# Genetics

The **history of**[**genetics**](https://en.wikipedia.org/wiki/Genetics) started with the work of the [Augustinian friar](https://en.wikipedia.org/wiki/Augustinian_friar) [Gregor Johann Mendel](https://en.wikipedia.org/wiki/Gregor_Johann_Mendel). [His work](https://en.wikipedia.org/wiki/Experiments_on_Plant_Hybridization) on pea plants, published in 1866, described what came to be known as [Mendelian Inheritance](https://en.wikipedia.org/wiki/Mendelian_Inheritance). In the centuries before—and for several decades after—Mendel's work,wide variety of theories of [heredity](https://en.wikipedia.org/wiki/Heredity) proliferated.

The year 1900 marked the "rediscovery of Mendel" by [Hugo de Vries](https://en.wikipedia.org/wiki/Hugo_de_Vries), [Carl Correns](https://en.wikipedia.org/wiki/Carl_Correns) and [Erich von Tschermak](https://en.wikipedia.org/wiki/Erich_von_Tschermak), and by 1915 the basic principles of Mendelian genetics had been applied to a wide variety of organisms—most notably the fruit fly [*Drosophila melanogaster*](https://en.wikipedia.org/wiki/Drosophila_melanogaster). Led by [Thomas Hunt Morgan](https://en.wikipedia.org/wiki/Thomas_Hunt_Morgan) and his fellow "drosophilists", geneticists developed the [Mendelian](https://en.wikipedia.org/wiki/Mendelian) model, which was widely accepted by 1925. Alongside experimental work, mathematicians developed the statistical framework of [population genetics](https://en.wikipedia.org/wiki/Population_genetics), bringing genetic explanations into the study of [evolution](https://en.wikipedia.org/wiki/Evolution).

With the basic patterns of genetic inheritance established, many biologists turned to investigations of the physical nature of the [gene](https://en.wikipedia.org/wiki/Gene). In the 1940s and early 1950s, experiments pointed to [DNA](https://en.wikipedia.org/wiki/DNA) as the portion of chromosomes (and perhaps other nucleoproteins) that held genes. A focus on new model organisms such as viruses and bacteria, along with the discovery of the double helical structure of DNA in 1953, marked the transition to the era of [molecular genetics](https://en.wikipedia.org/wiki/Molecular_genetics).

In the following years, chemists developed techniques for sequencing both nucleic acids and proteins, while others worked out the relationship between the two forms of biological molecules: the [genetic code](https://en.wikipedia.org/wiki/Genetic_code). The regulation of [gene expression](https://en.wikipedia.org/wiki/Gene_expression) became a central issue in the 1960s; by the 1970s gene expression could be controlled and manipulated through [genetic engineering](https://en.wikipedia.org/wiki/Genetic_engineering). In the last decades of the 20th century, many biologists focused on large-scale genetics projects, sequencing entire genomes.

Mendel

In breeding experiments between 1856 and 1865, [Gregor Mendel](https://en.wikipedia.org/wiki/Gregor_Mendel) first traced inheritance patterns of certain traits in pea plants and showed that they obeyed simple statistical rules. Although not all features show these patterns of [Mendelian inheritance](https://en.wikipedia.org/wiki/Mendelian_inheritance), his work acted as a proof that application of statistics to inheritance could be highly useful. Since that time many more complex forms of inheritance have been demonstrated.

From his statistical analysis Mendel defined a concept that he described as a character (which in his mind holds also for "determinant of that character"). In only one sentence of his historical paper he used the term "factors" to designate the "material creating" the character: " So far as experience goes, we find it in every case confirmed that constant progeny can only be formed when the egg cells and the fertilizing pollen are of like character, so that both are provided with the material for creating quite similar individuals, as is the case with the normal fertilization of pure species. We must therefore regard it as certain that exactly similar factors must be at work also in the production of the constant forms in the hybrid plants."(Mendel, 1866).

