



Science Unit: *Growing Plants*

Lesson 3: *Designing a Germination Experiment - Part 2*

School Year: 2007/2008
Developed for: Charles Dickens Elementary School, Vancouver School District
Developed by: Shona Ellis (scientist), Paula Naylor and Susan Garber (teachers)
Grade level: Presented to grades 3, 4, 5; appropriate for grades 2 – 7 with age appropriate modifications.
Duration of lesson: 2 hours
Notes: The germination experiment will be set up during this session. Data collection will be done on two addition days approximately one week (*Mimosa*) and two weeks (sunflower) later.

Objectives

1. Learn how to design a science experiment and collect data.
2. Set-up two experiments to examine seed germination and seedling development.
3. Learn the importance of light (presence/absence) to seed germination and subsequent seedling development.

Background Information

In the previous lesson students learned the structure of a seed and embryo. They observed and discussed seed germination and seedling growth. They were able to witness how an embryonic structure develops into the different organs of the young plant. Seeds require specific conditions for germination (these vary between species). Last week we identified a number of factors that could effect germination: temperature, light, nutrients, and moisture. Light is important for plant growth. Some seeds require it for germination, while germination in other seeds are inhibited by it. We will examine the role of light in germination of two types of seeds by performing two experiments.

Vocabulary

<u>control</u>	A sample that is treated the same as the rest of the samples, but has not been exposed to the condition/variable being tested.
<u>data</u>	Qualitative and quantitative information obtained from an experiment.
<u>replicate</u>	A repeat of an experiment to collect more data.
<u>experiment</u>	An exercise designed to determine if a hypothesis is true or false.
<u>treatment</u>	The condition being tested.
<u>observation</u>	To watch and record something that is happening, such as a natural phenomenon.

Materials

- 40 sunflower seeds soaked in wet paper towels for four days, half in dark, half in light
- sunflower seeds soaked in water overnight
- plastic plant labels
- tray for greenhouse



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- *Mimosa pudica* seeds (soaked overnight)
- Petri dish (plastic or glass)
- filter papers
- sterile water in Erlenmeyer flask
- 3 inch pots (one per student)
- growth facility
- potting soil
- *Dark Germination Chamber
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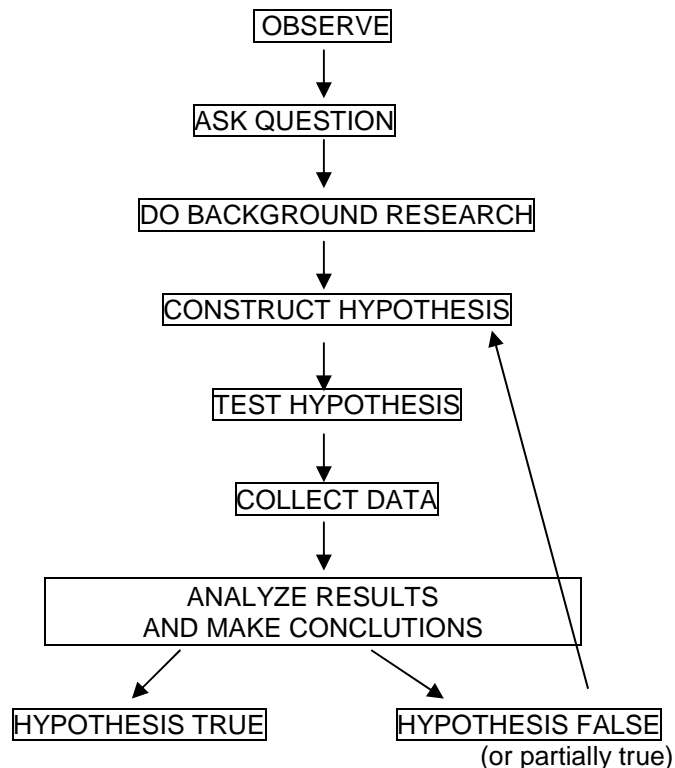
*Germination chamber can be made with a box over a plant tray (holes for water to get through). One end of the box is cut away for watering access. The tray must be big enough to accommodate for the plant pot pots yet leave an 18-20 cm (7 inch) gap at the front of the tray which will provide access for watering. The entire structure is placed in a heavy garbage bag; clamp is used to keep open end closed except for small opening for watering. The pots are watered from the bottom.

