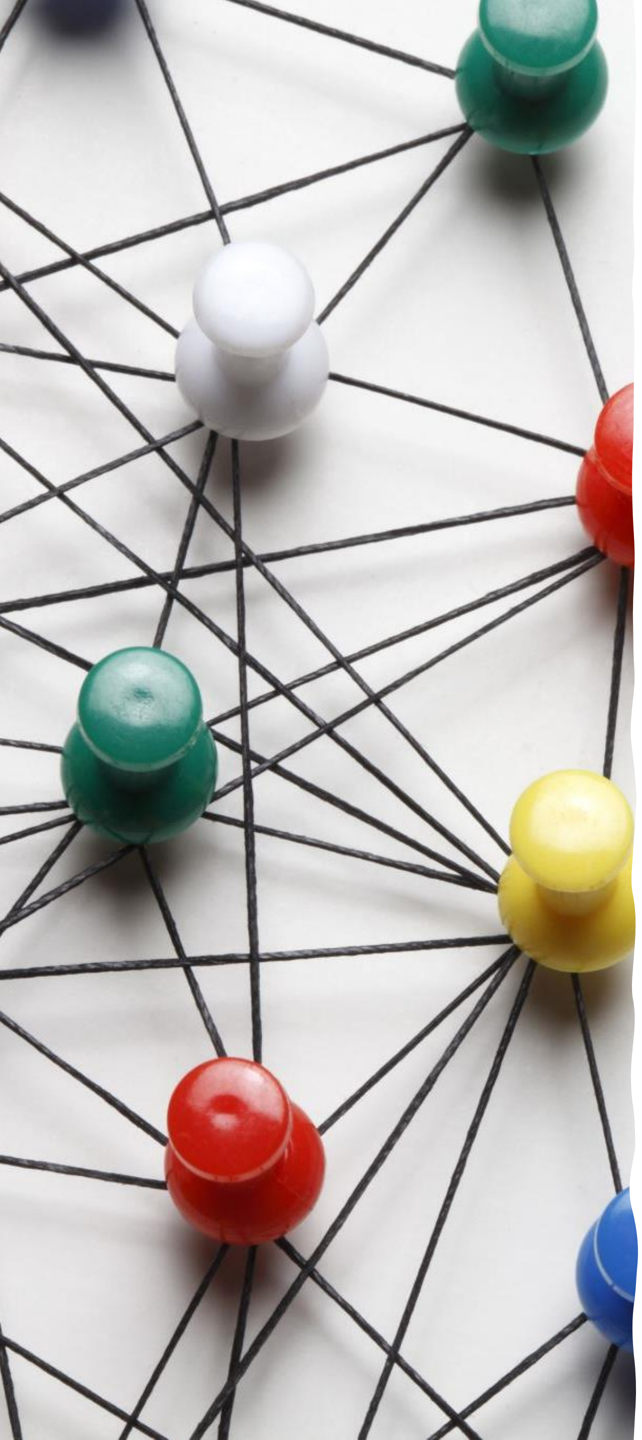
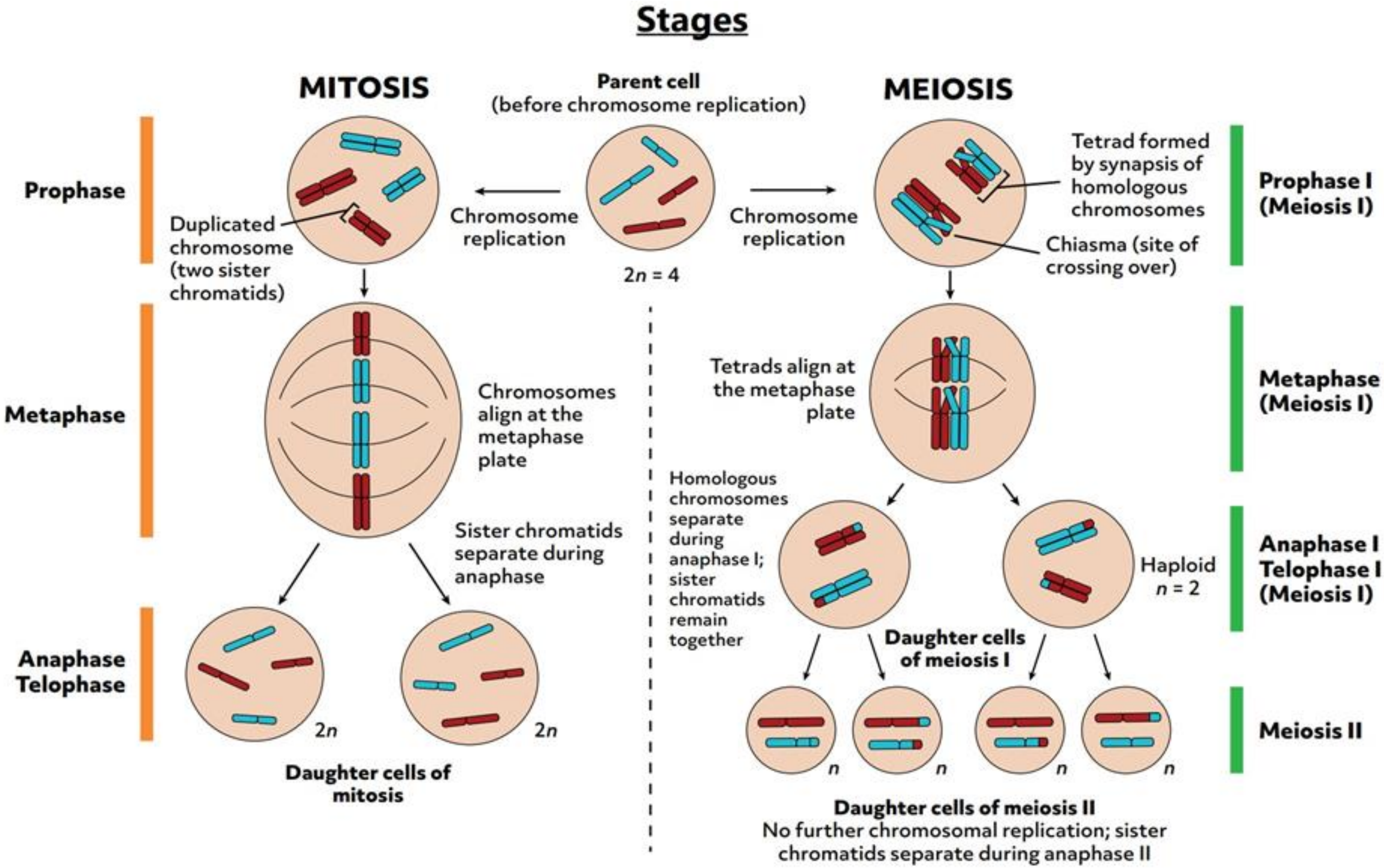
Heredity II



