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Prophase plant cell

The first stage of cell division in both mitosis and meiosis Prophase is the first step of cell division in mitosis. As it happens after the G2 of the interphase, DNA has already been replicated when prophase begins. [1] Fluorescence microscope image of two prophase mouse cell nuclei (scale is 5 µm). [2] Prophase (from the Greek πρό, before and φάσις, stage) is the first stage of cell division in both mitosis and meiosis. Starting after the interphase, DNA has already been replicated when the cell enters prophase. The main deposits in prophase are the condensation of chromatin and the disappearance of the nucleus. [3] Dyeing and microscopy Microscopy can be used to visualize condensed chromosomes as they move through meiosis and mitosis. [4] Various DNA spots are used to treat cells so that condensing chromosomes can be visualized as the transition through prophase. [4] The Giemsa G-banding technique is often used to identify mammalian chromosomes, but utilizing the technology on plant cells was difficult due to the high degree of chromosome compression in plant cells. [5] [4] G-banding was fully realized for plant chromosomes in 1990. [6] During both meiotic and mitotic prophase, giemsa coloring can be used on cells to induce G-banding in chromosomes. [2] Silver coloring, a more modern technology, along with giesma coloring can be used to image the synaptoneic complex through the various stages of meiotic prophase. [7] To perform G-banding, chromosomes must be fixed, and thus it is not possible to perform on living cells. [8] Fluorescent spots such as DAPI can be used in both living plant and animal cells. These spots do not gang chromosomes, but instead allow DNA probing of specific regions and genes. The use of fluorescent microscopy has significantly improved spatial resolution. [9] Mitotic prophase Prophase is the first stage of mitosis in animal cells, and the second stage of mitosis in plant cells. [10] At the start of prophase, there are two identical copies of each chromosome in the cell due to interphase replication. These copies are referred to as sister chromotidides and are attached by DNA element called centromere. [11] The main events of prophase are: condensation of chromosomes, the movement of the centrosomes, the formation of mitotic spindle, and the beginning of the nucleoli breaking down. [3] Condensation of chromosomes DNA replicated in interphase is condensed from molecules with lengths that reach 4 cm to chromosomes measured in micrograms. [3] This process uses the condensine complex. [11] Condensed chromosomes consist of two sister chromatates that were merged at centromere. [12] Movement of centrosomes Under prophase in animal cells, centrosomes move far enough apart to be fixed using a light microscope. [3] Microtubuli activity in each centrosome is increased due to recruitment γ-tubulin. Centrosomes from interphase move apart against opposite poles of the cell, driven by centrosome associated motor proteins. [13] Interdigitated interpolary microtubules from each centrosome interact with each other, helping to move centrosomes to opposite poles. [13] [3] The formation of the mititotic spindle Mikrotubules involved in interphase scaffolding break down as replicated centrosomes distinction. [3] The movement of centrosomes to opposite poles is accompanied in animal cells by the organization of individual radial microtubule arrays (asters) of each centromere. Interpolary microtubules from both centrosomes interact, join the sets of microtubules and form the basic structure of the mitotic spindle. In cells without centrioles chromosomes can nucleus microtubule assembly in the mitotic apparatus. [13] In plant cells, microtubules are collected on opposite poles and begin to form the spindle apparatus in places called foci. [10] The mititotic spindle is of great importance in the process of mitosis and will eventually separate the sister chromomatides in the metaphase. [3] The onset of nucleoli degradation The nucleus begins to break down into prophase, resulting in discontinuation of ribosome production. This indicates a redirection of cellular energy from general cellular metabolism to cellular division. [3] The nuclear envelope remains intact during this process. [10] Meiotic prophase Meiosis involves two rounds of chromosome segregation and thus undergoes prophase twice, resulting in prophase I and prophase II. [12] Prophase In the most complex phase of all of meiosis because homologous chromosomes must pair and exchange genetic information. [3] Prophase II is very similar to mitotic prophase. [12] Prophase I Prophase I is divided into five phases: the leptothes, zygotes, pachytene, diplots and diakinesis. In addition to the events that occur in mititotic prophase, several important events occur in these phases such as the pairing of homologous chromosomes and the mutual exchange of