KANSAS CORN STEM

Kansas Corn:
Structurally Speaking

This lab is made possible with the support and content contributions of the Kansas Corn Commission.

KANSAS CORN COMMISSION

Kansas Corn: Structurally Speaking

Grade Level: 4th

Lesson 1: Planting (30 minutes)

To be done 3 weeks prior to the rest of the unit; then ongoing observations for the next 3 weeks to document plant growth

Key Question

- How does a plant grow?

Learning Objectives

- The children will propose ideas about how a seed sprouts and a plant grows.
- The children will plant seeds and water them over the course of three weeks.
- The children will observe the plants and record their findings by drawing and writing over the course of three weeks.

Materials

- Pretest (page S1)
- Science journal (page S5-7)
- Corn seeds (1-3 for each child)
- Soil
- Planting containers
- Water and spray bottle

**Note: Science notebook materials and pretest can be shown to the children and they can write their answers on a separate piece of paper should you choose not to make copies.

Guided Teaching

Procedures for Instruction

1. Pre-lesson preparation: Using the science journal have children record the investigation using sample format found on pages S5-6.
2. Assess the children for prior understanding: Have the children fill out the pretest to assess their understanding of the parts that help the plant grow. Collect the pretests and then on their first journal page, give them 5 minutes to draw and/or write in their science journal about how they think a plant grows.
3. Introduce project and engage the children:
   - "We recorded our thoughts on how seeds grow. How many of you have grown seeds before?"
   - Pass out corn seeds and ask, "What are these?" "Where do you think they came from?"
   - Guide them to recognize corn seeds come from a corn cob and we eat corn seeds when we eat corn.
   - "Today we are going to plant these corn seeds to grow our own plants!"

4. Plant seeds:
    - Provide materials to the children.
    - Have the children label the containers with their name.
    - Fill the container ¾ full with potting soil. Place the seed 1 inch down from the soil's surface. Water seed until soil is damp, approximately 2 Tablespoons. Monitor dampness daily; water as needed.
5. Document the children's thinking:
    - In their science journal, have children draw a picture of what their container looks like now and what they imagine it will look like in 3 weeks.
6. Observe and record results over 3 weeks.
    - Have children water the soil as needed with spray bottles over the next 3 weeks to keep soil damp.
    - Provide brief (3-5 minutes) observation times every few days for children to observe (draw) and record (describe) in their science journals the progress (or lack thereof) of their plants.

Early Elementary Activity

This first lesson is to grow the corn plant in three weeks, so children can learn about the structure of the corn plant. The following activities talk about architecture and the structures of buildings. By learning about the structure of a building and the careers that go along with it, this will carry over to learning about the structure of a plant.

Reading

- Read the story, Iggy Peck Architect by Andrea Beaty. You can get this from your local library, or you can listen to this read aloud on YouTube.
- What is an architect? An architect is a person who plans, designs and oversees the construction and structure of buildings.

Writing/Art

- Pretend you are an architect! Design your own greenhouse for growing corn. Do some research online to see the different types of greenhouses. Design this greenhouse on paper with crayons and markers.
- If you are up for it, then construct the greenhouse from recycled materials found around your home.

Upper Elementary Activity

Science

- What is an agronomist? Read about what an agronomist is at https://agexplorer.ffa.org/career/agronomist.
- What is a horticulturist? Read about what a horticulturist is at https://agexplorer.ffa.org/career/horticulturist

Kansas Corn: Structurally Speaking
Grade Level: 4th

Writing/Art

- Write about the difference between an agronomist and a horticulturist. Next, draw a plant that one of these types of professionals would study. Pretend like you are working to improve that plant. Draw and write about the improvements you would make to the plant and indicate the benefits that would be provided with the improvements. Would there be any negative impacts that may come from those changes?

Kansas Corn: Structurally Speaking
Grade Level: 4th

Lesson 2: Seed Germination (45 minutes)

This should take place 1-2 weeks after Lesson 1.

With follow-up observations for 3-5 days and 45 minutes on the final day.

*This lesson will just focus on the seed going through the germination process

Key Question

- How does a seed germinate?

Learning Objectives

- The children will plan and conduct an investigation to determine the best germination conditions for corn seeds.
- The children will observe and record data (drawings and descriptions) while seeds are germinating.
- The children will analyze their recorded data, labeling structures they observe and indicating the functions for them.

Materials

- Corn seeds in 2 plastic bags *prepare before the lessons.... See day 1 step 1
- Additional dry seeds
- Bags
- Water and a variety of other liquids such as orange juice, soda, energy drink, vinegar, oil, milk, baking soda water mixture
- Science notebook with seed growth journals (page S5-7)
- Colored pencils
- Magnifying glass
- Corn seed germination diagram with labeled structures (page S2-4)

Before the Lesson

- Set up two bags 3 days prior to the lesson.
  - Bag 1: just a corn kernel
  - Bag 2: corn kernel with some water in it
- By day 3 the kernel with water should be germinating

Kansas Corn: Structurally Speaking
Grade Level: 4th

Guided Teaching

Procedures for Instruction

DAY 1: (45 minutes)

1. Introduce the topic and assess prior understanding:
    - Present the 2 bags of seeds to the children, one that had a little water and a seed in it and one that just had a seed in it.
    - Tell the children you aren't sure what happened to the seeds: "Look what I found! Here are 2 bags of seeds."
    - Don't tell the children that one has water in it- let them discover this on their own. Pass the bags around.
        - "What do you see?"
        - "What do you think happened?"
        - "They look different- I wonder why?"
2. Record the children's thinking in their science journals and discuss their thinking. Do not signal right or wrong answers. Just let them discuss their ideas and guide the flow with such prompts as:
    - "Can you say more about that?"
    - "Why do you think that?"
    - "Who agrees/disagrees with this idea and why?"
    - "Does anyone have a different idea?"
    - "Would this be true all the time?"
3. Develop an investigation based on the questions, "How does a seed germinate?" Hand out corn seeds and bags, letting children figure out that they will be placing a few seeds in each bag and seeing if they will germinate in different conditions. Have a variety of liquids setting out. Guide the development of the investigation with such questions as:
    - "What does a seed need to germinate?" (Based on the introductory activity, they should realize it needs water. If not, guide them to reflect on the introductory activity to understand this.)
    - "Does it have to be water or can it be any liquid? Does it have to be a liquid?"
    - "Which liquid will work best? Why?"
    - "Should the bag be opened or closed? Why?"
4. Focus the elements of their investigations:
    - "What are our research question(s)?" Have the children generate their own questions about the seeds.
    - "What kind of data do we need to collect to show what we know?" (Introduce seed germination journal pages and how they will observe, draw and write in their science journals.)
    - "What are the different conditions (variables) you want to test?" Let the children pick the different kinds of liquids they would like to test.
    - "Should we have something to compare to? Would the seeds just have germinated anyway? Should we set up comparisons of bags (control group) using no water and just water?"
    - "What do you think will happen and why in each condition?" Have them record this as a prediction or hypothesis.