Objectives

- Describe the inheritance pattern of monohybrid and dihybrid crosses in *Arabidopsis thaliana*.

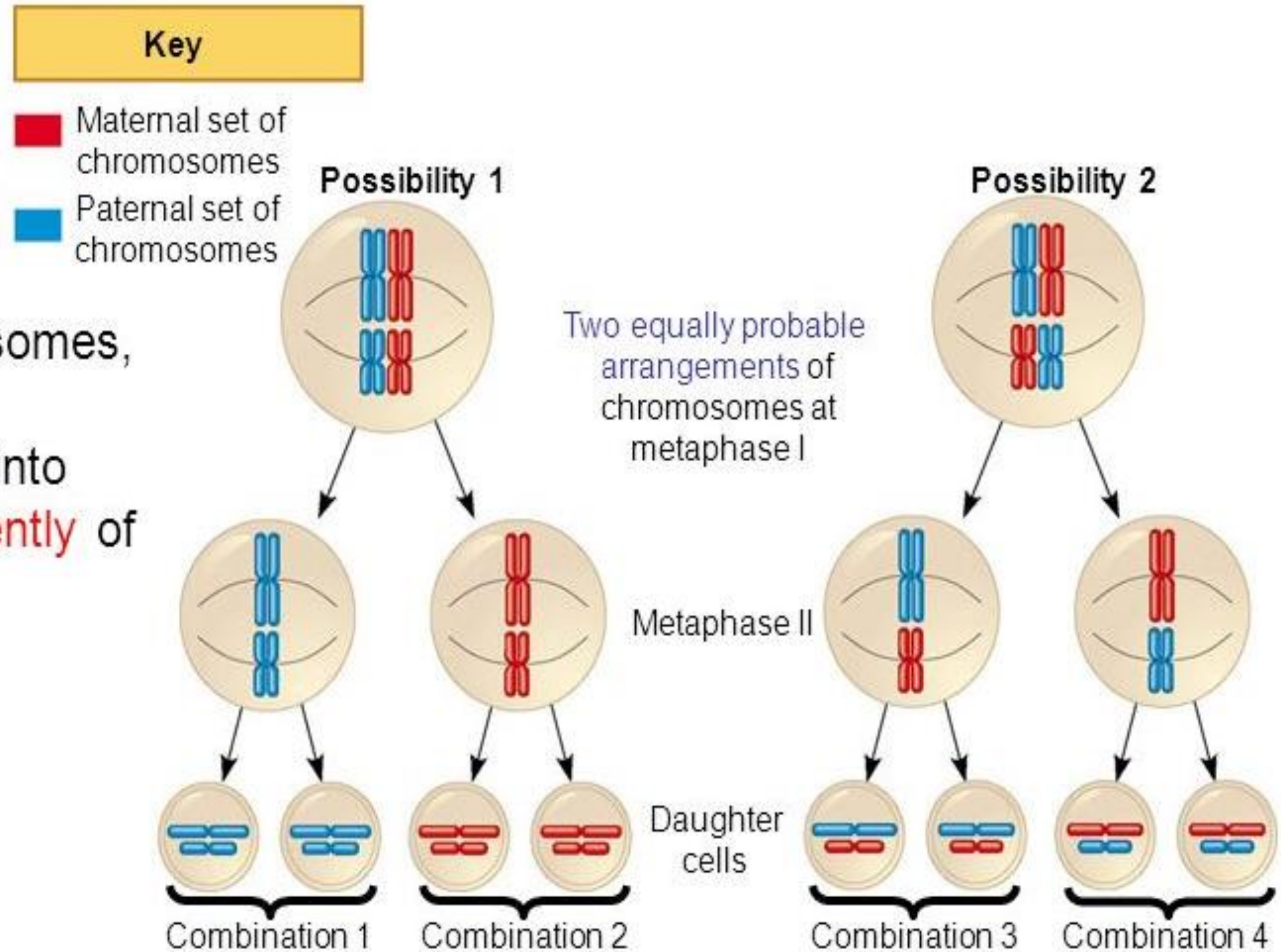


Mitosis: A specific stage in the cell cycle where somatic cells divide, resulting in two identical diploid daughter cells.

