

Soybean Hybrids



Introduction

Biotechnology can help create new plants that have been chosen for desirable traits. In order to get the best new seed or hybrid, scientists need to try many different combinations of parent seeds. A hybrid seed is created when you cross two genetically pure and different lines. Some traits that are wanted in hybrid soybean seeds are the ability to withstand higher temperatures, retain water better during times of drought, being able to fix nitrogen faster in order to better carry out life processes, and creating a more sustainable plant by having stronger roots and hardier stocks.



Grades: 8-10

Time Needed: One 45-min class period

Learning Objectives:

After completing this lesson, students will be able to:

1. Identify if their hybrid seeds have some or all desired qualities wanted in a soybean
2. Use Punnett squares to determine what potential traits the hybrid will have and its likelihood of getting those traits
3. Explain the benefits and/or downfalls that the randomness genetic variation creates when breeding a hybrid soybean

Materials:

- Soybean Hybrid Student Page (one per student)
- Soybean Parents (cut up & enough for a set for every pair)
- Dice
- Colored pencils, markers, etc.

Next Generation Science Standards (NGSS)

As a result of activities in grades 8-10, all students should develop:

Topic

- **LS3:** Heredity: Inheritance and Variation of Traits

Performance Expectations

- **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.
- **HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Dimensions

Practices:

- Developing and Using Models

Disciplinary Core Ideas:

- **LS3.A:** Inheritance of Traits
- **LS3.B:** Variation of Traits

Crosscutting Concepts:

- Patterns
- Scale, Proportion & Quantity



Instructional Process

1. Ask students “What is a hybrid?” Use their car example to get the real meaning of something made by combining two different elements. Bring up that this is done with plants, like soybeans, by using biotechnology.
2. Explain how they are going to be a seed company that sells their product to farmers today, and they will cross breed two different parent seeds to get a hybrid seed. They need to be able to evaluate if their hybrid seed will have a better growing potential than the parent seeds. Of course genetic random variation always plays a part and that is where the Punnett squares and a roll of the die comes in.
3. Hand out copies of the Soybean Hybrid Student Page to each student to look through. Read the student directions and answer any questions. Walk around the room and let pairs randomly choose the male and female seed they will use as parents.
4. Help students with Punnett squares and the probabilities as needed. Encourage them to draw detailed pictures of their new hybrid baby. Have students share their pictures and some new advantages their hybrid seed has.

Modifications

For high school students:

- Have students write a paragraph of the abiotic environmental scenario that would be best suited for their particular seed. Share these scenarios to see if other students’ hybrids would survive or perish.
- Debate on whose hybrid seed has the best traits and if that should become the next super-crop of soybeans to be bred.

Differentiation in the 6-8th grade classroom

For advanced learners:

- Have students create a pedigree chart of their soybeans, adding a third generation. Add a negative carrier trait, like fungal rot to two breeding seeds and see how this translates into genotypes for all parts of the pedigree chart.

For struggling learners:

- Highlight the chosen parents on the paper with blue (male) and pink (female) highlighters. Highlight the outsides of the Punnett squares with coordinating colors. Walk through one of the Punnett squares completely.
- Allow or add percentages (ex. $\frac{1}{2}$ = 50%) to probability if student finds that more comfortable.



Sources

Information

<http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf1164w.htm>

Images

<http://agrocambodia.wordpress.com/2011/06/02/soybean-exports-to-rise-on-high-prices/>

Soybean Hybrid Student Page



Name: _____

Core: _____

Directions:

1. Work in pairs to randomly select your soybean pairs to crossbreed and create a hybrid seed (one male and one female).
2. Fill in the Punnett squares to see the possibilities of your hybrid seed's traits. Father's traits go on the left side; Mother's traits go on top. Fill in the chances for each Punnett square below each square.
4. Roll the die to determine the hybrid offspring's trait. Roll a 1 and they'll have box 1's trait, etc. Roll again if you get a 5 or 6 (until you get a 1, 2, 3 or 4). Repeat for all four traits.
5. On the back of this paper, list your hybrid baby's unique phenotype and genotype. Draw a picture of your seed including its special traits and ideal surroundings!

Heat Resistance

1	2
3	4

High /
 Medium /
 Normal /

Drought Resistance

1	2
3	4

Super /
 Strong /
 Normal /

Parents

Mom:
 Dad:

**Congratulations on
 your new baby seed!**

Nitrogen Fixation

1	2
3	4

Fast /
 Normal /

Root & Stock Strength

1	2
3	4

Super /
 Good /
 Normal /



Soybean Hybrid Babies!

Phenotype (trait)

Genotype (ex. AA, Aa, aa)

1. _____
2. _____
3. _____
4. _____

Picture of Soybean Hybrid (including optimal surroundings):

Soybean Hybrid Student Page

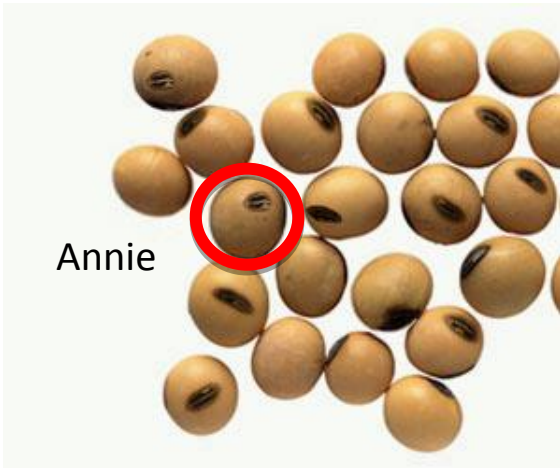


Male	Heat Resistance		Drought Resistance		Nitrogen Fixation		Root & Stock Strength	
	Phenotype	Genotype	Phenotype	Genotype	Phenotype	Genotype	Phenotype	Genotype
Albert	Medium	Hh	Strong	Dd	Fast	Ff	Super	SS
Bob	High	HH	Super Strong	DD	Fast	FF	Normal	ss
Clyde	Normal	hh	Normal	dd	Normal	ff	Good	Ss
Danny	Medium	Hh	Super Strong	DD	Fast	FF	Good	Ss
Elijah	High	HH	Strong	Dd	Normal	ff	Good	Ss

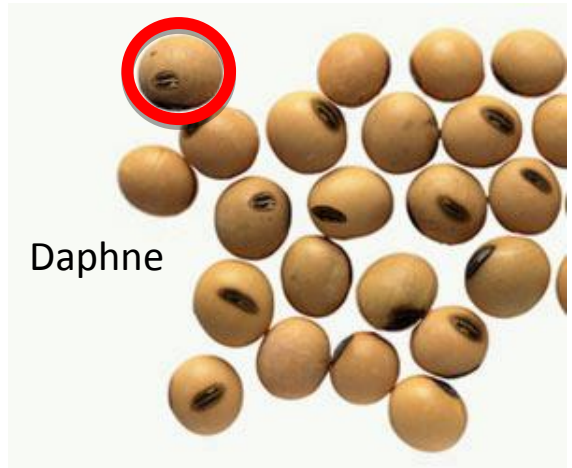
Female	Heat Resistance		Drought Resistance		Nitrogen Fixation		Root & Stock Strength	
	Phenotype	Genotype	Phenotype	Genotype	Phenotype	Genotype	Phenotype	Genotype
Annie	Medium	Hh	Super Strong	DD	Normal	ff	Good	Ss
Betty	High	HH	Normal	dd	Normal	ff	Good	Ss
Claire	Normal	hh	Super Strong	DD	Fast	Ff	Normal	ss
Daphne	High	HH	Normal	dd	Fast	FF	Super	SS
Erica	Medium	Hh	Strong	Dd	Fast	Ff	Super	SS

Traits	Heat Resistance	Drought Resistance	Nitrogen Fixation	Root & Stock Strength
	-being able to withstand higher temperatures High HH Medium Hh Normal hh	-retaining water when other plants are dehydrated Super DD Strong Dd Normal dd	-needed to make amino acids, protein, and DNA Fast FF or Ff Normal ff	-growing stronger roots and hardier stocks Super SS Good Ss Normal ss

