SIXTH GRADE GARDEN BASED CURRICULUM

Note: This unit will work best in place of the monocot and dicot portion of the Diversity of Life Unit. After multiple years of students with peanut allergies I have had to rework the lima bean portion of the Diversity of Life unit.

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UNIT 1: Plant Exploration

Unit Summary: In this unit, 6th grade students will learn that there are different kinds and types of seeds. They will experience the growth process of a seed from planting, to root eruption, to sprouting. By using a glass aquarium and planting close to the glass they will get to experience all steps. This will lend nicely to using the Scientific method by allowing classes to manipulate parts of the growth process; the orientation of the seed, the depth at which the seed is planted, the amount of water used, or even the frequency of watering by using both long sides of the aquarium. This will allow each class to have two ongoing experiments with two different manipulated variables. At this point it is important to keep all other variables consistent, which lends nicely to re-enforcement of a control, manipulated, and responding variable. This is designed for a class that is 5 sections of science with any amount of students, size of classes only determines how many seed cards you will need. They can/should be reused between each class. While waiting for seeds to sprout, students will learn about the major structures of plants and their purpose.

Lesson Summaries:

Note: Given the sprouting time of the seeds, Lesson 3 can be done first, then go on with lessons 1, 2, 4, 5, 6…. while waiting on the seeds to sprout.

Lesson 1: Seed cards
Teacher will introduce students to the seed cards. Explaining that in front of them are 5 different kinds of seed. Students will then have time to compare and contrast the 5 different seeds, drawing colored pictures and writing observations. The 4th column (Monocot or dicot) on the worksheet is for the end of Lesson 2.

Preparation:
Seed cards- using an index card glue or tape down an example of the following seeds: corn, sunflower, pea, lima bean, watermelon. For the sunflower you might want to give an example in the shell and out. It would be best to have one card to every two students. Another option would be to give each group of 4-5 students a bowl with one of each seed and one card to help identify each seed. Only label them as A-E on the seed cards or in the bowls, not with names. Teachers should consider putting the seed cards in sandwich Ziplocs to protect them from fingers and to capture any seeds that fall off while being used.
Sprouting times:

Corn	*10d-2w*
Sunflowers	*7-10d*
Pea	*7-14d*
Lima beans	*5d*
Watermelon	*7-10d*

Lesson 2: Types of seeds
After students have finished with the seed cards teacher will go into the differences between two types of seeds gymnosperm and angiosperm then going from there into the two types of angiosperm: monocots and dicots. (Power point) After this lesson have students return to the seed cards and try to guess which seeds are monocot and which ones are dicots, there is a remaining column on their seed card worksheet to note this. Go through and ask for what they labeled them and reasons why. Then have them correct their answers if needed after you tell them the correct answers.

Lesson 3: Seed Experiment
Introduce seed experiment- use lima beans for each class as they have the shortest sprouting time and you can really alter the orientation of the seed. Teacher will question students on all the variables that might effect the growth of a seed, write all mentioned on board for class to see. The variables that would be easiest to test are seed orientation, seed depth, amount of water, and frequency of watering. Teacher can narrow the list down to these 4 and allow class to vote on which two they want to apply to their class experiment.
This is a good place to remind them you don't want to change more then one thing in an experiment.

Lesson 4: The Purpose of Plant Structures
Before going into the structural differences between Monocots and Dicots this lesson will introduce the students to the purpose of each of the major plant structures. While following a teacher lead power point students will fill in a guided note taking worksheet. This worksheet will give them a chance to predict what they think the purpose of each plant structure is and then there is space to fill in notes of what the purpose is of each structure. This will also introduce them to common foods we eat that are from different structures of the plant. This lesson will introduce them to transpiration. Slide 16 is the major structures of the flower. They can use this slide to fill in the information on the second page of the Day 4 worksheet.

Lesson 5-6: Major Parts of a Plant
Using the Parts of the Plant worksheet, students will explore the major parts of monocot and dicot plants starting with the seed and cotyledon, to roots, stems, leaves and finally flowers and how they differ between Monocots and Dicots.
Finally, using all that information students will construct a drawing of an entire plant representing a Monocot and a Dicot plant. For each of the structures students need to label them and state the difference, ie: on the monocot the leaves need to be labeled and also state parallel veins. As a review it may also be a good assignment to have students label the purpose of each of the structures on their drawings.

Plant Exploration

Lesson 1: Seed Cards

Teacher: Grade Level: 6th

Common Core Standard:	6-S1-C1 Formulate predictions, questions, or hypotheses based on observations. 6-S1-C2 Design and conduct controlled investigations. 6-S1-C3 Analyze and interpret data to explain correlations and results; formulate new questions. 6-S1-C4 Communicate results of investigations. 6-S2-C2 Understand how science is a process for generating knowledge. 6-S4-C1 Understand the relationships between structures and functions of organisms. 6-S4-C3 Analyze the relationships among various organisms and their environment.
Enduring Understandings/ Essential Questions:	• **Biodiversity (the variety of life on Earth):** ***All ecosystems contain a variety of organisms that are interdependent.*** **Essential Questions:** • How is biodiversity affected by human behavior? • How does decreased or increased biodiversity affect life on Earth? • How are humans dependent on biodiversity?
Content Objective: *Math Reading* *Writing* *Other:*	Using observation skills students will create a list of observations and a drawing of each of the 5 kinds of seeds.
Language Objective:	

Vocabulary	**Materials**
Seed Observations	*Seeds- ~35 of each unless otherwise noted* *Corn* *Sunflower (45 seeds) to have one in shell and one out of shell* *Peas* *Lima beans* *Watermelon* *Index cards* *Hand lenses* *Science notebooks* *Lesson 1 seed cards worksheet*
Guiding Questions: See bell work below	

Anticipatory Set:

Day 1 bell work: What do you think the purpose of a seed is? Explain

Activity/Investigation:

1. After discussing the bell work introduce the students to the seed cards. Explain that they will have the chance to observe 5 kinds of seeds. They will need to create a colored drawing and a list of observations of each seed. For right now they can skip the 4th column. We will come back to that one in the next lesson.
2. At this point, working in pairs, student should begin their observations of the seed cards. Using hand lenses or dissecting microscopes may add in their detailed observations. Encourage them to take a guess as to what type of seeds they are. The sunflower seed and the corn should be pretty easy to identify. The others may stump them.
3. At the end of the lesson, ask students if they can identify any of the seeds. Hold off on telling them what the seeds are until the end of the next lesson, after they have decided if they think the seed is a monocot or a dicot.

Closure Question:

Are all seeds the same? What are some differences?

Teacher Reflection:

What went well, what could be improved upon, what will you keep in mind for the next lesson, etc.

Plant Exploration

Lesson 2: Types of seeds

Teacher: Grade Level: 6th

Common Core Standard:	6-S1-C1 Formulate predictions, questions, or hypotheses based on observations. 6-S1-C2 Design and conduct controlled investigations. 6-S1-C3 Analyze and interpret data to explain correlations and results; formulate new questions. 6-S1-C4 Communicate results of investigations. 6-S2-C2 Understand how science is a process for generating knowledge. 6-S4-C1 Understand the relationships between structures and functions of organisms. 6-S4-C3 Analyze the relationships among various organisms and their environment.
Enduring Understandings/ Essential Questions:	• **Biodiversity (the variety of life on Earth):** ***All ecosystems contain a variety of organisms that are interdependent.*** **Essential Questions:** • How is biodiversity affected by human behavior? • How does decreased or increased biodiversity affect life on Earth? • How are humans dependent on biodiversity?
Content Objective: *Math Reading* *Writing* *Other:*	Through a power point students will begin to understand the different kinds of seeds and their differences. Using the new information gained students will attempt to identify the seeds from the seed cards as monocots and dicots with 50% accuracy.
Language Objective:	

Vocabulary	**Materials**
Gymnosperm Angiosperm Monocot Dicot Seed Cotyledon Seed coat Embryo endosperm	*Science notebooks* *Lesson 2 Types of Seeds worksheet* *Lesson 2 Types of Seeds Power point* *Seed cards*
Guiding Questions: See bell work below	

Anticipatory Set:

Day 2 bell work: What is one difference between the seeds on the seed card?
What is one similarity between the seeds on the seed card?

Activity/Investigation:

1. After discussion of the bell work, class will work their way through the Types of Seeds power point presentation. They should be taking notes and making drawings of the two different types of seeds on the worksheet.
2. This lesson will begin with introducing them to the two types of seeds, gymnosperms and angiosperms. After being given a description of the gymnosperms they will have to opportunity to name some examples. At this time we will go no deeper into gymnosperms and explore the two types of angiosperms, monocots and dicots.
3. There will be notes taken, vocabulary defined and drawings of examples to add in understanding.

At the end- Have students return to the seed cards and see if they can identify which seeds are monocots and which are dicots. They need to give at least one reason to support their claim. At the end you can reveal what type of seed they actually are and then whether or not they think it is monocot or a dicot. The answers are in the notes section of the last slide of the power point.

Closure Question:

How many seeds were you able to identify correctly? What evidence did you use to support you claim of a monocot or dicot?

Teacher Reflection:

What went well, what could be improved upon, what will you keep in mind for the next lesson, etc.

Plant Exploration

Lesson 3: Seed Experiment

Teacher: Grade Level: 6th

Common Core Standard:	6-S1-C1 Formulate predictions, questions, or hypotheses based on observations. 6-S1-C2 Design and conduct controlled investigations. 6-S1-C3 Analyze and interpret data to explain correlations and results; formulate new questions. 6-S1-C4 Communicate results of investigations. 6-S2-C2 Understand how science is a process for generating knowledge. 6-S4-C1 Understand the relationships between structures and functions of organisms. 6-S4-C3 Analyze the relationships among various organisms and their environment.
Enduring Understandings/ Essential Questions:	• **Biodiversity (the variety of life on Earth):** ***All ecosystems contain a variety of organisms that are interdependent.*** **Essential Questions:** • How is biodiversity affected by human behavior? • How does decreased or increased biodiversity affect life on Earth? • How are humans dependent on biodiversity?
Content Objective:	Through the Scientific Method students will design and construct an experiment to determine the variables effecting seed sprouting.
Language Objective:	

Vocabulary	**Materials**
Monocot Dicot Seed Stem Flower Cotyledon Veins Vascular bundles Fibrous roots Tap root Floral parts leaves stems orientation depth	*10 gallon aquarium w/ the long sides marked off into 5 sections (1 for each period on each long side)* *Potting soil* *Seeds- the number of seeds needed depends on if you are using only lima beans or each seed for each period. Each class should plant at least three seeds for each of their two experiments.* *Corn* *Sunflower* *Onion* *Lima beans* *Radish* *Water* *Something to measure water in* *Scientific method*
Guiding Questions: See bell work below	

Anticipatory Set:

Day 3 bell work: What is one difference between a monocot and a dicot? (If done in lesson order)

What is the difference between the manipulated variable and the dependant variable? (if done out of order before lesson 2)

Activity/Investigation:

4. After discussing the anticipatory set explain with the students review the Scientific Method. Have them explain the major parts to the Scientific method as review. Explain to the students that we will be using this while experimenting with the seeds. Explain to the students as a class they are going to plant one of the 5 types of seeds they saw in the seed cards. Or tell them we are going to use the lima beans because they have a faster sprouting time under normal conditions. Discuss the variables that could affect a seed and its ability to sprout successfully. Things like amount of water, soil quality, depth, orientation, quality of water, type of soil, watering schedule. Focus on the soil depth, amount of water, or orientation of the seeds for this experiment.
5. As a class walk through the parts of the Scientific Method posing the question to the students of "What can affect a seeds ability to sprout successfully?" Also have students determine what success looks like in their experiment.
6. As a class form a hypothesis for each of the two experiments together based on their thoughts of how the depth, amount of water, frequency of watering or orientation of the seed might affect the seed.
7. They will then need to create a list of materials and procedures to follow.