genetic material between these homologous chromosomes. Prophase I occur at different speeds depending on species and sex. Many species arrest meiosis in the diplots of prophase I to ovulation. [3] In humans, decades can pass as oocytes remain arrested in prophase I only to quickly complete meiose I before ovulation. [12] Leptothes Elaborate article: Leptotheene stage In the first stage of prophase I, the leptothes (from Greek for delicate), chromosomes begin to condense. Each chromosome is in a haploid state and consists of two sister chromiums; However, chromatin of the sister chromatomas is not yet condensed enough to be solved in microscopy. [3] Homologous regions within homologous chromosome pairs begin to associate with each other. [2] Zygotene In the second phase of prophase I, the zygotes (from Greek for inflection), all maternally and paternally derived have found their homologous partner. [3] The homologous pairs then undergo synapsis, a process in which synaptonemic complex (a protein structure) aligns similar regions with genetic information about maternal and paternally derived non-sister chromosome time by homologous chromosome pairs. [3] [12] The paired homologous chromosome bound by synaptonemic complex is called bivalents or tetrads. [10] [3] Sex (X and Y) chromosomes are not completely synapse because only a small region of chromosomes is homologous. [3] The core moves from a central to a peripheral position in the core. Pachytene The third stage of prophase I, pachytene (from Greek too thick), begins upon completion of synapsis. Chromatin has condensed enough that chromosomes can now be solved in microscopy. [10] Structures called recombination snaps are formed on the synaptone-painted complex of beekeepers. These recombination nodes facilitate genetic exchange between non-sister chromocamtides to synaptonemic complex in an event known as crossing or genetic recombination. [3] Multiple recombination events may occur on each bivalent. In humans, on average, 2-3 events occur on each chromosome. [13] The diplots In the fourth phase of prophase I, the diplots (from Greek for two-part), the crossing is complete. [3] [10] Homologous chromosomes retain a complete set of genetic information; However, the homologous chromosomes are now of mixed maternal and paternal descent. [3] Visible intersections called chiasmata hold the homologous chromosomes together in places where the recombination occurred when the synaptonemic complex dissolves. [12] It is at this stage where meiotic arrest occurs in many species. [3] Diakinesis In the fifth and final stage of prophase I, diakinesis (from Greek for double movement), full chromatin condensation has occurred and all four sister chromates can be seen in beekeepers with microscopy. The rest of the phase resembles the early stages of mititotic prometaphase, as the mediocre prophase ends with the spindle apparatus begins to form, and the atomic membrane begins to break down. [10] [3] Prophase II Prophase II of meiosis is very similar to prophase of mitosis. The most noticeable difference is that prophase II occurs with a haploid number of chromosomes as opposed to diploid number in mitotic prophase. [12] In both animal and plant cells, chromosomes can decadg during telophase, and I require them to recondition in prophase II. [3] [10] If chromosomes do not need to condense again, prophase II often proceeds very quickly as seen in the model organism Arabidopsis. [10] Differences in plant and animal cell prophase Arabidopsis thaliana cell in preprophase, prophase and prometaphase. Preprophase band is present along the cell wall from pictures 1-3, is fading in picture 4, and disappears of picture 5. [1] The most remarkable between prophase in plant cells and animal cells occurs because plant cells lack centrioles. The organization of the spindle apparatus is instead associated with foci on opposite poles of the cell or is mediated by chromosomes. Another notable difference is preprophase, an additional step in plant mitosis resulting in the formation of the preprophase band, a structure consisting of microtubules. In mititotic prophase I of plants, this band disappears. [10] Cell control points Prophase I in meiosis is the most complex iteration of prophase occurring in both plant cells and animal cells. [3] To ensure the pairing of homologous chromosomes and the recombination of genetic material occurs correctly, there are cellular checkpoints in place. The meiotic checkpoint network is a DNA damage response system that controls double wire break repair, chromatin structure and movement and pairing of chromosomes. [15] The system consists of several pathways (including the mediocre recombination checkpoint) that prevent the cell from entering metaphase I with errors due to recombination. [16] See also Metaphase Anaphase Telophase Meiosis Mitosis Cytoskeleton Homologous Chromosome

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