

Introduction to Corn

Why is corn such a valuable crop? How does corn grow, pollinate, and produce kernels? What farming techniques are important to increase corn yield?

Corn is a grass, native to the Americas. Evidence in central Mexico suggests corn was used there about 9,000 years ago. Various Native American tribes shared their knowledge of corn, known as maize, with early European settlers, saving many from starvation. Early American colonists ground dried corn as meal for flour to use in porridge, cake, and bread. Sweet corn, served as “corn on the cob,” was not developed until the 1700s.

Along with wheat and rice, corn is one of the world’s major grain crops. It is the largest grain crop grown in the United States. About 9 percent of all the corn is used to produce food for humans: corn meal, cooking oils, margarine, corn syrups, and sweeteners (fructose). About 64 percent of all corn is used for livestock feed.

Corn is harvested for either grain or silage, with most of the grain going to dairies, animal feeding operations, and poultry operations. Corncobs have been used in the manufacturing of nylon fibers as well as being a source for producing biodegradable plastics. Ethanol, made from corn, is a renewable fuel used in today’s cars.

Corn is pollinated by wind and is typically planted in 30-inch rows. A single seed, or kernel, of corn may produce a plant that yields more than 600 kernels of corn per ear. Approximately 22,000 to 35,000 individual plants may be grown on an acre of land. Hybrid corn is developed to produce from one to two ears per plant. More than 80 million acres of the heartland are planted in corn each year. That’s almost as big as 60 million football fields!

After corn is harvested, farmers begin to prepare the soil for the next season by mixing in nutrients, such as potassium and phosphorus, with some form of tillage (breaking up soil) to incorporate them. In the spring, farmers will do a light tillage pass to create smooth bedding for planting. When the ground temperature is ready (50°F and expected to rise), farmers will plant the corn seeds. Farmers will then add fertilizer, two inches deep and two inches to the side of the kernels to help the seeds get a healthy start. After the seed is planted, most farmers will spray a pre-emergent herbicide to prohibit weed growth. When seedlings emerge and grow, farmers will inject the soil with some form of nitrogen fertilizer before the V8 (eighth leaf development) stage. This spring fertilizer will allow for the plant to “green-up” and establish good photosynthetic activity through harvest.

Farmers will continue to scout the crop through maturity for any additional pests. Farmers will harvest the crop when it is ripe in the fall.



A Brief History of Corn



Teosinte

Corn was first domesticated in Mesoamerica around 10,000 years ago. Its earliest ancestor is a grassy plant called teosinte. This wild grass is a far cry from modern-day corn. Teosinte is characterized as being approximately three inches tall and has between five and twelve “tooth-crackingly” hard kernels. Compared to modern day corn, which can have 600-800 kernels, it’s no wonder botanists originally didn’t believe the two were related! Over many generations, early Mesoamericans selectively bred for longer ears and softer kernels, thus giving us the soft, golden ears of corn we know today.

Photo courtesy of Matt Lavin
https://www.flickr.com/photos/plant_diversity/4055517697

Implications of Early Agriculture



Agriculture meant laying down roots! The planting of crops and raising cattle is known as domestication. It was an end to the hunter-gatherer lifestyle and a beginning to sedentary life.



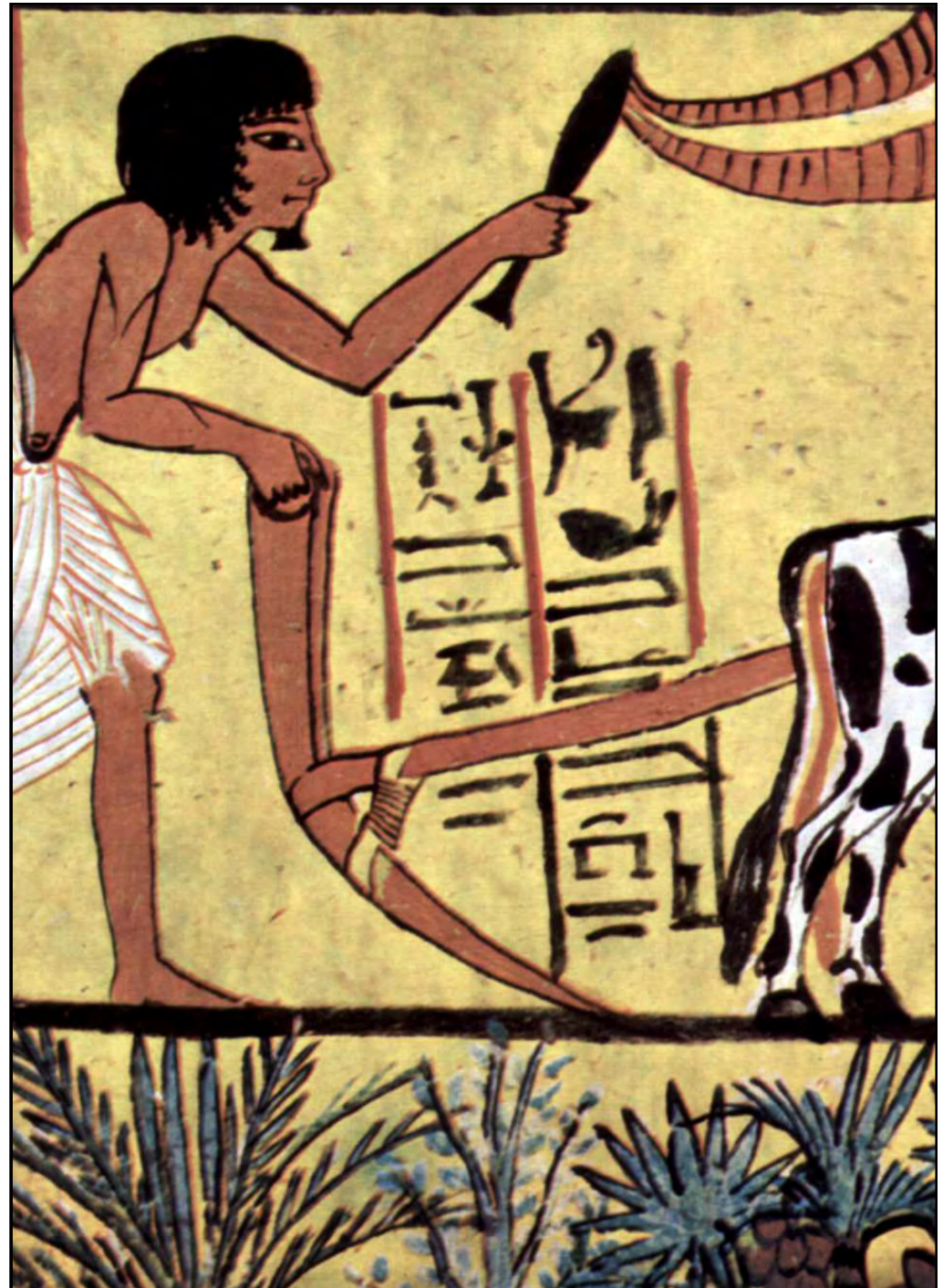
Native communities had to stay in one place to plant, grow, and harvest crops. They began to build permanent dwellings and form villages.



By settling in permanent areas, this led to the idea of “personal property.” People were willing to defend this property from attacks by those who wanted to take it.



What are other consequences of early agriculture and domestication?



Blood and Corn

One of the most important civilizations in Mesoamerica, the Mayans, were very dependent on corn.

Based on isotopic analysis of skeletal remains, 70% of their diet was corn-based!

In fact, according to the Mayan creation legend, the Gods formed the Mayans from a dough made of corn and blood.



Corn Goes Global!

From Mesoamerica, corn was brought north to present-day America. In fact, the Southwest was the first place where corn agriculture began in America. This was in present-day Arizona and New Mexico.

From there, corn was brought through America by the Native Americans. When European colonists arrived, the Native Americans taught them how to grow corn, an act that was vital to successful colonization efforts.

After learning how to grow corn, Christopher Columbus and other explorers introduced corn to Europe. Because of this, corn plants mature somewhere in the world nearly every month of the year and corn has become the most important crop in the United States!



“John Smith trying to get more food for the settlers.” Photo courtesy of National Park Service
5 <https://www.nps.gov/jame/learn/historyculture/pocahontas-her-life-and-legend.htm>



“Interview of Samoset with the Pilgrims.” Book Engraving. 1853.
{{PD-US-Expired}}

Dent

This corn is named for having a small indentation on the top of each of its kernels and has the scientific name of *Zea mays indentata*. It is a type of field corn that has a high, starch content that is soft enough to make into cornmeal flour for cornbread, corn chips, tortilla shells and taco shells. Though, it is mainly used for animal feed, cooking oil and the production of ethanol, a biofuel. Its starch can also be used to create plastics, such as water bottles and disposable kitchen utensils as well as high fructose corn syrup which is a sweetener for many foods. It can even be used to create paper and food-grade starch to thicken your gravy! It is grown more than any other crop on the planet and was developed by an Illinois farmer by the name of James Reid which won him the blue ribbon at the 1893 World's Fair.



Flint

This corn goes by the scientific name of *Zea mays indurata* but is also known as Indian or Calico corn due to its many different colors of kernels. Because of its coloration, it is used as decoration for the holidays which give it another name, ornamental corn. Though, its official name is flint corn because its kernels have a hard outer layer that protects its soft inner endosperm. Other than decorations, you may have come across it as hominy and perhaps eaten it as grits or popcorn which is a specific variety of flint corn. It is famous for being the only crop to survive New England's "Year without summer" in 1816. This was because it has very low water content in the kernel that makes it more resistant to freezing.



Pod

Zea mays tunicata is one crazy looking variety of corn! There are leaves growing around each kernel which is why it is also known as wild maize. This is a mutant variety of corn and not an ancestor of the maize family.



Popcorn

This is a special variety of flint corn with remnants being dated all the back to 3600 BC. *Zea mays everta* has the strongest hull and contains a hard, starchy endosperm with a moisture content between 13.5 and 14 percent. This moisture is what heats up and turns to steam creating an inside pressure of up to 135 psi! The steam gelatinizes the starch when it finally "pops" breaking through the hull and immediately expands into an airy foam. This creates two types of popcorn "flakes:" the butterflies or snowflakes that are irregularly shaped with a number of protruding wings, and the mushrooms which are ball-shaped. Those poor kernels that do not pop are called "old maids." During the Great Depression in the 1930s and World War II in the 1940s, popcorn became one the most popular snacks around. It wasn't until 1981, when General Mills patented the very first microwaveable bag for us to enjoy in a jiffy!



Flour

What can be said about *Zea mays amyloperla*? As its common name suggests; it is mainly used to make corn flour, which can be found as an ingredient in many food products. It is easy to ground into flour due to its soft, starchy endosperm within a thin pericarp.

Sweet

Now this is the one corn type that makes it to the dinner table, especially during the summer grilling season! *Zea mays rugosa* was first recorded by European settlers in 1779 when it was introduced by the Iroquois, which was not all that long ago.

It has a high sugar content due to a natural recessive mutation. It is harvested very quickly, when the kernels are in the immature milk stage. It is then cooled down by putting it on ice to stop the sugars converting into starch, keeping them from losing their sweetness. This lack of starch causes sweetcorn to not store very well which is why you find it many times in the refrigerated section in the produce aisle. In Latin America, it is eaten with beans in order to balance out the abundance and deficiency of essential amino acids contained in each.

Blue

What kind of tortilla chips do you think are made from this corn type? Yep, it's blue tortilla chips! It's the different kinds of anthocyanin pigments that give this corn its unique color. This is another variety of flint corn that has roots that go deeper into the soil, making it more drought tolerant, but has an overall shorter height at only 4-5 feet tall. That is short for corn! It packs a bit more protein, 7.8 percent, versus yellow corn's puny 5.7 percent. It was originally developed by the Pueblo Indians of the Rio Grande, known as the Hopi.

Amylomaize

This is a new kind of corn that was developed to have a very high amylose content. Amylose is a polysaccharide sugar and this type of corn contains 50 percent greater amylose than other corn types. Some have even reached 94 percent! This makes it great for industrial wet milling processes such as the production of ethanol and biodegradable plastics.

