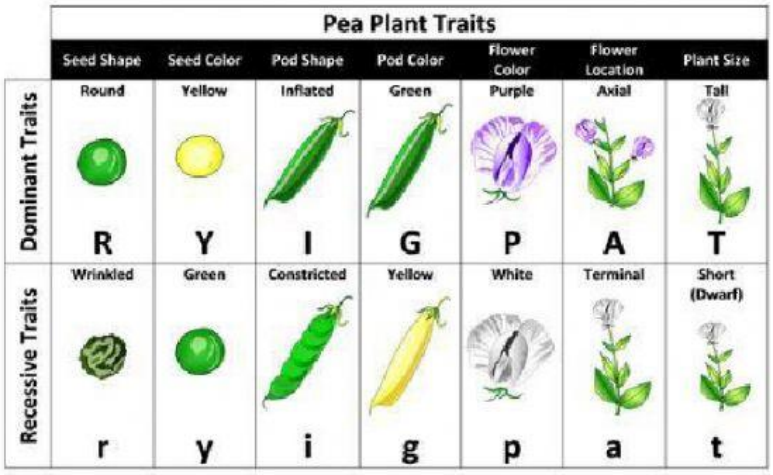
INHERITANCE - MENDELIAN GENETICS

Gregor Mendel was a priest of the Augustinian order who lived in a monastery in the 1800's. He started a major experimental hybridization program to trace the transmission of hereditary characters in successive generations. His interest in such experiments stemmed from the fact that plant and animal breeders could produce a variety of new forms by crossbreeding of individuals.

Mendel chose the pea (*Pisum sativum*) as his study organism because of its ease of culture, pollination, and high proportion of successful seed germination. In these plants, he chose 7 traits:



https://www.ontrack-media.net/biology/bm2l4aimage1.jpg

Mendel thought that each trait was passed on as a "hereditary unit". Also, each of the seven traits chosen had 2 "alternatives" each. For any given trait, one of the "alternatives" was dominant and the other one recessive. Today, we understand that what Mendel called a "hereditary unit" is what we call a **gene**, and the "alternatives" are its **alleles**. In his work, Gregor Mendel also related his results to the fact that, in sexual reproduction, new organisms are produced from the fusion of two gametes.

You will follow Mendel's experimentation process through a series of crosses that will show the traits used, and the genotype and phenotype of the parents and offspring.

Please, follow the guide and read the instructions and questions carefully. For the purpose of these exercises, we will follow some basic ground rules of Mendelian genetics:

- One letter represents one trait
- An upper-case letter indicates a trait is dominant (a dominant trait masks the expression of a recessive trait)
- A lower-case letter indicates a trait is recessive (a recessive trait is only expressed when the dominant allele is absent)

Part I. Practicing the relevant concepts: genotype, phenotype, diploid, haploid, homozygous, heterozygous.

a) Mark the following genotypes as diploid (d) or haploid (h).
b) **For the diploid genotypes only**, indicate whether they are homozygous or heterozygous.
c) Indicate the phenotype for each of the genotypes (use the table above)

Genotype	Tt	A	PP	R	Rr	Aa	AaPp	aY
Diploid or haploid?								
Homo- or Heterozygous?								
Phenotype								

Part II. Mendel's first law: The principle of uniformity. When two pure-bred (homozygous) parents that differ in just one trait are crossed, then the resulting hybrids will be uniform in that chosen trait.

a) Two homozygous parents are crossed, one with white flowers and one with purple flowers. Please fill out the information for parents and offspring in the corresponding boxes.

Gene:	Dominant allele (letter and color):	Recessive allele (letter and color):

P generation

X

Genotype: Genotype:

Phenotype: Phenotype:

F_1 generation

Genotype:

Phenotype:

b) Fill in the Punnett square and determine the percentages of offspring in the F1 generation.

F1		

% of offspring that are homozygous dominant: %

% of offspring that are homozygous recessive: %

% of offspring that are heterozygous: %

c) If there were 100 seeds collected, predict how many plants would:

i. have white flowers:

ii. have purple flowers:
iii. be homozygous dominant:
iv. be homozygous recessive:
v. be heterozygous:

Part III. Mendel's second law: The principle of segregation. When 2 individuals of the F1 generation are crossed, the following generation (F2) will not be uniform. Instead, the traits segregate: each new organism inherits one allele of each parent. **For this part III, let's continue working with the trait that we worked on in Part II.

a) Two organisms of the F1 are crossed. Please fill out the information for parents and offspring in the corresponding boxes.

Gene:	Dominant allele (letter and color):	Recessive allele (letter and color):

F_1 generation

X

Genotype: Genotype:

Phenotype: Phenotype:

F_2 generation

Genotype:

Phenotype:

b) Fill in the Punnett square and determine the percentages of offspring in the F2 generation.

F2		

% of offspring that are homozygous dominant: %

% of offspring that are homozygous recessive: %

% of offspring that are heterozygous: %

c) If there were 100 seeds collected

i. have white flowers:
ii. have purple flowers:
iii. be homozygous dominant:
iv. be homozygous recessive:

v. be heterozygous:

Part IIIB. Mendel's second law: The principle of segregation. When 2 individuals of the F1 generation are crossed, the following generation (F2) will not be uniform. Instead, the traits segregate: each new organism inherits one allele of each parent. **For this part III, we will practice the law of segregation using a different trait.

a) Two organisms with round seeds of the F1 generation are crossed. Please fill out the information for parents and offspring in the corresponding boxes.

Gene:	Dominant allele (letter and color):	Recessive allele (letter and color):

F_1 generation

X

Genotype: Genotype:

Phenotype: Phenotype:

F_2 generation

Genotype:

Phenotype:

b) Fill in the Punnett square and determine the percentages of offspring in the F2 generation.

F2		

% of offspring that are homozygous dominant: %

% of offspring that are homozygous recessive: %

% of offspring that are heterozygous: %

c) If there were 350 seeds collected, predict how many plants would:

i. round seeds:
ii. have wrinkled seeds:
iii. be homozygous dominant:
iv. be homozygous recessive:
v. be heterozygous:

Information for this worksheet was obtained and adapted from:
https://www.britannica.com/biography/Gregor-Mendel
www.NGSSBiology.com