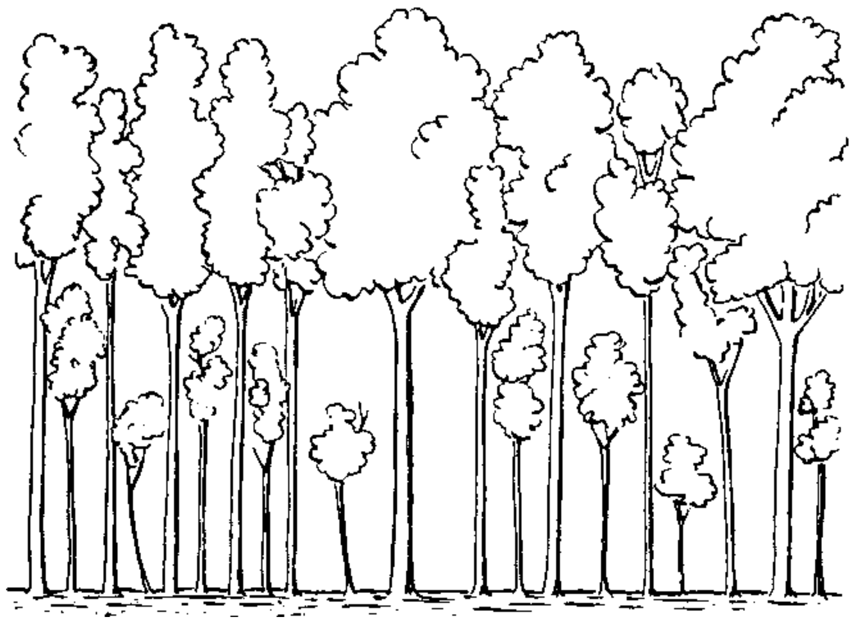
The Ecological Significance of Intra-specific Competition in Plant Populations



Things To Do Before Lab

1. Read this lab text, especially the sections entitled "TODAY'S LAB" and "COLLECTING YOUR LAB'S DATA", before coming to lab. Your GSI will assume that you're familiar with the concept of competition, the effects of competition on a population, and the descriptions of the various jobs associated with the care and study of Fast Plant populations.

2. Make sure that you're familiar with the terms and concepts listed below. Consult your lecture notes, textbook, or this lab manual about any item that is new or unclear to you before coming to lab. Your GSI may ask you to define or explain some of them to the class.

competition
density-dependent factor
density-independent factor
equilibrium population size *(K)*
exponential population growth
instantaneous rate of population growth *(dN/dt)*
interspecific competition
intraspecific competition
intrinsic rate of population growth *(r)*
limiting resource
logistic population growth
niche
population
population birth rate
population death rate

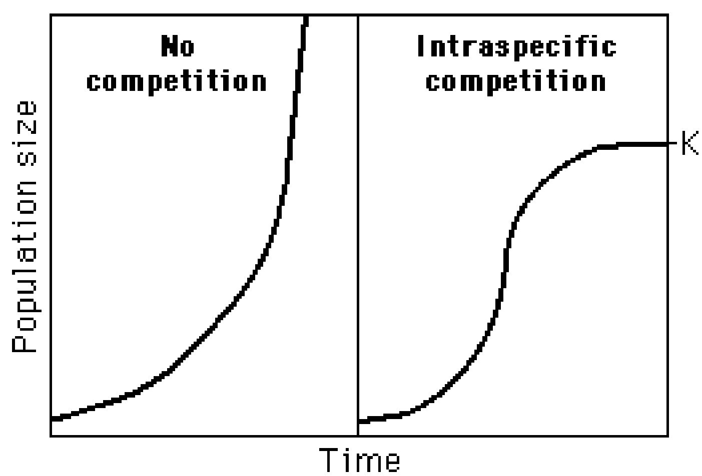
Today's Lab

Organisms require resources like food, light, water, and nesting sites to survive, grow, and reproduce. If two organisms that occupy the same habitat rely on a similar resource, and if that resource is present in limited supply (i.e., it's a **limiting resource**), then **competition** will ensue. Competition may involve direct interaction between individuals, such as combat or the release of toxic chemicals (allelopathy). On the other hand, it may occur indirectly when one individual reduces the quantity of resources available to others without coming into direct contact with them.

If competing organisms belong to the same species, ecologists refer to their interaction as **intraspecific competition**. Competitors that belong to different species participate in **interspecific competition**. Competition is most fierce in the case of intraspecific competition because the competitors have almost identical resource needs (their **niches** are essentially the same). Interspecific competition is more benign because the competing organisms have fewer resource needs in common (their niches share only certain similarities). The greater the resemblance between two coexisting organisms, the more intense the competitive struggle between them.

General Responses of a Population to Competition

Some familiar models provide predictions about the effects of **density-independent** and **density-dependent factors** on the growth rate of a **population** over time. The former influence the individuals making up a population <u>regardless</u> of the degree of crowding. The latter <u>varies</u> in importance as the population size changes. Weather is a density-independent factor. Competition is a density-dependent factor. How does a population respond to competition? Think about an experiment in which small populations of a single species are placed in two different situations:



When all resources are present in excess, the individuals composing the population are free of competition. In the absence of competition, the population is uninhibited by the consequences of its own growth (or that of other populations). Therefore, the population grows at its **intrinsic rate of increase *(r)***, and it exhibits an exponential expansion in size over time (**the exponential model of population growth**).

If at least one resource is limiting, and potentially competing species are absent, then the individuals belonging to the population will compete only with one another. Such intraspecific competition tends to dampen the population's ability to expand in size. Since intraspecific competition increases in intensity as the population becomes larger, it causes a "leveling-off" of exponential growth. The population is unable to grow indefinitely at its intrinsic rate *(r)*. By the time the population has reached its **equilibrium size *(K)***, intraspecific competition has become so severe that further growth is stopped (the **instantaneous rate of growth *[dN/dt]*** falls to zero). The population exhibits an S-shaped pattern of growth over time (**the logistic model of population growth**).