Meiosis: The process by which sex cells divide, resulting in four haploid gametes.

Independent Assortment

For each pair of chromosomes, maternal and paternal homologues are sorted into daughter cells independently of the other pairs

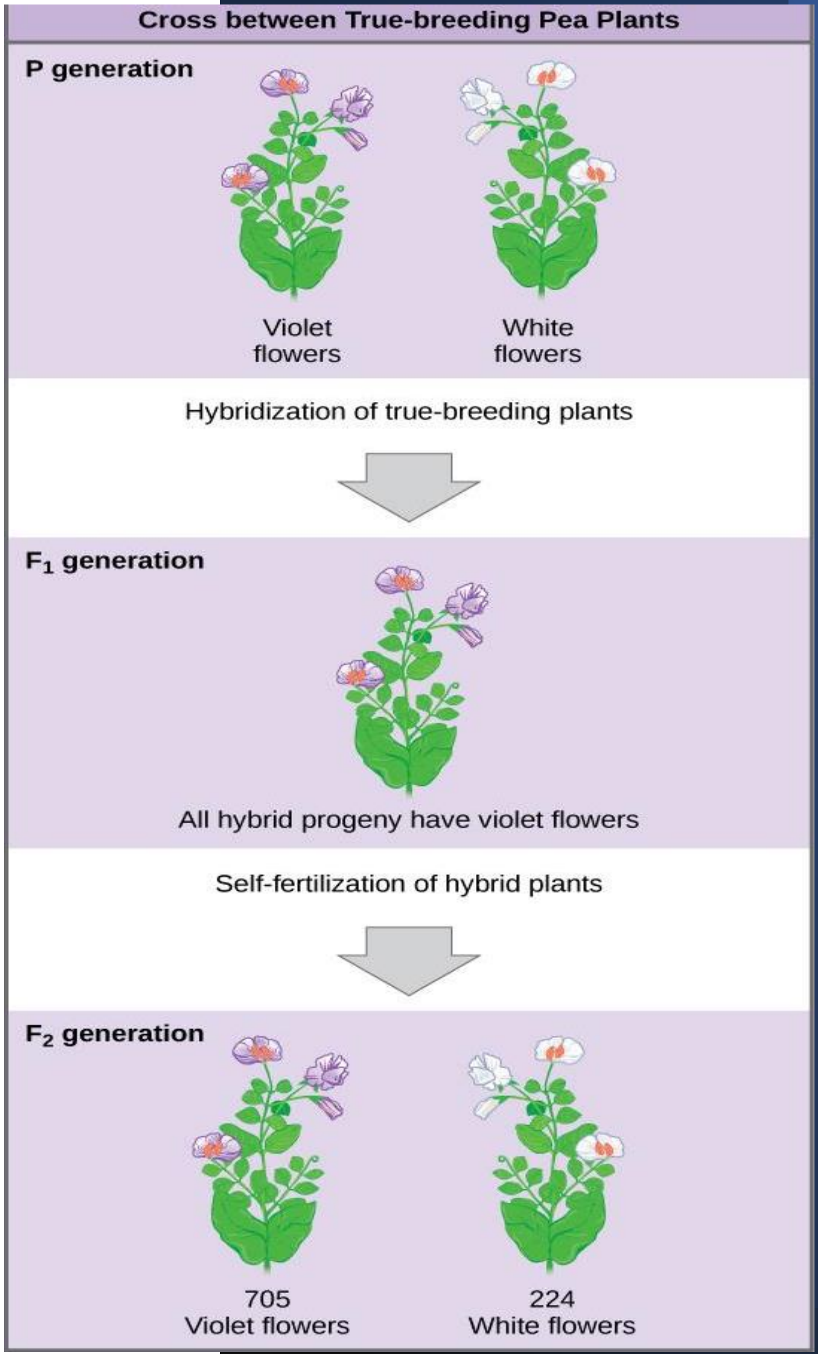


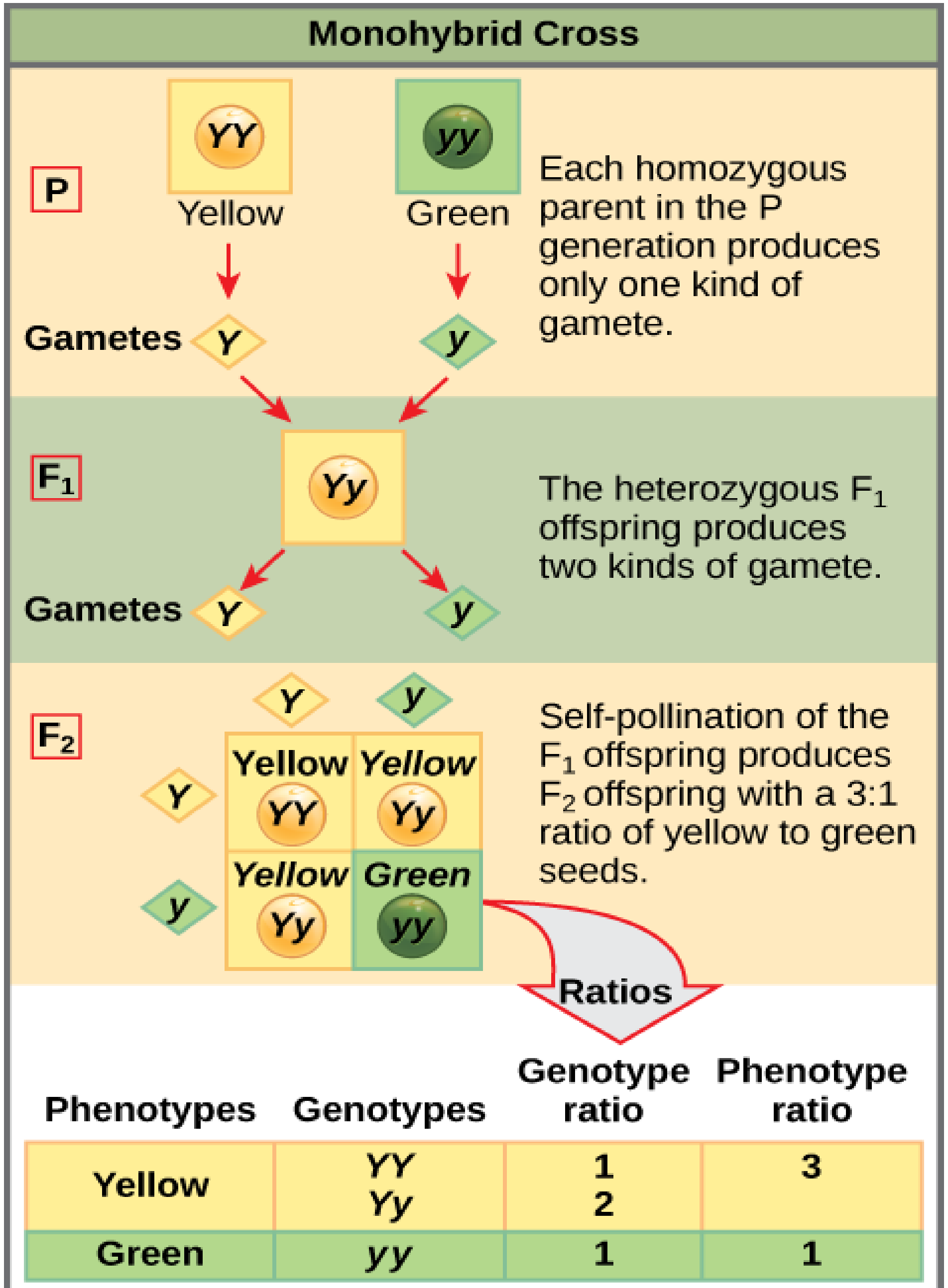
Dominant vs Recessive

- **Dominant traits** are those that are inherited unchanged in a hybridization (F1).
- **Recessive traits** become latent, or disappear, in the offspring of a hybridization (F1).
- The recessive trait does, however, reappear in the progeny of the hybrid offspring (F2).

Mendelian Crosses

- Mendel crossed plants that were true-breeding for violet flower color with plants true-breeding for white flower color (the P generation). Homozygous.
- The resulting hybrids in the F1 generation all had violet flowers. One of the two alleles must be dominant.
- In the F2 generation, approximately three quarters of the plants had violet flowers, and one quarter had white flowers. Expected with a dominant and recessive allele in the F1.