Closure Question:

Discuss class predictions. Do they think depth matters and which of their seeds do they think will be the most successful?

Teacher Reflection:

What went well, what could be improved upon, what will you keep in mind for the next lesson, etc.

Plant Exploration

Lesson 4: Purpose of the Plant Structures

Teacher: Grade Level: 6th Grade

Common Core Standard:	6-S1-C1 Formulate predictions, questions, or hypotheses based on observations. 6-S1-C2 Design and conduct controlled investigations. 6-S1-C3 Analyze and interpret data to explain correlations and results; formulate new questions. 6-S1-C4 Communicate results of investigations. 6-S2-C2 Understand how science is a process for generating knowledge. 6-S4-C1 Understand the relationships between structures and functions of organisms. 6-S4-C3 Analyze the relationships among various organisms and their environment.
Enduring Understandings/ Essential Questions:	• **Biodiversity (the variety of life on Earth):** ***All ecosystems contain a variety of organisms that are interdependent.*** **Essential Questions:** • How is biodiversity affected by human behavior? • How does decreased or increased biodiversity affect life on Earth? How are humans dependent on biodiversity?
Content Objective: *Math Reading* *Writing* *Other:*	Through a presentation and filling in a graphic organizer students will begin to understand the major structures of plants and their purpose with 80% confidence.
Language Objective:	

Vocabulary	**Materials**
Seeds Stem Flower Leaves Roots cotyledon	*Science notebooks* *Lesson 4 Purpose of Plant structures worksheet* *Lesson 4 Purpose of Plant structures Power point*

Seasonality				
Monsoon July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June
Guiding Questions:				

See anticipatory set below

Anticipatory Set:
Day 4 bell work: What is one similarity between a monocot and a dicot?

Activity/Investigation:

1. After discussion of the bell work, class will work their way through the Day 4 Purpose of the plant structure power point presentation.
2. Students should first predict what they think the structures purpose is. Teacher should follow this with the actual purpose of that structure.
3. After taking notes, students can predict what foods we eat come from that structure.
4. This lesson wraps up with the flower. Here the students will fill in a blank diagram followed by taking notes on the parts of a flower.

Closure Question:
What do you think the most important structure of any plant is? Give evidence to support your claim.
Could this change based on the environment the plant is growing in?

Teacher Reflection:
What went well, what could be improved upon, what will you keep in mind for the next lesson, etc.

Plant Exploration

Lesson 5-6: Major Parts of a Plant

Teacher: Grade Level: 6th

Common Core Standard:	6-S1-C1 Formulate predictions, questions, or hypotheses based on observations. 6-S1-C2 Design and conduct controlled investigations. 6-S1-C3 Analyze and interpret data to explain correlations and results; formulate new questions. 6-S1-C4 Communicate results of investigations. 6-S2-C2 Understand how science is a process for generating knowledge. 6-S4-C1 Understand the relationships between structures and functions of organisms. 6-S4-C3 Analyze the relationships among various organisms and their environment.
Enduring Understandings/ Essential Questions:	• **Biodiversity (the variety of life on Earth):** ***All ecosystems contain a variety of organisms that are interdependent.*** **Essential Questions:** • How is biodiversity affected by human behavior? • How does decreased or increased biodiversity affect life on Earth? • How are humans dependent on biodiversity?
Content Objective:	Through a presentation and filling in a graphic organizer students will begin to understand the major differences between monocot and dicot plants with 80% confidence. Using their notes, students will be able to construct a drawing of a monocot and dicot plant with 80% accuracy.
Language Objective:	

Vocabulary	**Materials**
Monocot Dicot Seed Stem Flower Cotyledon Veins Vascular bundles Fibrous roots Tap root Floral parts leaves	*Science notebooks* *Lesson 5-6 Parts of a plant worksheet* *Lesson 5-6 Parts of a Plant Power point*
Seasonality *none*	

Monsoon July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June

Anticipatory Set:

Day 5- What is one stem of a plant that we commonly eat?
Day 6-What is one root of a plant that we commonly eat?

Activity/Investigation:

1. This lesson will take place over two days and requires the Day 5-6 worksheet
2. The lesson starts with review of the similarities and differences between monocot and dicot cotyledons.
3. This will take them through the differences between the major structures of a plant based on whether or not they are a monocot or a dicot. They will be filling in notes and create drawings in their Day 5-6 graphic organizer.

Lesson 6: Once they have gathered all the information they need they should be able to create a full plant from seed to root all the way to flower for a monocot and a dicot to demonstrate understanding of the differences between the plants. This could be used as an assessment.

Closure Question:
Could you look at a plant and determine if it is a monocot or a dicot? How?

Teacher Reflection:

Name:_____

Period:_____

Seed Cards Worksheet

Seed	Picture	Observations	Monocot or Dicot?
A			
B			
C			
D			
E			

Types of seeds

Two types of seeds

Gymnosperm and Angiosperm

Gymnosperms

- "naked seeds"
- cone bearing plants (seeds grow on cones)
- needle like leaves
- usually stay green year round
- wind pollinated
- Can you think of a plant that fits these description?

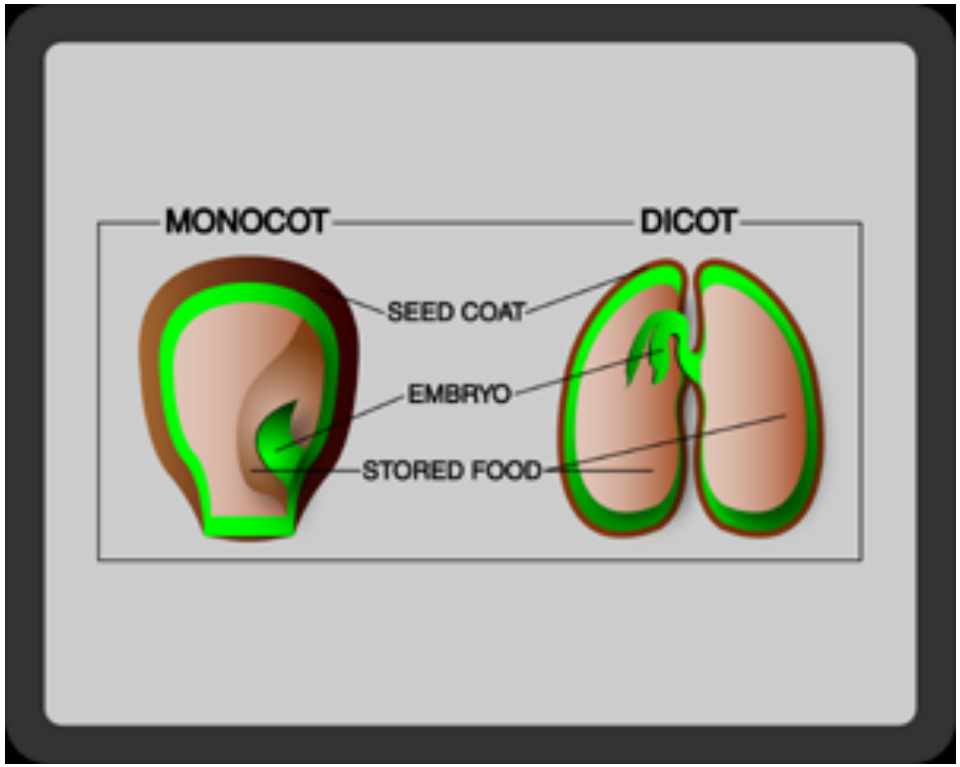
Pine trees, evergreens

Angiosperm

- flowering plants
- seeds are enclosed in a fruit
- most are pollinated by birds & bees
- have finite growing seasons (What do you think finite means? What does that mean for a growing season?)
- Examples: grasses, tulips, oaks, dandelions
- Divided into two main groups: Monocots & Dicots

We will be concentrating on the Monocots and Dicots.

Monocots vs. Dicots



Seeds

- Contain everything needed for the growth and development of a new plant.

- 3 Major parts- embryo, endosperm, and seed coat

Vocabulary to start

- Seed Coat- outer protective coating of the seed, protects against physical, temperature related or water damage. Also makes sure the seed stays in a dormant state until conditions are right.
- Embryo- baby plant
- Cotyledon- important part of the embryo, first leaves of the seedling, provides food to the developing plant, where dicots store their food.
- Endosperm- source of stored food for the developing plant, primarily starches, where monocots store their food.

What does “mono” mean?