The Peculiar Reactions of Plant Populations to Competition

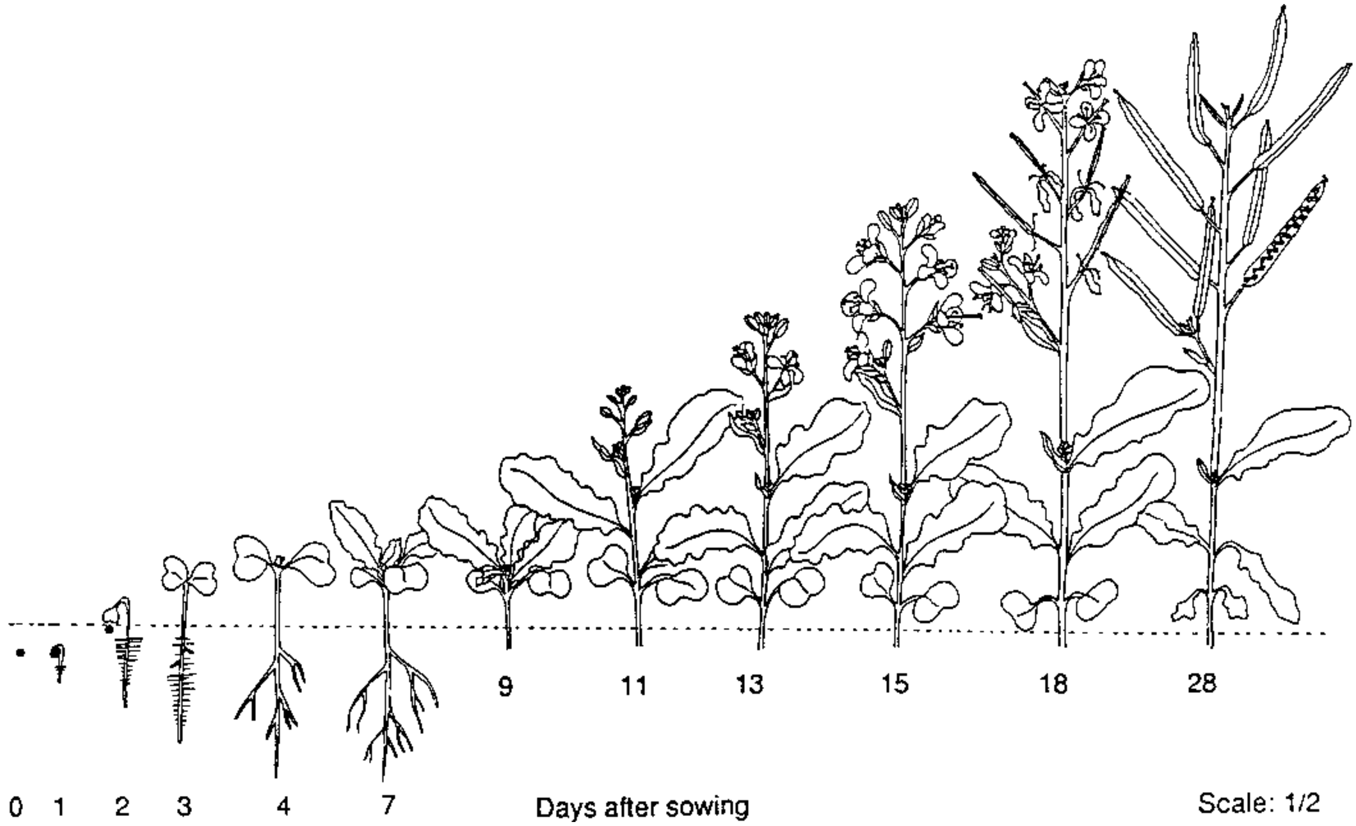
Animals and plants respond to competition in fundamentally different ways. Because of this difference (among other reasons), ecologists measure the sizes, or densities, of animal and plant populations quite differently.

Competition among animals typically causes changes in the numbers of individuals composing present and future populations by its influence on **birth and death rates**. Ecologists generally express the density of an animal population as the number of individuals per unit area.

The effects of competition are more complex on plant (and fish) populations: Competition may alter the birth and death rates of a population (as it does in the majority of animal populations), but it also may bring about developmental changes in individuals. These developmental modifications include changes in overall size as well as changes in the number, size, and timing of appearance of each of various organs (e.g., leaves and flowers). Ecologists most commonly express the density of a plant population in terms of biomass per unit area. Biomass is the weight of living matter. It can refer to the weight of the aboveground tissues of all plants belonging to a population, the weight of all leaves, or even the weight of all seeds. As plant tissues vary substantially in water content, ecologists usually measure biomass as the weight of dried plant material.

Can you take a closer look at the unique responses of a plant population to competition, particularly the developmental changes that typically accompany the struggle for resources? Yes, by eliciting the help of all of the students in Biology 1B, and by adopting a rather simple experimental approach. You can keep things simple by documenting the effects of in<u>traspecific</u> competition on populations of "Fast Plants" grown under uniform environmental conditions, but at different densities (i.e., different levels of intraspecific competition).

Through breeding and artificial selection, plant pathologists at the University of Wisconsin have developed a remarkable variety of mustards *(Brassica rapa)* called Fast Plants. These amazing organisms, which are close relatives of such vegetable crops as cabbage, cauliflower, broccoli, and turnips, are small, easy to grow, and complete their life cycles just six weeks after planting (normal mustards require 6-12 months to produce a crop of seeds). Populations of Fast Plants are ideal experimental models for investigating the responses of plant populations to competition. Here is an illustration of a typical Fast Plant life cycle.



Your Objective

The objectives of this exercise is to test for the various responses of Fast Plants populations to intraspecies competition. Each section will periodically observe and measure the responses of each population to intraspecific competition. At the end of the sampling you will pool the data contributed by **ALL** lab sections. You will then play “farmer.” You have a limited budget for seeds and you want to maximize your profits. As you will see, intraspecies competition may affect your decisions on how many seeds to plant.

