







# Introduction to Genetics and Breeding

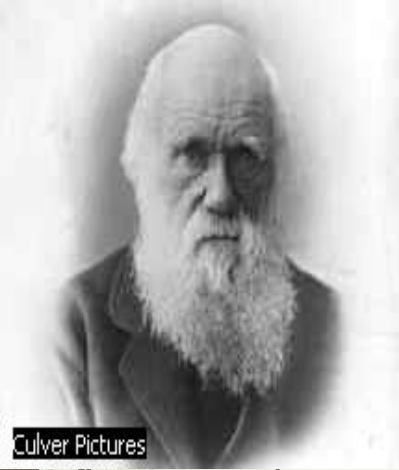
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- **Genetics** – the study of heredity and variation
  - **Heredity** – the passing of traits from parents to offspring
  - **Genes** – units of heredity, located on chromosomes found in every cell of the body

“Fish Genetics” may be defined as a

*“Branch of fisheries science that deals with the application of genetic principles and methods to enhance aquaculture productivity by genetically modifying fish stocks and for the management of fish populations to obtain maximum sustainable benefit without affecting genetic diversity”.*

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1. **Hereditary variations:** Among the sexually reproducing organisms no two individuals have the same heredity. The differences in hereditary constitutions of the individuals of a species are known as **hereditary or genetical variations**.
  2. **Environmental variations:** The variations which are not inherited but are due to the effects of temperature, moisture, food, light or other environmental factors on the development of the organisms are called **environmental variations**. For example, the differences between a well-nourished and malnourished person. The heredity and variations have a significant role in the formation of new species (i.e., speciation).

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- In the past, although it was noticed that traits were passed along, the “how” is not known clearly
  - Aristotle – passed through the blood (“bloodline”)
  - Early naturalists – believed in “hybrids”—where species result from breeding between other species
  - Georges Buffon (1700s) – head and limbs from (male), rest of body from (female)
  - 1800s – common belief was a blending of the traits from both parents
  - Very late of 1800s, microscope developed to point where meiosis was observed and scientists started speculating about the possibility of chromosomes being involved in heredity but before that....



Charles Darwin's theory of natural selection became the foundation concept supporting the theory of evolution.

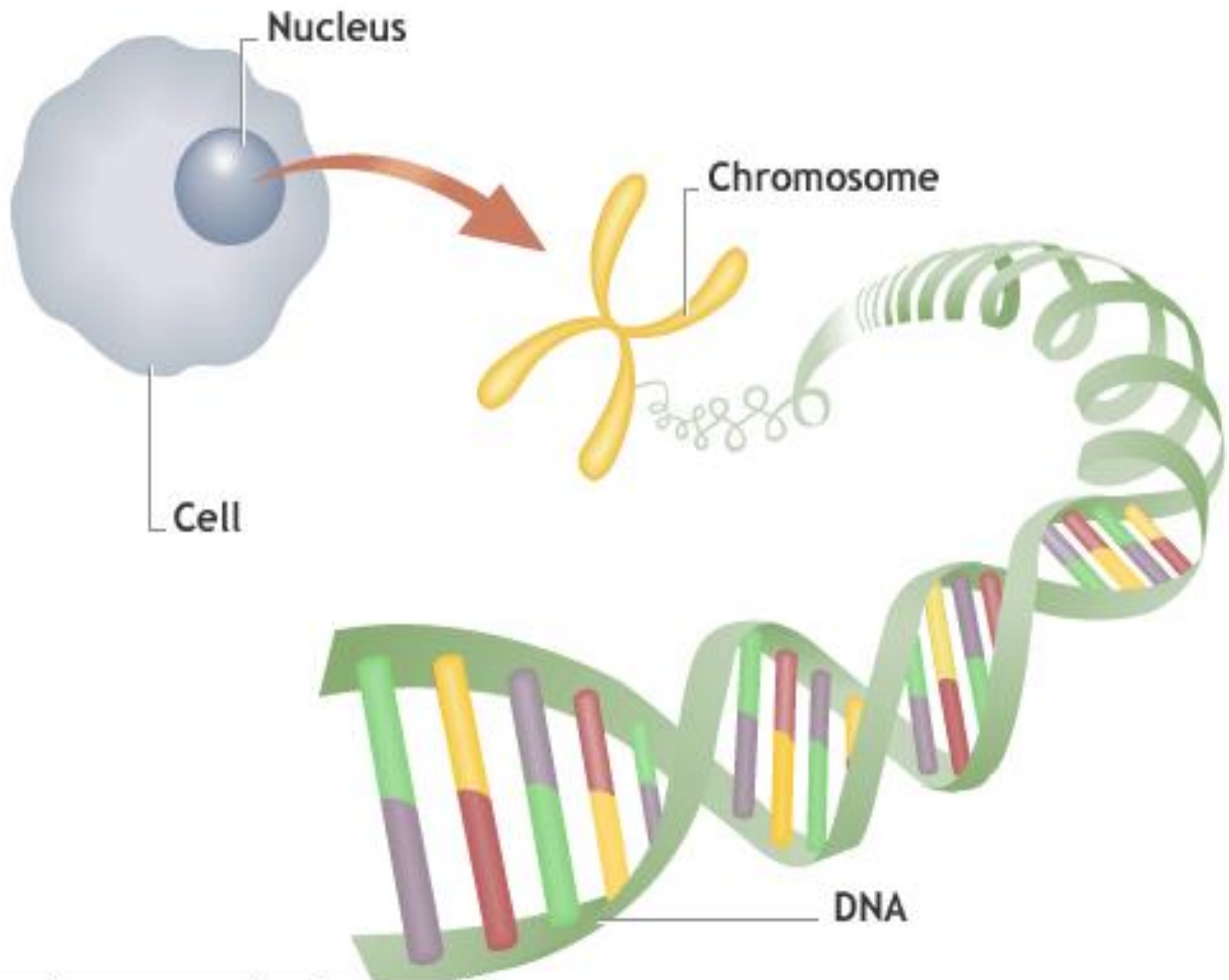
Revolutionary theory was published in 1859 in Darwin's famous treatise

