

## BIMM 122 COURSE OUTLINE:

### I. Organization of the Bacterial Chromosome

- Genome vs. cell size: prokaryotes and eukaryotes
- Compactation
- Supercoiling
- Gyrase (topoisomerase II)
- Topoisomerase I
- Permanent bends
- DNA binding proteins
- HU
- IHF
- Fis
- H-NS
- DNA Structural Forms
- A, B, C, D ... Z
- Cruciforms
- Triple strands
- Single and double stranded loops
- GC content
- Mutator genes
- Recurrent Nucleotide Sequences
- Chi
- REP
- DAM
- Chromosomal Number
- Copies per cell
- Plasmid or chromosome?
- Protoplast fusion
- Chromosomal inactivation
- Chromosomal Dynamics
- Extra-intrachromosomal elements
- Plasmids
- Transposons
- IS DNA
- Phage
- Long term rearrangements
- rrn loci
- tRNA loci
- Alternative alleles
- Deletions-Insertions
- Amplification
- M protein variation
- sigma-K in Bacillus and nif in Anabaena
- Phase and antigenic variation
- hin, gin, pin, cin

- fim
- pil and opa
- Direction of Transcription
- DNA polymerase
- oriC; DNA replication
- Operon orientation and promoter strength
- Consequences of polymerase collision
- Completely Sequenced Genomes
- Mycoplasma genitalium – the minimal genome
- E. coli – the prototype

## II. Transcription (Tx)

- RNA Polymerase
- Protein structure
- Gene and operon structure
- Accessory proteins
- Steps of Transcription
- Initiation
- Elongation
- Termination
- Sigma Factors
- Multiple Promoters
- Functions
- Structures and homologies
- Recognition sequences
- Criteria
- Operons encoding sigma factors
- DNA Binding Proteins
- gal vs. lac
- Promoter strength
- Operon specific repressors and activators
- Pleiotropic regulatory proteins
- Antiterminators
- Enhancers
- Protein and DNA modification
- trp and Amino Acid Biosynthesis
- Carbon Catabolite Repression
- SOS Regulon
- Translational Regulation

## III. Sensory Transmission and Protein Phosphorylation

- Classical protein kinases
- Novel protein kinases
- PTS and the bgl operon

- Sensor kinase – Response regulator systems
- Osmoregulation (EnvZ-OmpR)
- Virulence (VirA – VirG; ChvE)
- Hexose phosphate transport (UhpA, B and C)
- Nitrogen regulation
- UT/UR and PII
- NtrB and NtrC
- sigma-54
- Phosphate regulation
- PhoR-PhoB, PhoU
- PstSABC

#### IV. Genetics of Bacterial Differentiation

- Sporulation in Bacillus
- Initiation of sporulation
- The sigma factor cascade
- Control of cell division
- Programmed bacterial cell death
- Regulation of competence
- Fruiting in Myxobacteria
- Control of progression
- C-signal
- frz vs. che: differences in chemoresponse
- Myxobacteria vs Dictyostelium
- Heterocyst development in Cyanobacteria
- Temporal control
- Spatial control
- Circadian rhythms

#### V. Symbiosis and Pathogenesis

- Nitrogen Fixation and Nodulation
- Agrobacterium – Plant Tumorigenesis
- Salmonella – Cellular Invasion
- Phase VariationPattern Formation during Bacterial Colonization
- Flagellar phase variation in Salmonella
- Mu: host range specificity determination
- fim in E. coli
- pil in Neisseria
- opa in Neisseria