Study Guide: Highlights and Themes from Midterm #2 Lecture Series

Lecture Series 5 – Cell Cycle & Cell Division

- Systems of Cell Division
  - Bacterial Cell Division
- Interphase and the Control of Cell Division
  - The Eukaryotic Cell Cycle
  - Cell Cycle Control
    - Internal and External
- Eukaryotic Chromosomes
  - Organization of Chromosomes
    - Levels of Packing
    - Histones
    - Cohesins and Condensins
- Mitosis = Cloning
  - All the steps
  - Cytokinesis in Animal vs Plant Cells
  - Evolutionary Development Issues
- Meiosis = Diversity
  - All the steps – twice!
  - Alternation of Generations
- *Genetic Variation Provided by Sex:*
  - *Independent Assortment of Chromosomes*
  - *Crossing Over Events of Non-Sister Chromatids*
  - *Random Fertilization*
- Meiotic Errors
  - Nondisjunction
  - Aneuploidy
- Programmed Cell Death
  - Apoptosis

Lecture Series 6 – DNA and Its Role in Heredity

DNA: The Genetic Material
- Griffiths' rough and smooth *Streptococcus pneumoniae*
- Hershey-Chase Blender Experiment

The Structure of DNA
- Models and X-ray crystallography

DNA Replication
- Meselson and Stahl's experiment proved *semiconservative model*

The Mechanism of DNA Replication
- Enzymes involved
- Lagging strand problem and resolution

DNA Proofreading and Repair
- DNA repair mechanisms
- Thymine dimers, depurination and deamination
- Lost telomeric DNA replaced by telomerase

Practical Applications of DNA Replication
- DNA sequencing
- Polymerase Chain Reaction

Lecture Series 7 – From DNA to Protein: Genotype to Phenotype (aka The Central Dogma)

The Hypothesis of one-gene, one-polypeptide

Transcription: DNA-Directed RNA Synthesis
- Steps: Initiation, Elongation, Termination

RNA Processing: Capping, Tailing, Splicing, UTRs
- snRNP's
- Spliceosomes
- Introns vs Exons

The Genetic Code
- *Degenerate but not ambiguous*

The three types of RNA: tRNA, mRNA, and rRNA

Why are aminoacyl-tRNA synthetases so important not to mutate or otherwise mess with???

Translation: RNA-Directed Polypeptide Synthesis

Steps: Initiation, Elongation, Termination

Rem: Elongation includes codon recognition, peptide bond formation & translocation

Regulation of Translation

Polysome aka polyribosome

Posttranslational Events

Signal sequences and multiple modifications

Lecture Series 8 – Eukaryotic Genome & Gene Expression

Compare and contrast Bacteria with Eucarya

Genome size vs complexity issue

Levels of chromatin packing

Mutations: Heritable Changes in Genes

Small scale or point mutations: silent, missense, nonsense, & frameshift

Large scale at chromosome level: deletion, duplication, inversion, & reciprocal translocation

Frequency of Repetitive Sequences (rem: teleomeres)

Transposition (Transposons or Jumping Genes)

Function of Transposase

The Structures of Protein-Coding Genes

Introns vs Exons revisited

Gene families and Pseudogenes

Differential Gene Expression **END MT#2 MATERIAL**

Transcriptional Control

DNA binding protein motifs

Proximal vs distal control

Histones control access via acetylation level

Posttranscriptional and Posttranslational Control
- Alternative RNA splicing
- Proteasomes degrade “old & tired” proteins

Operon Control: Regulation in Bacteria
- Inducible/Repressible Enymes
- lac vs trp operons
- + vs - control
- cAMP/CRP complex
- *Where is the Operator?*

Comparison of Control Features in Bacteria and Eucarya