GENETICS: THE STUDY OF HEREDITY

Mendel's Work

Gregor Mendel was a high school teacher from Austria who developed the foundation of genetics. He worked with pea plants in the monastery where he lived in the 17th century. Without his work the study of heredity would not be where it is today.

Gregor wondered how and why pea plants had different physical characteristics, otherwise known as traits. Some of the pea plants grew short while others grew tall, and some had green pods while others had yellow pods.

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The P G

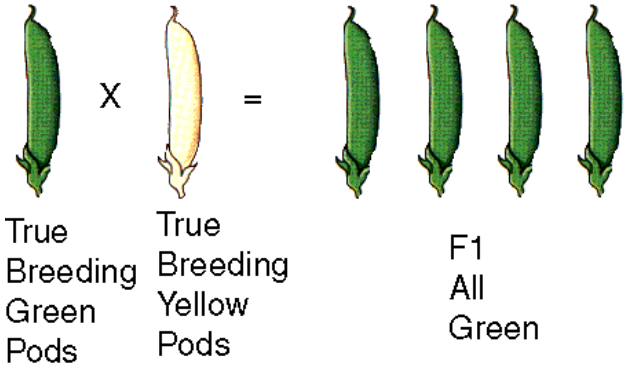
A purebred parent. This is achieved by letting plants with a certain trait reproduce for many generations. Mendel crossed a purebred short stem pea plant with a purebred tall stem plant. He called it the P generation or the parent generation. Mendel called the first generation the F_1 generation. The F stands for the filial, or 'son' in Latin, generation and the $_1$ stands for which generation it is from. All of the offspring in the F_1 generation were tall. Mendel allowed the offspring (F_1 plants) to grow and reproduce. The results of the F_2 generation were a mix of tall and short plants.

Dominant and Recessive Alleles

From Mendel's work on peas, he was able to hypothesize that the traits existed in pairs and that each parent contributed one trait to the offspring.

What is an Allele?

Mendel reasoned further that one trait can be masked by another trait in the parents. For example, the purebred parents for green and yellow pod colors F_1 generation will all have a green pod. So the yellow pod color will not show up at all in the F_1 generation.



In the F_2 generation the yellow pod color comes back at a ratio of about 3:1.

An allele is the different forms of a particular trait or gene. The gene that controls the pod color has one allele for green and another allele for yellow. Each generation of pea plants inherits one allele from each parent, a total of 2 alleles, for each physical characteristic.

A **dominant allele** is the allele that will always show up in an organism if the allele is present in the organism. So in the pea pod example, the green allele is the dominant allele.
A **recessive allele** is the allele that will be masked if the dominant allele is present. The only possible way that the recessive allele will show up is if the dominant allele is not present at all.

Lesson Checkpoint: What is a dominant allele?

Hybrids

A hybrid is the F1 generation that has two different forms of an allele.

Probability and Heredity

Probability is the chance that a certain event will occur. If you were to flip a coin into the air and let it hit the ground, which side would it land on?

There are two different possibilities, heads or tails. It is equally probable that the coin will land on the heads side as it is that it will land on the tails side.
This translates to… the probability of a coin landing on heads or tails is 1 in 2. There is a 50% chance that the coin will land on the heads side and there is a 50% chance that it will land on the tails side totaling 100%.
Mendel's probability illustrated that probability can be used to predict an organisms traits.

Lesson Checkpoint:
What is the probability of a coin landing on tails?

Punnett

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They show the different combinations of alleles that are possible with a particular trait and show the ratio's of those traits. Probability of this Punnett Square: GG = 25%, Gg = 50%, and gg = 25%

Phenotypes and Genotypes

There are **four important terms** that geneticists use on regular basis and they are phenotype, genotype, homozygous, and heterozygous.

- A **phenotype** is the physical appearance of a particular organism. A pea plant can have one of two different physical appearances for pod color: either green or yellow.

- The **genotype** is the genetic make-up of a particular organism. An organism has two separate alleles for a trait. The allele combination is the genotype.
- A **homozygous** organism is one that has two of the same alleles for a particular trait. A pea plant with the alleles GG has a green pod while a pea plant with the alleles gg has a yellow pod. Both are said to be homozygous (Homozygous = the same).
- A **heterozygous** organism is one that has two different alleles for a particular trait. A pea plant with the alleles Gg has a green pod in every circumstance and are considered to be heterozygous (heterozygous = different).

Chromosomes and Inheritance

A chromosome is a strand of DNA that contains genes which define the traits of the individual. Chromosomes are passed on from parents to their offspring through the sex (eggs or sperm). These sex cells contain ½ of the total number of chromosomes as do the other cells that make up the rest of the body.

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The Chromosome Theory of Inheritance

These concepts led to the chromosome theory of inheritance that states that genes are carried via chromosomes from the parents to their offspring. Each sex cell contains exactly half of each parent's total number of chromosomes through a process known as meiosis.

All organisms have a specific number of chromosomes that are different according to their particular species.

Each chromosome is made up of thousands of different genes and on those chromosomes are genes that have two alleles on opposite chromatid that can either be the same or different from one another.