

Seed Germination

Standard: 3240-02	Students will investigate changes in biological energy.	<i>Topic:</i> Chemical Changes and Physical Change <i>Course:</i> # 3240
Objective: 3240-0201	Relate energy requirements of plants and animals to physical and chemical changes.	
ILO's	1d Make estimations and predictions 2a Identify variables 2b Formulate research questions 2c Plan controlled experiment 2d Collect and record data	

Description of Activity

Title: "Seed Germination"

Overview: Students will investigate how changes in energy affect the chemical and physical changes that seeds go through during germination.

Duration: 2-10 days, depending on seeds used.

Materials, Facilities and Resources: Seeds (beans, radish, lentil, alfalfa), pots, soil, thermometer, heat source, light source.

Background Information

Seeds initially germinate when they absorb water, bursting the seed coat. This starts a chain of chemical changes which will result in the development of the plant embryo. Heat and light are also necessary for the process of germination. Some plants rely more on heat, others more on light. Chemical energy stored as starch in the seed is changed to sugar for use during germination. The development of the plant embryo is controlled by hormones as well and a plant can be artificially made to germinate by treating it with the correct hormones.

Germination can be recognized by the appearance of a root tip or leaves and stem.

Teaching and Learning Strategies

Begin the activity with a discussion of the amazing longevity of seeds. Students may be familiar with the idea that seeds have been stored for hundreds of years and then germinated and grown into plants. Ask the question: What determines when a seed will germinate?

Before students write their own experiment to test this question, do the skill building activity included in these materials. It will help students to learn what conditions will germinate seeds. In their experiment they will change one variable to see if it is a critical one.

Students should develop their experiments based on the scientific method and should use science process skills throughout. Cooperative learning groups work well for this activity. It is important to have the students write up their experiment plan for review and approval by the instructor before they begin. Instructors should carefully review each plan for safety problems before they are approved.

Development of Laboratory Skills and Tools

Few students in urban settings have much experience with seeds and germination. The skill building activity included on following pages will introduce the variables involved in germination. It should also help them see what is meant by germination.

Invitation to Learn

Students should be aware, after completing the skill building activity "My Green Thumb," of some variables concerning seed germination. Ask the question: Seeds can be stored in packages for years without ever growing. Sometimes in the fall of the year they may even become buried in the soil and still they don't grow until spring. What conditions are needed for seed germination?

Working in groups students need to fill out the Student Designed Experiment form and identify the variable they want to test. They have done the control in the skill building activity. Insist that each group do a different experiment, testing a different variable. They can test different types light sources (or colors of light), no light, a warm place with light, a cold one, different types of seeds, water, no water, periods of dryness and many others. To ensure inquiry, do not help them as they decide. All conditions should be the same as their skill builder lab (the control) except for one.

Observations will need to be made for a period of time, probably a week or two.

Summary of Learning

Multiple Choice:

1. Which of the following factors was the most important for seed germination?

- a. lots of light
- b. warm temperatures
- c. adequate water
- d. paper towels

answer: c

2. What are two sources of energy for the physical and chemical changes plants make during germination?

- a. water, soil
- b. the sun, stored chemicals in the seed
- c. soil, warmth from the interior of the earth
- d. light, organisms in the soil

answer: b

Strategies to Share Findings:

Students could debate the importance of the variable they tested. Debate topic: Is water is the most important factor in seed germination?

Student Designed Experiment Format

TITLE:

PURPOSE: (What an I trying to find out?)

PREDICTION: (What is a possible answer?)

MATERIALS: (What will I use to find out?)

PROCEDURES: (What steps will I take to find out?)

DATA: (What happened?)

ANALYZE RESULTS: (What does may data mean? Will a graph help? Is there more than one way to view the data? Could I have done something differently?)

CONCLUSIONS: (What did I learn?)

Student Designed Experiment Scoring Rubric

RESPONSE	CRITERIA	RATING
Exemplary	Completes all steps. Experiment has a control, logical and clear procedures, data is recorded and thoroughly analyzed. Graphs are present. Prediction made. Conclusions thorough and thoughtful.	6
Competent	Completes all steps. Experiment may lack control, procedures lack thoroughness. Data is recorded, analysis not complete. Conclusions too brief.	5
Satisfactory	Completes nearly all steps. Control missing, procedures lacking or illogical. More than one variable present. Data recorded but poorly analyzed. Conclusion does not accurately sum up experiment.	4
Nearly Satisfactory	Completes most steps. Procedures missing. Data recorded but not analyzed. Conclusion missing.	3
Fails to Complete	Most steps missing. Data recorded but procedures do not indicate it's origin. Conclusion missing.	2
Fails to Begin Effectively	Directions not followed. Nearly all steps missing. Doesn't show understanding of how to develop experiment.	1
No Attempt Made	Does not begin experiment.	0

Teacher Page

Skill Building Activity for "Seed Germination"

Title: "My Green Thumb"

Description: An activity to designed to acquaint students with seed germination and plant growth.

Materials and Facilities: paper towels, baby food jars or petri dishes, radish seeds, water, light source, student page (included)

Background: Ideal conditions for seed growth include plenty of water (helped by an absorbent material to hold it, the paper towel) and warmth or light. The seeds must be kept from drying out, either by covering the plants or watering them very regularly, including weekends.

The type of seed determines how the seed will germinate. Dicots (ex. corn) will typically split open and a root and a stem and leaves will grow at about the same time. Monocots (ex. radish) will not split and a root begins first. Students can see root hairs under the microscope as an enrichment activity. Encourage the students to make as careful of observations as possible.

Safety suggestions: None

Student Page

Title: "My Green Thumb"

Purpose: To observe the germination and growth of seeds under ideal conditions.

Materials: paper towels, baby food jars or petri dishes, radish seeds, water, light source.

Prediction: Which will grow first, the root or the stem?

Procedure:

1. Crumple a piece of paper toweling in the bottom of your jar. Add enough water so that the paper is wet and there is a layer on the bottom.
2. Drop 5 radish seeds on the paper towel, keeping them out of the water.
3. Place in the location your teacher requests and observe daily.
4. Draw your seeds in the data.

Data:

day 1	day 2	day 3	day 4	day 5
day 6	day 7	day 8	day 9	day 10

Analysis:

1. Which grew first, the root or the stem?
2. What factors were present that may have helped the seed germinate and grow?
3. Is growth a physical or chemical change? Why?
4. Is energy gained or lost as the plant grows?
5. What were the two sources of energy the seed had in this experiment?

Conclusion: