Selective breeding vs. genetic modification

Focus questions	What are the advantages of selective breeding? How does selective breeding differ from genetic modification?
Vocabulary	Genetics, trait, drought, meiosis, genetic modification

The purpose of this activity is to simulate selective breeding as it is accomplished by plant scientists.

https://commons.wikimedia.org/wiki/File:Diabrotica_virgifera_virgifera_larvae.jpg

- According to Pioneer, the yield loss due to drought ranges from 40–80 bu/acre in Nebraska, with higher ranges in the west.
- Economic effects of drought can be up to $9 billion in a drought year.
- Economic impacts may include farmers who lose money because drought destroyed or lowered the yield of their crops.
- These economic impacts can be both direct, such as decreases in corn production, and indirect, as seen by increases in the price of animal feed.
- The traits that will help reduce the effects of drought in corn include: a strong root system, resistance to root worm, and resistance to seedling diseases.

The Starburst® candies in the cup represent different traits that are desirable in corn to provide drought resistance. A **strong root system** is important to drought resistance since strong roots support a healthy stem and plant and make it easier for water and nutrients to enter the plant. **Seedling disease resistance** will add to drought resistance if the corn has some natural immunity to fungi, bacteria, nematodes, and root-feeding insects. One of the root-feeding insects is called rootworm, which becomes a beetle as an adult. The larvae feed on the roots during the early part of the growing season. If the corn has **rootworm resistance,** it is more likely to survive drought as well.

Procedure

1. You have three Starburst candies. Which characteristics does your corn plant have? Circle the combination of traits you have.

R	**R**	**R**	**R**	**R**	**R**	**P**	**P**	**P**	**Y**
R	**R**	**Y**	**R**	**P**	**P**	**P**	**Y**	**P**	**Y**
R	**Y**	**Y**	**P**	**P**	**Y**	**Y**	**Y**	**P**	**Y**
Strong root system	Strong root system Seedling diseases resistance	Strong root system Seedling diseases resistance	Strong root system Rootworm resistance	Strong root system Rootworm resistance	Strong root system Rootworm resistance Seedling diseases resistance	Rootworm resistance Seedling diseases resistance	Rootworm resistance Seedling diseases resistance	Root- worm resistance	Seedling diseases resistance

Red (R) = strong root system; Yellow (Y) = seedling disease resistance; Pink (P) = rootworm resistance

2. Combine your Starburst with those of someone else at your table. Place your six traits in the cup.
3. Shake the cup.
4. Draw out three Starburst (traits). This represents the offspring from your cross.
5. Which characteristics does your new corn plant have? Circle the combination of traits you have.

R	**R**	**R**	**R**	**R**	**R**	**P**	**P**	**P**	**Y**
R	**R**	**Y**	**R**	**P**	**P**	**P**	**Y**	**P**	**Y**
R	**Y**	**Y**	**P**	**P**	**Y**	**Y**	**Y**	**P**	**Y**
Strong root system	Strong root system Seedling diseases resistance	Strong root system Seedling diseases resistance	Strong root system Rootworm resistance	Strong root system Rootworm resistance	Strong root system Rootworm resistance Seedling diseases resistance	Rootworm resistance Seedling diseases resistance	Rootworm resistance Seedling diseases resistance	Root- worm resistance	Seedling diseases resistance

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6. Select another corn plant at your table that has some or all of the desired traits. Cross your plant with that plant by repeating steps 2-4. How many offspring in the class have all three of the desired traits? (Report as the number that do out of the total possible.)

7. Why didn't choosing the parents result in all of the offspring having the desired traits?

8. How does meiosis affect the outcome? What are the limitations of this model?

9. How might plant breeders overcome these obstacles?

10. How much might it cost (in dollars and time) to make these modifications? What are the environmental costs and benefits?

Rubric for self-assessment

Skill	Yes	No	Unsure
Constructing Explanations: I constructed an explanation of the selective breeding process and the obstacles to it.			
Evaluate or refine a technological solution that considers structure and function, stability and change and the impact of human activities on natural systems: I can list the costs (both economic and time) and benefits of genetic modification			
I can explain how structure and function of genes and chromosomes impacts selective breeding.			
I can explain how selective breeding and genetic modification may have an impact on natural systems.			