MiSP Solubility Lab L3

Name _____ Date _____

In today's lab you will be working in groups to determine whether sugar or salt dissolves more quickly in water. The rate at which different substances dissolve depends on a number of factors. You should know several of these factors. (For instance, which dissolves quicker: a sugar cube or granulated sugar?) What other factors affect how quickly a solute dissolves?

1) _____
2) _____
3) _____

The rate at which solutes dissolve is related to, but not the same as, solubility. Solubility is defined as the maximum quantity of solute that can dissolve in a certain quantity of solvent at a specified temperature. Differences in the solubility of different solutes are related primarily to differences in the chemical nature of the solutes and the solvents. Water is a very good solvent and many different substances dissolve quickly in water. Which do you think will dissolve more quickly in water: salt or sugar? Write your prediction and the reason for your choice in the space below.

_____

_____

_____

_____

Lab Procedure:

Your group will be given:

- 2 beakers, each with 100 ml of room temperature water
- 2 stirring rods
- 4 containers, each with 1 gram of salt
- 4 containers, each with 1 gram of sugar
- a stopwatch
- colored pencils

Collect Data:

Within your group, assign one person to add and stir the salt; one person to add and stir the sugar; one timer; and one data recorder.

Salt

Add 1 gram of salt to the beaker of water. Start the timer and begin stirring immediately. Watch the solution. When all of the salt appears to have dissolved, stop stirring but do not stop the stopwatch. Check to see if all of the salt has dissolved. If it has, note the time. Do not stop the stopwatch. Immediately add the second gram of salt to the beaker and begin to stir. If the salt has not completely dissolved, start stirring again. Continue this procedure until all 4 grams of salt are completely dissolved. Record the elapsed time each time a gram of salt completely dissolves. Record your data in table 1.

Sugar

Repeat the same procedure, using the sugar. Record the data in table 1.

Table 1. Time needed to dissolve salt and sugar in 100 ml water.

Amount of solute (grams)	Elapsed Time (seconds)	
	Salt	Sugar
1		
2		
3		
4		

As a class you will collect individual group data and create a class data table. Copy the class data in table 2 below.

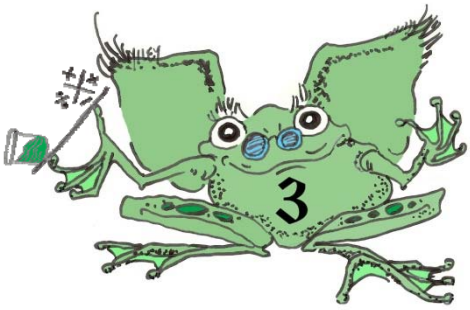
Table 2: Rate of dissolving for salt and sugar in water — class data.

Salt	Amount of salt (grams)			
	1 gram	2 grams	3 grams	4 grams
Elapsed Time (seconds) – individual group data				
Average				
Sugar	Amount of sugar (grams)			
	1 gram	2 grams	3 grams	4 grams
Elapsed Time (seconds) – individual group data				
Average				

Graph the Data:

1. Plot the averaged data for salt and sugar on the graph (separate sheet at the end of the lab worksheet).
2. The amount of solute is the variable that you manipulated. You measure the elapsed dissolving time for each gram of solute added. On the basis of this information, you should plot "Amount of solute in grams" on the ___ axis and "Elapsed time in seconds" on the ____ axis.
3. Because we are interested in comparing how long it took the two solutes to dissolve, however, it makes more sense to plot "Elapsed time in seconds" on the *x*-axis and "Amount of solute in grams" on the *y*-axis.
4. Decide on an appropriate interval for both the *x*-axis and the *y*-axis. Remember that the *x*-interval must include the highest and lowest values for all three **ELAPSED TIME** data tables.
5. Plot the AVERAGED ELAPSED TIME for each gram of salt. Draw a best-fit line. Make this line green.
6. Plot the AVERAGED ELAPSED TIME for each gram of sugar. Draw a best-fit line. Make this line red.
7. Create a key on the side of the graph that shows what each color represents.
8. Add a title to the graph.

