

Exploring Types of Seeds Monocots & Dicots

Grade Level: 4-8

Lesson Overview

Students will identify the parts of a seed, learn about germination, and compare the growth of monocots and dicots.

Student Objectives

1. Identify the parts of a seed. (Activity 1)
2. Observe the action of water on soybean seeds. (Activity 2)
3. Compare the growth and development of two types of seeds - monocots & dicots. (Activity 3)
4. Identify the major parts of mature (full grown) corn and soybean plants. (Activity 4)

Materials

For each student you will need:

- ✓ paper towel
- ✓ soaked soybean seed (soak soybean seeds for about 24 hours before class)
- ✓ magnifying lens
- ✓ corn seed cut in half (a pill cutter works well)
- ✓ 2 clear 9 ounce plastic cups
- ✓ 5 tablespoons of Plaster of Paris
- ✓ plastic spoon or popsicle stick (for stirring)
- ✓ 5 corn seeds
- ✓ 8 soybean seeds
- ✓ clear 9 oz plastic cup
- ✓ coffee filter
- ✓ about a cup of vermiculite
- ✓ water (about a ½ cup)
- ✓ Monocots and Dicots - Main Parts of the Soybean Seed student worksheet
- ✓ Comparing the Seed Activity of a Monocot (Corn) and a Dicot (Soybean) Observation Journal

For the entire class you will need:

- ✓ forceps (optional to remove soaked soybeans)
- ✓ iodine solution (Caution: Iodine stains and is a poison.)
- ✓ medicine dropper or pipette
- ✓ Main Parts of a Soybean seed worksheet

During the second week:

- ✓ mature corn and soybean plants from the field if available

Vocabulary

- **cob** – the woody, central core on which kernels of corn are attached.
- **coleoptile** - the protective sheath that surrounds the young shoot tip of a grass during its passage through the soil to the surface.
- **cotyledon** - stores food for the developing embryo and is the first part of the plant that emerges from the soil.
- **dicot, dicotyledon** - has two cotyledons; has broad leaves with netted veins.
- **embryo** - the undeveloped plant.
- **endosperm** - source of energy (starch) and protein for the germinating corn seed.
- **epicotyl** - forms the stem of the plant; growing point of the plant.
- **epigeal emergence** - seed germination emergence where the cotyledons are pushed up above the ground surface.
- **hilum** - the point at which the seed is attached to the fruit.
- **husk** – the outer covering of certain fruits or seeds.
- **hypocotyl** - forms the stem below the cotyledon; connects the cotyledons and the radicle.
- **hypogeal emergence** - seed germination and emergence where cotyledons remain beneath the ground surface.
- **monocot, monocotyledon** - has one cotyledon; has long, narrow leaves with parallel veins.
- **pericarp** - outer covering of the corn kernel that protects it from deterioration.
- **pod** – a structure that holds seeds, especially in legumes.
- **radicle** - first observable sign of soybean growth that repairs and builds body tissue, the primary root.
- **seed coat** - the outer covering of the seed that protects the embryo from insects, disease, and damage.

Background Information

Monocots and dicots are two classifications of flowering plants. In this lesson, corn is the monocot used and soybeans are the dicot used. Monocot is short for monocotyledon which means one (mono) cotyledon. Monocots usually have parallel veins in the leaves and a fibrous root system. Other examples of monocots include wheat, oats, grass, sugarcane, pineapple, and chives. Dicot is short for dicotyledon which means two (di) cotyledons. Dicots usually have netlike veins and a tap root system. Other examples of dicots include peanuts, spinach, trees, lettuce, and sunflowers.

This lesson has several diagrams that help illustrate the parts of a seed, corn and soybean plant diagrams, and comparisons of monocots and dicots.

In this lesson vermiculite is used to hold the moisture for the seed to germinate. Sometimes students wonder what vermiculite is. Vermiculite is a mineral sometimes used as a part of soil mixes or soil-less media. This material is lightweight and can hold water. When water is added to vermiculite, the flakes expand in to a worm-like shape and act like an absorbing sponge. It is made from compressed dry flakes of a silicate material.

Procedure

Identify the parts of a seed – Activity 1

1. Pass out a paper towel, water-soaked soybeans, corn seed that has been cut in half, magnifying lens, and the Main Parts of a Soybean Seed Worksheet to each student.
2. Have students share some observations about the similarities and differences between the two seeds.
3. Introduce the words monocot and dicot.
 - Monocot is short for monocotyledon which means one (mono) cotyledon. One example is a corn seed.
 - Dicot is short for dicotyledon which means two (di) cotyledons. An example is a soybean seed.
4. Begin examining the parts of the corn seed. Ask students to locate the pericarp and the endosperm.
5. Begin examining the parts of the soybean seed. Ask students to locate the seed coat and hilum. Explain their purposes. Have students carefully remove the seed coat.
6. Then, ask students to gently split the soybean seed into two halves or cotyledons. Students should use their magnifying lens to locate the radicle, hypocotyl, and epicotyl. Explain their purposes. Explain the purposes of the pericarp and the endosperm.

7. Since the cotyledon stores the food for the embryo, we will test the seed for starch (carbohydrate source). Iodine solution will indicate the presence of starch with a dark stain. The darker the stain - the more starch the seed contains.

Caution: Iodine stains and is a poison.

8. Ask students to place their corn and soybean seed towards the center of the paper towel with the inside of the seed facing up. What do they think will happen?

Then, the teacher should apply a drop of iodine on the corn seed and soybean seed.

Remind students to only look and not touch the seeds to compare the results.

What did happen?

This will illustrate to the students how much starch is in each seed.

The corn seed is 75% starch and will turn a blue-black color with the iodine. The soybean contains only 25% starch and will not show much of a difference.