Dent



Pod



Flour



Flint



Popcorn



Sweet



Amylomaize



Blue



Field corn with a high, soft starch content



Named for having a small indentation on the top of each kernel



Developed by an Illinois Farmer by the name of James L. Reid



Won the blue ribbon at the World's Fair in 1893



Most corn grown today is of this variety



Used to make cornmeal flour for cornbread, corn chips, tortillas and taco shells



It's starch can be used to create plastics and high fructose corn syrup



Primarily used for animal feed, cooking oils and production of ethanol



Used to create food-grade starch and paper



Also known as Indian Corn or Calico Corn



Named for having a hard outer layer to protect the soft endosperm



Has a very low water content which makes it more resistant to freezing



The only crop to survive New England's "Year without Summer" in 1816



Most of this type is multi-colored



Popcorn is a variant of this type of corn



Used to make hominy



Is also named ornamental because of its use during the holidays due to its multiple colorations



Also known as wild maize



It is a mutant - not an ancestor of the maize family



Leaves are formed around each kernel in this type



Has the strongest hull that contains a hard, starchy endosperm



Has a moisture content between 13.5-14%



Is a variety of flint corn



Remnants of this type have been found all the way back to 3600 BC



Was a very popular snack during the Great Depression and WWII



General Mills in 1981 patented the first microwaveable bag for this type



Pressurized steam gelatinizes the starch inside and breaks through the hull at 135 psi, expanding the starch into an airy foam



Unpopped kernels are called "Old Maids" whereas popped kernels are called "Flakes"



There are two types of Flakes - Butterflies or Snowflakes that are irregular with a number of expanded wings and Mushrooms which are ball-shaped



Has a soft, starchy endosperm and a thin pericarp



Used to make corn flour



Has a high sugar content due to a naturally occurring recessive mutation



Harvested when kernels are immature - in the milk stage



Stores poorly due to lack of starch



First recorded by European settlers in 1779 when given by the Iroquois



Eaten with beans in Latin America because each is deficient in certain amino acids that are abundant in the other



Is a variety of flint corn



Originally developed by the Hopi - the Pueblo Indians of the Rio Grande



This type is more drought tolerant, deeper rooted and shorter (4-5 ft)



For each 100g, it has a protein content of 7.8% versus 5.7% in yellow corn



Contains different types of anthocyanins that give corn its unique color



Used to make blue tortilla chips



Has an amylose content of 50% or greater - up to 94%



Used primarily for wet milling like in the production of ethanol and biodegradable plastics



Zea mays indurata



Zea mays tunicata



Zea mays everta



Zea mays amylacea



Zea mays rugosa



Zea mays indentata



Kernal Card Game

AMYLOMAIZE



AMYLOMAIZE



DENT



DENT



DENT



DENT



DENT



DENT



DENT



DENT



POPCORN



POPCORN



POPCORN



POPCORN



POPCORN



POPCORN



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POPCORN



FLINT



FLINT



FLINT



FLINT



FLINT



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FLINT



FLINT



SWEET



SWEET



SWEET



SWEET



SWEET



SWEET



BLUE



BLUE



BLUE



BLUE



BLUE



BLUE



POD



POD



FLOUR



FLOUR



+2



+2



+2



+2



REVERSE



REVERSE



REVERSE



REVERSE



SKIP



SKIP



SKIP



SKIP



**DENT, FLINT, SWEET,
POP, POD, FLOUR,
BLUE, AMYLOMAIZE**



**DENT, FLINT, SWEET,
POP, POD, FLOUR,
BLUE, AMYLOMAIZE**



**DENT, FLINT, SWEET,
POP, POD**

+4

**FLOUR, BLUE,
AMYLOMAIZE**



**DENT, FLINT, SWEET,
POP, POD**

+4

**FLOUR, BLUE,
AMYLOMAIZE**



Corn Staging Student Worksheet

Name: _____

Group: _____

How does corn go from the vegetative to reproductive stage?

- From under the ground (germination) to the first stage (VE), as shown in the picture below.

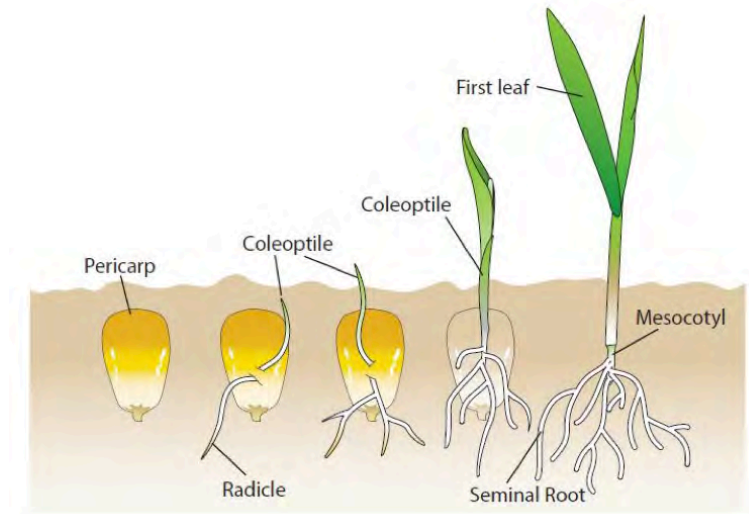


Photo provided by Dr. Ciampitti, KSUCROPS Team, K-State Agronomy and Bob Holcombe, K-State Communications

Corn Staging:

Visit the DuPont Pioneer website (tinyurl.com/cornstages). Fill in the grid describing the vegetative and reproductive stages. If link does not work visit kansascornstem.com for updated link.

VE		R1	
V1		R2	
V2		R3	
V3		R4	
V(n)		R5	
VT		R6	

Corn Staging Student Worksheet (Continued)

Stages of Development (Vegetative):

Visit the DuPont Pioneer website (tinyurl.com/PioneerCornVegetativeStages). Write why each stage is important (significance) and draw a picture showing how the plant would look in that stage. If link does not work visit kansascornstem.com for updated link.

Stage	Significance	Picture
VE-V1		
V3		
V6		
V9		
VT		

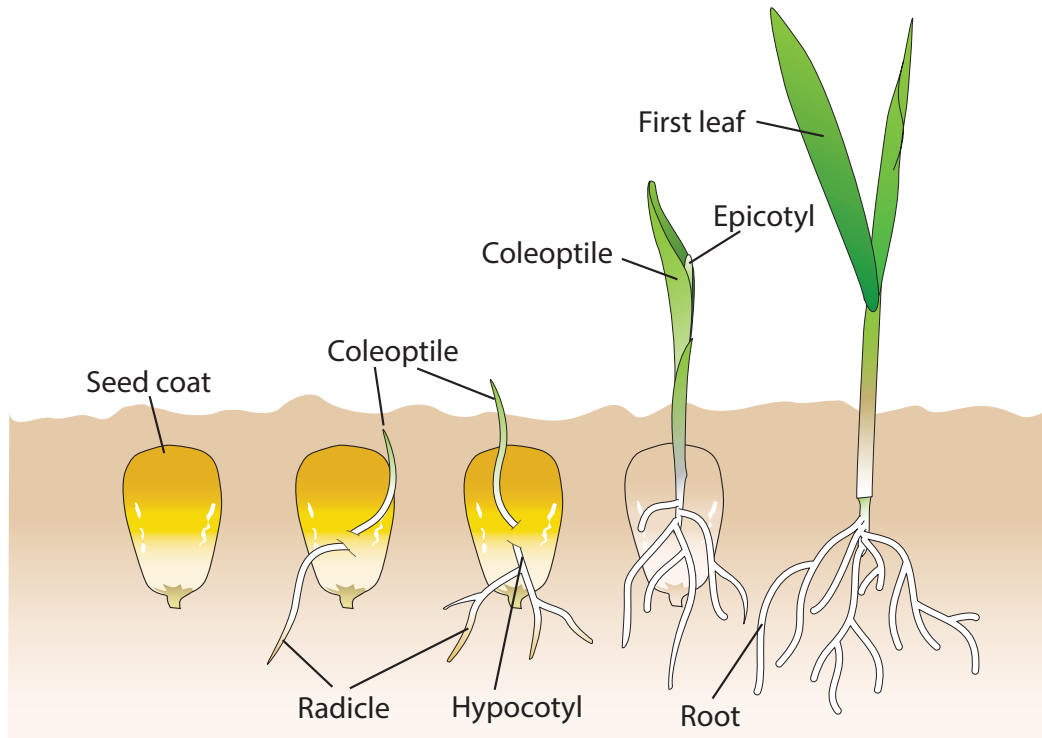
Corn Staging Student Worksheet (Continued)

Stages of Development (Reproductive):

Visit the DuPont Pioneer website (tinyurl.com/PioneerCornVegetativeStages). Write why each stage is important (significance) and draw a picture showing how the plant would look in that stage. If link does not work visit kansascornstem.com for updated link.

Stage	Significance	Picture	GDUs
R1			
R2			
R3			
R4			
R5			
R6			

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

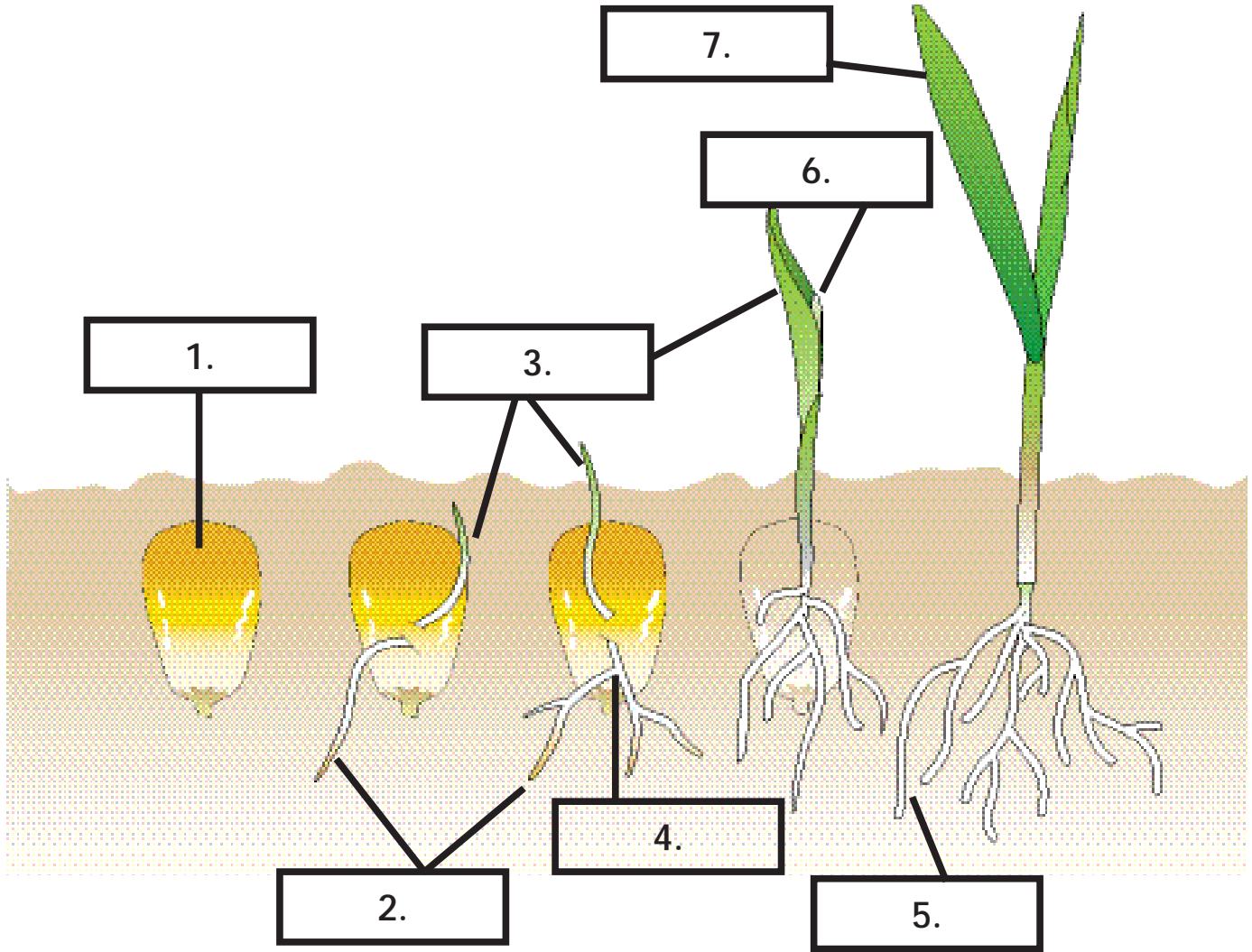
Corn seed coleoptile: a pointed protective sheath covering the emerging shoot (epicotyl) that pushes above the ground for the first leaves to appear

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.

Parts of an Emerging Corn Plant



1.

2.

3.

4.

5.

6.

7.

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.

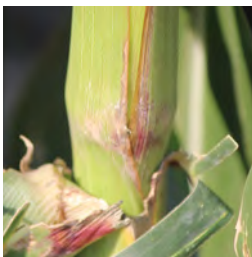


Silk: a hollow tube that comes from the female part (ovary) on the ear. The silk grows outside of the husk until the pollen lands on the silk and then moves down silk tube to fertilize the ovary to form the seed. Each ear has one silk strand for each kernel on the ear.

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.

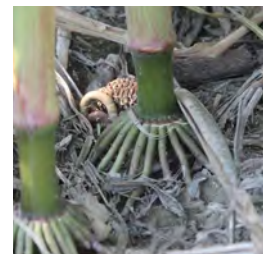
Kernel: it is the corn seed with one main function; to make another corn plant.



Node: a place on the stem where growth occurs. Leaves, roots, ears, and tassels form from nodes.

