

Genetics and Genomics

1. The Genetic Code of Genes and Genomes

- Review

2. Transmission Genetics: Heritage from Mendel

- Review

3. The Chromosomal Basis of Heredity

- Each species has a characteristic set of chromosomes
- The daughter cells of mitosis have identical chromosomes
- Meiosis results in gametes that differ genetically
- Eukaryotic chromosomes are highly coiled complexes of DNA and protein
- The centromere and telomere are essential parts of chromosomes
- Genes are located in chromosomes
- Genetic data analysis makes use of probability and statistics

4. Gene Linkage and Genetic Mapping

- Linked alleles tend to stay together in meiosis
- Recombination results from crossing-over between linked alleles
- Polymorphic DNA sequences are used in human genetic mapping
- Double crossovers are revealed in three-point crosses
- Tetrads contain all four products of meiosis
- Recombination is initiated by a double-stranded break in DNA

5. Human Chromosomes and Chromosome Behavior

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6. DNA Structure, Replication, and Manipulation

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7. The Genetics of Bacteria and Their Viruses

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8. The Molecular Genetics of Gene Expression

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10. Genomics, Proteomics, and Genetic Engineering

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13. Molecular Genetics of the Cell Cycle and Cancer

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14. Molecular Evolution and Population Genetics

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15. The Genetic Basis of Complex Traits

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Chapter 1: The Genetic Code of Genes and Genomes

Chapter 1: Summary

- Inherited traits are affected by genes.
- Genes are composed of the chemical deoxyribonucleic acid (DNA).
- DNA replicates to form (usually identical) copies of itself.
- DNA contains a code specifying what types of enzymes and other proteins are made in cells.
- DNA occasionally mutates, and the mutant forms specify altered proteins.
- A mutant enzyme is an “inborn error of metabolism” that blocks one step in a biochemical pathway for the metabolism of small molecules.
- Genetic analysis of mutants of the fungus *Neurospora* unable to synthesize an essential nutrient led to the one gene–one enzyme hypothesis.
- Different mutations in the same gene can be identified by means of a complementation test, in which the mutants are brought together in the same cell or organism. Mutations in the same gene fail to complement one another, whereas mutations in different genes show complementation.
- Most traits are complex traits affected by multiple genes as well as by environmental factors.
- Organisms change genetically through generations in the process of biological evolution.
- Because of their common descent, organisms share many features of their genetics and biochemistry.

Chapter 2: The Genetic Code of Genes and Genomes

Chapter 2: Summary

- Inherited traits are determined by the genes present in the reproductive cells united in fertilization.
- Genes are usually inherited in pairs, one from the mother and one from the father.
- The genes in a pair may differ in DNA sequence and in their effect on the expression of a particular inherited trait.
- The maternally and paternally inherited genes are not changed by being together in the same organism.
- In the formation of reproductive cells, the paired genes separate again into different cells.
- Random combinations of reproductive cells containing different genes result in Mendel's ratios of traits appearing among the progeny.
- Simple Mendelian inheritance results in characteristic patterns in human pedigrees for both dominant and recessive traits.
- When two possible outcomes of a cross are mutually exclusive, they cannot occur together. In this case, the probability that either one or the other outcome occurs is given by the sum of their respective probabilities (the addition rule).
- When two possible outcomes of a cross are independent, then knowledge that one has occurred provides no information whether the other has occurred. In this case, the probability that both outcomes occur together is given by the product of their respective probabilities (the multiplication rule).
- The ratios actually observed for any traits are determined by the types of dominance and gene interaction (epistasis).

Chapter 3: The Chromosomal Basis of Heredity

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