

Germination of Seeds

Employing the Scientific Method and Practicing Thoughtful Experimental Design

Summary

In this first lab, you and your lab team will design and conduct your own experiment based on some general information on the biology of seeds. The focus of your experiment will be on seedling germination and plant growth. You and the other students in your team will come up with your own variables to test and then conduct your own experiment. Finally, your group will create a web-based presentation of its lab research project.

Objectives

- Students will be able to describe and explain the basic requirements for seed germination and plant growth.
- Students will develop a question and a testable hypothesis to test in a scientific experiment.
- Students will, following the scientific method, design, perform, and summarize* a controlled experiment.

*in a formal web-based presentation

Pre-Lab: This is our first actual lab activity. All safety rules apply. For this lab and all subsequent labs you are required to do the following before coming to class for the actual lab:

1. Read this entire handout
2. Complete all pre-lab tasks as directed by the lab handout and/or your teacher

Materials

Scientific Method Chart

Seed Germination Experiment handout (this paper)

Seed Germination Procedure worksheet

Lab Report Guidelines

Seeds

Cups & Potting soil or Paper towels & Plastic bags

Water

Ruler

May need depending on experiments:

Colored saran wrap as light filter

Desk lamp or Fluorescent lights

Soda water or flavored soda

Gravel

Whatever else students come up with that is easily obtained

Vocabulary

- experimental design
- variable
- independent (input) variable
- dependent (output) variable
- controlled variable (constant)
- control group
- radicle
- germination
- biotic factor
- abiotic factor
- growth medium
- nutrient
- pollution

The Experiment

Day 1

1) Break into groups of four (some groups may have five members) to come up with a group name and to develop your own hypothesis to test (for example: *If seeds are germinated in Dr. Pepper they will have lower germination rates than seeds germinated in water.*) Team leaders will need to get a lab station assignment from Mr. Bursch. Review the *Seed Germination Procedure* worksheet (1 per student). Make sure your hypothesis is something you can test. Students can measure number of seeds germinated, as well as average growth rates of plants after the seeds germinate. This is easily calculated by dividing height of the plant by the time they have been growing.

2) Now design a procedure to test your hypothesis. Write out your group's hypothesis, materials, procedure (including what they intend to measure), and how they will compare their data to their control on their worksheet. One copy (choose a scribe) needs to be turned in from each group to make sure that it is a testable hypothesis and the procedure is something that can be done and that the materials can be obtained.

3) After reviewing the procedure for each experiment (a sample procedure has been included below), your group should look at the adjustments that need to be made. Edit the procedure on your worksheet.

Day 2

4) Each group should send someone to get the materials they need to set up their

experiment.

5) The groups should follow their own procedure to set up their experiment. Your group **MUST** keep its own notes (in your notebooks) specific to your experiment because you will be putting together a web-based presentation at the end of the experiment. You may use your personal electronic devices to snap pictures and record information during your experiment. NOTE: set aside one blank sheet in your notebook for notes AND a second sheet to tape in your *Seed Germination Procedure* worksheet.

Days 3-8

6) This experiment will be ongoing for nearly a week, with watering/monitoring of seeds and plants happening as often as you decide in your procedure (This could occur everyday, every other day, etc.)

7) After data collection is complete, students will summarize their data in charts and graphs. These charts and graphs can be made on a computer (excel or power point) or by hand on graphing paper (and then scanned).

8) Type up a lab report based on your experiment. Look over the *Lab Report Guidelines* worksheet and review it with your group. Take the typed electronic version of your report and copy and paste the sections of your report into your *The Story of the Seed* blog. Make sure you label the entry "Seed Germination Lab Report." Your web-based report should include your group's hypothesis; a brief version of your procedure; your results, including the graphs you made; and any conclusions you drew from your results. A simple example has been included in this handout. Don't forget to include some pictures, too!

9) Each student must turn in his/her own completed *Seed Germination Procedure* worksheet in his/her biology notebook.

Assessments

Student assessment for this lab will be done in two parts. The first score is based on the completeness and level of detail of your group's final web-based report/presentation and will be determined by the teacher (50 points possible). The second score is determined by a formal peer evaluation of your performance within your group throughout the entire lab (50 points possible).

Lab report guidelines:

Introduction: Should contain background information justifying why you are testing your specific hypothesis. The introduction should end with a clear statement of your hypothesis and expectations.

Methods: Should be a detailed description of how your experiment was conducted. It

should be detailed enough that someone else could read it and recreate your experiment.

Results and Data Analysis: This section should clearly describe what your results were and what you did to them to make sense of the data. This includes talking about how and why you made each graph or table.

Conclusions: This section should interpret your results and make some conclusions about your research. If no clear conclusions can be made, it should be used to talk about how you could improve the experiment. This section should also include a discussion of future experiments that could be done based on the knowledge you have obtained through your experiment.

Sample Procedure

Hypothesis: Seeds germinated and grown in soda will not grow as well as those grown in water.