Extension Activity: Distribute the Monocots and Dicots – Main Parts of the Corn and Soybean Seed Student Worksheet.

Observe the action of water on soybean seeds – Activity 2

Note: This activity can be done individually or in groups.

1. Place 5 tablespoons of plaster of Paris in a clear plastic cup.
2. Add two tablespoons of water and mix with a plastic spoon. Continue adding drops of water until the mixture has the consistency of a very thick milkshake.
3. Push 3 soybean seeds into the plaster mixture until they are covered, and the surface is smooth.
4. Ask students to write down what they think will happen and why.
5. Make regular observations.
6. The next day, add a tablespoon of water to the cup and continue to observe.

What is happening?

Seeds need moisture and warmth to grow. In this activity, the seed absorbs moisture from the plaster mixture. As the seed absorbs water, it increases in size which applies pressure to the surrounding plaster. This force eventually causes the plaster to crack. The crack allows the soybean stem to grow up through the plaster. The strength and ability of the soybean to grow in adverse conditions allow the plants to survive in a variety of environments.

Another Activity Option or Extension:

Materials needed:

- soybeans
- fine textured sand
- water
- small glass jar or bottle (juice bottle, mayonnaise jar, or pickle jar)
- clear plastic 2-liter bottle with the top cut partially open

1. Fill a clean jar or bottle one half full of soybeans.
2. Add fine textured sand and shake the jar until the beans and sand are evenly distributed and the contents fills the jar to the top.
3. Fill the jar with warm water and screw the lid back on.
4. Place the jar inside the clear plastic 2-liter bottle at the front of the class.
5. At the start of class ask students to present hypotheses as to what will happen. Depending on how well the jar was filled, the glass will crack in roughly an hour due to the buildup of pressure caused by the seeds' absorption of water.

Compare the growth and development of two types of seeds – Activity 3.

1. Begin by reviewing what seeds need in order to grow. Answers may include light, air, soil (or something to grow in), space, water, proper temperature, fertilizer (sometimes), and length of growing time.
2. To compare the growth and development of monocots and dicots, students will plant some corn and soybean seeds. Each student should line the sides of the clear plastic cup with a damp coffee filter. Students should write their name or initials on their cups.
3. Fill the center of the coffee filter with vermiculite. Pack softly. The vermiculite will hold the moisture needed for the seeds.

[Note: Vermiculite is a mineral sometimes used as a part of soil mixes or soil-less media. This material is lightweight and can hold water. When water is added to vermiculite, the flakes expand into a worm-like shape and act like an absorbing sponge. It is made from compressed dry flakes of a silicate material.]



4. Between the coffee filter and the cup, carefully place 5 corn seeds and 5 soybean seeds about halfway down. The seeds do not go in the vermiculite. The cup serves as a window to the seeds allowing students to watch the seeds grow.
5. Add just enough water to dampen the vermiculite. Avoid standing water.
6. Place the cups in a warm place out of sunlight.
7. Distribute the Comparing the Seed Activity of a Monocot (Corn) and a Dicot (Soybean) Observation Journal.
8. Have students make their first entry with today's date and what they did today.
9. Students should make and record their observations daily on the worksheet. They should also make sure the coffee filter and vermiculite remain moist. Avoid standing water.



Identify the major parts of mature corn and soybean plants – Activity 4

1. Review what the students having been doing the past two weeks. First, they planted two types of seeds. Ask them to explain what the two types are and which seeds represent which type. A monocot, of which corn is an example, has only one cotyledon. A dicot, of which a soybean is an example, has two cotyledons.
2. As students look at their plants and observation worksheets, ask them to share some of their observations from the last two weeks. As they make their observations, guide them to compare the two types of seeds.

Observations may include the following:

- First, the seeds absorbed water and swelled, especially the soybean seeds.
- The seeds germinated. A root grew down and a sprout headed up. They may notice that the actual seed location has changed for the soybean but not the corn. Discuss the different emergence styles. Corn is an example of a hypogeal emergence in that the cotyledon stays below the soil. The seed stays below the ground as does the food reserves. The coleoptile rises to the surface from which the leaves will emerge. The soybean is an example of an epigeal emergence in that the cotyledons are above the surface of the soil. They emerge and open up into the two halves. Then, the first true leaves appear.
- The leaves are beginning to grow. The corn leaves are long and narrow. They soybean leaves are smaller and broader.

- There may be a difference in height.
 - They may notice a difference in the roots.
 - Some seeds may not have grown. There may be some mold or discoloration.
3. To continue looking at how the plants grow, have the students look at the diagrams provided with this lesson. If available, bring in a mature corn and soybean plant. Ask them to compare their similarities and differences.

Observations may include:

- Depending on the stage the plants are in, there may be a difference in color.
 - They are different heights. Corn plants can grow to be 6'-10' tall while soybeans average 3'-5' tall.
 - The root systems are different. The corn plant has a fibrous root system, which is made up of many small roots that spread out. The corn plant also has crown roots that show above the soil to help support the tall stalk. The soybean plant has a taproot system, which is made up of one primary root with a number of small secondary roots.
 - The leaves are different. The corn leaves are long, narrow and have parallel veins. Soybeans have broad leaves with netted veins.
 - Depending on the stage of the plants, there may be a noticeable difference in the flowers. The flowers may no longer be evident on the soybean plant. The corn plant has two different flower parts - the tassel and the ear of corn with silks. This could be a good time to discuss pollination. Explain that the tassel contained the pollen that must fall upon the silks.
 - The silk is a thread that runs from the kernel up the row and sticks out of the end of the ear. When pollination occurs, the kernel will begin to develop. Soybeans on the other hand self-pollinate.
 - On both plants the seeds are protected by some type of covering (husk on corn plant and pod on soybean plant). However, the seeds are stored in different ways. The corn has an ear with all the seeds attached while the soybean has lots of pods with a few seeds in each. Open the husk and pass around the ear of corn. Pass around some open soybean pods.
4. Students may ask what to do with their plants in their cups now. They'll want to know if they will continue to grow. You may want to explain that these seeds need more space in order to grow to maturity. The plants in their cup will reach a point when they will no longer grow due to the lack of space. They could take them home to try and transplant them into a garden depending on the time of year.

