"Education Begins with Life, Life Is A science"

Jignsa project on the Cell Cycle

2018-2019

(Plato)

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PROJECT

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INTRODUCTION

" The great secrete of Education is to secure the body and mental exercise shall always serve that relax one another "

(rosseue)

Like that prove the great secrete of living organism is a cell, that cell is a structural and functional unit of all living organism .

Now we see about how the cell is divided and how it regulates with the help of "cell cycle"

We select this topic for clearly understand the living organism how it made, and grow the living body .first we know about cell, What is a cell ?

A cell is the smallest unit of an organism that can take nutrition use energy to grow reproduce as well as respond and adapt to their environment because of there small size they were not observed until the invention of microscope .

Robert hook (1665) observed thin slice of cork under microscope and observed rectangular space which looked smaller to cellular or small rooms inhabited by monks, hence named them cells. However, what hook actually saw under the microscope was cell walls of dead cells and had no idea of the nucleus and other organelles found in most living cells the first man to observed a living cell under a microscope was Anton Van Leewonhoek (1674) he observed many microscopic organism like protozoan, bacteria, algae and sperms and described them as animalcules.

The living organism growth takes place through the production of new cells from the nuclei of old cells.

In 1839 , Theodor shawann ,a German biologist ,reached the same conclusion as sheilden about animal tissue being composed of cells, that their observation that plants and animals were fundamentally different .

The observation of Scheilden and Schwann led to the formulation of cell theory .However many other scientist like Roudelf Verchow also contributed to the theory.

In cell theory we learn about cell division cycle or cell cycle , and its regulation.

The cell cycle or cell division cycle is a series of events that take place in a eukaryotic cell leading to its division and duplication of its DNA (DNA replication) to produce to genetically identical daughter cell.

OBJECTIVES

In this slide we see about phases of cell cycle .The life cycle of a eukaryotic cell alternate between microscopically visible mitotic phase (m phase) and microscopically invisible interphase .Hence ,for a long time , it was believed that the cell takes rest in interphase ,infact, during interphase ,the cell grows by synthesizing RNA and proteins and replicates its DNA and prepares the cell for mitotic division .In the mitotic (M) phase ,the cell separates its replicated DNA into two sets called nuclear division (mitosis)followed by division of its cytoplasm , known as cytokinesis ,forming two genetically identical daughter cells.

Interphase is so named because it occurs between two consecutive mitotic divisions .It consists of three phases namely G_1 ,G_2 and S .

G_1 stands for first gap, interval between completion of mitosis and beginning of DNA synthesis .Synthetic phase (Sphase) is concerned with DNA synthesis or replication G_2 is a second gap , between completion of DNA replication and beginning of mitosis .During all the phases of interphase ,the cell grows by producing RNA and proteins prepares for mitosis in G_2 and finally divides in M phase .

Cell often pause in G1 before DNA replication and enter a resting state called G_0 phase ,they may remain in this phase for days to years before resuming cell division .At any given time most of the animal cells are in G_0 phase .some terminally differentiated cells .Such as muscle and nerve cells, remain in G_0 stage permanently and stop dividing some cells ,such as liver cells ,can resume G_1 phase in response to growth factors released during injury .

