

Mendelian Genetics and Natural Selection  
Teacher's Guide

Cyanogenesis and Mendelian Genetics

1. Define the following terms:

- a. heredity: transmission of traits from parents to offspring
- b. gene: A unit of heredity; also, a region of DNA that is transcribed as a unit.
- c. allele: either of 2 or more alternative forms of a gene
- d. cyanogenic glucosides: cyanide-containing sugars (linamarin and lotaustralin) responsible for cyanide production in white clover
- e. linamarase: Enzyme responsible for triggering cyanogenic response from the cyanogenic glucoside
- f. Petiole: part of the plant that the 3 leaflets are attached to
- g. Cyanogenesis: The release of cyanide when tissue is damaged.

2. Complete the following sentences:

- a. A cross that involves only one trait with two phenotypes is called a monohybrid cross
- b. A cross involving two different traits is called a dihybrid cross
- c. The Principle of Independent Assortment states that the inheritance of alleles for one trait is not affected by the inheritance of alleles for a different trait if the genes for those traits are located on separate chromosomes.

Applying Mendel's Concepts

1. There are 2 alleles of the gene that controls the ability to produce the cyanide-containing sugar. In order to express this trait, the clover must have a dominant allele at the C gene. Using upper-case or lower-case letters for dominant and recessive alleles, write the allele combinations that could be found in a clover plant. Underline those that would produce the cyanogenic glucoside.      CC   Cc   cc

2. There are 2 alleles of the E gene, which controls the production of the linamarase enzyme required to break down the cyanogenic glucosides and release cyanide. In order to express this enzyme, the clover must have a dominant allele. Using upper-case and lower-case letters, write the allele combinations that could be found in a clover plant. Underline those that would produce the cyanide-releasing enzyme.

EE   Ee   ee

3. Clover plants inherit the gene for the cyanogenic glucoside and the enzyme separately. Write the possible genetic combinations in the table below and indicate whether they would result in the production of cyanide. The first one is done as an example.

Genotype	Cyanide (y / n)
CCEE	Y
<i>CcEE</i>	<i>Y</i>
<i>ccEE</i>	<i>N</i>
<i>CCEe</i>	<i>Y</i>
<i>CCee</i>	<i>N</i>
<i>CcEe</i>	<i>Y</i>
<i>Ccee</i>	<i>N</i>
<i>ccee</i>	<i>N</i>

### Clover Genetics and Natural Selection

1. Define the following terms:

- a. Genotype: *the combination of alleles for a given gene; the genetic make-up of an organism*
- b. Phenotype: *the physical appearance or function of an organism as determined by their genotype as it is expressed in the particular environment in which that organism lives.*
- c. Natural selection: *differential survival and reproduction of some individuals over others in a population based on their phenotypic differences.*
- d. Evolution: *changes in species over multiple generations*

2. Complete the following sentences:

- a. The relative ability of an individual to survive and reproduce is its fitness.
- b. The sum total of the genetic material of organisms in a population that exchange genes with one another is their gene pool.
- c. Stabilizing selection favors individuals with the average phenotype.
- d. Polymorphism occurs when two genetically different forms of a trait are present in a population.