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MENDEL'S FURTHER TESTS

Making up a hypothesis that explains the experimental facts does not necessarily prove that the hypothesis is true. In fact, a scientist never regards a hypothesis as proven; it is merely "supported" and must be subjected to every possible experimental challenge. In keeping with this philosophy, Mendel did not stop when he thought he had a good explanation. He subjected it to two further tests: self-pollination of the F_2 plants and test crosses.

Color the heading F_2 Self-Pollination and titles A through C. Color the headings F_2 Phenotypes and F_3 Phenotypes on the upper part of the plate, and color the associated illustrations.

When Mendel allowed the F_2 plants to *self-pollinate,* the resulting F_3 generation fit his explanation perfectly. The F_2 plants with the *purple flowers* (dominant) turned out to be of two kinds. One-third of them produced only offspring with purple flowers (the dominant trait), indicating that they must have been homozygous dominant, with the genotype WW. The other two-thirds of the F_2 plants with purple flowers (dominant) produced offspring in a ratio of three purple (dominant) to one white (recessive), just as their parents had done, indicating that they must have been heterozygous, with the genotype Ww. All the F_2 plants with *white flowers* (recessive) proved to be pure-breeding and produced only white-flowered (recessive) offspring, so they must have been homozygous recessive, with the genotype ww. With typical thoroughness, Mendel continued to allow successive generations of these plants to self-pollinate for eight years and found that the pattern was always the same. Obviously, the phenotypic ratio of three purple (dominant) to one white (recessive) was almost certainly caused by a genotypic ratio of one homozygous dominant to two heterozygous to one homozygous recessive.

Color the heading F_2 Test Crosses and title D. Then color the remaining headings and the associated illustrations.

Mendel's second test was a type of experimental cross known today as a *"test cross,"* a term used when organisms with dominant phenotypes but uncertain genotypes are crossed with homozygous recessive individuals to disclose which of the dominants also carry a recessive gene. He crossed the F_2 plants (WW, Ww, and ww) with plants that had white flowers and therefore were homozygous for the recessive trait (genotype ww).

Here again the results were consistent with Mendel's hypotheses. One-third of the purple-flowered (dominant) F_2 plants produced only purple-flowered (dominant) offspring, in spite of being crossed with a homozygous recessive. These parents, then, must have been homozygous for the dominant trait (genotype WW) and thus their offspring had to be all heterozygous (genotype Ww). The other two-thirds of the purple-flowered (dominant) F_2 plants produced offspring that were approximately one-half purple-flowered (dominant) and one-half white-flowered (recessive). These F_2 parent plants must have been heterozygous (Ww), so half of their gametes carried the dominant gene (W) and resulted in heterozygous offspring (genotype Ww) while half of their gametes carried the recessive gene (w) and resulted in homozygous recessive offspring (genotype ww). The white-flowered (recessive) F_2 plants produced only white-flowered offspring, showing that those parent plants were homozygous for the recessive trait (genotype ww), as were their offspring. Thus the experimental evidence supported Mendel's law of segregation. More than a century of additional experimentation by thousands of investigators has continued to support it.

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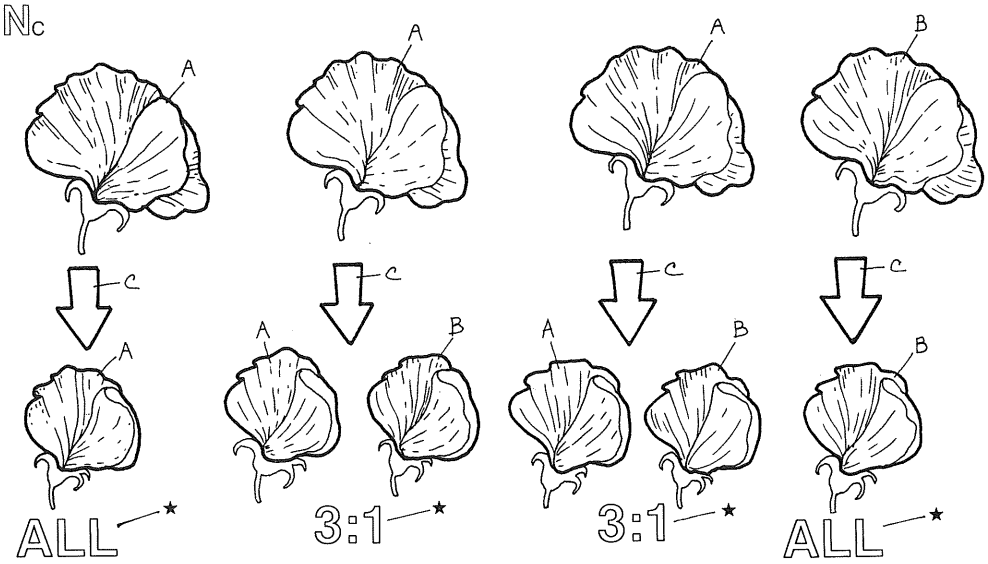
F_2 SELF-POLLINATION★
PURPLE FLOWER$_A$/GENE$_{A'}$
WHITE FLOWER$_B$/GENE$_{B'}$
SELF-POLLINATION$_C$