Extension Activities

1. Learn about how corn and soybeans are processed and products that are made through the Corn & Soybean Processing and Products lesson in the Illinois mAGic lessons.

Additional Resources

- <http://www.agintheclassroom.org/TeacherResources/TeacherResources.shtml>
Illinois Agriculture in the Classroom interactive Corn & Soybean Ag Mags & Readers
- <http://www.agintheclassroom.org/TeacherResources/InterestApproaches/Bean%20Book.pdf> Bean book activity

Standards

Illinois Science Standard

MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth conditions affect on the growth of the adult plant.

Illinois English Language Arts Standard

RST 1: Cite specific textual evidence to support analysis of science and technical texts.

The **M**ultidisciplinary **A**gricultural Integrated Curriculum (mAGic) was created in 2004 under the leadership of the Illinois State Board of Education (ISBE) and the Facilitating Coordination in Agricultural Education Project (FCAE). Funding was made available through the FCAE grant budget from the agricultural education line item of the ISBE budget. This revision, as printed, was developed in April 2021.



These mAGic lessons are designed to bring agriculture to life in your classroom. They address the Illinois Learning Standards in math, science, English language arts and social studies.

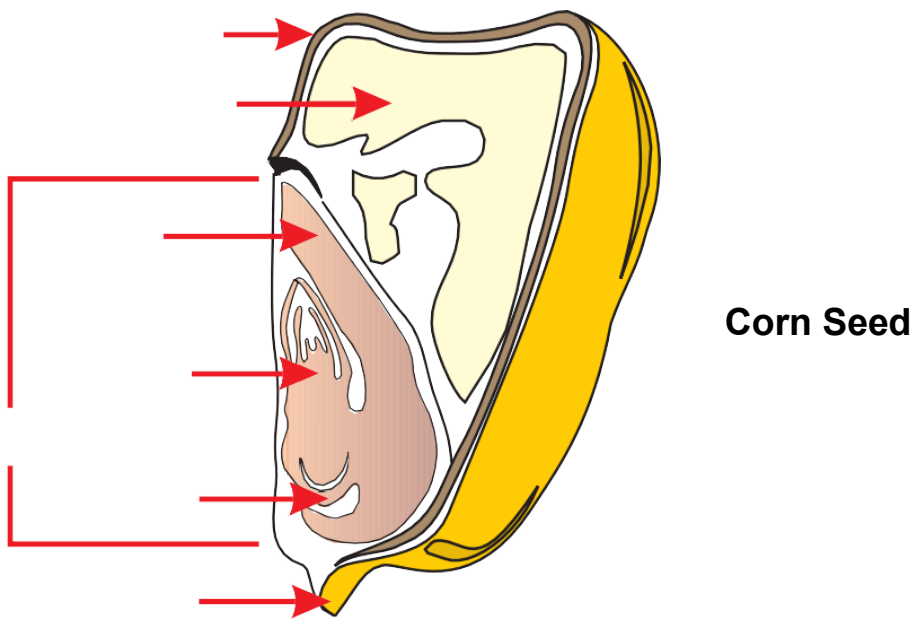
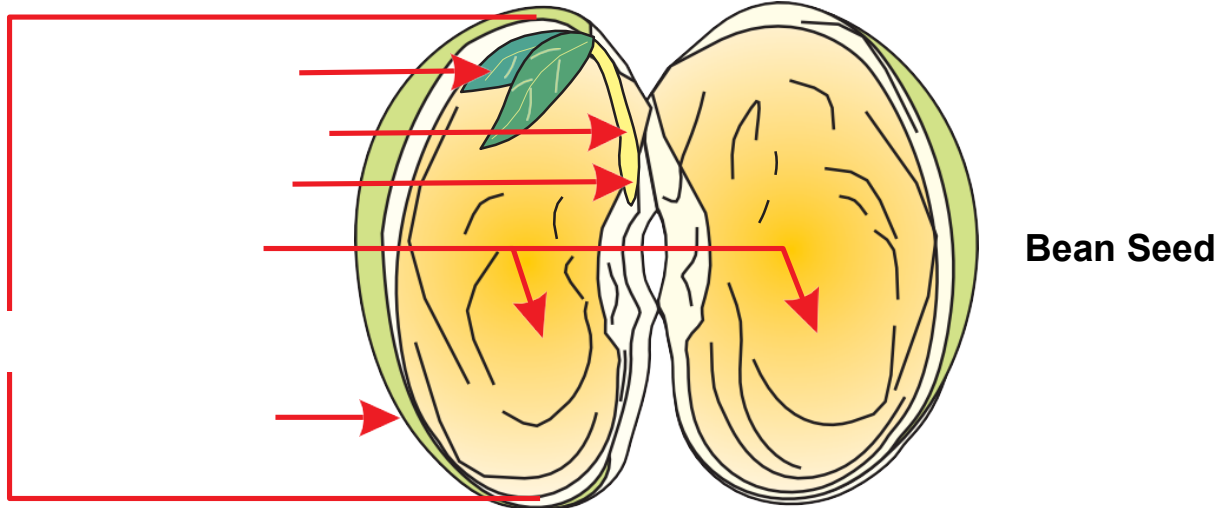
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Name _____

Monocots and Dicots – Main Part of the Corn and Soybean Seed

Using the following terms, label the parts of the seed.

