Mendel and the gene

The theory of inheritance

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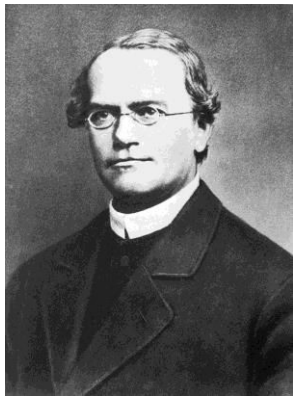
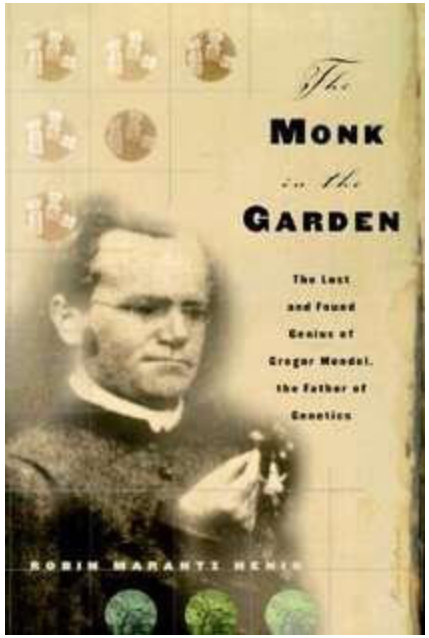
The monk in the garden: Gregor Mendel

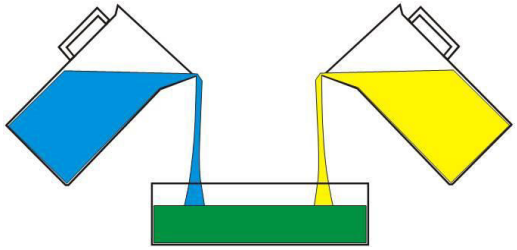


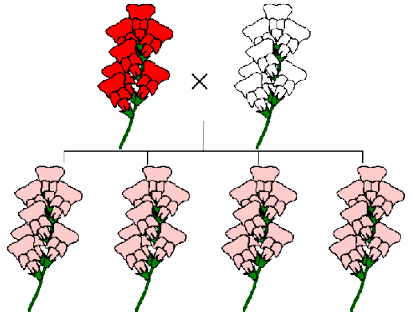
Johann Gregor Mendel (1822–1884), is called the "father of genetics," was a monk, teacher, and scientist. He persevered through difficult circumstances to make the most important discoveries in biology that is ***theory of inheritance***.



What Questions Was Mendel Trying to Answer?

Blending inheritance: proposed that the traits observed in a mother and father blend together to form traits in their offspring. As a result, an offspring's traits are intermediate between traits of the mother and father.

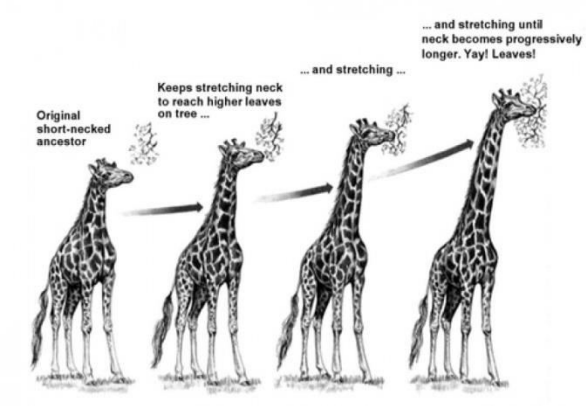




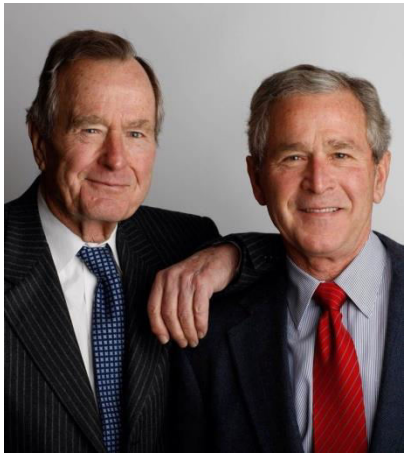
"It is a blending of genetic information"

What Questions Was Mendel Trying to Answer?

Inheritance of acquired: characters proposed that traits present in parents are modified through use and then passed on to their offspring in the modified form.



Is this true ??