Mono means one, only single

Monocot Seed

- Has 1 cotyledon
- Start life with one leaf

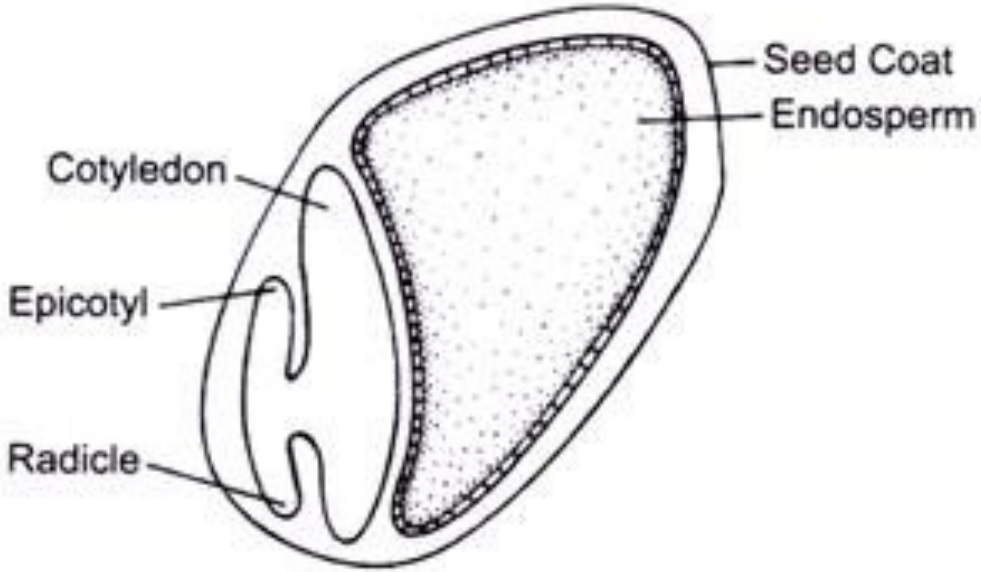


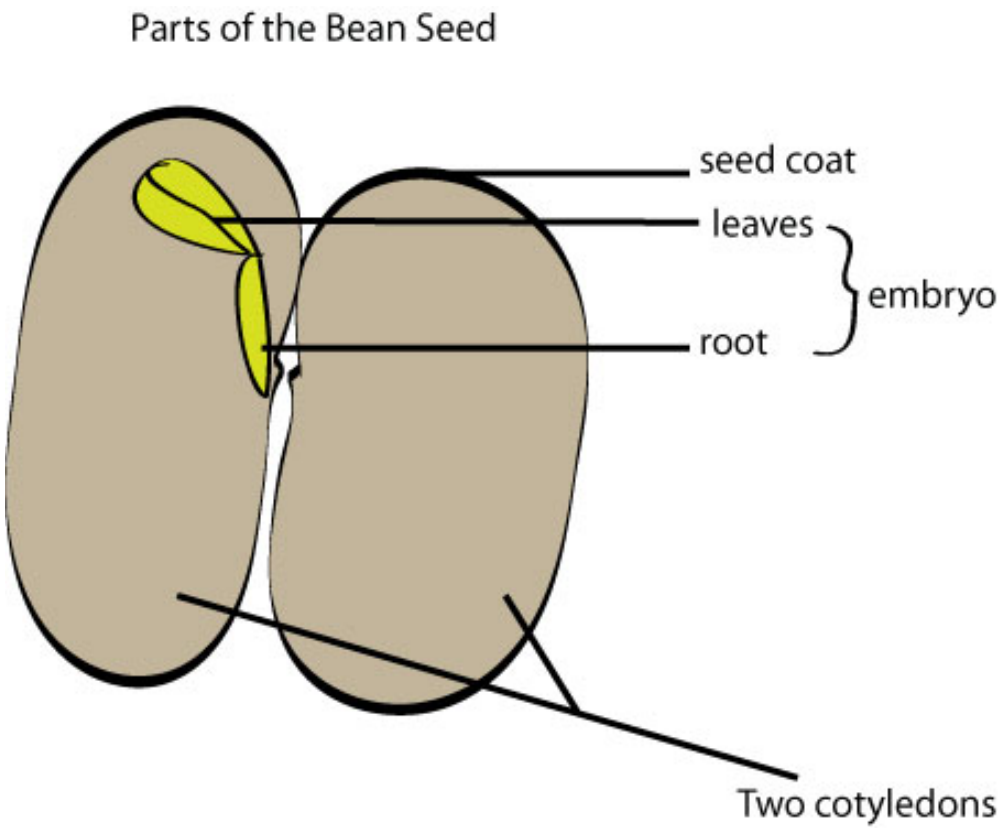
Fig. 4.16 (i) Monocot Seed Structure

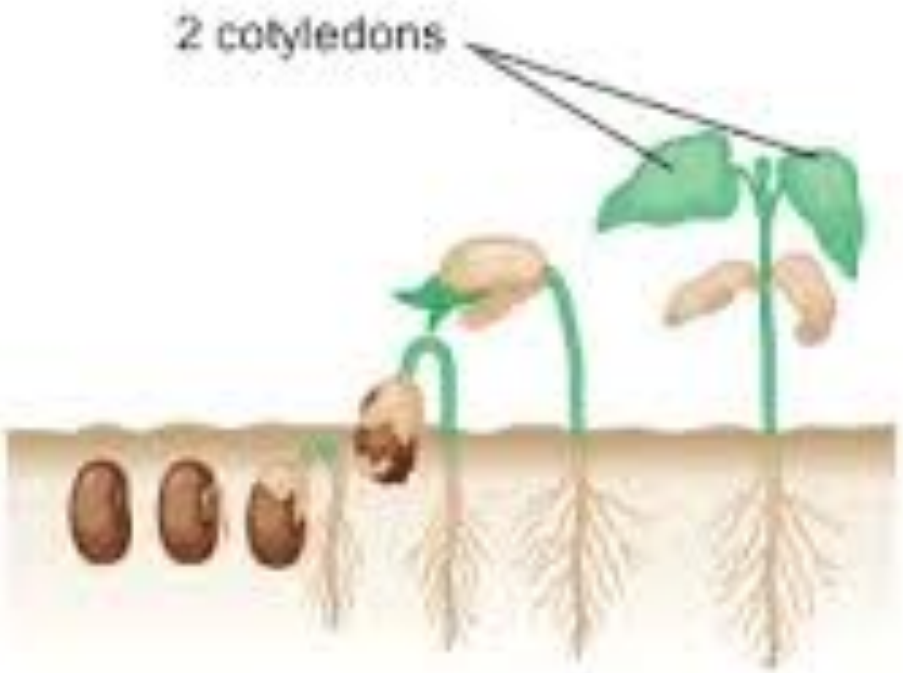
What does “di” mean?

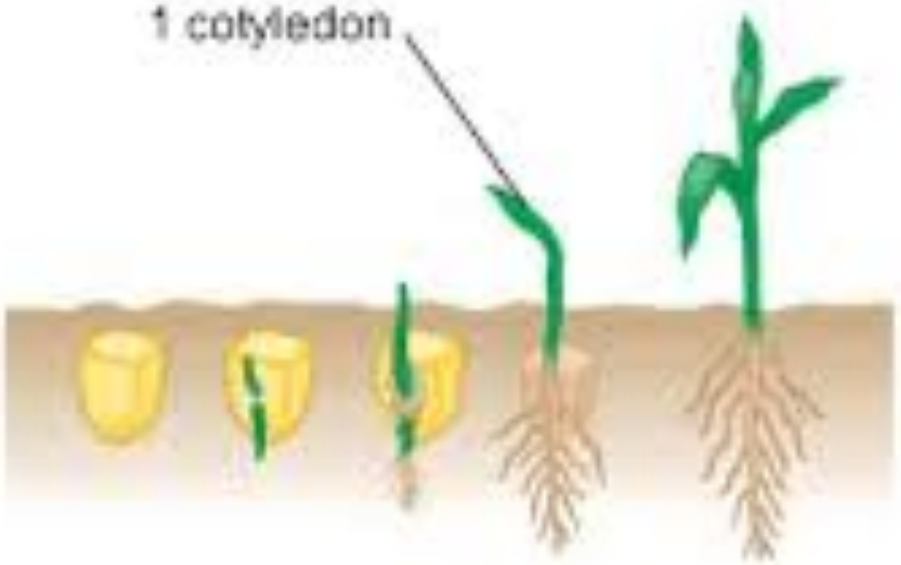
Di means two, twice, double

Dicot seeds

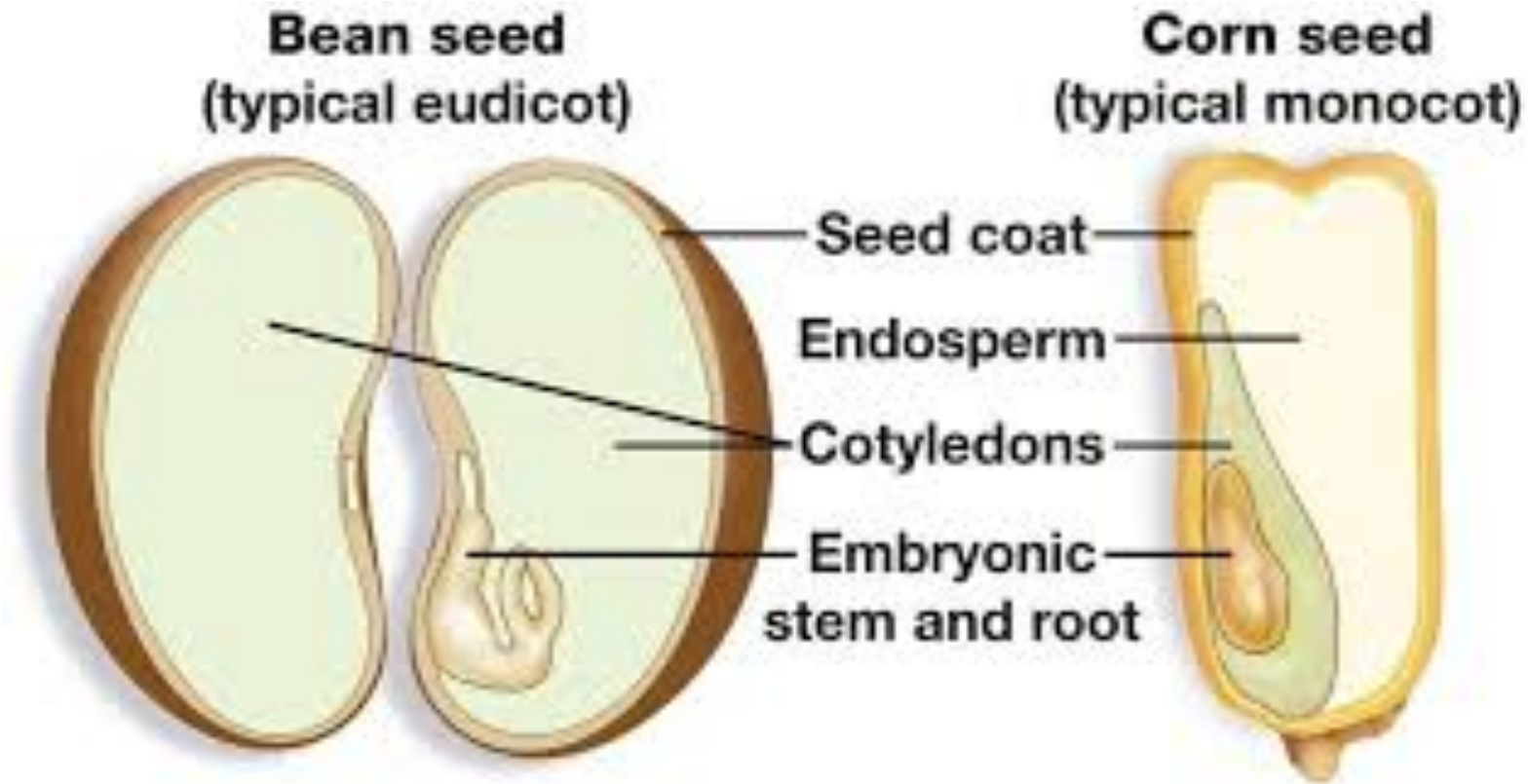
- Have two cotyledons
- Start life with two leaves




2 cotyledons


1 cotyledon

Monocot seeds vs. Dicot seeds



As you can see they share a lot of common structures.

