

POLYGENIC TRAITS

Background:

Polygenic traits are traits that are controlled by more than one gene, ie. height, weight, hair color, skin color (basically anything dealing with color). This allows for a wide range of physical traits. For example, if height was controlled by one gene A and if AA = 6' and Aa = 5'7" and aa = 5', then people would either be 6', 5'7", or 5'. Since height is controlled by more than one gene this does not occur and a wide range of heights is possible.

Learning Objectives: to use M&Ms to represent genes and simulate how height is inherited in humans.

Materials: 6 M&Ms in a cup graph paper

Procedure:

1. Each group will shake the M&Ms in the cup and dump them onto a paper towel.

2. Record the number landing on the M side and the number landing on the blank side into a data table.

Title it and label all the columns.

3. Repeat sets 1 and 2 for a total of 10 trials.

4. Complete table 2 by adding up the number of times the following situations occurred.

0 tails and 6 heads ;1 tails and 5 heads; 2 tails and 4 heads; 3 tails and 3 heads; 4 tails and 2 heads ;5 tails and 1 heads 6 tails and 0 heads

5. Record your results from table 2 on the board with the class results.

6. Record the class results in table 2

Data Table 2 will look like this. Copy it into your science notebook and give it a title.

| Toss results | 0 M 6 blank | 1 M 5 blank | 2 M 4 blank | 3 M 3 blank | 4M 2 blank | 5 M 1 blank | 6 M 0 blank |
|------------------|----------------|----------------|----------------|----------------|---------------|----------------|----------------|
| Your group total | | | | | | | |
| Class totals | | | | | | | |

7. Use the following height table to construct a bar graph and to answer the discussion questions.

| Toss Results | Height |
|-----------------|------------|
| 0 M and 6 blank | 5 ft 1 in |
| 1 M and 5 blank | 5 ft 3 in |
| 2 M and 4 blank | 5 ft 5 in |
| 3 M and 3 blank | 5 ft 7 in |
| 4 M and 2 blank | 5 ft 9 in |
| 5 M and 1 blank | 5 ft 11 in |
| 6 M and 0 blank | 6 ft 1 in |

- The M side represents the dominant gene and the blank side represents the recessive gene.

Data Analysis: write a sentence or two that summarizes the data trends.

Discussion:

- 1) Do parents give (All or Half) of their genetic material to their children?
- 2) Explain ways that the use of the M&Ms accurately represents inheritance?

Example for questions #3-10: A man is 5 feet 7 inches tall, has 3 Ms (dominant genes) and 3 blanks (recessive genes). He will give 3 genes to his child. These 3 genes can be given randomly.

- He can give 3 dominant genes and no recessive genes
- He can give 2 dominant genes and 1 recessive gene
- He can give 1 dominant gene and 2 recessive genes
- He can give 0 dominant genes and 3 recessive genes

These are all the possible combinations that he can give his child. The height of the mother will dictate the genes that she will give to the child. The combination of the mother's genes and the father's genes will decide the height of the child.

3) If a male is 5 feet 9 inches tall, it means that he has 4 dominant genes and 2 recessive. He will only give 3 genes to his child. What are the possible combinations of genes that he can give?

- He can give _____ dominant and _____ recessive
- He can give _____ dominant and _____ recessive
- He can give _____ dominant and _____ recessive

4) The male is 5 feet 7 inches and the female is 5 feet 5 inches. Is it possible for them to give their child the necessary genes so the child can be 5 feet 11 inches tall? Explain your answer. Diagrams are often useful.

5) If 2 parents are 5 feet 7 inches, is it possible to have a child that is 6 feet tall? Explain how this is possible.

6) If the male is 5 feet 5 inches tall and the female is 5 feet 3 inches tall, what is the tallest height that their child could attain? Explain.

7) If the male is 5 feet 7 inches tall and the mother is 5 feet 3 inches tall, what is the shortest height their child could attain?

8) How are polygenic traits different from traits that only require 2 genes?

9) Why do you think that some children are taller than their parents?

10) Coloration in humans – hair and skin color – is a polygenic trait involving at least 3 known genes.
Each capital letter in the box below represents an active gene for melanin production color).

| | |
|------------|-----------------------------------|
| 6 capitals | Very dark black skin (MM, MM, MM) |
| 5 capitals | Very dark brown (Mm, MM, MM) |
| 4 capitals | Dark brown (Mm, Mm, MM) |
| 3 capitals | Medium brown (Mm, Mm, Mm) |
| 2 capitals | Light brown (Mm, Mm, mm) |
| 1 capitals | Light tan (Mm, mm, mm) |
| 0 capitals | White (mm, mm, mm) |

Explain how it is possible for 2 parents with dark brown skin/hair color to have a baby with much lighter skin/hair coloration.