

Name _____

Pre-Lab: Plant Structure and Growth

1. Explain the difference between determinate and indeterminate growth. What regions in plants have the perpetual embryonic tissue that allows for continuous growth?

2. What is an epiphytic plant?

3. Graph the average leaf length with age. Put the values in the appropriate space on the axes. Connect the data points with a line.

Length (mm)			
Age (days)	Leaf 1	Leaf 2	Leaf 3
0.5	5.0	4.0	3.0
3	4.0	4.0	4.0
7	6.0	11.0	11.0
14	98.0	83.0	92.0
21	121.5	148.5	137.5
28	143.5	139.0	136.0



Plant Structure and Growth

Purpose

- Dissect and examine seed structure
- Distinguish between determinate and indeterminate growth
- Observe the localization of cell growth in pea root tips
- Compare development of monocot and eudicot plants
- Communicate observations graphically

Introduction

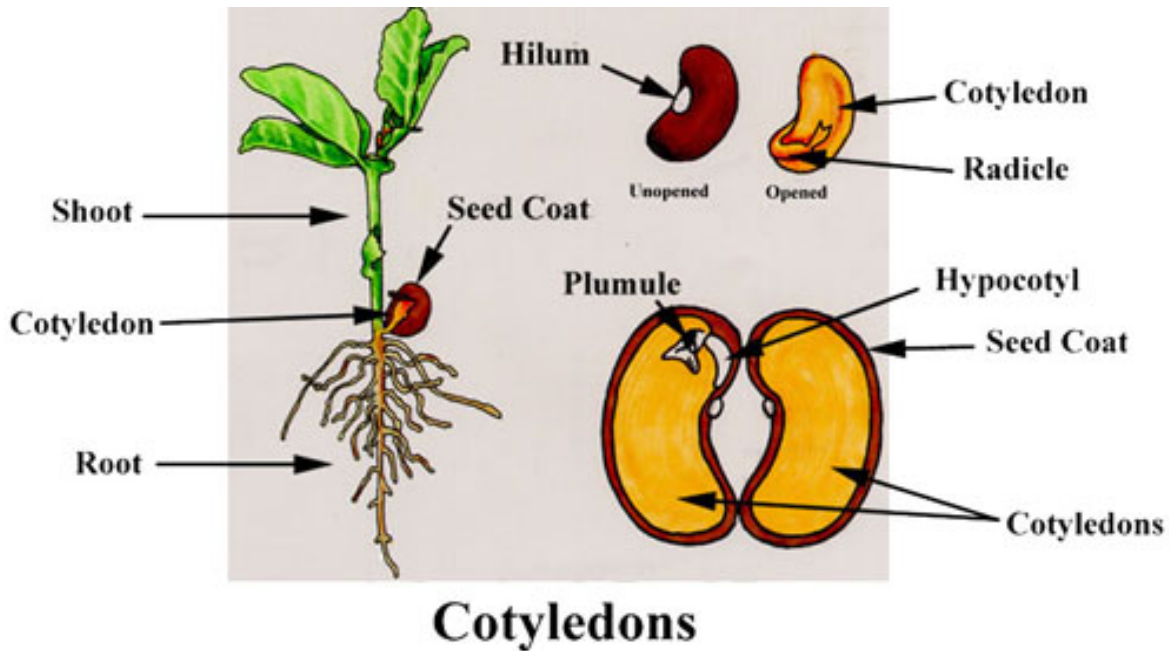
From zygote to mature form, a plant develops through a series of changes involving both **growth** and **differentiation**. For any organism, the term growth refers to quantitative and irreversible changes that take place during the life cycle. (What is the fundamental process of growth in plants?) Differentiation applies to qualitative differences between cells, tissues, and organs that occur during the process of development.

A very young plant embryo consists of a spherical mass of rapidly dividing cells. However, when the embryo reaches a certain size, cell division becomes restricted to a few regions of the embryo, such as shoot and root meristems. Within an embryo, development proceeds by predictable and sequential steps that lead ultimately to the normal growth and development of the plant.