- Now using your notes go back to the seed cards and see if you can identify the seeds as monocots or dicots, give one reason for your label.

Purpose of the plant structures

Seed

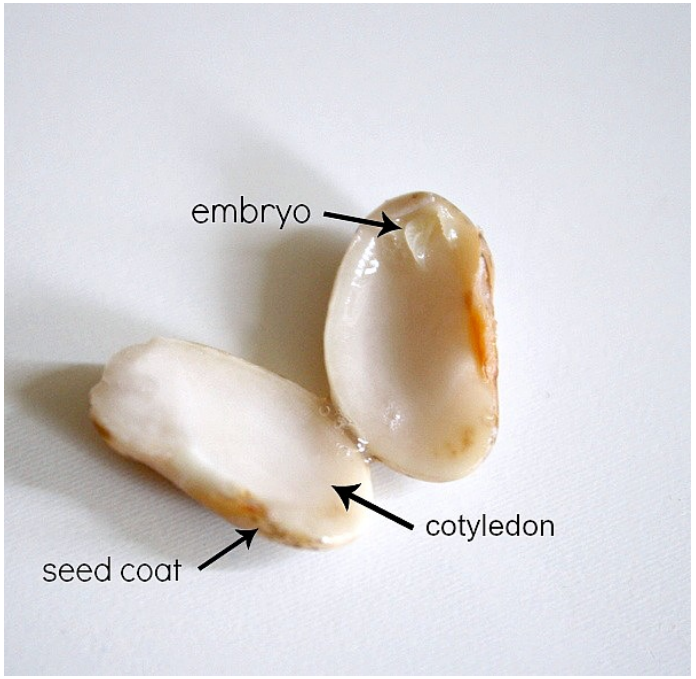
Roots

Stem

Leaves

Flowers

What do you think the purpose of the seed is?



The main purpose of a seed is reproduction.

It contains the stored food, first root and first leaves of the new plant.

Can you think of seeds we eat?

What do you think the purpose of the roots is?

The purpose of the roots is to anchor the plant/tree in the soil, keeping it straight and stable, and absorb water from the soil.

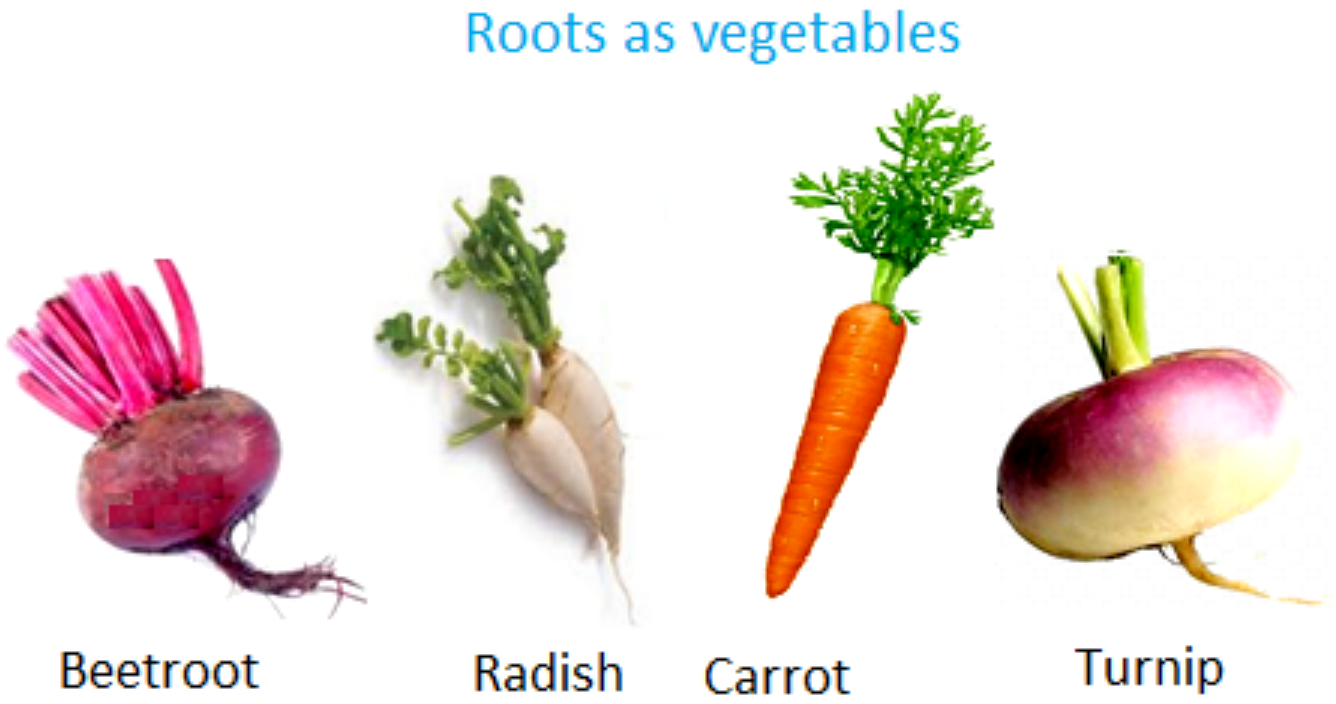
What structure of the plant do you think emerges first?

Video of a Radish seed sprouting.

Pay close attention to which structure emerges first.

http://www.neok12.com/video/Plants/zX560a00745f517353705577.htm

How about roots we eat?



What are your thoughts on the purpose of the stem?

Stems have 4 major functions:

-Support for the leaves, flowers and fruits

-Provide elevation for the leaves, flowers, and fruit

-Keep the leaves in the light

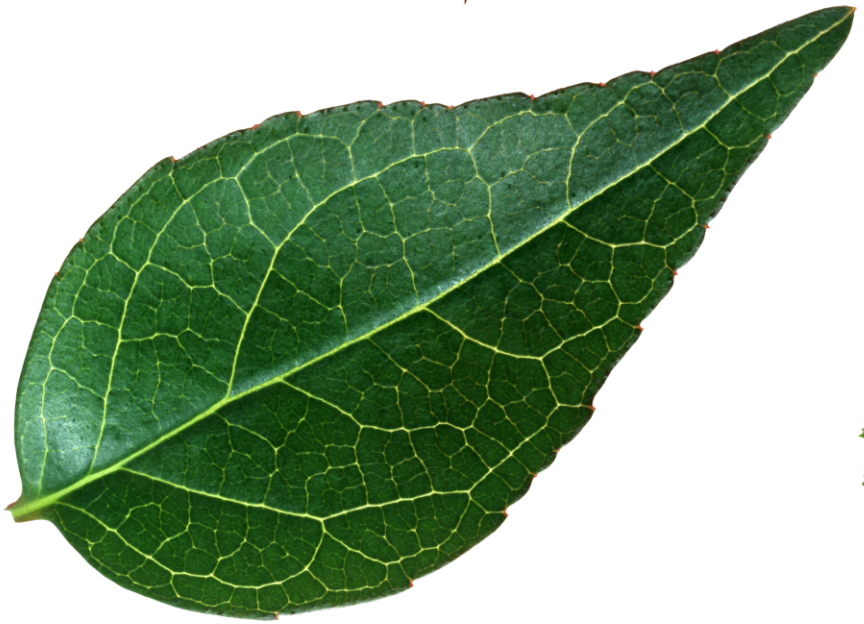
-Transport fluids (water) between the roots and the shoots

Can you think of stems we may eat?

asparagus

Leaves

What do you think the purpose of the leaves is?

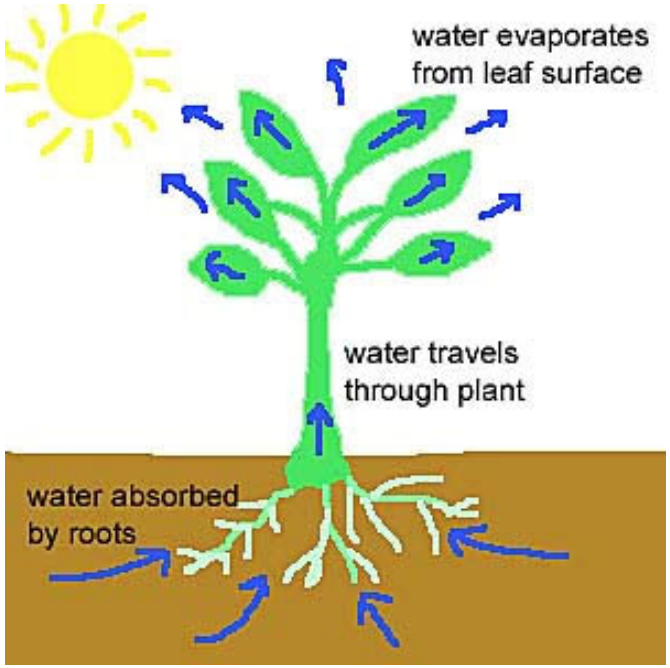


Purpose of leaves

- Chlorophyll in the leaves converts the energy in sunlight into chemical energy the plant uses as food. A process known as photosynthesis
- Leaves have a structure called the stomata where the plant “breathes” from. They allow water vapor and gases to enter and exit the leaves.

Transpiration

- Transpiration occurs in the leaves. The stomata are responsible for this process.
- Water travels up from the roots through the stem. Then through transpiration the water leaves the plant in the form of water vapor.



Can you think of leaves we might eat?