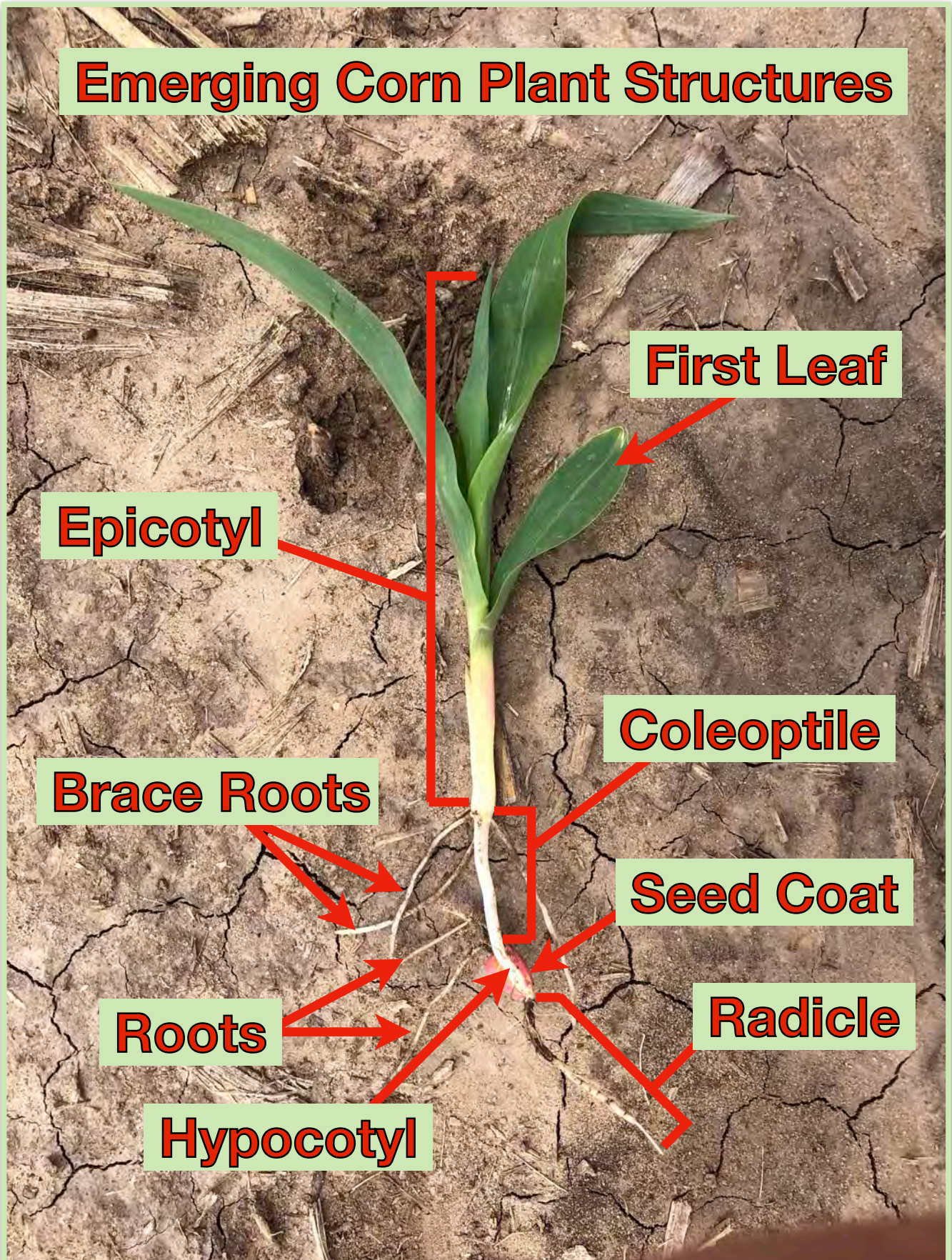
Stalk: the main body (stem) of the corn plant. Stalks have to be sturdy to support the weight of the corn ears and provide pathways for the nutrients to move up and down the plant.

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.

Emerging Corn Plant Structures



Parts of a Corn Plant

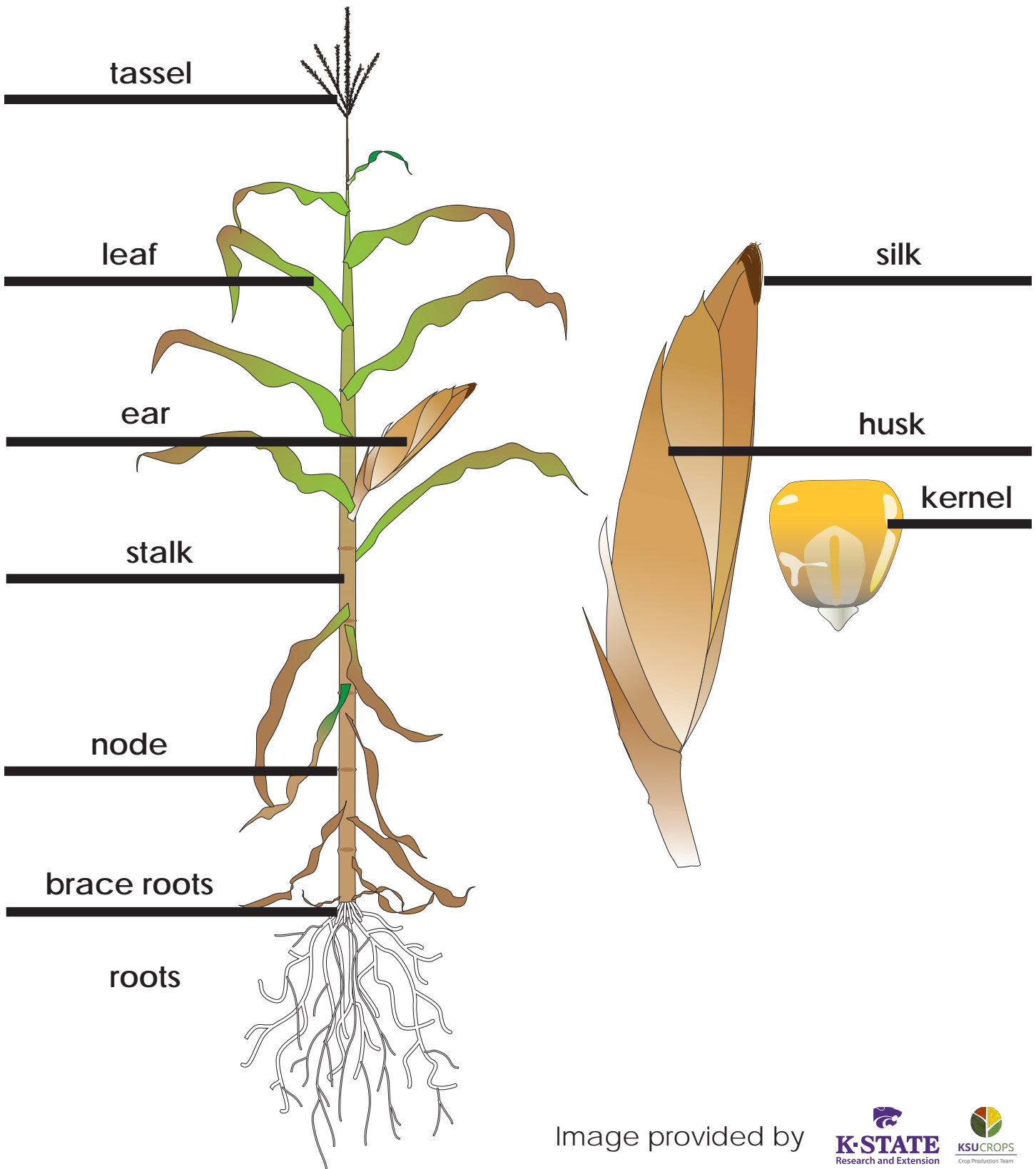


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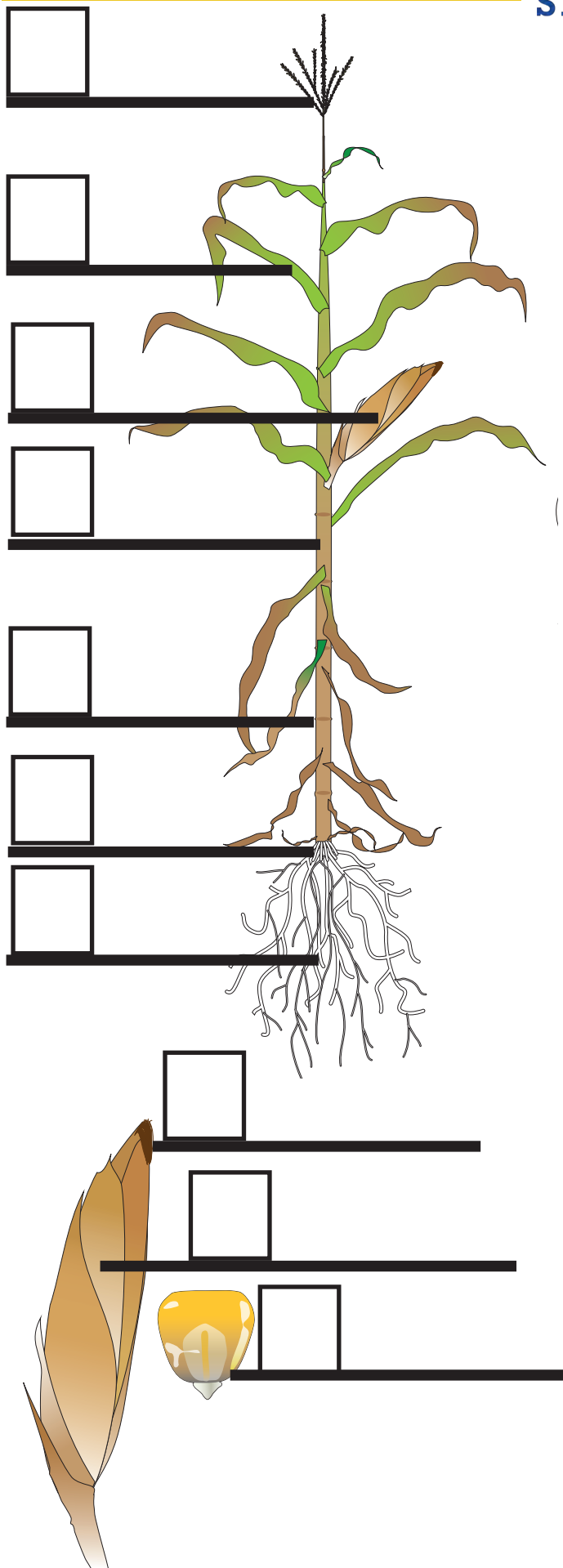
Parts of a Corn Plant



Image provided by

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.

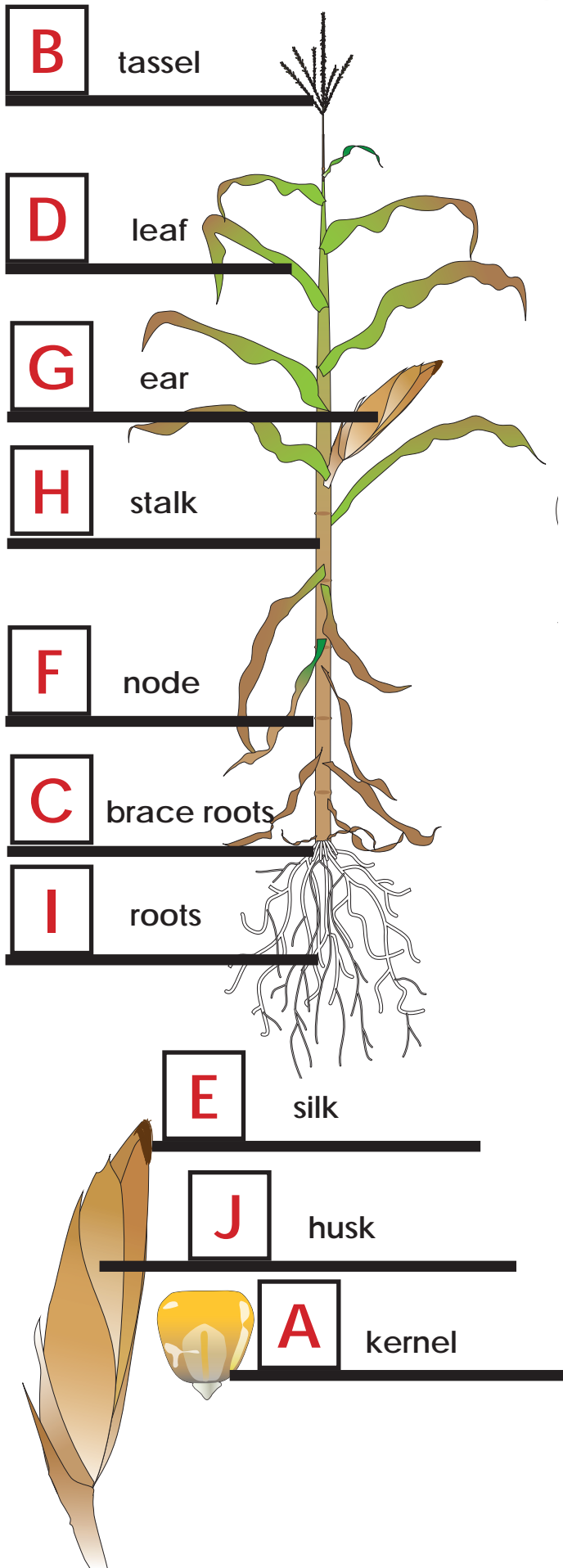
F. Node: a place on the stem where growth occurs.

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.

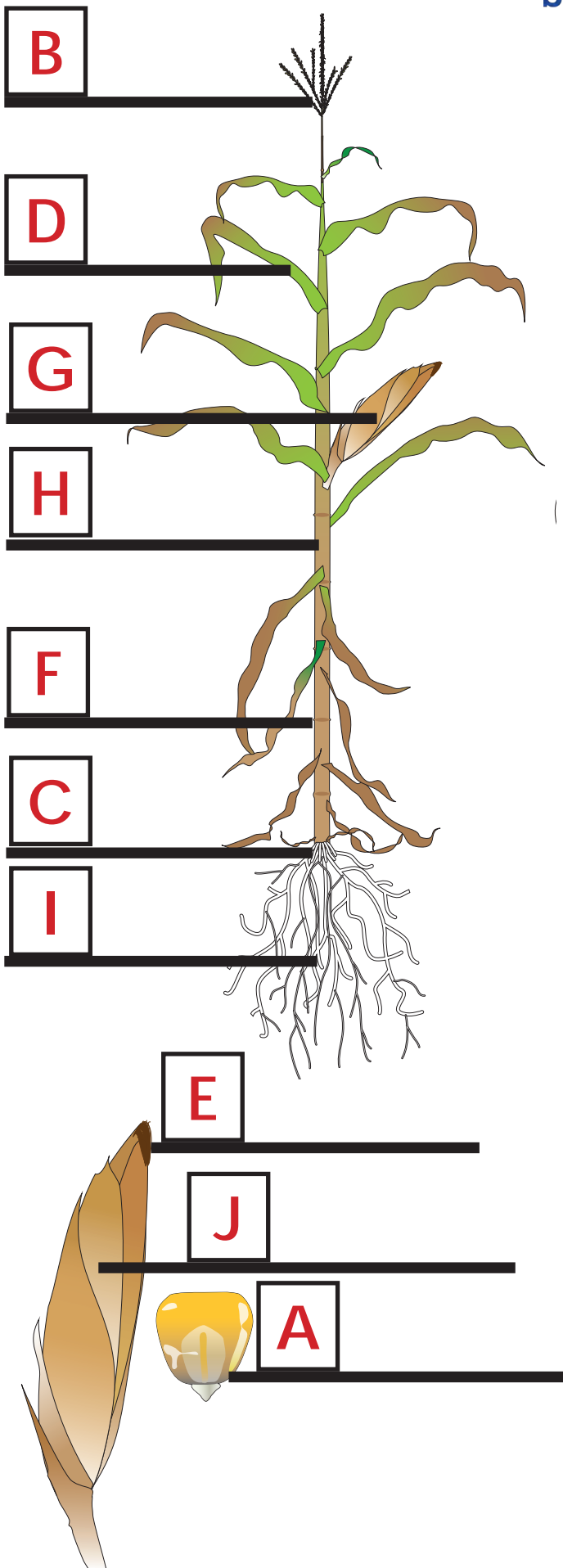
J. Husk: leaf like structure that wraps around the ear for protection.



