

Conductivity of Gatorade Worksheet **Answers**

- Use the set of solutions on your lab bench and the conductivity meter to complete the data table below. If some of the LEDs remain continuously lit, while others flicker, record the average value (for example, say for the 0.03 solution, the meter reads the bottom 3 LEDs as continuously lit, while the fourth LED from the bottom flickers on and off, record this reading as 3.5). Use the following equation to compute the amount of NaCl needed to make the calibration solutions at the necessary concentrations:

$$C \cdot V \cdot MW = \text{grams NaCl}$$

C = concentration (molarity) of solution

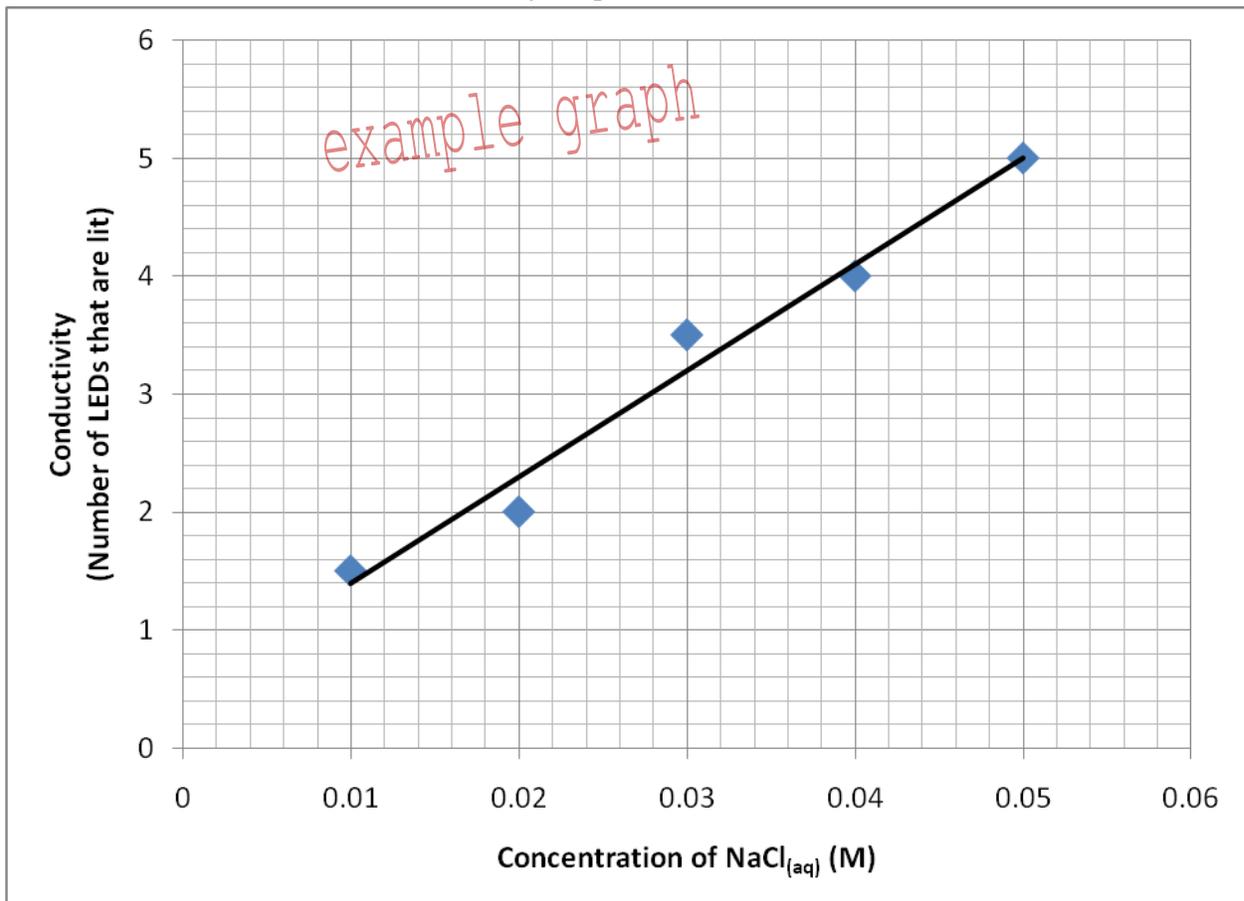
V = volume of solution

MW = molecular weight of NaCl (58.44 g/mole)