Kansas Corn: Structurally Speaking
Grade Level: 4th

DAYS 2-5:

1. Record the children's observations in their journals by drawing and writing. Use colored pencils and magnifying glasses.
    - Each day for 3-5 days, have children observe the progress of the germinating seeds and record their data. Be sure the children draw and write in their journals what they see happening with the corn seeds in their bags.

FINAL DAY (45 Minutes)

1. Discuss the children's findings by sharing results. Lead the discussion with such questions as:
    - "The corn seeds germinated best in which conditions?"
    - "How did the various liquids compare to the control conditions (water and dry)?"
    - "Why do you think you got the results you did?"
    - "Were there any contradictory results?"
    - "What new questions do you have based on your findings?"
    - "Based on your evidence, how do you think a corn seed germinates?"
    - "Do you think this is true of all seeds? How could we find out?"
2. Explore seed and sprouting seed structures by asking children to examine their drawings from the different days.
    - Have them label the different structures they drew or wrote about. Do not give them the "proper" terms for the structures. Let them use their own descriptive words.
    - Have them suggest functions for each structure. Again, do not signal if they are correct or not, but have them justify why they think that. Encourage their thinking.
    - Discuss these structures and have the children share their labeled structures and proposed functions.
3. Explain how their discoveries are very much like those of scientists' discoveries.
    - "You planned and conducted an investigation to determine how corn seeds germinate and you formed conclusions based on very convincing evidence! You are a budding scientist!"
    - "You observed carefully and identified parts of the seeds and proposed functions for them. You are certainly a budding scientist, because that's what many plant scientists do, they observe carefully and identify structures on plants that many people never even knew were there! If those structures have no names, they have to name them. They also observe very carefully over time to see what functions those structures have."
    - "Let's look at what scientists have named the structures you identified and what they have found are their functions."
4. Show a diagram (model) of corn seed germination, with major structures labeled.
    - Distribute copies of diagrams to the children and have them label the structures as you guide them.
    - Have them compare their terms for each structure to the term scientists use.

- If they have room, they can label their own drawings with scientific terms.
    - Discuss the function of each structure.

5. Conclude:
    - "Were you surprised to discover so much going on in the seed as you observed them germinating?"
    - "What do you wonder about now?"
    - Show the time lapse videos of corn growth
        - https://www.youtube.com/watch?v=aJM3gb4QoJA
        - https://www.youtube.com/watch?v=YBTvgILU56o

Early Elementary Activity

Science

- The outside layer of the corn seed is called the seed coat. What is the job of the seed coat? Do other seeds have seed coats? Think about sunflower seeds, apple seeds, watermelon seeds, etc. Do some research to find out more about the job of a seed coat.

Art/English Language Arts

- An idiom is a phrase that has a figurative meaning that is different from the literal meaning.
    - Example: "it is raining cats and dogs" has the figurative meaning of raining very hard - the literal meaning would be cats and dogs falling from the sky! If you were to draw a picture of the literal meaning, it would be a picture of cats and dogs falling from the sky.
- Think about the seed coat you just learned more about. Draw a picture to show the literal meaning of seed coat. So draw your corn seed in a coat. Be creative! Is it in a winter coat, a raincoat, or maybe a coat that makes it look like a dinosaur!

Upper Elementary Activity

Science

- Dig deeper. Below is more information about the corn seed. Use the diagram on page S3 as you go through this extra information. Encourage further research about seed germination by looking online. Either watching videos or comparing the corn seed to a sunflower seed. Do all seeds have coleoptile, radicle and hypocotyl?

Kansas Corn: Structurally Speaking
Grade Level: 4th

Extra Information for the Educator

A seed is the house for a future plant, outfitted to furnish what a baby plant needs to start to grow and succeed in life. A seed is wrapped in a tough outer coating (seed coat) that prevents the future plant from damage. Inside, there is a food supply and the beginnings of a new plant. In the world of flowering plants, there are monocots and dicots. A monocot seed has an embryo that contains one cotyledon, the part of the plant that becomes its first leaf-like structures. A dicot seed has an embryo with two cotyledons. The cotyledons help provide and absorb nutrients from the plant until the plant is ready to make its own food through photosynthesis. Corn kernels are monocots and beans are dicots.

Inside a corn kernel (seed) there is a cotyledon near the bottom, pointy part of the kernel, where the new plant begins to grow. It is surrounded by the endosperm, which is starchy food for the baby plant. When the seed begins to grow, its protective covering breaks open in two places. The top breaks open to reveal the coleoptile and eventually the plumule, the future shoot of the plant. The bottom breaks open to reveal the coleorhiza and eventually the radicle, the future root of the plant.

Like the corn seed, the bean seed has places where the root and the leaves emerge. However, since bean seeds are dicots, when you open one up, you'll see it has two cotyledons that look like reverse copies of each other. Instead of having a separate baby plant and food supply, inside the bean plant the cotyledons contain the endosperm (the food supply).

As the root grows, tiny little root hairs extend out to form a net-like mass to absorb water at a microscopic level. Guide the children to look for these and all the structures using magnifying lenses.

Kansas Corn: Structurally Speaking
Grade Level: 4th

Lesson 3: Corn Plant Observations (45 minutes)

This lesson should take place 3 weeks after Lesson 1

*This lesson will focus on the structure of the corn plant that has been growing for 3 weeks

Key Questions

- What structures does a corn plant have?
- What functions do the plant structures serve?

Learning Objectives

- The children will observe carefully and record their observations of a corn plant by drawing and labeling what they observe.
- Children will construct an explanation based on evidence that plants have structures that function to support survival, growth, behavior and reproduction.

Materials

- 3-week old corn plants
- White paper
- Colored pencils
- Magnifying glass
- Flash cards of plant structure names (printable version online and 4x6 index cards included in the kit)
- Diagram of corn plant with structures labeled (pages S8-10)
- Content video on structures and functions
- Post-test (pages S12-15)

Guided Teaching

Procedures for Instruction

1. Introduce the topic and engage children:
    - Give the children their corn plant and distribute paper, colored pencils and magnifying glasses.
    - Instruct children to observe carefully and draw what they see.
    - Instruct them to label the parts (structures) -they can make up words for any structures they don't know.
        - The technical terms does not matter now, but rather the goal is for them to observe and draw the important structures of the plant.
    - Instruct the children to write what they propose the function is for each structure.
    - Give 20 minutes for the children to explore, draw and label the parts of the plant. Be completely quiet during the drawing and labeling of the plant parts. Use the magnifying glass to help with the exploration.

