

# MCB502A Syllabus

**Lecture 1:** DNA structure; RNA Polymerase properties; Bacterial RNA Polymerase subunits; Sigma factor 70

Techniques: Filter binding assay; Methylation-S1 nuclease; Electro-Mobility Shift Assay (EMSA); DNA Radio-labeling; UV Crosslinking; DNA footprinting; Förster resonance energy transfer (FRET); Run-Off transcription assay

**Lecture 2:** Transcription termination; Sigma factor cascades; Small molecule signaling; Transcription factors; Lac Operon

Techniques: Promoter bashing; Linker-scanning mutagenesis; Genetic screening by blue/white selection

**Lecture 3:** DNA bending; Activation mechanisms; Promoter classes; Combinatorial Regulation

Techniques: Site-directed mutagenesis; DNA bending EMSA; Chromatin Immunoprecipitation (ChIP) assay; Genetic suppressor screens

**Lecture 4:** Proximal regulation by DNA bending; Distal regulation by DNA looping; Kinase signaling; Bacterial histone-like proteins; Packaging of Prokaryotic Genomes

Techniques: Plasmid concatemers; Topoisomerase assay; Fluorescent proteins; STORM imaging; 3C assay

**Lecture 5:** Lambda Genetic Switch

Techniques: Phage genetic screen; Northern blots; Real time RT-PCR; DNA Microarrays; RNA-Seq

**Lecture 6:** Eukaryotic RNA Polymerase; General transcription factors; Basal promoter elements; CTD phosphorylation; Post-initiation events

Techniques: Epitope-tag pull-down assay; Helicase assay

**Lecture 7:** DNA packaging; Chromatin and transcription; Position effect variegation; Histone code; Boundary elements; CpG islands as markers of cancer

Techniques: Micrococcal nuclease assay; DNase I assay; Indirect end labeling; Bisulfite PCR

**Lecture 8:** Phosphate signaling and the Pho5 chromatin model; Lysine acetyltransferases

**Lecture 9:** Chromatin remodelers; Histone chaperones

Techniques: Chromatin templates in vitro

**Lecture 10:** Signaling pathways; Agonists & Antagonists; Transcription factor cascades; Intracellular hormone receptors; Combinatorial regulation; Response elements; Synergy

Techniques: Protein domain mapping; DNase-Seq

**Lecture 11:** Transcriptional coactivators; Post-translational modifications (PTMs)

Techniques: Two-hybrid; GST pull-down

**Lecture 12:** Ordered and cyclical transcription pathways; Utilization of PTMs

Techniques: Nuclear run-on assay

**Lecture 13:** Dynamic protein promoter complexes in vivo; Nuclear roles of molecular chaperones; Self-assembly vs. self-organization

Techniques: FISH; GFP; FRAP, FLIP, FLIM, Photoactivation, Protein Microarrays

**Lecture 14:** Genome organization; 3D genomes; Nuclear organization during cell cycle; Pioneering factors

Techniques: Chromosome conformation capture based assays