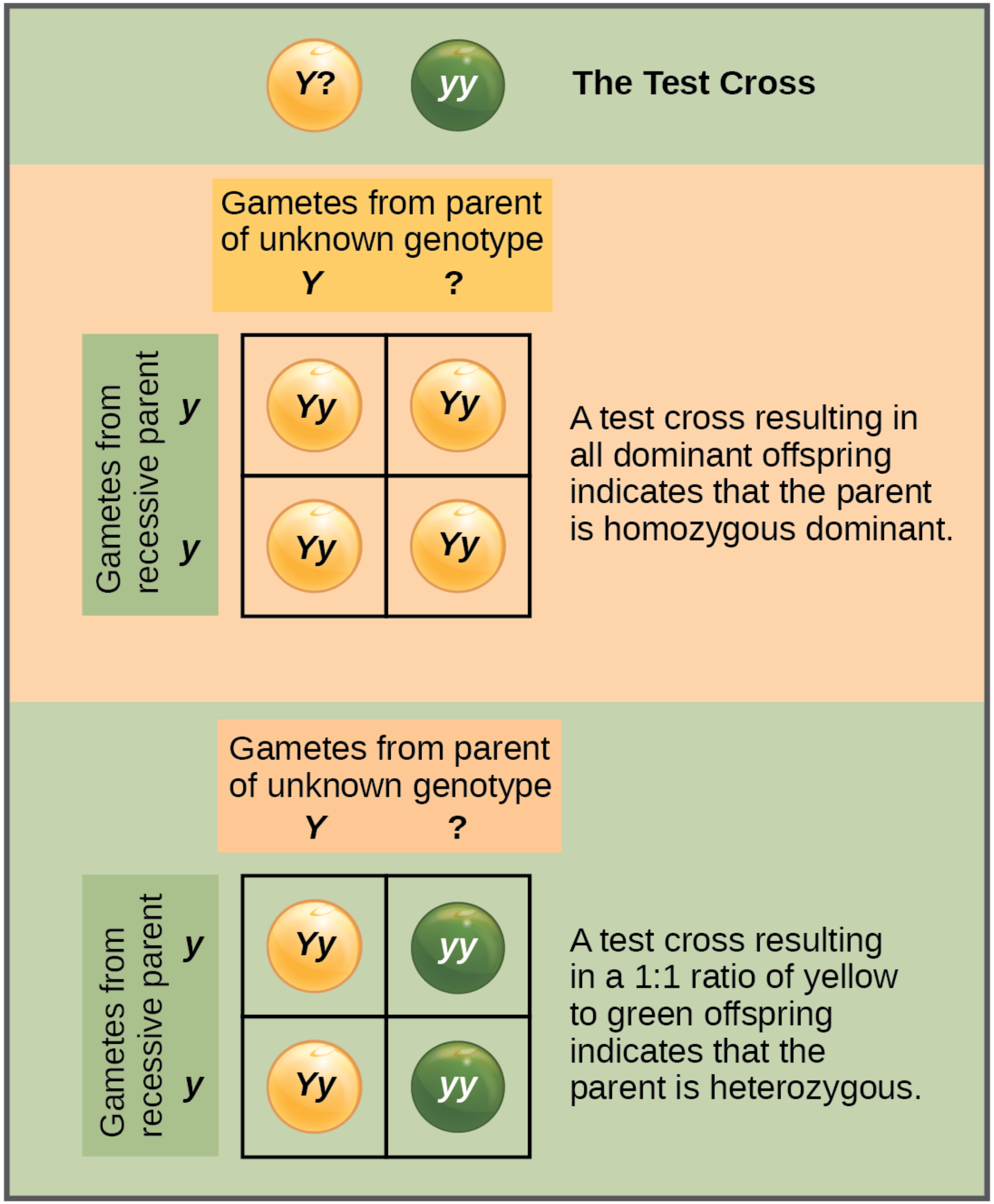


Punnett square

- All possible combinations of the parental alleles are listed along the top (for one parent) and side (for the other parent) of a grid, representing their meiotic segregation into haploid gametes.
- Combinations of egg and sperm are made in the boxes in the table to show which alleles are combining.
- Each box represents the diploid genotype of a zygote, or fertilized egg, that could result from this mating.

Test Cross

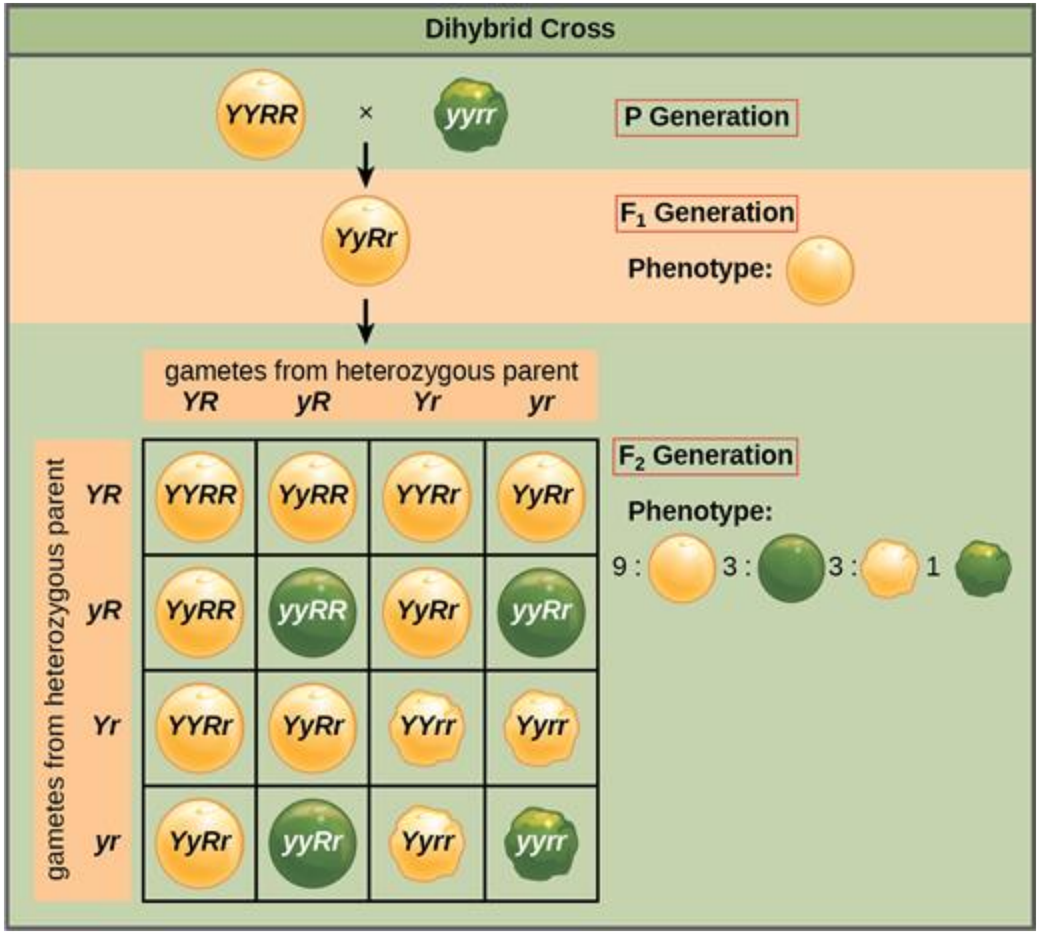
- In pea plants, round peas (R) are dominant to wrinkled peas (r).
- You do a test cross between a pea plant with wrinkled peas (genotype rr) and a plant of unknown genotype that has round peas (genotype RR or Rr).
- You end up with three plants, all which have round peas. From this data, can you tell if the round pea parent plant is homozygous dominant or heterozygous



