



Chapter 1

Corn: Your Preference is the New Variety

Standards

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

MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms

Potential Extensions:

MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation

MS-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects the structure and function of the organism.

Objectives

Students will be able to:

list examples of beneficial characteristics that resulted from plant breeding.

assess potential crosses in a plant breeding program to be positive or negative.

Materials

Copies of activities (one per student)

Corn: What's Your Preference?

Corn: Find Your Variety

Agronomy Grow With It

Colored pencils or markers

A coin for each student

Time

Part 1: 25 minutes, Part 2: 40 minutes

Grades

6-8

Prior to the Activity

Read the entire *Agronomists Feed the World* chapter of the book *Agronomy-Grow With It!*

Author

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This activity is designed to provide an opportunity for students to evaluate a corn plant for traits that could be beneficial to society. In this process they will also see the basic steps that scientists use to select traits and to breed for different varieties of a specific crop to meet a production goal.

Have students read the *Agronomists Feed the World* chapter of the book *Agronomy-Grow With It!*

In the last 50 years the proportion of hungry people has decreased in developing countries

- Ask students why the proportion has decreased, what has changed
- Allow students to answer but let them talk about what could have changed... Most will say something about technology or wasting less.

Students should find more examples of what has changed to help decrease world hunger

Ask students "what do we use plants for?"

Students should respond with food, animal food, medicine, turf, fuel, fiber and protection and enrichment of soil. Students may need coaching on these uses, but could be coached to get the right answers (See page 10 of *Agronomy Grow With It* for extra examples of each use)

Ask students if all plants do the 7 tasks and have them explain

Students should quickly say no, and provide an example of something common like a tree and explain how we do not wear a tree, or use it to power our cars.

Once students provide these examples have them think of ways that these plants are specialized. How some trees will produce fruit, how a cotton plant will produce a fiber we use for our clothes, and finish with what they know to be the differences in corn.

Ask the class if all corn is the same? (No there are multiple varieties with different characteristics.) Then ask what different kinds there are.

Students should come up with corn varieties like sweet corn, corn for animals (field corn), popcorn, and potentially ornamental corn—if you can provide some pictures of the differences it may help.

Have the students independently think about what a good corn plant would be like (at this time you will need to hand out the first activity "Corn: What's Your Preference?")

Review the Activity

Explain some characteristics that corn varieties already express.

- **tall/short**—A taller corn plant would have more of an ability to get nutrients to its grain to produce more food. When the corn plant (not grain) is harvested as silage and fed to livestock we want more plant material to produce more feed. (a taller plant should produce more food)
- **long cob/short cob**—A longer cob will have more space for corn kernels to develop and will produce more grain. (A longer cob should increase production)
- **strong stem/weak stem**—Sometimes in harsh weather corn can be blown over or break. If this happens, the corn plant will not grow correctly and decrease the productivity of the plant. Blown over corn is also harder to harvest.
- **yellow kernel/multi-color**—The multi-color corn relates more to ornamental corn versus typical field corn for grain. The ornamental corn is used for the single purpose of being fun to look at.

AGRONOMY LESSONS
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Corn: Your Preference is the New Variety

- **thirsty/not thirsty**—This characteristic is related to the corn's ability to save water. If a corn plant is more drought resistant (not thirsty) it can thrive in areas that receive a lower amount of rainfall and still produce well.
- **healthy/unhealthy**—This characteristic relates to specific varieties that are resistant or more immune to specific pests or known concerns that a plant may be exposed to. A "healthier" corn plant in this scenario is going to withstand more of these issues without extra resources being used to prevent or treat an issue, which results in a decrease in production costs.

Read the directions with the students about how they will need to select specific traits from the options to draw their corn. *be sure they circle or underline their desired traits as some may be difficult to distinguish strictly from the drawing at the bottom of the page. Draw attention to the example image for a reference while they work and have students complete the activity (10-20 minutes).

At the end of the allotted time ask students what traits they selected and why they would be good.

Guide student responses toward identifying the traits that will help meet one or more of the 7 uses of plants.

Activity two picks up by directing the students to record the characteristics they selected for their idea corn in column two of the chart.

After students have recorded the ideal characteristics read the directions for the second step of the activity with the students. Be sure they understand how they are selecting the traits of the original parent. Hand out coins for each student to complete the second step.

Once the students have recorded the original parent characteristics they will begin to look ahead and think about what they will be trying to accomplish.

Ask the class if anyone got their ideal corn plant as their starting parent.

Most students will not have the same ideal traits. Pose the question of what are you going to do to get your ideal corn plant. Write your strategy in the lines provided.

Ask students if they looked ahead and saw the mating columns

Most will have looked ahead already and thought about the process of going from one trait to the next

Ask students what we know about mating and passing traits

Students should answer that you get traits from the parents

If needed ask if anyone has ever said that you look just like your mom or dad? Most will begin to think about getting traits from the parents

The next point is to get students to start thinking about changing the traits. How will they do that?

Ask students if they are exactly like one of their parents

Students should answer no—follow up and ask why don't you look like one parent

The students should answer with the simple fact that they have two parents and get traits from both.

This is a great time to introduce heredity—the passing of traits from parents to offspring. This is also a good time to explain that these traits are a part of the genetic code or directions that we call DNA, and that we get a copy of each parent's DNA.

- Tangent to talk about: sexual reproduction vs. asexual

Direct the students to use the strategy they outlined for achieving the ideal corn plant to select a mate for their corn.

Once students have found a mate it is important to explain the following:

The mating may only work for one person and is not mandatory for both to record the same mating.

The probability is low unless they cheated, but if a student did get the then you have some good options

You can tell them that they still need to find a mate to produce more seed. That mating should make them change characteristics—if not they selected a mate that would maintain the ideal corn which is the goal.

Students need to record their mate's traits in the Mate 1 column

The need to flip a coin to see if they get the new trait or keep the original trait

Remind students to record the new characteristics in the offspring column

Students should be instructed that the offspring is now the parent that they are using for the second generation.

This is a good time to explain how the second generation should be getting closer to the ideal corn plant

They can repeat the steps for the remaining generations to try to achieve the ideal corn plant. They will need multiple crosses (partners).

Mid way through the generations, try to spark student interest by seeing who is getting close to meeting their goal. Ask the class who is within 3 traits, 2 traits and even 1 trait. Naturally students will be competitive and will want to beat their classmates. At the completion of generation 5 see how many students were successful

Talk through the process of meeting the goal of producing the ideal corn plant. Ask the following questions and direct their responses to the anticipated answers

What was the strategy—should be something on the lines of selecting a mate that has the traits you are looking for.

Did this always work—No it probably did not each time, Explain how this is science it's not perfect, but repetition helps.

What made it not work—if there was a trait that was undesirable,

How do we fix that problem—limit the incorrect traits, this is a good time to bring up gene mapping

Explain that this is what Norman Borlaug did with wheat, and what B.B. Singh did with cowpeas. They took the seed from the plants that expressed the traits that they wanted. They did this enough times that they got the results that they wanted and were beneficial to the world.



Knowing that what you want doesn't always happen on the first try, you have major challenge ahead of you!

Using the ideal corn plant that you created on the other handout, you next need to complete the "ideal" column of the chart below.

Hint: to fit better in the table use the identifying letter in the characteristic column.

Once you have filled in the ideal characteristics, determine what you are characteristics you starting your breeding program with. To determine the characteristics of the original parent, will flip a coin. Heads = first option, Tails = second option.

Example: Height: Heads = Tall, Tails = Short

*** Be sure to record your original parent characteristics in the correct column**

After determining your original parent characteristics you will notice this is not your ideal corn plant. So, you need to breed your corn to create the ideal plant! What is your master plan to beat the challenge to create your ideal corn plant? Write your secret below.

Using your strategy above, select a mate that will help give you the perfect plant. Write their characteristics below in the "Mate 1 column."

*Each of you may not need the same characteristics so your mate might not need you to meet their goal!

In order to determine the next generation's characteristics you will follow the following rules of genetics:

- If the two plants share a characteristic (both tall) the next generation will be tall
- If the two plants have opposite characteristics you will flip a coin to see which characteristic the offspring will express
 - If heads, the offspring will have the characteristic that is listed first
 - If tails, the offspring will have the characteristic that is listed second
- After mating, the offspring becomes the new parent.
- You will need to use multiple crosses (other parents) to breed (make) the ideal corn plant!

Your challenge is to make your ideal corn plant. See if you can do this in 5 generations (abbreviated Gen.)

Characteristic	Ideal Corn	Original Parent	Mate 1	Offspring Gen. 1	Mate 2	Gen. 2	Mate 3	Gen. 3	Mate 4	Gen. 5	Goal Met? Y or N?
Height: T / S											
Cob Length: L / S											
Stem Strength: S / W											
Kernel Color: Y / Multi											
Water use: T / Not T											
Health: H / Not H											



For the following activity you need to draw and color a corn plant that has the following characteristics listed below. **Circle six** of the characteristics that your ideal corn is going to have. Follow the example below to help.

Example:

- tall/short
- long cob/short cob
- strong stem/weak stem
- yellow kernel/multicolor
- thirsty/not thirsty
- healthy/unhealthy



Characteristics: *circle six*

- tall (tall stalk) / short (short stalk)
- long cob / short cob
- strong stem (upright stalk) /
weak stem (stalk leaning over)
- yellow kernels / multi-color kernels
- thirsty (curled leaves) / not thirsty (straight leaves)
- healthy (perky leaves) / unhealthy (wilted leaves)