A significant difference between plants and most animals is that plants have **indeterminate growth** while animals have **determinate growth**. Animals grow during a juvenile period until the adult form is reached and growth ceases. Cells are replenished and energy is generated by the organism but its size is limited. Plants, however, can grow in size throughout their lifespan. Regions in stems and roots have perpetually embryonic tissues called **apical meristems** and this is where primary growth occurs. Secondary growth appears in **lateral meristems** which causes thickness in woody plants. Certain parts of plants have determinate growth such as leaves, flowers and fruit.

There are 4 parts to today's lab and a related assignment to be handed in:

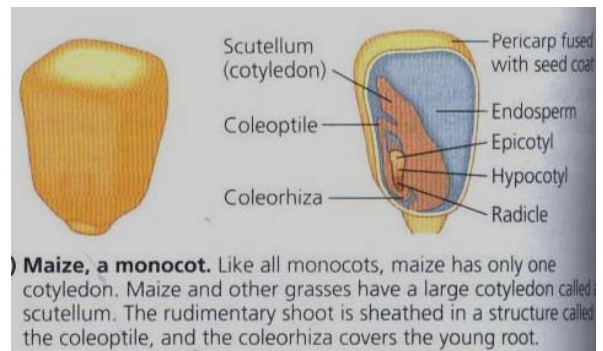
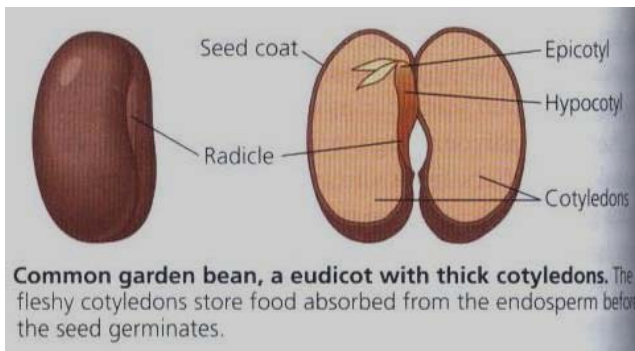
- 1 – **Dissection – bean seed** observe early growth stages
- 2 – **Dissection – corn kernel** observe early growth stages
- 3 – **Localization of Plant Growth** – measure growth in pea roots
- 4 – **Determinate Growth** – measure bean leaves of various ages



Procedure

1. Structure of Bean Seeds and Corn Kernel

Obtain 2 or 3 soaked bean seeds and corn kernel. Observe the scar on the seed coat, the **hilum**, where the seed was attached to the wall of the pod. Beside the hilum there is a small opening, the **micropyle**, through which the pollen tube enters the ovule. Remove the seed coat (testa) and notice the number of **cotyledons**. The embryonic axis lies between the two cotyledons. Locate the **hypocotyl** with the **plumule** (the parts that develop into the shoot and the first foliar leaves, respectively) and the **radicle** (the region that becomes the primary root). Sketch the bean seed and corn kernel and label the parts in bold above. Use the dissecting microscope to get a closer view. Save these beans to use later in Part 3.

