

Chapter 1 - Overview of Genetics

Studyz Outline

- I. The Relationship Between Genes and Traits
 - A. Living cells are composed of biochemicals
 - B. Each cell contains many different proteins that determine cellular structure and function
 - C. DNA stores the information for protein synthesis
 - D. The information in DNA is accessed during the process of gene expression
 - E. The molecular expression of genes within cells leads to an organism's outwardly visible traits
 - F. Inherited differences in traits are due to genetic variation
 - G. Traits are governed by genes and by the environment
 - H. During reproduction, genes are passed from parent to offspring
 - I. The genetic composition of a species evolves over the course of many generations
- II. Fields of Genetics
 - A. Transmission genetics explores the inheritance patterns of traits as they are passed from parents to offspring
 - B. Molecular genetics seeks a biochemical understanding of the hereditary material
 - C. Population genetics is concerned with genetic variation and its role in evolution
 - D. Genetics is an experimental science

Chapter 9 Molecular Structure of DNA and RNA

Study Outline

- III. Identification of DNA as the Genetic Material
 - A. Experiments with pneumococcus suggested that DNA is the genetic material
 - B. Hershey and Chase provided evidence that DNA is the genetic material of T2 phage
 - C. RNA functions as the genetic material in some viruses
- IV. Nucleic acid structure
 - A. Nucleotides are the building blocks of nucleic acids
 - B. Nucleotides are linked together to form a strand
 - C. A few key events led to the discovery of the double helix structure
 - D. Chargaff found that DNA has a biochemical composition in which the amount of A equals T and the amount of G equals C
 - E. Watson and Crick deduced the double helical structure of DNA
 - F. The molecular structure of the DNA double helix has several key features
 - G. DNA can form alternative types of double helices
 - H. DNA can form a triple helix, called triplex DNA
 - I. The three-dimensional structure of DNA within chromosomes requires additional folding and the association with proteins
 - J. RNA molecules are composed of strands that fold into specific structures

Chapter 03 Reproduction and Chromosome Transmission

Study Outline

- I. General features of chromosomes

- A. Eukaryotic chromosomes are examined cytologically to yield a karyotype
- B. Eukaryotic chromosomes are inherited in sets
- II. Cell division
 - A. Bacteria reproduce asexually by binary fission
 - B. Eukaryotic cells progress through a cell cycle to produce genetically identical daughter cells
 - C. The mitotic spindle apparatus organizes and sorts eukaryotic chromosome
 - D. The transmission of chromosomes during the division of eukaryotic cells requires a process known as mitosis
- III. Sexual reproduction
 - E. Meiosis produces cells that are haploid
 - F. In animals, spermatogenesis produces four haploid sperm cells and oogenesis produces a single haploid egg cell
 - G. Plant species alternate between haploid (gametophyte) and diploid (sporophyte) generations
- IV. The chromosome theory of inheritance and sex chromosomes
 - H. The chromosome theory of inheritance relates the behavior of chromosomes to the Mendelian inheritance of traits
 - I. Sex differences often correlate with the presence of sex chromosomes
 - J. Morgan's experiments showed a connection between a genetic trait and the inheritance of a sex chromosome in *Drosophila*

Chapter 10 Chromosome Organization and Molecular Structure

Study Outline

- V. Viral Genomes
 - A. Viral genomes are relatively small and are composed of DNA or RNA
 - B. Viral genomes are packaged into the capsid in an assembly process
- VI. Bacterial Chromosomes
 - A. Bacterial chromosomes contain a few thousand gene sequences that are interspersed with other functionally important sequences
 - B. The formation of chromosomal loops helps make the bacterial chromosome more compact
 - C. DNA supercoiling further compacts the bacterial chromosome
 - D. Chromosome function is influenced by DNA supercoiling
- VII. Eukaryotic Chromosomes
 - A. The sizes of eukaryotic genomes vary substantially
 - B. Eukaryotic chromosomes have many functionally important sequences including genes, origins of replication, centromeres, and telomeres
 - C. The genomes of eukaryotes contains sequences that are unique, moderately repetitive, or highly repetitive
 - D. Sequence complexity can be evaluated in a renaturation experiment
 - E. Eukaryotic chromatin must be compacted to fit within the cell
 - F. Linear DNA wraps around histone proteins to form nucleosomes, the repeating structural unit of chromatin

- G. The repeating nucleosome structure is revealed by digestion of the linker region
- H. Nucleosomes become closely associated to form a 30 nm fiber
- I. Chromosomes are further compacted by anchoring the 30 nm fiber into radial loop domains along the nuclear matrix
- J. Condensin and cohesin promote the formation of metaphase chromosomes

Chapter 11 DNA Replication

Study Outline

- VIII. Structural Overview of DNA Replication
 - A. Existing DNA strands act as templates for the synthesis of new strands
 - B. Three different models were proposed that described the net result of DNA replication
- IX. Bacterial DNA Replication
 - A. Bacterial chromosomes contain a single origin of replication
 - B. Replication is initiated by the binding of DnaA protein to the origin of replication
 - C. Several proteins are required for DNA replication at the replication fork
 - D. DNA polymerase III is a processive enzyme that uses deoxyribonucleoside triphosphates
 - E. Replication is terminated when the replication forks meet at the termination sequences
 - F. Certain enzymes of DNA replication bind to each other to form a complex
 - G. The fidelity of DNA replication is ensured by proofreading mechanisms
 - H. Bacterial DNA replication is coordinated with cell division
 - I. DNA replication can be studied in vitro
 - J. The isolation of mutants has been instrumental to our understanding of DNA replication
- X. Eukaryotic DNA replication
 - A. Initiation occurs at multiple origins of replication on linear eukaryotic chromosomes
 - B. Eukaryotes contain several different DNA polymerases
 - C. Flap endonuclease removes RNA primers during eukaryotic DNA replication
 - D. The ends of eukaryotic chromosomes are replicated by telomerase

Chapter 12 Gene Transcription and RNA Modification

Study Outline

- XI. Overview of Transcription
 - K. Gene expression requires base sequences that perform different functional roles
 - L. The three stages of transcription are initiation, elongation, and termination
 - M. RNA transcripts have different functions
- XII. Transcription in Bacteria
 - A. A promoter is a short sequence of DNA that is necessary to initiate transcription
 - B. Bacterial transcription is initiated when RNA polymerase holoenzyme binds at a promoter sequence
 - C. The RNA transcript is synthesized during the elongation stage
 - D. Transcription is terminated by either an RNA-binding protein or an intrinsic terminator
- XIII. Transcription in Eukaryotes
 - A. Eukaryotes have multiple RNA polymerases that are structurally similar to the bacterial enzyme
 - B. Eukaryotic structural genes have a core promoter and regulatory elements