

A Brief Introduction to Genetics

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Abstract

This very brief introduction to genetics is included to provide greater accessibility to the papers in this volume. More extensive details are available in genetics textbooks and the literature.

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1 Introduction

What follows is a very brief introduction to genetics concepts to provide greater accessibility to the papers in this volume. More extensive details are available in genetics and molecular biology textbooks, *e.g.* [2, 3, 4, 6, 8].

2 Genomes

The *genome* of an organism consists of the biological information content of a cell. This information is necessary for all cellular processes required by the organism. With the exception of some viruses, genomes are comprised of *deoxyribonucleic acid*, or *DNA*. DNA is a double-stranded, linear polymer consisting of a sugar-phosphate backbone attached to subunits called *nucleotides*. There are four nucleotides: the *purines*, *adenine* (*A*) and *thymine* (*T*), and the *pyrimidines*, *cytosine* (*C*) and *guanine* (*G*). Although DNA can form other tertiary structures, the best known is that of the double helix. The two strands of the double helix are held together by weak hydrogen bonds between complementary bases on the strands. Base pairing occurs as follows: *A* pairs with its complementary base *T*, and *G* pairs with *C*. The sequence complementarity provides a mechanism for DNA replication: each strand may serve as a template for synthesis of a new DNA molecule. *Ribonucleic acid*, or *RNA*, is similar to DNA but (i) contains the sugar ribose rather than deoxyribose, (ii) uses the base *uracil* (*U*) instead of thymine (*T*), and (iii) is usually single-stranded rather than double-stranded.

Genomic DNA is distributed along *chromosomes* in the cell nucleus. A *gene* is a segment of DNA that codes for a *protein*. Proteins perform a large number of diverse functions, serving as enzymes or antibodies, providing storage or transportation for other molecules, and providing structure (*e.g.* *collagen*). Proteins are made up of