Your Assignment

You are a Fast Plant Farmer (FPF). You had Biology 1B at UCB and know that interspecies competition can effect the development, growth and seed production of Fast Plants (FP). You have a small farm of one hectare. At the beginning of each season you have to decide on the planting density. Of course the more seeds you sow, the more plants you will get in the end. But you want to maximize your profit and minimize your effort, so planting fewer seeds may product larger profits per unit effort. You are a smart FPF and have diversified the uses of the FP you produce. You can sell the FP forage by the gram to a dairy for cattle feed. Hence you will want the highest possible yield of forage (the leaves and stems) and seeds per hectare. The wholesale price for FP forage this year is $1 per 0.01 gram. Alternately, you can sell the seeds in packets to FP Gardener’s Co-op. Each packet contains 10 seeds and the wholesale price per packet is $10. Or you can grind the seeds into flour and sell the flour by the gram to the local bakers. They will pay you $1 per 0.001 gram. Each year you lease your field to a beekeeper who sells FP Killer Bee honey. The beekeeper wants to get the bees on the flowers as soon after planting as possible. They will pay you a bonus of $10 per day for each day the flowers appear before day 20 after planting.

Since several of the uses of the FP are mutually exclusive (e.g. You can't both sell the seeds to the gardens and make flour out of it for the bakers) you have to decide which products to produce. You have three variables you have to deal with (You have no control over the weather); 1) The cost of fast plant seeds you use to sow your crop (Since you could have sold them to the Co-op, you have to deduct this from your profit; wholesale price is 33% of retail); 2) The planting density per hectare. You have found that, depending on the wholesale price paid for the forage, seeds, flour and the bonus from the beekeeper, you do best at densities of either 5 plants/hectare or 50 plants/hectare.

Similar to most FPF, you have to borrow money from the bank each year to buy seeds and get started. The Loan Officer at Big Bucks Bank is only interested in the bottom line; the best strategy to make sure you can pay back the loan. You have to justify your planting density by showing them what products you plan to produce and the expected profits.

You remember that as a student in Biology 1B you had done something similar. You find your old manual and look up the FP exercise. You also remember that the pooled data was saved on the web page. (http://www-ib.berkeley.EDU/IB/INSTRUCTION/BIO1B/BIO1B.HTML). You hope that this exercise will give you some hints on what to consider when justifying your loan application to the Big Bucks Loan Officer.

From old Biology1B Lab Manual
Hints for FFPF (Future Fast Plants Farmers)

(Remember to answer these questions in terms of **PER HECTARE**)

1. What density (5 or 50 seeds/hectare) of FP seeds should you sow to give you the highest yield/ hectare of forage and when should you harvest the forage?

2. What density (5 or 50 seeds/hectare) of FP seeds should you sow to give you the highest yield/ hectare of seeds for the gardeners and when should you harvest the seeds?

3. What density (5 or 50 seeds/hectare) of FP seeds should you sow to give you the highest yield/ hectare of flour for the bakers and when should you harvest the seeds?

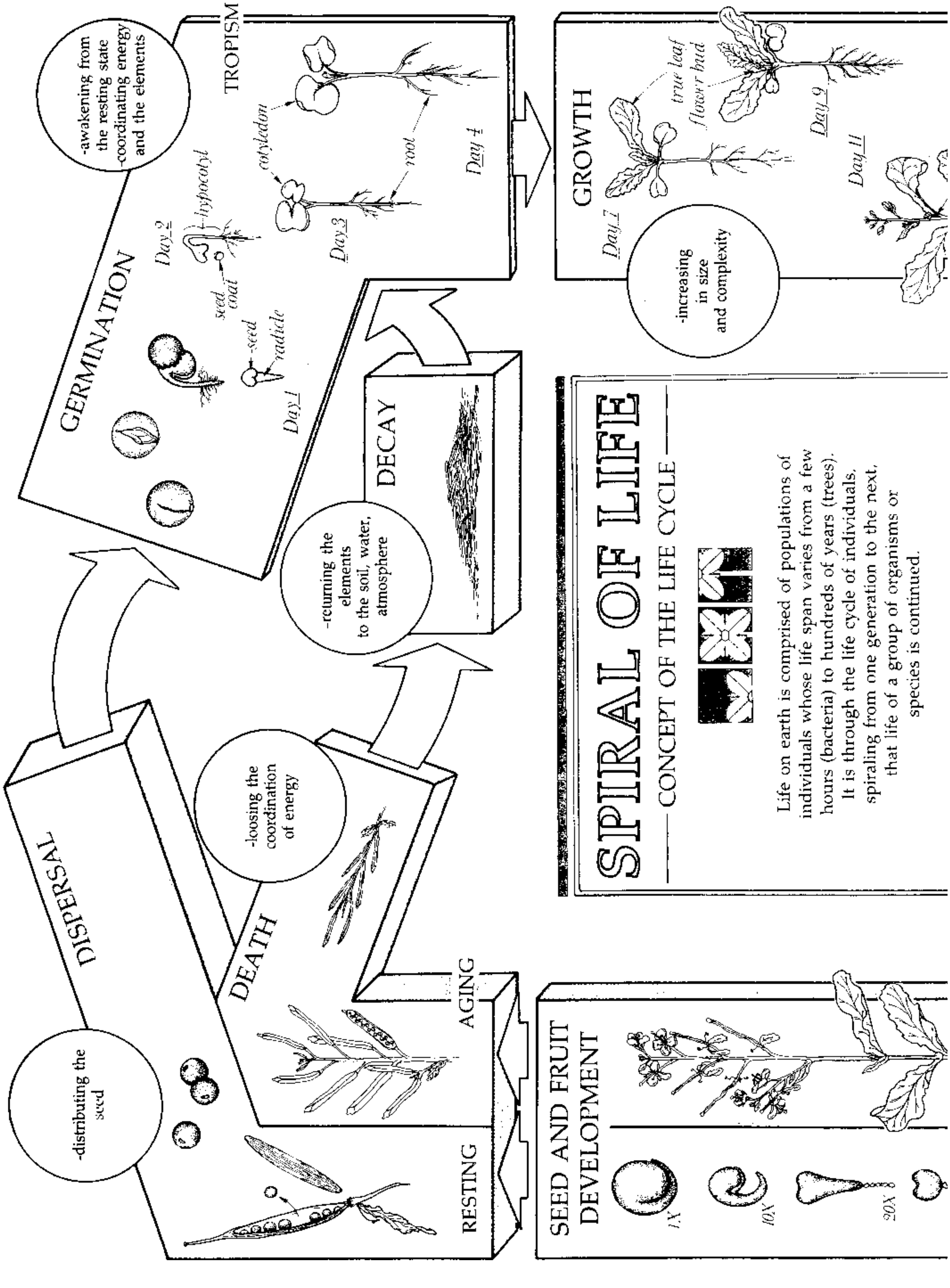
4. What density (5 or 50 seeds/hectare) of FP will allow beekeeper to get the bees on the flowers as soon as possible?

