History of molecular genetics

Molecular genetics is a branch of biology that studies genes and heredity at the molecular level. It focuses on the study of DNA and RNA, and their functions in living organisms. The history of molecular genetics has witnessed significant developments over the years, starting with the discovery of DNA as a carrier of genetic information, through understanding the role of genes in determining hereditary traits, and finally advancing genetic sequencing and analysis techniques.

The most important stages of the development of molecular genetics:

After the rediscovery of Mendel's work, there was a conflict between William Bateson and Pearson over the mechanism of inheritance, a conflict that was resolved by Ronald Fisher in his work "Relationship between Kins based on Mendel's Genetic Hypothesis.

A series of discoveries in subsequent decades revealed that genetic material is made of DNA (deoxyribonucleic acid). In 1941, George Beadle and Edward Tatum showed that mutations in genes cause errors in specific steps in metabolic pathways

The DNA Era

1944: Isolation of DNA as genetic material in the Avery-McLeod-McCarty experiment (which was then called the transduction principle).

1947: Salvador Luria discovered the reactivation of radioactive phages, which stimulated numerous studies of DNA repair processes in bacteria and other organisms, including humans.

1948: Barbara McClintock discovered transposons in maize.

1950: Chargaff determined how nitrogenous bases pair. He discovered three things (also known as Chargaff's rules). First, the concentration of pyrimidines (guanine and adenine) is always present in the same proportion to each other. Second, the concentration of purines (cytosine and thymidine) is always the same. Finally, Chargaff and his team discovered that the ratio of pyrimidines to purines is consistent with each other.

1952: The Hershey-Chase experiment demonstrated that the genetic information in phages (and, by extension, all other organisms) is DNA.

1952: An X-ray diffraction image of DNA was taken in May 1952 by Raymond Gosling, a student supervised by Rosalind Franklin.

1953: The structure of DNA was discovered in the form of a double helix by James Watson and Francis Crick.

http://www.mendelweb.org/MWolby.html

Griffiths ،William M. ؛Miller ،Jeffrey H. ؛Suzuki ،David T. ؛Lewontin ،Richard C. ؛Gelbart ،المحررون (2000).

Genetic material verification experiments

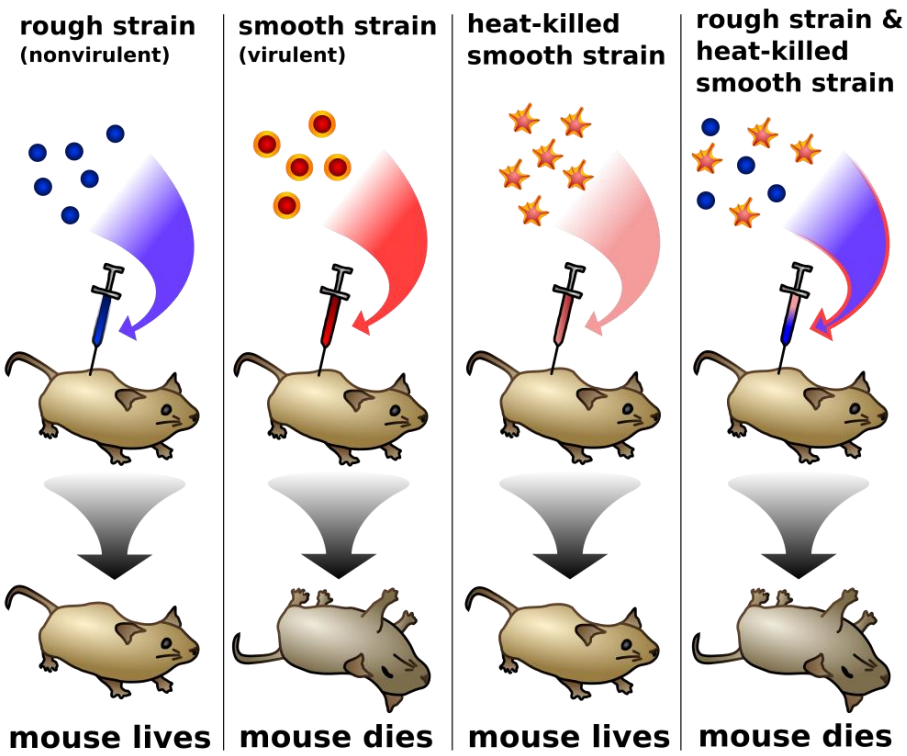
First: Griffith's experiment

In 1928, Griffith conducted one of the first experiments indicating that bacteria are capable of transferring genetic information through the process of transduction, i.e., the transfer of genetic material from one strain to another. This led to the discovery that DNA is the hereditary material in living organisms.

Griffith studied two strains of Streptococci bacteria that cause pneumonia, and found that one of these strains could mutate, or change into another form

One of the two strains he studied had a capsule-like coating of sugars (protecting it from the host's immune system, leading to host death) that caused pneumonia. He called it III-S, meaning "smooth," while the other strain did not have a coating and did not cause pneumonia. He called it II-R, meaning "rough." The edges of the R-strain colonies appear ragged because they have no coating surrounding them.

Griffith conducted a number of experiments on mice by injecting them . with the (S) strain. He noticed that the mouse died, while the (R) cells did not kill the mouse. He then prepared a mixture of live (R) cells and dead (S) cells and injected the mouse with this mixture, which led to the mouse’s death. After that, Griffith isolated live bacterial cells from the dead mouse.



When these bacteria were cultured, it was found that they had the smooth characteristic, indicating that the causative agent of the disease had moved from dead bacteria (S) to live bacteria (R). Griffith concluded that a transformation had occurred from live bacteria (R) to live bacteria (S).

The "transformation principle" that Griffith observed was that the DNA of the III-S strain bacteria survived the heating process and was taken up by the II-R strain. The III-S strain DNA contains the genes that form the protective polysaccharide capsule.

Second: Avery's experiment

In 1944, Avery, MacLeod, and McCarty conducted their experiment to prove that DNA is the genetic material that causes bacterial transformation.

At a time when proteins were believed to be the carriers of genetic information, Oswald Avery and his colleagues (Colin McCloud and Macklin McCarty) identified the molecule that surrounds bacteria from the R strain to the S strain. Avery isolated various large molecules such as DNA, protein and lipids from heat-killed S bacteria cells,

He then exposed live (R) bacterial cells to the large molecules separately. The (R) bacteria transformed into (S) bacteria when exposed to DNA molecules. Avery and his colleagues concluded that when the (S) bacteria were killed in Griffith's experiment, DNA molecules were released. Some (R) bacterial cells exploited these DNA molecules, which led to the (R) bacterial cells changing into (S) bacteria and the development of a dead-line infection.

The phenomenon of bacterial transformation can be explained based on this experiment as follows:

1. One bacterial strain (strain R) absorbed the DNA of another strain (strain S) and integrated it with its own DNA.

2. These bacteria acquired the characteristics of the bacteria from which the DNA came. More importantly, this bacterial transformation of the recipient bacteria was passed on to the offspring.