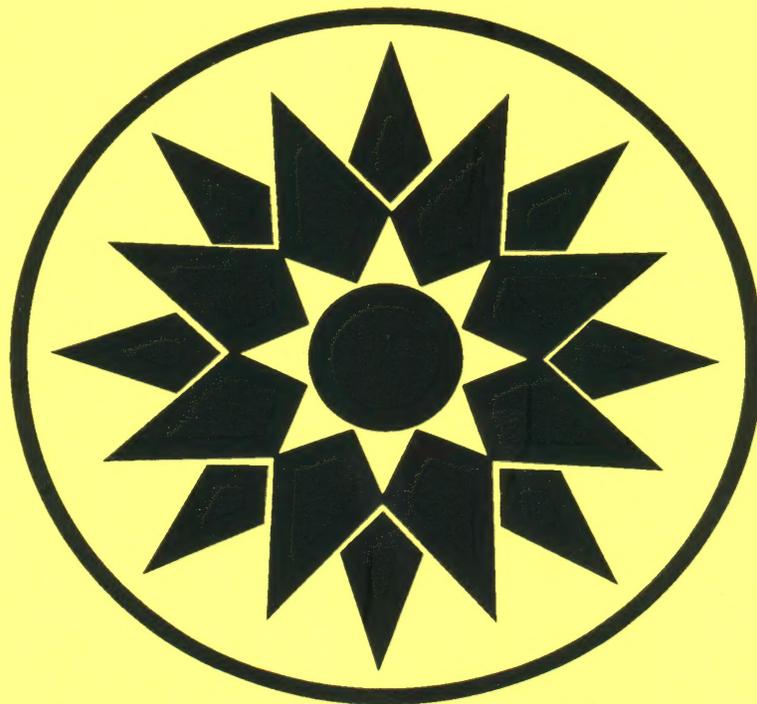


Teacher's Guide

Botanical Gardens

Apple



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Designers : Robert Q. Kimball
 David Donoghue

About the Designers:

Dr. Robert Kimball began teaching physics and mathematics in 1967. Later he received a Ph. D. from the University of Michigan. His dissertation, written in 1974, involved the development and evaluation of a computer-based classroom simulation in teacher education. Dr. Kimball is currently an Associate Professor at Mercy College of Detroit. In this capacity, he has been involved in computer training of teachers, summer computer camps for children and adults, and computer inservices for bilingual teachers. Dr. Kimball continues to teach college level computer science courses and mathematics courses.

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Botanical Gardens

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Botanical Gardens

Introduction

by Robert Q. Kimball

As a science teacher for nearly twenty years, I have often been invited to judge local science fairs at all levels. Judging fifty to sixty science fair projects in perhaps two hours is a difficult task. A judge has to develop a mental list of criteria to apply to each project. The best projects should meet these criteria. In my mind, a good science project has to demonstrate to me that the student knows how to control variables. A second criterion is that the student should be able to present the results in an informative and attractive manner.

Two years ago I judged a local science fair. Two projects stood out from the row upon row of projects. The first was an experimental study of soap detergents and their effectiveness at removing various stains. This topic is of course far from original. But what struck me was the careful attention the student had paid to controlling outside variables. All the stains were made on the same materials. All the washing cycles were of equal length. The student even measured the water temperature to make sure it didn't vary during the experiment. I had seen this same experiment many times before, but this was the first time I felt I knew something about the various cleaning agents.

Further down the rows of projects I came to the "classic" plant growing experiment. I have seen many variations on this theme. "Will plants grow better in orange soda or ginger ale?" "Do plants prefer Rock and Roll or Classical music?" "How do plants grow in light of different colors?" This particular experiment examined the effects of a variety of commercial plant foods on the growth of bean plants. Again I was pleased to see careful attention paid to controlling the variables and presenting the results. These ultimately were the two winners of the 7th grade division of the science fair. They won because they demonstrated the students' grasp of the scientific process of investigation.

I went home that night and sketched out ***Botanical Gardens***.

Botanical Gardens was designed to help students see the value in controlling experimental variables. To successfully grow plants in the greenhouses, students

have to vary the light, water, soil, and temperature to find the values that produce optimum growth. A random approach to this task is possible but the results are never satisfying. When the experiments are conducted systematically and the results carefully recorded, the students will grow their plants with confidence.

As a basis for the development of problem solving material, Sunburst has adopted a Problem-Solving Matrix. The Matrix (see page 3) organizes problem solving skills and strategies into four columns:

MEMORY
COGNITIVE SKILLS (Discrimination, Attributes, and Rules)
STRATEGIES
CREATIVITY

Botanical Gardens is designed to provide practice in the third matrix column - Strategies.

The program involves the strategies of:

Conservative Focusing - (Bruner) - Varying only one aspect of value at a time to eliminate non-critical attributes.

Analyzing - Breaking down the problem, solving it in parts if possible, and identifying necessary and unnecessary information.

Making Organized Lists - Systematically organizing lists of information, possible questions, possible answers, etc., that will help in finding the solution(s).

Looking for a Pattern or a Sequence - Involves finding order and discovering relationships.

Another important skill developed by ***Botanical Gardens*** is that of interpretation of data. Students discover that accumulating a lot of data becomes useful only when they can make some valid conclusions from that data.

The program is designed for a 64K Apple II+, IIe, or IIc with disk drive. If you need assistance in operating your computer, check the section of this Teacher's Guide entitled "Working with Your Computer" and "What Happens If...?" You can call Sunburst toll-free at 800-431-1934.

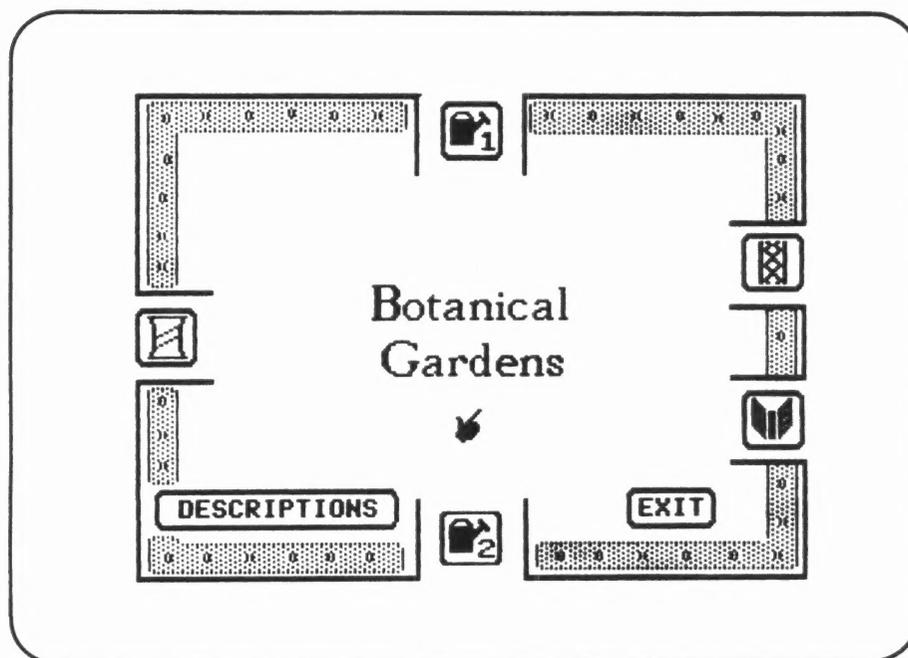
Problem Solving Skill Matrix

<ul style="list-style-type: none"> • Mnemonic Systems • Visual Association • Whole to Part • Self Testing • Creating a Context • Personalization • Regrouping • Auditory Aids • Number of Items to Remember • Sequence 	<div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">Botanical Gardens</div> <ul style="list-style-type: none"> • Higher Order Rules • Rules • Defined Concepts • Discrimination 	<ul style="list-style-type: none"> • Simultaneous Scanning • Selecting Appropriate Notation • Identifying Multiple Solutions • Examining Assumptions • Working Backward • Using a Model • Focus Gambling • Conservative Focusing • Estimating, Predicting, Projecting • Scanning for Clues, Hints • Restating the Problem • Analyzing • Making Organized Lists • Looking for a Pattern or Sequence • Brainstorming • Openness to Insight, Flexibility • Successive Scanning • Retrieval Strategies • Information Gathering • Problem Finding 	<ul style="list-style-type: none"> • Fluency • Flexibility • Originality • Elaboration
MEMORY	COGNITIVE SKILLS DISCRIMINATION, ATTRIBUTES AND RULES	COGNITIVE CONTROL STRATEGIES	CREATIVITY

This matrix was developed under a Title IVC grant to Rochester, MN schools under the direction of Donna Stanger. The matrix is based on the works of Gagne, but also reflects Piaget, Guilford, Meeker, Bruner, Bloom and Torrance.

Botanical Gardens

Objectives



Skills: Controlling Variables
Interpretation of Data

Grade Level: 6-adult

Reading Level: Grade 6 (FRY)

- Objectives:
1. Students learn to collect experimental data and calculate averages.
 2. Students learn to interpret data that has been displayed graphically.
 3. Students learn the advantages to systematic problem solving through controlling variables.

Botanical Gardens

Overview

Botanical Gardens was designed to take students into a "Botanical Garden" laboratory where plant experiments can be conducted. A variety of seeds are available, each with its own hidden growth needs (parameters). This program focuses on problem-solving strategies of controlling variables, graphing data, and analyzing results.

The Gardens - Students can select seeds and experiment with seeds in the gardens portion of the program. The seeds are grown in either of two gardens (Greenhouse 1 & Greenhouse 2). The conditions of light, heat, soil, and water are set by the students. The results of each experiment are shown pictorially on the screen in the laboratory and also graphically in the graphing room.

The Genetics Laboratory - Students can design their own custom seeds for experimentation. Designing a seed includes selecting a name, writing a brief description, determining plant parameters, and selecting the appearance of the plant.

The Change Options - The change options program is designed to allow teachers to modify the Gardens program to best meet the needs of their students. The change options allow the teacher to:

- 1) view plant parameters
- 2) create a new plant
- 3) delete a plant
- 4) turn sound on/off
- 5) unlock/lock library
- 6) unlock/lock genetics lab
- 7) select custom/standard seeds
- 8) select keyboard/mouse input

Botanical Gardens

Program Description

Botanical Gardens is a two-dimensional world where the student's location is represented by a small hand. Point the tip of the pointing finger to the option you want and click the mouse button or press the Return key. Students move the hand from room to room to perform a variety of tasks.

Hand Movement

Mouse - The simplest and fastest way of moving about in ***Botanical Gardens*** is by using a mouse connected to the Apple IIe or the Apple IIc. Movement of the mouse forward and back, left and right results in corresponding movements of the hand on the screen. The mouse button is used to make a selection.

Arrow keys - On the Apple IIe or the Apple IIc, the four arrow keys can be used to move and position the hand. When an arrow key is pressed once, the hand moves one step in the direction of the arrow. Holding the arrow key down moves the hand rapidly across the screen. When using the arrow keys, the Return key or the Space Bar can be used to make a selection.

Keyboard keys - On the Apple II+, movement of the hand is controlled by the I,J,K, and M keys which form a diamond shape pattern on the right side of the keyboard.

I - moves the hand one step towards the top of the screen.

J - moves the hand one step towards the left of the screen.

K - moves the hand one step towards the right of the screen.

M - moves the hand one step towards the bottom of the screen.

