

Brick Genetics: Soybean Style



Objectives: Students will learn about inherited traits, calculate genotypes and phenotypes of soybean plants, and create models using interlocking building bricks to exhibit their knowledge.

Oklahoma Academic Standards:

Science: 8.LS1.5; 8.LS3.2; 8.LS4.5; B.LS1.1; B.LS3.1; B.LS3.3

Math: 6.N.3; 6.D.2; 7.D.1; 7.D.2

Teacher Background:

Like other sexually reproducing organisms, soybeans have inherited traits that they receive from their parents. This lesson focuses on what inheritance is and how organisms inherit those traits. Students learn about genotypes and phenotypes and how genes are expressed through dominant and recessive traits, they then calculate genotype and phenotype ratios using Punnett Squares. They also get a look at the possible effects of incomplete dominance on organisms. Note: Genetic inheritance can be a very complicated subject, and sometimes it is more than one gene that codes for a characteristic. This lesson acknowledges this fact, but during calculations assumes that one gene codes for a trait.

Important Vocabulary:

Inheritance: Transmission of traits or information from one generation of individuals or cells to the next

Genes: segments of DNA that code for a characteristic (trait)

Alleles: variants of a gene

Genotype: The genetic makeup of an organism

Phenotype: The physical characteristics of an organism

Trait: A specific characteristic of an individual

Dominant Allele: Allele that is phenotypically expressed over another allele

Recessive Allele: Allele that is only expressed in absence of a dominant allele

Incomplete Dominance: when a dominant allele may not completely mask a recessive allele

Homozygous: Having two identical alleles for a particular gene

Heterozygous: Having two different alleles for a particular gene

Punnett Square: Diagram that can be used to predict the genotypes and phenotypes resulting from a genetic cross

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Materials:

- [Brick Genetics Slides](#)
- [Brick Genetics Worksheet](#) - 1 per student
- Two-sided coins (pennies, nickels, dimes, quarters- any will work!) - 1 per group of 3-4
- Pen/Paper for notes
- Interlocking building bricks
 - Note: It is also possible to use other alternative materials.

Lesson:

1. Show students images of parents and offspring. This could be of any sexually reproducing organism. OR use the Brick Genetics slides provided: [Brick Genetics Slides](#). Ask them: Why does the offspring look like its parents?
 - a. Accept all answers at this point, but guide them towards the words inheritance, traits, and genes.
1. Explain to students that offspring inherit some traits (characteristics) from their parents and that genes are segments of organisms DNA that code for this traits. Tell students that organisms have both a genotype (genetic makeup) and phenotype (physical or expressed appearance of traits). An organism's genotype determines their phenotype.
1. Explain that alleles are variants of a gene and that they code for the same trait (ex: hair color), but they can be expressed differently (black hair, brown hair, blonde, etc.) For most genes, one allele is inherited from each parent- making a total of two that aid in the expression of a gene. Alleles can be dominant or recessive. Ask students: What does dominant and and recessive mean?
 - a. Accept all answers. Make sure students end with an understanding that dominant traits are expressed over recessive ones because they are dominant (powerful/influential). This does not mean that they occur more frequently- just that they show up, or are more powerful in expression, if they are present.
1. Write a capital letter on the board, or hold one up that you wrote on paper. Tell students that we can label genes and alleles with the letters of the alphabet. Capital letters represent a dominant allele and lowercase letters represent a recessive allele. Feel free to use your own example, or use the labrador coat color example in the slides. We could label the gene that codes for coat color with a C. A black coat is dominant so a capital "C" would be used. A chocolate coat is recessive so a lowercase "c" would represent this allele.

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Lesson:

5. Remind students that an organism gets one allele of a gene from each parent- making two total. If they inherit two identical alleles for a gene they are called homozygous (the same). Ex: Two alleles for black coat color would be “CC” or homozygous dominant and two alleles for a chocolate coat would be “cc” or homozygous recessive. If they inherit two different alleles they are called heterozygous (different). Ex: One black coat allele and one chocolate coat allele “Cc”. A dominant allele is expressed over a recessive, so this lab would have a black coat.
 - a. Show students the images of labs on slide 10. Ask them to work with a partner to determine the possible genotypes of each dog.
 - i. Answer: Black coat could be “CC” or “Cc” and chocolate coat would be “cc”
5. Draw an example of a punnett square diagram and have students copy one on a sheet of paper. Explain that punnett squares are diagrams that we can use to predict genotypes and phenotypes of offspring. Fill one in with them. You may utilize the lab coat color one provided in the slides, or create your own!
5. Let students know that in some instances, a dominant allele may not completely mask a recessive one- this is called incomplete dominance. An example would be a straight haired lab breeding with a curly haired poodle. Some offspring may end up with a wavy coat (which is neither straight nor curly- but in-between!).
5. Ask students what traits of a soybean plant they think may be inherited.
5. Tell them that flower color and pod color are two of these traits and we will be utilizing them today to practice calculating genotypes and phenotypes.
 - a. Soybean flower color is designated with a, “W” and that purple is dominant and white is recessive “w”. Incomplete dominance can occur and lead to flowers that are neither purple or white- but somewhere in between.
 - b. Soybean pod color is designated with a, “L”. Black pod color is dominant and represented with a capital “L” and tan pods are recessive and designated with a lowercase “l”. Incomplete dominance can occur and lead to pods that are neither black or tan- but somewhere in between.
5. Have students get in a group of 3-4 and get out their building brick sets. Give them different genotypes (Ex: WW, Ww, and ww for flower color) and have them create a soybean plant with those characteristics. Note: if the genotype is Ww then the flower would not be purple or white- but a shade in between (incomplete dominance). Check for their understanding.
5. Pass out a copy of the Brick Genetics Worksheet to each student and have them complete the tasks in groups. Use this as a formative assessment of concepts taught.

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Image Sources:

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