

THE BASIC STRUCTURE AND COMPONENTS OF CHROMOSOMES

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ABOUT THE STUDY

Chromosomes, the thread-like structures residing within the nucleus of a cell, serve as the repositories of an organism's genetic information. These compact bundles of DNA play a pivotal role in the transmission of hereditary traits, cell division, and the life's fundamental processes. This article aims to intricate world of chromosomes, exploring their structure, function and the remarkable journey they embark upon during the life cycle of a cell.

Structure of chromosomes

Chromosomes are composed of Deoxyribo Nucleic Acid (DNA), a long molecule that carries the genetic instructions for the development, functioning, growth, and reproduction of all known living organisms. The basic structural unit of DNA is the nucleotide, consisting of a sugar molecule, a phosphate group, and one of four nitrogenous bases: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G). The DNA in chromosomes is not a loose, chaotic tangle but rather organized into a highly structured form. DNA wraps around histone proteins, forming nucleosomes, which are akin to beads on a string. This coiling and packing of DNA create a condensed structure known as chromatin. The fundamental structure of a chromosome includes a constriction point called the centromere, which divides the chromosome into two arms short (p) and long (q). The location of the centromere and the relative lengths of the arms define the chromosome's structure and are used for identification. Human cells typically contain 23 pairs of chromosomes, resulting in a total of 46 chromosomes. These chromosomes are categorized into two types: autosomes, which are numbered 1 through 22, and sex chromosomes, designated as X and Y. The combination of sex chromosomes determines an individual's biological sex, with XX indicating female and XY indicating male

Cell cycle and chromosome duplication

The life of a cell unfolds through a series of events collectively known as the cell cycle. One crucial phase of the cell cycle is DNA replication, during which the genetic material, including the chromosomes, is duplicated. This process occurs in the S (synthesis) phase, ensuring that each daughter cell receives an identical set of genetic instructions during cell division. The chromosome duplication involves the unwinding of DNA, separation of the two strands, and the synthesis of new complementary strands. Enzymes such as DNA polymerase catalyze this process, meticulously ensuring the accuracy of copying the genetic code. As a result of DNA replication, each chromosome transforms into a pair of sister chromatids, held together at the centromere. These sister chromatids are genetically identical and represent the duplicated form of the original chromosome.

Sex chromosomes and sex determination

Sex chromosomes play a crucial role in determining an individual's sex. In humans, females typically have two X chromosomes (XX), while males have one X and one Y chromosome (XY). The combination of sex chromosomes is determined at fertilization when a sperm cell carrying either an X or a Y chromosome fertilizes an egg. The inheritance of sex chromosomes follows a specific pattern. Females inherit an X chromosome from both parents (XX), while males inherit an X chromosome from their mother and a Y chromosome from their father (XY). This system ensures a roughly equal distribution of males and females in a population.

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