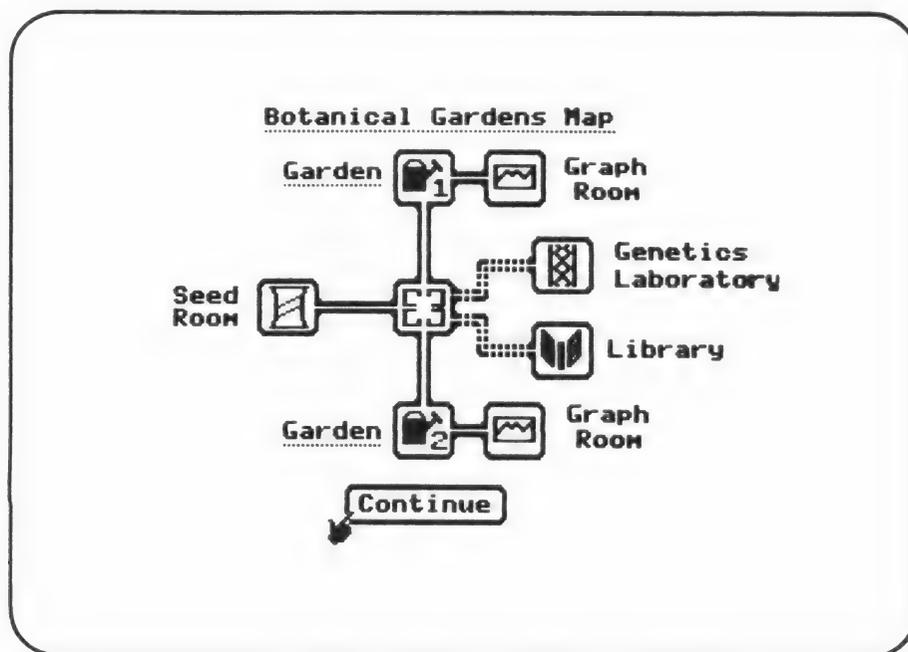
The Repeat key (REPT) can be used with the I, J, K, or M keys to move the hand rapidly across the screen. When using this option, the Return key or the Space Bar are used to make a selection.

NOTE: Students can exit ***Botanical Gardens*** from any room to the Lobby by holding down the Control (CTRL) key and pressing the letter E. Students can also exit by selecting the EXIT button in the Lobby.

Botanical Gardens

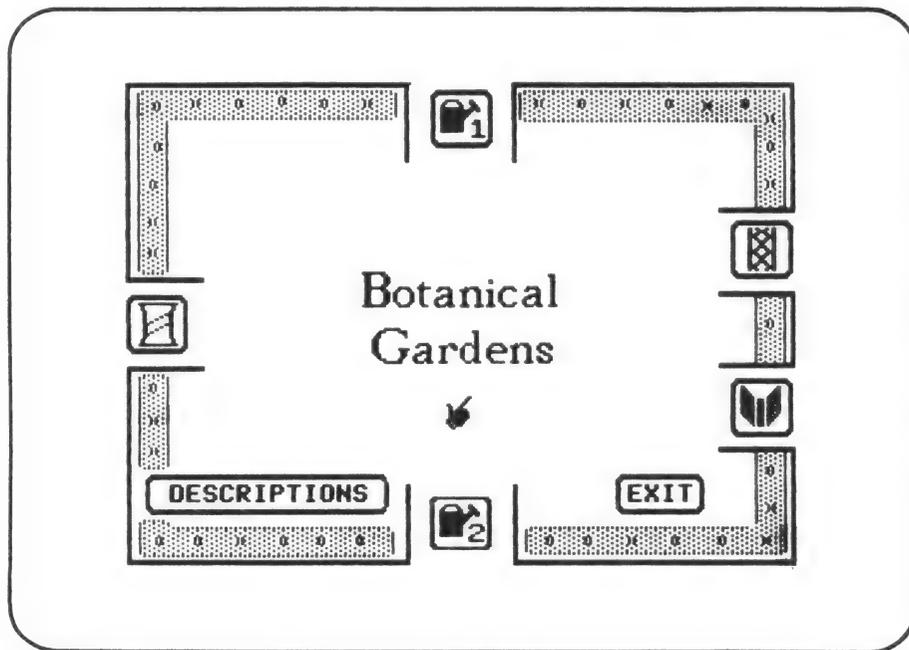
BOTANICAL GARDENS MAP

Botanical Gardens consists of a total of six different types of rooms as shown below:



The room in the center is called the Lobby. From the Lobby, students can always gain direct access to the two Gardens (Greenhouse 1 & Greenhouse 2), and the Seed Room. From either Greenhouse the students can enter a corresponding Graph Room. Two additional rooms are optionally available. The teacher can "unlock" a Library Room and a Genetics Lab through the Change Options (see page 19). When these two rooms are "unlocked," they appear as doors on the right side of the Lobby.

LOBBY 

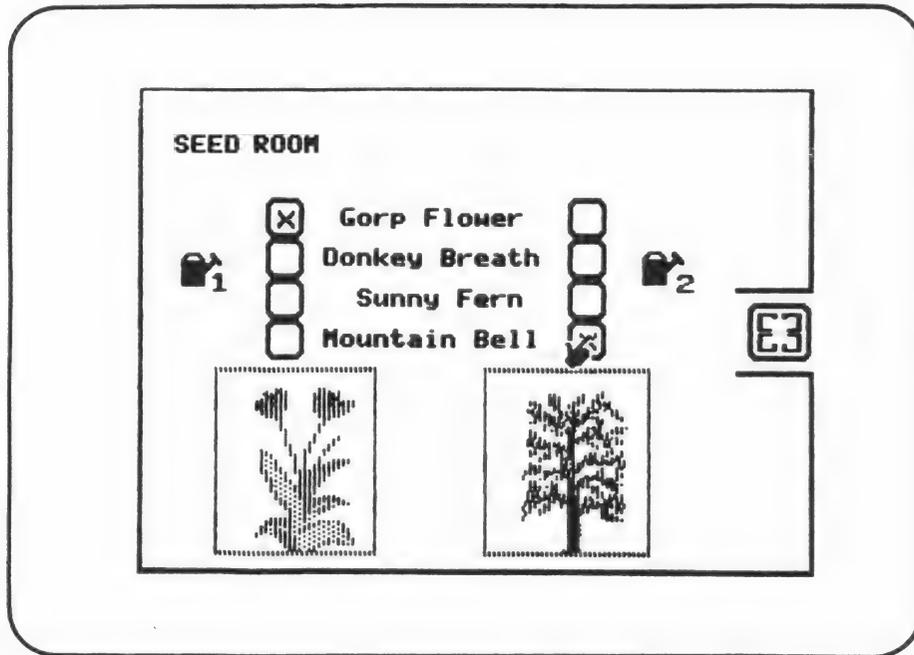


Descriptions - The description button in the lower left corner of the Lobby can be selected by placing the pointing finger of the hand on the button and pressing either the mouse button, Return key, or Space Bar.

Exit Button - Students can exit *Botanical Gardens*, to use another disk or end the session, by selecting the button in the Lobby. The EXIT button in the lower right corner of the Lobby can be selected by placing the pointing finger of the hand on the button and pressing either the mouse button, Return key, or Space Bar.

 **Door to Seed Room** - The door to the Seed Room is located on the left side of the Lobby. To enter the Seed Room students place the hand in the doorway and press either the mouse button, Return key, or Space Bar. The door will immediately close and the Seed Room will appear.

SEED ROOM



Selecting Seeds - In the center of the Seed Room are the seeds currently available for experimentation. Students select a seed for Greenhouse 1 by placing the pointing finger of the hand in one of the boxes to the left of the seed names and then pressing either the mouse button, Return key, or Space Bar. An "X" will appear in the box indicating its selection, and a picture of the full grown plant will appear at the bottom. Students select a seed for Greenhouse 2 in the same manner.

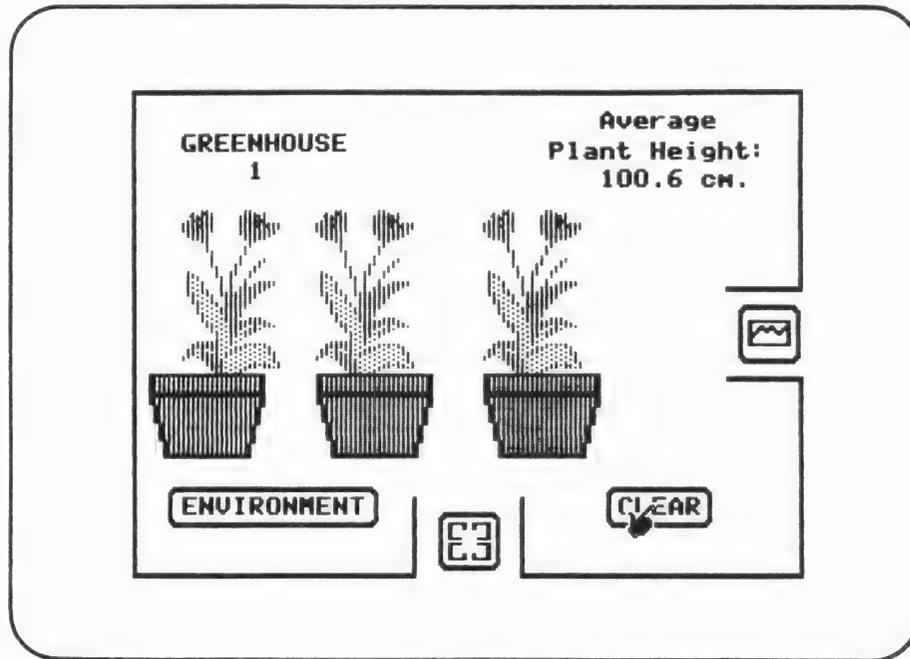
Changing Seeds - The current seed in each Greenhouse can be changed by placing the hand in a new box and pressing the mouse button, Return key, or Space Bar. The "X" will move to the new seed name and the plant picture will change.

When students change seeds in a Greenhouse, the Greenhouse is sterilized, environmental control set to zero, and all Graphing Room data is erased.

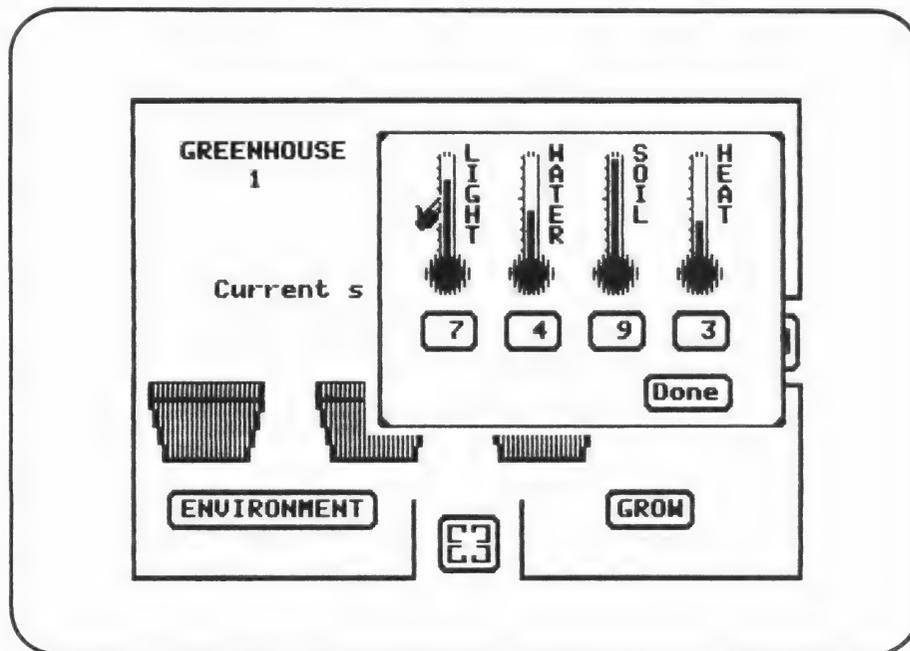
 **Door to Lobby** - The door to the Lobby is located on the right side of the Seed Room. To enter the Lobby, students place the hand in the doorway and press either the mouse button, Return key, or Space Bar. The door will immediately close and the Lobby will appear.

  **Doors to Greenhouses 1 & 2** - The door to Greenhouse 1 is located at the top of the Lobby (see page 8). The door to Greenhouse 2 is located at the bottom of the Lobby. To enter the Greenhouses, students place the hand in the doorway and press either the mouse button, Return key, or Space Bar. The door will immediately close and the appropriate Greenhouse will appear.

GREENHOUSES 1 & 2  



Environment - Students select the Environment by placing the hand on the Environment button and pressing the mouse button, Return key, or Space Bar. The Environmental Control Window will open and the hand will appear to the left of the window.



Setting Thermometers - The four control indicators, (light, water, soil, and heat) show the current environmental setting for the current Greenhouse. The setting can be changed in two ways:

Using the Hand - Students can place the pointing finger of the hand at the desired level with the hand to the left of the control. Pressing the mouse button, Return key, or Space Bar will cause the control to rise or fall to the desired level.

Using the Keyboard - Students can place the pointing finger of the hand next to the control and enter the desired value (0 - 9) from the keyboard.

Exiting Environment - Students close the Environmental Control Window by placing the hand on the Done button and pressing the mouse button, Return key, or Space Bar. The Environmental Control Window will close and the hand will reappear on the Grow/Clear button.

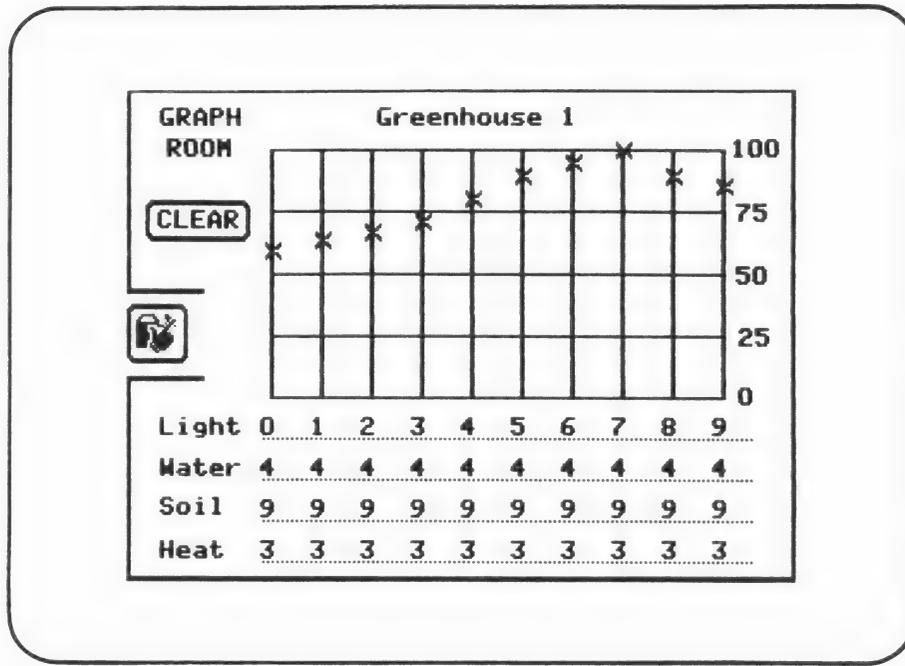
Grow - Grow is selected by placing the pointing finger of the hand on Grow and pressing the mouse button, Return key, or Space Bar. The current plant will grow in the three flower pots in response to the environmental control settings. The average height of the three plants will appear in the upper right hand corner of the Greenhouse. (Plants should be grown several times at each environmental setting because seed growths vary slightly.)

Clear - Once the plants have grown, Grow is replaced by Clear. Clear is selected by placing the pointing finger of the hand on Clear and pressing the mouse button, Return key, or Space Bar. The plants and average plant height will be immediately cleared from the screen and Grow will reappear.

 **Door to Graph Room** - The door to the Graph Room is located on the right side of the Greenhouse. To enter the Graph Room students place the hand in the doorway and press either the mouse button, Return key, or Space Bar. The door will immediately close and the Graph Room will appear.

 **Door to Lobby** - The door to the Lobby is located on the bottom of Greenhouse 1 and the top of Greenhouse 2. To enter the Lobby, students place the hand in the doorway and press either the mouse button, Return key, or Space Bar.

GRAPH ROOM



The Display-The Graph Room displays the results of student's experiments. Each time students change the environmental control settings in the Greenhouse, the settings are saved and recorded in the Graph Room. An average of the plant growth for the setting is displayed. (If students run several experiments at a particular setting, the average for all experiments at that setting is displayed.) The environmental settings are listed under the graph.

The Graph - There is space to display the results for ten different environmental settings. If more than ten experiments are conducted, the data for the first experiment is dropped automatically from the left of the graph and the new data appended to the right.

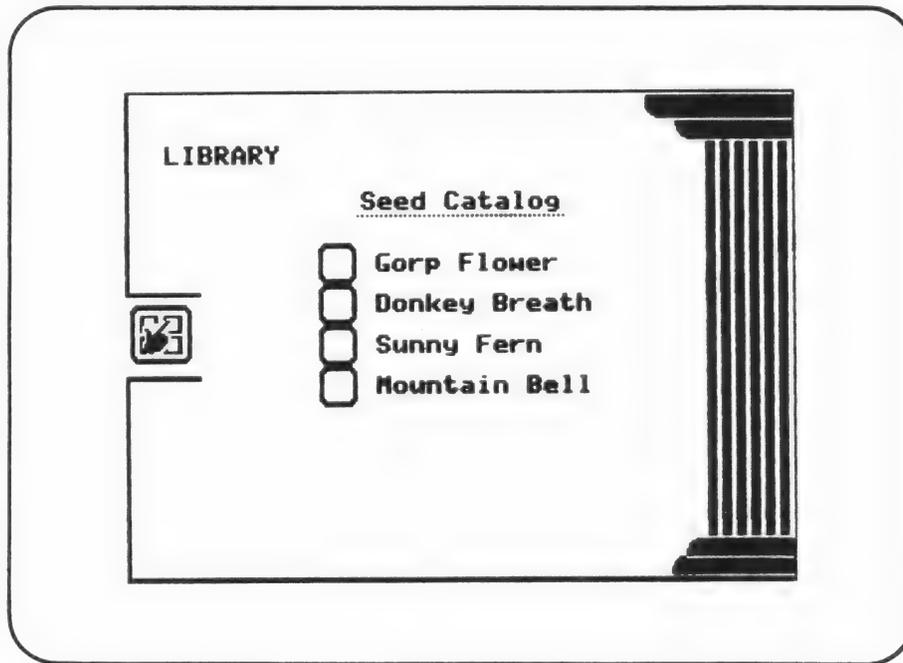
Clear - Clear can be selected by placing the pointing finger of the hand on Clear and pressing the mouse button, Return key, or Space Bar. Clear erases the points plotted on the graph. This data **can not** be retrieved once the graph has been cleared.

  **Door to Greenhouse** - The door to the Greenhouse is located on the left side of the Graph Room. To enter the Greenhouse, students place the hand in the doorway and press either the mouse button, Return key, or Space Bar. The door will immediately close and the Greenhouse will appear.

Optional Doors

 **Door to Library** - The door to the Library Room will appear on the lower right side of the Lobby if it has been "unlocked" by the teacher in the Change Options. Students enter the Library by placing the hand in the doorway and pressing the mouse button, Return key, or Space Bar. The door will close and the Library will appear.

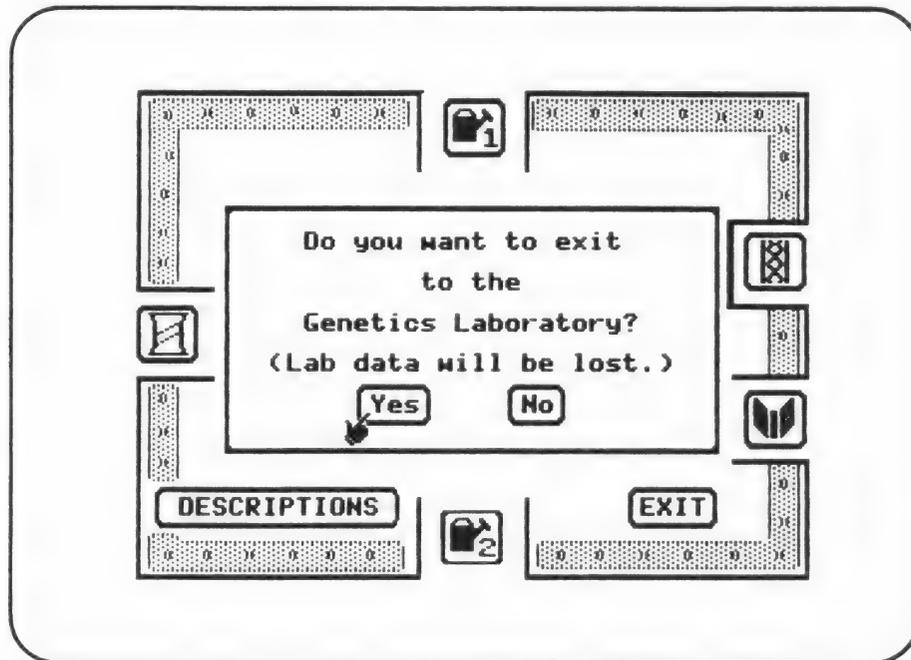
LIBRARY 



Selecting Plant -The Library contains a list of seeds currently available for experimentation. Students can read a brief description of each plant by placing the pointing finger of the hand in the box to the left of the seed name and pressing the mouse button, Return key, or Space Bar. The Library reference displays the name of the plant, a brief description, and a picture of the full grown plant. To close the plant's library reference, the student selects Done.

 **Door to Lobby** - The door to the Lobby is located on the left side of the Library. To enter the Lobby, students place the hand in the doorway and press either the mouse button, Return key, or Space Bar. The door will immediately close and the Lobby will appear.

 **Door to Genetics Lab** - The door to the Genetics Lab will appear on the upper right side of the Lobby if it has been "unlocked" by the teacher in the Change Options. Students enter the Genetics Lab by placing the hand in the doorway and pressing the mouse button, Return key, or Space Bar. The door will immediately close. At this point, a warning box will appear on the screen with the following message:



Student must use the hand to answer either "Yes" or "No" to this question.

YES - A response of "Yes" will bring the Genetics Laboratory menu onto the screen. Any data graphed in the Graph Rooms is lost when the students go to the Genetics Laboratory. Students will need to go to the Seed Room and select new seeds when they return to the Botanical Gardens.

NO - A response of "No" will return the students to the Botanical Garden's Lobby.

GENETICS LAB

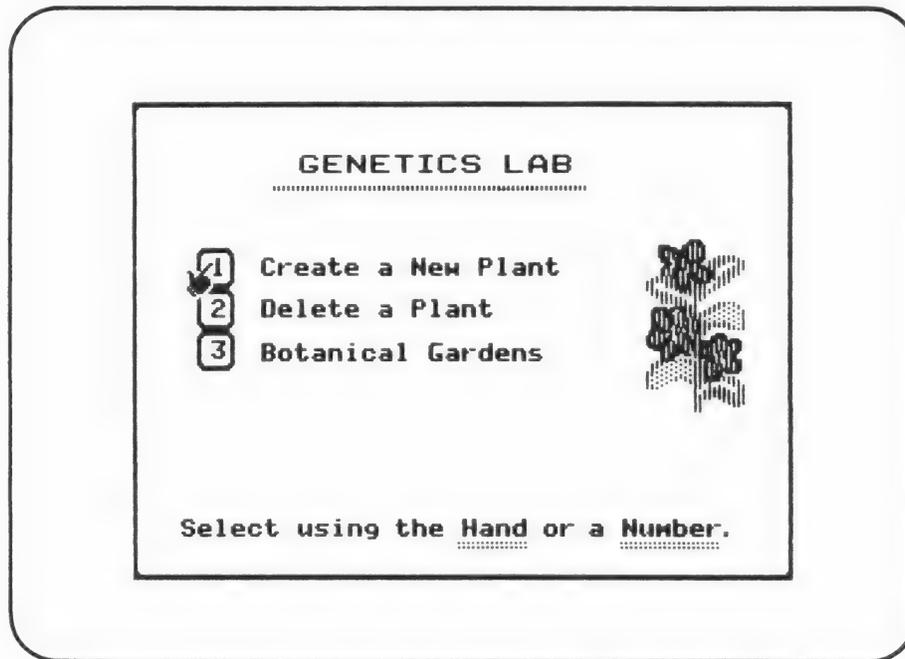
The Genetics Laboratory gives students an opportunity to design their own custom seeds. These seeds can then be grown in the Botanical Gardens. The process of designing a seed involves selection of a name, writing a short description, selection of the plant's appearance, and generation of the hidden plant growth parameters. Once a plant is designed it can be saved on the disk.

Warnings:

1. A maximum of four custom seeds can be stored. If the disk already contains four custom seeds, students must delete a seed before designing their new seed. The four standard seeds that come with *Botanical Gardens* can not be deleted.

2. The Write-Protect Tab must be removed from the notch on the right-hand edge of the disk before a new custom seed can be saved or deleted. If an attempt is made to save or delete a seed on a Write-Protected disk, a message will appear asking that the tab be removed.

Create a New Plant -The process of creating a seed begins when students select "Create a New Plant" from the Genetics Laboratory Menu.

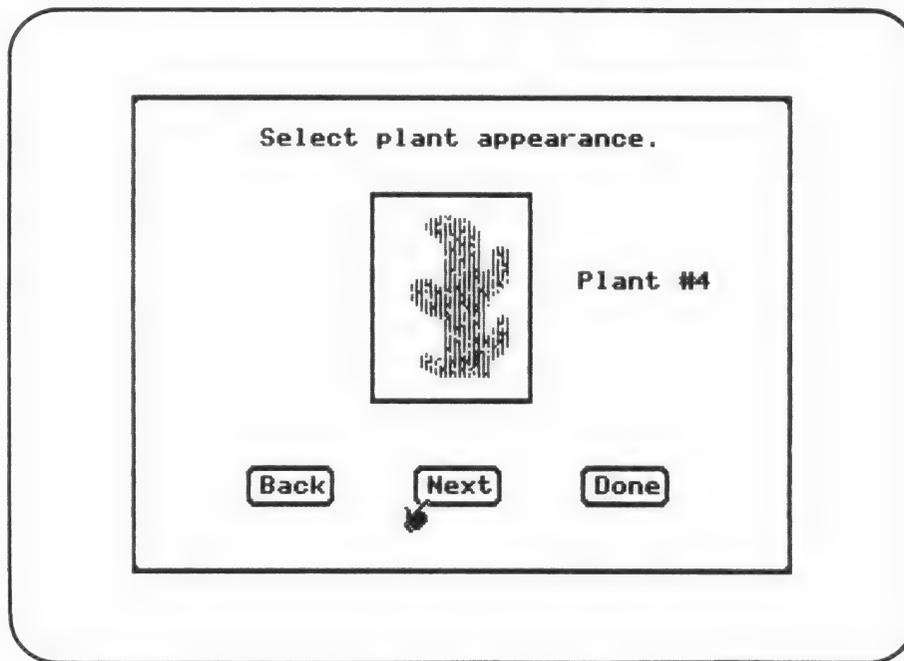


This is accomplished by placing the pointing finger of the hand in the box to the left of "Create a New Plant" and pressing the mouse button, Return key, or Space Bar. (The selection can also be made by typing a number "1" from the keyboard.)

Naming the Plant - A plant name can contain up to 13 letters. The name should **not** contain punctuation marks. The letters can be either upper case or lower case. Once the name is entered, students press the Return key to continue. Students are then given an opportunity to verify the name they have entered.

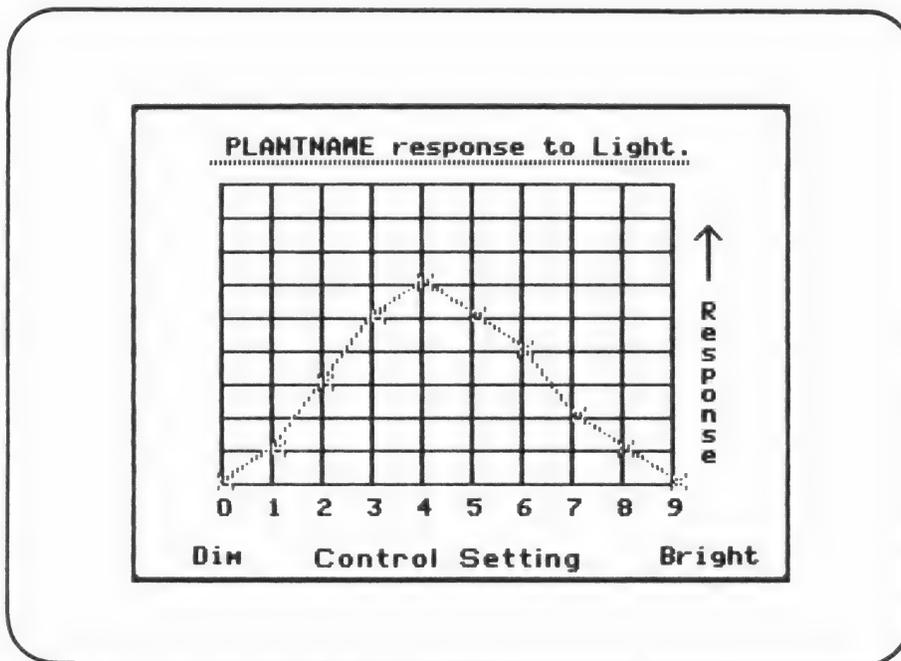
Written Narrative - The written description of the plant is limited to six lines, each with approximately thirty letters. Students should **not** press Return at the end of each line. The description should give some interesting details about the plant and perhaps some hints as to the conditions under which the plant thrives. This narrative will appear in the Library. Once the descriptive narrative is entered, students press the Return key to continue. Students are then given an opportunity to verify the description they have entered.

Selection of Plant Appearance - The *Botanical Gardens* disk contains eight different plant appearances. Students can view these plants by placing the pointing finger of the hand on Next and pressing the mouse button, Return key, or Space Bar. Students can view previous plant appearances by activating the Back button. Once the desired plant appears in the display window, the students select the Done button to continue.



Defining Plant Parameters - The plant parameters control the plants response to light, heat, water, and soil conditions. A plant might grow well in dim light and poorly in bright light. Students define these plant parameters by moving the hand and plotting responses on a series of four graphs.

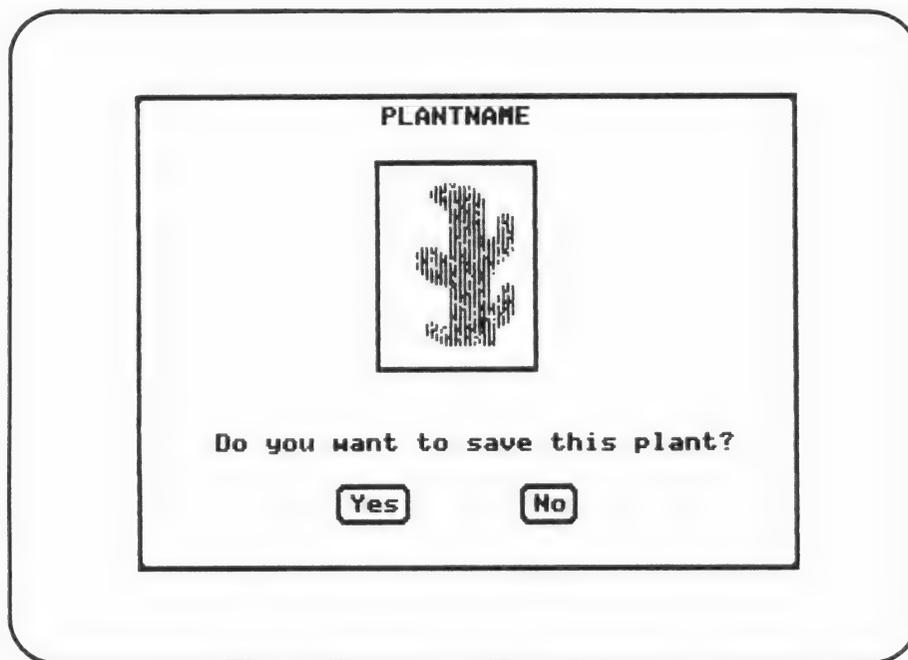
The first parameter to be entered is the one for light. A blank graph appears with the light setting (Dim to Bright) measured along the horizontal axis and growth response measured along the vertical axis. The hand is initially locked so that only the plant's response to "dim" light can be entered. The value desired is selected by moving the hand to the desired height and pressing the mouse button, Return key, or Space Bar. Students are graphically answering the question, "How well will this plant grow when the light setting is set at zero (0)?" Once the desired setting has been plotted, the hand moves one line to the right and students enter the plant's growth response to a light setting of "1." This process continues until a complete response graph has been generated. Students have an opportunity to verify the response graph after it has been completed.



Students continue in the same manner to define the plant's response parameters for water, soil, and heat.

Editing Plant Parameters - Students are presented with a graphic overview of the four plant growth parameters they have developed. At this point, they can edit any of the graphs they have developed by activating the appropriate response graph, or they can select Done to continue.

Saving Plant Parameters - Students are asked whether or not they wish to save the newly created plant on the disk. An answer of "Yes" saves their name, narrative, picture, and plant parameters to the disk. An answer of "No" erases all of the data entered and returns the student to the Genetics Laboratory Menu.



Deleting a Seed - Students can remove custom seeds by selecting "Delete a Plant" from the Genetics Laboratory Menu. A list of all custom seeds is presented with numbered buttons to the left of each plant name. Activation of one of the numbered buttons selects the seed for deletion. Students are asked to verify the deletion of the plant before the information is physically erased from the disk.

Exiting Genetics Laboratory to Gardens - Students can leave the Genetics Laboratory and go directly to the garden by selecting Botanical Gardens from the Genetics Laboratory Menu. When the students "arrive" at the Botanical Gardens, they will need to go to the Seed Room and select new seeds for their experiments.

(Note: Botanical Gardens is initially set to allow student to experiment with the four standard seeds. Before students can experiment with custom seeds, the teacher must select "Custom Seeds" in the Change Options.)

Botanical Gardens

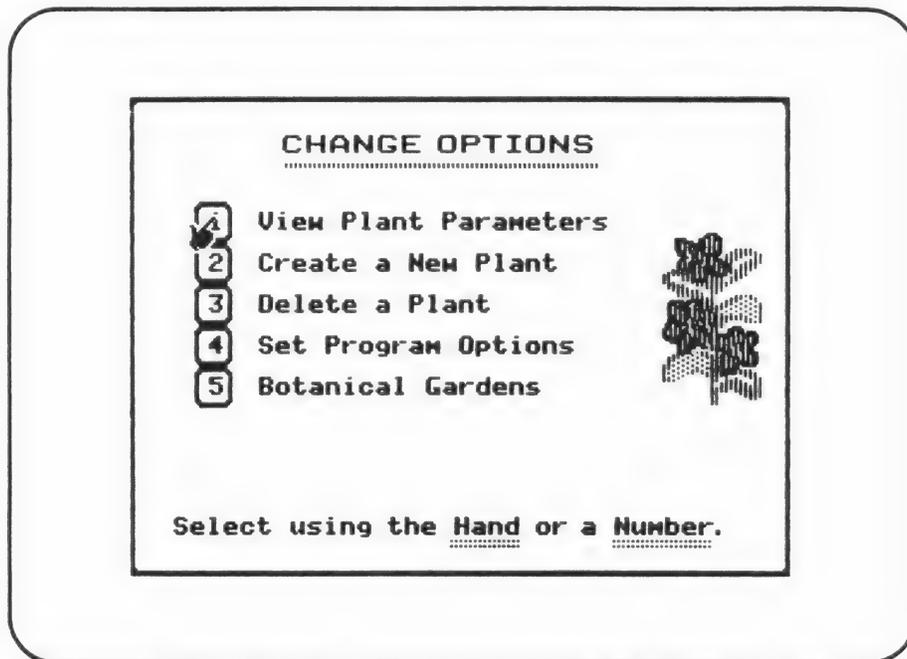
Change Options

The Change Options allow teachers to adapt ***Botanical Gardens*** to best meet the needs of their students. The Change Options can be reached two different ways.

(1) When starting the program, hold down the Control (CTRL) key and press the letter T immediately after the SUNBURST logo has appeared on the screen.

(2) Hold down the Control (CTRL) key and press the letter T while the hand is in the Lobby of the Botanical Gardens. **Going to the Change Option from within the Botanical Gardens will sterilize the garden and all data to that point will be lost.**

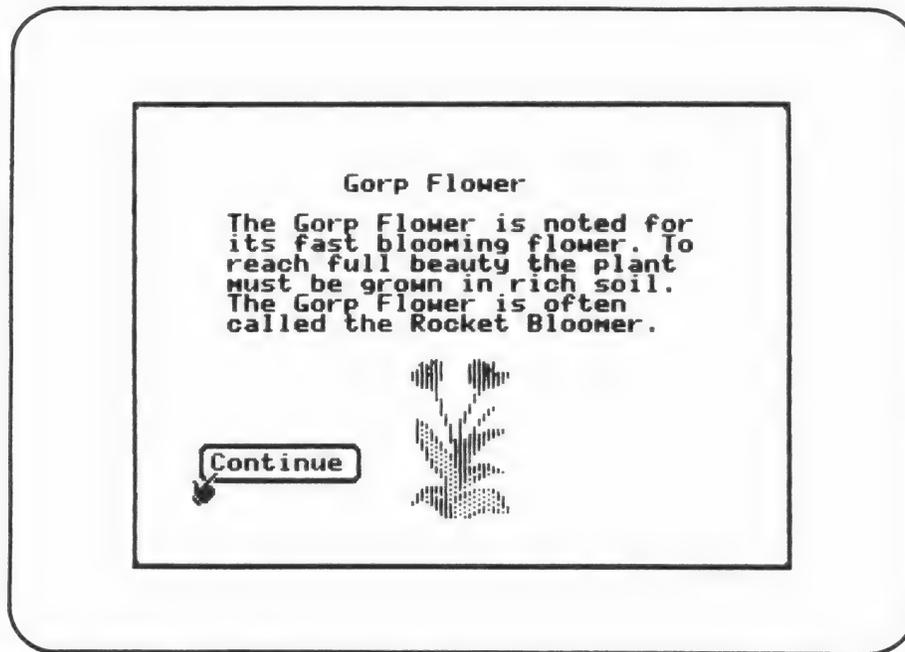
A menu of five options is presented to the teacher:



1. View Plant Parameters - This option allows teachers to view the plant growth parameters controlling the growth of each plant. To view the plant parameters, place the pointing finger of the hand on the button to the left of "View Plant Parameters" and press the mouse button, Return key, or Space Bar. (This selection can also be made by typing the number "1" from the keyboard.)

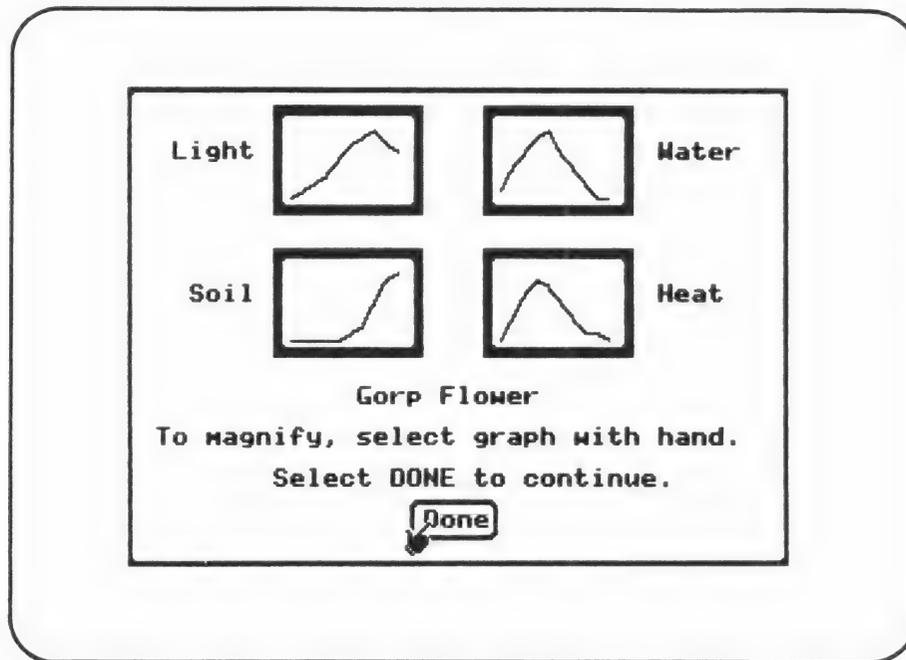
Immediately after this selection, a list of all plants stored on the disk is presented. This list contains the four standard seeds provided with ***Botanical Gardens*** and any custom seeds designed by the teacher or students. To select a seed for viewing, place the pointing finger of the hand on the button to the left of the plant name and press the

mouse button, Return key, or Space Bar. (The selection can also be made by typing a number from the keyboard corresponding to the position of the plant in the list.)



Once the plant has been selected, the description and a picture of the plant appears on the screen. To proceed, select Continue.

Next is a graphic overview of the four plant growth parameters for the selected plant. At this point, any of the graphs can be examined in detail by activating the appropriate Graph.



To return to the Change Options menu, activate the Done button.

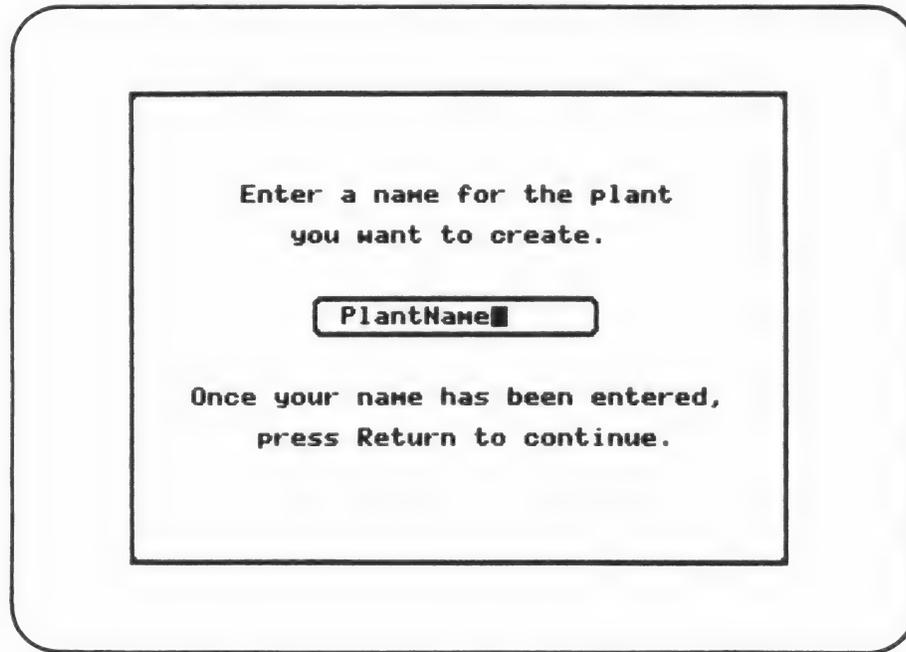
2. Create a New Plant - This option is used for teachers to design their own custom seeds. These seeds can then be grown in the garden. The process of designing a seed involves selection of a name, writing a short description, selection of the plant's appearance, and generation of the hidden plant growth parameters. Once a plant is designed it can be saved.

The process of creating a seed begins when teachers select "Create a New Plant" from the Change Options Menu. This is accomplished by placing the pointing finger of the hand on the button to the left of "Create a New Plant" and pressing the mouse button, Return key, or Space Bar. (The selection can also be made by typing a number "2" from the keyboard.)

Warnings:

1. A maximum of four Custom Seeds can be stored on the program disk. If the disk already contains four Custom Seeds, you must delete a seed before designing their new seed. The four Standard Seeds that come with the Botanical Gardens can not be deleted.

Naming the Plant - A plant name can contain up to 13 letters. The name should **not** contain punctuation marks. The letters can be either upper case or lower case. Once the name is entered, teachers press the Return key to continue. They are then given an opportunity to verify the name that was entered.



Enter a name for the plant
you want to create.

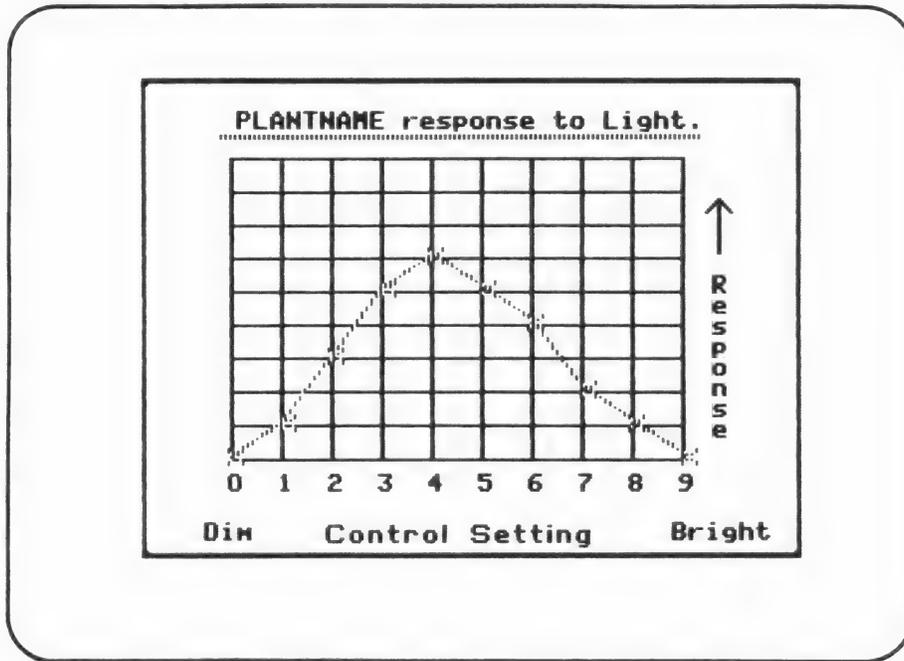
PlantName█

Once your name has been entered,
press Return to continue.