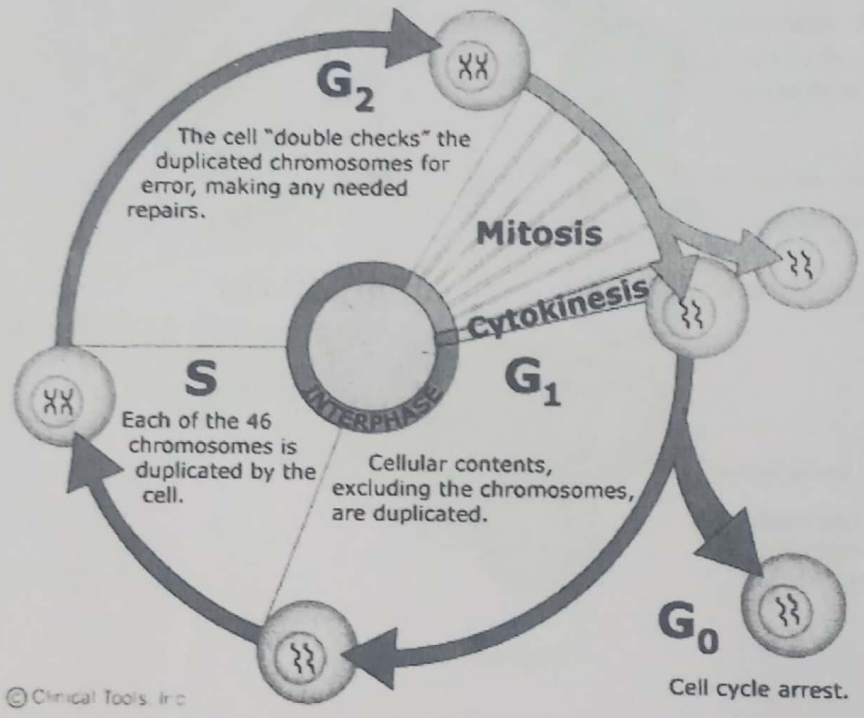
Virtual Genetics Education Centre

The Cell Cycle, Mitosis and Meiosis

Access Topic related resources

The cell cycle

Actively dividing eukaryote cells pass through a series of stages known collectively as the cell cycle: two gap phases (G1 and G2); an S (for synthesis) phase, in which the genetic material is duplicated; and an M phase, in which mitosis partitions the genetic material and the cell divides.



- G1 phase. Metabolic changes prepare the cell for division. At a certain point - the restriction point - the cell is committed to division and moves into the S phase.
- S phase. DNA synthesis replicates the genetic material. Each chromosome now consists of two sister chromatids.
- G2 phase. Metabolic changes assemble the cytoplasmic materials necessary for mitosis and cytokinesis.
- M phase. A nuclear division (mitosis) followed by a cell division (cytokinesis).

The period between mitotic divisions - that is, G1, S and G2 - is known as interphase.

Mitosis

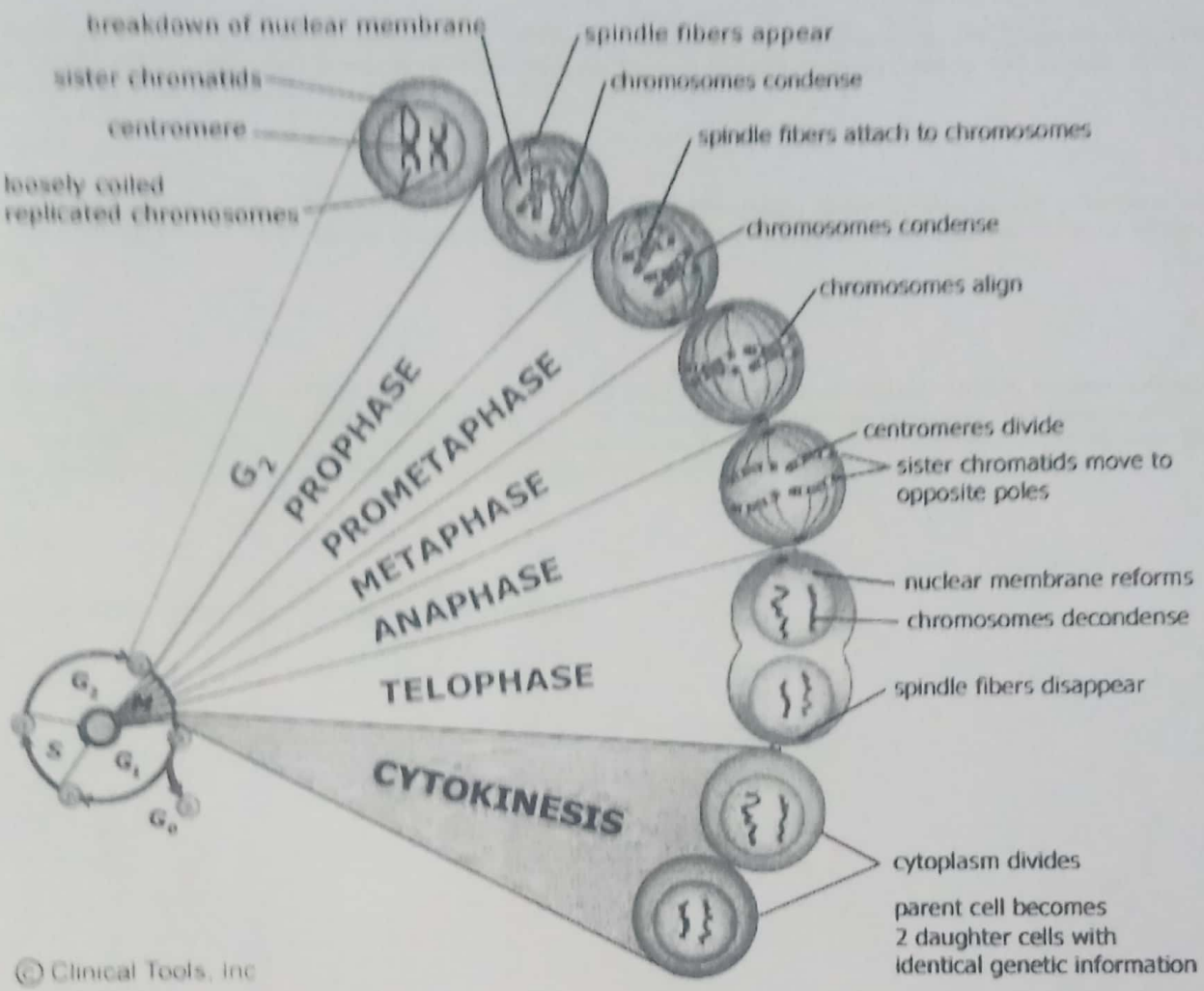
Mitosis is a form of eukaryotic cell division that produces two daughter cells with the same genetic component as the parent cell. Chromosomes replicated during the S phase are divided in such a way as to ensure that each daughter cell receives a copy of every chromosome. In actively dividing animal cells, the whole process takes about one hour.