- cotyledon
- epicotyl
- hilum
- hypocotyl
- radicle
- seed coat

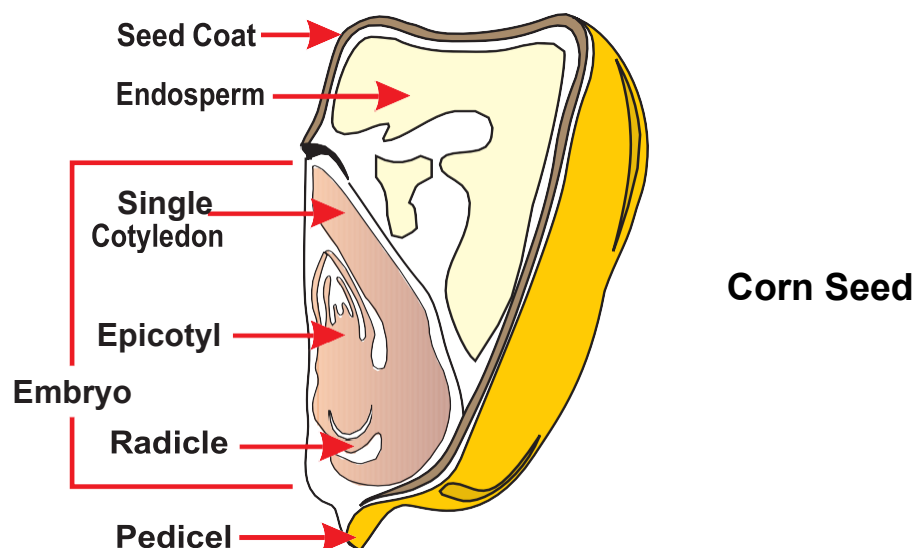
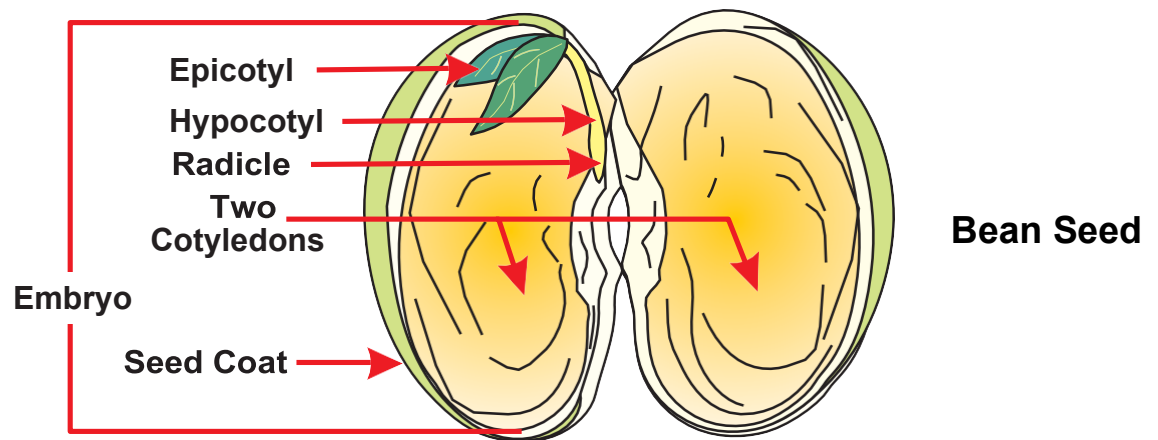


Monocots and Dicots – Main Part of the Corn and Soybean Seed

ANSWER KEY

Using the following terms, label the parts of the seed.

- **cotyledon** - stores food for the developing embryo and is the first part of the plant that emerges from the soil.
- **endosperm** - source of energy and protein (starch) for the germinating corn seed.
- **epicotyl** - forms the stem of the plant; growing point of the plant.
- **hypocotyl** - forms the stem below the cotyledon; connects the cotyledons and the radicle.
- **radicle** - first observable sign of soybean growth that repairs and builds body tissue, the primary root.
- **seed coat** - the outer covering of the seed that protects the embryo from insects, disease, and damage.



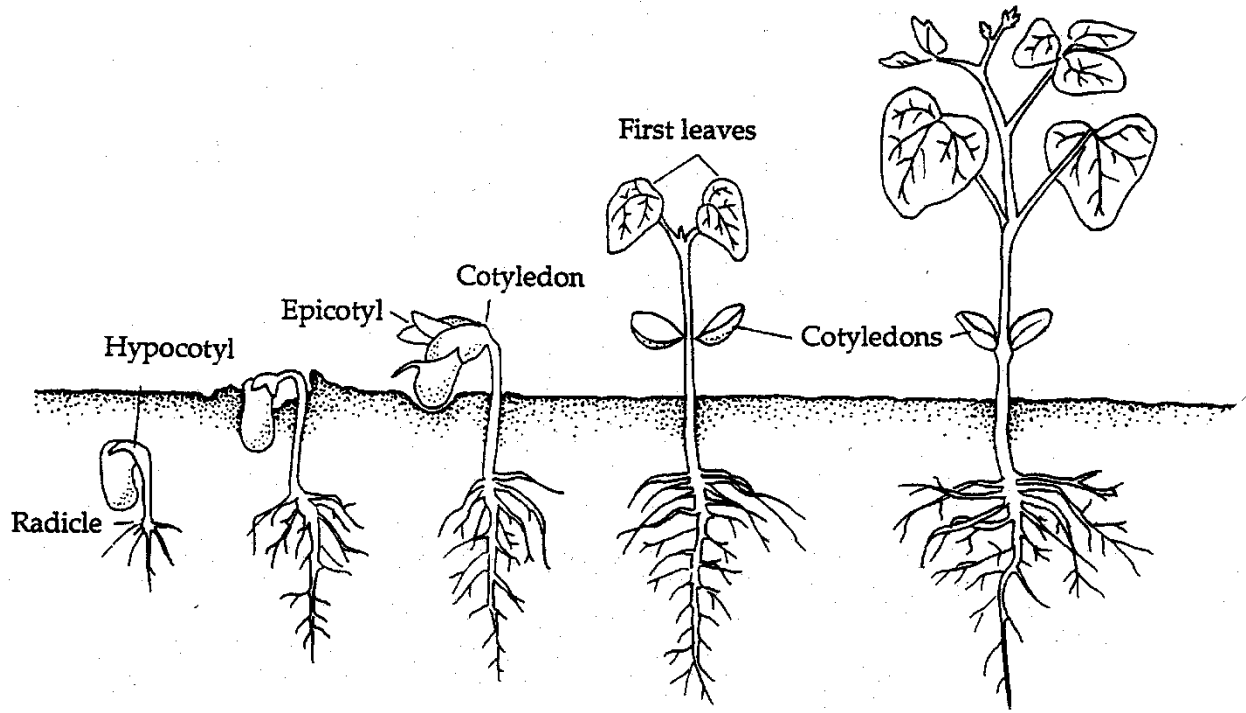
Comparing the Seed Activity of a Monocot (Corn) and a Dicot (Soybean) Observation Journal