Written Narrative - The written description of the plant is limited to six lines, each with approximately thirty letters. The letters can be either upper case or lower case. Do **not** press Return at the end of each line. The description should give some interesting details about the plant and perhaps some hints as to the conditions under which the plant thrives. Once the descriptive narrative is entered, press the Return key to continue. Teachers are then given an opportunity to verify the description they have entered.

Selection of Plant Appearance - The *Botanical Gardens* disk contains eight different plant appearances. These plants can be viewed by placing the pointing finger of the hand on Next and pressing the mouse button, Return key, or Space Bar. Teachers can view previous plant appearances by selecting Back. Once the desired plant appears in the display window, activating Done will continue.

Defining Plant Parameters - The plant parameters control the plants response to light, heat, water, and soil conditions. A plant might grow well in dim light and poorly in bright light. These plant parameters are defined by moving the hand and plotting responses on a series of four graphs, one graph for each of the four parameters.



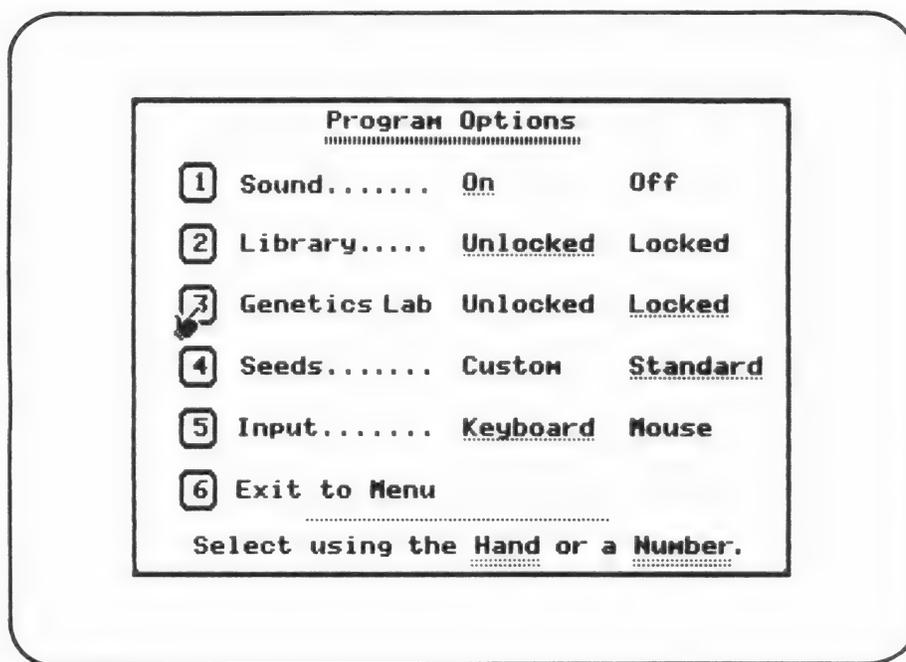
The first parameter to be entered is the one for light. A blank graph appears with the light setting (Dim to Bright) measured along the horizontal axis and growth response measured along the vertical axis. The hand is initially locked so that only the plant's response to "dim" light can be entered. The value desired is selected by moving the hand to the desired height and pressing the mouse button, Return key, or Space Bar. Basically the teachers are graphically answering the question, "How well will this plant grow when the light setting is set at zero (0)?" Once the desired setting has been plotted, the hand moves one line to the right and the plant's growth response to a light setting of "1" is entered. This process continues until a complete response graph has been generated. There is an opportunity to verify the response graph after it has been completed. Teachers continue in the same manner to define the plant's response parameters for water, soil, and heat.

Editing Plant Parameters - A graphic overview of the four plant growth parameters is presented. At this point, teachers can edit any of the graphs developed by activating the appropriate graph. Activating the Done button will continue to allow teachers to save the plant.

Saving Plant Parameters - Teachers are asked whether or not they wish to save the newly created plant on the disk. An answer of "Yes" will save the name, narrative, picture, and plant parameters to the disk. An answer of "No" erases all of the data entered and returns to the Change Options Menu.

3. Delete a Plant - Teachers can remove custom seeds (seeds created by the teacher or students) from the disk by selecting "Delete a Plant" from the Change Options Menu. A list of all custom seeds is presented with numbered buttons to the left of each plant name. Activation of one of the numbered buttons selects the seed for deletion. They must verify the deletion of the plant before the information is permanently erased.

4. Set Program Options - The Program Options allow the teacher to control *Botanical Gardens* so that it is most effective for the students. The initial settings, when the disk is purchased, are underlined below:



The program options can be changed by placing the pointing finger of the hand in the box to the left of the option and pressing the mouse button, Return key, or Space Bar. (Options can also be changed by typing the corresponding option number from the keyboard.)

Warning: The Write-Protect Tab must be removed from the notch on the right-hand edge of the disk before changing the program options. If an attempt is made to change program options on a Write-Protected disk, a message will appear asking that the tab be removed. All options are saved on the disk and remain as set until changed through the program options.

Sound - The sound of the opening and closing doors is controlled by the sound options. If Botanical Gardens is going to be used in an area where silence is required this option should be changed to "Off."

Library - If the Library is set to "Unlocked," the doorway to the Library will appear on the right hand side of the Lobby. Students will be able to enter the Library and read the description of the plant seeds they are experimenting with. If the Library is set to "Locked" the door to the Library will not appear in the Lobby.

Genetics Lab - If the Genetics Lab is set to "Unlocked" the doorway to the Genetics Lab will appear on the right side of the Lobby. Students will be able to enter the Genetics Lab and create and delete custom seeds. If the Genetics Lab is set to "Locked", the door to the Genetics Lab will not appear in the Lobby.

Seeds - If the Seeds are set to "Standard," student will be able to experiment with the four standard seeds provided with *Botanical Gardens*. If this option is set to "Custom", the student will only be able to experiment with the custom seeds designed by the teacher or the students.

Note: If the Genetics Lab is Unlocked but the seeds are set to Standard, then the students can create new seeds but must experiment with the standard ones.

Input - *Botanical Gardens* supports the use of an Apple Mouse if this option is set to "Mouse." If this option is set to "Keyboard," the use of a mouse is not possible and the students must enter all information using the keyboard.

Exit to menu - Selecting this option returns you to the Change Options Menu.

5. Botanical Gardens - You can leave the Change Options and go directly to the Lobby by selecting Botanical Gardens from the Change Options Menu.

Botanical Gardens

Classroom Lessons

Overview

The following Classroom Lessons are offered to help you guide your students' use of ***Botanical Gardens***.

The three lessons help students develop data collection and graphing skills. The scientific method of controlling variables is developed as the primary focus of ***Botanical Gardens***.

The lessons are so constructed that they should be used in sequence. Lesson #1 and Lesson #2 can be interchanged depending on your particular focus. Lesson #3 should only be attempted after students are very familiar with the graphing skills and problem solving processes taught in lessons 1# and #2.

Briefly outlined, the lessons are as follows:

Lesson #1

Students use the Botanical Gardens Experimenter's Logs to collect experimental data on a plant grown in a Greenhouse.

Students are asked to select one plant and one variable and do a thorough investigation of the plant's growth response to the selected variable. The data is then summarized and graphed. Students are asked to write a descriptive statement about the response graph they have made.

Lesson #2

Students use the built-in Graphing Room to systematically investigate the growth of one plant in response to the four experimental variables.

Students work with one variable at a time to conduct experiments to establish the response curve for heat, light, water, and soil. Students are asked to draw a graph and write descriptive statements about the nature of each of the graphs on Plant Growth Worksheet 1.

Lesson #3

Students use the Plant Growth Worksheet 2 to design an original plant. They then enter the Genetics Laboratory and build their own custom seed. Other students in the class are then asked to experiment with the newly developed plant.

Classroom Lesson #1

Collecting and Interpreting Data

OBJECTIVES:

- to be able to collect and average experimental data for one plant for 10 different control settings.
- to be able to graph a series of points on a two dimensional graph.
- to be able to write a descriptive statement which describes the plant's response to the changing control setting.

MATERIALS:

- Classroom set of Botanical Gardens Experimenter's Logs 1 & 2
- A hand calculator (optional)

Lesson Plan

Have the students work in groups of two or three. Start by having students look at the descriptions. Make sure they study the map of the gardens and read the room descriptions carefully. Ask the students to enter the Seed Room and select the Gorp Flower for their first experiment.

Have the students find Greenhouse 1 and explain how the environmental condition can be changed. Allow the students to have 10 to 15 minutes trying to guess the proper control settings. After this initial orientation and experimentation, have the students suggest a plan for attacking the problem in a scientific way. Be patient and wait until one of your students suggests studying one variable at a time.

Pass out the Experimenter's Log 1 and have the students fill in the information at the top of the sheet. Have all of the students experiment with various light settings while holding the other three variables constant. Ask the students why it is important to measure the growth of each plant more than once at each setting (see sample Experimenter's Log 1 on page 35).

Once the students have completed their data collection, have them transfer the averages to Experiment Log 2. You will probably have to help younger students number the left-hand side of the graph. Have the students graph their data and write a descriptive statement about the shape of their graph (see sample Experimenter's Log 2 on page 37).

Classroom Lesson #2

Investigating Plant Variables

OBJECTIVES:

- Students will be able to experiment controlling one variable at a time. Students will work systematically through the four environmental variables.
- Students will be able to interpret the data presented in the Graph Room. From the data, the students will be able to infer the best conditions for the selected plant.

MATERIALS:

- Classroom set of Plant Growth Worksheet 1
- A hand calculator (optional)

Lesson Plan

Students are asked to select one of the four Standard seeds for experimentation. Have the students select one variable and try growing the plant at each of the possible settings (0 - 9). Make sure that the students start at one end of the scale and work step by step towards the other end of the scale with four growths at each setting. Ask the students why it is important to grow the plant several times at each setting. Have the students enter the Graph Room and examine the graph.

Students should copy the graph in the Graph Room on the Plant Growth Worksheet 1 (see pages 38 & 39). Ask them to look closely at the shape of the graph and then write a statement that describes the shape of the graph. Have the students mark an arrow indicating the highest point on the graph.

Students should continue this process until they have experimented with each of the environmental variables.

Students should be asked to compare this long and detailed process of gathering information and a less organized "let's change everything" approach.

Classroom Lesson #3

Designing Custom Seeds

OBJECTIVES:

- Students will be able to write a brief paragraph describing the plant they wish to create.
- Students will be able to prepare four plant response graphs using the Plant Growth Worksheets that reflect growth characteristics similar to those described in their written description.
- Using the Genetics Laboratory, students design their plant and save it on the disk for later experimentation.

MATERIALS:

- Classroom set of Plant Growth Worksheet 2

Special Notes

1. Before the students can complete this lesson, they must be given access to the Genetics Laboratory. To do this the teacher must enter the Change Options either by pressing Control-T while the program is loading or pressing Control-T when the hand is in the Lobby. Select "4. Change Program Options" from the Change Options Menu. Change the Genetics Laboratory to "**Unlocked.**" This will allow the students to access the Genetics Laboratory when they use *Botanical Gardens*.
2. If you plan to have the students experiment with the seeds they design, teachers should also change the selected seeds to "**Custom.**" That way the "Custom" seeds will be presented to the students in place of the four standard seeds that are originally set in *Botanical Gardens*.
3. It is important that students complete the Plant Growth Worksheet 2 (see page 40) before they enter the Genetics Laboratory. This will improve the quality of the seeds developed and reduce frustration at the computer when they finally enter their plant information.

Have the students think of a plant they would like to design. It could be a real plant that they know something about or it could be a completely new plant. Sometimes it is easier to start by defining a set of environmental conditions first, then describing a plant that might live in those conditions.