Concept of Phenotype

Mendel experimented on varieties of peas that differed in seven traits: seed shape, seed color, pod shape, pod color, flower color, flower and pod position, and stem length. These are called phenotype

Seed shape

Biologists refer to the observable traits of an individual, such as the shape of a pea seed or the eye color of a person, as its **phenotype** (literally, “show-type”).

(A **trait** is any characteristic of an individual, ranging from outward appearance like height to molecular characteristics such as the primary structure of a particular membrane protein)

The garden pea served as the first model organism in genetics

Mendel's Experiments with a Single Trait

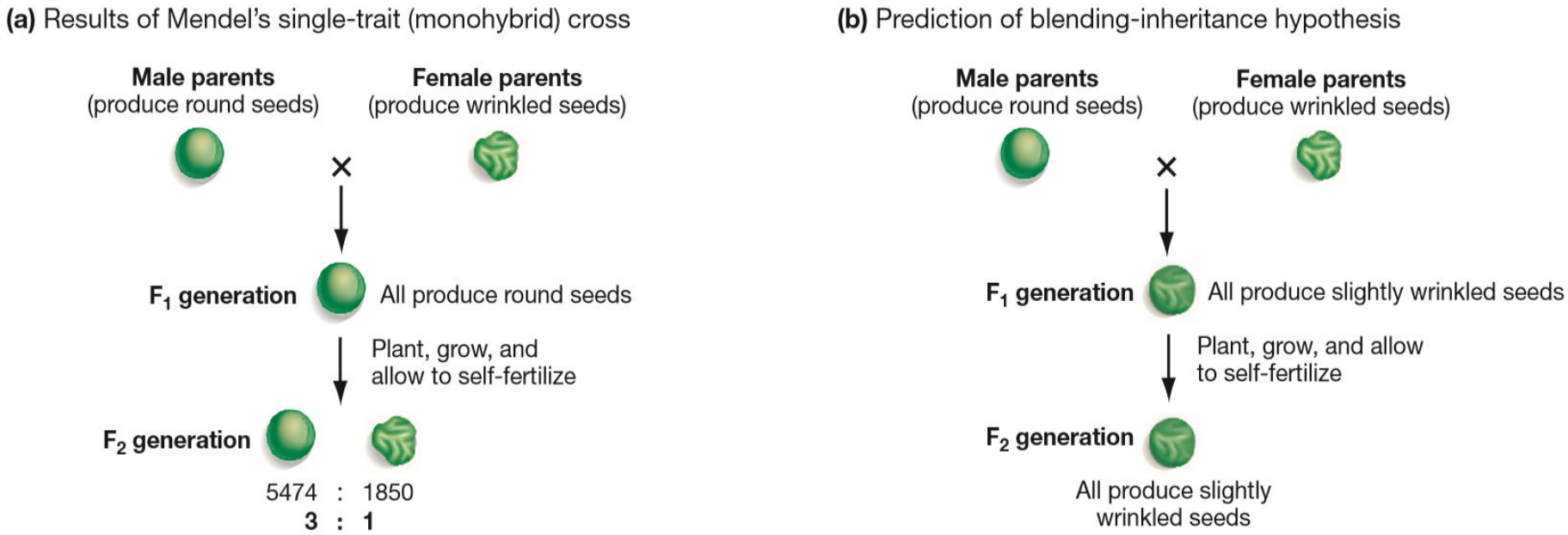


Figure 14.2 Mendel Performed a Monohybrid Cross. The results of Mendel's crosses involving a single trait **(a)** contrasted strongly with the predictions of the blending-inheritance hypothesis **(b)**.

Mendel called **wrinkled shape a recessive** and **round shape a dominant** trait relative to wrinkled shape. because the round-seed phenotype appeared to dominate over the wrinkled-seed determinant when both were present in the hybrid F1.