Test What You Learned

Match the functions with their plant structures.

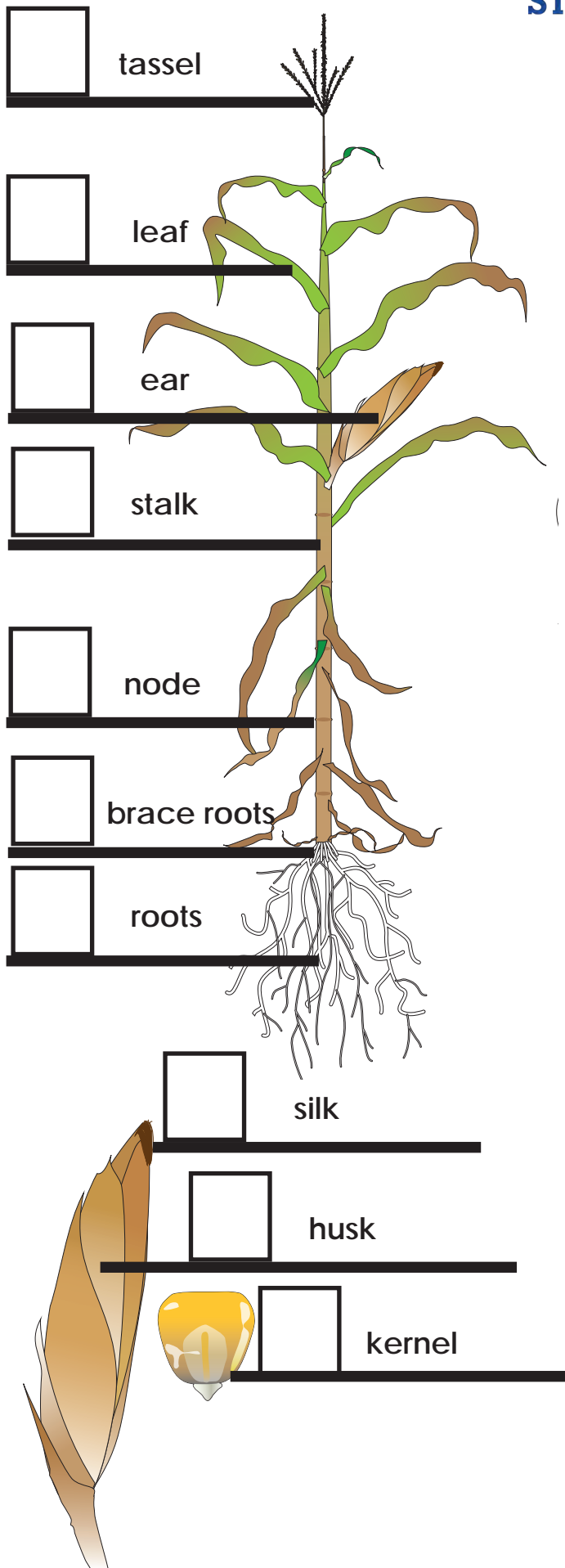
- A. it is the corn's seed with one main function; to make another corn plant.
- B. the male part of the corn plant that contains the pollen.
- C. roots that form above ground to keep the plant standing upright.
- D. provides the surface area where light is intercepted and photosynthesis takes place.
- 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.



Test What You Learned

Match the functions with their plant structures.

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Corn 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. It 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

The region between the radicle and the coleoptile and forms more roots.



Corn Seed Epicotyl

The region inside the coleoptile that forms the leaves and stems



First Leaf

Has a rounded tip and comes from the inside of the coleoptile. Will fall off as the plant grows



Tassel

The male part of the corn plant that contains the pollen. Located on top of the corn plant



Leaf

Provides the surface area that collects sunlight for photosynthesis



Silk

Each kernel has one of these hollow tubes that act as a pathway for pollen to the ovary

Husk

Leaf-like structure that wraps around the ear for protection

Ear

The female part of the corn plant and contains the kernels

Kernel

The seed of the corn plant with the one goal - create another corn plant

Node

A place on the stem where growth occurs. Leaves, roots, ears and tassels form from this

Stalk

The main body of the corn plant that supports the ear and provides pathways for nutrients to to move up and down

Brace Root

Forms above the ground and helps keep the corn plant anchored into the soil

Root

Grow underground and bring water and nutrients to the rest of the plant

Directions:

1. Each student gets a copy of the corn plant and corn seed pictures. They can paste these pictures into their notebook.
2. Each student gets a copy of the seventeen name cards.
3. They can cut these out, fold them in half with the name on the outside and then paste the white backside to the notebook next to the line that identifies the structure.
4. Students can then flip up the name card and write its function on the inside.

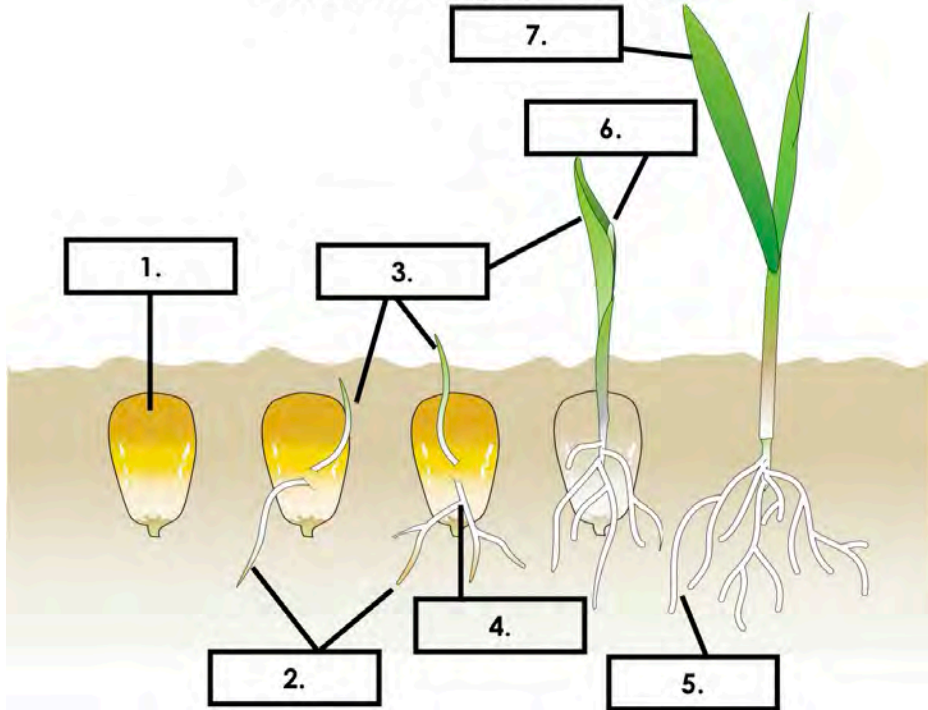


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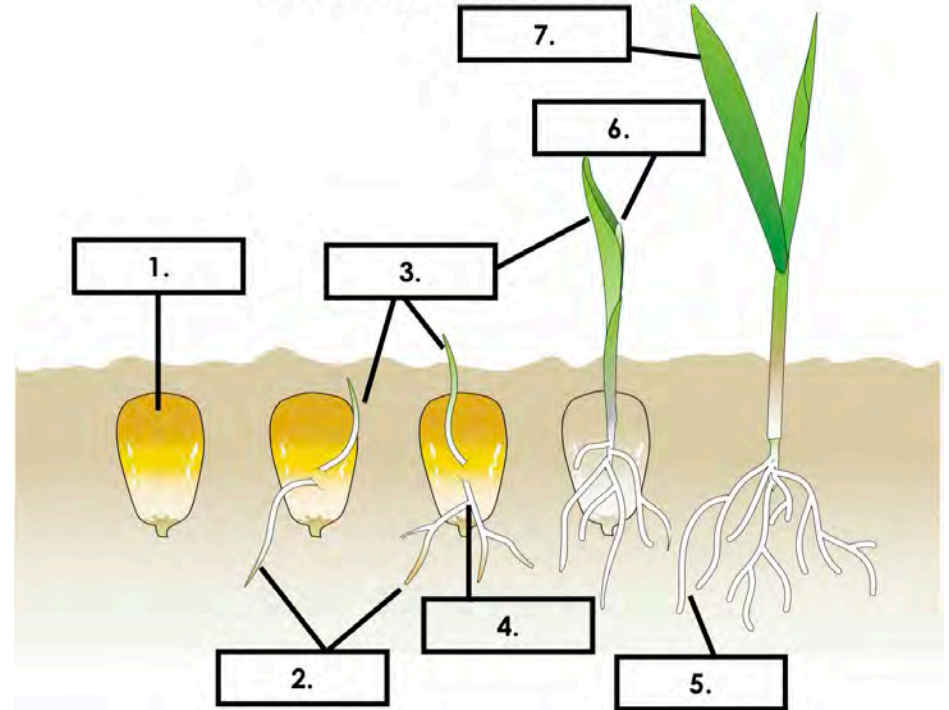


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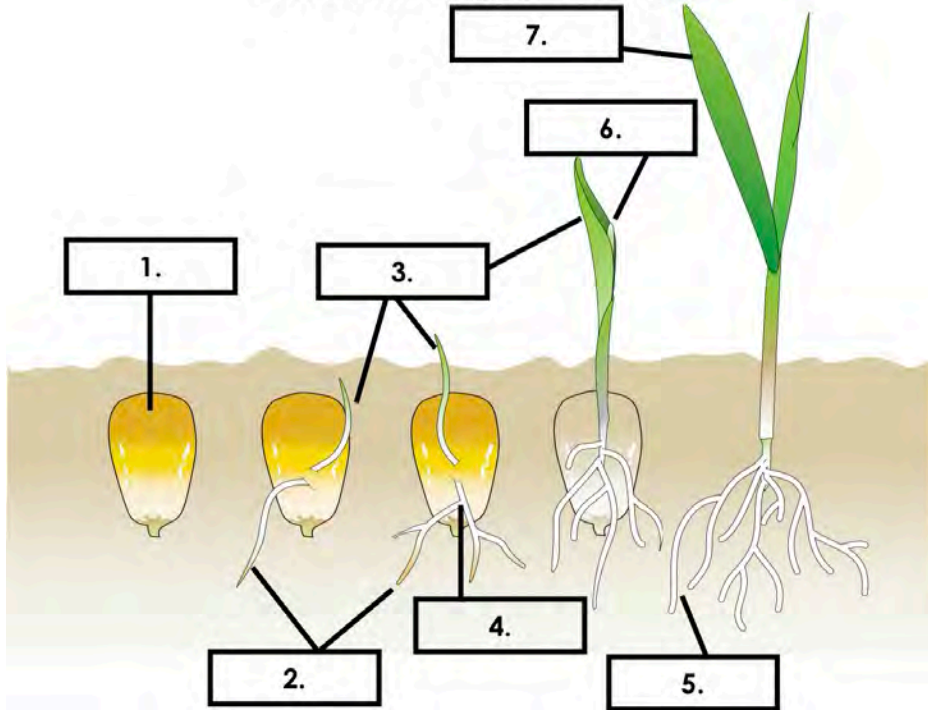
Parts of an Emerging Corn Plant



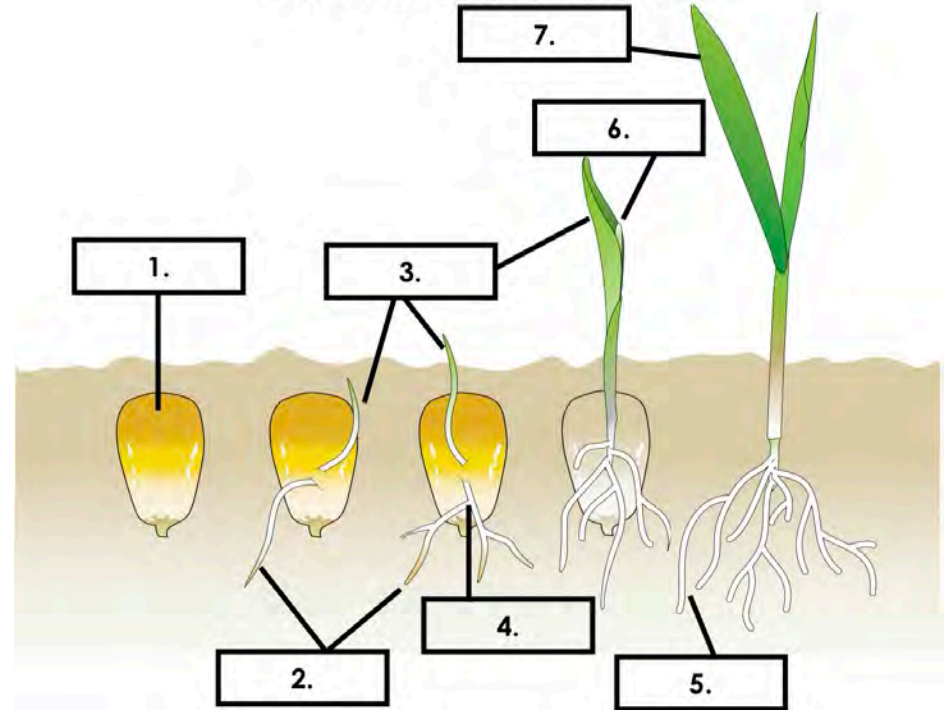
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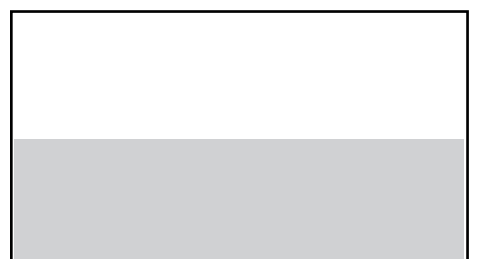
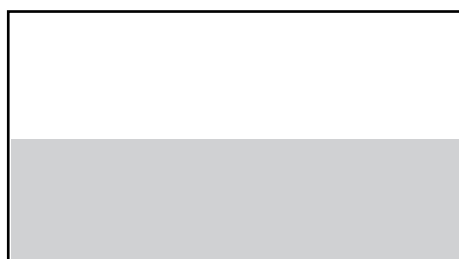
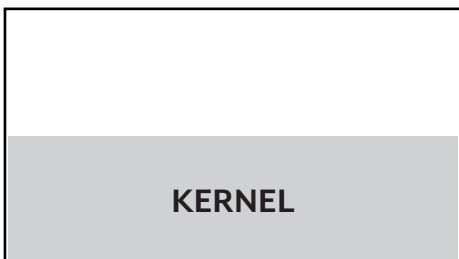
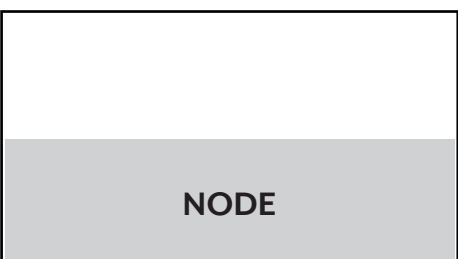
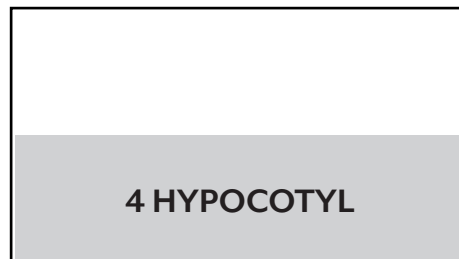
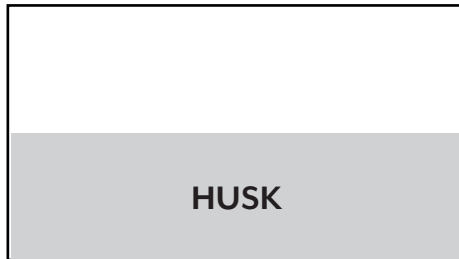
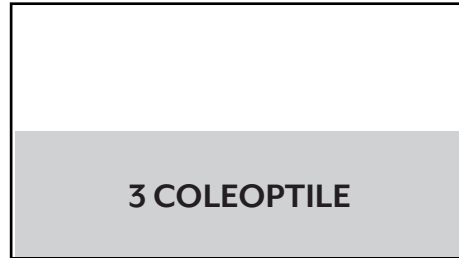
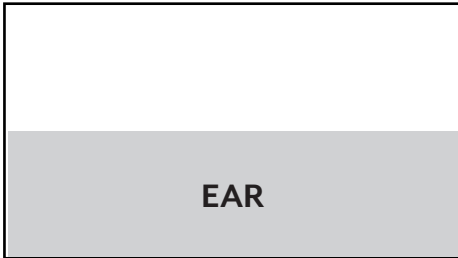
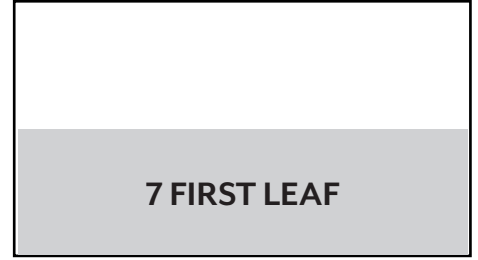
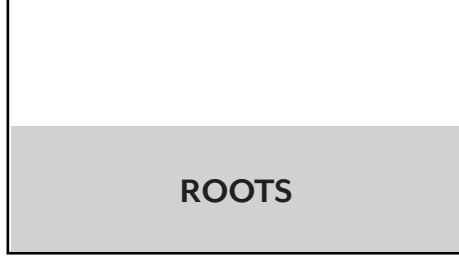
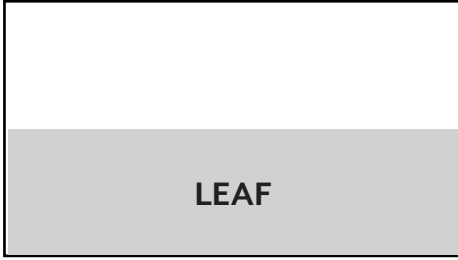
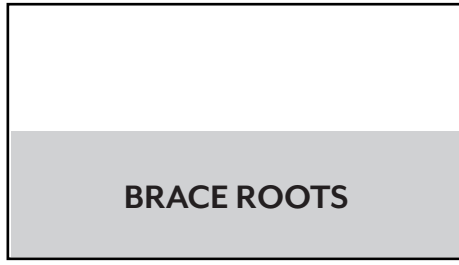
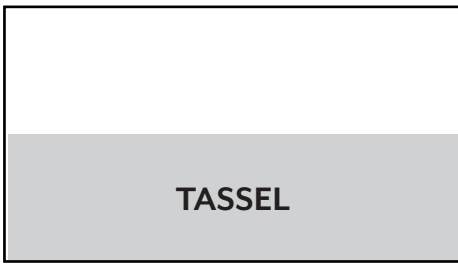


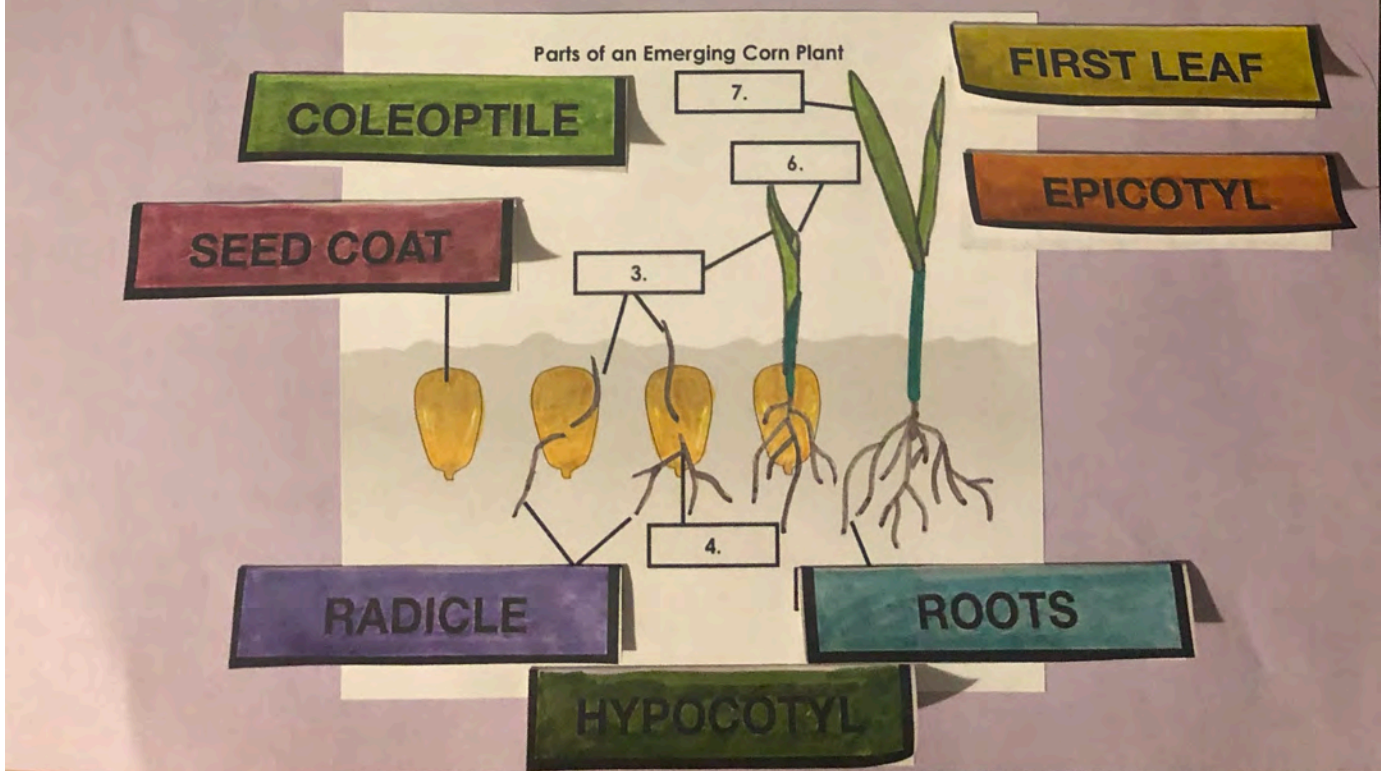
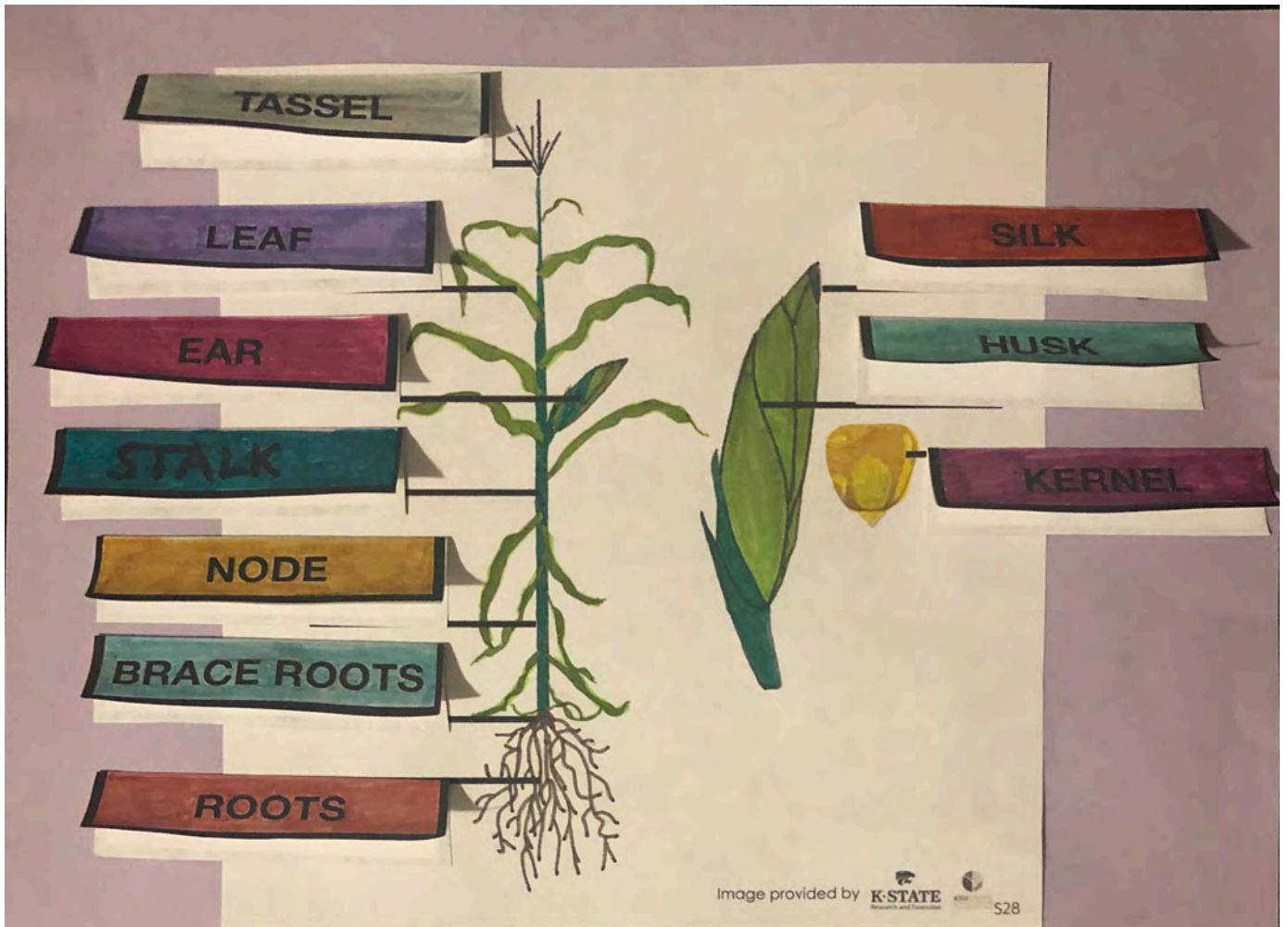
Parts of an Emerging Corn Plant



Parts of an Emerging Corn Plant







Corn Kernel Math with Ear of Corn Dissection

Directions: In this assignment, you will explore multiple ears of corn. From them, you will count the number of rows and kernels found on each ear of corn. You will then use the average mass of a kernel to determine how many kernels are in a container - without having to count every single one! Lastly, you will then find out how many kernels of corn are in a bushel. The weight of a bushel of corn can be found on the internet or somewhere on these pages.

Part 1: Explore an Ear of Corn

- You have multiple ears of corn at your station.
- For each ear of corn, **count the number of rows** and record them below:

Ear 1: _____

Ear 3: _____

Ear 5: _____

Ear 2: _____

Ear 4: _____

Ear 6: _____

a. Do they have the same number of rows? _____

b. Is it an even or an odd number of rows? _____

1 lb = 453.592 g

- Find the **total number of kernels** in each ear of corn by doing the following calculation: **count how many kernels are in one row and then multiply by the number of rows**. Show your work in the spaces provided.

Ear 1:	Ear 4:
Ear 2:	Ear 5:
Ear 3:	Ear 6:

- Find the **average number of kernels** for an ear of corn – this will be called **Multiplied Kernels**:

$$\text{average number of kernels} = \frac{\text{Total \# of Kernels}}{\text{\# of Ears of Corn}} = \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

- Then, actually **count the total number of kernels** on the ear of corn – this will be called **Actual Kernels**:

$$\text{actual average number of kernels} = \frac{\text{Actual \# of Kernels}}{\text{\# of Ears of Corn}} = \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

- Determine the **percent error** between **Multiplied Kernels (from #4)** and **Actual Kernels (from #5)**.

$$\% \text{ Error} = \frac{(\text{Actual \# of Kernels}) - (\text{\# of Multiplied Kernels})}{(\text{Actual \# of Kernels})} \times 100\% = \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

Part 2: How Many Kernels are in a Container?

- Your teacher has a container filled with corn kernels. You and your group are to **determine how many kernels are in the container without counting**. You will be using mass to determine the number of kernels.
- Your teacher has the **mass of the empty container**. Find the **total mass of the kernels and the container** by placing it on a scale. Use this mass and subtract out the mass of the empty container to find the **mass of the kernels inside the container**. Show your work inside the table.

Mass of Kernels and Container	Mass of Empty Container	Total Mass of Kernels in Container

- Determine **how many kernels of corn are in the container** by finding the **average mass of a corn kernel** and dividing that average kernel mass into the **total mass of the kernels in the container**.
 - Find the **total mass of each number of the kernel(s)** – 1, 5, 10, 20 and 50 kernels. **56 lbs**
 - Calculate the **average mass of a kernel for each set** = $\frac{\text{Total mass of Kernels}}{\# \text{ of Kernels}}$
 - Take the **average mass of the kernel found in 10(b)** and divide it into the **Total Mass of the Kernels in the Container** $\frac{\text{Total mass of kernels in container}}{\text{Average mass of a kernel}}$ this equals the **number of kernels in the container**.
 - Get the **actual number of kernels in the container** from your teacher.
 - Calculate the **percent error** for each kernel number $\frac{(\text{Actual \# of Kernels}) - (\text{Exp \# of Kernels})}{(\text{Actual \# of Kernels})} \times 100\%$

# of Kernels	1	5	10	20	50
Total Mass of Kernel(s)					
Average Mass per Kernel					
Total Mass of Kernels in Container					
Number of Kernels in Container					
Actual Number of Kernels in the Container (From Teacher)					
Percent Error					

Part 3: How Many Kernels of Corn are in a Bushel?

- Using the table above, find the **Average Mass per Kernel** that has the **smallest Percent Error**.

Place that value in the table below.

12 in. = 1 foot

2. Use the internet to find **how many grams are in a pound**.
3. Multiply the **number of grams in a pound** by the **number of pounds in a bushel**.
This is the number of **grams in a bushel**.
4. To find out how many **kernels are in a bushel**, divide the **number of grams in a bushel** by the **average mass per kernel**.

Average Mass per Kernel in grams	Grams in 1 Pound	Grams in a Bushel	Number of Kernels in a Bushel

Part 4: Estimating the Number of Corn Plants per Acre of Land (6-12th)

1. You will be estimating the number of corn plants in an acre of land based on the planting of 30-inch rows.
2. The teacher has placed multiple strips of tape down on the ground with spaced-out colored dots. These colored dots represent where a corn seed has been planted.
3. You will be counting the number of seeds for a distance of 17.5 feet. You will not be using a meter or yard stick for this distance. You will be using your feet.
4. Determine the number of inches in 17.5 feet by multiplying it by the number of inches in one foot. This conversion can be found somewhere on this paper or on the internet. Enter that number in the table below.
5. Using a ruler, determine the length of your foot in inches with your shoes on. We don't want smelly feet. Place that number in the table below.
6. Then determine how many of your feet equal 17.5 feet by dividing the Number of Inches in 17.5 Feet (#4) by the Your Foot in Inches (#5).
7. This is how many steps you will take along the taped seed row. Make sure to place one step directly in front of the other as you walk down the length of the seed row.
8. Determine the number of Corn Kernels in 17.5 Feet.
9. Calculate the number of corn seeds per acre by multiplying the Number of Corn Kernels in 17.5 Feet (#8) by 1,000.

Inches in 17.5 Feet	Your Foot in inches	How Many of Your Feet in 17.5 Feet	Number of Corn Kernels in 17.5 Feet	Number of Corn Seeds per Acre (x 1,000)

Questions

1. Which number of kernels (1, 5, 10, 20, 50) came the closest to the Actual Number of Kernels? _____
2. Which number of kernels had the highest percent error? _____
Explain why that number of kernels would give you the greatest error.

3. Using the internet, what is the average number of kernels for an ear of corn? _____
How does the average number of kernels you calculated compare to what you found?

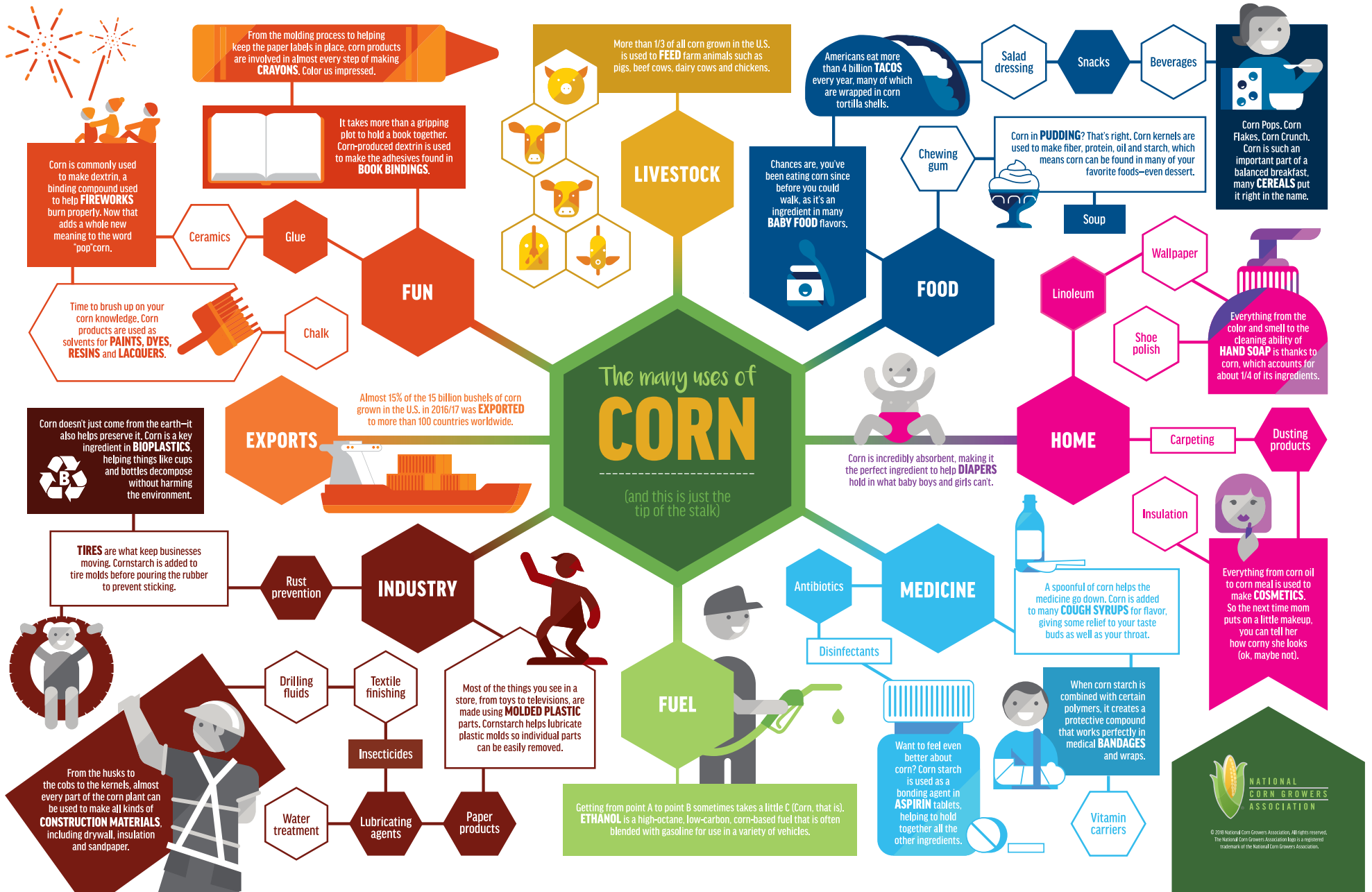
4. The average number of bushels per acre of corn in America is 176.4. How many kernels of corn are in the average American acre? Show your work below.

5. Using the number of corn plants you found in Part 4, how many kernels of corn will be in that acre? Show your work below.

6. The average human body contains 18% carbon. From that amount, the average percentage of carbon that comes from corn is 70% due to the many products that are derived from corn in our diet. We will find out how much carbon in your body comes from corn and then determine how many corn kernels you are!
 - a. How much do you or the average student weigh (in pounds): _____ lbs
 - b. Convert that into grams (remember 1 lb = 453.592 g): _____ g
 - c. Multiply your weight in grams by 0.18. This is how much carbon is in your body: _____ g
 - d. Multiply the carbon in your body by 0.70. The weight of carbon that comes from corn: _____ g
 - e. Divide the amount of carbon that comes from corn by your most accurate average mass per kernel found in Part 2 from above. This is the number of corn kernels that make up your body!

You are made up of _____ kernels of corn!

How many bushels of corn are you? _____ bushels of corn!



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Common Items Containing Corn

Toothpaste: Sorbitol is an ingredient in toothpaste derived from corn. It helps create toothpaste's flavoring and texture.

Yogurt: Uses high-fructose corn syrup as a sweetener; the cows that make the milk also eat corn in their daily meals.

Gum: Uses high fructose corn syrup and maltitol as sweeteners and sorbitol for flavoring.

Cosmetics: Blush and eye shadow often contain zeaxanthin, which is another name for corn.

Shampoo: Citric acid is a common ingredient in shampoos and conditioners and is derived from corn.

Diapers: Corn starch is used to soak up moisture in diapers.

Envelopes: Corn is used to make nitrocellulose glue, which holds envelopes closed so they can be mailed.

Corn Bread: The main ingredient is corn meal, which gives corn bread its gritty texture compared to other types of bread.

Handsoap: For many different purposes, at least 25% of the ingredients in some hand soaps contain or were derived from corn.

Windex: This glass cleaner contains at least 5 different ingredients derived from corn.

Jellybeans and Licorice: These candies not only include corn syrup of some form to give them their texture but also, powdered corn starch is used to coat their molds and allows manufacturers to more easily pop them out after they're finished being molded.

Corn Flakes: If you are someone who enjoys a hearty bowl of flakes for breakfast, you're eating the corn grit that has been steamed and flaked.

Paper, Recycled Paper and Cardboard: Industrial corn starch is used during the paper-making process.

Crayons and Chalk: Utilize industrial corn starch to get them out of their molds and corn products also help the paper labels adhere to the crayons.

Running Shoes- Currently, most shoes are made with oil-based plastics, but Reebok has announced that it will begin to make the sole of their new sustainable shoe with petroleum-free, non-toxic, industrial-grown corn.

Common Items Containing Corn

Spark Plugs: Spark plugs in your car are made from metal and ceramics. When the crystalline structures of cornstarch are heated to very high temperatures, they harden and it becomes a type of ceramic. The ceramic is able to withstand high temperatures and also withstands the corrosive properties of some specific acids.

Rubber Tires: Instead of using oil-based rubber, Goodyear and their research partner Genencor are using cornstarch to chemically bind the ingredients of its new kind of tire.

Fireworks: Some of the compounds in fireworks require a “binder” in order to burn properly. A common binder is dextrin, a light carbohydrate most commonly made from corn.

Popcorn: Popcorn is its own type of corn. There are three common types of corn; sweet corn, popcorn and field corn. The two we eat in their natural form are sweet corn and popcorn.

Pet Food: Pet food is regulated to the same level of safety as human food. Corn is used in pet food to create a balanced diet for all kinds of pets including dogs, cats and even fish.

Batteries: Corn starch is often used as an electrical conductor in batteries.

