

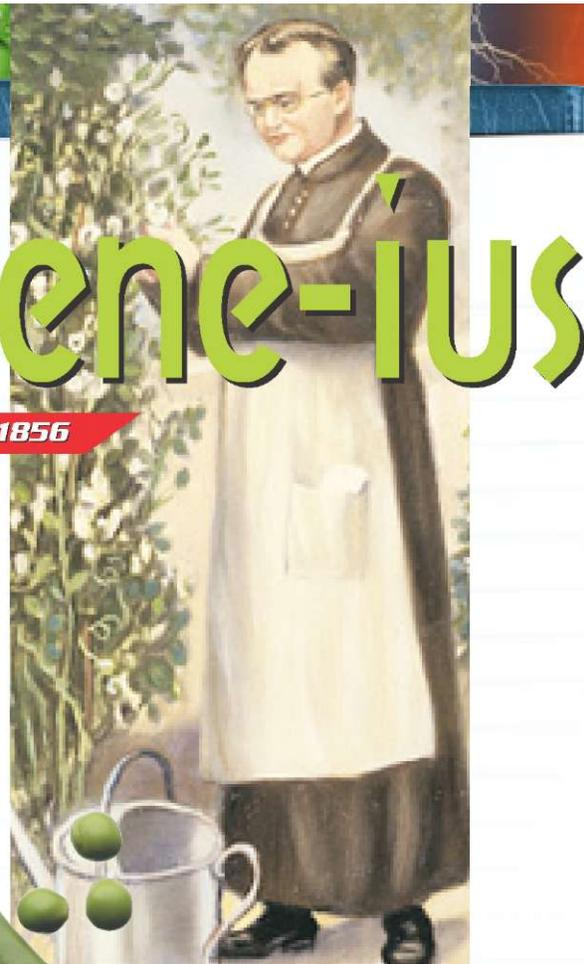
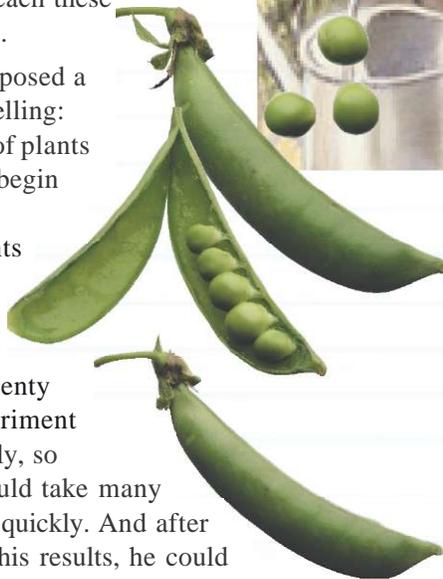
# True Gene-i-us

**Brno, Austria (now the Czech Republic), 1856**

Few scientists have had the impact on their field that Gregor Mendel had on genetics. Yet he was a monk before he became a scientist. He joined the Augustinian monastery in the city now known as Brno. His talents and interests soon became clear to his superiors, and Mendel gladly went to the University of Vienna to receive training in math and science. He returned to teach these subjects at the monastery.

As a scientist, Mendel posed a question he found compelling: Why do the same kinds of plants show different traits? To begin answering this question, Mendel began experiments with garden peas in 1856. Why the pea? The monks raised 22 varieties, so there were plenty of different traits to experiment with. The pea grew quickly, so Mendel's experiments could take many generations into account quickly. And after observing and recording his results, he could snack on his research subjects, which we certainly couldn't have done with humans.

Mendel picked seven pea characteristics to study. Each characteristic came in two traits: plant height, seed color (green or yellow), seed coat color (gray or white), pod shape (full or wrinkled), pod color (green or yellow), and flower distribution (along length or at the end of stem). Unlike many obvious human characteristics, most of these pea characteristics



showed what is called discontinuous variation: tall *or* short, green *or* yellow, smooth *or* wrinkled, with no in-betweens. That makes peas easier for a geneticist to study than continuous variation (such as *how tall*, *what shade of brown hair*, or *eyes flecked with two colors*).

Mendel worked meticulously. He kept careful records of the plants that were crossed and the offspring produced. When he crossed short plants with other short plants, the offspring were always short. But when he crossed tall plants with other tall plants, he found that some tall plants produced tall offspring, while others produced both tall and short offspring.

This was puzzling. Sitting in front of his notes, chewing on a tough pea pod, Mendel came up with another experiment. He crossed

tall plants that had produced only tall offspring with short plants that had produced only short plants. The results: in the first generation (geneticists call it F1), all the plants were tall. Yet when the tall F1 plants were crossed, some of the second generation (F2) were short. The tall F1 plants must have had a capacity for shortness; they didn't show it, but they passed it onto their offspring.

In 1865, Mendel published a paper entitled "Experiments in Plant Hybridization." After many experiments, Mendel formulated three laws of genetics. They are still the guiding ideas of inheritance today.

**Principle of Segregation:** Every single trait is the result of a pair of "factors," now known as genes.

**Principle of Independent Assortment:** The pair separates, or segregates, when sex cells (the female's egg and the male's sperm) form. Therefore, a sperm or egg will contain a factor either for tallness or shortness—not both. Genes for different traits thus segregate independently of one another during the formation of sex cells, so that genes are inherited independently of each other. That is, the gene for tallness may be inherited with green or yellow seeds, smooth or wrinkled pods.

**Principle of Dominance:** An organism receives two genes for each trait, one gene from each parent. Only one gene of each pair is expressed. A dominant gene hides the other, or prevents it from being expressed. That's why two tall pea plants could still have short offspring. One of the parents had the recessive gene for shortness, which was "hidden" by the dominant gene for tallness.

Mendel's work is all the more impressive in that it was done a century before the DNA molecule was characterized. But at the time, no one, including Mendel himself, thought of him as a great scientist.

## Hip to Be Square

An English geneticist named Reginald Punnett developed a convenient way to show the inheritance of a particular trait. Known as the Punnett square, this is how it works. Let's imagine creatures called clackatoids. Most clackatoids are purple, but a few are orange. In clackatoids, purple is the dominant gene for color. A geneticist would indicate the purple gene with a capital "P" and the orange gene with a lowercase "p."

An orange clackatoid cannot have a purple gene because its genetic makeup, or "genotype," for color is "pp," or two recessive genes for orange. Its offspring would inherit a "p" no matter what. A purple clackatoid, on the other hand, might have a color genotype of "PP" or "Pp," but you couldn't tell the difference just by looking at it, because this clackatoid is purple. In this case, the purple clackatoid's genotype is "Pp."

What would happen if these two clackatoids had offspring? What colors would they be? The Punnett square will help indicate all possible genotypes for the baby clackatoids. The color genes for the orange clackatoid's sex cells are shown on top of the box. Those of the purple clackatoid run on the left side. The genotypes inside the box indicate the four possible combinations for their offspring. Any baby with a genotype that includes a "P" will be purple, while any with *both* "p" genes will be orange.