Mendel's work was published in 1866 as *"Versuche über Pflanzen-Hybriden" (*[*Experiments on Plant Hybridization*](https://en.wikipedia.org/wiki/Experiments_on_Plant_Hybridization)*)* in the *Verhandlungen des Naturforschenden Vereins zu Brünn (Proceedings of the Natural History Society of Brünn)*, following two lectures he gave on the work in early 1866.

Post-Mendel, pre-re-discovery

Mendel's work was published in a relatively obscure [scientific journal](https://en.wikipedia.org/wiki/Scientific_journal), and it was not given any attention in the scientific community. Instead, discussions about modes of heredity were galvanized by [Darwin](https://en.wikipedia.org/wiki/Charles_Darwin)'s theory of [evolution](https://en.wikipedia.org/wiki/Evolution) by natural selection, in which mechanisms of non-[Lamarckian](https://en.wikipedia.org/wiki/Lamarckian) heredity seemed to be required. Darwin's own theory of heredity,[pangenesis](https://en.wikipedia.org/wiki/Pangenesis), did not meet with any large degree of acceptance. A more mathematical version of pangenesis, one which dropped much of Darwin's Lamarckian holdovers, was developed as the "biometrical" school of heredity by Darwin's cousin, [Francis Galton](https://en.wikipedia.org/wiki/Francis_Galton). Under Galton and his successor [Karl Pearson](https://en.wikipedia.org/wiki/Karl_Pearson), the biometrical school attempted to build statistical models for heredity and evolution, with some limited but real success, though the exact methods of heredity were unknown and largely unquestioned.

Emergence of molecular genetics

The significance of Mendel's work was not understood until early in the twentieth century, after his death, when his research was re-discovered by other scientists working on similar problems: [Hugo de Vries](https://en.wikipedia.org/wiki/Hugo_de_Vries), [Carl Correns](https://en.wikipedia.org/wiki/Carl_Correns) and [Erich von Tschermak](https://en.wikipedia.org/wiki/Erich_von_Tschermak). There was then a feud between [Bateson](https://en.wikipedia.org/wiki/William_Bateson) and [Pearson](https://en.wikipedia.org/wiki/Karl_Pearson) over the hereditary mechanism, solved by [Fisher](https://en.wikipedia.org/wiki/Ronald_Fisher)in his work "[The Correlation Between Relatives on the Supposition of Mendelian Inheritance](https://en.wikipedia.org/wiki/The_Correlation_Between_Relatives_on_the_Supposition_of_Mendelian_Inheritance)".

In 1910, [Thomas Hunt Morgan](https://en.wikipedia.org/wiki/Thomas_Hunt_Morgan) showed that genes reside on specific [chromosomes](https://en.wikipedia.org/wiki/Chromosome). He later showed that genes occupy specific locations on the chromosome. With this knowledge, Morgan and his students began the first chromosomal map of the fruit fly [*Drosophila*](https://en.wikipedia.org/wiki/Drosophila_melanogaster). In 1928, [Frederick Griffith](https://en.wikipedia.org/wiki/Frederick_Griffith) showed that genes could be transferred. In what is now known as [Griffith's experiment](https://en.wikipedia.org/wiki/Griffith%27s_experiment), injections into a mouse of a deadly strain of [bacteria](https://en.wikipedia.org/wiki/Bacteria) that had been heat-killed transferred genetic information to a safe strain of the same bacteria, killing the mouse.