Look at your experiment each day. Observe and write down what you see. Compare the monocots (corn) to the dicots (soybeans). Make a note of similarities and differences. As the seeds grow, measure and record their sizes. Please feel free to use descriptive words, draw pictures or diagrams, etc.

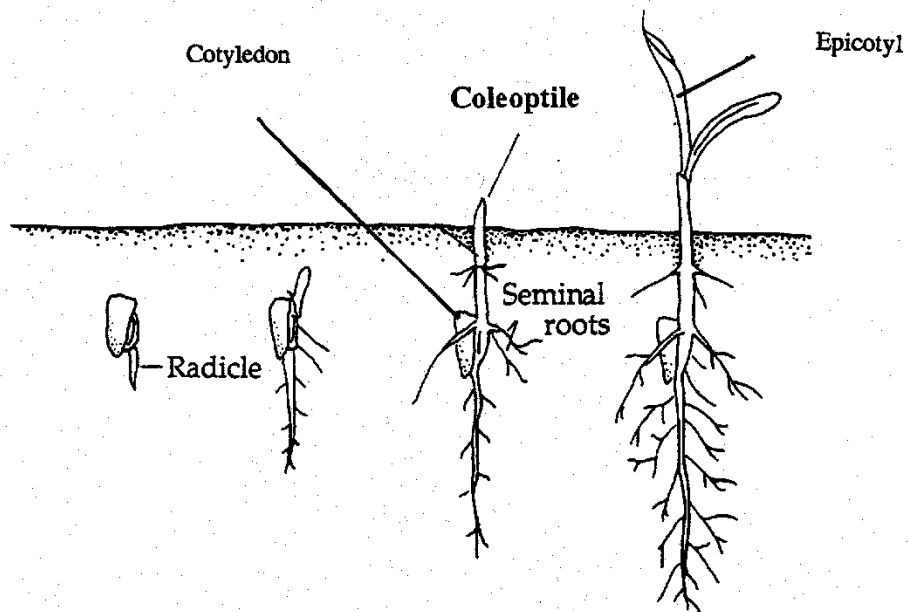
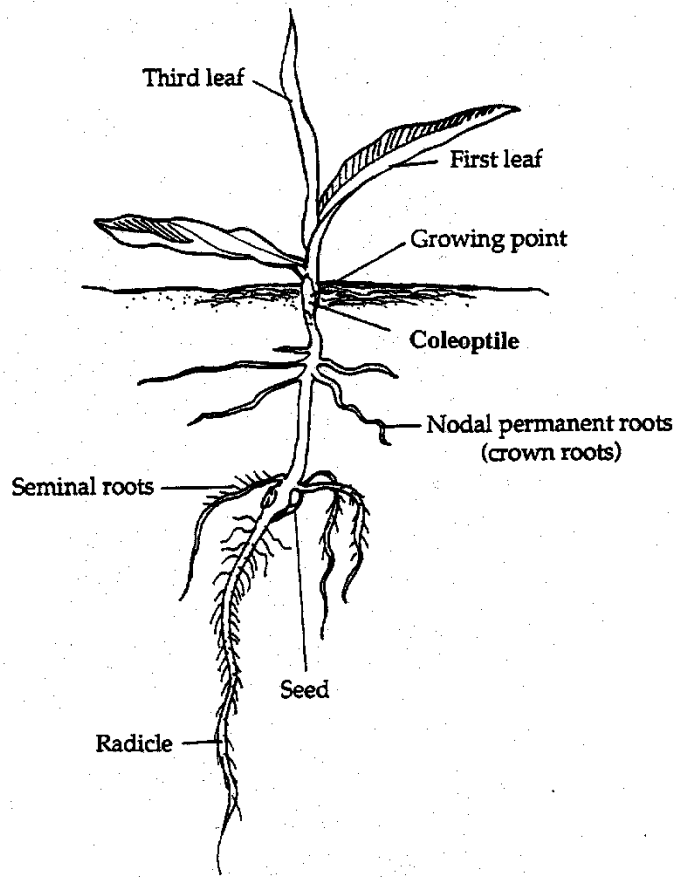
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Observation

