

## Lecture 1

## 01. HISTORY OF GENETICS

The **history of genetics** started with the work of the Augustinian friar Gregor Johann Mendel. His work on pea plants, published in 1866, described what came to be known as Mendelian Inheritance. In the centuries before—and for several decades after—Mendel's work, a wide variety of theories of heredity proliferated.

1900 marked the "rediscovery of Mendel" by Hugo de Vries, Carl Correns and 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*. Led by Thomas Hunt Morgan and his fellow "drosophilists", geneticists developed the Mendelian model, which was widely accepted by 1925. Alongside experimental work, mathematicians developed the statistical framework of population genetics, bringing genetic explanations into the study of evolution.

With the basic patterns of genetic inheritance established, many biologists turned to investigations of the physical nature of the gene. In the 1940s and early 1950s, experiments pointed to 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.

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. The regulation of gene expression became a central issue in the 1960s; by the 1970s gene expression could be controlled and manipulated through genetic engineering. In the last decades of the 20th century, many biologists focused on large-scale genetics projects, sequencing entire genomes.

## HISTORICAL DEVELOPMENTS IN GENETICS

Year	Scientist	Contribution
1485	L. da Vinci	Recommended the use of lenses for viewing small objects
1590	Z. Janssen and H. Janssen	Produced the first operational microscope.
1665	R. Hooke	Introduced the term "cell" and described cork cells.
1668	F. Redi	Disproved the theory of spontaneous generation of maggots.
1672	Malphigi	Classified the tissues.
1674	A. van Leeuwenhoek	Improved lens system of microscope by grinding.
1682	N. Crew	Described bladders and pores in wood and pith.
1694	J.R. Camerarius	Conducted early experiments on pollination and reported the existence of sex in plants.
1700	R. Linnaeus	Classified the biological organisms.
1761	J.C. Kolreuter	Hybridized various species of tobacco and concluded that each parent contributed equally to the characteristics of the progeny.
1779	C.F. Wolff	Founder of embryology.
1809	J.B. Lamarck	Coined the word "biology" and stressed the importance of cell in living organisms. He put forth the theory of inheritance of acquired characters.
1824	Dutrochet	Showed that all plants and animals are composed of cells.
1825	F.V. Raspail	Developed the frozen-section technique and used iodine for detection of starch.
1835	H. von Mohli	Emphasized the importance of protoplasm and described cell division.
1837	R. Brown	Discovered the nucleus in cells of flowering plants.

Year	Scientist	Contribution
1838	M.J. Schleiden and T. Schwann	Formulated the cell theory in plants and animals.
1840	J.E. Purkinj	Gave the term “protoplasm”.
1845	A. Donne	Used photomicroscopy for the first time.
1846	K. Nageli	Showed that plant cells arise from the division of pre-existing cells.
1846	G.B. Amici	Showed that egg in the ovary is stimulated to develop into an embryo by the entrance of pollen tube.
1858	R. Virchow	Showed that animal cells arise from the division of pre-existing cells.
1859	C. Darwin	Put forth the theory of natural selection.
1862	Kolliker	Used the term “cytoplasm” for the living material surrounding the nucleus.
1865	G. Mendel	Developed the fundamental principles of heredity.
1870	W. His	Invented the microtome.
1871	F. Meischer	Isolated nucleic acids from pus cells.
1873	H. Fol	Described spindle and astral rays.
1875	O. Hertwig	Studied reproduction in sea urchins and concluded that fertilization involves the union of sperm and egg nucleus.
1875	E. Strasburger	Discovered cell division in plants and gave the terms “cytoplasm” and “nucleoplasm”.
1879	W. Flemming	Introduced the term “chromatin”.
1879	H. Fol	Showed that only one sperm enters the egg during fertilization.
1881	E.G. Balbiani	Discovered giant chromosomes in salivary glands of Drosophila.
1882	W. Flemming	Coined the term “mitosis”.
1883	W. Rouse	Proposed that chromosomes contain genes which are the units of heredity.

