The cell cycle

G0: some cells may stay in this stage for over a year

G1: first growth phase

S: copying of chromosomes, DNA replication

G2: second growth phase,preparation for mitosis

M: cytokinesis (division of the cytoplasm)

G1+S+G2=interphase

Structure of Chromosome

It is a single piece of coiled DNA containing many genes, regulatory elements and other nucleotide sequence. It also contain DNA-bound proteins, which serve to package the DNA and control its functions.

|  |  |
| --- | --- |
| Prokaryotic | eukaryotic |
| circular | linear |
| Very small | Fairly long |
| 1 chromosome per cell | Several chromosomes per cell |
| Some enzymes and proteins are associated with the DNA | Histone proteins “spool”. same in all eukaryotes |
| Not housed in a nucleus | Housed in a nucleus |
|  | Nucleosome:2 loops of DNA wrapped around 8 histone proteins |
|  | Unity theme |

Chromatin

The major components of chromatin are DNA and histone proteins

Function:

1. Package DNA into a smaller volume to fit in the cell
2. strengthen the DNA to allow mitosis and meiosis
3. serve as a mechanism to control expression and DNA replication

Changes in chromatin structure are affected by chemical modifications of histone proteins such as methylation (DNA and proteins) and acetylation (proteins), and by non-histone, DNA-binding proteins.

Chromosome structure

1. The nucleosome histones (H2A,H2B, H3, H4)

package and order the DNA into structural units called nucleosomes

Play a role in gene regulation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| type | MW | AA number | conserve | Ratio in chromatin | position |
| H1 | 21 | 223 | No | 0.5 | linker |
| H2A | 14.5 | 129 | yes | 1 | core |
| H2B | 13.8 | 125 | yes | 1 | core |
| H3 | 15.3 | 135 | Yes, very | 1 | core |
| H4 | 11.3 | 102 | Yes, very | 1 | core |

H1、H2A、H2B、H3 and H4 all contain higher ratio of Lys and Arg

1. The histone octamere
2. Histone H1 the linker histone
3. Chromatin loops and scaffolds(SAR)

SARs are very AT-rich fragments several hundred base pairs in length that define the bases of the DNA loops.

1. Non histone chromatin proteins
2. Heterochromatin and euchromatin

Heterochromatin is a form of tightly-coiled chromosomal material that carries genes, and is considered to be largely inert genetically.

Euchromatin is a lightly packed form of chromatin that is rich in gene concentration, and is often (but not always) under active transcription.

1. Chromosome G and R bands