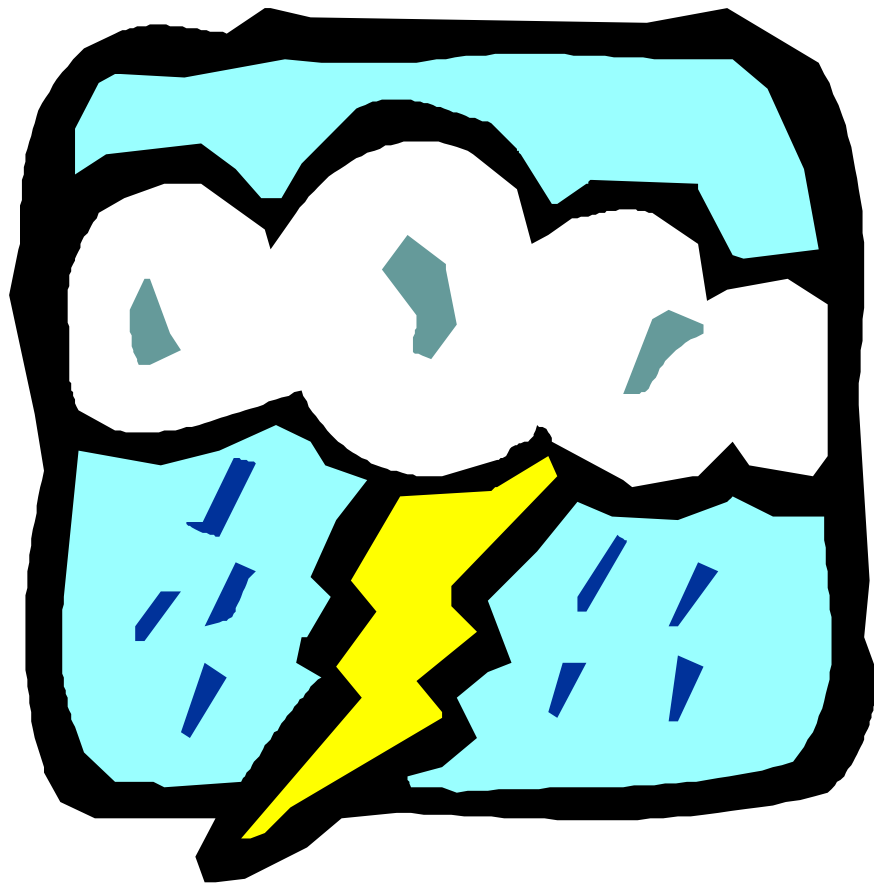


# Don't Get Zapped!

Parameter Changes in Linear Equations of the Form  $y=mx+b$



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## Parameter Changes in Linear Equations of the Form $y=mx+b$

### About the math

In this lesson, the students will investigate parameter changes of a linear function. The students should be able to recall from Algebra I:

- When two equations have the same slope and different y-intercepts, they are parallel. (no point of intersection)
- When the equations have different slopes, they will intersect. (one point of intersection)
- When the equations have the same slope and the same y-intercept, they are the same line. (infinite points of intersection)

### Set Up

Teacher Preparation and Pre-Lab Demonstration

#### Materials:

For  $\text{CaCl}_2$  in distilled water teacher demonstration:

Logger Pro Software and Don't Get Zapped File  
1 conductivity probe (set on the 0-2000 range)  
1 100 mL beaker  
1 dropper  
60 mL distilled water  
100 mL of a 1.0M solution of  $\text{CaCl}_2$

For NaCl in distilled and tap water student activity:

Logger Pro Software and Don't Get Zapped File  
Class set of conductivity probes (set to the 0-2000 range)  
Class set of 100 mL beakers  
Class set of dropper  
Distilled water (enough for each group in all classes to have 60 mL)  
1.0 M solution NaCl (in dropper bottles)  
Tap water (enough for each group in all classes to have 60 mL)

How to make the solutions:

To make the 1.0M solution of  $\text{CaCl}_2$ , use either an electronic or a triple-beam balance to measure 14.7 g of  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  solid **OR** 11.1 g of dehydrated  $\text{CaCl}_2$  solid. Mix the solid with enough distilled water to bring the total volume up to 100mL.

To make the 1.0 M solution of NaCl, use the balance to measure 5.85 g of NaCl. Mix the salt with enough distilled water to bring the total volume up to 100mL.

*OR, just get the nearest Chemistry teacher to do this for you!!*

**Procedure:**

Plug the conductivity probe into the Din1 port. Make sure that the probe is set for the 0-2000 range (there is a switch on the probe). Launch Logger Pro and open the file called “Don’t Get Zapped Demo”(in the conductivity folder). Rinse the probe off with distilled water to make sure that the experiment is not contaminated. Place the probe in the 60 mL of distilled water and take a reading before any  $\text{CaCl}_2$  is added. Click the “Keep” button and enter a value of “0” for zero drops. Then, add 2 drops of the salt solution. Stir the mixture and then click on “Keep.” Enter a value of “2” since drops have been added. Continue this process until 12 drops have been added. Copy the data into the table on the student activity sheet. Have the students complete this process for NaCl in distilled water and NaCl in tap water.

