**Epigenetic**:

Epigenetics is the study to changes in gene function.

It refers to modification to DNA and the protein that interacts with it.

The modification influences regulation and expression of the gene.

It can also turn the genes “on” or “off”, can affect the phenotype and the organism’s development.

The modifications are not always inherited.

Epigenetic changes can either come from inheritance or the environment and are reversible changes. (Pace, 2018)

The Epigenome refers to the collection of epigenetic changes to the DNA and histones in a living organism, cell, organ, or similar entity. (Encode, sd)

The mechanism of epigenetics is affected by multiple factors like, Aging, Diet, Drugs, Pharmaceuticals and Environmental chemicals.

And the mechanism affects multiple factors too, Cancer development, Autoimmune diseases, Mental disorders and Diabetes. (Health, 2018)

The changes can be detected for up to three generations.

Epigenetic changes were analyzed and defined into three categories: Direct (DE), Within-Individual (WIE), and Across-Generations (AIE). DE changes occur in an individual's lifetime due to direct environmental experiences. WIE changes happen during gestation and are influenced by events inside the womb. AIE changes affect an individual's ancestors due to events before conception and are transmitted across generations. (Ventura, 2018)

TSS (Transcription Start Sites) and Splice variant, both are alternative promoter.

**Histone & Chromatin:**

Histones are basic and small protein that play a major role.

They can be bind with DNA to form chromatin. Nucleosome is the unit for chromatin and contain two set of the primary histone (H2A, H2B, H3 & H4). (Palak Gujral, 2020) (Rakesh Pathak, 2018)

In a eukaryotic cell, the DNA must be compressed to have an efficient functioning. The structure of chromatin (compressed DNA) is controlled by various processes such as DNA methylation, ATP-dependent remodeling of nucleosomes, covalent modifications of histone tails, replacement of core histones, and nucleosome eviction. These processes alter the physical properties of individual nucleosomes and change the state of chromatin, affecting gene transcription and DNA accessibility. (Pace, 2018) (Kovalchuk, 2012)

Histone can have multiple types of modifications, the commonest are Acetylation and Methylation.

**DNA Methylation:**

DNA methylation is a type of epigenetic mechanism in which a methyl group is added to the cytosine base of a DNA molecule. This regulates gene expression and is involved in the development of differentiated cells with unique DNA methylation patterns. DNA methylation is also associated with histone modification and non-coding RNA molecules. In the nervous system, DNA methylation is dynamic and regulated by factors such as neuronal activity and environmental stimuli and is essential for normal cognitive function. Abnormal DNA methylation can result in mental impairment and is a possible target for treating neuropsychiatric disorders. (Lisa D Moore, 2012) (Binzer-Panchal, 2022)

A picture containing text, clock

Description automatically generated (Mukherjee, 2015) (Pace, 2018)

**CpG Sites:**

CpG sites are regions in DNA where a cytosine nucleotide is followed by a guanine nucleotide in the 5’->3’ direction. Between them, there’s a phosphate, that’s why we call that a “CpG site”. On the CpG site, the methylation is applied on both strand of the DNA. These sites often occur in clusters called CG islands and DNA methylation, a type of epigenetic modification, is almost exclusively found in these CG dinucleotides. The cytosines on both strands can be methylated.

Only 10% of the all cytosine in the genome is methylated. (Binzer-Panchal, 2022) (Pace, 2018) (Mannstadt, 1999)

**Cassava:**

“After this, there is no turning back. You take the blue pill—the story ends, you wake up in your bed and believe whatever you want to believe. You take the red pill—you stay in Wonderland, and I show you how deep the rabbit hole goes. Remember: all I’m offering is the truth.

Epigenetics is a bit like the red pill—the more it is researched the further down the rabbit hole we are going—the realisation that my choices today as my parents and grandparents’ choices yesterday influence who I am now and who I am going to be tomorrow ” (Pace, 2018)

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