The replicated chromosomes are attached to a 'mitotic apparatus' that aligns them and then separates the sister chromatids to produce an even partitioning of the genetic material. This separation of the genetic material in a mitotic nuclear division (or karyokinesis) is followed by a separation of the cell cytoplasm in a cellular division (or cytokinesis) to produce two daughter cells.

In some single-celled organisms mitosis forms the basis of asexual reproduction. In diploid multicellular organisms sexual reproduction involves the fusion of two haploid gametes to produce a diploid zygote. Mitotic divisions of the

zygote and daughter cells are then responsible for the subsequent growth and development of the organism. In the adult organism, mitosis plays a role in cell replacement, wound healing and tumour formation.

Mitosis, although a continuous process, is conventionally divided into five stages: prophase, prometaphase, metaphase, anaphase and telophase.



The phases of mitosis

Prophase

Prophase occupies over half of mitosis. The nuclear membrane breaks down to form a number of small vesicles and the nucleolus disintegrates. A structure known as the centrosome duplicates itself to form two daughter centrosomes that migrate to opposite ends of the cell. The centrosomes organise the production of microtubules that form the spindle fibres that constitute the mitotic spindle. The chromosomes condense into compact structures. Each replicated chromosome can now be seen to consist of two identical chromatids (or sister chromatids) held together by a structure known as the centromere.

Prometaphase

The chromosomes, led by their centromeres, migrate to the equatorial plane in the mid-line of the cell - at right-angles to the axis formed by the centrosomes. This region of the mitotic spindle is known as the metaphase plate. The spindle fibres bind to a structure associated with the centromere of each chromosome called a kinetochore. Individual spindle fibres bind to a kinetochore structure on each side of the centromere. The chromosomes continue to condense.

Metaphase

The chromosomes align themselves along the metaphase plate of the spindle apparatus.

Anaphase

The shortest stage of mitosis. The centromeres divide, and the sister chromatids of each chromosome are pulled apart - or 'disjoin' - and move to the opposite ends of the cell, pulled by spindle fibres attached to the kinetochore regions. The separated sister chromatids are now referred to as daughter chromosomes. (It is the alignment and separation in metaphase and anaphase that is important in ensuring that each daughter cell receives a copy of every chromosome.)

Telophase

The final stage of mitosis, and a reversal of many of the processes observed during prophase. The nuclear membrane reforms around the chromosomes grouped at either pole of the cell, the chromosomes uncoil and become diffuse, and the spindle fibres disappear.