Reciprocal cross

Whether genetic determinant comes from male or female? NO

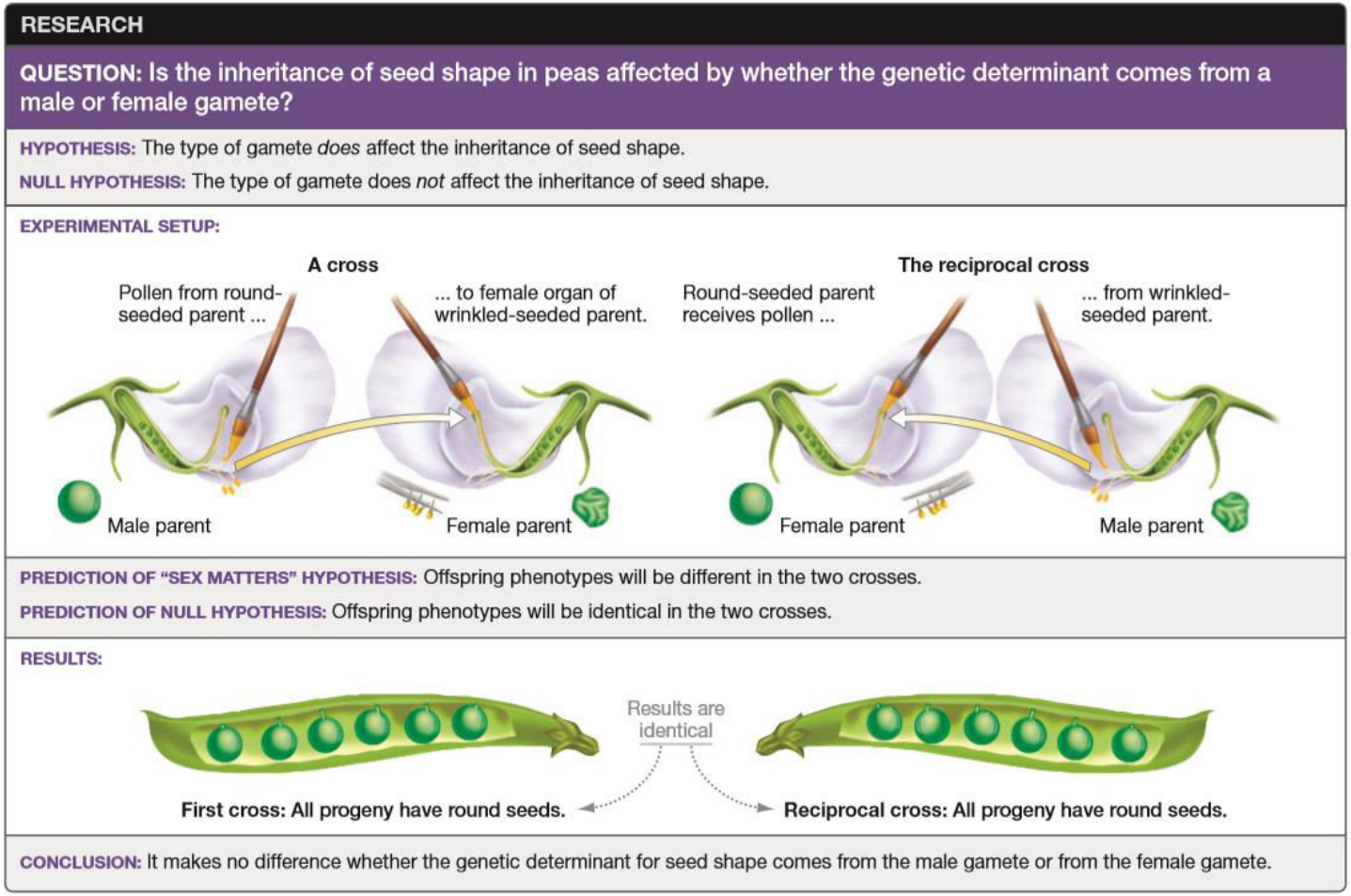


Figure 14.3 Mendel Also Performed a Reciprocal Cross.

SOURCE: Mendel, G. 1866. Versuche über Pflanzen-hybriden. *Verhandlungen des naturforschenden Vereines in Brünn* 4: 3–47. English translation available from ESP: Electronic Scholarly Publishing (www.esp.org).

Observation from Mendel's experiment

Table 14.2 The F_2 Produced from Mendel's Monohybrid Crosses

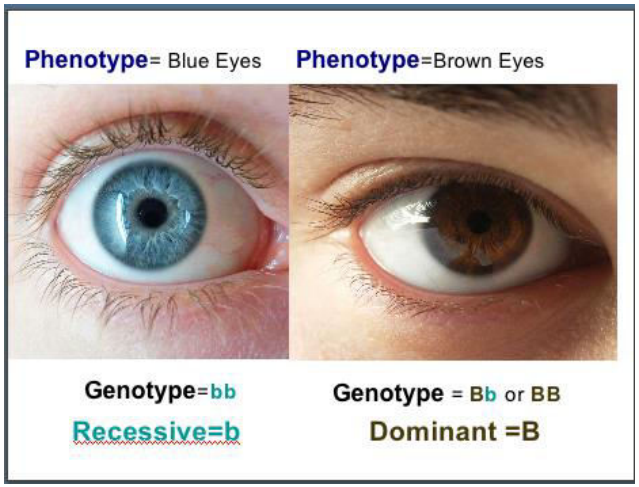
Trait	Dominant Phenotype	Recessive Phenotype	Ratio
Seed shape	5474 round	1850 wrinkled	2.96 : 1
Seed color	6022 yellow	2001 green	3.01 : 1
Pod shape	882 inflated	299 constricted	2.95 : 1
Pod color	428 green	152 yellow	2.82 : 1
Flower color	705 purple	224 white	3.15 : 1
Flower and pod position	651 axial	207 terminal	3.14 : 1
Stem length	787 tall	266 dwarf	2.96 : 1