On the Plant Growth Worksheet 2, students could write a short paragraph describing the plant they are designing. They should give some hints as to the conditions the plant needs, but they should not give everything. Students should be discouraged from giving misleading information in their descriptive paragraph.

Students then should draw response graphs for each of the four environmental variables. Students should be urged to make their graphs smooth. There should be only one maximum for each plant. (After they have designed their first plant, they may want to design a "difficult" or "funny" plant.)

Important: It should be stressed that the 4 variables are independent variables and will respond according to how they are set, relative to their own maximum and minimum points. The control variable settings have no effect on an individual experimental variable. That is, the 3 control variables could even be set to zero and the experimental variable will respond according to its particular preset graph.

Students could conceivably design a plant with all conditions set to one number (for example 5). But then, the plant would have a constant growth pattern in all conditions or settings (no maximum or minimum points). Therefore when experimenting, students could even set each variable to zero and since the plant grows BEST on every setting, the plant would grow to full height at all times. For this reason, students must plan out their designs to a set of specific environmental factors with maximum and minimum points.

Have the students boot up the *Botanical Gardens* disk and immediately enter the Genetics Laboratory. When the Genetics Laboratory Menu appears have them select "1. Create a Plant." Once the plant is completed it should be saved to the *Botanical Gardens* disk.

Just as a final check, have the students go back to the Botanical Gardens and select the seed they have designed. (Remember, they can only do this if you have selected "Custom" seeds in the Change Options.) If they find that their plant grows as expected, they should have other students in the class try to experiment and discover the hidden "parameters" they have designed for their plant.

Follow-up Activities

Once students have learned to run controlled experiments in **Botanical Gardens**, it is time to have them plan real controlled experiments in the classroom. These experiments should require the students to collect data, define variables, and control all but the experimental variable.

Activity 1 - Growing Plants - Having the students experiment with the growth of beans is a natural place to start. As in **Botanical Gardens**, soil, light, heat, and water can all be controlled. Experimenting with different soils is the easiest experiment to conduct.

Equipment required:

- 36 Bean seeds
- 18 Styrofoam cups
- Sand and potting soil

Make two rows of cups, with nine cups in each row. Fill the first cup in each row completely with sand. Continue down the rows placing less sand in each cup. The final cups should have no sand at all.



Now fill the remaining space in each cup with potting soil. Students should then mix the contents of each cup thoroughly. This process will produce two sets of identical cups with soil varying evenly from sandy to humus. Plant two bean seeds in each cup. Place the cups near a window where the plants will receive equal light. (If this experiment is conducted during the winter months, make sure the plants are not frozen at night or on the weekends when the heat is turned off.) Students should carefully water each plant, using the same amount of water for each plant.

Students record the height of each plant every day and display the data graphically. Students should also be urged to make observations on the general health of each plant. Students should be encouraged to interpret their experiment through written descriptive statements.

Activity 2 - Rubber Band Elasticity - Controlled experimentation is just as much a part of the physical sciences as it is the biological sciences. In this experiment, students study how elasticity varies with respect to the rubber bands width and length.

Equipment required:

- Rulers
- Paperclips
- Several dozen metal washers
- Assorted bands

Students should look closely at the rubber bands to see what variables can be controlled. Often it is possible to find several rubber bands with the same length but cut to different thicknesses. Another possibility is to use several rubber bands with the same thickness but different lengths. Tie one end of the rubber band to the top of the ruler and attach a paper clip hook to the opposite end. Students can test the rubber bands elasticity by placing washers in the paperclip hook and recording the new length of the rubber band.



Students should be encouraged to write descriptive statements along with graphing the results of the rubber band experiments.

Botanical Gardens

Sharing Some Field Test Results

Botanical Gardens was extensively field tested with 6th, 7th, and 8th grade students as part of a Master's Thesis conducted by a graduate student at Mercy College of Detroit. The program has also been used with upper elementary children. The following observations are gleaned from these field tests:

1. Many students preferred to work collaboratively, in groups of 2 -3, rather than alone. Students working in a group tended to attack the problem less systematically than the students working individually. When groups of students worked with ***Botanical Gardens*** for the first time they tended to start by randomly guessing at the correct control settings. They often varied several or all of the control simultaneously. After several tries, and some frustration, almost always someone in the group suggested a systematic approach.
2. Students with previous computer experience had very little difficulty moving the hand around the screen. First time users required some practice time before they could efficiently move from screen to screen. Using the mouse with ***Botanical Gardens*** seemed to be the best input mode for students of all ages. If you have a mouse connected to your Apple, make sure to select "Mouse" in the Change Options.
3. The students enjoyed reading about the plants in the Library and often asked if there was some way to get additional information. Many times the students failed to apply the "hints" in the Library to their plant growing experiments. After several experiments they made the connection and often returned to the Library for clues.
4. We found ***Botanical Gardens*** to be very motivational with the students we tested. At times, the students became overly competitive. Groups competed to see who could reach maximum growth in the fewest number of trials. This competitive "energy" needed to be focused on the task.
5. Many students tried to relate their control setting to their own experiences with plants in their homes. It is important to remind students that these are "fake" plants which may or may not grow in conditions similar to plants they have previously grown.
6. For some reason the "Mountain Bell" caused students the most difficulty. It might be best to save this plant for more experienced experimenters. Due to this observation, the "Mountain Bell" is the last of the standard seeds. (Boys tended to grow the "Donkey Breath" when given a free choice, whereas the girls often picked the "Mountain Bell.")
7. While it is not necessary to use a color monitor with ***Botanical Gardens***, students enjoyed the growth of the colorful flowers on the color monitors. Often students would leave their green screen monitors to see fully grown plants on someone else's color monitor.

Botanical Gardens

Experimenter's Log 1

Plant _____ Name _____

Experimental Variable _____ Date _____

Control Variables _____

Experiment 1

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 2

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 3

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 4

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 5

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 6

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 7

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 8

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 9

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Experiment 10

Exp. variable _____
Setting _____

Trial 1 _____
Trial 2 _____
Trial 3 _____
Trial 4 _____

Total _____
Average _____

Botanical Gardens

Experimenter's Log 1

Plant Sunshine Rose

Name **SAMPLE**

Experimental Variable Light

Date _____

Control Variables Heat (5) Water (5) Soil (5)

Experiment 1

Exp. variable Light
Setting 0

Trial 1 9.2 cm
Trial 2 12.2 cm
Trial 3 14.9 cm
Trial 4 15.1 cm

Total 51.4 cm
Average 12.9 cm

Experiment 2

Exp. variable Light
Setting 1

Trial 1 24.5 cm
Trial 2 25.7 cm
Trial 3 27.3 cm
Trial 4 20.5 cm

Total 98.0 cm
Average 24.5 cm

Experiment 3

Exp. variable Light
Setting 2

Trial 1 42.5 cm
Trial 2 39.5 cm
Trial 3 37.9 cm
Trial 4 36.4 cm

Total 156.3 cm
Average 39.1 cm

Experiment 4

Exp. variable Light
Setting 3

Trial 1 22.2 cm
Trial 2 26.0 cm
Trial 3 21.4 cm
Trial 4 26.1 cm

Total 95.7 cm
Average 23.9 cm

Experiment 5

Exp. variable Light
Setting 4

Trial 1 23.1 cm
Trial 2 22.1 cm
Trial 3 18.6 cm
Trial 4 18.3 cm

Total 82.1 cm
Average 20.5 cm

Experiment 6

Exp. variable Light
Setting 5

Trial 1 12.4 cm
Trial 2 14.5 cm
Trial 3 16.1 cm
Trial 4 13.9 cm

Total 56.9 cm
Average 14.2 cm

Experiment 7

Exp. variable Light
Setting 6

Trial 1 18.8 cm
Trial 2 15.0 cm
Trial 3 12.5 cm
Trial 4 12.1 cm

Total 58.4 cm
Average 14.6 cm

Experiment 8

Exp. variable Light
Setting 7

Trial 1 16.9 cm
Trial 2 18.3 cm
Trial 3 14.4 cm
Trial 4 11.8 cm

Total 61.4 cm
Average 15.4 cm

Experiment 9

Exp. variable Light
Setting 8

Trial 1 13.5 cm
Trial 2 11.2 cm
Trial 3 18.1 cm
Trial 4 14.1 cm

Total 56.9 cm
Average 14.2 cm

Experiment 10

Exp. variable Light
Setting 9

Trial 1 11.8 cm
Trial 2 14.5 cm
Trial 3 13.0 cm
Trial 4 14.0 cm

Total 53.3 cm
Average 13.3 cm

Botanical Gardens

Experimenter's Log 2

Plant _____ Name _____

Experimental Variable _____ Date _____

Control Variables _____

Experiment 1 _____

Experiment 6 _____

Experiment 2 _____

Experiment 7 _____

Experiment 3 _____

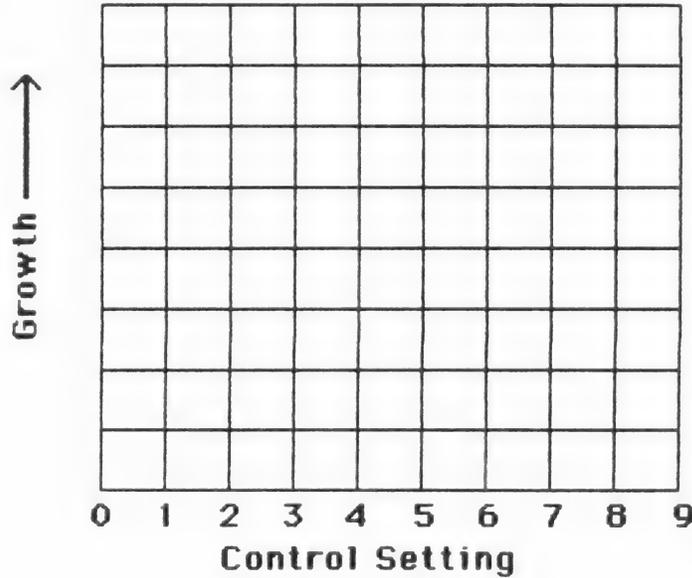
Experiment 8 _____

Experiment 4 _____

Experiment 9 _____

Experiment 5 _____

Experiment 10 _____



Describe what happens:

Botanical Gardens

Experimenter's Log 2

Plant Sunshine Rose Name **SAMPLE**

Experimental Variable Light Date _____

Control Variables Heat (5) Water (5) Soil (5)

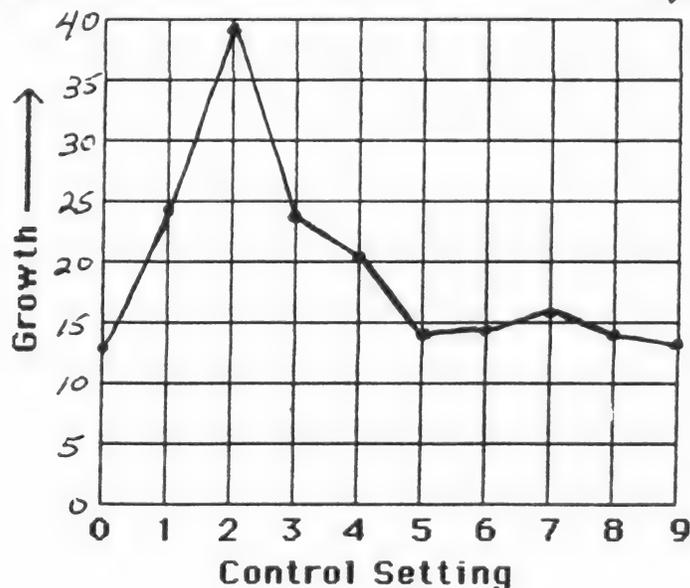
Experiment 1 Light=0 12.9cm Experiment 6 Light=5 14.2cm

Experiment 2 Light=1 24.5cm Experiment 7 Light=6 14.6cm

Experiment 3 Light=2 39.1cm Experiment 8 Light=7 15.4cm

Experiment 4 Light=3 23.9cm Experiment 9 Light=8 14.2cm

Experiment 5 Light=4 20.5cm Experiment 10 Light=9 13.3cm



Describe what happens:

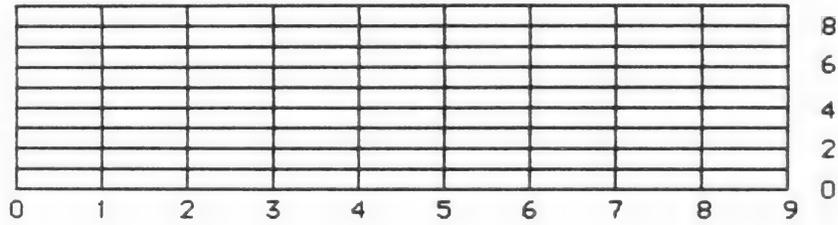
The Sunshine Rose, with Heat, Water, and Soil kept constant, will grow best with a Light setting of two. Therefore, even though the name implies the need for much Light, the experiments with Light show that it likes low Light the best.