2. Share out loud! What did the children notice and what did they predict the functions for each part is with questions such as:
    - "What did you notice?"
    - "Did you know its name, or did you give it your own name?"
    - "Why do you think that plant has that part? What do you think it's used for (function)?"
    - "Why do you think that? What is it about that shape or that structure that makes you think that?"
        - Do not indicate right or wrong- just collect their observations and thoughts.
3. Learn the science terms for structures and their functions.
    - Hand out the flash cards with the plant structure names.
    - Have the students place the flash card next to the structure they think corresponds with that name.
    - Hand out the plant diagram with the structure labeled.
    - Ask the children to revise any placement of their flashcards.
4. Show the content video about the functions of the different corn structures.
    - https://bit.ly/3gK3Cr3
5. Revise their drawings
    - Have the children go back to their drawings and revise their labels.
    - Add the terms that scientists use for the structures (don't encourage the children to cross out since their own terms were not "wrong", just add the scientific terms).
    - Add the functions of each part according to scientists.

6. Conclusion
    - Discuss that the children worked as scientist would because they:
        - Observed carefully
        - Recorded what they observed
        - Proposed names for structures and functions
        - Revised the names for structures and functions based on what other scientists have learned
        - Worked together and communicated with each other
7. Assess using post-test
    - Three different post-test options are available on pages S12-15 and online. Each ranges in degree of difficulty. They could be used as practice worksheets to help the children learn the corn plant structures and their functions.

Kansas Corn: Structurally Speaking
Grade Level: 4th

Early Elementary Activity

Writing

- Have the children write 2-4 sentences about the structure of their corn plant, using plant structure names. Encourage them to write about the jobs of the different parts of the plant.

Upper Elementary Activity

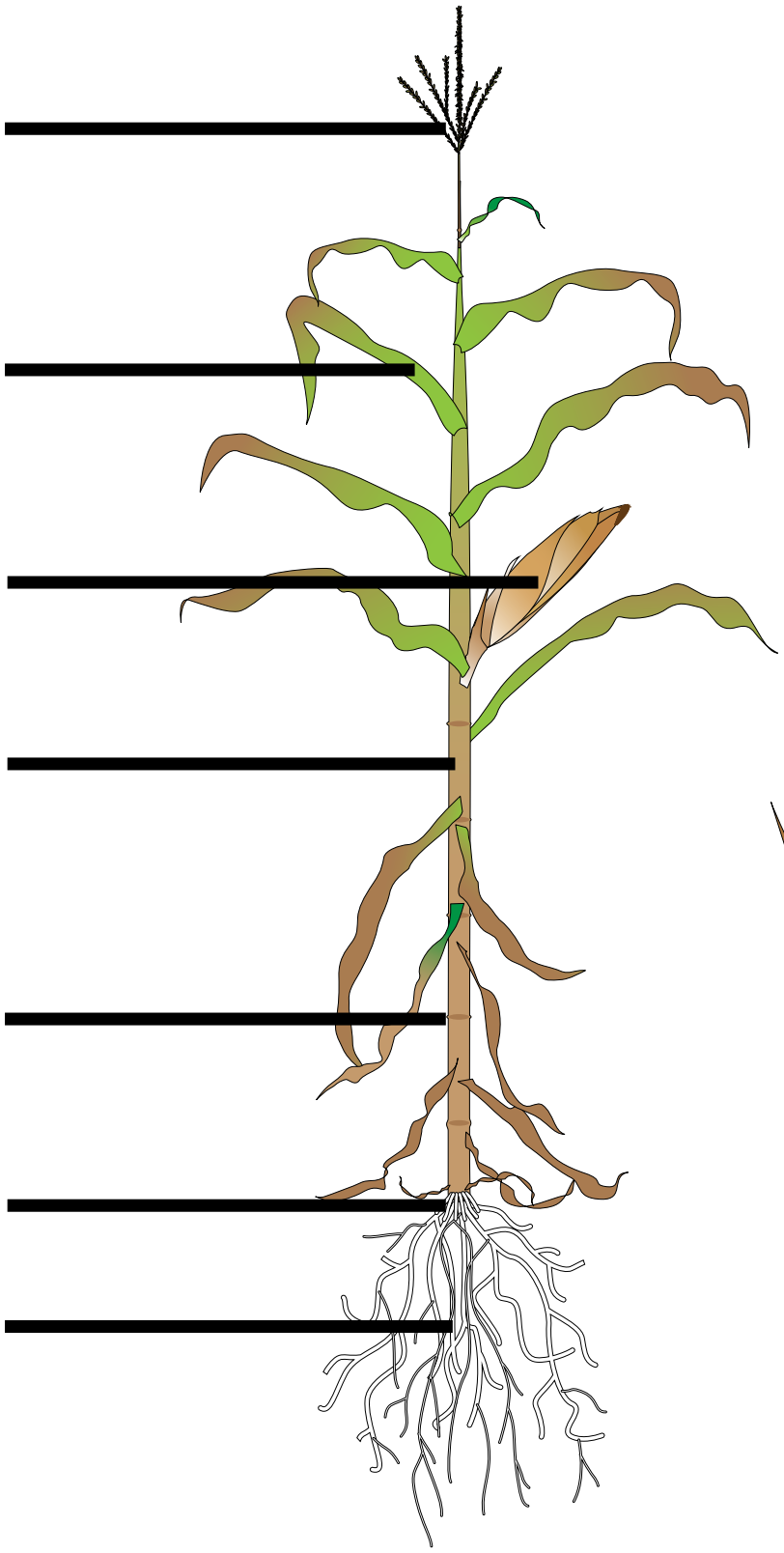
Writing

- Have the children write 3-5 sentences about the structure of their corn plant, using plant structure names. Encourage them to write about the jobs of the different parts of the plant.

KANSAS CORN STEM

Do You Know the Parts of a Corn Plant?

In the blanks below, label the parts of the corn plant.



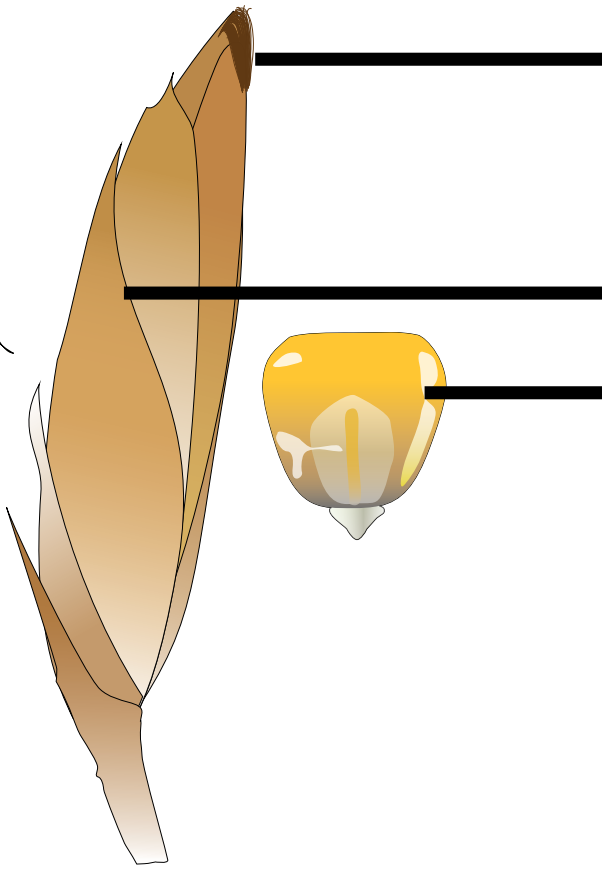
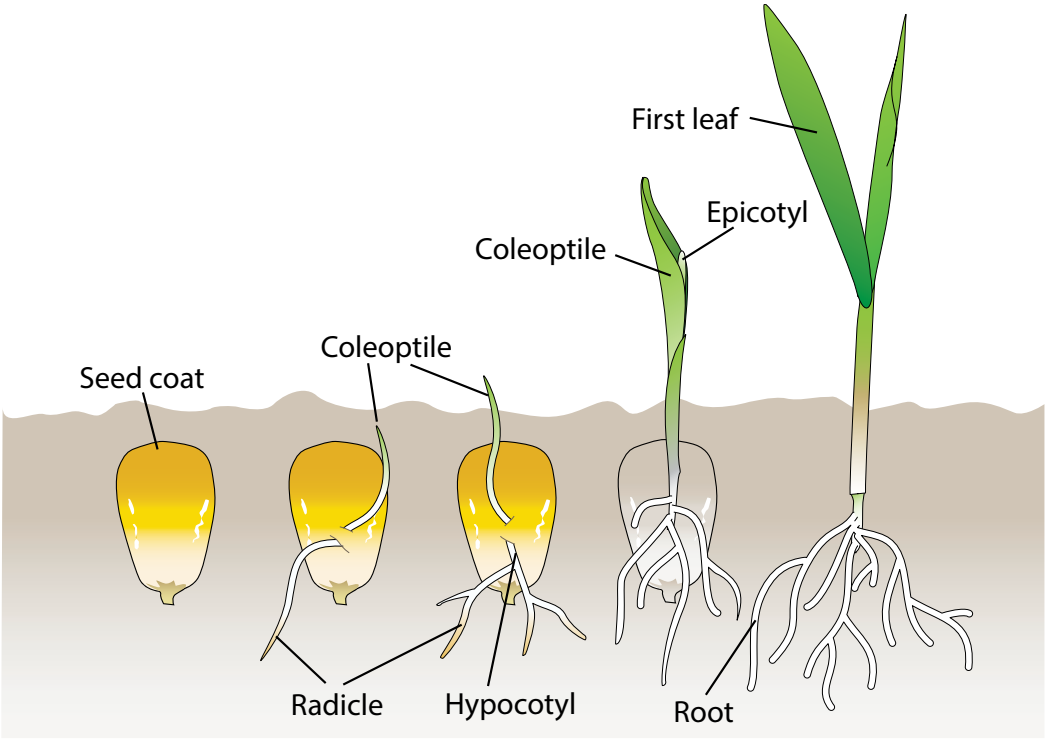


Image provided by K-STATE Research and Extension KSU CROPS Crop Production Team

Lesson 2: Where is the Corn Seed?

Emerging Corn Plant Structures and Functions



Seed coat: protects the starch and embryo from insects and diseases: both at planting and in storage

Corn seed radicle: first part of a growing plant embryo that emerges from the seed during germination. The radicle is the first root of the plant and grows downward in the soil

Corn seed coleoptile: a pointed protective sheath covering the emerging shoot (epicotyl) that pushes above the ground for the first leaves to appear

Corn seed hypocotyl: region between the radicle and the coleoptile and forms more roots

Corn seed epicotyl: region inside the coleoptile that forms the leaves and stems

First leaf: the true first leaf comes from the inside of the coleoptile and is distinguished by have a rounded tip. All other future leaves have a pointed tip. This first leaf will fall off as the plant is growing and the stem is enlarging. By six leaves the first leaf is hard to find.

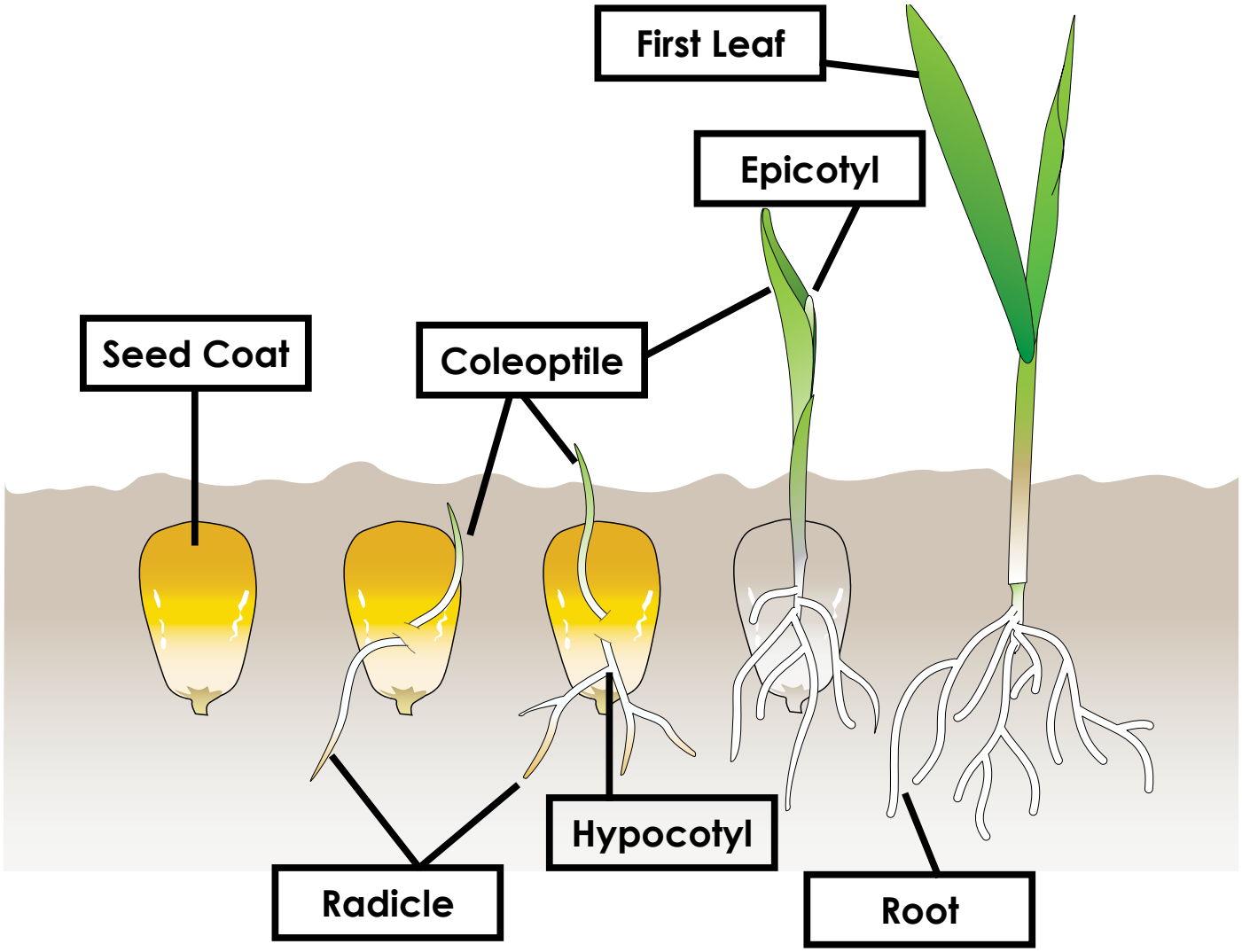
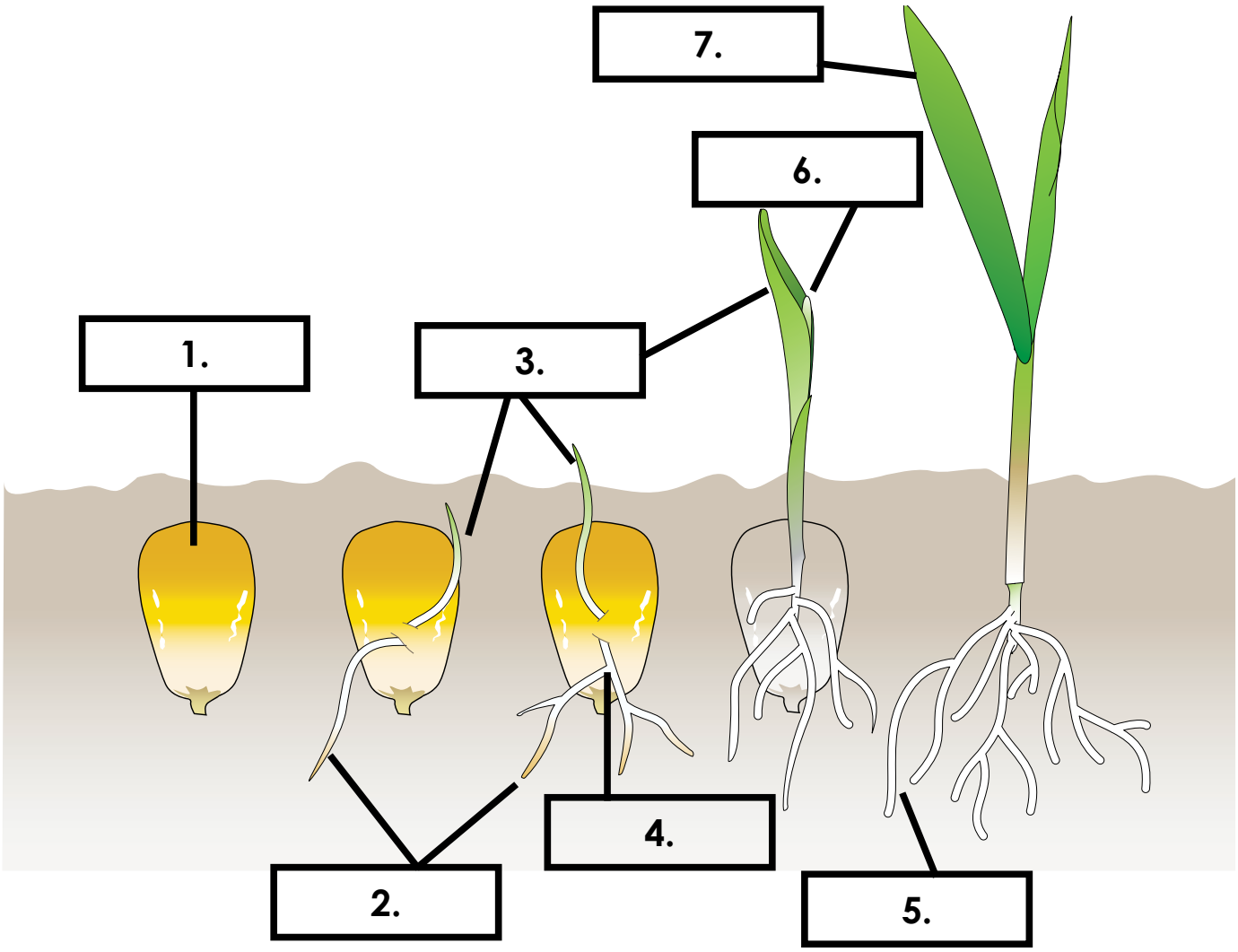


Image provided by K-STATE Research and Extension KSU CROPS Crop Production Team



1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

Image provided by K-STATE Research and Extension KSUCROPS Crop Production Team

Record Your Thinking

What do you think happend? Why?

Seed Germination Investigation

Today's Date:

Research Questions:

Type of Data:

Variables:

Control:

Prediction/Hypothesis:

My Seed's Progress

Date:	**CONTROL:**
Date:	**CONTROL:**
Date:	**CONTROL:**

Corn Plant Structures and Functions

Tassel: the male part of the corn plant that contains the pollen. The tassel is on top of the corn plant.

Leaf: a full grown corn plant has 16-19 leaves although 5 leaves fall off by the time the plant tassels. The leaf provides the surface area where light is intercepted and photosynthesis takes place.