Year	Scientist	Contribution
1885	A.F.W. Schimper	Introduced the term “plastids”.
1888	Th. Boveri	Coined the term “centrosomes”.
1888	W. Waldeyer	Coined the term “chromosomes”.
1892	O. Hertwig	Proposed the protoplasm theory of inheritance.
1892	J. Ruckert	Described lamp brush chromosomes in oocytes of shark.
1892	W. Weisman	Stated that chromosomes are the most important part of the nucleus.
1892	Th. Boveri	Described meiosis in Ascaris.
1898	C. Golgi	Described the golgi apparatus in nerve cells.
1898	C. Benda	Discovered mitochondria in spermatozoa and other cells.
1899	S. Altman	Introduced the term “nucleic acid”.
1900	C.E. Correns, H. de Vries and E. Tschermak	Re-discovered Mendel’s laws of inheritance.
1901	E. Strasburger	Introduced the term “plasmodesmata”.
1902	C.E. McClung	Identified sex chromosomes in bugs.
1902	H. de Vries	Coined the term “mutation”.
1902	W.S. Sutton Th. Boveri	Proposed the chromosome theory of heredity and identified chromosomes as carriers of genetic material.
1903	W. Waldeyer	Proved centromeres are the chromosomal regions with which the spindle fibres become associated during mitosis
1905	L. Cuenot	Discovered lethal genes affecting coat colour in mice.
1905	J.B. Farmer and J.E. Moore	Coined the term “meiosis”.
1906	W. Bateson	Coined the term “Genetics” and proposed the concept of allele.
1906	W. Bateson and R.C. Punnet	Discovered genetic linkage in sweet pea.

Year	Scientist	Contribution
1906	W.L. Johannsen	Coined the terms “gene”, “genotype” and “phenotype”.
1909	W. Bateson	Coined the term “epitasis”.
1909	C. Correns	Reported cytoplasmic inheritance in <i>Mirabilis jalapa</i> .
1909	F.A. Janssens	Indicated that chiasmata are produced by exchanges between non-sister chromatids of homologous chromosomes.
1910	T.H. Morgan	Studied crossing over and recombination in <i>Drosophila</i> and coined the term “crossing over”.
1910	H. Nilsson-Ehle	Proposed the multiple factor hypothesis.
1911	A.H. Sturtevant	Constructed the first linkage map in <i>Drosophila</i> .
1912	Vejdovsky	Coined the term “chromonema”.
1915	T.H. Morgan	Correlated genetic studies with cytological studies. He put forth the theory of linkage and studied sex linked inheritance in <i>Drosophila melanogaster</i> .
1917	C.E. Allen	Discovered sex determination in plants.
1921	F.G. Banting C.H. Best	Isolated insulin.
1922	C.B. Bridges	Put forth the genic balance theory of sex determination.
1923	C.B. Bridges	Discovered duplications, deletions and translocations in chromosomes.
1923	Crew	Reported complete reversal of sex in hens.
1924	A.F. Blakeslee and J. Belling	Studied trisomics in Jimson weed ( <i>Datura stramonium</i> ).
1924	R. Feulgen	Described a test to confirm the presence of DNA.
1926	A.H. Sturtevant	Discovered inversions in chromosomes.
1927	G.K. Karpechenko	Synthesized Raphano brassica.
1927	H.J. Muller	Induced mutations in <i>Drosophila melanogaster</i> by X-rays
1928	L.J. Stadler	Induced mutations in maize and barley by X-rays.