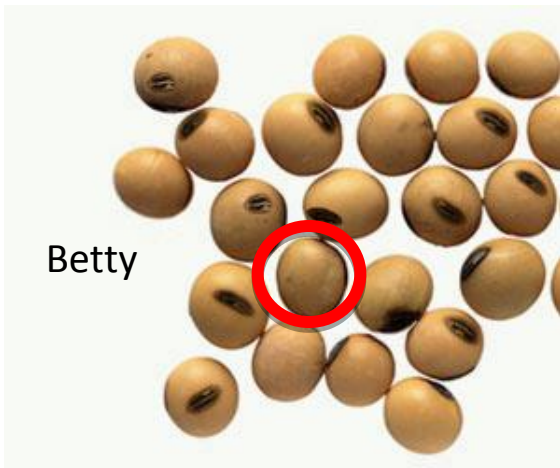
Soybean Female Parents



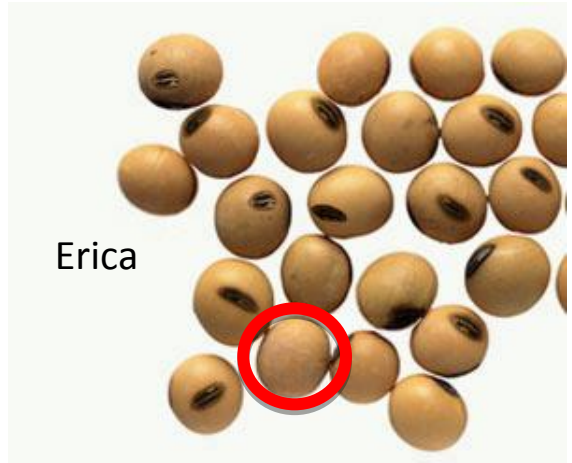
Annie



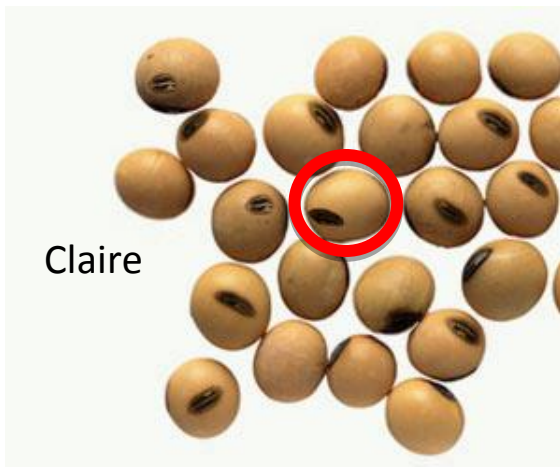
Daphne



Betty

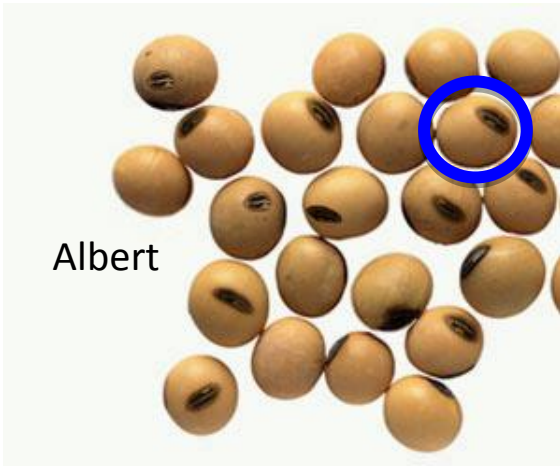


Erica

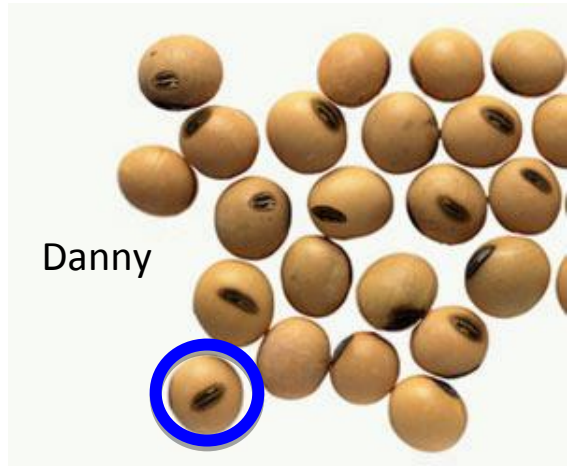


Claire

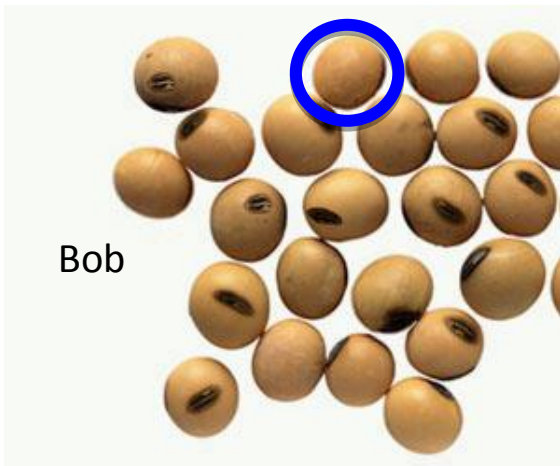
Soybean Male Parents



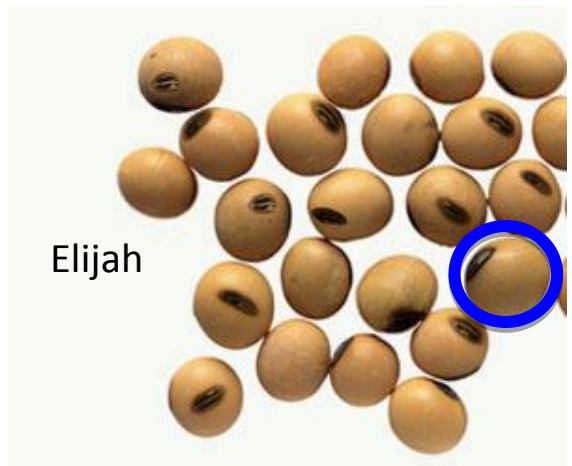
Albert



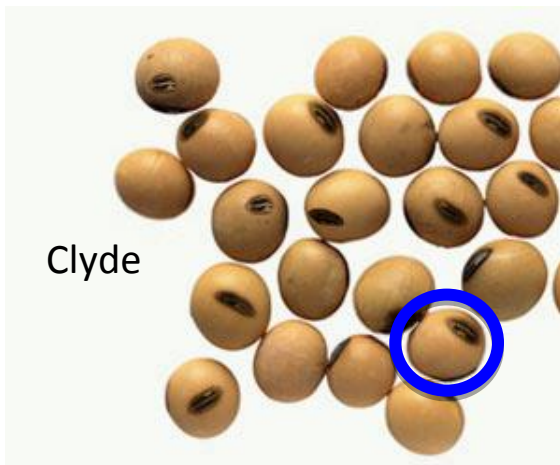
Danny



Bob



Elijah



Clyde