MiSP Weather Data Worksheet #1 L2

Name ____________________________________ Date ____________

TEMPERATURE AND WATER VAPOR (HUMIDITY)

Introduction:

Absolute humidity is the amount of water vapor contained in a given amount of air. It is measured as the mass of water in a certain volume of air (often expressed as grams per cubic meter). For any temperature of air, only a certain amount of water can "fit" in the air. Once that limit is reached, the air is saturated; it cannot hold any more water.

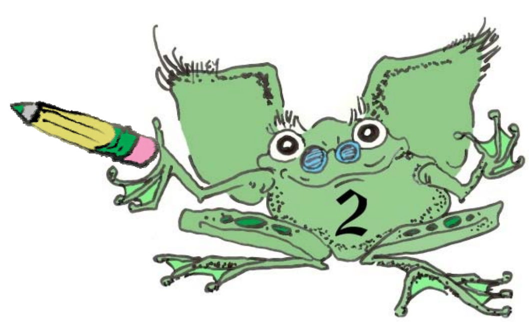
Mixing ratio also measures the amount of water vapor contained in air at a given temperature. It is measured as mass of water vapor in a defined mass of air (usually expressed as grams per kilogram of air). *Saturation mixing ratio* is the amount of water vapor (grams) needed to completely "fill" a kilogram of air.

Relative humidity compares the mass of water vapor in the air with the maximum mass of water vapor that could "fit" in the air to make it saturated using the *saturation mixing ratio*. Relative humidity is expressed as a percent.

Dew point is the temperature at which air, with a particular amount of water vapor in it, releases some of the air as liquid water (condensation or "dew". It is the temperature at which the air's relative humidity is 100%.

Problem:

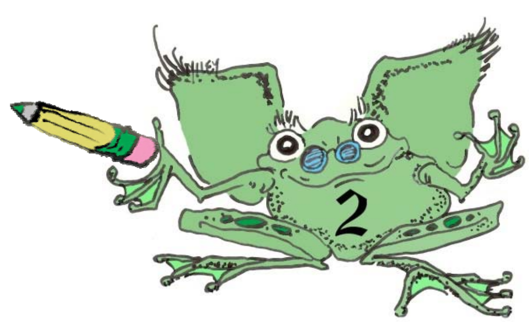
How does temperature affect the maximum amount of water (in grams) that one kilogram of air can contain?