In the Classroom

Introductory Discussion

1. Begin by welcoming the students to the teaching lab.
 - Emphasize appropriate conduct in the lab
2. Review what was learned last week about experimentation , and experimental design.

On Board:





Science Experiment

Part 1:

Experiment Title: Effect of Light on *Mimosa pudica* Germination

Background Discussion: The package of Mimosa seeds states “seeds require total dark for germination”, but when the teachers and scientist tested this (germinating three seeds in the dark) not one germinated!

What could be wrong? – not large enough sample size (we learned about variability last lesson) and the seeds selected were not viable, seeds require light (or some other growth condition) to germinate.

Students will test the hypothesis as stated on the seed package: “seeds require total dark for germination”

Purpose of Experiment: To see if the package directions for germination of Mimosa are accurate

Question: Do *Mimosa* seeds require total darkness for germination?

Hypothesis: *Mimosa* requires dark for germination.

Experimental Treatments:

Control treatment	- seeds germinated in light
Test treatment	- seeds germinated in total darkness

Experimental Design

Materials:

- Petri dishes
- Filter paper to line Petri dishes
- Water
- Parafilm
- Pen (Sharpie)
- Sterile water in Erlenmeyer flask
- Mimosa seeds soaked overnight

Methods:

- Each pair of students
- Wet filter paper with water, Place six seeds in each Petri dish
- Seal the Petri dish with parafilm
- Label with students' names and L(light) or D (dark)
- Place one plate (D) in the dark chamber (shoebox) and the other (L) in the light (window sill)
- Incubate dark chamber near those in the light (to keep temperature

Collect Results: Check the seeds in the box after about a week.

Note: Trials = when you carry out the entire experiment more than once

Part 2:

Experiment Title: Effect of Light on Sunflower Seedling Development

Background Discussion: The seeds exhibited 100% germination whether light or dark.

Question: What happens to seedlings when they are germinated and grown in the dark?



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Hypothesis: Seedlings that are germinated and grown in the dark _____ (do not grow as well as those in the light).

How do we test this hypothesis? – with an experiment
- germinate seeds in the dark and light and let the seedlings grow

Again we will set up the experiment so there are many pots of each treatment. Each pair of students will set up a pot for the light and a pot for the dark. We will therefore have a number of replicates

Experimental Design

Materials:

- Plant Pots
- Soil
- Soaked sunflower seeds
- Germination Chamber
- Tray for plants grown in light
- Pen
- Labels

Methods:

- Fill each pot to about a cm from the top with soil
- Make four holes with your finger and insert a seed into each hole
- Gently cover with soil
- Make a label with the treatment and your name.
- Place one pot in each treatment tray
- Plants can be grown in a greenhouse or on a sunny window ledge

Watering – based on germination chamber we will water from below for both sets of plants

After 2 weeks collect results – students also know that parts of the seedling so will be able to use appropriate terminology when making observations.

Closure Discussion

1. Why would some seeds require light for germination while others require dark?
2. What other conditions are important for germination?

References (examples of the format to use for different types of references are below)

1. Griffiths, Anthony 1999. Kidscience: Real Science your child can do APASE, Vancouver.
2. < <http://jstait.addr.com/sunflowers/howto.htm>> The Sunflower Stop's Home Guide To Growing Sunflowers Accessed August 18, 2008.
3. < <http://wolfweb.unr.edu/homepage/crowther/ejse/rillero.html>> *Raphanus sativus*, Germination, and Inquiry: A Learning Cycle Approach for Novice Experimenters Accessed Aug. 18, 2008.

Extension of Lesson Plan

1. After 5-7 days examine the *Mimosa* plates and collect data (data sheets attached). Each group will collect data for their own plates. On a flipchart the data is collected for the entire class. What are the conclusions? Do not be surprised if the hypothesis turns out to be false.