Silk: a hollow tube that comes from the female part (ovary) on the ear. The silk grows outside of the husk until the pollen lands on the silk and then moves down silk tube to fertilize the ovary to form the seed. Each ear has one silk strand for each kernel on the ear.
Husk: leaf like structure that wraps around the ear for protection.

Ear: the structure that contains the kernels that are forming after fertilization. The female part of the corn plant.
Kernel: it is the corn seed with one main function; to make another corn plant.

Node: a place on the stem where growth occurs. Leaves, roots, ears, and tassels form from nodes.
Stalk: the main body (stem) of the corn plant. Stalks have to be sturdy to support the weight of the corn ears and provide pathways for the nutrients to move up and down the plant.

Brace root: roots that form above ground one the sixth node (the first five nodes are below ground where other roots are formed) Grow from the node and then down to the soil and keep the plant standing upright.

Roots: grow underground and bring water and nutrients to the rest of the plant.

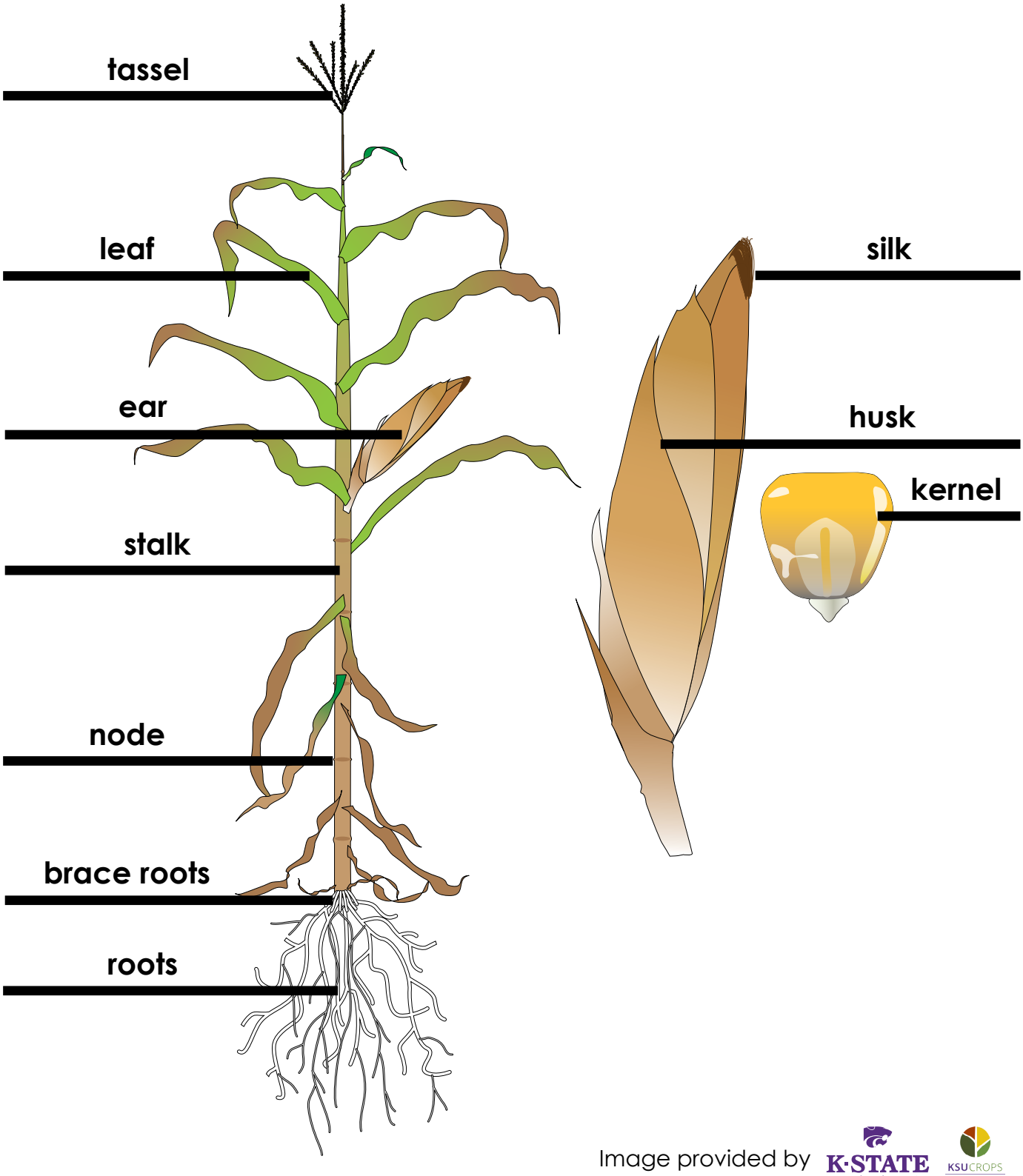


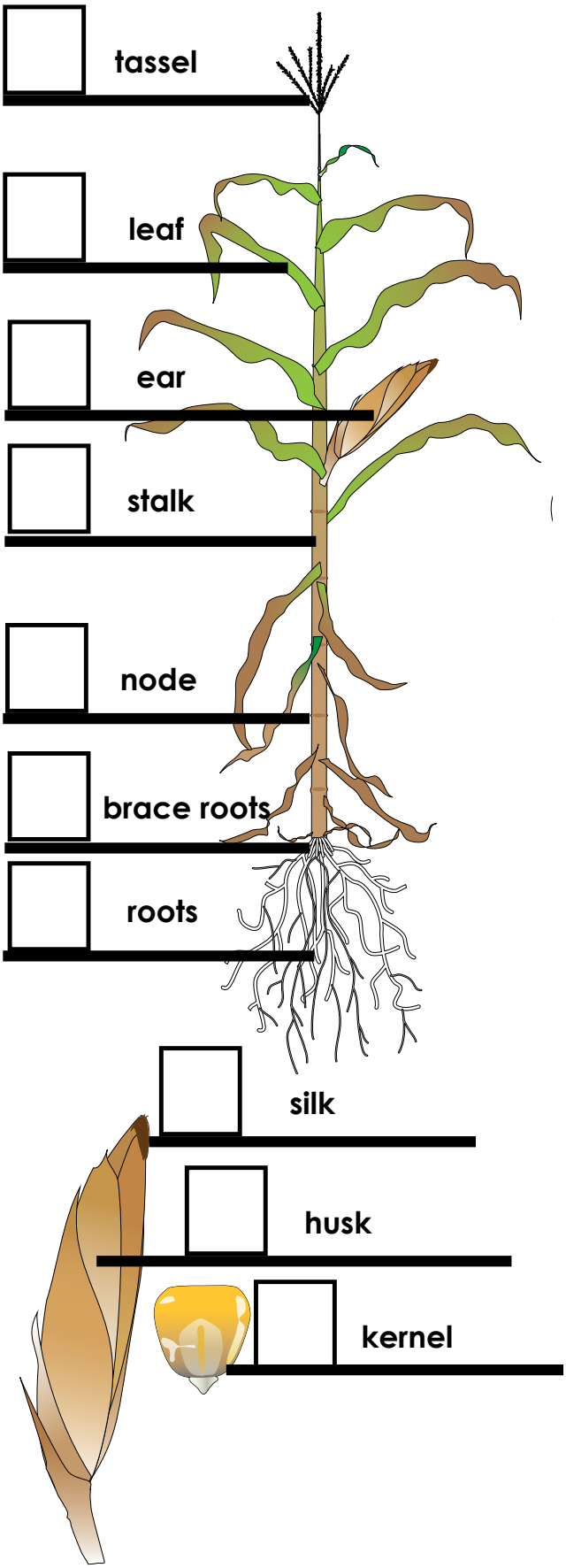
Image provided by K-STATE Research and Extension KSUCROPS