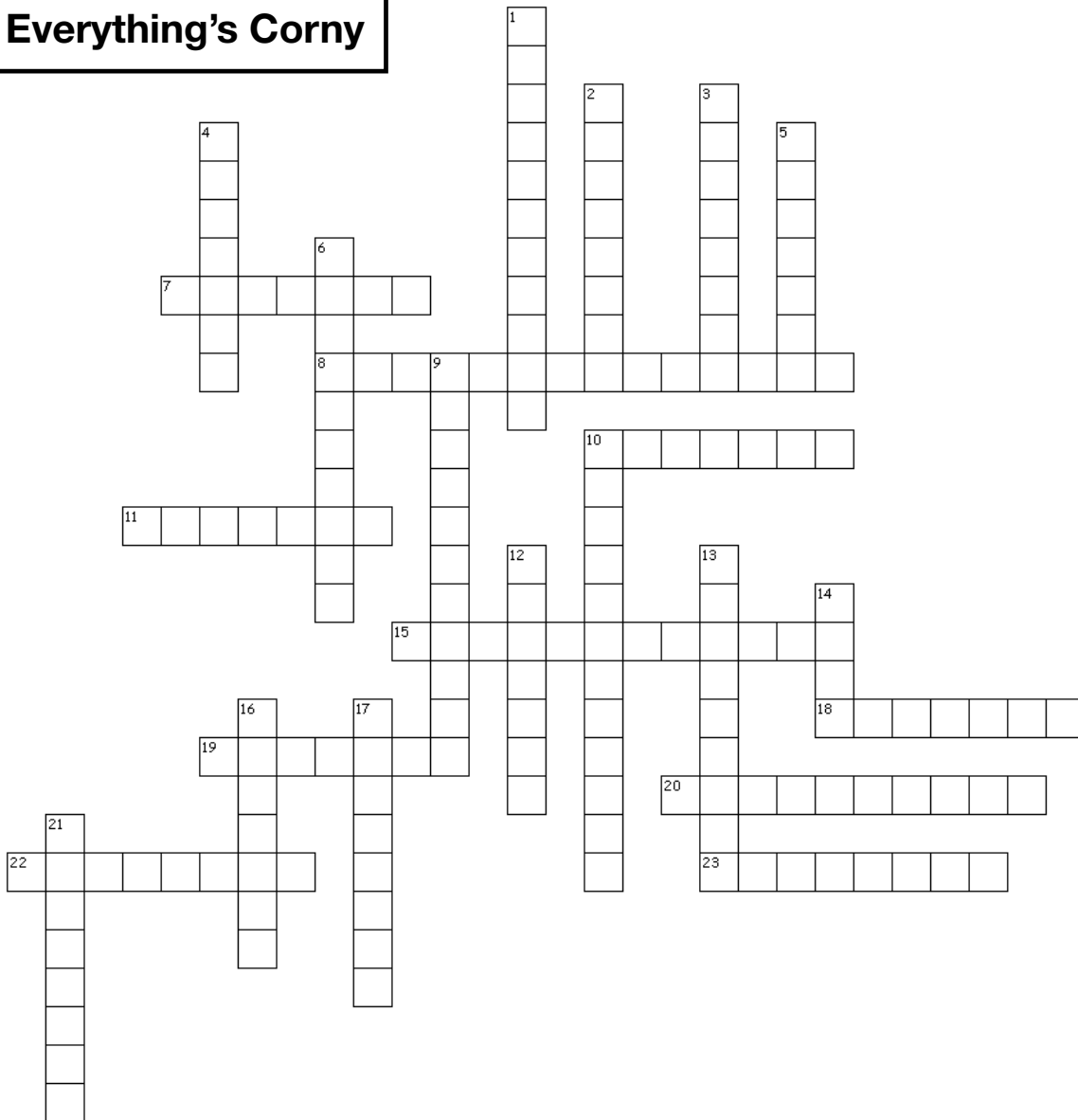
Deodorant: Uses corn starch because of its absorbent nature.

Hand Sanitizer: Contains ethanol which typically is made by fermenting corn.

Carpet and Other Textile Products: Corn-based textile products are often preferred to the petroleum based products because they are more environmentally friendly.

Plastic Products: While it’s not a widespread use like the other products, bioplastic is being used in many different products such as bags, containers and cups. Corn-based plastics are biodegradable and use up to 68% less fossil fuels during production than traditional plastics and are estimated to emit 55% less greenhouse gases.

Everything's Corny



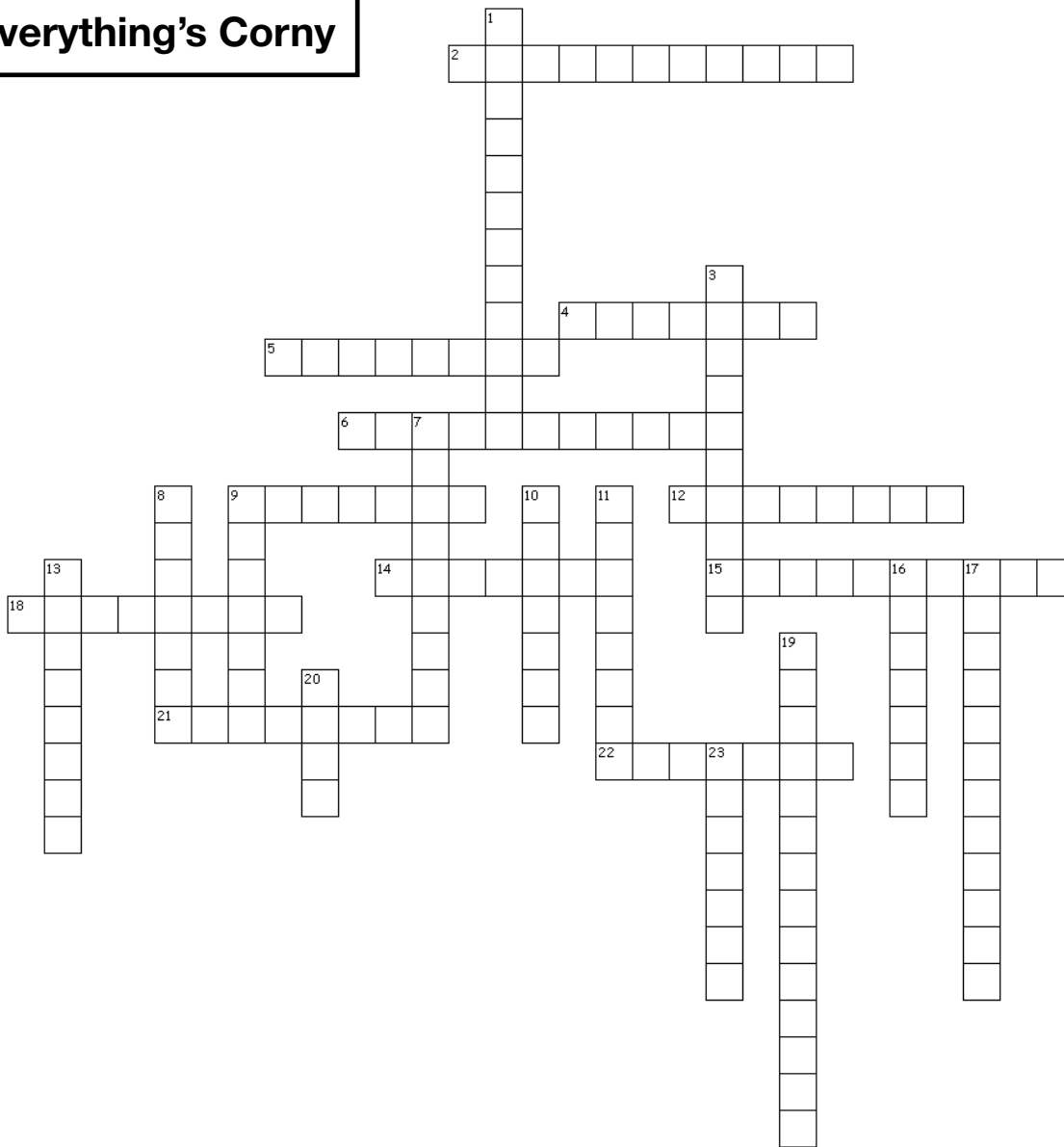
Across

7. Corn is an ingredient in these products in order to create a balanced diet for your animals
8. Corn is used to make this type of glue that seals envelopes shut
10. When crystalline cornstarch is heated to very high temperatures, it creates a _____ that is used in spark plugs
11. This type of corn is found in movie theaters and sports games
15. This type of corn syrup is used as a sweetener in many products
18. A carbohydrate used to bind the compounds in fireworks, aspirin and book pages together
19. We enjoy these corn-based products for breakfast
20. Found in shampoos and conditioners and many food products
22. More than a quarter of the ingredients come from corn to create the smell, color and cleaning ability of this product
23. Corn products are used as these in paints, dyes, resins and lacquers

Down

1. Corn is used to create these biodegradable, renewable alternatives to petroleum-based products such as utensils, cups and bottles
2. Gives corn bread that gritty texture
3. Found in toothpaste that helps with flavor and texture
4. This part of the corn plant can be used to make fiber, protein, oil and starch found in many foods
5. 15% of U.S. corn is shipped to over 100 countries around the globe
6. Absorbs moisture in diapers, thickens gravies and helps release products from industrial molds
9. Goodyear and Genencor are using corn starch as an alternative to this oil-based product
10. These types of materials are used to build homes and can contain almost every part of the corn plant.
12. Made from the fermentation of corn
13. Cornstarch is used as electrical conductors in these
14. More than a third of all corn goes to farm animals and is called _____?
16. Blush, eye shadow and many other cosmetics use corn as an ingredient but call it by another name
17. Cornstarch and polymers are combined together to form these products with protective barriers
21. Used as a sweetener in gum

Everything's Corny



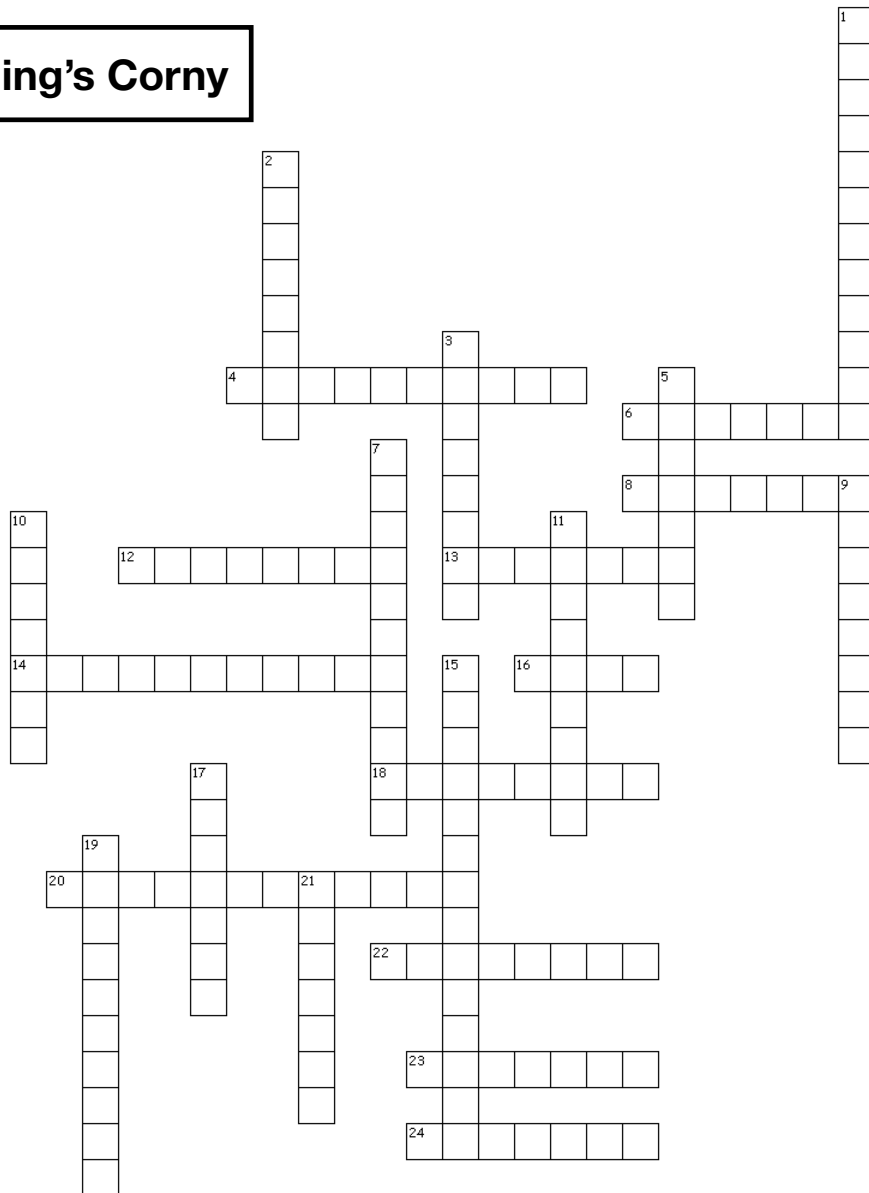
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17. These types of materials are used to build homes and can contain almost every part of the corn plant
19. Corn is used to make this type of glue that seals envelopes shut
20. More than a third of all corn goes to farm animals and is called _____?
23. When crystalline cornstarch is heated to very high temperatures, it creates a _____ that is used in spark plugs