Leaves as food

Spinach

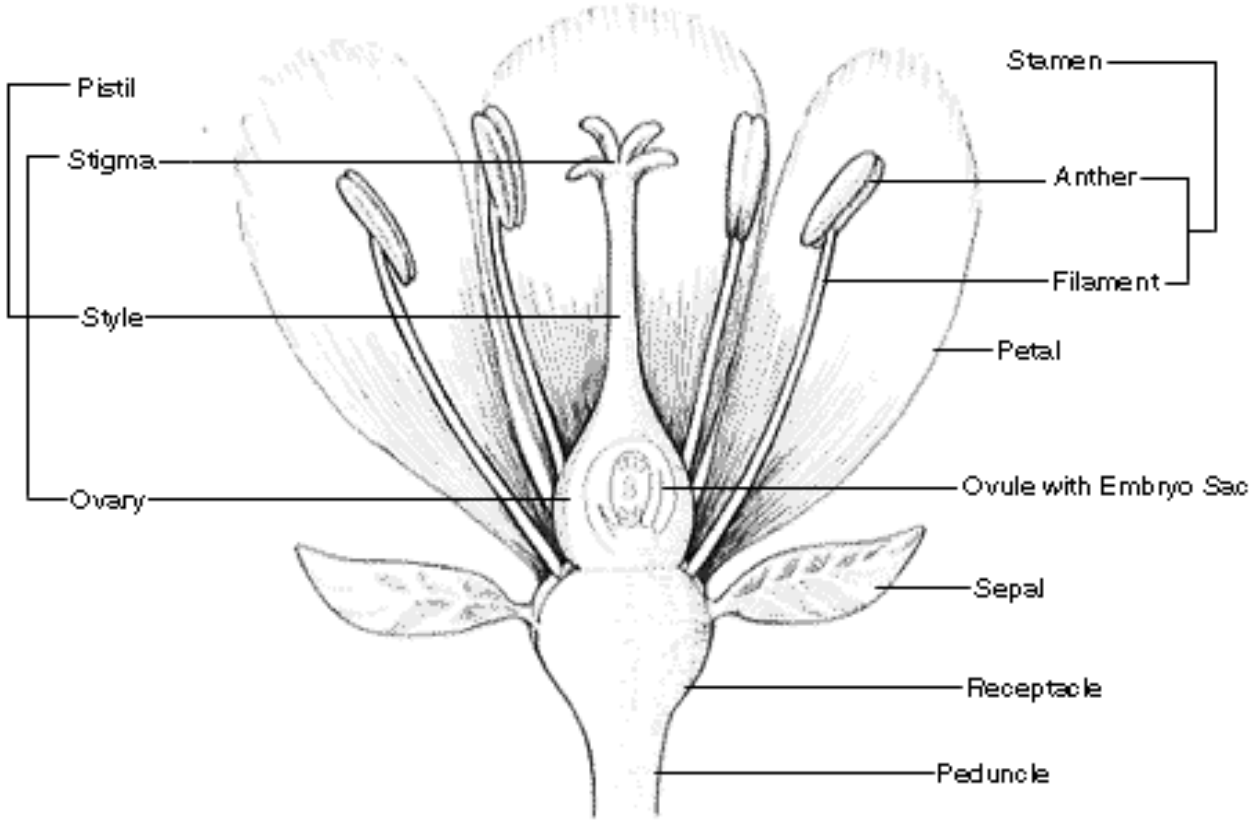
Lettuce

Cabbage

Flowers

What are your thoughts on the purpose of the flower?

- Main purpose is reproduction.
- All the reproductive parts of a plant are in the flower.
- Two types of flowers:
  - Complete- contains both male and female reproductive organs. Does not require help with pollination.
  - Incomplete- can not self fertilize and the female flowers will not produce seeds without being pollinated by a male flower.



Peduncle: The stalk of a flower.
Receptacle: The part of a flower stalk where the parts of the flower are attached.
Sepal: The outer parts of the flower (often green and leaf-like) that enclose a developing bud.
Petal: The parts of a flower that are often conspicuously colored.
Stamen: The pollen producing part of a flower, usually with a slender filament supporting the anther.
Anther: The part of the stamen where pollen is produced.
Pistil: The ovule producing part of a flower. The ovary often supports a long style, topped by a stigma. The mature ovary is a fruit, and the mature ovule is a seed.
Stigma: The part of the pistil where pollen germinates.
Ovary: The enlarged basal portion of the pistil where ovules are produced.

10 Common Varieties of
EDIBLE FLOWERS

CLOVER

DANDELION

ROSE

LAVENDER

SUNFLOWER

CHAMOMILE

PANSY

NASTURTIUM

MARIGOLD

TULIP

edibletherapy.com

Parts of a plant

Monocots and Dicots

Seeds/Cotyledon

- How many cotyledons does a monocot have?

1

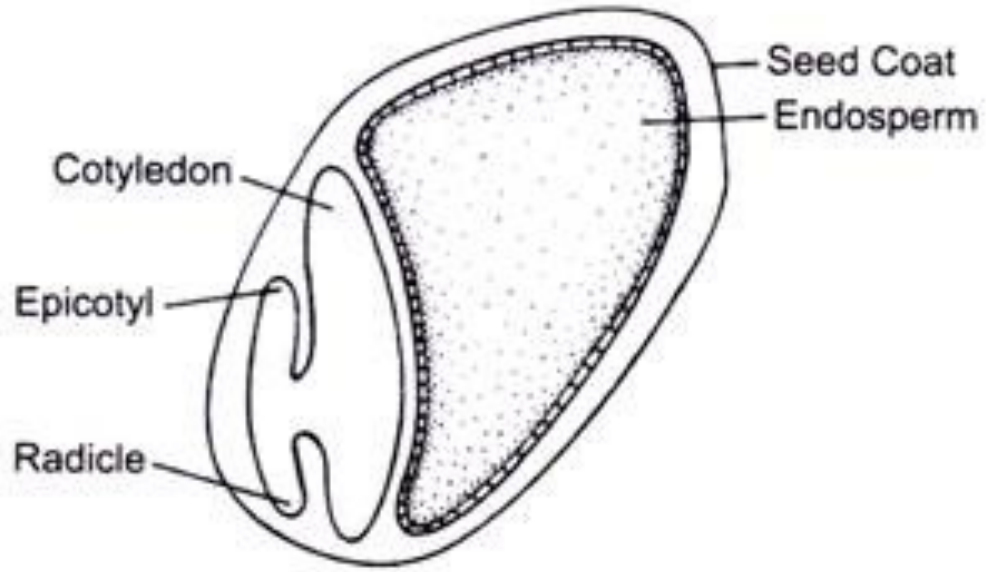
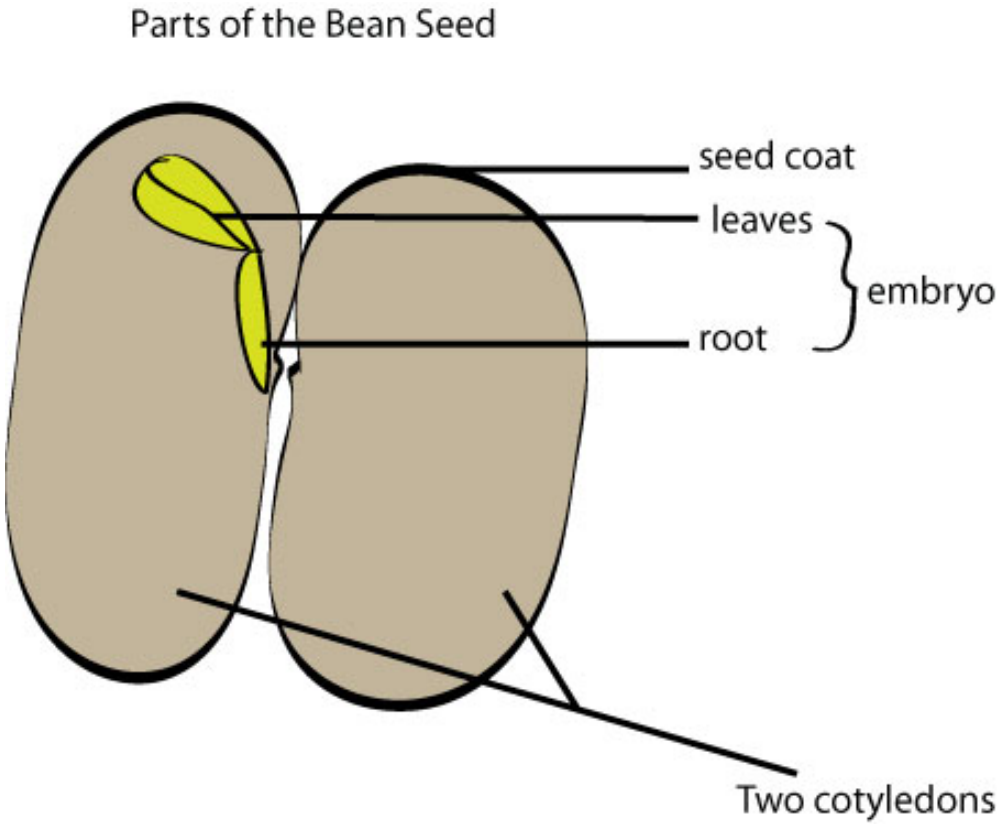


Fig. 4.16 (i) Monocot Seed Structure

How many cotyledons does a dicot have?

2



Lets talk about the differences between the major parts of a monocot and dicot plant.