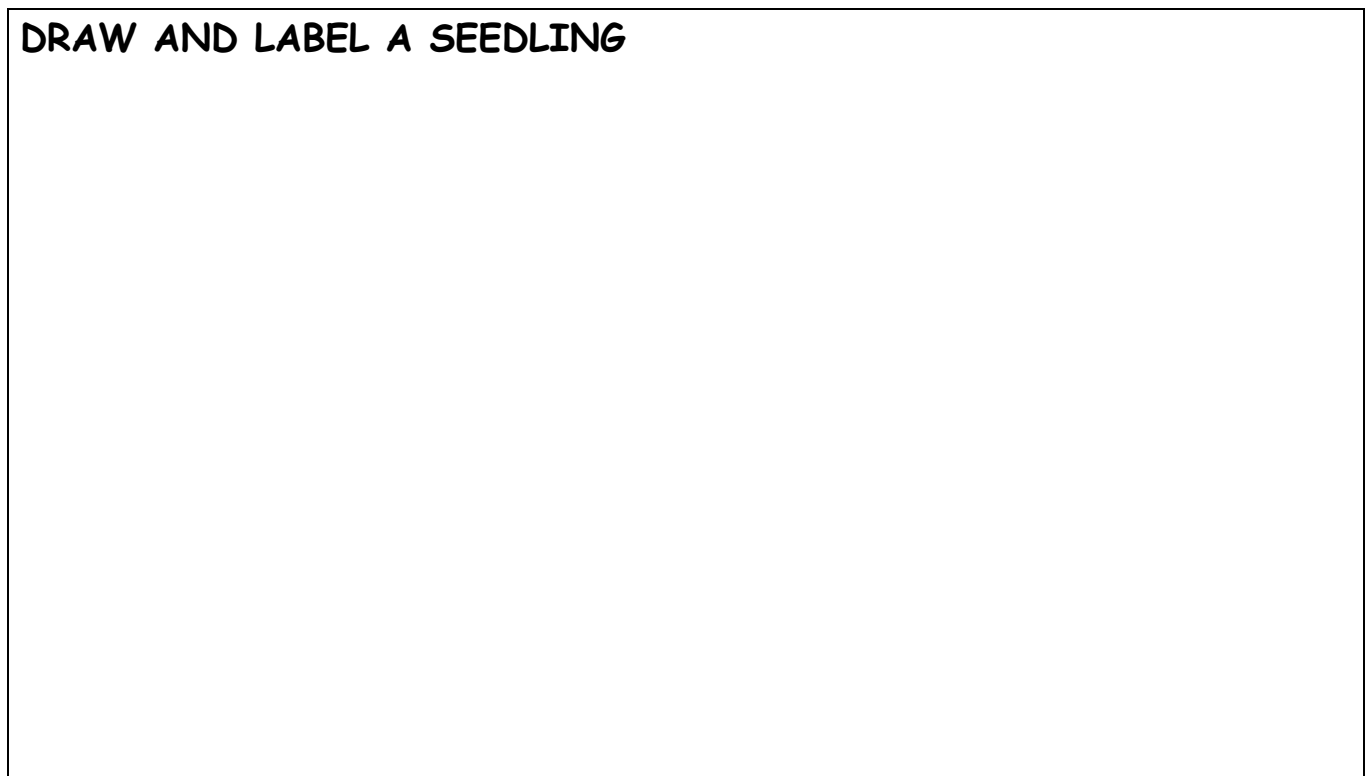
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2. After 2 weeks check on the sunflower plants (sheets attached). Each group will collect data for their own pots. On the flipchart the data is collected for the entire class. What are the conclusions? The seedlings grown in the dark will be etiolated (yellow) and the stems more elongate (growing to find the light).
3. Seedlings can be transplanted to pots containing potting mix and either taken home or grown on a windowsill in the classroom.

MIMOSA EXPERIMENT - DATA COLLECTION SHEET

	Seeds Germinated in Light	Seeds Germinated in Dark
Light-Coloured Seeds: Germinated (+) Not Germinated (-)	_____	_____
Dark-Coloured Seeds Germinated (+) Not Germinated (-)	_____	_____
General Observations:		

DRAW AND LABEL A SEEDLING



Replicate # _____

SUNFLOWER EXPERIMENT - DATA COLLECTION SHEET

Hypothesis: Sunflower seeds germinate and grow better in the light than in the dark.

Seeds Germinated and Grown in Light (L)	Seeds Germinated and Grown in Dark (D)
Height of plant in mm: _____ Height of plant in mm: _____	Height of plant in mm: _____ Height of plant in mm: _____
General Observations (L)	General Observations (D)
Draw and Label Seedling (L)	Draw and Label Seedling (D)

CONCLUSIONS

State your main conclusion based on whether our hypothesis is true or false (one sentence)?

(Hypothesis: Sunflower seeds germinate and grow better in the light than in the dark)

What other conclusions can you make from this experiment?

Why did the seedlings grow like that?