You also find some additional comparisons and definitions which might help your analysis of the data.

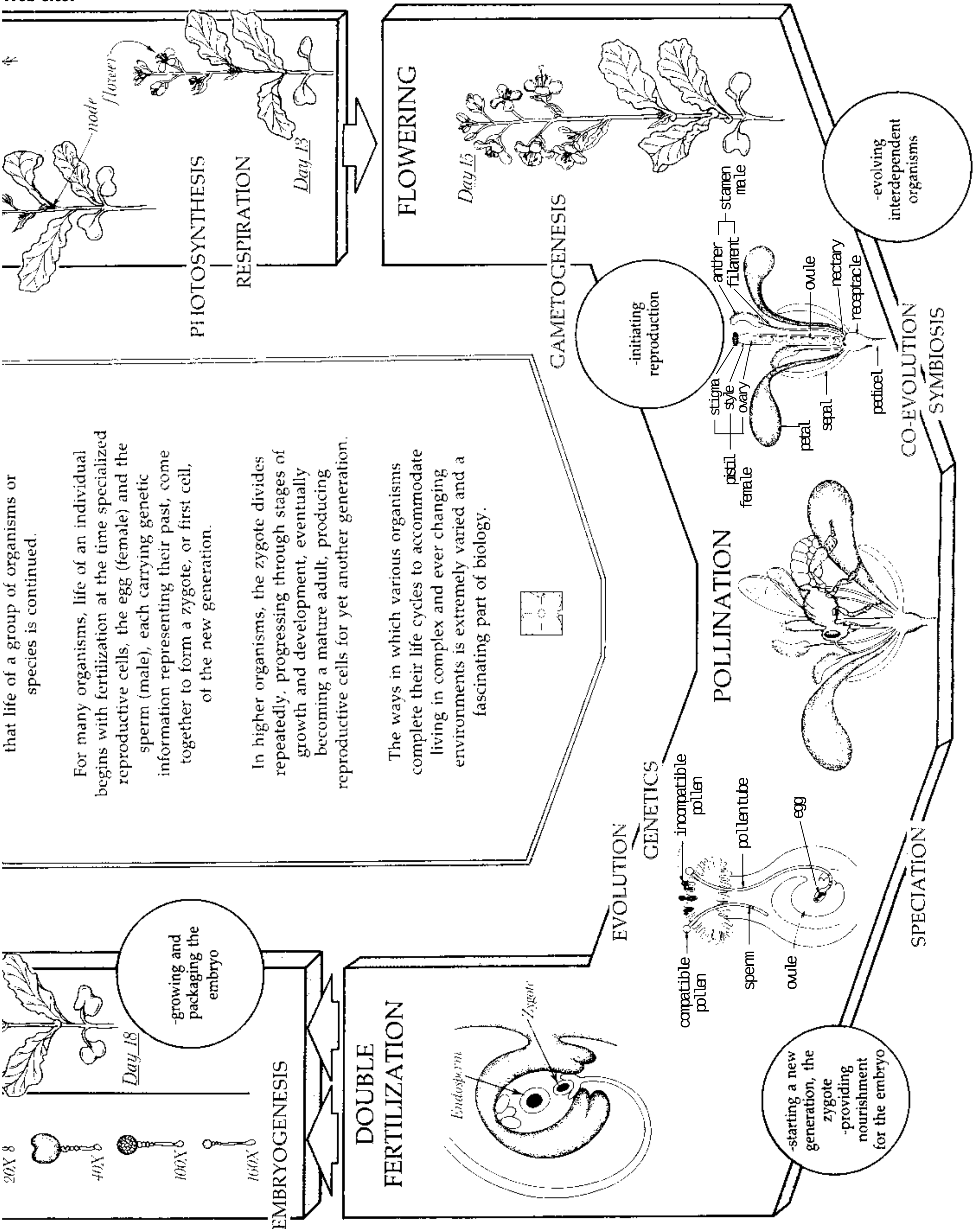
1. Developmental times of the flowers and pods/Planting Density

2. Mean Forage Biomass (g) = Forage Biomass (g)/Planting Density

On the Web: **http://fastplants.cals.wisc.edu/WFPbackground/lifecycle.html**



This web site has pictures / diagrams / descriptions of fast plants. The Biology 1B web site also has a link to this Fast Plants web site.



3. Mean Number of Seeds = Number of Seeds/Planting Density

4. Mean Biomass of Seeds = Biomass of Seeds/Planting Density

You should use the following graphs on page 23 - 27 to chart and analyze your data.

Graph #1
Graph #2
Graph #3

Collecting Your Lab's Data

Your section has been assigned at least one task to perform during the next 39 days. The success of this experiment depends upon your section's performing this task correctly and on time and entering the data accurately on the charts. These tasks are described below.

Getting Started

1. Your GSI will provide you with some important information regarding the basic biology of the Fast Plants. There is a video which demonstrates the techniques used for sampling and the life cycle of the Fast Plants.