Seeds/Cotyledon

- Monocot
  - 1 Cotyledon

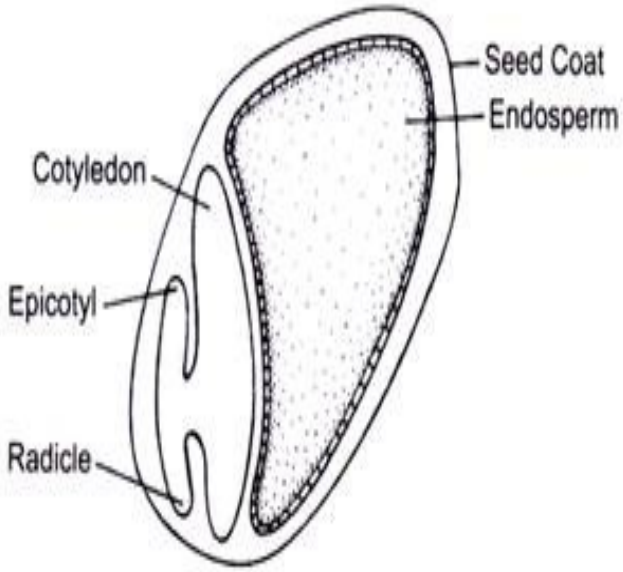
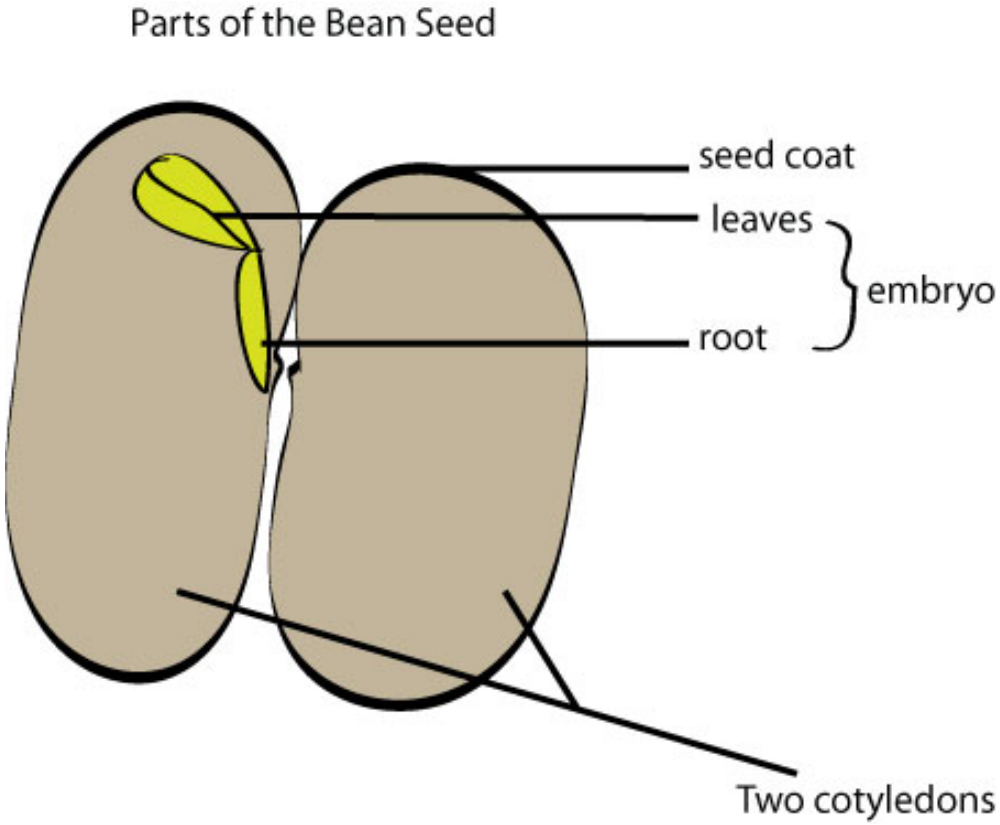


Fig. 4.16 (i) Monocot Seed Structure

- Dicot
  - 2 Cotyledon



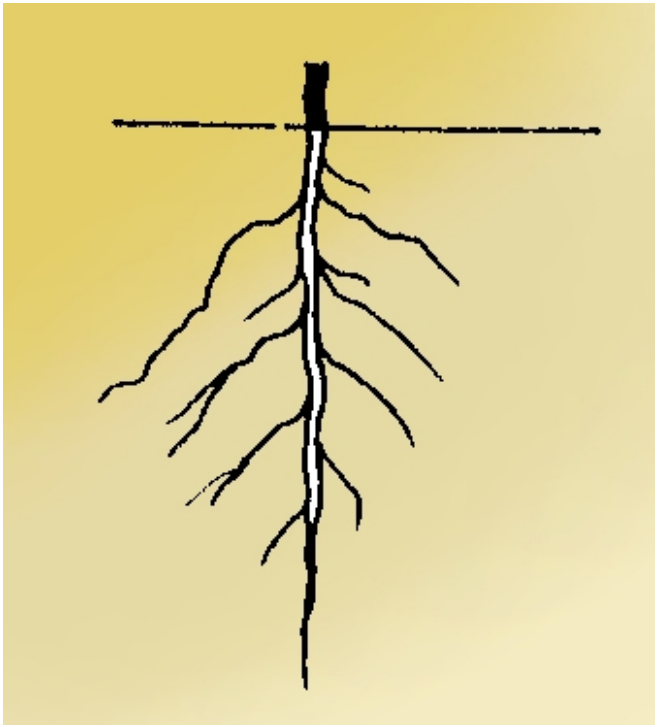
Roots

Monocot

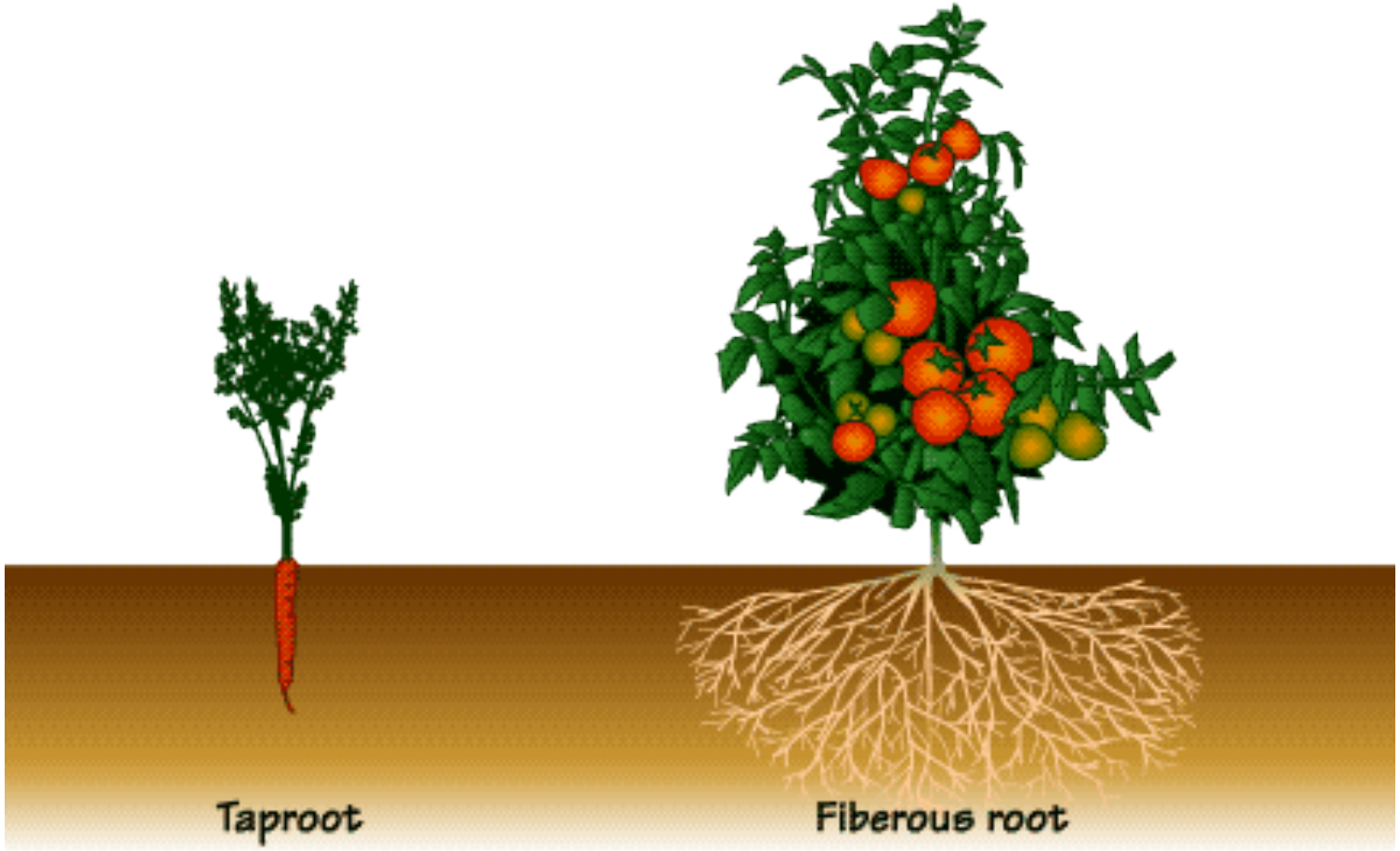
- Fibrous roots

Dicot

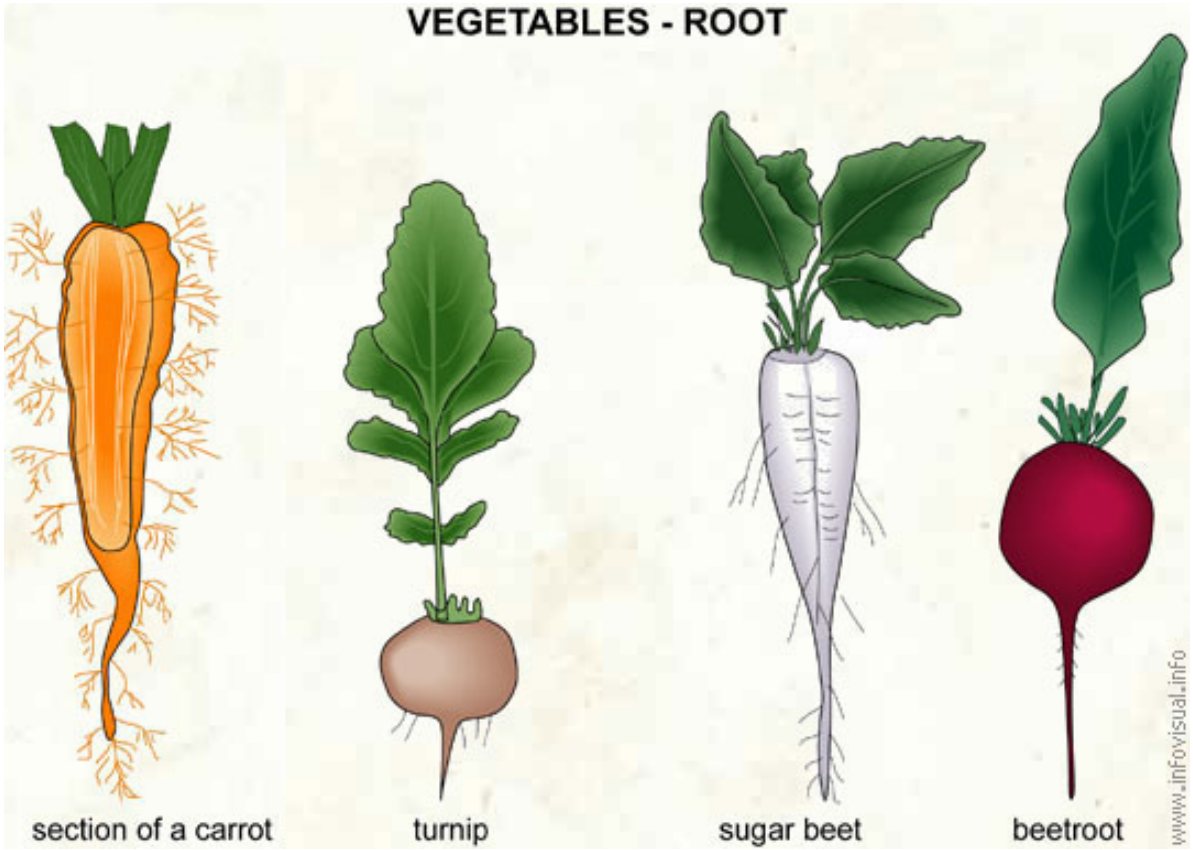
- Tap root



Do you recognize these plants?