Analyze the Data:



1. Which dissolves faster in water: salt or sugar? _____

2. What do you notice about the slopes of the lines representing salt and sugar?

   _____

3. Approximately how much salt was dissolved in water at 45 seconds? _____

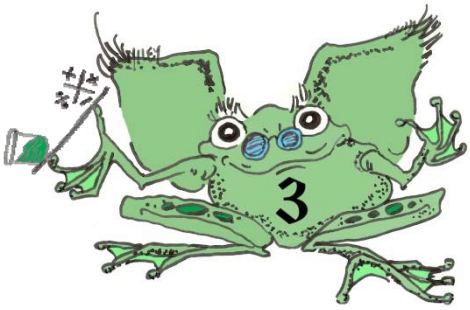
4. Approximately how much sugar was dissolved in water at 45 seconds? _____

5. On a graph, how do you know if the solute was dissolving at a constant rate?

   _____

6. Using two ordered pairs on the best-fit line, calculate the unit rate of change (slope) for the dissolving rate of salt.

Unit Rate of Change = $\frac{\Delta y}{} = \frac{(y_2 - y_1)}{}$



Δx $(x_2 - x_1)$

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Amount of salt dissolved (g) Δy	Δ Time (sec) Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$

7. What is the dissolving rate for salt? _____

8. Calculate the dissolving rate for sugar.

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Amount of salt dissolved (g) Δy	Δ Time (sec) Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$

9. What is the relationship between slope and dissolving rate?

_____

10. Use the equation for a line to calculate the *y*-intercept for the two best-fit lines. The equation for a line is $\boldsymbol{y = mx + b}$ where *m* is the unit rate of change (slope) and *b* is the *y*-intercept.

Y-Intercept	Salt	Sugar
$m =$		
Ordered pair (x, y)		
$y = mx + b$ Substitute and solve for b:		

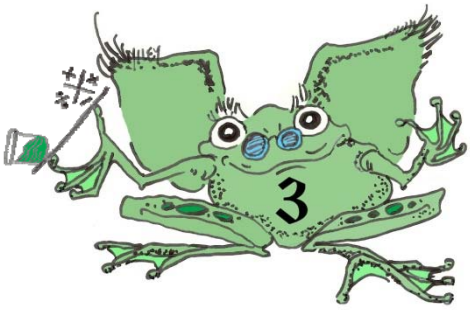
11. Use your calculated values for m and b to write an equation for the dissolving rate of salt: _____

    sugar: _____

12. Use the equation for salt to determine how many grams of salt were dissolved in 18 seconds.

13. Use the equation for sugar to determine how much time it would take to dissolve 3.4 grams of sugar.

14. Use the equation for salt to determine how long it would take to dissolve 100 grams of salt.



15. Question #14 asked for you to use the equation for a line to extrapolate data. How could this lead to an error?

_____

_____

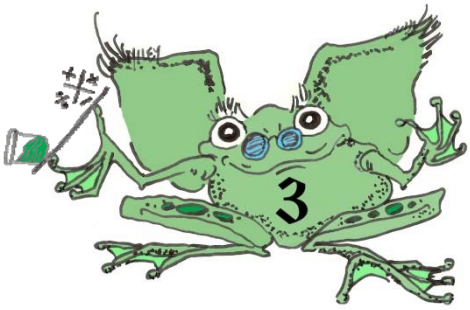
16. If a different solute dissolved much faster than salt, where would the line be on the graph compared to the line for salt?

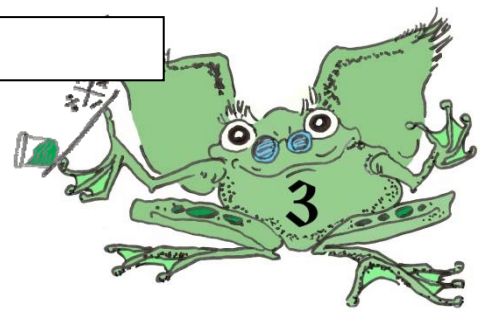
_____

_____

17. At any given temperature, there is a maximum amount of any solute that can be dissolved in water. When no more of the solute can be dissolved, water is said to be saturated with that solute. What would your graph for the rate of dissolving of salt or sugar look like after the point of saturation?

_____

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