2. The Grower's Calendar is near the end of this exercise (Table 1) as well as posted in room 2009. The Grower's Calendar lists 11 jobs and the dates that they must be performed. Posted in room 2009 you will find the Grower's Calendar, which has the jobs and a place to indicate that you have finished the job. This is to let the other members of your section know that the task has already been performed. *Be sure to check off when you have completed a task on the Grower's Calendar posted in room 2009!*

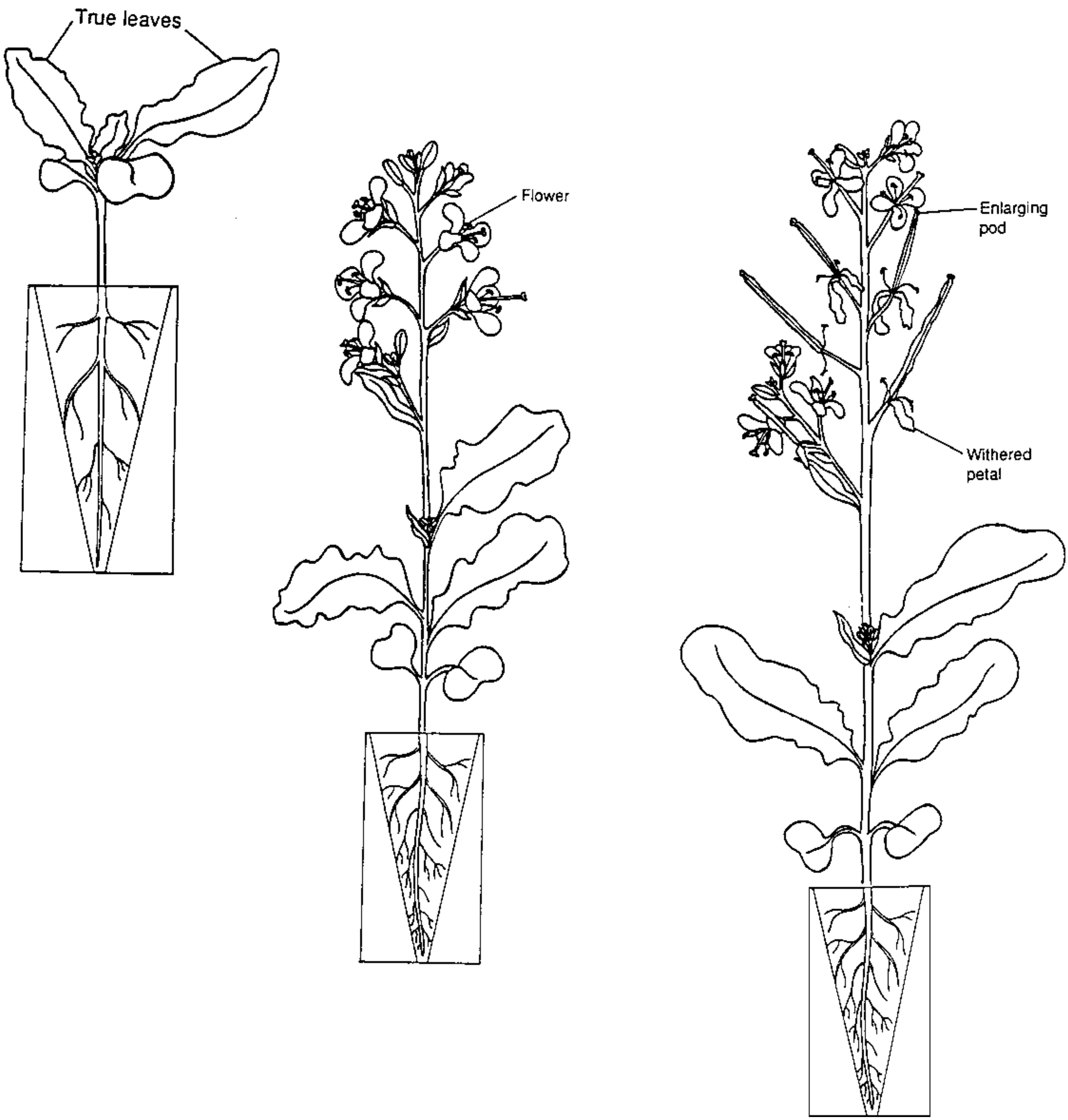
3. At the end of this section and posted in room 2009 is the Fast Plants Data Board (Table 2). Locate your room number on the board. On the Data Board, the first lines will indicate 5 and 50 seeds that were initially planted in each of your three pots (planting density) [total of six pots, or populations].

All Sections Read the following (Planting - Day 1)

Planting - Day 1

1. Go into room 2009. The light and watering system on the left is designiated for room 2005 and the one on the right for room 2007. You will find 6 pots on each water table. In this

exercise each pot represents ONE HECTARE. Three pots have been planted with 5 seeds each and three pots have been planted with 50 seeds each. There is a small plastic stake to identify each pot. Note there is a white strip of wicking extending from the bottom of the pot to the water bath. This is a self-watering system. The wick must always hang straight directly into the water. Do NOT allow it to become twisted or folded UNDER THE POT (this would prevent the transfer of water to the plants).



2. Notice on the wall Table 1 (Grower's Calendar) to check off your task when complete and enter your data your data on the computer in room 2003.

3. This room (2003) will be open 8 AM to 5 PM, Monday through Friday.

Watering From Above - Day 2

1. Locate, but do not move the six pots on your watering system.

2. Using the plastic watering can, slowly add water to each pot until you see water flowing away from its base. Make sure the wick goes directly into the water.

3. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

First Fertilizing - Day 3

1. Locate, but don't move, the six pots on your watering system.

2. Using the Fertilizing Can, slowly add fertilizer solution to each pot until you see liquid flowing away from its base. Make sure the wick goes directly into the water.

3. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

First Harvest, Second Fertilizing - Day 8

1. Locate, but don't move, the six pots on your watering system.

2. If any plant within the six populations possesses an open flower and none has yet been observed, then enter the number of days since planting for "FIRST OPEN FLOWER" on the Fast Plants Data Board in your lab manual and on the Data Board posted in room 2009. If any plant has a pod and not has yet been observed, then enter the number of days since planting for "FIRST POD" in your lab manual and on the computer in room 2003.

