Note: Mendel was a country boy from a fairly backward area of Europe. He became abbot of a small monastery, and communicated with some prestigious university professors, but otherwise was not well known during his lifetime. The significance of his work was not recognised until seventeen years after his death. It is, therefore, difficult to be certain of many of the details of his life, since there are various "myths" and little opportunity to verify them from original sources. Elements of the story below may or may not be absolute truth, but the story at least captures the sense of what happened.

Since people started cultivating plants and keeping livestock and pets, it was obvious that at least most offspring resembled their parents more closely than other members of their species. Even the Egyptians and ancient Hebrews also knew that some diseases were passed down in families. What was a mystery was "Why?" Most people believed in some sort of blending (if they didn't just accept the whole thing as one of God's mysteries), but blending could not explain the occasional appearance of differences from the parents, or even the reappearance of a trait from a grandparent that was not visible in the parent.

In the early 1800's, a farm boy from the Austrian Empire (now part of the Czech Republic) by the name of Gregor Mendel began noticing patterns in the offspring of some of the breeding animals on his father's farm. He even experimented a little with some animals. When Gregor grew up, he had the unusual privilege of getting an education, and showed real talent in math and science. He also had a calling to the church (Austria was still dominated by the Catholic church), and he entered a monastery.

Entering a monastery was not as unusual as it might sound today. Austria was still largely feudal, meaning that sons who would not inherit their father's land often had few other options for making a living. Joining the army or joining a religious community were often the only choices. Monasteries also offered security in a very turbulent world, and paradoxically a place where one could pursue individual interests. They were often places of intellectual activity.

A monastic community generally had several functions. Prayer and worship were obviously the first priority, but most monasteries strove to be self-sufficient in this world, too. They grew their own food, and frequently produced some special product for sale to the outside world. (Most of the great liqueurs, specialty wines, and cheeses had their origins in the secret recipes of a group of monks.) Finally, most monasteries performed some service for the greater world, whether it was taking care of the poor, running hospitals, or doing missionary work.

The monastery that Mendel joined was a teaching order that provided teachers for schools. Mendel taught for a while but was not able to pass his teaching exams. He was sent to the University of Vienna to upgrade his skills. There he developed his ability to apply mathematics to science, and deepened his interest in botany.
Gregor Mendel soon found himself overseeing some of the community food gardens and teaching mathematics in a school. One of the main crops grown in the gardens would have been peas. Peas are one vegetable that can easily be dried and stored for the long European winter, and they have a higher protein content than grains.

Peas tend to self fertilize, so they are highly inbred. There were many varieties of peas available in Europe that always produced offspring that were identical to their parents. Different varieties differed from each other in height, flower colour, starch content, pod shape, etc. Mendel recognised that he could test ideas about inheritance by deliberately crossing different strains of peas.

Over a few years, Mendel made thousands of crosses between strains that differed in seven different traits. He made sure he could identify the parents of every seed, by removing the stamens (male parts) from all the flowers of the mother plants so that they could not self fertilise. He then transferred pollen by hand from the father plants, using a tiny paintbrush. When the pods ripened, he collected them, counted and catalogued their seeds, and kept very careful records. He could then plant the seeds and grow a second generation of peas to determine what traits the offspring of each cross had.

After growing two to three generations of several different crosses, Mendel began to notice certain patterns. If he crossed plants that differed in one trait - say height, or flower colour - all of the next generation resembled just one of the parents. Offspring with one tall and one short parent were all tall, while offspring of parents with white flowers and purple flowers all bore purple flowers. When he grew seeds from the offspring (self-pollinated) however, some of the offspring had the missing trait - shortness or white flowers.

Fortunately, Mendel was both a scientist and a mathematician. He kept close count of all the results of individual crosses, and used his mathematical insights and skills to look for regular patterns. He found the same patterns cropping up again and again for completely different traits. From these he generalised some principles of inheritance (he called them laws) which proposed a radical new view. The most radical idea was that inheritance was due to some sort of "particles" which were passed from parent to offspring (he called them factors; we call them genes) and which remained unchanged throughout the life of the offspring and could then be passed on to later generations. Mendel's principles of segregation, dominance, and independent assortment gave a logically consistent, if a bit simplistic, account of how traits from an individual could be passed on, expressed and remixed in that individual's descendants.