Everything's Corny



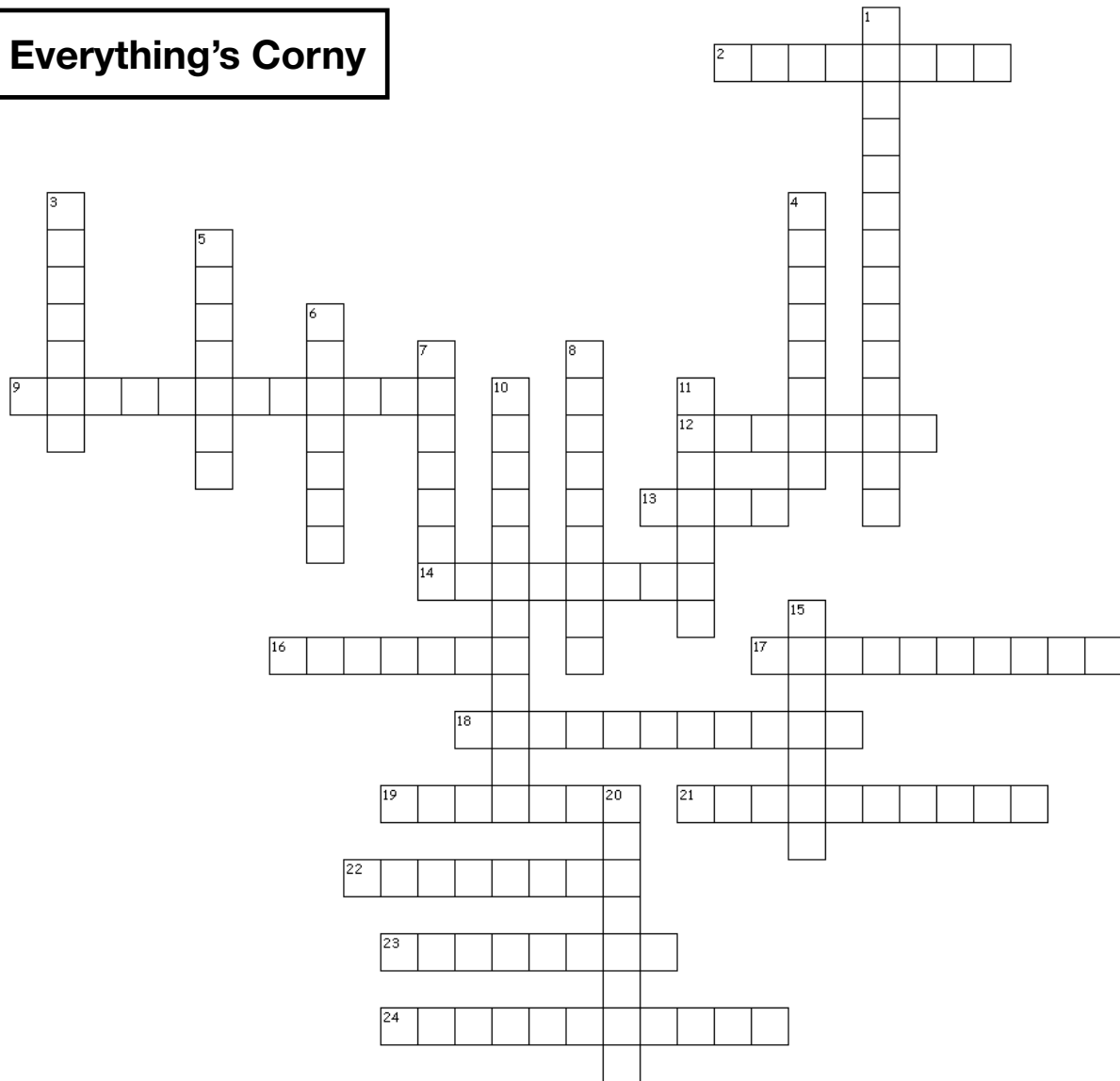
Across

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- 20. This type of corn syrup is used as a sweetener in many products
- 22. Corn products are used as these in paints, dyes, resins and lacquers
- 23. This type of corn is found in movie theaters and sports games
- 24. Blush, eye shadow and many other cosmetics use corn as an ingredient but call it by another name

Down

- 1. These types of materials are used to build homes and can contain almost every part of the corn plant
- 2. Used as a sweetener in gum
- 3. Cornstarch and polymers are combined together to form these products with protective barriers
- 5. We enjoy these corn-based products for breakfast
- 7. Corn is used to create these biodegradable, renewable alternatives to petroleum-based products such as utensils, cups and bottles
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Everything's Corny



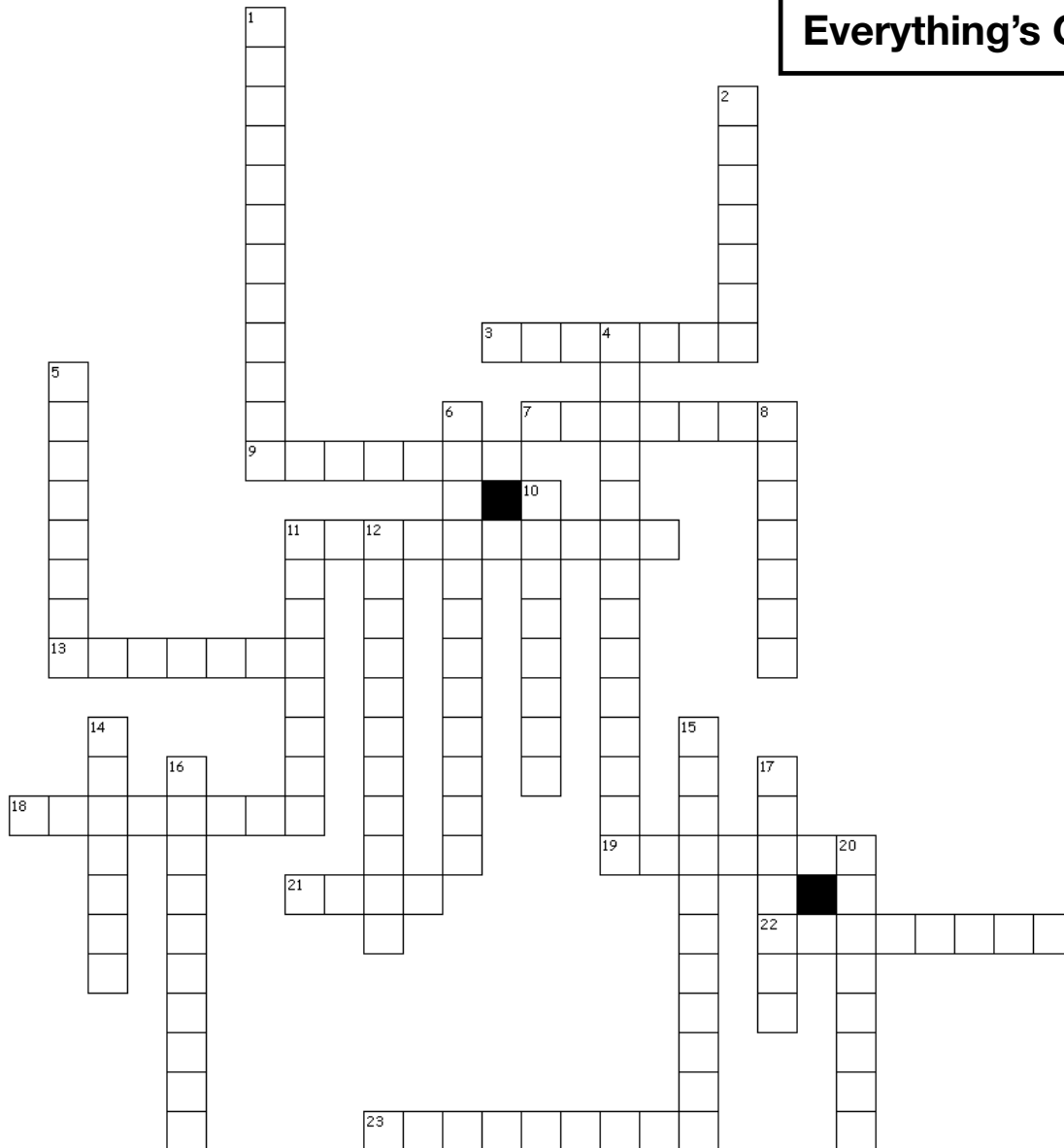
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Across

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Name: _____

Period: _____

Date: _____

Corn Graphs and Maths - World of Corn 2020

Directions: Students will use National Corn Growers Association's *World of Corn 2020* infographic to answer the following questions. This assignment is to help students find and interpret data from tables and graphs. Useful formulas can be found on the last page. Be sure to show your work in the spaces provided.

1. What is the percent increase in the number of **bushels per acre harvested** from 1929 to 2019?
2. What is the percent increase in the number of **acres harvested** from 2018 to 2019?
3. Out of **All U.S. Crop Acres Harvested**, what percentage was **corn (grain)** in 2019?
4. Based on the **Components of Yellow Dent Corn**, what percentage of the kernel is **starch**?
5. What is the **fat (oil) to protein to carbohydrate (starch)** ratio of **yellow dent corn**?
6. What is the percentage of **corn acres harvested** out of **corn acres planted**?
7. Using the number of **corn bushels produced** and the **corn crop value** in 2019, determine the **average price per bushel**.

8. Using the **nutritional label** (located on last page) from a 12-ounce can of Coca-Cola (www.coca-colaproductsfacts.com), how many cans of Coca-Cola can be made from **1 bushel of corn** when the amount of added sugars is **high fructose corn syrup**? Use 453.592 grams = 1 pound
9. In 2019, which **state** had the highest **average yield in bushels/acre**? Which **state** had the largest **total production** of corn?
- a. Highest average yield: _____ bushels/acre State: _____
- b. Largest total production: _____ 1,000 bushels State: _____
10. Which year saw the **highest price per bushel of corn**? Year: _____ Price: _____
11. What is the **Total World Corn Production** from 2019-2020 in millions of bushels? _____
12. Using the number of **bushels produced from 2019-2020**, what percentage of U.S. corn production is **exported** to other countries?
13. Looking at the **U.S. Corn Exports from 1999-2019**, why was **2012** the lowest year for corn exports?
14. Looking at the **Corn Processed by Segment 1999 – 2019**, what is the difference in millions of bushels in **Feed & Residual** between the highest processed year and the lowest processed year?
- Highest Year: _____, millions of bushels _____
- Lowest Year: _____, millions of bushels _____
- Difference: _____ millions of bushels
15. Looking at the **Corn Usage by Segment 2019** dot graph, determine how many **millions of bushels each dot represents**. Hint: make this easy on yourself. Look at a segment that has a nice whole number or percentage, like **sweeteners**.

16. Looking at **High-Fructose Corn Syrup Usage 1989 – 2019**, we see that peak usage was in 1999 and has slowly lowered each year to 2019. What is the **average decrease in HFCS usage**, in millions of bushels per year, in the 12 years between 1999 and 2019?
17. Looking at the **Sweetener Usage 1989 – 2019**, we see that the lowest level of usage was in 1989. If the use of sweeteners **increased at an average of 11.214 million bushels per year** for fourteen years, how many bushels of corn were used as sweeteners in 2019?
18. What percentage of **U.S. ethanol production** comes from **Iowa**?
19. What percentage of **U.S. ethanol production** comes from **Kansas**?
20. What percentage of planted **Biotech Corn Acreage in 2019** has **stacked traits**?

*****2 Question Bonus***Use the Corn Fed by Species 2006 – 2019 graph.**

Conversion factors: 56 pounds = 1 bushel 2204.62 pounds = 1 metric ton

21. Determine how much **grain, in pounds**, an average chicken consumes over its life if there were **9.2 billion chickens** in 2019.
22. Determine how much **grain, in pounds**, an average cow consumes over its life if there were **39 million cows** in 2019.

Helpful Mathematical Formulas

- $Percent\ Increase = \frac{End\ Value - Starting\ Value}{Starting\ Value} \times 100\%$

- $Percent = \frac{Individual\ Value}{Total\ Value} \times 100\%$

- Ratios: Find the smallest value and divide that number into the other numbers. It is OK to have final values with decimals.

Example $\rightarrow 4.5\ red : 18\ blue : 9\ green = \frac{4.5}{4.5}\ red : \frac{18}{4.5}\ blue : \frac{9}{4.5}\ green = 1\ red : 4\ blue : 2\ green$

- Conversions: Use conversion factors and dimensional analysis to find your answer.

12 inches = 1 foot 2.54 centimeters = 1 inch

- Example Question: How many inches are in 3.65 feet?

$$3.65\ feet \times \frac{12\ inches}{1\ foot} = 43.8\ inches$$

- Example Question: How many centimeters are in 3.65 feet?

$$3.65\ feet \times \frac{12\ inches}{1\ foot} \times \frac{2.54\ centimeters}{1\ inch} = 111\ centimeters$$

Nutrition Facts	
1 Serving Per Container	
Serving Size	1 Can
Amount Per Serving	
Calories	140
	% Daily Value
Total Fat 0g	0%
Sodium 45mg	2%
Total Carbohydrate	14%
39g	
Total Sugars 39g	
Includes 39g Added Sugars	78%
Cholesterol 0mg	0%
Protein 0g	
Vitamin D	0%
Calcium	0%
Iron	0%
Potassium	0%
Not a significant source of saturated fat, trans fat, cholesterol, dietary fiber, vitamin D, calcium, iron and potassium.	

Leaf Collar Method Student Worksheet

Name: _____

Group: _____

What can the corn plant tell the farmer?

Background:

Vegetative (V) stages are determined by the total number of leaves with visible collars (e.g., a plant with three visible leaf collars is at V3). A collar is the off white band at the base of the leaf blade where it extends away from the stalk. A new leaf appears every three to four days with good growing conditions until tasseling. As the plant grows, lower leaves are lost. These leaves must be counted; otherwise, the development stage will be misidentified. Split stalks to accurately determine the leaf stage. Each leaf is attached to a single node, and nodes are visible as lines across the split stalk. The first four nodes are usually indistinguishable within the crown. The 5th node is about 1/2 inch above the area that contains the first nodes. The node corresponding with the uppermost leaf, with a visible collar, defines the vegetative stage. This knowledge is important because it helps the farmer determine any inputs that might be necessary to add to his crop, as well as the crop's potential yield. Corn needs little fertilizer boost until V5, but requires a large nitrogen intake to promote yield from V8 until VT (tasseling). It is important to side dress (inject between corn rows) nitrogen before the V8 stage. This allows the plant to maximize its photosynthetic potential. Ear length is determined between the V12 and VT vegetative stages. Tassel emergence occurs from V17 to V22, depending upon the corn variety.

Procedure for Lesson:

1. Use a knife and cutting board to carefully split the stalk of a corn plant in half, vertically, down to the roots.
2. Remembering that the first four nodes are often indistinguishable within the crown, count the number of nodes to determine the vegetative stage that the corn plant is in.
3. Compare the nodes counted within the stalk to the number of leaf collars found on the outside of the plant.

Reflection

1. Why is it necessary to split the stalk to accurately determine what vegetative stage the corn plant is in?
2. How do the internal nodes compare to the external leaf collars found in/on the plant?
3. How can determining the vegetative stage of the corn plant help the farmer determine when to input fertilizers and predict the ear length?