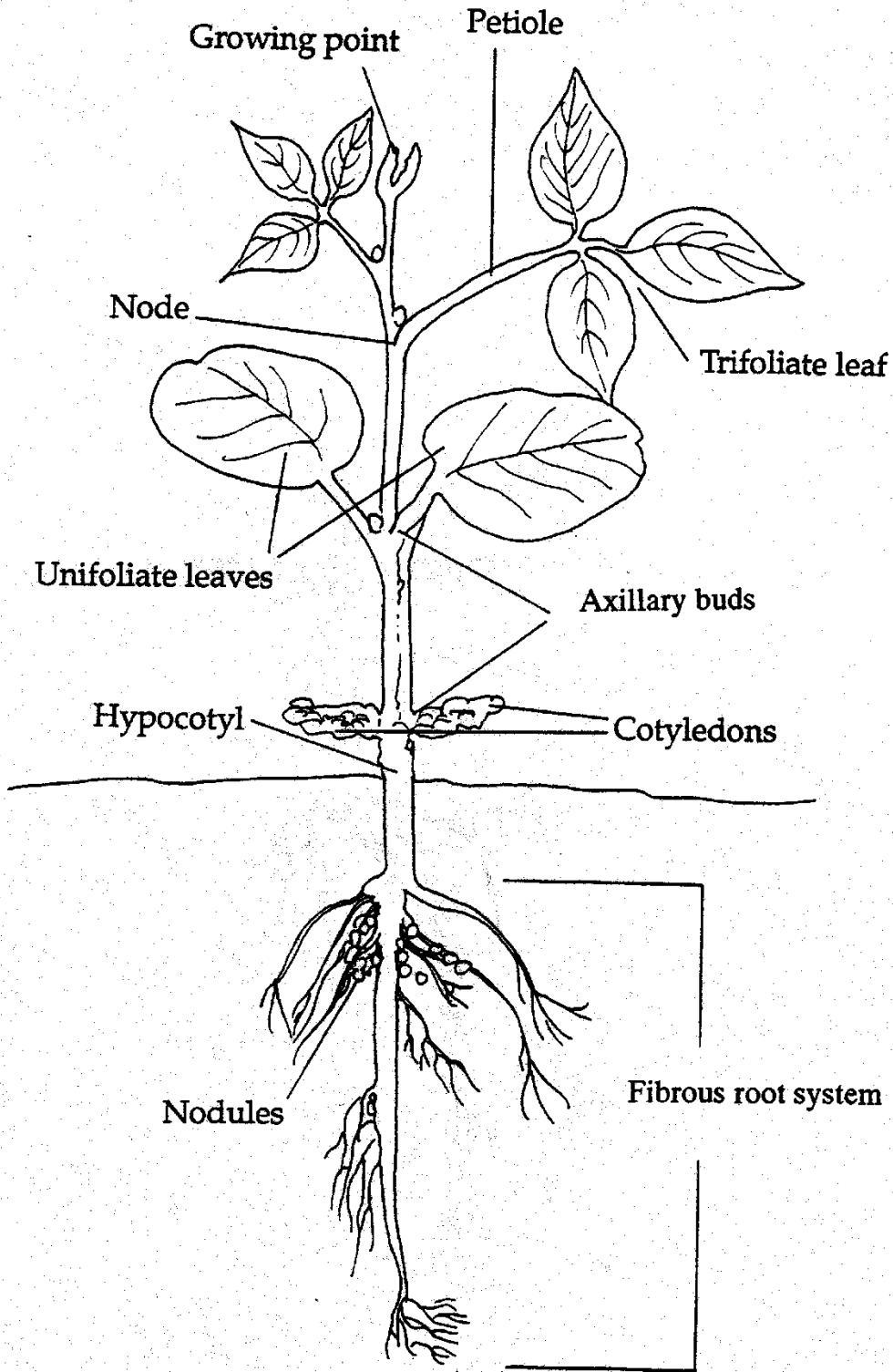
Development of the Soybean Plant



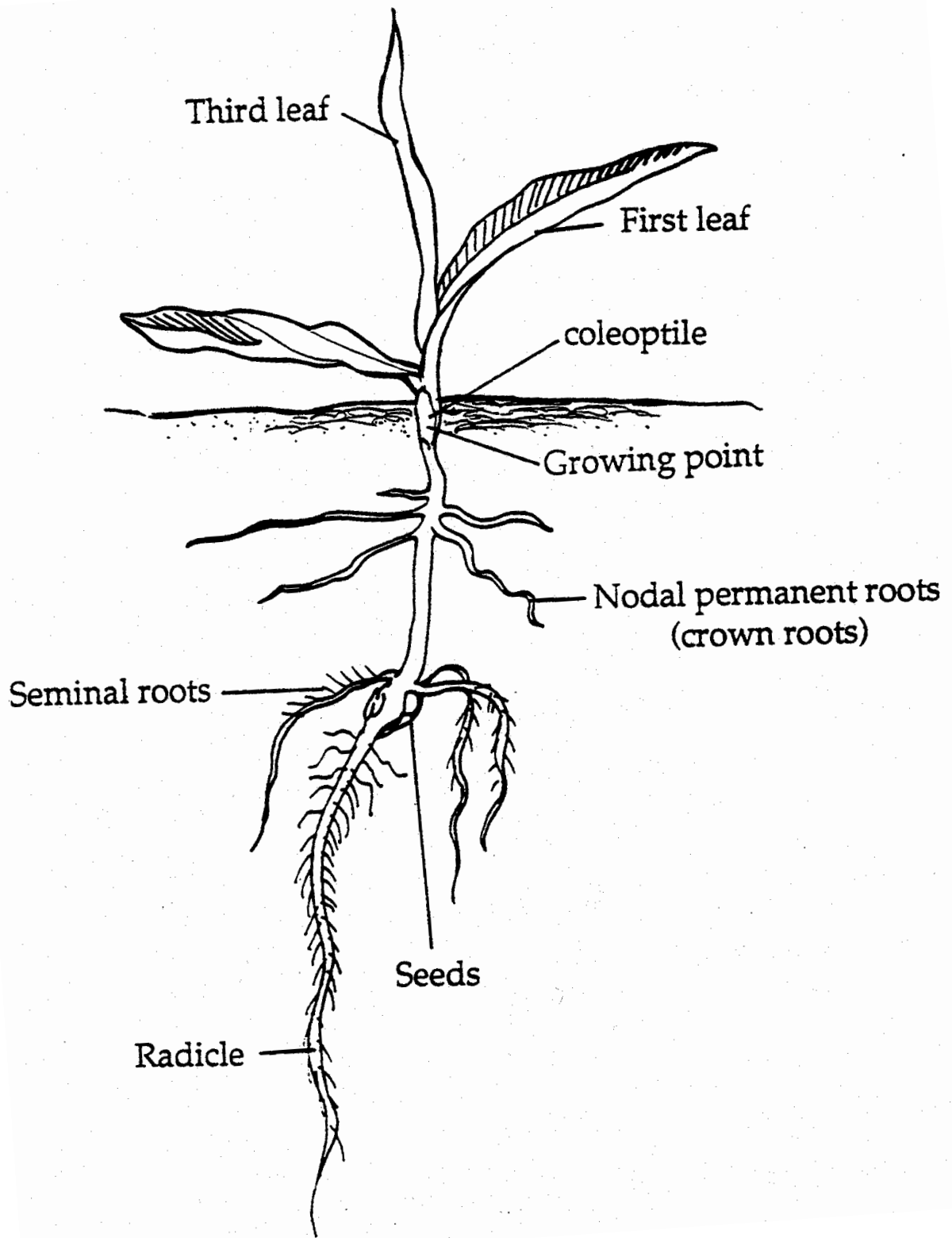
Development of the Corn Plant



Main Parts of the Soybean Seedling



Main Parts of the Corn Seedling



Mature Corn Plant

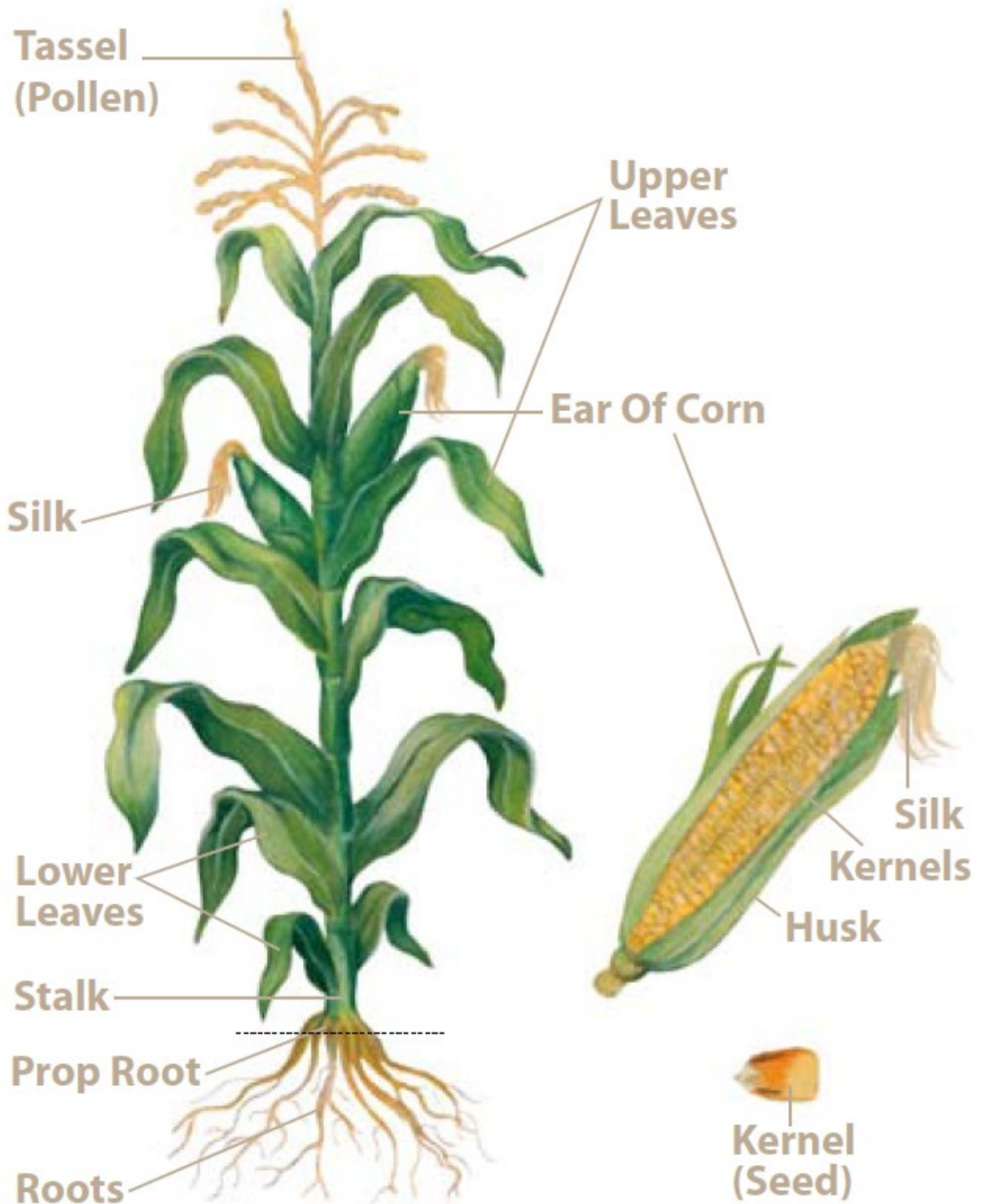


Image from cards developed by the Nebraska Foundation for Agricultural Awareness.