Botanical Gardens

Plant Growth Worksheet 1
(page 1)

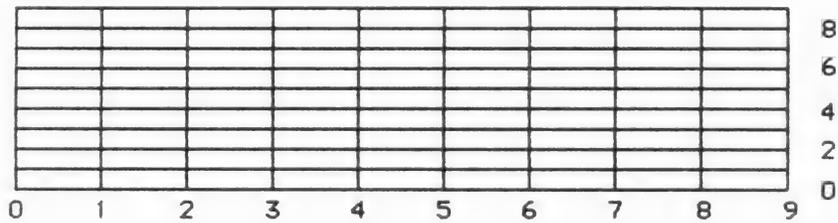
Plant Name: _____

Heat



Describe what happens:

Water



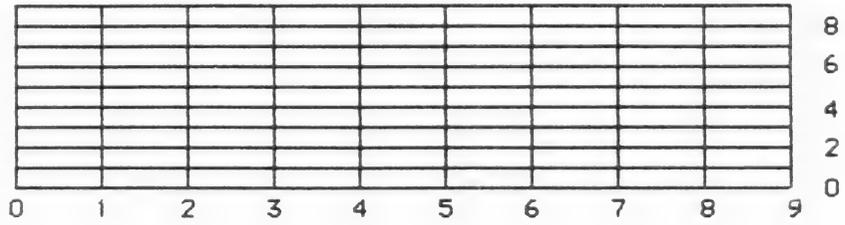
Describe what happens:

Botanical Gardens

Plant Growth Worksheet 1
(page 2)

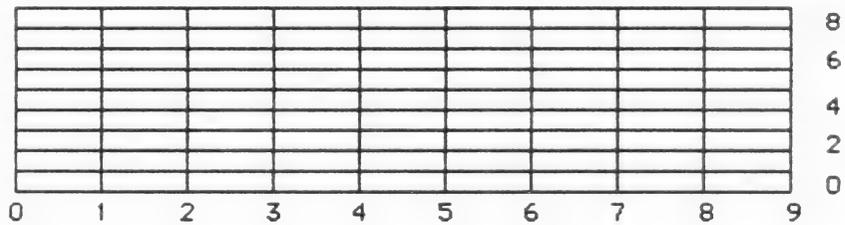
Plant Name: _____

Light



Describe what happens:

Soil



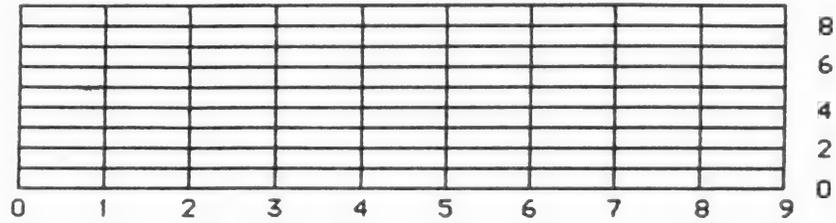
Describe what happens:

Botanical Gardens

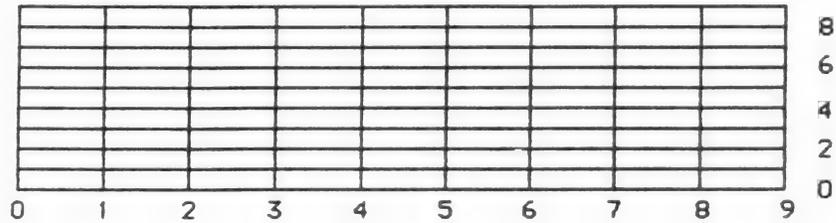
Plant Growth Worksheet 2

Plant Name: _____

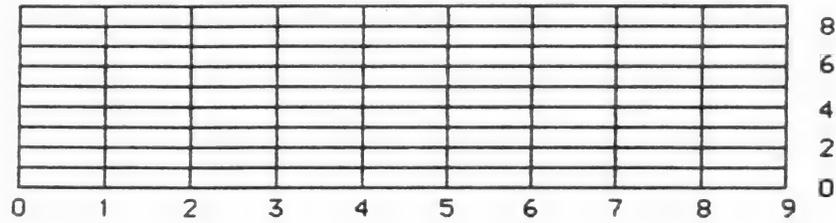
Heat



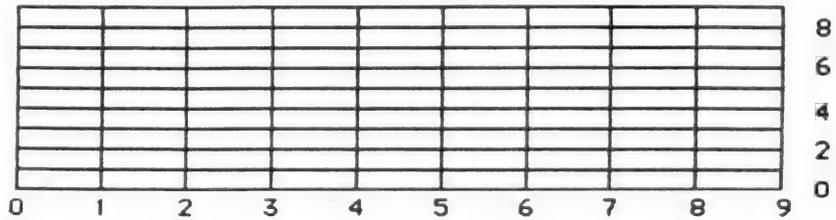
Water



Light



Soil



Library Description:

Apple: Working with the Computer

1. Turn on the television or monitor
2. Insert the diskette into the disk drive with the label facing you and on the right .
3. Close the door to the disk drive.
4. Turn on the Apple
5. You will see a red light on the disk drive turn on. If the disk drive does not turn off, turn the Apple off and make sure your diskette is placed correctly in the disk drive.
6. Sunburst will appear on the screen, followed by the program name.
7. Follow the directions in the program.
8. If you want to stop, hold the Control (CTRL) key and press the E key.

Shutting off the System

1. Remove the diskette from the disk drive and return it to its place of storage.
2. Turn off the Apple.
3. Turn off the television or monitor.

Note: On the Apple II+ , use the I,J,K,M keys to position the hand instead of the arrow keys. If you have a mouse, it can be used instead of the arrow keys.

Apple IIgs: Control Panel Settings

To allow your Apple IIgs to work properly with Sunburst software, certain Control Panel settings should be selected. The Apple IIgs retains these settings even after the power is turned off.

To Use the Control Panel:

- Turn on the Apple IIgs and monitor.
- Enter the Control Panel main menu by holding down the CONTROL and OPTION keys, and then press RESET (the rectangular key located above the number keys). If your Apple IIgs is in an Apple //e case, use the closed-apple (⌘) key instead of OPTION.
- Press the 1 key to enter the Control Panel.
- Use ↓ and ↑ to highlight the feature you want to change and press RETURN. Again use ↓ and ↑ to highlight a specific option and change it by using the ← and → keys.
- After you have finished making changes, select Quit to use the Apple IIgs.

To Change the Display:

- Highlight **Display** and press RETURN.
- Set **Type** to **Color**.
- Set **Text** to **White**.
- Set **Background** to **Black**.
- Set **Border** to **Black**.
- Press RETURN to save the changes and to go back to the Control Panel.

To Change the System Speed:

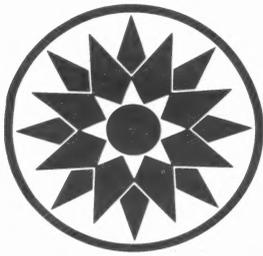
- Highlight **System Speed** and press RETURN.
- Set **System Speed** to **Normal**.
- Press RETURN to go back to the Control Panel.

To Change the Slots:

- Highlight **Slots** and press RETURN.
- Set **Slot 1** to **Printer Port**. If you are using a printer card, select the slot number your printer is in.
- Set **Slot 5** to **Smart Port**, if you are using a 3.5" drive connected to the disk drive port.
- Set **Slot 6** to **Disk Port**, if you are using a 5.25" drive connected to the disk drive port.
- Set **Slot 6** to **Your Card**, if you are using a 5.25" drive connected to a controller card in Slot 6.
- Set **Startup Slot** to **Scan**.
- Press RETURN to go back to the Control Panel.

What happens if....? Sunburst Courseware and Warranty

1. What happens if a program will not load or run?
Call us on our toll-free number and we will send you a new diskette.
2. What if I find an error in the program?
We have thoroughly tested the programs that SUNBURST carries so we hope this does not happen. But if you find an error, please note what you did before the error occurred. Also, if a message appears on the screen, please write the message down. Then fill out the evaluation form or call us with the information. We will correct the error and send you a new diskette.
3. What happens if the courseware is accidentally destroyed?
SUNBURST has a lifetime guarantee on its courseware. Send us the product that was damaged and we will send you a new one.
4. How do I stop in the middle to go on to something new?
These programs can be interrupted by holding down the Control (CTRL) key and typing the letter "E." Then follow the directions on the screen to end the program.
5. Can I copy this diskette?
The material on the diskette is copyrighted. You should not copy the courseware.
6. Can I take this diskette out of the computer after the program has loaded and put it into another computer?
No, the program periodically takes information from the diskette. Removing the diskette will cause a disk error.



SUNBURST
COMMUNICATIONS

TEACHER EVALUATION FORM

Please indicate your reactions to the following questions about this Sunburst program. Use the space at the bottom of the page to summarize your overall feelings about the program. The other side of this evaluation may be reproduced and used for student evaluations.

NAME OF SUNBURST PROGRAM _____

COMPUTER SYSTEM / MODEL _____

NAME OF SCHOOL _____

GRADE LEVEL OF SCHOOL _____

ADDRESS _____

YOUR NAME _____

CITY STATE ZIP _____

TITLE _____

DATE _____

PHONE NUMBER _____

1. Does the material meet its objectives as stated in the teacher's guide? _____

2. What suggestions would you make for improvement in the teacher's guide? _____

3. Is this program educationally valuable to you? Why? _____

4. With which grade level would you use the program? _____

5. Will this program interest your students enough that they will want to use it more than once? _____

6. How would you use this program with your students? _____

Please use this space to describe your overall reaction to the program.

Did you order this product for evaluation or as a purchase? (Circle one.)

STUDENT EVALUATION FORM

1. What is the name of the program that you used? _____

2. Would you like to use this program again? Explain why.

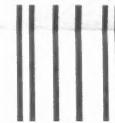
3. Did you understand the instructions?

4. Were the pictures in the program interesting?

5. What did you learn from the program that you didn't know before?

6. What didn't you like about the program?

Fold into thirds, tape closed (do not staple) and mail.

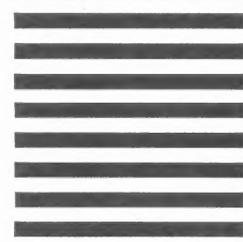


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User Name

Title

School or Business Name

Address

City State Zip

Grade Span of School

Product Title Date Purchased

Product Number Computer System

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