3. Remove **ONLY ONE** of your pots with 5 plants and **ONLY ONE** of you pots with 50 plants from the watering system for harvesting. **(If you harvest more pots, your room cannot correctly complete this assignment)**. If you only have two pots with 5 plants or 50 plants (i.e. one population did not survive), skip this harvest and write on the Grower's Calendar "Only 2 Pots" and indicate the number of plants (5 or 50) in these pots. Cut all the plants in the pot at ground level with scissors. Separate the dead and living plants. Count the number of living plants ("DENSITY OF SURVIVORS") and record the result in your lab manual and on the computer in room 2003.

4. Using a pencil or permanent marker, label two brown paper bags with your room number. On one bag mark "5 plants" and on the other "50 plants." Put all of the survivors in the bag.

Place the bag, with the top open, in the drying oven in room 2003 (your room number is on the drying oven).

5. Empty the contents of the pot into the trash. Save the pot and plastic stake for recycling.

6. Using the Fertilizing Can, slowly add fertilizer solution to each remaining pot until you see liquid flowing away from its base. Make sure the wick goes directly into the water.

7. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

First Weighing - Day 11

1. Take your lab's brown paper bags out of the drying oven. Carefully remove and weigh the **entire** contents of each bag.

2. Balance Instructions:

   a) **Do NOT move balance**—otherwise you will need to re-level balance by adjusting feet so that bubble is centered in circle of the bubble level.
   b) Push down on the on/off/tare bar switch to turn balance on.
   c) Place weigh dish on center of balance after balance is on.
   d) Push down on on/off/tare bar switch to zero (tare) balance.
   e) Place dried plant material into weigh dish to determine dry weight.
   f) Empty contents of weigh dish into trash after determining weight *(do not leave weigh dish on balance when not in use!).*
   g) **Turn off balance** by flipping up on/off/tare bar switch.
   h) ♻ Save paper bags to re-use for your next measurement.

3. This weight, rounded to the nearest 0.01 g, is the "FORAGE BIOMASS (leaves and stems)". Record your result on the Fast Plants Data Boards in your lab manual and on the computer in room 2003.

4. Place all plant material in the trash and save the bag.

5. Locate, but don't move, the pots on your watering system. Make sure the wick goes directly into the water.

6. If any plant within the four populations possesses an open flower and none has yet been observed, then enter the number of days since planting for "FIRST OPEN FLOWER" on the Fast Plants Data Board in your lab manual and on the computer in room 2003. If any plant has a pod and not has yet been observed, then enter the number of days since planting for "FIRST POD" in your lab manual and on the computer in room 2003.

7. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

Third Fertilizing - Day 16

If the flowers are not open, inform Mike Moser (room 2013) or the staff (room 2002).

1. Locate, but don't move, the four pots on your watering system. Make sure the wick goes directly into the water.

2. Using the Fertilizing Can, slowly add fertilizer solution to each remaining pots until you see liquid flowing away from its base.

3. If any plant within the four populations possesses an open flower and none has yet been observed, then enter the number of days since planting for "FIRST OPEN FLOWER" on the Fast Plants Data Board in your lab manual and on the computer in room 2003. If any plant has a pod and not has yet been observed, then enter the number of days since planting for "FIRST POD" in your lab manual and on the computer in room 2003.

4. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

First, Second, and Third Cross-Pollinations - Day 17

These tasks may have to be delayed a day or two if the flowers are not fully open. Your GSI will inform you of a delay in pollination.

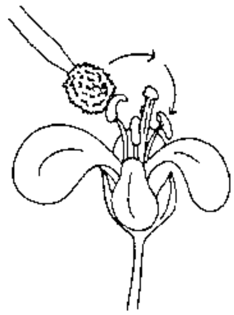
1. Take two of the cotton-tipped applicator sticks.

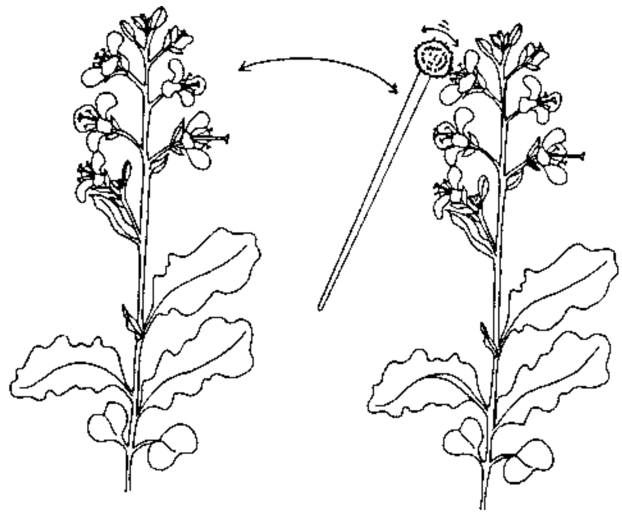
2. Locate, but don't move, the four pots on your watering system. Make sure the wick goes directly into the water.
3. <u>Using a different cotton-tipped applicator stick for each pot</u>, rotate the applicator stick over the flowers <u>within the same pot</u> to pick up pollen grains from anthers and distribute them to stigmas. Move pollen back and forth among the different plants within the same pot, but don't transfer pollen from one pot to the other (see drawings next page).

4. Put the applicator stick into the pot and tie the plants together with a wire tie.

5. If any plant within the four populations possesses an open flower and none has yet been observed, then enter the number of days since planting for "FIRST OPEN FLOWER" on the Fast Plants Data Board in your lab manual and on the Data Board posted in room 2009. If any plant has a pod and not has yet been observed, then enter the number of days since planting for "FIRST POD" in your lab manual and on the computer in room 2003.

6. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.





Second Harvest

1. Locate, but don't move, the four pots on your watering system. Make sure the wick goes directly into the water.

2. If any plant has an open flower and none has yet been observed, then enter the number of days since planting for "FIRST OPEN FLOWER" (#12). If any plant has a pod and not has yet been observed, then enter the number of days since planting for "FIRST POD" (#13).