For example, to make 2 liters of a 0.01 M solution of NaCl, weigh out 1.17 g of NaCl and add 2 liters of water.

Concentration of NaCl _(aq) (M)	Conductivity (number of lights)
0.01	1.5
0.02	2
0.03	3.5
0.04	4
0.05	5

- Graph the data from the table on the grid below. Label both axes with an appropriate title, scale and units. Circle and connect your points.



3. Explain, in terms of particles, why NaCl(aq) conducts electricity.

When NaCl dissolves in water, it dissociates into ions (Na^+ and Cl^-) which conduct electricity.

4. Based on your graph, what is the relationship between the concentration of the solution and the conductivity?

As the concentration of salt increases, the conductivity of the solution also increases.

5. Explain how you could use your graph to find the concentration of an unknown aqueous solution of NaCl.

The concentration of an unknown solution of NaCl, can be discerned by matching up its conductivity reading with the corresponding concentration using a best fit line of the data points.

6. Use your graph to determine the concentration of the unknown NaCl solution located at the front of the room. Make sure to include units.

Answer depends on NaCl solution provided by teacher.

7. How accurate is the concentration you recorded for the unknown NaCl solution? (Hint: What are some limitations of the conductivity meters?)

Any concentration that is greater than 0.05M NaCl will yield a reading of 5 LEDs, so it is unclear what true concentration is. The same is true for concentrations that yield 0 LEDs.

8. Complete the table below for the different flavors of Gatorade. Use your conductivity meter and your graph.

Gatorade Flavor / Color	Conductivity (number of lights)	Concentration of ions (M)
blue	3	0.0275
yellow	3	0.0275
red	3.5	0.03

9. Answer the following based on the Gatorade data in #8:

- a. Which flavor/color of Gatorade has the greatest concentration of dissolved ions?

They are all the same.

- b. Which flavor/color of Gatorade has the lowest concentration of dissolved ions?

They are all the same.

- c. The general ingredient list for Gatorade includes: water, liquid sugar, glucose-fructose, citric acid, natural flavors, salt, sodium citrate, monopotassium phosphate, color, ester gum and brominated vegetable oil. List *three* electrolytes found in Gatorade.

citric acid, salt, sodium citrate, monopotassium phosphate

- d. Why is the heading in the Gatorade data table “concentration of ions” and not “concentration of NaCl”?

As Gatorade contains many different kinds of salt, which dissociate into ions, the conductivity reading is a measurement of the total amount of ions.

- e. Which flavor/color of Gatorade would be most beneficial for someone who has an electrolyte imbalance (kidney disease, eating disorders, stomach virus, flu)? Explain.

Any flavor would suffice.

10. Obtain a sample of pickle juice, which we will assume is mostly NaCl(aq). Test the conductivity. Is pickle juice a dilute or concentrated solution of salt? Explain how you arrived at this conclusion.

The pickle juice should be highly concentrated, therefore it should give a conductivity reading of 5 solid LEDs.

11. Based on your understanding of electrolytes, circle which of the following two solutions you predict will show greater conductivity. Explain your answer in terms of particles.

0.03 M NaCl_(aq)

or

0.03 M CaCl_{2(aq)}

12. Obtain a sample of 0.03 M CaCl_{2(aq)} and determine its conductivity. Was your prediction correct? Why or why not?

CaCl₂ has more ions (3 vs. 2 for NaCl) which should allow it to have a higher conductivity.