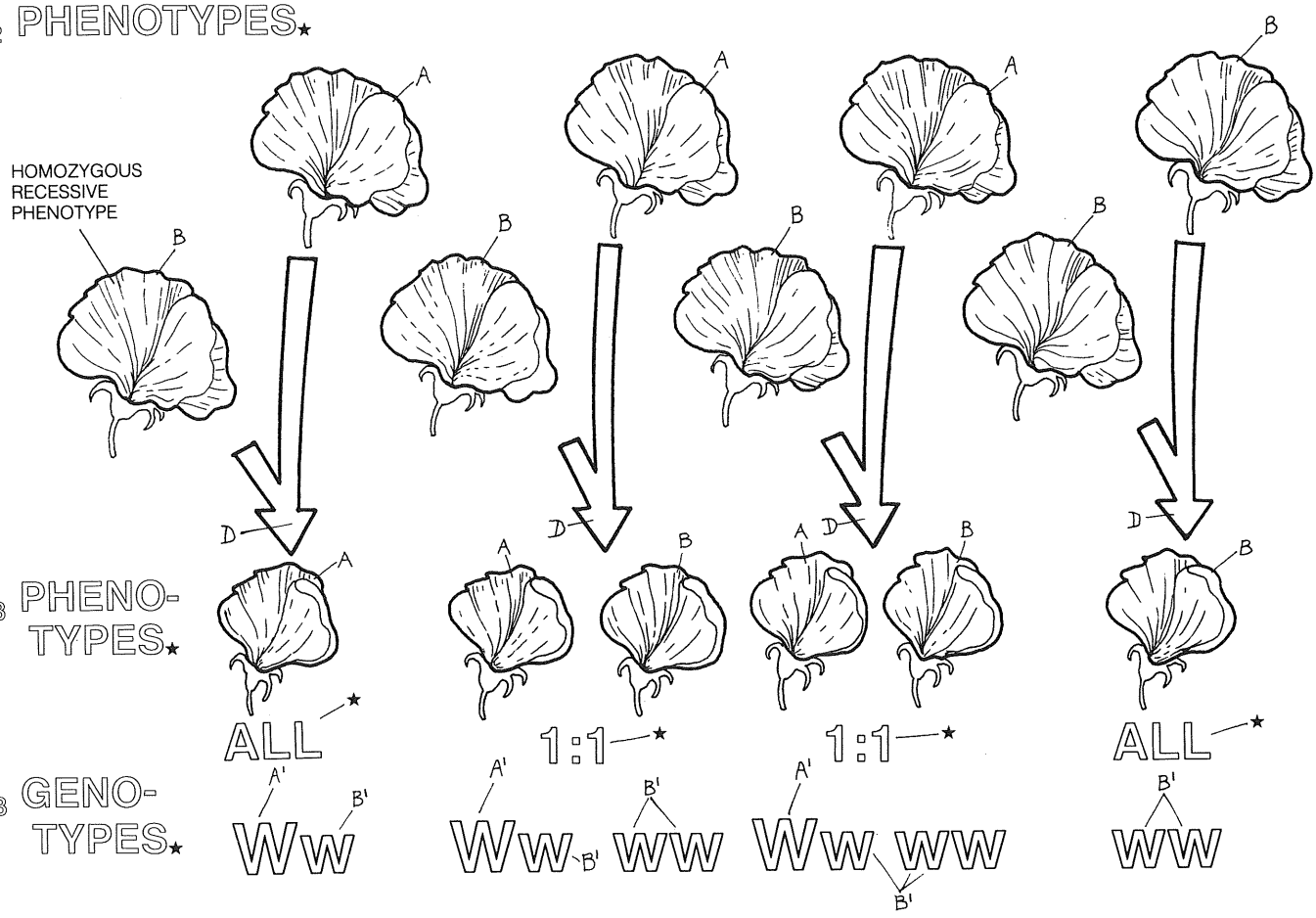
F_2 PHENOTYPES★



F_3 PHENOTYPES★

F_2 TEST CROSSES★
TEST CROSS$_D$

F_2 PHENOTYPES★



F_3 PHENO-TYPES★

F_3 GENO-TYPES★