3. Remove **ONLY ONE** of your pots with 5 plants and **ONLY ONE** of you pots with 50 plants from the watering system for harvesting. **(If you harvest more pots, your room cannot correctly complete this assignment)**. If you only have one pot with 5 plants or 50 plants (i.e. one population did not survive), skip this harvest and write on the Grower's Calendar "Only 1 Pot" and indicate the number of plants (5 or 50) in this pot. Cut all the plants in the pot at ground level with scissors. Separate the dead and living plants. Count the number of living plants ("DENSITY OF SURVIVORS") and record the result in your lab manual and on the computer in room 2003.

4. Locate the two brown paper bags in the recycle box with your room number. One will be marked "5 plants" and the other "50 plants." Put all of the survivors in the bag. Place the bag, with the top open, in the drying oven. The drying oven is marked with your room number.

5. Empty the contents of the pot into the trash. Save the pot and plastic stake for recycling.

6. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

Second Weighing

1. Take your room's two brown paper bags out of the drying oven. Carefully remove and weigh the **entire** contents of each bag.

2. Balance Instructions:

   a) **Do NOT move balance**—otherwise you will need to re-level balance by adjusting feet so that bubble is centered in circle of the bubble level.
   b) Push down on the on/off/tare bar switch to turn balance on.
   c) Place weigh dish on center of balance after balance is on.
   d) Push down on on/off/tare bar switch to zero (tare) balance.
   e) Place dried plant material into weigh dish to determine dry weight.
   f) Empty contents of weigh dish into trash after determining weight *(do not leave weigh dish on balance when not in use!).*
   g) **Turn off balance** by flipping up on/off/tare bar switch.
   h) ♲ Save paper bags to re-use for your next measurement.

3. This weight, rounded to the nearest 0.01 g, is the "FORAGE BIOMASS (leaves and stems)". Record your result on the Fast Plants Data Board in your lab manual and on the computer in room 2003.

4. Place all plant material in the trash and save the bag.

5. Locate, but don't move, the pots on your watering system. Make sure the wick goes directly into the water.

5. If any plant within the two populations possesses an open flower and none has yet been observed, then enter the number of days since planting for "FIRST OPEN FLOWER" on the Fast Plants Data Board in your lab manual and on the computer in room 2003. If any plant has a pod and not has yet been observed, then enter the number of days since planting for "FIRST POD" in your lab manual and on the computer in room 2003.

7. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

Third Harvest

1. Remove the last two pots marked with your room number from the watering system.

2. If any plant has a pod and not has yet been observed, then enter the number of days since planting for "FIRST POD."

3. Cut all the plants in the pot at ground level with scissors. Separate the dead and living plants. Count the number of living plants ("DENSITY OF SURVIVORS") and record the result on the Fast Plants Data Board in your lab manual and on the computer in room 2003.

4. Locate the two brown paper bags in the recycle box with your lab section number. One will be marked "5 plants" and the other "50 plants." Put all of the survivors in the bag. Place the bag, with the top open, in the drying oven. The drying oven is marked with your room number.

5. Empty the contents of the pot into the trash. Save the pot and plastic stake for recycling.

6. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

Third Weighing

1. This is a time consuming task. Please allow enough time to do it properly.

3. Take your room's two brown paper bags out of the drying oven. Carefully remove and weigh the **entire** contents of each bag.

3. Balance Instructions:

    a) **Do NOT move balance**—otherwise you will need to re-level balance by adjusting feet so that bubble is centered in circle of the bubble level.
    b) Push down on the on/off/tare bar switch to turn balance on.
    c) Place weigh dish on center of balance after balance is on.
    d) Push down on on/off/tare bar switch to zero (tare) balance.
    e) Place dried plant material into weigh dish to determine dry weight.
    f) Empty contents of weigh dish into trash after determining weight *(do not leave weigh dish on balance when not in use!).*
    g) **Turn off balance** by <u>flipping up</u> on/off/tare bar switch.
    h) ♻ Save paper bags to re-use for your next measurement.

4. This weight, rounded to the nearest 0.01 g, is the "FORAGE BIOMASS (leaves and stems)." Record your result on the Fast Plants Data Board in your lab manual and on the computer in room 2003.

5. To separate the seeds, put the pods in an envelope and crush the pods. Transfer the seeds to a petri dish and remove any additional chaff from the pods. Be careful not to allow any of the pod material to become mixed in with the seeds. Count the total number of seeds ("NUMBER OF SEEDS") and weigh them in the petri dishes ("BIOMASS OF SEEDS"). Record your results on the Fast Plants Data Board in your lab manual and on the computer in room 2003.

6. Discard all plant material and the bag in the trash.

8. Check off this job as completed on the appropriate Grower's Calendar posted in room 2009.

Pooling the Data

To increase the amount of data you have to work with, **you will consolidate all the data from both rooms** on the Pooled Data Table (Table 3). Pooled data can be obtained from the values entered by both lab rooms (2005 and 2007) from the computer in room 2003.

Table 1 - Grower's Calendar

DAY	DATE	JOB	Room 2005		Room 2007	
			Section	Check off task in Rm. 2009	Section	Check off task in Rm. 2009
1		Planting	done by staff		done by staff	
2		Watering from above	done by staff		done by staff	
3		First fertilizing	done by staff		done by staff	
8		First harvest, second fertilizing, check development (enter data in Table 2 on computer, Rm. 2003)	101		102	
11		First weighing, check development (enter data in Table 2 on computer, Rm. 2003)	104		103	
16		Third fertilizing, check development (enter data in Table 2 on computer, Rm. 2003)	106*		107	
17		First cross-pollination, check development (enter data in Table 2 on computer, Rm. 2003)	105		111	
18		Second cross-pollination, check development (enter data in Table 2 on computer, Rm. 2003)	110		113	
19		Third cross-pollination, check development (enter data in Table 2 on computer, Rm. 2003)	110		114	
29		Second harvest, check development (enter data in Table 2 on computer, Rm. 2003)	112		116	
32		Second weighing, check development (enter data in Table 2 on computer, Rm. 2003)	115		118	
36		Third harvest, check development (enter data in Table 2 on computer, Rm. 2003)	117		119	
39		Third weighing (enter data in Table 2 on computer, Rm. 2003)	120		121	

* Although section 106 meets in room 2007, they will perform this exercise grouped with the lab sections that meet in room 2005.