Dihybrid Cross

- The independent assortment of genes can be illustrated by the dihybrid cross, a cross between two true-breeding parents that express different traits for two characteristics.

- Because each parent is homozygous, the law of segregation indicates that the gametes for the green/wrinkled plant all are yr, and the gametes for the yellow/round plant are all YR. Therefore, the F1 generation of offspring all are YyRr.



Expectation vs Reality

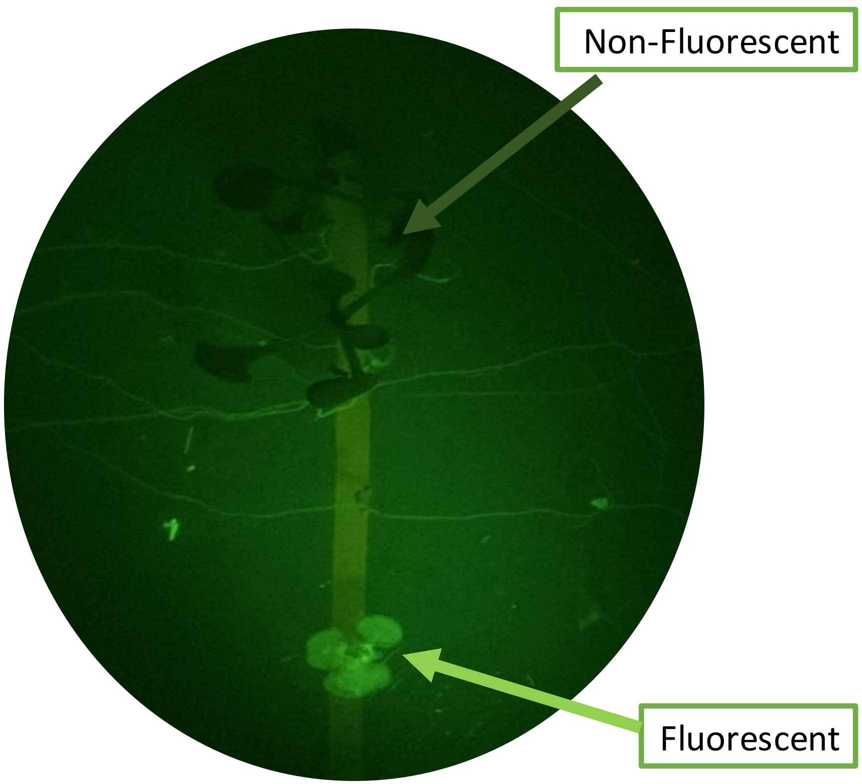
- The chance of seeing Green Wrinkled Peas = 1/16
- The chance of **NOT** seeing Green Wrinkled Peas = 15/16

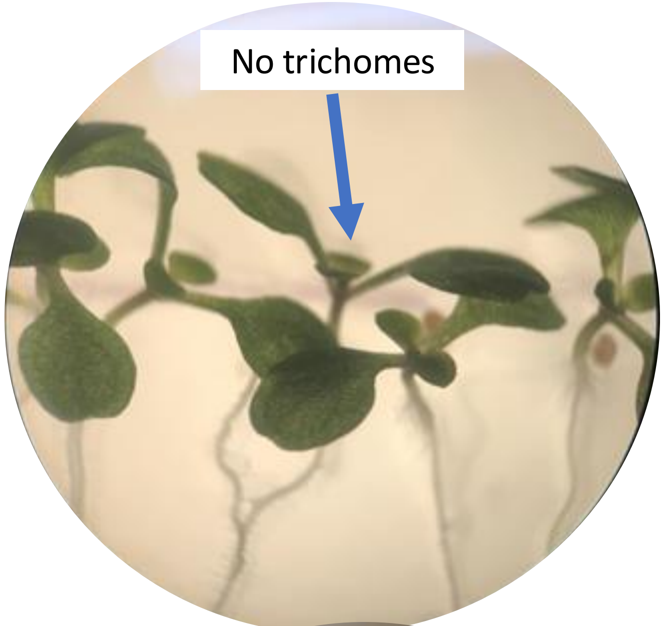
- If we look at 10 plants then
- (15/16)^10 = 0.52 ~52% of NOT seeing Gr. Wr. Peas

