

## **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 Prokaryotes with Eukaryotes

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

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 Enzymes

- lac vs trp operons

- + vs - control

- cAMP/CRP complex

- Where is the Operator?*

## Comparison of Control Features in Bacteria and Eucarya