Materials:

Seeds
Paper Towels
Water
Dr. Pepper
Plastic Bottle
Ruler

Procedure:

1. 10 seeds will be tested as the variable and 10 seeds will be tested as the control.
2. The seeds will be placed on a paper towel on the bottom of a plastic bottle. A different plastic bottle will be used for each treatment (control and variable).
3. Each paper towel will be dampened by the liquids (Dr. Pepper and water).
4. The paper towels will be checked daily (except weekends) and moistened as needed.
5. The length of time it takes for each seed to germinate will be recorded (# of days) and a seed will be considered ungerminated after 1 week of no growth.
6. After the seeds germinate, growth will be determined by measuring the height of the plant with a ruler.
7. This will be done for the next week.
8. After the data is collected, the mean number of days it takes a seed to germinate will be recorded for both the variable and the control. This will be displayed in a bar graph, with the x-axis having two categories (water and Dr. Pepper) and the y-axis being the average number of days.
9. The median will also be determined and displayed in a table for the average days to germinate.
10. The average growth for each seedling will be determined and displayed on a similar

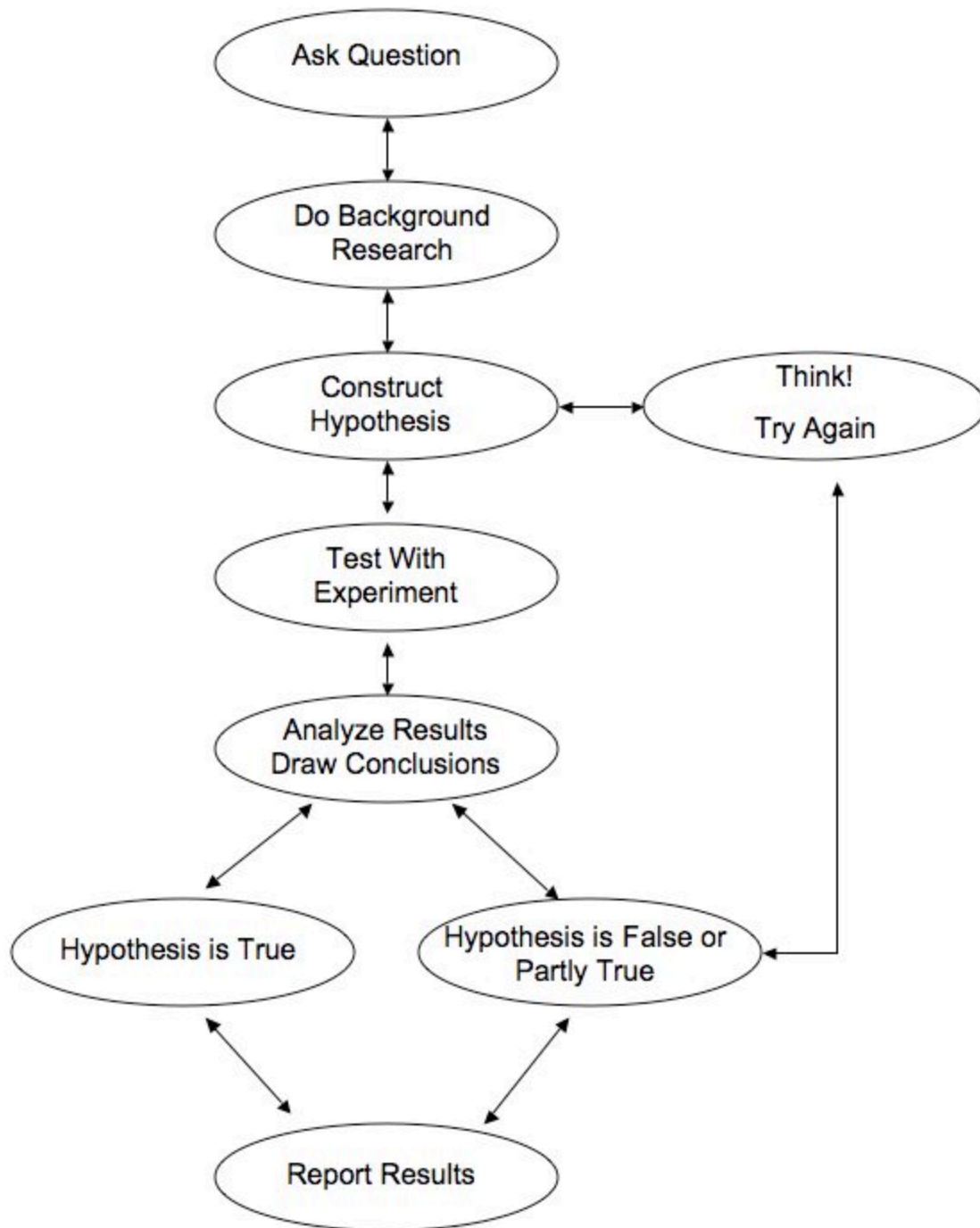
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Name: _____

Period: _____

Date: _____

bar graph. The median will also be determined for seedling growth.



Seed Germination Lab Worksheet

Problem or Question to Be Investigated:

Initial Hypothesis:

Description of Your Control Group and What Makes It Your Control Group:

Variables (Independent and Dependent):

Justification of Hypothesis (Why did you choose this as your hypothesis?):

Materials:

Procedure (Steps):

Data and Results:

Analysis:

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Period: _____

Date: _____

Conclusions:

Seed germination K-W-L

What do you know about seed germination?

What do you want to know about seed germination?

What did you learn about seed germination?

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