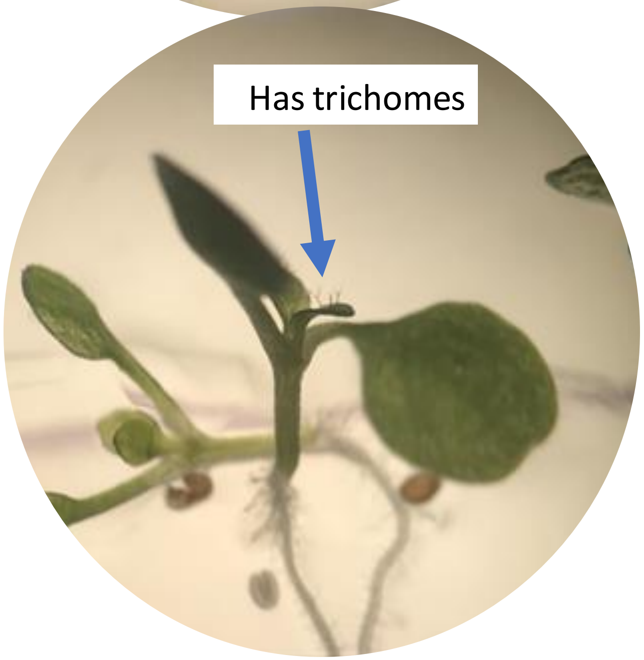
- If we look at 60 plants then
- (15/16)^60 = 0.02 ~2% of NOT seeing Gr. Wr. Peas

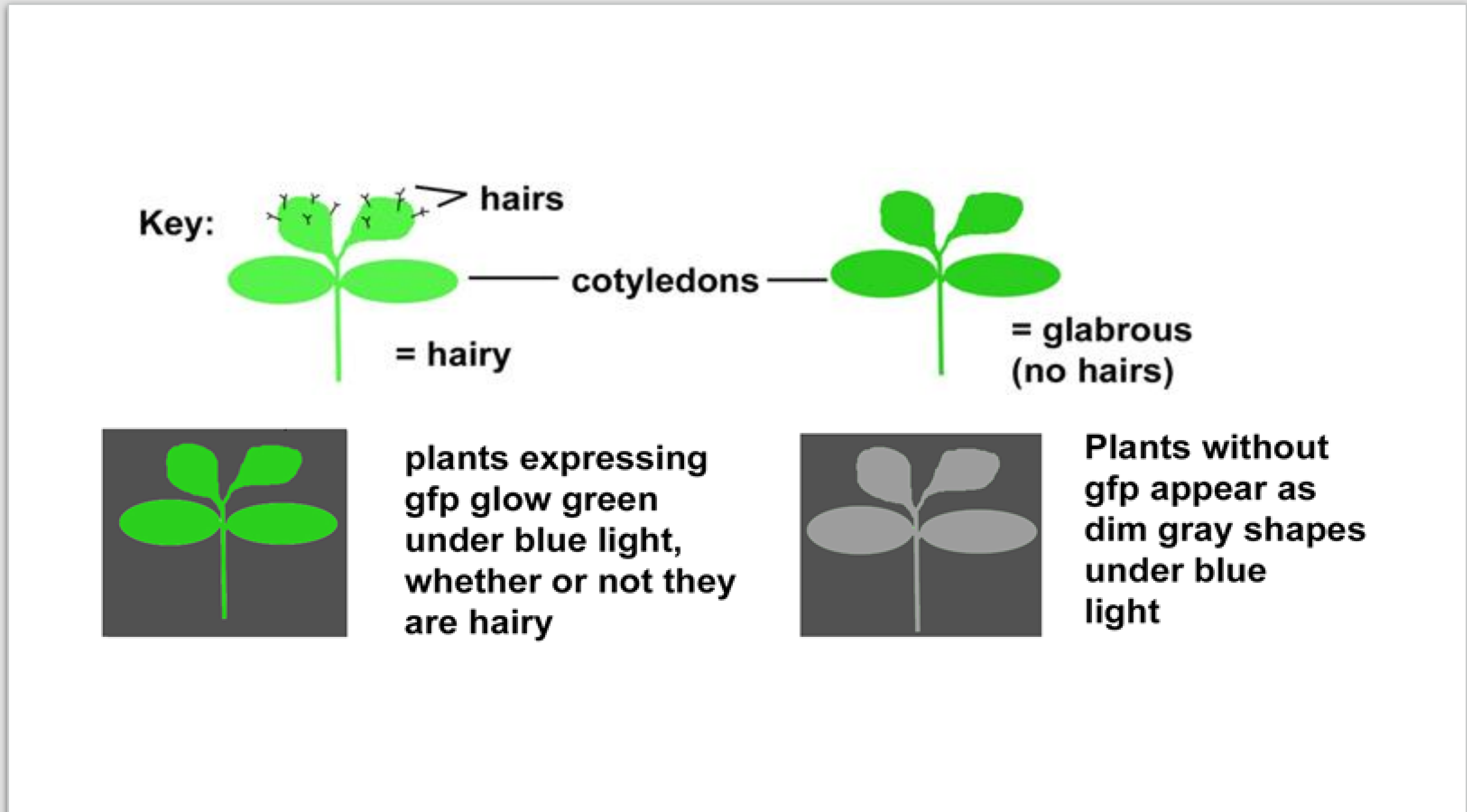
Heredity I: *Observe the plants, note What's different*