What part of this plant is the root?



Important vocabulary

- Vascular bundles- consists of the xylem, which aides in the travel of water and minerals from the soil to the leaves and phloem.
- Xylem- one of the two types of transport tissues. Transports water.
- Phloem- being the other type of transport tissues. Transports food and nutrients.

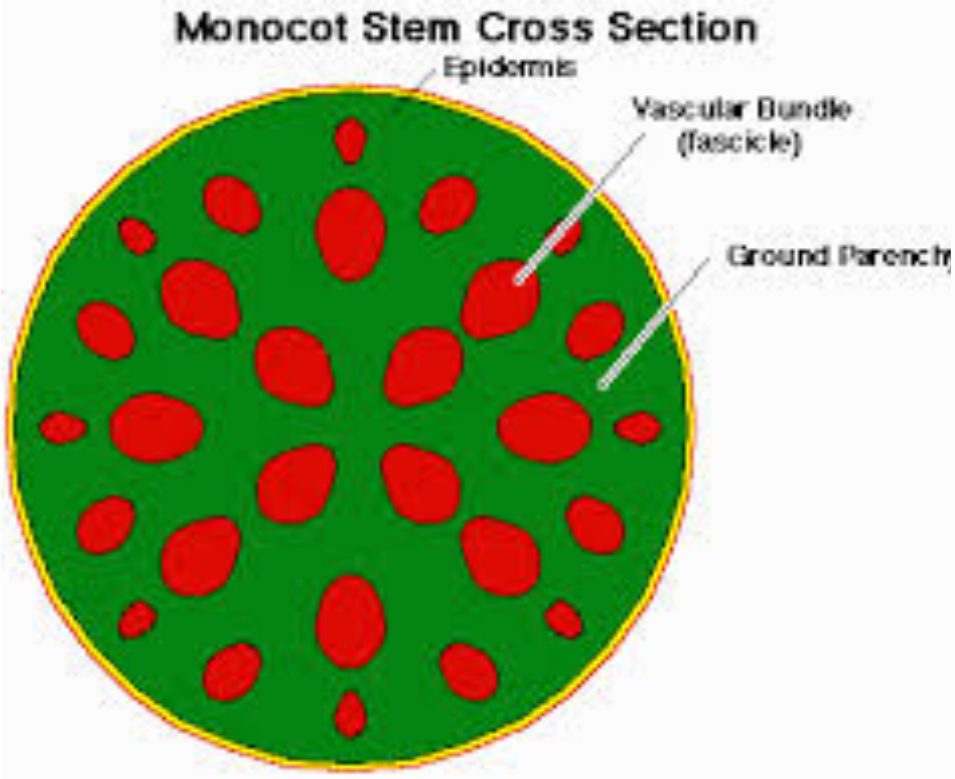
Stems

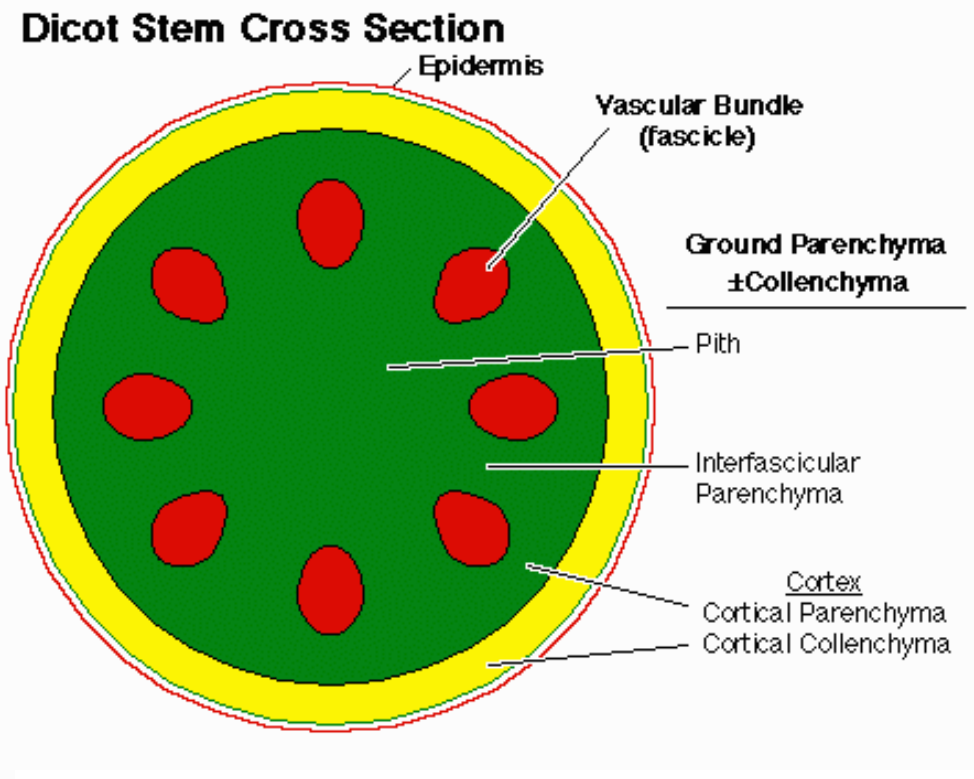
Monocot

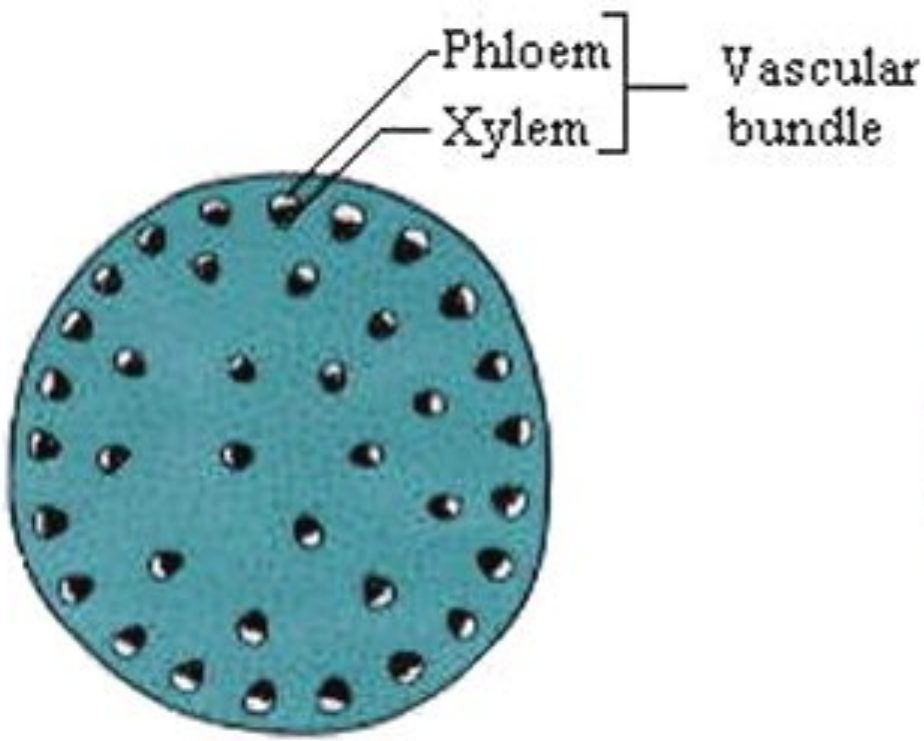
- Vascular bundles usually arranged in a complex manner.

Dicot

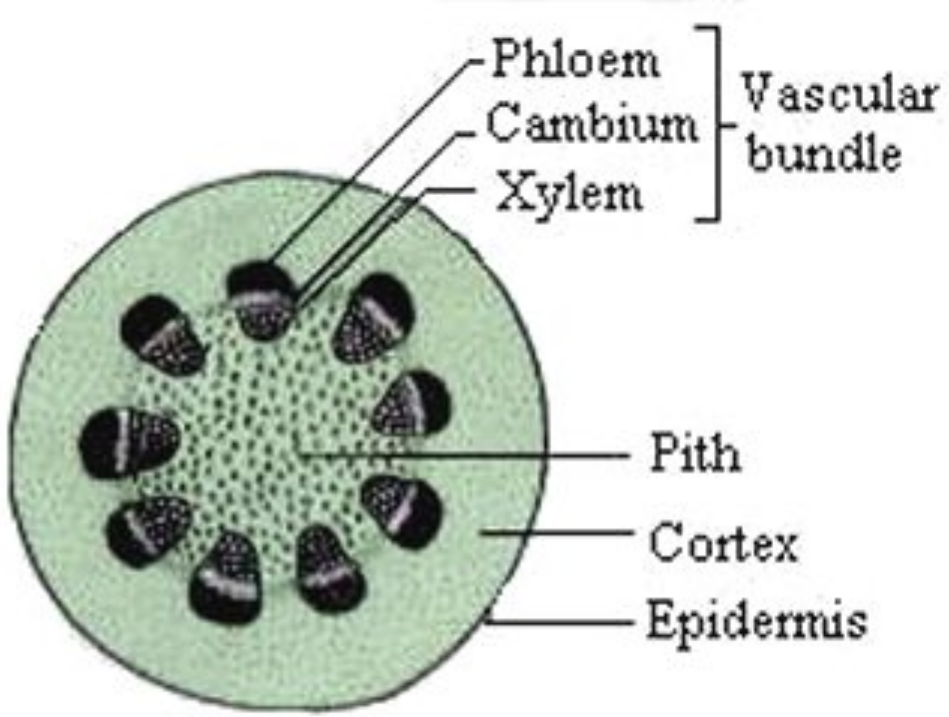
- Vascular bundles are arranged in rings







