

## The Right Solution Data Collection Lab Answer Key

1. Determine the concentration of the solution for each cell and record it in the data table below.  
 Example: In cell #2, one out of 10 drops was food coloring. The concentration of food coloring is  $\frac{1}{10}$  or .10 or 100,000 ppm.

Cell #	Concentration (fraction and decimal)	ppm	Color (use colored pencils)
1	$\frac{1}{1}$ or 1 (a pure substance)	1,000,000	
2	$\frac{1}{10}$ or .10	100,000	
3	$\frac{1}{100}$ or .01	10,000	
4	$\frac{1}{1,000}$ or .001	1,000	
5	$\frac{1}{10,000}$ or .0001	100	
6	$\frac{1}{100,000}$ or .00001	10	
7	$\frac{1}{1,000,000}$ or .000001	1	
8	$\frac{1}{10,000,000}$ or 0000001	.01	
9	$\frac{1}{100,000,000}$ or .00000001	.001	
10	$\frac{1}{1,000,000,000}$ or .000000001	.0001	

2. Compare and contrast the solutions in each cell. In which cell is the color most intense? Why?

*Cell #1. This cell represents a pure substance, with no solvent present.*

In this activity, what agriculture concept does the food coloring in the first cell represent?

*A pure fertilizer concentration.*

3. In which cell is the color least intense? Why?

*Cell #10. This cell has the largest quantity of solvent and is therefore the most diluted. Cell #10 has 1 part food coloring and 999,999,999 parts water.*

In this activity, what agriculture concept does the solution in the last cell represent?

*A very diluted fertilizer solution.*

## The Right Solution Data Collection Lab Answer Key *(continued)*

4. Carefully examine your cells. Are there any cells where the liquid is colorless? \_\_\_\_\_ Is there any food coloring in these cells? \_\_\_\_\_ How do you know?

*Yes. Cells 6 through 10 are colorless; however there is still some food coloring in the cells. The concentration is so weak, color is not visible. We know there is food coloring because in a homogeneous solution, the solute is evenly distributed throughout the solvent, regardless of sample size.*

5. A fertilizer solution contains 1% nitrogen and 12% calcium. Write these percentages as concentrations in ppm.

*There is a factor of 10,000 between ppm and percentage; ppm stands for parts per million, whereas percent means per hundred, and there is a factor of 10,000 between one hundred and one million. To go from ppm to percentage divide by 10,000 and from percentage to ppm multiply by 10,000.*

*Nitrogen:  $1\% \times 10,000 = 10,000 \text{ ppm}$*

*Calcium:  $12\% \times 10,000 = 120,000 \text{ ppm}$*

6. Which cell is closest to the concentration of nitrogen? Which cell is closest to the concentration of calcium?

*Cell # 3 (10,000 ppm) is closest in concentration to nitrogen.*

*Cell # 2 (100,000 ppm) is closest in concentration to calcium.*

7. Nitrogen, phosphorus, potassium, magnesium, and calcium are essential nutrients for plant growth. Deficiencies in these nutrients can be corrected by fertilizer application. General recommended concentrations for cucumbers are listed below. Convert the ppm concentrations to ppb. Which of your cells of food coloring is closest in concentration to each fertilizer concentration?

Nutrient	Concentration	Cell Number
Nitrogen (N)	230 ppm = 230,000 ppb	5
Phosphorus (P)	40 ppm = 40,000 ppb	6
Potassium (K)	315 ppm = 315,000 ppb	5
Magnesium (Mg)	42 ppm = 42,000 ppb	6
Calcium (Ca)	175 ppm = 170,000 ppb	5

Why do growers use the process of dilution?

*Dilution allows growers to strategically apply the specific nutrients a plant needs to grow. Most fertilizers are purchased in concentrated formulas that cannot be directly applied to plants without dilution.*

## The Right Solution Data Collection Lab Answer Key *(continued)*

8. Explain at least two possible problems associated with applying a fertilizer solution that is too concentrated.

*Plants can only use a certain amount of nutrients. In some cases, too much of a single nutrient can be toxic to the plant or even induce a deficiency in another nutrient. High concentrations applied in excessive amounts can pollute water sources and encourage weed growth. It is in the grower's best interest to apply the correct concentration and quantity of a fertilizer solution. The grower is also losing money when paying for the extra fertilizer that is being used to over fertilize the crops.*

9. Explain at least two problems associated with applying a fertilizer solution that is too diluted.

*A fertilizer solution that is too diluted may not contain the sufficient nutrients required for healthy plant development. This can impact crop yield, and in some cases cause plant death and the grower will lose money. Additionally, a solution that is too diluted will require more solvent (water) to deliver the same amount of nutrients. Water is a precious resource in California and must be used conservatively.*

10. Your boss gives you a bag of fertilizer with the following chart and instructs you to prepare a fertilizer solution for the stock tank that will deliver 100 ppm nitrogen to the flower seedlings in one of the greenhouses. Your boss tells you that the injector ratio is set to 1:200.

*a. 13.50 oz, b. 67.50 oz, c. 1,910.25 grams. Next you will mix the 1,910.25 grams of fertilizer concentrate with 5 gallons of water in the stock tank and make sure that the fertilizer injectors are calibrated to a 1:200 ratio.*