**Mendelian Transmission**

This problem-solving task is based on Mendelian principles of genetic transmission.

Mendel investigated contrasting phenotypic traits of pea plants - that is, observable traits (e.g., seed color) with just two phenotype values (e.g., yellow, green) - and developed the following model of genetic transmission for these traits:

• each trait is determined by a single gene;

• each gene has two alleles, or possible alternative forms: a dominant allele (represented by a capital letter) and a recessive allele (represented by a small letter);

• each individual has two copies of each gene and simple dominance applies:

* a Homozygous Dominant organism, with 2 dominant alleles (GG), has the dominant phenotype, (yellow, in the case of seed color),
* a Homozygous Recessive organism, with 2 recessive alleles (gg), has the recessive phenotype, (green, in the case of seed color),
* a Heterozygous organism, with 1 dominant and 1 recessive allele (Gg) has the dominant phenotype, (yellow in the case of seed color);

• in reproduction, each offspring inherits one copy of each gene from each parent;

• the single gene copy that each parent transmits is selected randomly with equal probability;

This model can be summarized in the following six Punnett squares, which display the offspring genotypes and phenotypes that result from crossing two parent strains. Each of the four cells in a Punnett square represents 25% of the offspring.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Parent 2**  **yellow** | |  |  | **Parent 2**  **yellow** | |  |  | **Parent 2**  **green** | |  |
| **Parent 1**  **yellow** | G | G |  | **Parent 1**  **yellow** | G | g |  | **Parent 1**  **yellow** | g | g |  |
| G | GG  yellow | GG  yellow |  | G | GG  yellow | Gg  yellow |  | G | Gg  yellow | Gg  yellow |  |
| G | GG  yellow | GG  yellow |  | G | GG  yellow | Gg  yellow |  | G | Gg  yellow | Gg  yellow |  |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Parent 2**  **yellow** | |  |  | **Parent 2**  **green** | |  |  | **Parent 2**  **green** | |  |
| **Parent 1**  **yellow** | G | g |  | **Parent 1**  **yellow** | g | g |  | **Parent 1**  **green** | g | g |  |
| G | GG  yellow | Gg  yellow |  | G | Gg  yellow | Gg  yellow |  | g | gg  green | gg  green |  |
| g | Gg  yellow | gg  green |  | g | gg  green | gg  green |  | g | gg  green | gg  green |  |

In this problem-solving task, each problem focuses on a single trait in a plant with two phenotypic values. The phenotypic values of three strains are presented, (e.g., pink flowers, blue flowers, blue flowers) and the student’s task is to determine the genotype of each strain by performing crosses.