DATA: Mendel, G. 1866. *Verhandlungen des naturforschenden Vereines in Brünn* 4: 3–47.

1. The F1 progeny showed only the dominant trait and did not exhibit an intermediate phenotype.
2. Reciprocal crosses produced the same results.
3. The ratio of dominant to recessive phenotypes in F2-generation individuals was about 3 to 1.

Phenotype and Genotype

Observable traits (Phenotype) of an individual depends on **Genotype.**



Genes, Alleles, and Genotypes:

Gene to indicate the hereditary determinant for a trait

Alleles: Mendel also proposed that each individual can have two versions of any gene. Today different versions of the same gene are called alleles.

Genotype: The combination of alleles found in an individual is called the genotype

Conclusion from Mendel's experiment: Particulate inheritance

1. Hereditary determinants for traits do not blend together or become modified through use.

2. Hereditary determinants maintain their integrity from generation to generation.

Mendel's postulate that there are two copies of each gene, which opened the possibility that when **F1** hybrids are crossed, some of the **F2** offspring may inherit two copies of the recessive allele, one from each of the hybrid parents. These F2 offspring with only the recessive allele would be expected to show the recessive phenotype that was hidden in the F1 hybrids.

The Principle of Segregation

To account for the characteristic 3 : 1 ratio of phenotypes in F2 individuals, Mendel reasoned that the two members of each gene pair must segregate—that is, separate—into different gamete cells during the formation of eggs and sperm. As a result, each gamete contains one allele of each gene. This idea is called the principle of segregation.