- *gl1* – glabrous (bald) phenotype
- *gl2* – trichomes phenotype
- gfp1 – fluorescent
- gfp2 - non-fluorescent

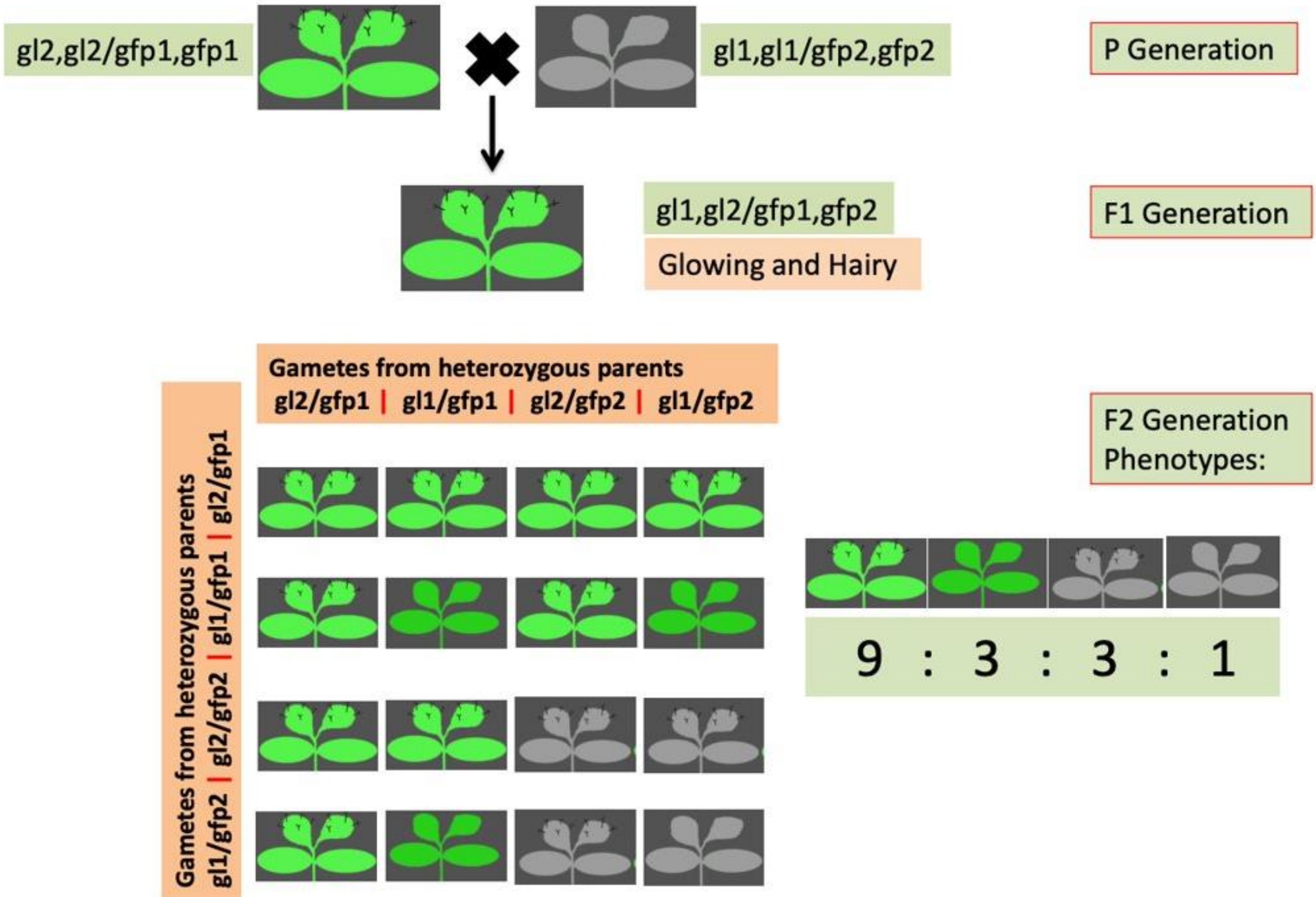







Key:
hairs
cotyledons
= hairy
= glabrous
(no hairs)
plants expressing
gfp glow green
under blue light,
whether or not they
are hairy
Plants without
gfp appear as
dim gray shapes
under blue
light

Phenotypes


gl2,gl2/gfp1,gfp1
gl1,gl1/gfp2,gfp2
P Generation
gl1,gl2/gfp1,gfp2
Glowing and Hairy
F1 Generation
Gametes from heterozygous parents
gl2/gfp1 | gl1/gfp1 | gl2/gfp2 | gl1/gfp2
Gametes from heterozygous parents
gl1/gfp2 | gl2/gfp2 | gl1/gfp1 | gl2/gfp1
F2 Generation
Phenotypes:
9 : 3 : 3 : 1

Data that you need for digital simulation

- Set A
- Set B
- Set C
- Set D
- Set E
- Set F