Mature Soybean Plant

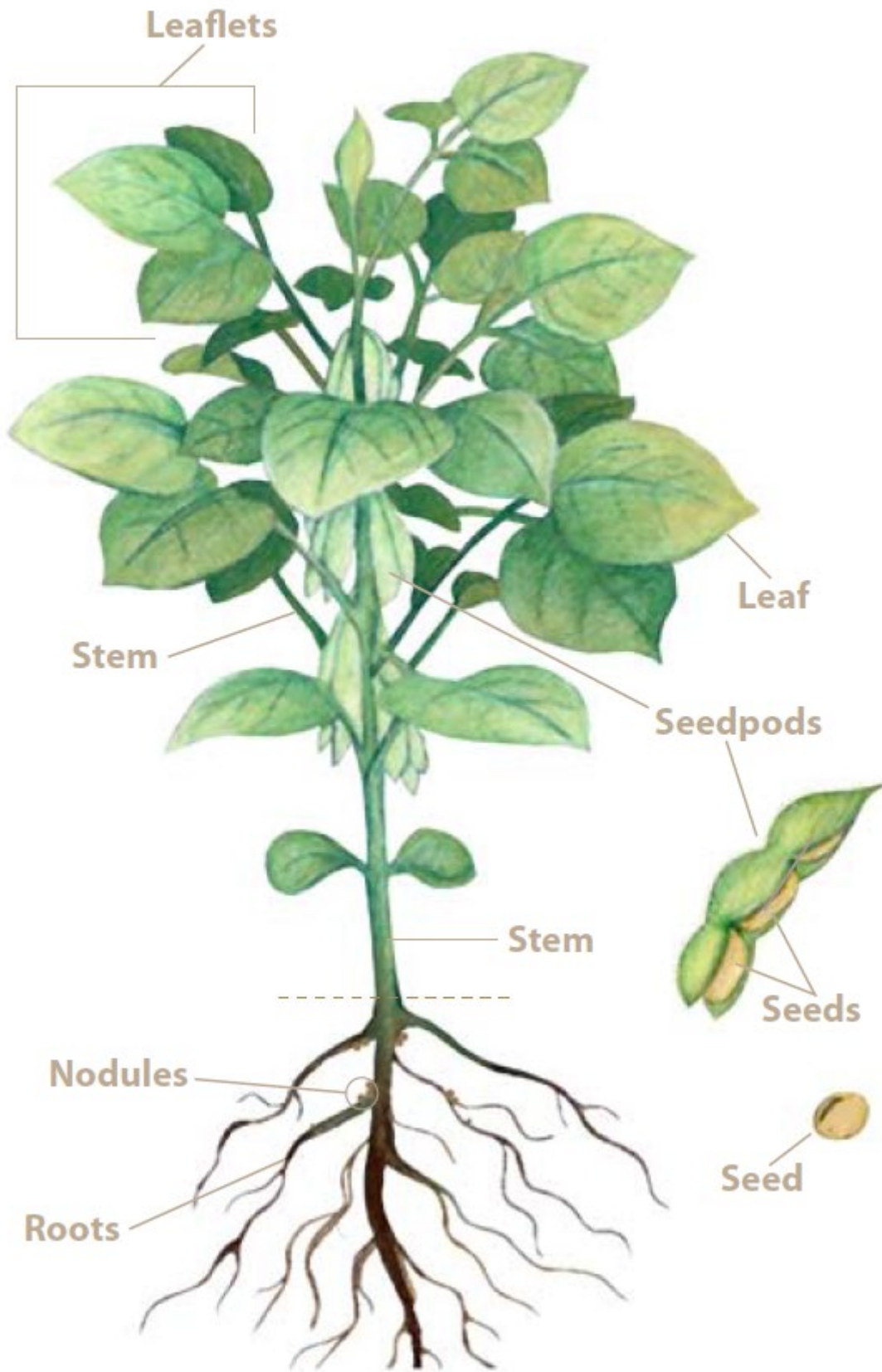



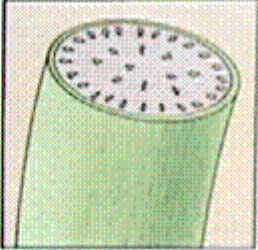
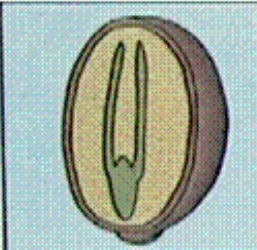
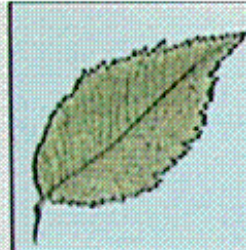
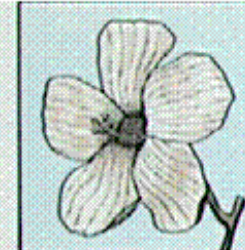
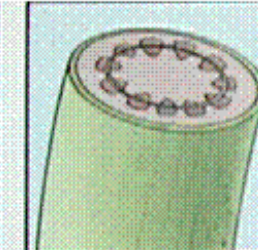


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Monocot and Dicot Comparison

MONOCOTS			
Cotyledons	Veins in leaves	Flower parts	Arrangement of primary vascular bundles in stem
			
One cotyledon	Usually Parallel	Usually in multiples of three	Scattered

Examples of Monocots: corn, wheat, oats, grass, sugarcane, pineapple, chives

DICOTS			
Two cotyledons	Usually netlike	Usually in fours or fives	In a ring
			

Examples of Dicots: soybeans, peanuts, spinach, trees, lettuce, sunflowers