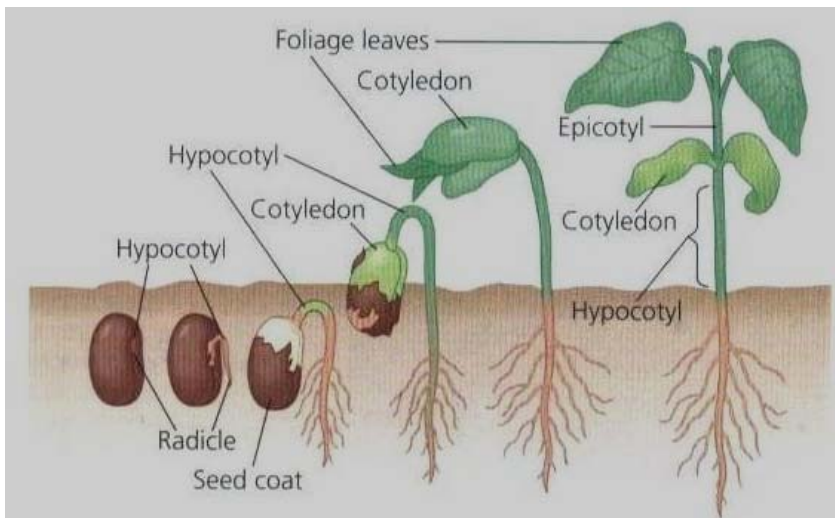


2. Early growth of monocots and eudicots; look at series of germination bean and corn plants. Answer the following questions for both corn and bean growth:

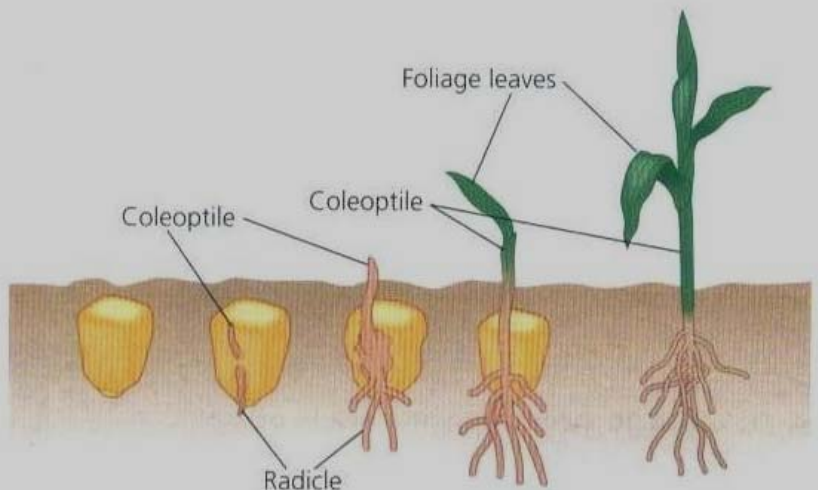
a. Which part emerges first?

Corn _____ Bean _____

b. How does early growth differ between the two plants?



(a) Common garden bean. In common garden beans, straightening of a hook in the hypocotyl pulls the cotyledons from the soil.



(b) Maize. In maize and other grasses, the shoot grows straight up through the tube of the coleoptile.

3. Indeterminate Growth – Pea Root Tips - Localization of Growth

A. In the previous lab you marked the last centimeter of 6 pea root tips at 1 millimeter intervals. Today you will open your growth chamber, observe the ink marks and measure the distance between each millimeter mark after 2 days growth. If any of the ink marks cannot be seen on a root tip and you know which marks are missing, you can list the interval distances that you know and leave blank the ones that are missing. Calculate the average length of growth for each interval, adjusting the total number of seeds you divide by if there are missing values in that column. Record your data in a tabular form (below) and graph the results with the root tip intervals on the X-axis and the average root tip growth on the Y-axis.

		Intervals									
Root number		1	2	3	4	5	6	7	8	9	10
1											
2											
3											
4											
5											
6											
Average											

Is growth in the pea root tip consistent throughout the length of the root or more pronounced in one area? What is that one area called (hint: see section 3B)?