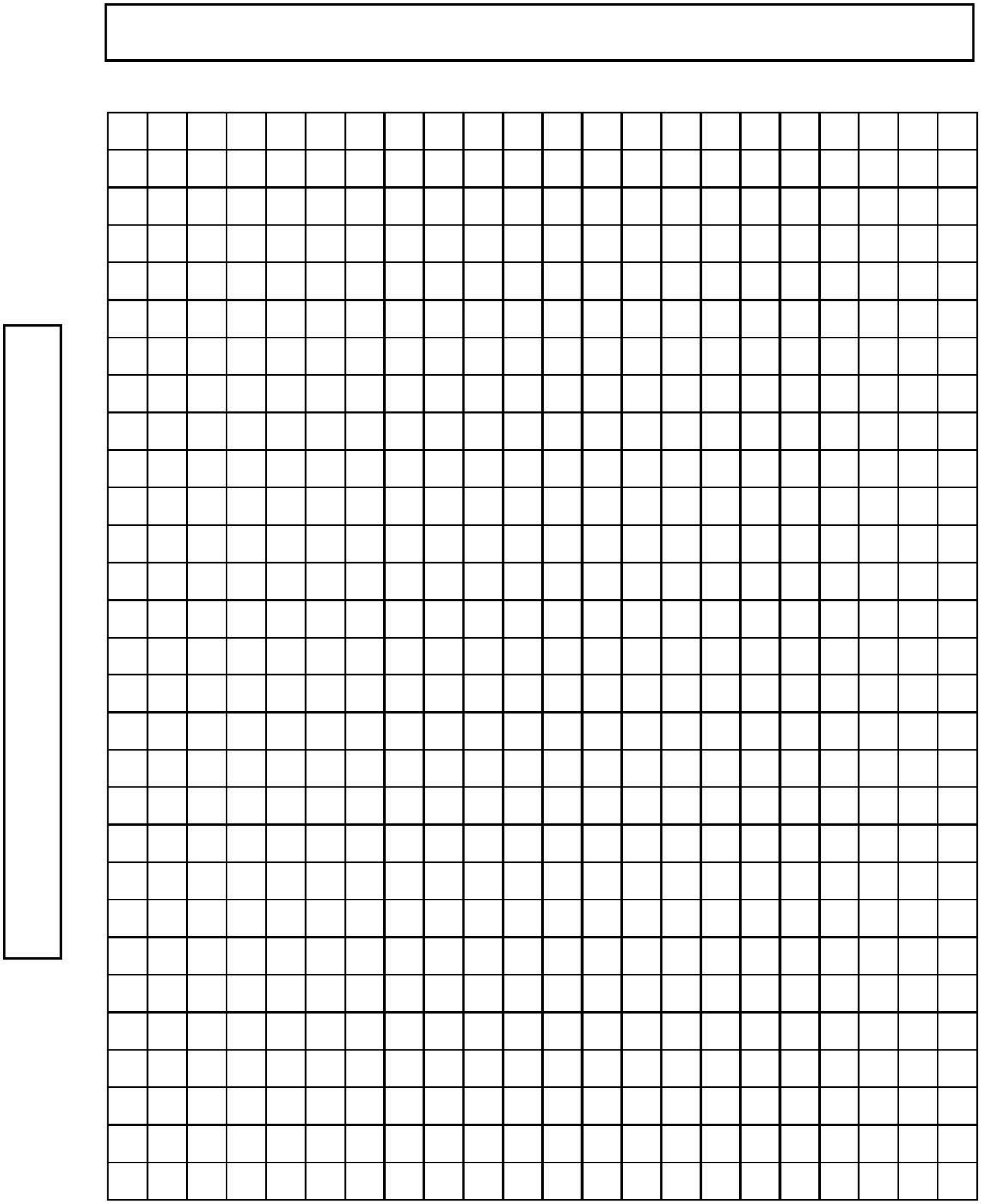


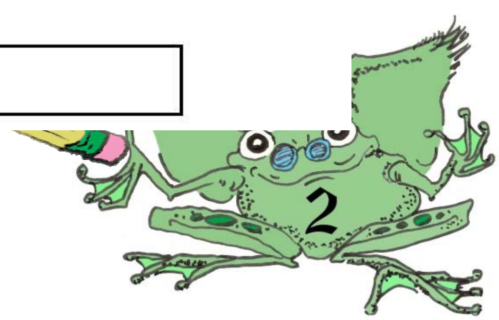
<u>Data</u>: Saturation mixing ratio (at 1000 mb).	
Temperature Degrees Celsius	Maximum Amount of Water Vapor (g) per Kilogram of Dry Air
0	4.0
10	8.0
20	15
30	28
40	50
50	88

Graphing the data:

- Label the *x*-axis.
- Label the *y*-axis.
- Connect the points.
- Draw a best-fit line through the points.
- Put a title on your graph.



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Discussion Questions:

1. Make a generalization about the maximum amount of water 1 kilogram of air can contain by completing the following sentence:
   As air temperature increases, the maximum amount of water (g) that 1 kilogram of air can contain ________________________.

2. Relative humidity compares the amount of water (g) in 1 kilogram of air with the maximum amount of water (g) that the air could contain at a given temperature (saturation mixing ratio – *what you graphed*). Relative humidity is expressed as a percent:

   $$\text{Relative humidity (\%)} = \frac{\text{Water (g)}}{\text{Maximum water (g)}} \times 100$$

   What is the relative humidity of the following 1 kilogram samples of air if 6.0 g of water vapor is contained in the samples? Show your work.

   1 kilogram of air at 10°C

   1 kilogram of air at 50°C

3. Look at the data on the graph from 30°C to 50°C. If three samples of air at 30°C, 40°C, and 50°C each contained 26 g of water vapor, which sample would have the highest relative humidity? Explain how you found your answer from the data on the graph.

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4. Air at 20°C with 15 g water vapor per kilogram of air is saturated. What would happen if the air is cooled?

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5. Use the best-fit line to estimate how much water would be contained in a saturated 1 kilogram sample of air at:

   15ºC ____________________

   60ºC ____________________

6. Compare the changes in the mass of water (g) in 1 kilogram of saturated air as temperature (ºC) increases by calculating the unit rate of change (slope). *Use ordered pairs from the best-fit line. Do not use your data chart.*

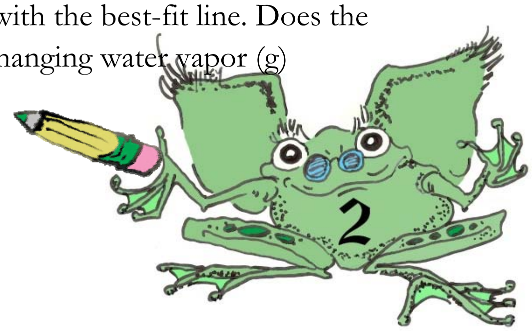
$$\textbf{Unit Rate of Change} = \frac{\Delta \text{ Mass of Water (g)}}{\Delta \text{ Temperature }^{o}\text{C}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Mass of Water (g) Δy	Δ Temperature ºC Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$

7. Put the unit rate of change (slope) of the best-fit line into words by completing the sentence below:
   When temperature increases by 1 ˚C, the maximum amount of water vapor that 1 kilogram of air may contain

   ___________________________ *by* ___________ *grams.*

8. Look at the graph. Compare the lines connecting each data point with the best-fit line. Does the unit rate of change (slope) of the best-fit line fairly represent the changing water vapor (g) capacity of 1 kilogram of air as temperature increases? Explain.

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