Year	Scientist	Contribution
1928	F. Griffith	Conducted experiments on transformations in <i>Diplococcus pneumonia</i> .
1931	C. Stern	Gave cytological proof for crossing over in <i>Drosophila</i> .
1931	H. Creighton and B. McClintock	Gave cytological proof for crossing over in maize.
1932	M. Knoll and E. Ruska	Developed the electron microscope.
1933	M. Rhodes	Reported cytoplasmic male sterility in corn.
1935	F. Zernicke	Developed the phase contrast microscope.
1935	R.B. Goldschmidt	Coined the term “phenocopy”.
1939	R.A. Steinberg	Induced mutations in <i>Aspergillus</i> sp. with chemicals.
1944	O.T. Avery, C.M. MacLeod and M. McCarty	Explained the significance of DNA and proved that it is the genetic material.
1946	C. Auerbach and J.M. Robson	Induced mutations in <i>Drosophila melanogaster</i> using chemicals.
1946	E.S. McFadden, E.R. Sears and H. Kihara	Synthesized <i>Triticum spelta</i> in the laboratory.
1948	K.R. Porter	Described the endoplasmic reticulum.
1950	B. McClintock	Discovered jumping genes in maize.
1951	A. Muntzing	Synthesized Triticale.
1952	A.D. Hershey and M.J. Chase	Provided experimental proof of DNA as genetic material.
1953	Robinson and Brown	Observed ribosomes in plant cells.
1953	J.D. Watson, F.H.C. Crick and M.H.F. Wilkins	Proposed the double helix model for DNA molecule.
1954	E.R. Sears	Produced monosomic series of “Chinese Spring” variety of wheat.
1955	S. Benzer	Described the fine structure of gene—Cistron, Recon and Muton.

Year	Scientist	Contribution
1955	C. DeDuve	Coined the term “ lysosomes ”.
1955	G.E. Palade	Observed ribosomes in animal cells.
1955	L. Pauling	Studied the relationship between the structure of the DNA molecule and protein synthesis.
1958	G.W. Beadle, E.L. Tatum and J. Lederberg	Put forth the one gene – one enzyme hypothesis.
1958	F.H.C. Crick	Explained the central dogma of molecular biology.
1958	M.S. Meselson and F.W. Stahl	Proved experimentally that DNA replicates by semi-conservative mechanism.
1959	A. Kornberg and S. Ochoa	Synthesized the DNA molecule in vitro.
1961	A.E. Jacob and J. Monod	Explained the genetic regulatory mechanism in protein synthesis – Operon concept.
1968	N.W. Nirenberg , H.G. Khorana and H. Holley	Deciphered the genetic code and polynucleotide synthesis.
1968	Woodcock and Fernandez	Isolated DNA from chloroplasts.
1974	Clande, G.E. Palade and C. DeDuve	Re-discovered a number of cell organelles by electron microscope.
1975	R. Dulbecco, H. Temin and D. Baltimore	Discovered the mechanism of reverse transcription – Teminism.
1975	N. Borlaug	Responsible for development of dwarf wheat and green revolution.
1978	D. Nathans , H.O. Smith and W. Arber	Isolated restriction enzymes.
1985	Potrykus	Used electroporation technique for direct gene transfer in plants.
1986	Helentzaris	Developed the RFLP map in maize and tomato.

Year	Scientist	Contribution
1986	Ow	Transferred and studied the expression of gene for enzyme lucifersase (causes fire flies to glow) in tobacco cells.
1987	Fischhoff	Developed insect resistant transgenic tomato plants with Bt gene.
1987	K.B. Mullis	Developed polymerase chain reaction technique.
1988	Ouozzo	Developed transgenic tobacco with CMV coat protein.
1991	Oeller	Developed transgenic tomato with an antisense gene.
1992	Vasil	Developed herbicide resistant transgenic wheat.
1993	Sharp Roberts	Proposed the split gene concept.
1993	Smith	Studied site directed mutagenesis.
1994	Gilman and Rodbell	Studied G proteins and their role in turning external signals into action within cells.
1995	Lewis, Volard and Wieschaus	Studied the role of genes in organ differentiation.
1997	I. Wilmut	Cloned sheep – Dolly.
1997	Prusiner	Studied prions – Mad cow disease.
1998	Delta & Pine Co.	Developed the terminator gene technology.
1998	Monsanto Co.	Developed bollguard variety of cotton.
1998	T. Wakayama and R. Yanagimachi	Created the first cloned mice.
2000	Roslin Institute	Created the first cloned pigs.
2001	Advanced Cell Technology	Birth of first cloned Asian ox called “Gaur”.
2002	Natl. Institute of Agronomic Research, France.	Created the first cloned rabbit