kelvin		89.35	Fahrenheit	87.86
RH:		31.86	Celsius	31.04
80 %		305.02	Kelvin	304.2
Enter your actual station pressure (not the altimeter setting):				
760 ○ in of mercury ● mm of mercury ○ millibars (hPA)				
Convert		Clear Values		

Increase T, increase T$_W$

89.35 -> 94.09

Enter a temperature, relative humidity and actual station pressure		wet-bulb	unit	dewpoint
Temperature:		**wet-bulb**	**unit**	**dewpoint**
100 ● Fahrenheit ○ Celsius ○ Kelvin		94.09	Fahrenheit	92.72
RH:		34.49	Celsius	33.73
80 %		307.66	Kelvin	306.89
Enter your actual station pressure (not the altimeter setting):				
760 ○ in of mercury ● mm of mercury ○ millibars (hPA)				
Convert		Clear Values		

Relative Humidity
by Tim Brice and Todd Hall

Enter a temperature, relative humidity and actual station pressure			
Temperature:	**wet-bulb**	**unit**	**dewpoint**
95 ● Fahrenheit ○ Celsius ○ Kelvin	89.35	Fahrenheit	87.86
RH:	31.86	Celsius	31.04
80 %	305.02	Kelvin	304.2
Enter your actual station pressure (not the altimeter setting):			
760 ○ in of mercury ● mm of mercury ○ millibars (hPA)			
Convert	Clear Values		

89.35 -> 92.26

Increase RH, increase T_W: less evaporation

Enter a temperature, relative humidity and actual station pressure			
Temperature:	**wet-bulb**	**unit**	**dewpoint**
95 ● Fahrenheit ○ Celsius ○ Kelvin	92.26	Fahrenheit	91.6
RH:	33.48	Celsius	33.11
90 %	306.64	Kelvin	306.27
Enter your actual station pressure (not the altimeter setting):			
760 ○ in of mercury ● mm of mercury ○ millibars (hPA)			
Convert	Clear Values		

Relative Humidity
by [Tim Brice](#) and [Todd Hall](#)

Enter a temperature, relative humidity and actual station pressure

Temperature:	wet-bulb	unit	dewpoint
95 ● Fahrenheit ○ Celsius ○ Kelvin	89.35	Fahrenheit	87.86
RH:	31.86	Celsius	31.04
80 %	305.02	Kelvin	304.2
Enter your actual station pressure (not the altimeter setting):			
760 ○ in of mercury ● mm of mercury ○ millibars (hPA)			
Convert	Clear Values		

89.35 -> 90.18

Increase p, increase TW:
less evaporation

Enter a temperature, relative humidity and actual station pressure

Temperature:	wet-bulb	unit	dewpoint
95 ● Fahrenheit ○ Celsius ○ Kelvin	90.18	Fahrenheit	87.86
RH:	32.32	Celsius	31.04
80 %	305.48	Kelvin	304.2
Enter your actual station pressure (not the altimeter setting):			
1400 ○ in of mercury ● mm of mercury ○ millibars (hPA)			
Convert	Clear Values		