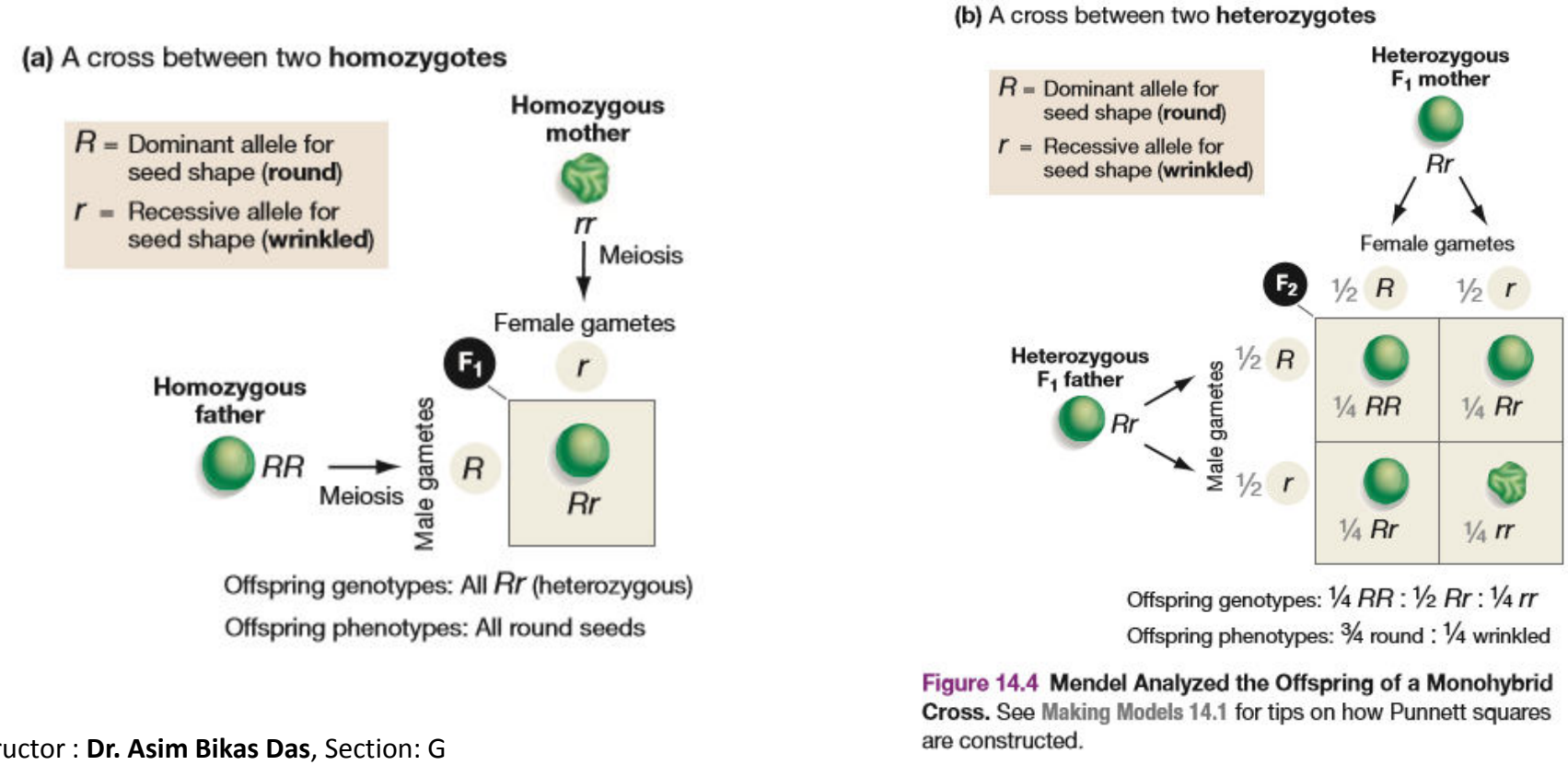
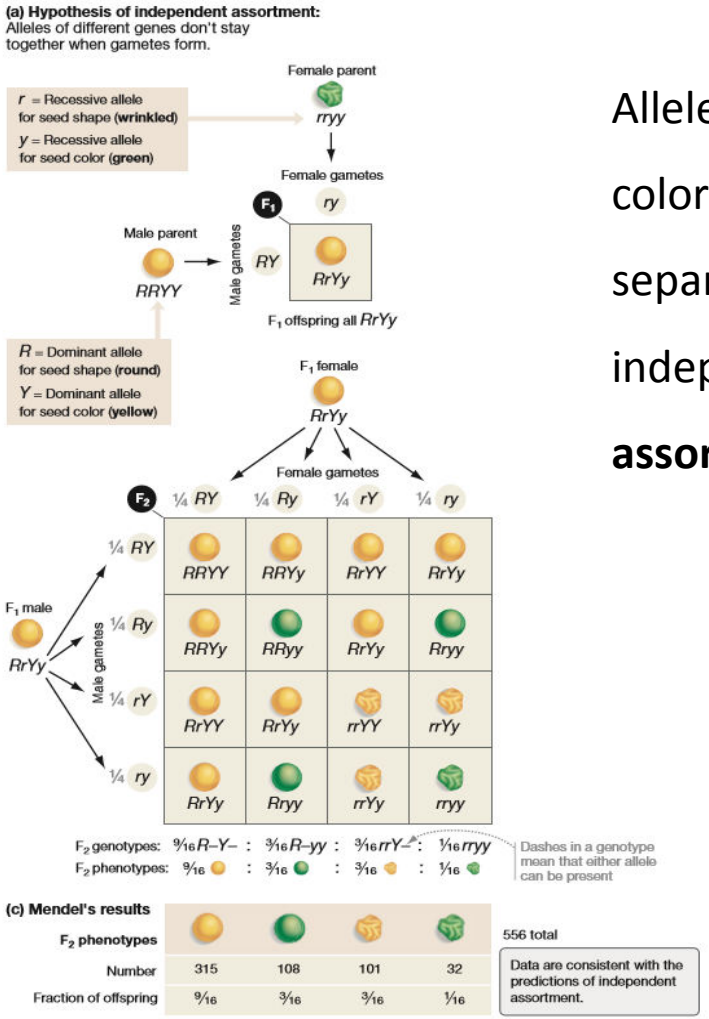


Figure 14.4 Mendel Analyzed the Offspring of a Monohybrid Cross. See Making Models 14.1 for tips on how Punnett squares are constructed.

Mendel's Experiments with Two Traits

The Dihybrid Cross

A mating between two individuals who are heterozygous for two traits is called a **Dihybrid cross**



Allele for seed shape and the allele for seed color originally present in each parent and separate from each other and be transmitted independently. This is kown as **independent assortment**

If not Independent Assortment