

Introduction to Genetics

Animals and plants possess a great variety of CHARACTERS. Character is the general term for a heritable feature such as flower color among plants or eye color among animals. Humans have various hair and eye color, heights, etc. Plants can be tall or short, have red, yellow or white flowers, etc. A guinea pig can have white or brown fur which can be long, short or curly. TRAITS are different versions of the same character and describe how the individual looks or appears to you. GENETICS is the study of how these hereditary traits are passed on from one generation to another. It is a fascinating study and one that will enable you to understand how you may have inherited certain hereditary characteristics you possess. You will also understand how traits you have would be passed on to your offspring and future generations.

1) Write the definition for GENETICS presented earlier without looking back.

2) List 4 of the traits mentioned in the first paragraph in this topic.

3) List some specific genetic traits that you possess.

BASIC CONCEPT NUMBER ONE:

4) EACH TRAIT is determined by TWO GENES. The genes are on chromosomes inside the nucleus of each one of your cells. You will learn more about this later. If a person has blue eyes, how many genes would be needed to produce blue eyes? _____

5) If a geranium plant was a special short variety and produced only red flowers, how many genes would that plant possess for those two traits? _____

6) A person has blond, curly hair and blue eyes. How many genes would be needed to produce these traits? _____

7) Write the symbol for the allele of each character Gregor Mendel studied with pea plants. Use the symbols geneticists use. **The letter to denote an allele is usually the first letter of the dominant trait. An uppercase letter indicates dominance and a lowercase letter indicates recessive.** For example, the symbols for seed color would be yellow (Y), green (y).

Character	Allele	Symbol	Allele	Symbol
Seed color	Yellow	Y	Green	y
Seed shape				
Flower color		P		p
Pod color				
Pod shape				
Flower position	Axial		Terminal	
Stem length				

8) Since each trait is represented by 2 genes, a pea plant with a yellow seed would be represented as **YY** and a pea plant with a green seed would be **yy**. The observed appearance of a trait is called its **PHENOTYPE**. The symbolized form or gene formula for that trait is called its **GENOTYPE**.

Write the genotype and phenotype for a pea plant with a round seed shape below.

- 9) What is the genotype of a pea plant with a purple flower? _____
 What is the phenotype of a short pea plant? _____
 What is the genotype of a short pea plant? _____

10) When a tall pea plant is crossed (mated) with a short pea plant, all the offspring are always tall. This means that tallness is **DOMINANT** over shortness. Shortness is said to be a **recessive** trait. This is the reason geneticists use capital letters to represent DOMINANT trait and lower case letters to represent RECESSIVE traits.

Which is the dominant flower color, purple or white? _____

Which flower position, axial or terminal, is the dominant trait? _____

Which flower position is recessive? _____

- 11) Are dominant traits symbolized with capital or lower case letters? _____
 Are recessive traits symbolized by capital or lower case letters? _____
 The letter selected as the symbol always comes from which trait? _____

12) If a tall plant is crossed with a short plant... TT x tt ... all the offspring are tall. Remembering that each parent contributes genetic material to the offspring, what would you predict to be the genotype of these tall offspring? _____

13) Note: this new plant has a gene for tallness and a gene for shortness. The fact that the plant is tall illustrates the principle or **dominance**. The **t** gene for shortness is dominated by the presence of the **T** gene for tallness and shortness is not expressed. If a pea plant with green pod color **GG** is crossed with a pea plant with a yellow pod color **gg**, what would the **genotype** of the offspring be? _____
 What would the **phenotype** be? _____

14) Crosses are often diagrammed as follows:

Purple flowered pea plant (PP)	X	White flowered pea plant (pp)
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What are the genotypes for the 2 parent plants above? _____

What is the genotype for the offspring? _____ phenotype? _____

15) Two terms are routinely used by geneticists to distinguish between the 2 different types of genotypes. Notice that a genotype can have the same genes in the pair: **TT**, **tt**, or **RR**, **rr**. This kind of genotype is called a **HOMOZYGOUS** genotype. Homo means "same" and zygous means "in the zygote", therefore **HOMOZYGOUS** means the 2 genes in the zygote are the same. Also note that the 2 genes in the zygote can be different, as with **Tt**, or **Rr**. This condition is called **HETEROZYGOUS**. Hetero means different. Indicate whether each of the following genotypes are homozygous or heterozygous:

BB _____ **Rr** _____ **rr** _____ **Aa** _____ **YY** _____

17) In review, and without looking back, see if you can define the 6 terms:

- a) GENOTYPE -
- b) PHENOTYPE -
- c) HOMOZYGOUS -
- d) HETEROZYGOUS -
- e) DOMINANT -
- f) RECESSIVE -

18) See if you can apply definitions to the following statements:

When we notice a person's blue eyes, we are noticing his (genotype or phenotype).

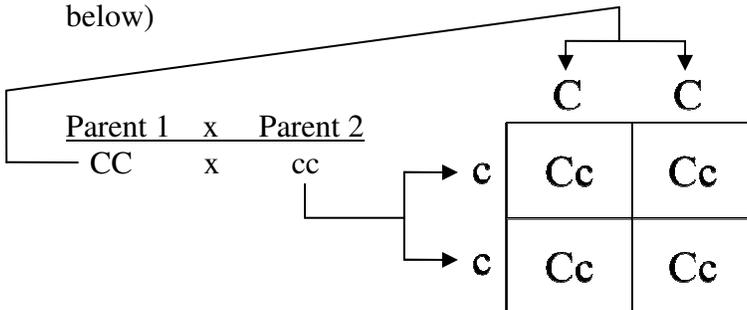
When one symbolizes a trait, what is it called? _____

This genotype for short pea plants is (homozygous or heterozygous)?

19) See if you can assign symbols for genotypes according to the principles learned. When an animal with curly hair is crossed with an animal with straight hair, all the offspring are curly haired. The curly-haired parent would appropriately be symbolized as _____ and the straight-haired parent would be symbolized as _____.

The offspring would be symbolized as _____ and would have _____ hair. Which trait is dominant? _____

Sample Punnett square: The above problem could be done using a Punnett Square (shown below)



Possible offspring:
 Genotypes: 100% Cc
 Phenotypes: 100% Curly

20) The offspring from the previous cross are termed F₁ (first offspring). Create a Punnett square and show the possible offspring for a cross between the F₁ generation.

Parent 1 x Parent 2
 Cc x Cc



Possible Offspring:
 Genotypes:

Phenotypes:

Monohybrid Cross Problems

Work out the following problems in your notebook. Show all of your work for each problem. Circle the final answers or answer.

- 1) Usually, but not always, human eye color is inherited as if brown eyes were dominant and blue eyes were recessive. Assume that this is correct for this problem and any others in this unit. (**B** = brown, **b** = blue)

A blue-eyed mother **bb** is married to a brown-eyed man (heterozygous **Bb**). What is the chance that their first child will be blue-eyed? Brown-eyed?

- 2) A tall pea plant (**Tt**) is crosses with a short pea plant (**tt**). What fraction of their offspring would you expect to be tall? Note that tall is dominant and shortness is recessive. (Use the square method)
- 3) Cross a white guinea pig **Ww** with another white guinea pig **Ww**. Both parents carry a gene for blackness (**w**) which is not expressed. In other words, both are heterozygous. Use the square method and answer the following:
- 3a. What fraction of the F1 offspring will be white? What % white?
- 3b. What fraction will be black? What % black?
- 4) Show all possible genotypes from the following cross: (Indicate the fractions of each genotype.)

Gg X gg

- 5) If **G** in the above problem is green apples and **g** is red apples, what would the fractions of each phenotype be in the two crosses in the above problem?
- 6) A brown-eyed mother and a blue-eyed father found that their first child was blue-eyed. What is the genotype of the mother? (The exact genotype)
- 7) What is the percent chance that the couple in problem #6 would have a second child that has brown eyes?
- 8) In cats, assume that a spotted coat is dominant to a white coat. A white mother cat gives birth to two white kittens and two spotted kittens. What are the genotypes and phenotypes of the father cat?
- 9) A man with blue eyes marries a brown-eyed woman whose mother had blue eyes. What portion of the children would be expected to have blue eyes? Show the genotypes of all people involved.