Image provided by K-STATE Research and Extension KSU CROPS Crop Production Team

Test What You Learned

In the blanks below, label the parts of the corn plant.

Image provided by K-STATE Research and Extension KSU CROPS Crop Production Team



Test What You Learned

Match the functions with their plant structures.

A. it is the corn's seed with one main function; to make another corn plant.

B. the male part of the corn plant that contains the pollen.

C. roots that form above ground to keep the plant standing upright.

D. provides the surface area where light is intercepted and photosynthesis takes place.

E. collects pollen and carries it inside to the female part of the plant to grow a seed.

F. a place on the stem where growth occurs.

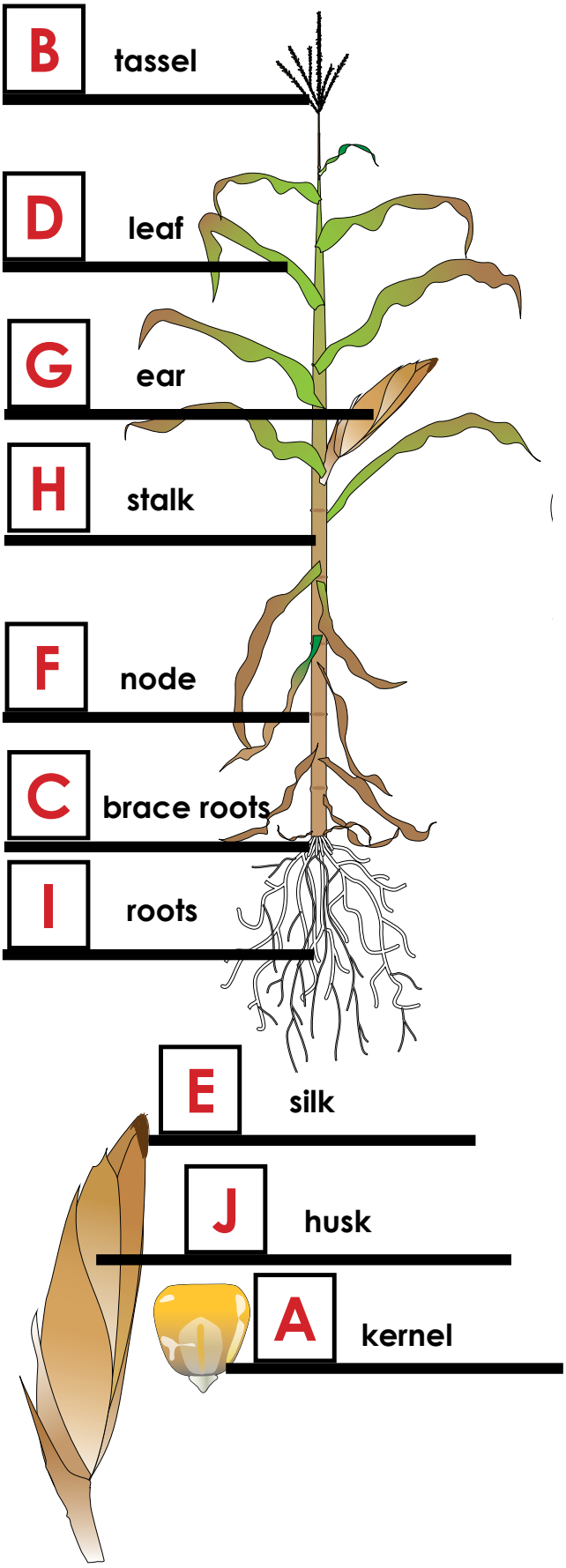
G. the female part of the plant that contains the kernels that are forming after fertilization.

H. the main body (stem) of the corn plant.

I. grow underground and bring water and nutrients to the rest of the plant.

J. leaf like structure that wraps around the ear for protection.

Image provided by K-STATE Research and Extension KSUCROPS



Test What You Learned

Match the functions with their plant structures.

A. it is the corn's seed with one main function; to make another corn plant.

B. the male part of the corn plant that contains the pollen.

C. roots that form above ground to keep the plant standing upright.

D. provides the surface area where light is intercepted and photosynthesis takes place.

E. collects pollen and carries it inside to the female part of the plant to grow a seed.

F. a place on the stem where growth occurs.

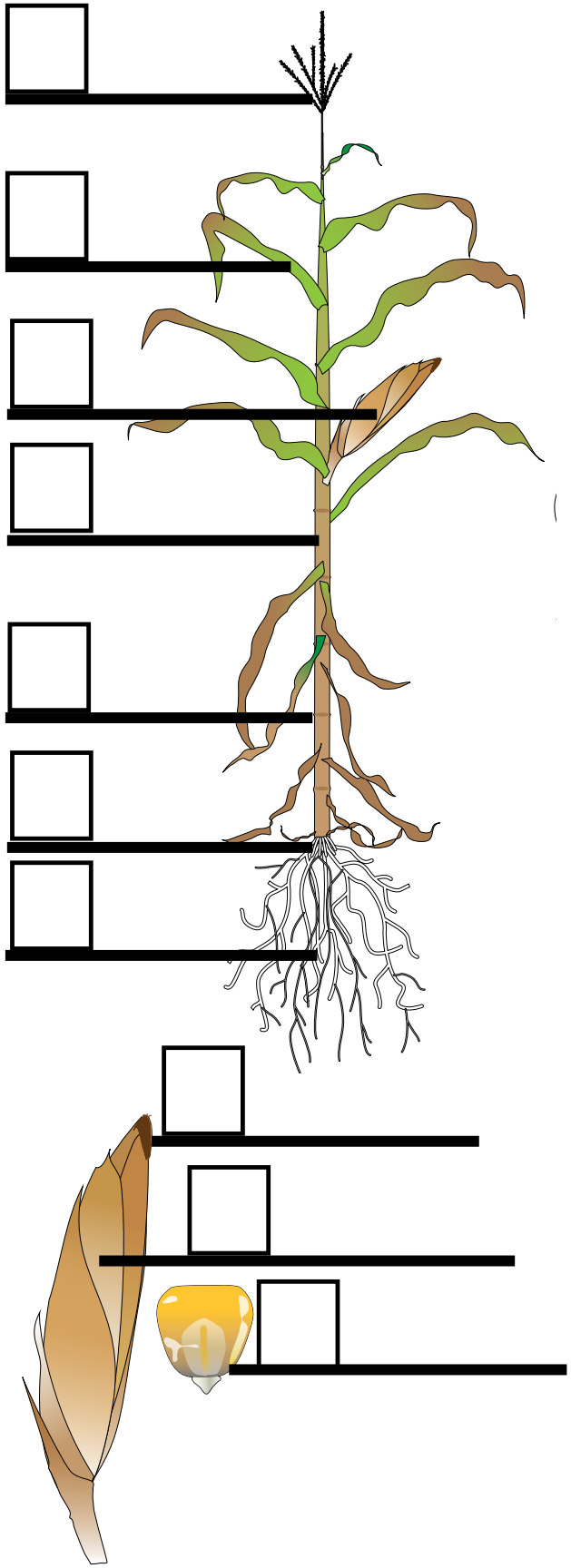
G. the female part of the plant that contains the kernels that are forming after fertilization.

H. the main body (stem) of the corn plant.

I. grow underground and bring water and nutrients to the rest of the plant.

J. leaf like structure that wraps around the ear for protection.

Image provided by K-STATE Research and Extension KSUCROPS Crop Production Team



Test What You Learned

Match the structures and their functions to the correct place on the corn plant.

A. Kernel: it is the corn seed with one main function; to make another corn plant.

B. Tassel: the male part of the corn plant that contains the pollen.

C. Brace root: roots that form above ground to keep the plant standing upright.

D. Leaf: provides the surface area where light is intercepted and photosynthesis takes place.

E. Silk: collects pollen and carries it inside to the female part of the plant to grow a seed.

F. Node: a place on the stem where growth occurs.

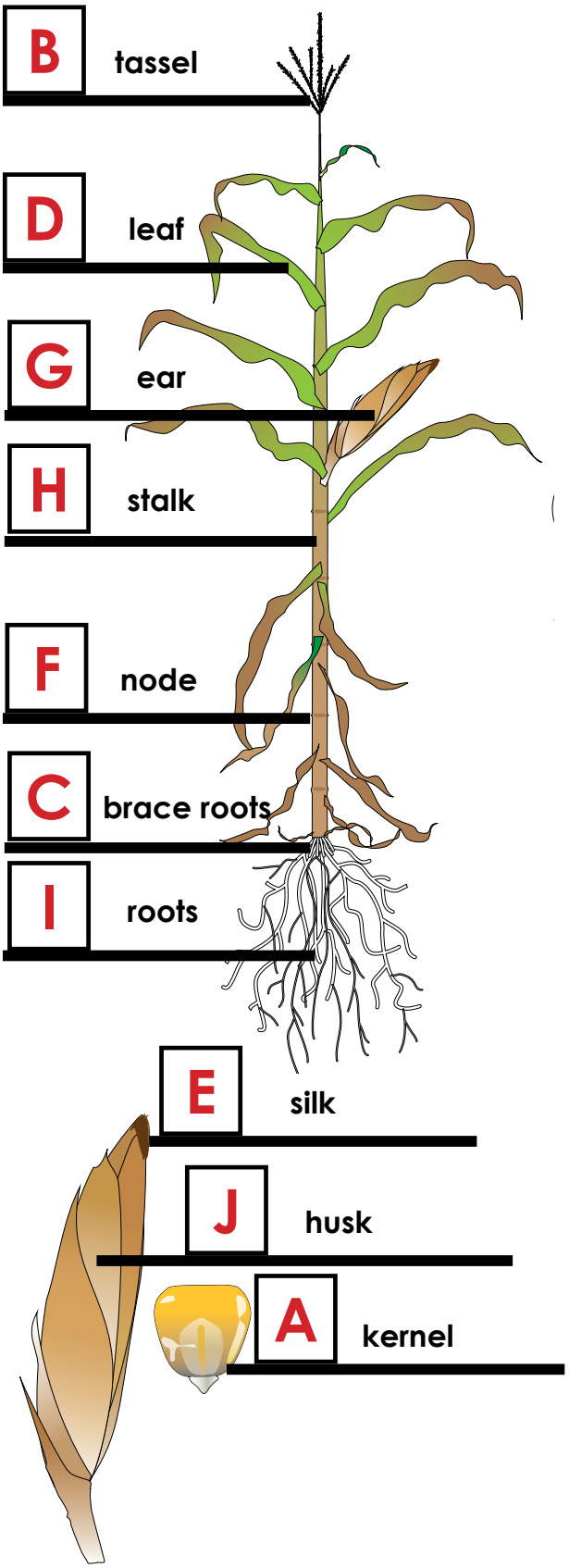
G. Ear: the female part of the plant that contains the kernels that are forming after fertilization.

H. Stalk: the main body (stem) of the corn plant.

I. Roots: grow underground and bring water and nutrients to the rest of the plant.

J. Husk: leaf like structure that wraps around the ear for protection.

Image provided by K-STATE Research and Extension KSUCROPS



Test What You Learned

Match the functions with their plant structures.

A. it is the corn's seed with one main function; to make another corn plant.

B. the male part of the corn plant that contains the pollen.

C. roots that form above ground to keep the plant standing upright.

D. provides the surface area where light is intercepted and photosynthesis takes place.

E. collects pollen and carries it inside to the female part of the plant to grow a seed.

F. a place on the stem where growth occurs.

G. the female part of the plant that contains the kernels that are forming after fertilization.

H. the main body (stem) of the corn plant.

I. grow underground and bring water and nutrients to the rest of the plant.

J. leaf like structure that wraps around the ear for protection.

Image provided by K-STATE Research and Extension KSUCROPS Crop Production Team