On the Origin of Species by Means of Natural Selection.

**Lamarck**-inheritance of acquired characteristics - proposed that organisms evolve by responding to changes in their environment. When organisms undergo a change in order to adjust to their environment, that change acts as a trait that can be passed on to offspring.

1902 American biologist Walter S. **Sutton** and German cell biologist Theodor **Boveri** separately noted the parallels between Mendel's units and chromosomes.

The demonstration of the **chromosomal basis of inheritance** gave rise to the modern science of genetics.







The term **genetics** itself was coined in 1905 by British biologist **William Bateson**.

The terms *gene* and *genotype* were contributed in 1909 by German scientist **Wilhelm Johannsen**.

American biologist **Thomas Hunt Morgan** in 1910 identified the first proof of a **sex-linked trait**, an eye- color characteristic that resides on the X chromosome of fruit flies.



**Morgan** became the first scientist to pin down the **location of a gene to a specific chromosome**.

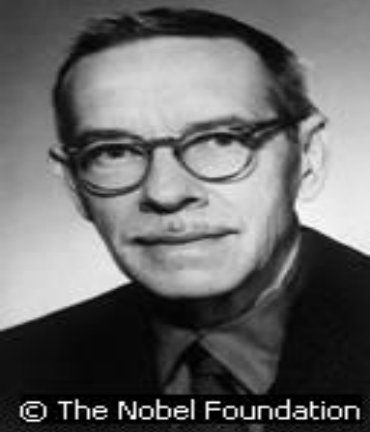
**Morgan** was also the first to explain the implications of **linkage**, unusual patterns of inheritance that occur when multiple genes found on the same chromosome are inherited together.

A student of Morgan's, American biologist Alfred **Sturtevant**, found early evidence of the mechanisms of **crossing over**, the phenomenon in which chromosomes interchange genes.

**McClintock** worked on **transposable elements**, large genetic segments that move within a chromosome or even between chromosomes. Her research into these elements, commonly known as **jumping genes**, earned McClintock the 1982 Nobel Prize in physiology or medicine.



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**Hershey and Chase** showed that when a type of virus called a **bacteriophage** infects a bacterium, it is the virus's DNA—not protein—that enters the bacterium to cause infection.

Their studies confirmed that DNA contained the virus's genetic information, which triggered viral replication within the bacteria.




British physical chemist **Rosalind Franklin** and  
British biophysicist **Maurice Wilkins** used **X-ray  
diffraction** to obtain DNA images of unprecedented  
clarity.




American biochemist **James Watson** and British biophysicist **Francis Crick** in 1953 proposed a model of DNA that is still accepted today: A double helix molecule formed by two chains, each composed of alternating sugar and phosphate groups, connected by nitrogenous bases. Watson and Crick (along with Wilkins) were awarded the 1962 Nobel Prize in physiology or medicine for their discoveries.





**DNA replication**  
**semi-conservative replication,**  
was demonstrated in 1958 by  
American molecular biologists  
**Matthew Meselson and Franklin**  
**Stahl.**





American geneticist **Har Gobind Khorana** helped scientists create a “dictionary” of codons that defined specific amino acids-**genetic code**



Swiss molecular biologist **Werner Arber** won the Nobel Prize in medicine in 1978. He discovered **restriction enzymes** and their application to problems of molecular genetics.





American physician and molecular biologist **Hamilton Othanel Smith** won the 1978 Nobel Prize in physiology or medicine. His work led to the discovery of **restrictive enzymes** and their relationship to molecular genetics.



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American biochemist **Kary Mullis** won the 1993 Nobel Prize in chemistry. He invented the **polymerase chain reaction (PCR)** method of producing multiple fragments of deoxyribonucleic acid (DNA).

British biochemist

**Frederick Sanger** won the 1958 Nobel Prize in chemistry. He won the award for his research on the **structure of proteins**. He was awarded a second Nobel Prize in 1987 for devising a method to rapidly **determine the nucleotide sequence of nucleic acids**.



Thanks

