The inheritance on cellular and molecular levels. Thomas Morgan experiments. The chromosomal theory.

- Molecular biology is the study of biology at the molecular level. The field overlaps with other areas of biology and chemistry, particularly genetics and biochemistry. Molecular and cellular biology are interrelated, since most of the properties and functions of a cell can be described at the molecular level. Molecular and cellular biology encompass many biological fields including: biotechnology, developmental biology, physiology, genetics and microbiology.

Molecular genetics

- Molecular Genetics Changes to genes (mutations) and the cell environment (e.g. toxins) can alter the by cells, and can change how an organism structure and function of proteins produced changes can be neutral, some beneficial looks and functions (phenotype). Some and others harmful to the organism.

The inheritance on cellular and molecular levels

- Perhaps the most fundamental property of all living things is the ability to reproduce. All organisms inherit the genetic information specifying their structure and function from their parents. How genetic information is replicated and transmitted from cell to cell and organism to organism thus represents a question that is central to all of biology. Consequently, elucidation of the mechanisms of genetic transmission and identification of the genetic material as DNA were discoveries that formed the foundation of our current understanding of biology at the molecular level.

The inheritance on cellular and molecular levels

- Biological continuity relies on successful cell division. Research over the years has provided a good understanding of how cells divide to form two daughter cells through mitosis. During mitosis, chromosomes are duplicated and divied up between the cells to provide each daughter cell with a complete copy of the organism's genome. The cell, however, doesn't contain only genomic DNA but can accumulate damage in the form of misfolded proteins.

Thomas Morgan

- **Thomas Hunt Morgan**, (1866- 1945), American zoologist and geneticist, famous for his experimental research with the fruit fly (*Drosophila*) by which he established the chromosome theory of heredity. He showed that genes are linked in a series on chromosomes and are responsible for identifiable, hereditary traits. Morgan's work played a key role in establishing the field of genetics. He received the Nobel Prize for Physiology or Medicine in 1933.

Experiments In Embryology

- During the period 1893–1910, Morgan applied experimental techniques to fundamental problems of embryology. In order to identify causally related events during development, he analyzed such problems as the formation of embryos from separated blastomeres (early embryonic cells) and fertilization in nucleated and nonnucleated egg fragments. As examples of the effects of physical factors, he analyzed the way in which the spatial orientation of eggs affects their future development and the action of salt concentration on the development of fertilized and unfertilized eggs.

Thomas Morgan experiments

- Like most embryologists and many biologists at the turn of the century, Morgan found the Darwinian theory of evolution lacking in plausibility. It was difficult to conceive of the development of complex adaptations simply by an accumulation of slight chance variations. Moreover, Darwin had provided no mechanism of heredity to account for the origin or transmission of variations, except his early and hypothetical theory of pangenesis. Although Morgan believed that evolution itself was a fact, the mechanism of natural selection proposed by Darwin seemed incomplete because it could not be put to an experimental test

Thomas Morgan experiments

- Morgan had quite different objections to the Mendelian and chromosome theories. Both theories attempted to explain biological phenomena by postulating units or material entities in the cell that somehow control developmental events. To Morgan this was too reminiscent of the preformation theory—the idea that the fully formed adult is present in the egg or sperm—that had dominated embryology in the 18th and early 19th centuries.

Chromosome Theory of Heredity

- Found that genes are located on chromosomes
- Discovered Sex-Linkage
- Worked with *Drosophila*
- Nobel Prize for Physiology / Medicine in 1933.

Thomas Hunt Morgan

The chromosomal theory

- The **Boveri–Sutton chromosome theory** (also known as the **chromosome theory of inheritance** or the **Sutton–Boveri theory**) is a fundamental unifying theory of genetics which identifies chromosomes as the carriers of genetic material. It correctly explains the mechanism underlying the laws of Mendelian inheritance by identifying chromosomes with the paired factors (particles) required by Mendel's laws. It also states that chromosomes are linear structures with genes located at specific sites called loci along them.
- It states simply that chromosomes, which are seen in all dividing cells and pass from one generation to the next, are the basis for all genetic inheritance. Genes are located on chromosomes.

- It is following the work of **Thomas Hunt Morgan** in the early twentieth century, that researchers were finally able to directly link the inheritance of genetic traits to the behaviour of chromosomes, thereby providing concrete evidence for what became known as the **chromosome theory of heredity.**
- The theory stated that inheritance patterns may be generally explained by assuming that genes are located in specific sites of chromosomes.
- In 1910, **Thomas Hunt Morgan** was the one to truly bring Mendel's Laws and the Chromosome Theory together into a revolutionary idea.
- The idea that genes are located on chromosomes was proposed based on experiments using *Drosophila melanogaster*, or more commonly known as a fruit fly.

Chromosomes and Genes.

- **Genes** are segments of deoxyribonucleic acid (DNA) that contain the code for a specific protein that functions in one or more types of cells in the body. **Chromosomes** are structures within cells that contain a person's genes.
- Genes are contained in chromosomes, which are mainly in the cell nucleus.
- A chromosome contains hundreds to thousands of genes.
- Every human cell contains 23 pairs of chromosomes, for a total of 46 chromosomes.
- A trait is any gene-determined characteristic and is often determined by more than one gene.
- Some traits are caused by abnormal genes that are inherited or that are the result of a new mutation.