

5 E Lesson on Solving Monohybrid Punnett Squares with Coding

Engage: Freckles Introduction

Freckles are small, concentrated irregularly shaped spots of skin pigments called melanin. Freckles are dominant (F) and primarily controlled by the MC1R gene.

A person that is *heterozygous* for freckles would have a *phenotype* that shows freckles on their skin and possess the *genotype* Ff. This person could provide either the *dominant allele*, F, or the *recessive allele*, f, to their offspring through the sex cells, also called *zygotes*.

You will be conducting this engagement exercise in partners. Find a partner and appoint one person Partner A, and the other person Partner B.

1. Look around the classroom and count how many people have freckles. _____
2. Determine Partner A's Phenotype: *Circle One* Freckles or No Freckles
3. Determine Partner A's possible Genotypes: _____
 - a. If there is more than one possible Genotype, flip a coin to determine which Genotype to continue with: Heads → FF Tails → Ff
4. Determine Partner B's Phenotype: *Circle One* Freckles or No Freckles
5. Determine Partner B's possible Genotypes: _____
 - a. If there is more than one possible Genotype, flip a coin to determine which Genotype to continue with: Heads → FF Tails → Ff

Each person's genotype represents the two alleles that they can pass on to their offspring!

Explore: Monohybrid Scratch Inquiry

Students will utilize the hands-on Scratch activity to explore the concept of genetic processes through monohybrid cross Punnett squares: <https://scratch.mit.edu/projects/274859804/>

6. Complete the Monohybrid Cross Simulation with the freckles genotype information acquired above with your partner.
7. On the left of the Punnett Square, put Partner A's alleles. On the top, put Partner B's alleles.
8. Use the Punnett Square to determine the genotype of the offspring between Partner A and B.
9. Use the T-Chart to list the genotypes and the probability of each phenotype, Freckles or No Freckles, in the 4 offspring.

| Genotype | Phenotype |
|----------|-----------|
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10. Continue to explore the Monohybrid Cross Simulation, while attempting to make connections with the following words:
 - a. Alleles
 - b. Dominant
 - c. Recessive
 - d. Heterozygous
 - e. Homozygous
 - f. Parent Genotype and Phenotype
 - g. Zygote
 - h. Offspring Genotype and Phenotype
 - i. Probability

Explain: Student Note accommodating Monohybrid Cross Review PowerPoint

Genetics: A field of biology that studies heredity, or the passing of traits from parents to offspring!

We can see that the labradoodle received the _____ trait from its dad, the Labrador, and received the _____ trait from its mom, the Poodle!

Fill in the Blank Options: 1. Brown Colour 2. Hair Texture



Genes and Chromosomes

- The chromosomes are contained in the nucleus of the cell.
- Chromosomes are made of _____.
- Chromosomes are a long chain of _____.
- A gene is a segment of DNA that controls a _____ and two different forms of a gene are called _____.

Hereditary Trait

- The characteristics that an organism has, such as _____, _____, tall or short, skin color.
- _____ must be present for a trait to show up in the offspring.
- One allele comes from the 1st parent and the other allele comes from the 2nd parent. When fertilization occurs, the new offspring, a _____, will have _____ for every trait.

If a parent has 2 alleles for a trait, how does the parent only pass 1 allele to their offspring?
Ideas:

- The answer is the cell division of _____.
- _____ is the cell division that forms _____, which are _____.
- During meiosis, the DNA is replicated and then separated into _____.

- This way, each _____ passes _____ for each gene to their offspring → _____
- The capital letter, Y, represents a dominant allele.
- The lower-case letter, y, represents a recessive allele.

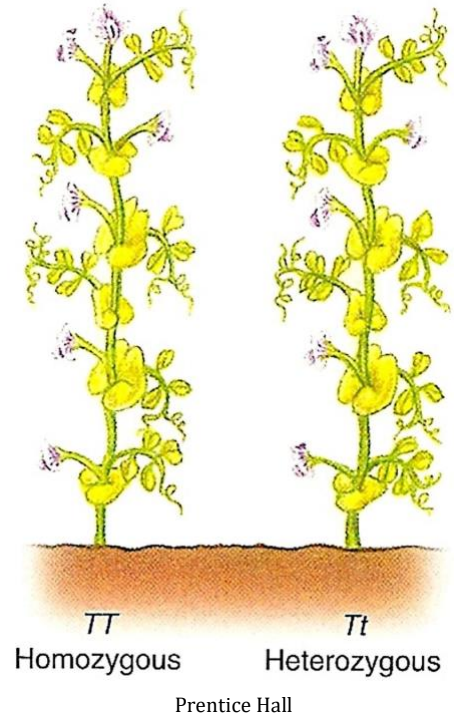
Genotype versus Phenotype

Genotype:

- Refers to the two alleles an individual has for a specific trait
- If identical, genotype is homozygous (TT, tt)
- If different, genotype is heterozygous (Tt)

Phenotype:

- Refers the physical appearance of the individual... The observable expression of the genotype. (“what you see”)



| Genotype | Phenotype |
|----------|-----------|
| TT | Tall |
| Tt | Tall |
| tt | Dwarf |

Probability

- If we know the genetic makeup of parents, we can determine what type of offspring they can produce.
- We can determine the probability of producing different types of offspring.
- Probability: _____

Punnett Squares

- Punnett Squares are used to show allele combinations that might results from a genetic cross between two parents.
- The alleles of the first parent will be placed on the left, and the alleles of the second parent on the top of the Punnett square.
- The possible gene combinations of the offspring will be placed inside the squares, representing zygotes.

- The letters represent the alleles.
 - A capital letter represents a _____ allele.
 - A lower-case letter represents a _____ allele.

Fill in the Blank Options: 1. Recessive 2. Dominant

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Question 1. The trait for being tall is dominant, T, over the recessive trait for being short, t.

A. What are the genotypes of the parents?

B. What are the phenotypes of the parents?

C. What are the genotypes of the offspring?

D. What are the phenotypes of the offspring?

E. What is the probability that each offspring genotype and phenotype will be present?

Question 2. In dogs, the allele for short hair (B) is dominant over the allele for long hair (b). Two short haired dogs have a litter of puppies. Some of the puppies have short hair and some of the puppies have long hair. Use the Punnett Square and T-Chart to answer the following questions.

A. What are the genotypes of the parents? _____ , _____

| | |
|----------|-----------|
| Genotype | Phenotype |
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B. If the litter of puppies contained 12 pups, how many would you expect to have short hair?

C. How many would you expect to have long hair?

Elaborate: Monohybrid Scratch Extension

Extend/remix the Monohybrid Scratch program, <https://scratch.mit.edu/projects/274859804/>, by coding in various additional functions, such as but not limited to:

- Add an Introduction
- Change the Background
- Add a Sprite Character
- Add a Monohybrid Cross Question
- Label for Parent Genotypes
- Label for Parent Phenotypes
- Label for Zygotes
- Add Probability Calculator for Zygote Genotypes
- Add Probability Calculator for Zygote Phenotypes
- Add Explanation for What Has Occurred

Brainstorming Space: