# BHARATHIDASAN UNIVERSITY

**Tiruchirappalli- 620 024**
**Tamil Nadu, India**

## Programme: M.Sc. Biochemistry

**Course Title : Chromatin and Epigenetics**
**Course Code : BC205DCE**

**Unit-6**
**Latest Research and News**

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# Unit-6 Overview

- Recent advances in chromatin and epigenetics
- Short talk presenters
- Detailed discussion of original research articles in class

Antonella Farsetti, Barbara Illi, Carlo Gaetano,

# How epigenetics impacts on human diseases

European Journal of Internal Medicine,

Volume 114, **2023**, Pages 15-22, ISSN 0953-6205,

https://doi.org/10.1016/j.ejim.2023.05.036.

**Abstract:** Epigenetics is a rapidly growing field of biology that studies the changes in gene expression that are not due to alterations in the DNA sequence but rather the chemical modifications of DNA and its associated proteins. Epigenetic mechanisms can profoundly influence gene expression, cell differentiation, tissue development, and disease susceptibility. Understanding epigenetic changes is essential to elucidate the mechanisms underlying the increasingly recognized role of environmental and lifestyle factors in health and disease and the intergenerational transmission of phenotypes. Recent studies suggest epigenetics may be critical in various diseases, from cardiovascular disease and cancer to neurodevelopmental and neurodegenerative disorders. Epigenetic modifications are potentially reversible and could provide new therapeutic avenues for treating these diseases using epigenetic modulators. Moreover, epigenetics provide insight into disease pathogenesis and biomarkers for disease diagnosis and risk stratification. Nevertheless, epigenetic interventions have the potential for unintended consequences and may potentially lead to increased risks of unexpected outcomes, such as adverse drug reactions, developmental abnormalities, and cancer. Therefore, rigorous studies are essential to minimize the risks associated with epigenetic therapies and to develop safe and effective interventions for improving human health. This article provides a synthetic and historical view of the origin of epigenetics and some of the most relevant achievements.

Keywords: DNA; RNA; Histone; Chromatin; Epigenetic enzyme; HAT; HDAC; Epigenetics; Chronic disease

Wu, YL., Lin, ZJ., Li, CC. *et al.*

# Epigenetic regulation in metabolic diseases: mechanisms and advances in clinical study.

*Sig Transduct Target Ther* **8**, 98 (**2023**). https://doi.org/10.1038/s41392-023-01333-7

**Abstract:** Epigenetics regulates gene expression and has been confirmed to play a critical role in a variety of metabolic diseases, such as diabetes, obesity, non-alcoholic fatty liver disease (NAFLD), osteoporosis, gout, hyperthyroidism, hypothyroidism and others. The term 'epigenetics' was firstly proposed in 1942 and with the development of technologies, the exploration of epigenetics has made great progresses. There are four main epigenetic mechanisms, including DNA methylation, histone modification, chromatin remodelling, and noncoding RNA (ncRNA), which exert different effects on metabolic diseases. Genetic and non-genetic factors, including ageing, diet, and exercise, interact with epigenetics and jointly affect the formation of a phenotype. Understanding epigenetics could be applied to diagnosing and treating metabolic diseases in the clinic, including epigenetic biomarkers, epigenetic drugs, and epigenetic editing. In this review, we introduce the brief history of epigenetics as well as the milestone events since the proposal of the term 'epigenetics'. Moreover, we summarise the research methods of epigenetics and introduce four main general mechanisms of epigenetic modulation. Furthermore, we summarise epigenetic mechanisms in metabolic diseases and introduce the interaction between epigenetics and genetic or non-genetic factors. Finally, we introduce the clinical trials and applications of epigenetics in metabolic diseases.

Nepali, K., Liou, JP.

# Recent developments in epigenetic cancer therapeutics: clinical advancement and emerging trends.

*J Biomed Sci* **28**, 27 (**2021**). https://doi.org/10.1186/s12929-021-00721-x

**Abstract:** Epigenetic drug discovery field has evidenced significant advancement in the recent times. A plethora of small molecule inhibitors have progressed to clinical stage investigations and are being explored exhaustively to ascertain conclusive benefits in diverse malignancies. Literature precedents indicates that substantial amount of efforts were directed towards the use of epigenetic tools in monotherapy as well as in combination regimens at the clinical level, however, the preclinical/preliminary explorations were inclined towards the identification of prudent approaches that can leverage the anticancer potential of small molecule epigenetic inhibitors as single agents only. This review article presents an update of FDA approved epigenetic drugs along with the epigenetic inhibitors undergoing clinical stage investigations in different cancer types. A detailed discussion of the pragmatic strategies that are expected to steer the progress of the epigenetic therapy through the implementation of emerging approaches such as PROTACS and CRISPR/Cas9 along with logical ways for scaffold fabrication to selectively approach the enzyme isoforms in pursuit of garnering amplified antitumor effects has been covered. In addition, the compilation also presents the rational strategies for the construction of multi-targeting scaffold assemblages employing previously identified pharmacophores as potential alternatives to the combination therapy.

Cavalli, G., Heard, E.

# Advances in epigenetics link genetics to the environment and disease.

*Nature* **571**, 489–499 (**2019**). https://doi.org/10.1038/s41586-019-1411-0

**Abstract:** Epigenetic research has accelerated rapidly in the twenty-first century, generating justified excitement and hope, but also a degree of hype. Here we review how the field has evolved over the last few decades and reflect on some of the recent advances that are changing our understanding of biology. We discuss the interplay between epigenetics and DNA sequence variation as well as the implications of epigenetics for cellular memory and plasticity. We consider the effects of the environment and both intergenerational and transgenerational epigenetic inheritance on biology, disease and evolution. Finally, we present some new frontiers in epigenetics with implications for human health.

Yuanyuan Li,

# Modern epigenetics methods in biological research

Methods, Volume 187, 2021, Pages 104-113, ISSN 1046-2023,
https://doi.org/10.1016/j.ymeth.2020.06.022.

**Abstract:** The definition of epigenetics refers that molecular modifications on DNA that can regulate gene activity are independent of DNA sequence and mitotically stable. Notably, epigenetics studies have grown exponentially in the past few years. Recent progresses that lead to exciting discoveries and groundbreaking nature of this area demand thorough methodologies and advanced technologies to move epigenetics to the forefront of molecular biology. The most recognized epigenetic regulations are DNA methylation, histone modifications, and non-coding RNAs (ncRNAs). This review will discuss the modern techniques that are available to detect locus-specific and genome-wide changes for all epigenetic codes. Furthermore, updated analysis of technologies, newly developed methods, recent breakthroughs and bioinformatics pipelines in epigenetic analysis will be presented. These methods, as well as many others presented in this specific issue, provide comprehensive guidelines in the area of epigenetics that facilitate further developments in this promising and rapidly developing field.