A series of subsequent discoveries led to the realization decades later that the genetic material is made of [DNA](https://en.wikipedia.org/wiki/DNA) (deoxyribonucleic acid). In 1941, [George Wells Beadle](https://en.wikipedia.org/wiki/George_Wells_Beadle) and[Edward Lawrie Tatum](https://en.wikipedia.org/wiki/Edward_Lawrie_Tatum) showed that mutations in genes caused errors in specific steps in [metabolic pathways](https://en.wikipedia.org/wiki/Metabolic_pathway). This showed that specific genes code for specific proteins, leading to the "[one gene, one enzyme](https://en.wikipedia.org/wiki/One_gene,_one_enzyme)" hypothesis.[[8]](https://en.wikipedia.org/wiki/History_of_genetics#cite_note-Gerstein-8) [Oswald Avery](https://en.wikipedia.org/wiki/Oswald_Avery), [Colin Munro MacLeod](https://en.wikipedia.org/wiki/Colin_Munro_MacLeod), and [Maclyn McCarty](https://en.wikipedia.org/wiki/Maclyn_McCarty) [showed in 1944](https://en.wikipedia.org/wiki/Avery-MacLeod-McCarty_experiment) that DNA holds the gene's information.[[9]](https://en.wikipedia.org/wiki/History_of_genetics#cite_note-9) In 1952,[Rosalind Franklin](https://en.wikipedia.org/wiki/Rosalind_Franklin) and Raymond Gosling produced a strikingly clear x-ray diffraction pattern indicating a helical form, and in 1953, [James D. Watson](https://en.wikipedia.org/wiki/James_D._Watson) and [Francis Crick](https://en.wikipedia.org/wiki/Francis_Crick)demonstrated the molecular structure of [DNA](https://en.wikipedia.org/wiki/DNA). Together, these discoveries established the [central dogma of molecular biology](https://en.wikipedia.org/wiki/Central_dogma_of_molecular_biology), which states that proteins are translated from [RNA](https://en.wikipedia.org/wiki/RNA)which is transcribed from DNA. This dogma has since been shown to have exceptions, such as [reverse transcription](https://en.wikipedia.org/wiki/Reverse_transcription) in [retroviruses](https://en.wikipedia.org/wiki/Retrovirus).

In 1972, [Walter Fiers](https://en.wikipedia.org/wiki/Walter_Fiers) and his team at the [University of Ghent](https://en.wikipedia.org/wiki/University_of_Ghent) were the first to determine the sequence of a gene: the gene for [Bacteriophage MS2](https://en.wikipedia.org/wiki/Bacteriophage_MS2) coat protein.[[10]](https://en.wikipedia.org/wiki/History_of_genetics#cite_note-Min_1972-10) [Richard J. Roberts](https://en.wikipedia.org/wiki/Richard_J._Roberts) and [Phillip Sharp](https://en.wikipedia.org/wiki/Phillip_Sharp) discovered in 1977 that genes can be split into segments. This led to the idea that one gene can make several proteins. The successful sequencing of many organisms' [genomes](https://en.wikipedia.org/wiki/Genome) has complicated the molecular definition of genes. In particular, genes do not seem to sit side by side on [DNA](https://en.wikipedia.org/wiki/DNA) like discrete beads. Instead, [regions](https://en.wikipedia.org/wiki/Region) of the DNA producing distinct proteins may overlap, so that the idea emerges that "genes are one long [continuum](https://en.wikipedia.org/wiki/Continuum_(theory))".[[11]](https://en.wikipedia.org/wiki/History_of_genetics#cite_note-Pearson_2006-11)[[12]](https://en.wikipedia.org/wiki/History_of_genetics#cite_note-Rethink-12) It was first hypothesized in 1986 by [Walter Gilbert](https://en.wikipedia.org/wiki/Walter_Gilbert) that neither DNA nor protein would be required in such a primitive system as that of a very early stage of the earth if RNA could perform as simply a catalyst and genetic information storage processor.

The modern study of [genetics](https://en.wikipedia.org/wiki/Genetics) at the level of DNA is known as [molecular genetics](https://en.wikipedia.org/wiki/Molecular_genetics) and the synthesis of molecular genetics with traditional [Darwinian](https://en.wikipedia.org/wiki/Charles_Darwin) [evolution](https://en.wikipedia.org/wiki/Evolution) is known as the[modern evolutionary synthesis](https://en.wikipedia.org/wiki/Modern_evolutionary_synthesis).

**ASSIGNMENT**

* Standard reading assignment:
  + Pick 7 words and define
  + Make a question for each word
    - No definition or yes/no questions
  + Answer each question
  + Summarize article in 7 sentences