Cytokinesis

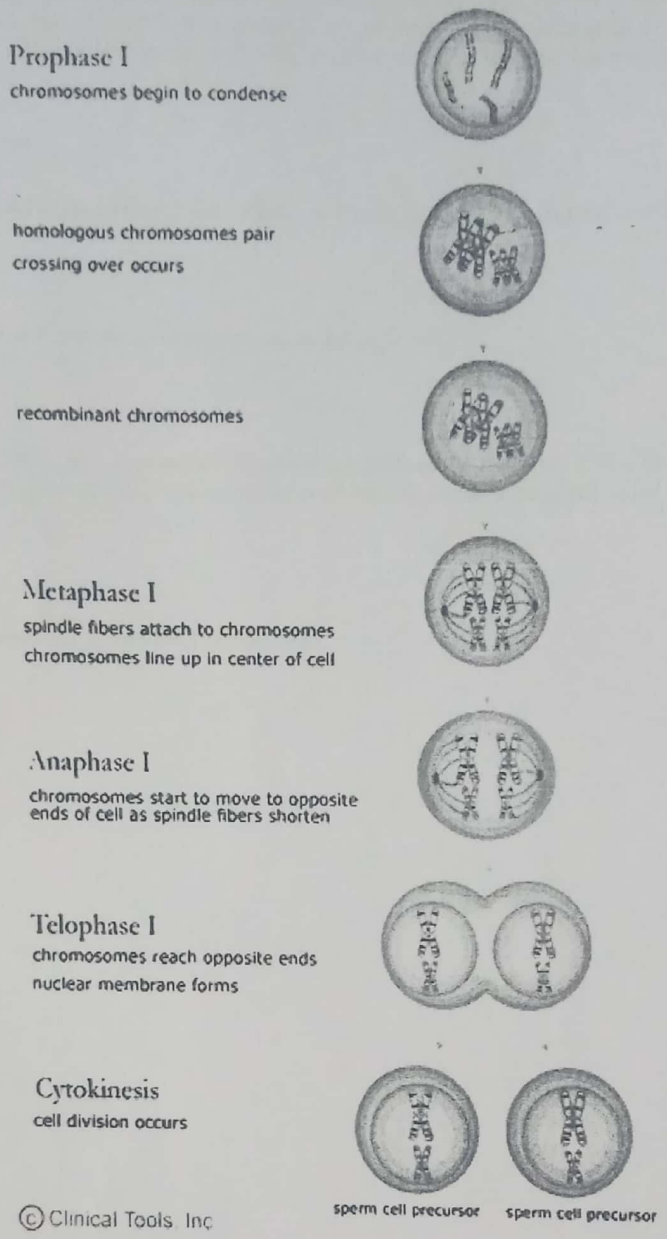
The final cellular division to form two new cells. In plants a cell plate forms along the line of the metaphase plate; in animals there is a constriction of the cytoplasm. The cell then enters interphase - the interval between mitotic divisions.

Meiosis

Meiosis is the form of eukaryotic cell division that produces haploid sex cells or gametes (which contain a single copy of each chromosome) from diploid cells (which contain two copies of each chromosome). The process takes the form of one DNA replication followed by two successive nuclear and cellular divisions (Meiosis I and Meiosis II). As in mitosis, meiosis is preceded by a process of DNA replication that converts each chromosome into two sister chromatids.

Meiosis I

Meiosis I separates the pairs of homologous chromosomes.



In Meiosis I a special cell division reduces the cell from diploid to haploid.

Prophase I

The homologous chromosomes pair and exchange DNA to form recombinant chromosomes. Prophase I is divided into five phases:

- **Leptotene: chromosomes start to condense.**
- **Zygotene: homologous chromosomes become closely associated (synapsis) to form pairs of chromosomes (bivalents) consisting of four chromatids (tetrads).**
- **Pachytene: crossing over between pairs of homologous chromosomes to form chiasmata (sing. chiasma).**
- **Diplotene: homologous chromosomes start to separate but remain attached by chiasmata.**
- **Diakinesis: homologous chromosomes continue to separate, and chiasmata move to the ends of the chromosomes.**

Prometaphase I

Spindle apparatus formed, and chromosomes attached to spindle fibres by kinetochores.

Metaphase I

Homologous pairs of chromosomes (bivalents) arranged as a double row along the metaphase plate. The arrangement of the paired chromosomes with respect to the poles of the spindle apparatus is random along the metaphase plate. (This is a source of genetic variation through random assortment, as the paternal and maternal chromosomes in a homologous pair are similar but not identical. The number of possible arrangements is 2^n, where n is the number of chromosomes in a haploid set. Human beings have 23 different chromosomes, so the number of possible combinations is 2^{23}, which is over 8 million.)

Anaphase I

The homologous chromosomes in each bivalent are separated and move to the opposite poles of the cell

Telophase I

The chromosomes become diffuse and the nuclear membrane reforms.

