

APES ~ Salinization Lab

What to turn in:	Hypothesis	Data table	Graphs 1 & 2	Analysis Questions #1-10
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Purpose

To involve students in a real world scientific investigation in which they design an experiment to determine how the concentration of salt in water affects the germination rate of seeds.

Background information

Salt buildup is a potential problem on almost all of the irrigated farmland in the United States. Much of the world's unused land is in arid or semiarid regions where irrigation would be necessary to grow crops. A small amount of salt in the soil will not affect the germination and growth of crops. Eventually, however, if salt concentrations increase, negative impacts occur. Eventually salt concentrations will affect the germination of seeds. Farmers need to know the relationship between the salt concentration and the percent of seeds that will germinate.

Salt kills germinating seedlings by removing the H₂O from their cells. There are several salts that are responsible but this lab will involve only one, sodium chloride (NaCl). From your results you can assume that other salt concentrations would also affect germination rate. NaCl has a solubility of 35.7g/100 mL of H₂O. Ocean water has a concentration of 3.5% which is 3.5g/100 mL of H₂O. Freshwater has a concentration of 0.005% salt, which is 0.005g/100 mL of H₂O.

Procedure

- 1) After reading the first part of the lab, the “problem” has been identified. Formulate a hypothesis.
- 2) Identify the independent and dependent variables. To do this, make a question: *What is the effect of the independent variable on the dependent variable?* This will tell not only the variables but also which variable to put on each axis of the graph. Remember, the x-axis is the horizontal axis and always is the independent variable. The y-axis is the vertical axis and is the dependent variable. (See Analysis Questions 2-3).
- 3) Decide what will be used as a control. Identify the constants in the experiment. (See Analysis Question #1).
- 4) Keep accurate data tables and check on the experiment daily.

Materials

Zip-top bags or Petri dishes
Serial dilutions of salt concentrations
Graduated cylinders
Balances
Plastic spoons
Flasks or beakers
Radish, squash or wheat seeds
Permanent markers

Procedure

- 1) Gather materials, and label each bag or Petri dish with the lab group number and period.
- 2) Count five seeds per bag or Petri dish.
- 3) Place five seeds onto each paper towel, fold over the towels, place in each Petri dish or bag, and label.
- 4) Solutions must be made with the following concentrations of salt *per 100 mL of water* :
0, 1, 2, 3, 4.1, 4.2, 4.4, and 5 g. (Don't do this yet – read step 4c).

- a) Each lab group will be assigned to mix one or two solution concentrations (depending on the number of groups), making enough to share with the class.
- b) Mix enough for all groups. Each group needs 20 mL of solution. Be careful: if your solution is incorrectly mixed, you will ruin it for the entire class, since everyone will be using some of your solution.
- c) If there are six lab groups, you will need 120 mL of water. Convert the original amounts of salt using this format to solve for x:
 (Example) $\frac{2 \text{ g}}{100 \text{ mL}} = \frac{x \text{ g}}{120 \text{ mL}}$
- d) Using a balance, weigh out the adjusted amounts of salt.
- e) Mix the water with the salt and stir until completely dissolved.
- 5) Pour 20 mL of the salt solution into one of the zip bags or Petri dishes.
- 6) Cover the Petri dish with a lid (or seal the bag) to avoid evaporation and label the concentration of salt used. Use the original concentration numbers per 100 mL for the labels.
- 7) Complete steps 5 and 6 until all amounts of salt are used.
- 8) If instructed to use your own paper, construct data tables like the ones included in this lab sheet.
- 9) Check seeds daily for 7-10 days, recording data in the table.

From the completed data table, draw two graphs:

- 1) **GRAPH 1:** Construct a line graph on which you compare the % of salt solution on the x-axis with the number of seeds which germinated on the y-axis. Give the graph a title and label the axes.
- 2) **GRAPH 2:** Construct a bar graph comparing the percentage of salt solution on the x-axis with the % of seeds that germinated on the y-axis.

Analysis Questions

- 1) What is the control group in this experiment?
- 2) What is the dependent variable in this experiment?
- 3) What is the independent variable in this experiment?
- 4) Does there seem to be a relationship between the number of seeds which germinated and the concentration of the salt water? If so, what is that relationship?
- 5) Does there seem to be a relationship between the % that germinated and the concentration of the salt water? If so, what?
- 6) Did your experiment support your hypothesis? Explain.
- 7) Can you think of any errors that might have occurred that would invalidate your experiment? If so what were they and how might they be corrected?
- 8) Explain why increasing levels of salt concentrations affect seed growth and why irrigation seems to be the main cause of this. (Use other sources, if necessary, but cite them.)
- 9) Do you think all seeds would be affected in similar ways as the ones you used?
- 10) When soil becomes too salty, what are some methods of remediation?

SALINIZATION LAB DATA TABLES

DATA TABLE 1: DAILY LOG

Observation Number	Date	Label	Number of seeds germinated	Number of seeds with no growth	Comments
1		Control			
		1.0			
		2.0			
		3.0			
		4.1			
		4.2			
		4.4			
		5.0			
2		Control			
		1.0			
		2.0			
		3.0			
		4.1			
		4.2			
		4.4			
		5.0			
3		Control			
		1.0			
		2.0			
		3.0			
		4.1			
		4.2			
		4.4			
		5.0			
4		Control			
		1.0			
		2.0			
		3.0			
		4.1			
		4.2			
		4.4			
		5.0			

5		Control			
		1.0			
		2.0			
		3.0			
		4.1			
		4.2			
		4.4			
		5.0			
6		Control			
		1.0			
		2.0			
		3.0			
		4.1			
		4.2			
		4.4			
		5.0			
7		Control			
		1.0			
		2.0			
		3.0			
		4.1			
		4.2			
		4.4			
		5.0			

DATA TABLE 2: SUMMARY OF RESULTS

Label	Number of seeds used	Amount of salt solution, mL	Concentration of salt solution	Total number of seeds germinated	Total number of seeds with no growth	% germination
Control			0			
1.0			1.0			
2.0			2.0			
3.0			3.0			
4.1			4.1			
4.2			4.2			
4.4			4.4			
5.0			5.0			