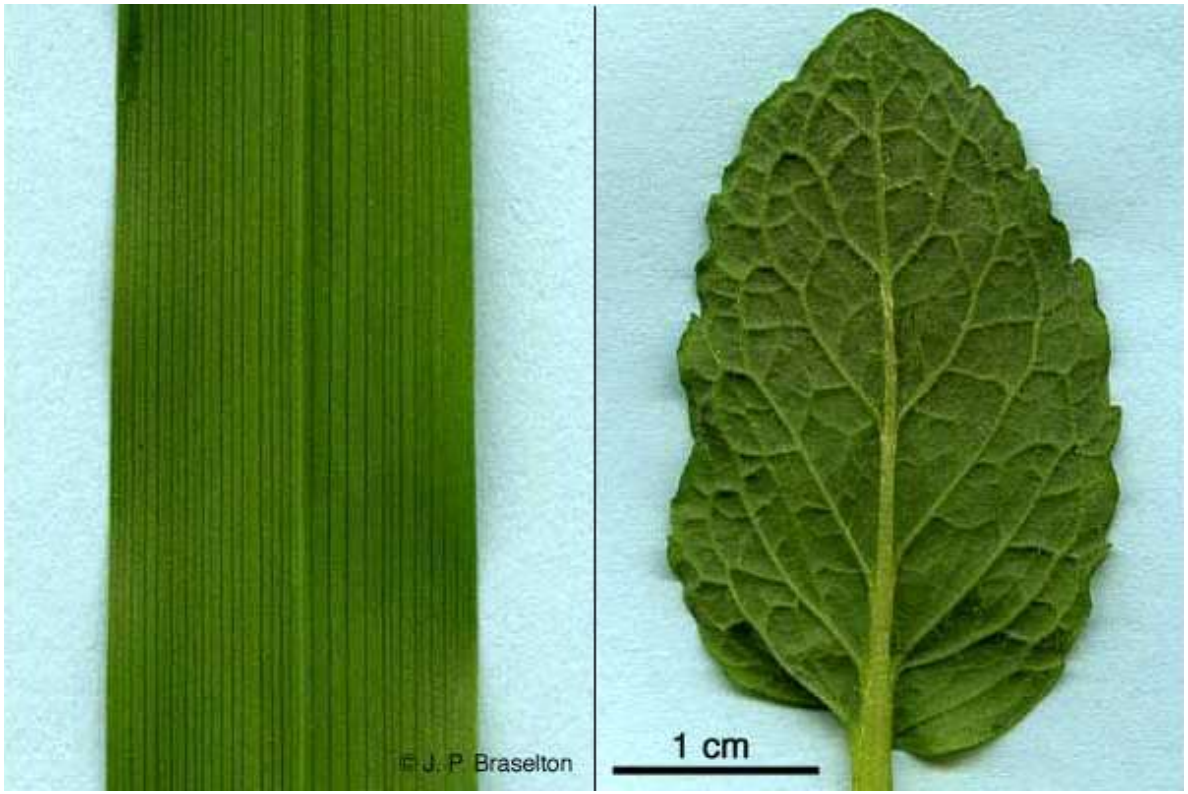
Monocot stem

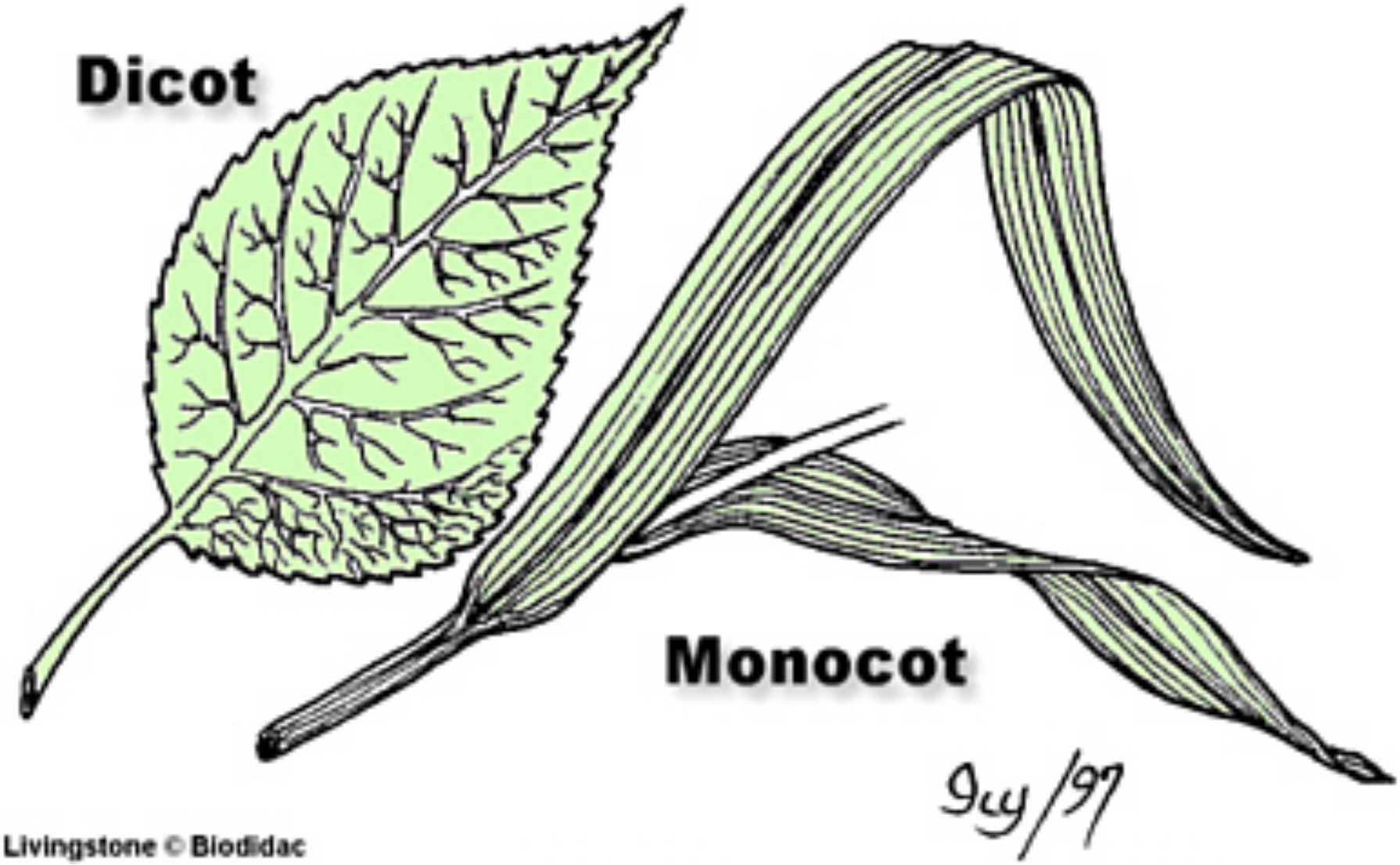


Dicot stem

Leaves

- Monocot
  - Veins are parallel to each other.
- Dicot
  - Veins are in a web like pattern.





Flowers

- Monocot
  - Multiples of 3
- Dicot
  - Multiples of 4 or 5

Monocots
Parts in 3s

Dicots
Parts in 4s or 5s

Monocot or Dicot? Why?

1.

2.

3.

4.

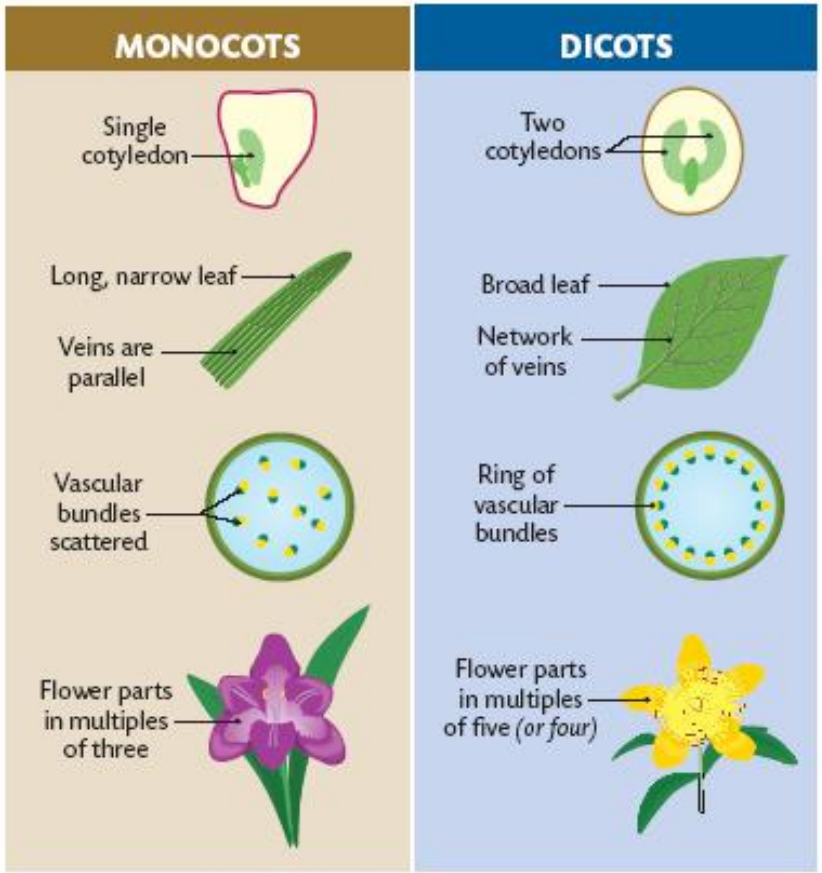
5.

	Embryos	Leaf venation	Stems	Roots	Flowers
Monocots	 One cotyledon	 Veins usually parallel	 Vascular bundles usually complexly arranged	 Fibrous root system	 Floral parts usually in multiples of three
Dicots	 Two cotyledons	 Veins usually netlike	 Vascular bundles usually arranged in ring	 Taproot usually present	 Floral parts usually in multiples of four or five

Put it all together

- Using your new knowledge you are going to create a monocot plant and a dicot plant, demonstrating your understanding of how each structure is different in the two types of plants.
- Do not section off the box and just draw each part individually. You need a complete plant.

Not like this



Like this, but with labels

Name:_____

Parts of a Plant: Monocot and Dicot

	Monocot	Dicot
Seed/Cotyledon		
Roots		
Stem		
Leaves		
Flowers		

Now put it all together and create a plant that demonstrates the different parts of a Monocot and a Dicot. Include details and labels.

Monocot	Dicot