Smart Irrigation System: Challenge #3

In this activity, you will use a Digital Temperature and Humidity (DHT) sensor to measure temperature and relative humidity. You will use these measurements to determine if conditions are ideal for watering.

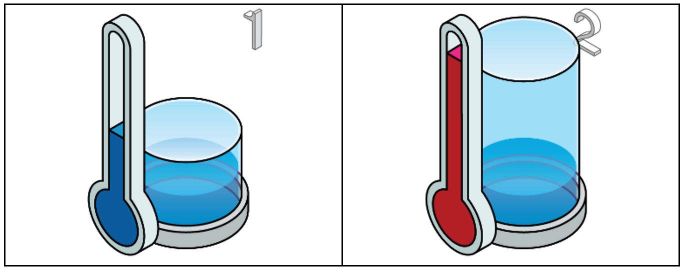
Goals:

1. Use the read command to read temperature.
2. Use the read command to read humidity.
3. Use a While loop to repeat code.
4. Use an If-Then statements to make decisions

Background:

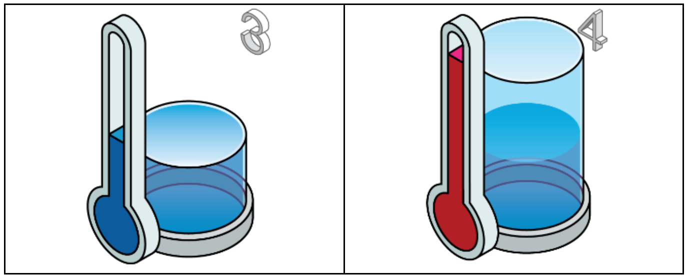
The amount of water from the ground that evaporates into the air is dependent on the ambient temperature and relative humidity. For a particular temperature, there is a maximum amount of water that can evaporate and exist as vapor in the air. This is referred to as the *saturation vapor pressure* and is calculated using the Clausius-Clapeyron relation.

Image #1 illustrates when the temperature is low, the corresponding maximum amount of water vapor the air can hold (saturation vapor pressure) is also low as represented by the small container. In image #2, the temperature is high and the maximum amount of water vapor the air can hold is also high as shown by the larger container.



On any given day, the air will contain a certain amount of water, this is the *water vapor pressure* as illustrated by the darker blue volume in images 1, 2, 3, and 4. The water vapor pressure may be less than or equal to the maximum saturation vapor pressure.

Image #3 illustrates a cool day with much water in the air. Notice the container is small and the water in the air just fills its container. Contrast with image #4 that illustrates a warm day with the same amount of water in the air as image #3.



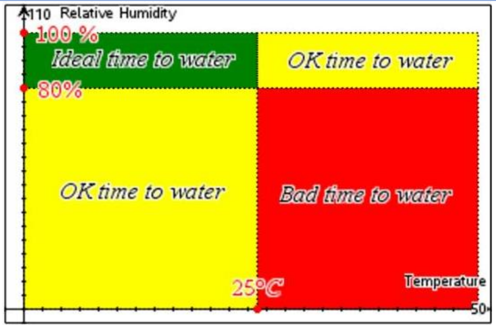
The relative humidity in image 3 is 100% because the amount of vapor in the air is 100% of the maximum the air can hold. The relative humidity in image #4 is 50% because the amount of vapor in the air is 50% of the maximum the air can hold

Relative humidity is the percentage of the measured vapor pressure divided by the theoretical saturation vapor pressure. Thus, relative humidity does not inform how much water is in the air, instead, the percentage of the theoretical maximum amount of water that is in the air at a particular temperature.
When relative humidity is 100%, and water evaporates from the ground, water vapor will precipitate back into the liquid phase and fall as rain and there will be no net transfer of liquid water from the ground into the air.

There are many inferences that can be made from the above concept.

- On a hot day, more water will evaporate from the ground to produce a relative humidity of 70% compared to a cold day with 70% relative humidity. This is because on a hot day there is a greater saturation vapor pressure and more water in the air is needed to establish 70%.
- When relative humidity is high, less evaporated water is required to reach the maximum saturated vapor density at a given temperature.
- To minimize the net transfer of liquid water on the ground into water vapor in the air (evaporation), water should be delivered when it is cool and the relative humidity is high.

Planning:



The graph above illustrates watering conditions based on relative humidity and temperature. Use the graph to explain in words when each condition would occur.

It is an ideal time to water when ____

It is an OK time to water when ____

It is an OK time to water when ____

It is a bad time to water when ____

Use the graph and your statements from the previous page to create a decision tree to illustrate the If – Then – End statements your program will use.

Command	Example	Behavior
CONNECT <type> <number> TO <port>	Send("CONNECT LIGHTLEVEL 1 TO IN1")	Associates the first LIGHTLEVEL object with a light sensor plugged into port IN1 on the Hub.
SET <type> <number> TO <value>	Send("SET ANALOG.OUT 1 TO 128")	Turns on an analog.out1 object, such as a pump, to a power setting of 128
RANGE <type> <number> <min value> <max value>	Send("RANGE LIGHTLEVEL 1 0 100")	Scales the measured values read from LIGHTLEVEL 1 to return in the range 0 to 100.
READ <type> <number>	Send("READ MOISTURE 1")	Reads one measurement from the first moisture sensor.
Get(<variable>)	Get(m)	Stores the moisture measurement into the variable named m. *Note a get command must immediately follow a read command. The value stored will contain the measurement from the immediately preceding READ command."
Output(<row> ,<column>, <"text">)	Output(1,3,"Hello World")	Displays "Helllo World" on row 1 column 3.
For(index variable , start, stop) <statements> End	For(n , 1, 3) Send("READ DHT 1 TEMPERATURE") Get(t) Wait2 End	Read and store the temperature as t 3 times. Wait 2 seconds between each reading
If <Boolean expression> Then <statements 1> Else <statements 2> End	If t >=40 Then Output(6,1,"It is Hot) Else If t>= 25 and t < 40 Then Output(6,1,"It is warm") Else Output(6,1,"It is Cool") End End	If the first Boolean expression is true, the corresponding statements are executed and the decision tree is immediately exited. In the example, if t=30 then the first expression is false and the <statements 1> are skipped, the second expression is true and <statements 2> are executed and the tree is exited. Additional If statements may be inserted if needed.
The DHT sensor requires a few seconds to "warm up" and begin communicating with the Hub. During this period, the temperature is	Output(3,1,"DHT WARMING UP") −273→T While T<−270	The program uses a While loop to continuously read the DHT every two seconds until it reports a value greater than absolute zero.

reported to be absolute zero (-273 °C).	Send("READ DHT 1 TEMPERATURE") Get(T) Wait 2 End Output(3,1,"DHT IS NOW READY")	

Challenge:

Write a program named *c3* that connects the Digital Temperature and Humidity (DHT) Sensor.

- Read 20 measurements at two-second intervals and display with an appropriate message.
- Use your decision tree to determine and display the present watering conditions. Display an appropriate message with each of the four cases.