Cytokinesis

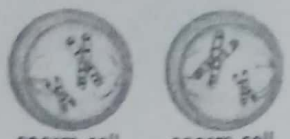
The final cellular division to form two new cells, followed by Meiosis II. Meiosis I is a reduction division: the original diploid cell had two copies of each chromosome; the newly formed haploid cells have one copy of each chromosome.

Meiosis II

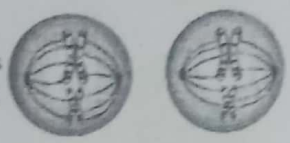
Meiosis II separates each chromosome into two chromatids.

Meiosis II in Males

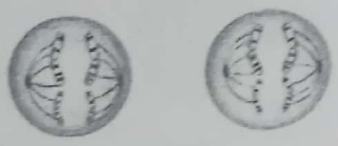
Prophase II
chromosomes begin to condense
nuclear membrane dissolves
spindle fibers form



Metaphase II
spindle fibers attach to chromosomes
chromosomes line up in center of cell

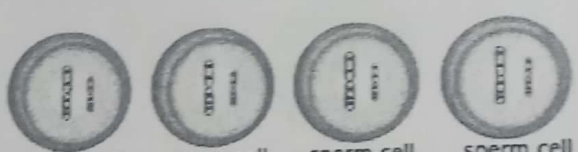


Anaphase II
centromeres divide and sister chromatids move to opposite ends of cell as spindle fibers shorten



Telophase II
chromosomes reach opposite ends
nuclear membrane forms

Cytokinesis
cell division occurs



The events of Meiosis II are analogous to those of a mitotic division, although the number of chromosomes involved has been halved.

Meiosis generates genetic diversity through:

- **the exchange of genetic material between homologous chromosomes during Meiosis I**
- **the random alignment of maternal and paternal chromosomes in Meiosis I**
- **the random alignment of the sister chromatids at Meiosis II**

Meiosis in females

Meiosis I in Females

Prophase I

chromosomes begin to condense

homologous chromosomes pair

crossing over occurs

recombinant chromosomes

Metaphase I

spindle fibers attach to chromosomes

chromosomes line up in center of cell

Anaphase I

chromosomes start to move to opposite ends of cell as spindle fibers shorten

Telophase I

chromosomes reach opposite ends

nuclear membrane forms

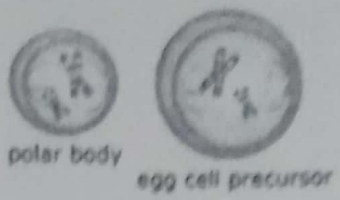
Cytokinesis

cell division occurs

Meiosis II in Females

Prophase II

chromosomes begin to condense
nuclear membrane dissolves
spindle fibers form



Metaphase II

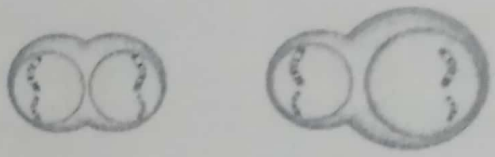
spindle fibers attach to chromosomes
chromosomes line up in center of cell

Anaphase II

centromeres divide and sister chromatids move to opposite ends of cell as spindle fibers shorten

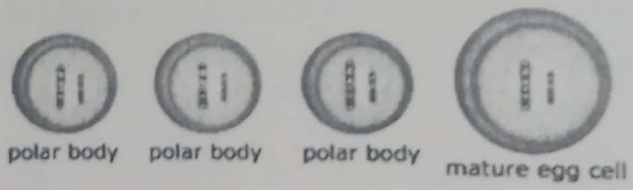
Telophase II

chromosomes reach opposite ends
nuclear membrane forms



Cytokinesis

cell division occurs



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CONCLUSION

By these statements, the cell cycle division completing the cell division and all cells arises from pre –existing cells .Metabolism and biochemical reactions with the process of energy flow occurs within cells .Cells contain hereditary information (DNA) which is passed from cell to cell.

During cell division .all cell are basically the same in chemical composition in organism of similar species all known living things are made up of one more cells the activity of an organism depends on the total activity independent cell at last the cell cycle actively dividing eukaryotes cell pass through a series of stage like as two gap phases (G1 & G2). An S (for synthesis) Phases in which the genetic material is duplicated and an M phase in which mitosis partition the genetic material and cell divides.

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THE END