



SALINIZATION LAB STUDENT LAB TEMPLATE

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Abstract

This lab activity has students work as a team to determine the effect salt has on plant germination. They then use their lab data to create a report on how the increasing salt concentrations affect the germination of the seeds and at what salt concentration no seeds will germinate.

Objectives

At the end of this lab, you will be able to determine how salinization affects the germination of various species of crop seeds and at what salt level concentration seeds will no longer germinate.

Introduction

Salt buildup is an existing or potential hazard on almost all of the 42 million acres of irrigated farmland in the United States. Much of the world's unused land is in arid and semiarid regions where irrigation will be necessary. Water contains a small amount of salt, and over time this salt accumulates in the soil. A small amount of salt in the soil will not affect the germination and growth of crops. However, as salt concentrations increase, negative impacts occur. Eventually salt concentrations will affect the germination of seeds. Excessive salinity is presently costing the U.S. billions of dollars in lost food crops.

In the vast Wetlands Water District in Central California's San Joaquin Valley, which provides irrigation water to 600,000 acres of farmland in western Fresno and Kings Counties, as many as 190,000 acres have salinity levels that limit a grower's choice of crops. That usually means cotton or sugar beets, if they can grow anything at all.

Salt kills germinating seedlings by removing the water from their cells (plasmolysis, exomosis). Several salts and their ions are responsible: NaCl, CaCl, KCl, MgCl, MgSO₄, HCO₃⁻, CO₃⁻, MgCO₃, NO₃⁻, NH₄⁺, K⁺.

In this investigation, your team will be investigating the effects of just one salt; NaCl will affect germinating seeds in a similar way, as would other salts or combinations of salts.

NaCl has a solubility of 35.7 grams per 100 ml of H₂O. It is known that ocean water has a 3.5 percent concentration (3.5 grams per 100 ml of H₂O). Freshwater has a concentration of 0.005 percent salt (0.005 gram per 100 ml of H₂O).

Background Research Links

A soil quality information sheet on salinization covering many topics is available at <http://soils.usda.gov/sqi/files/Salinization.pdf>.

A brief description of salinization and impact on soil is available at <http://www.gps.caltech.edu/~arid/salt/salt.html>.

A description of salinization and worldwide impacts is available at <http://oregonstate.edu/instruction/bi301/saliniz.htm>.

Materials

petri dishes	distilled water
paper towels	test tubes
tweezers for seed placement	labels
balances	graduated cylinders
Ziploc bags	flasks and beakers for mixing solution
salts	

You are welcome to create or use other types of equipment!

Procedure

Three scenarios that could be used for the lab are listed below.

Here is what each team has to do:

Scenario A: Farmers in the Central Valley of California have become increasingly concerned about the buildup of salt in the soil and water. Farmers know that small amounts of salt in the soil and water will not adversely affect the germination and growth of their crops. But as

salt concentration increases, negative impacts occur. Eventually salt concentration may become so great that seeds will no longer germinate.

Central Valley farmers have gotten together and hired your "company" (cooperative learning team) to investigate the problem for them. They want your company to do the research and present them with a report, including graphs, on how increasing salt concentrations will affect the germination of their seed crops. They need to know the relationship between salt concentration and the percent of seeds germinating.

Produce a research report for the farmers of the Central Valley of California, telling them how increasing concentrations of salt will affect the germination of their seed crops. One report will be turned in by each team. Everyone should put his or her name on the report, and everyone will receive the same grade.

Scenario B: Farmers in the Fertile Crescent have become increasingly concerned about the buildup of salt in the soil and water. Farmers know that small amounts of salt in the soil and water will not adversely affect the germination and growth of their crops. But as the salt concentration increases, negative impacts occur. Eventually salt concentration may become so great that seeds will no longer germinate.

The new government of Egypt has hired your "company" (cooperative learning team) to investigate the problem for them. They want your company to do the research and present them with a report, including graphs, on how increasing salt concentrations will affect the germination of their seed crops. They need to know the relationship between salt concentration and the percent of seeds germinating.

Produce a research report for the new government of Egypt telling them how increasing concentrations of salt will affect the germination of their seed crops. One report will be turned in by each team. Everyone should put his or her name on the report, and everyone will receive the same grade.

Scenario C: Motorists in the Northeast have long noticed that vegetation does very poorly on the shoulders of roads due to the salting of roads in the winter to prevent ice buildup. Recently, Citizens for Beautiful Byways, a group of ecology-minded commuters, has become involved in sponsoring and paying for beautification projects along state highways. They have planted many seeds on the shoulders to help eliminate the visual blight. They are increasingly concerned about the buildup of salt in the soil and water. They know that small amounts of salt in the soil and water will not adversely affect the germination and growth of their seeds. But as the salt concentration increases, negative impacts occur. Eventually salt concentration may become so great that seeds will no longer germinate.

The State Highway Department has hired your "company" (cooperative learning team) to investigate the problem for them. They want your company to do the research and present them with a report, including graphs, on how increasing salt concentrations will affect the germination of their seed plantings. They need to know the relationship between salt concentration and the percent of seeds germinating.

Produce a research report for the State Highway Department and the concerned groups, telling them how increasing concentrations of salt will affect the germination of roadside beautification plantings. One report will be turned in by each team. Everyone should put his or her name on the report, and everyone will receive the same grade.

Problem for all three scenarios:

The report should include the following:

1. A "**Hypothesis**" about how you think the salt concentrations will affect the germination of your seeds.
2. A "**Procedure**" that describes the design and steps of your experiment to figure out how increasing salt concentrations will affect the germination of your seeds. You should include diagrams and drawings as well as written information.
3. A "**Conclusion**" that should state whether or not your hypothesis was supported. Your conclusion should include data charts and graphs, which show how increasing concentrations of salt in water affect the germination of your seeds. You should also indicate at what salt concentration no seeds will germinate. All concentrations should be given in percentages.
4. The final step of the scientific method, "**Reporting What You Know**," is the finished report that you have prepared.

Lab Tips

- Remember that germinating seeds need both water and oxygen in order to grow.
- When water evaporates from your salt solutions, the concentration of salt will be changed.
- When salt crystallizes from your salt solution, the salt concentration of the solution will be changed.
- Use serial dilutions to make your salt solutions.
- Make careful observations.

Data/Observations

The percent of seed germination should be graphed against salt concentration, and data must be shown on a spreadsheet. This will be important for your formal report.

Analysis

What did the germination data tell you? What conclusions can you draw from your data based on the research you have done on the salt that you tested? What information on salinization is important to include in your report? Data results should be recorded on a spreadsheet, and analysis of data should be included in the report. The spreadsheet should be incorporated into the report.

Additional Resources

This will be left up to your group. You may embellish the project to enhance the effectiveness of the presentation. All of the items to meet the minimum requirements are contained in this description. You must decide on the most effective way to present the material.