**Teacher Notes:**

Objectives: To look at parameter changes of a linear function in real life situations. Students will investigate the change of the “b” value of the equation (y-intercept) and the change of the slope in different situations.

**TEKS**

(b) Foundations for functions: knowledge and skills and performance descriptions.

(1) The student understands that a function represents a dependence of one quantity on another and can be described in a variety of ways. Following are performance descriptions.

(A) The student describes independent and dependent quantities in functional relationships.

(B) The student gathers and records data, or uses data sets, to determine functional (systematic) relationships between quantities.

(c) Linear functions: knowledge and skills and performance descriptions.

(1) The student understands that linear functions can be represented in different ways and translates among their various representations. Following are performance descriptions.

(A) The student determines whether or not given situations can be represented by linear functions.

(B) The student determines the domain and range values for which linear functions make sense for given situations.

# Don't Get Zapped!

## Parameter Changes in Linear Equations of the Form $y=mx+b$

Have you ever been told not to use a hair dryer while taking a bath? You could be electrocuted if you dropped the dryer into the water because water conducts electricity. **Conductivity** is a way of measuring how many charged particles there are in a solution. The more charged particles there are in the water, the greater the conductivity. Tap water contains all kinds of substances you cannot see, but these particles are able to carry electrical current.

In this experiment you will use a conductivity probe to measure the effects of adding two different salts to water.

### Materials:

- Dropper bottle filled with NaCl solution
- 60 mL tap water in a beaker
- 60 mL distilled water in a beaker

### Data Tables:

Drops CaCl <sub>2</sub>	Conductivity
0	
2	
4	
6	
8	
10	
12	

**Distilled Water**

Drops NaCl	Conductivity
0	

**Distilled Water**

Drops NaCl	Conductivity
0	

**Tap Water**

**Procedure:**

- 1) Open the file "Don't Get Zapped".
- 2) Before adding any salt solution, click "Collect".
- 3) Swirl the distilled water with the probe briefly.
- 4) Monitor the conductivity of the distilled water until the conductivity reading stabilizes.
- 5) Click "Keep", and then type "0" in the edit box (for 0 drops added).
- 6) Press ENTER to store this data pair.
- 7) Add 2 drops of salt solution to the distilled water.
- 8) Swirl the solution briefly.
- 9) Monitor the conductivity of the solution until the reading stabilizes.
- 10) Click Keep, and type "2" in the edit box and press enter.
- 11) Repeat steps 7-10 for 4,6,8,10, and 12 drops.
- 12) Click "STOP" to end data collection.
- 13) Record the data in the tables provided above.
- 14) Repeat the above procedure for tap water.

Launch Graphical Analysis. Enter the data for **CaCl<sub>2</sub> in Distilled water** into the table

Answer the following questions.

1. What is the independent variable in this situation?

\_\_\_\_\_

2. What is the dependent variable in this situation?

\_\_\_\_\_

3. What type of function best represents the data?

\_\_\_\_\_

Use the manual curve fit option and your knowledge of slope and y-intercept to write an equation for this data. When you have found a good fit, write your equation below.

\_\_\_\_\_ Distilled water and CaCl<sub>2</sub>

4. What is the slope of your function? \_\_\_\_\_

5. What is the real-world meaning of this value?

6. What is the y-intercept of your function?

\_\_\_\_\_

7. What does this value tell you?

Replace the data in the table with the data for **distilled water and NaCl**. Use the manual curve fit option and your knowledge of slope and y-intercept to write an equation for this data. When you have found a good fit, write your equation below.

\_\_\_\_\_ Distilled water and NaCl

8. What is the slope of your function? \_\_\_\_\_

9. What is the real-world meaning of this value?

10. What is the y-intercept of your function?

\_\_\_\_\_

11. What does this value tell you?

12. How are the two equations the same?

13. How are the two equations different?

14. What does the fact that the second equation has a higher slope tell you?

15. Why do the two equations have the approximately the same y-intercept?

Replace the data in the table with the data for **tap water and NaCl**. Use the manual curve fit option and your knowledge of slope and y-intercept to write an equation for this data. When you have found a good fit, write your equation below.

\_\_\_\_\_ tap water and NaCl

16. What is the slope of your function? \_\_\_\_\_

17. What is the real-world meaning of this value?

18. What is the y-intercept of your function?

\_\_\_\_\_

19. What does this value tell you?

20. Should the slopes for the equations for distilled water with NaCl and tap water with NaCl be the same? \_\_\_\_\_ Why/Why not?

21. Are the slopes the same? \_\_\_\_\_ If the slopes are different, can you give a possible explanation for the difference?

22. The y-intercepts for these 2 equations are different. What does the difference tell you?

23. Which salt causes a more rapid increase in conductivity?

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24. How do you know this?

25. Which type of water (distilled or tap) would you rather stand in a pool of during an electrical storm?

Reflection:

So let's make some generalizations:

Use the back of your paper to explain what you know about the following:

- As "m" (i.e. slope, rate of change) changes, how does the line change (steeper/flatter)?
- What does changing the value of "b" (initial value) do to a line?