Table 2 – Fast Plants Data Board

DAY		Room 2005		Room 2007	
1	Planting Density (seeds/pot)	**5**	**50**	**5**	**50**
	Developmental Timing (days from planting)				
	First Open Flower				
	First Pod				
	First Harvest				
8	Density of Survivors (plants/pot)				
11	Forage Biomass (g)				
	Second Harvest				
29	Density of Survivors (plants/pot)				
32	Forage Biomass (g)				
	Third Harvest				
36	Density of Survivors (plants/pot)				
39	Forage Biomass (g)				
39	Number of Seeds				
39	Biomass of Seeds (g)				

Table 3 – Pooled Data

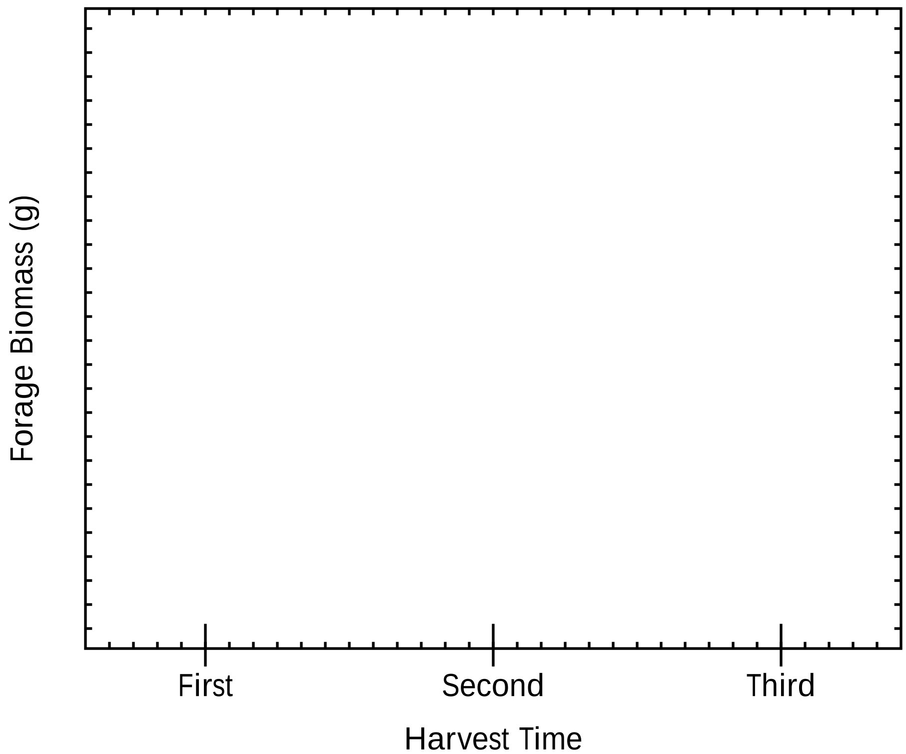
Planting Density (seeds/pot)	5	50
Developmental Timing (days from planting)		
First Open Flower		
First Pod		
First Harvest		
Density of Survivors (plants/pot)		
Forage Biomass (g)		
Second Harvest		
Density of Survivors (plants/pot)		
Forage Biomass (g)		
Third Harvest		
Density of Survivors (plants/pot)		
Forage Biomass (g)		
Number of Seeds		
Biomass of Seeds (g)		

Fast Plants Graphs **Names** ______________________

Graph #1

FORAGE BIOMASS vs. HARVEST TIME

[Graph both planting densities (5 and 50 planting densities)]

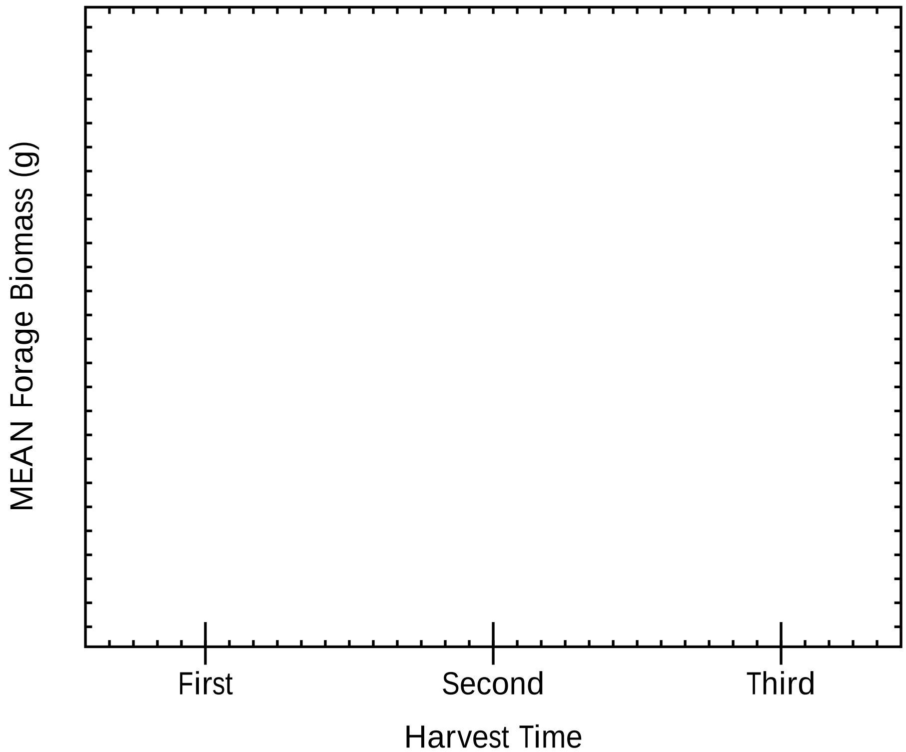


Fast Plants Graphs **Names** ______________________

Graph #2

MEAN FORAGE BIOMASS vs. HARVEST TIME

[Graph both planting densities (5 and 50 planting densities)]



Fast Plants Graphs **Names** ______________________

Graph #3

DENSITY OF SURVIVORS vs. TIME
[Graph both planting densities (5 and 50 planting densities)]