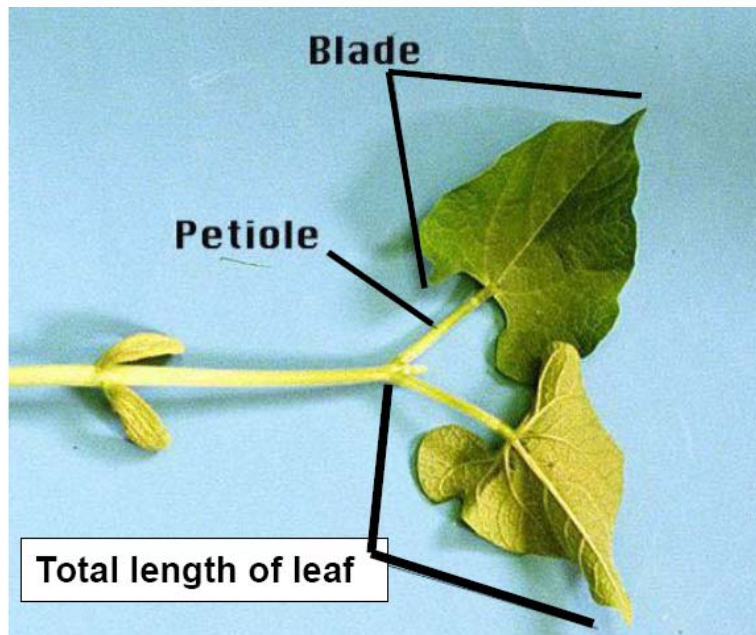
3 B. Examine a prepared slide of a longitudinal section through an onion root tip. The nuclei in these cells are stained dark and chromosomes in the nuclei can be seen in various stages of mitosis (use the 40x lens to see this). Where mitosis is occurring constantly, new cells are being produced. This is the apical meristem. The root cap covers and protects the apical meristem from the soil. These cells are relatively larger and have less mitosis taking place. Behind the apical meristem is the zone of elongation. Here mitosis slows and the cells lengthen. Behind the zone of elongation is the zone of differentiation. Here the cells become specialized in structure and function. For example some cells develop into root hairs, others into transporting tissue such as xylem and phloem and others into additional types of cells. Make a labeled sketch below that includes the following: root cap, apical meristem, zone of cell elongation and zone of cell differentiation.

4. Determinate Growth - Length of Bean Leaves Over Time

Bean leaves grow until they reach their mature size and stop. Cells in these leaves carry on metabolic functions and continue to reproduce but the *size* of the leaf does not increase once it reaches maturity. To observe this characteristic we will measure the length of leaves from bean plants and bean seeds as they develop from a few hours old to a few weeks old.

Procedure

Select three bean seeds that have been soaking in water for several hours. You can reuse the bean seeds that you opened earlier to see the structures in the seeds if the leaves are still intact. Split them open and measure the length of the first foliar embryonic leaves. Record the length in the table below. Measure the length of the first foliar leaves on 3 of the other 2 sets of beans seeds which have been soaking for 1 day and 5 days. Assume that both foliar leaves up to 5 days old are the same length. Measure and take the average of the first two foliar leaves on three plants from each group which were planted on different dates. When measuring leaves measure from petiole base to the blade tip for the total length. List all leaf measurements in the following table. Calculate the age of the plants you are measuring; the day each flat was planted is written on tape on the side of the plant box. Present your data in a graph with the average leaf length on the y-axis and the leaf age in days on the x-axis as you did in the pre-lab. Why are we averaging the length of 2 leaves on 3 plants? Why not just measure one leaf per plant?



Discuss the nature of the curve obtained. Compare and contrast the growth of roots with the growth of leaves in terms of determinate versus indeterminate growth.

Length of Bean Leaves (mm)

date planted	age (days)	plant 1			plant 2			plant 3			average length of all 3 plants
		leaf 1	leaf 2	average plant 1	leaf 1	leaf 2	average plant 2	leaf 1	leaf 2	average plant 3	

Lab assignments: Due next lab is a summary of your observations.

Be sure to complete the following measurements and drawings by the end of lab today. You will need them so you can synthesize and hand in a summary of observations of plant growth to your TA next lab. It is not a formal lab report, but it is a summary of your observations which will include your graphs.

Have the TA check off your raw data and drawings before you leave lab and time permitting draw graphs by hand to go over before you leave lab, to be sure you understand the proper depiction that you will produce and hand in next lab.

Required:

- Drawings of labeled dissected Bean seeds
- Drawings of labeled dissected Corn seeds
- Drawings of labeled root tip from the prepared slides
- Graph of root tip growth
- Graph of leaf growth v age
- Written description of graphs
- Written answers to all questions