

**PhD in
Molecular Medicine and Medical Biotechnology
Advanced courses 2025**

October 30 and 31, 2025

Course Title: Epigenetics in Health and Disease: Mechanisms and Applications

Seminar room, 1st floor Torre Biologica

October 30, 14-16 pm: Epigenetics in health and diseases (*Lorenzo Chiariotti*)

October 30, 16-18 pm: Epigenetic dynamics in stem cells (*Mariella Cuomo*)

October 31, 14-16 pm: Epigenetics and epigenomics in brain tumors (*Rosa Della Monica*)

Epigenetic regulation plays a pivotal role in defining cell identity and function, contributing to the understanding of both physiological and pathological processes. The interplay between DNA methylation, histone modifications, and chromatin remodeling complexes governs transcriptional programs that maintain pluripotency or promote lineage specification. In tumors, aberrant epigenetic modifications are increasingly recognized as key drivers of oncogenesis, tumor heterogeneity, and treatment resistance. Moreover, epigenetics offers a framework to investigate the molecular basis of neuropsychiatric disorders, which often arise from complex interactions between genetic predisposition and environmental stimuli. Thus, relevant information can be tracked investigating the alterations in the epigenomics profiles in cells and tissues. Epigenomics and epigenetics methodologies enable gene-specific or comprehensive profiling of chromatin states and transcriptional regulatory landscapes, offering insights into the molecular mechanisms underlying health and diseases. High-throughput epigenomic approaches, such as whole-genome bisulfite sequencing, ChIP-seq or Hi-C techniques, allow for the identification of genome-wide DNA methylation patterns, histone mark distributions and tridimensional status of the genome. Single molecules methylation analysis adds a further layer to the epigenetic landscape that allow to track the evolution and oscillations of epigenetic profiles in single cells. Integrating epigenetic and epigenomic data in these contexts not only enhances our understanding of disease pathogenesis but also supports the development of biomarker-based diagnostic tools and epigenetically guided therapeutic strategies.

References:

- 1) Cuomo M, Costabile D, Della Monica R, Buonaiuto M, Trio F, De Riso G, Visconti R, Chiariotti L. A specific pluripotency-associated eRNA controls Nanog locus by shaping the epigenetic landscape and stabilizing enhancer-promoter interaction. *Nucleic Acids Res.* 2025 Apr 10;53(7):gkaf274. doi: 10.1093/nar/gkaf274.
- 2) Cuomo M, Coretti L, Costabile D, Della Monica R, De Riso G, Buonaiuto M, Trio F, Bravaccio C, Visconti R, Berni Canani R, Chiariotti L, Lembo F. Host fecal DNA specific methylation signatures mark gut dysbiosis and inflammation in children affected by autism spectrum disorder. *Sci Rep.* 2023 Oct 24;13(1):18197. doi: 10.1038/s41598-023-45132-0.
- 3) Della Monica R, Buonaiuto M, Cuomo M, Pagano C, Trio F, Costabile D, de Riso G, Cicala FS, Raia M, Franca RA, Del Basso De Caro M, Sorrentino D, Navarra G, Coppola L, Tripodi L, Pastore L, Hench J, Frank S, Schonauer C, Catapano G, Bifulco M, Chiariotti L, Visconti R. Targeted inhibition of the methyltransferase SETD8 synergizes with the Wee1 inhibitor adavosertib in restraining glioblastoma growth. *Cell Death Dis.* 2023 Sep 27;14(9):638. doi: 10.1038/s41419-023-06167-3.
- 4) Montella L, Cuomo M, Del Gaudio N, Buonaiuto M, Costabile D, Visconti R, Di Risi T, Vinciguerra R, Trio F, Ferraro S, Bove G, Facchini G, Altucci L, Chiariotti L, Della Monica R. Epigenetic alterations in glioblastomas: Diagnostic, prognostic and therapeutic relevance. *Int J Cancer.* 2023 Aug 1;153(3):476-488. doi: 10.1002/ijc.34381.
- 5) Keller S, Punzo D, Cuomo M, Affinito O, Coretti L, Sacchi S, Florio E, Lembo F, Carella M, Copetti M, Cocozza S, Balu DT, Errico F, Usiello A, Chiariotti L. DNA methylation landscape of the genes regulating D-serine and D-aspartate metabolism in post-mortem brain from controls and subjects with schizophrenia. *Sci Rep.* 2018 Jul 5;8(1):10163. doi: 10.1038/s41598-018-28332-x.