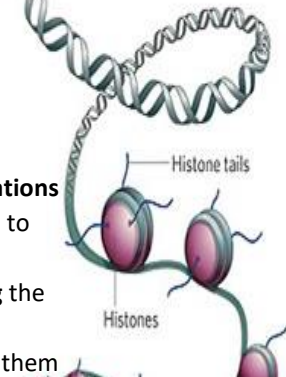


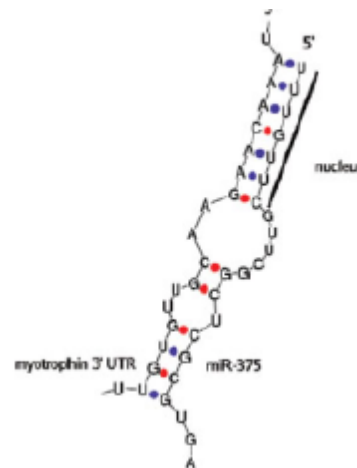
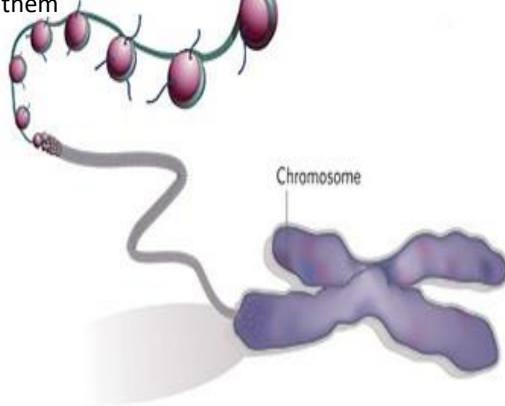
DNA Methylation

Methyl groups added to cytosines in CpG dinucleotide **repress** gene transcription



Histone Modifications

Molecules attach to tails of histone proteins, **altering** the activity of DNA wrapped around them



Micro RNAs

Small non-coding RNAs attach to mRNA and block translation of mRNA to proteins

What is Epigenetics?

- The literal meaning of epigenetics is “above” the genetics. It is the study of **heritable changes in the gene expression without any changes in DNA sequence**. It helps us understand how same genotypes can be expressed into different phenotypes.
- If genetic code is considered as “alphabets of life” as the DNA sequence contain the information on which protein is to be produced; then epigenetics can be considered as “grammar of life” as epigenetic markers determine when and where should the information be produced (when should the protein be produced by genes).
- Since epigenetic changes are **modifiable/reversible** in nature, they have a lot of potential in therapeutics. However, unlike genetic markers, epigenetic markers are **tissue specific** and thus need to be examined in the target tissue of interest.
- The epigenetic markers include DNA methylation, histone modifications and Micro RNAs.
- DNA methylation is the most well studied epigenetic marker due to easily available DNA source and well established laboratory techniques. There is a need of intact chromatin to study histone modifications and thus involve complex laboratory techniques. Similarly, RNA source is required to study microRNAs, which is generally not collected in large scale epidemiological studies.

Epigenetics and Health

- The epigenetic markers are influenced by a range of factors including diet, physical activity, smoking, alcohol, exposure to chemicals and radiations, etc. The epigenetic markers are now known to be associated with a number of health outcomes including cancer, diabetes, pulmonary disorders, neurodegenerative diseases, and cardiovascular diseases [1-5].
- The epigenetics changes have helped us understand the hidden mechanisms in the manifestation of diseases/traits, apart from the genetic and environmental factors alone.

Epigenetics and Environmental Health

- The environmental factors including polycyclic aromatic hydrocarbons, infectious pathogens, outdoor pollutants, indoor allergens and heavy metals are known to effect the epigenetic mechanisms [5]. The environmental exposures during early life (including in-utero exposure) are also known to have implications later in life [5].
- Unlike other biomarkers, epigenetic changes may persist over time even in absence of the conditions that caused them. Thus, it provides unique platform to reconstruct past exposures.
- Environmental health researchers study how the environmental factors result in negative epigenetic changes affecting the health outcomes. It is believed that epigenetic markers play a mediating role in the association between environmental exposures and health outcomes [5].

Air Pollution and Epigenetics

- Exposure to both ambient and indoor air pollution, including early life exposures [6] are known to alter epigenetic markers, thus effecting the respiratory and cardiovascular health.
- Long term exposure to outdoor air pollution has been reported to alter DNA methylation in circulating monocytes that are involved in atherosclerosis [7]. DNA methylation triggered by short and mid-term exposure to particulate matter is also reported to mediate the association between air pollution and glucose dysregulation [8]. Similarly, long term exposure to air pollution is reported to be associated with hypertension, mediated by ACE DNA methylation [9].
- Exposure to indoor air pollution from solid fuels, even early-life exposure, has the capacity to modify DNA methylation that can be detected in peripheral blood [10].
- The maternal tobacco smoke exposure has been reported to alter the miRNA expression in maternal and cord blood and thus susceptibility to allergy risk [11].
- Traffic related air pollutant have been reported to influence DNA methylation and histone modifications in both lung and blood tissues [12].

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