Mendel communicated his results to others who were interested in natural history, and they convinced him that he should publish. He presented a paper to the Natural History Society in Brünn. The paper received little serious attention, though there are some stories that an attempt was made to reproduce the results using hawkweeds, a common roadside weed resembling a dandelion. They failed.
Unfortunately, it was unknown at the time that, though hawkweeds need pollen to produce eggs, the pollen never actually fertilises the ova, and the offspring are in fact clones of the mother. If this story is true, it was a piece of terrible bad luck, since most plants produce sexually and follow Mendel's rules very closely!

Mendel was chosen as abbot shortly thereafter, and gave up his experimenting in favour of administration. His work remained largely unknown until it was rediscovered independently by three scientists in 1901. It immediately became the basis for a massive research program, and the basis on which all of modern genetics and much of evolutionary theory has been built. But Mendel died thinking he had found only some interesting things about peas.

The ultimate irony may be that there was one man who might have seen the importance of Mendel's findings right away, and have been in a position to draw the attention of the scientific community to them. Charles Darwin recognised that the biggest flaw in his theory of evolution by natural selection was his lack of an adequate theory of inheritance. He had even written in a letter to a critic that current views of inheritance, including his own, could undermine the whole model. In fact, while the scientific world almost immediately accepted Darwin's idea of common descent, it ignored or rejected the second part of his work, the model of how natural selection worked. Mendel's "particulate inheritance" model would have given Darwin exactly what he (and his colleagues) needed to complete the model. When Darwin died, a copy of that issue of the Brünn Natural History Society was found in his bookshelf, with the pages still uncut. He had never read it!

Was Mendel a Great Scientist?

On the surface Mendel appears to have been the model scientist, and there can be little doubt that he has left us with incredible insights into the workings of life. Among the attributes he showed were:

- Curiosity
- Willingness to experiment
- Understanding of the need to control variables
- Meticulous technique
- Patience to accumulate large sample sizes
- Excellent record keeping
- Mathematical analysis of patterns
- Ability to generalise and synthesise
- Willingness to publish his results

There have been some questions, however, about Mendel's objectivity in selecting his data for publication. Statisticians have suggested that it would be almost impossible to get results quite as good as his. Chance variations, and the difficulties of experimentation should have introduced greater errors. As well, Mendel reported on seven traits of peas. It just happens that peas have seven pairs of chromosomes, and the genes Mendel worked on happened to be arranged one on each pair of chromosomes. The odds of this happening are very small. Had the genes for two of the traits been on the same chromosome, Mendel would have got conflicting results, and might not have seen the general pattern. So, did Mendel cheat? Probably not, but he may have got lucky and seen the pattern emerging from a few experiments. He may then only have reported on the results of other experiments that
supported his ideas, assuming (as we all do from time to time) that experimental error was responsible for the unexplained results. So, Mendel may not have been scrupulously honest about his reporting, but the mere fact that he was able to find the patterns in the chaos of thousands of observations suggests that he deserves more praise than criticism. It was another forty years before cell biologists came up with the explanation for crosses that do not conform to Mendel's rules.

**Follow-up Questions:**

*Please answer the following on a separate page*

1) Before Gregor Mendel’s experiments were accepted, how did most people explain why offspring look similar to parents? What phenomena were difficult to explain with this theory?

2) Why was the monastery that Gregor Mendel joined a good place for to have been to investigate heredity in pea plants?

3) Plants can sometimes fertilize themselves. This would have made it difficult to study the heredity of traits when mixed from different parents. How did he prevent this from happening?

4) What characteristics did he choose to observe to track the heredity of traits in his pea plants?

5) When he crossed plants that differed in just one trait, what did he notice about that trait in the offspring?

6) What was surprising to him about the result when he crossed the offspring plants with each other? *Note that there were TWO features of these results which were surprising.*

7) What was the most radical idea he presented to explain his “Laws of Inheritance”?

8) Why were his ideas not accepted when then were published?

9) Why is Gregor Mendel sometimes referred to as the “Father of Genetics”?

10) Summarize the controversy that still exists about Mendel’s data and methods.