Cell Division

Mitosis involves the division of the cell nucleus and is part of the cell cycle. The majority of the cell cycle comprises of interphase when the cell is not dividing, but is functioning normally and creating proteins and is the lead up to M phase. Interphase consists of three parts G1, S phase and G2. During interphase the cell grows and doubles its protein content, organelles double in size or number, DNA is synthesised and the centrosome replicates. During G1 and G2 the cell is able to check that all processes have been carried out ready for M phase.

M phase lasts approximately one hour in rapidly dividing cells and consists of six parts, prophase, prometaphase, metaphase, anaphase, telophase and cytokinesis. During prophase the chromosomes condense, the mitotic spindle (microtubules and associated motor proteins) forms, the centrosomes move apart (to the polls) and the protein complex (kinetochore) forms at the centromere of the chromosome (which is where they attach to the mitotic spindle).

During prometaphase the nuclear envelope breaks down allowing the microtubules to access the chromosomes. The kinetochore microtubules grow and shrink to find the chromosome and they attach via the kinetochore complex. During metaphase chromosomes align (as they are positioned by motor proteins) at the equator and sister chromatids attach to opposite polls via the kinetochore microtubules. During anaphase the kinetochore between sister chromatids is released and the microtubules shorten and motor proteins move the centrosomes apart, all pulling the sister chromatids to opposite polls.

During metaphase the daughter chromosomes reach the poles and a nuclear envelope forms using fragments attached to the chromatids. A contractile ring also begins to form at the equator of the cell. Cytokinesis involves the contraction of the ring to partition the cytoplasm into two daughter cells each containing a nucleus, one centrosome and equal numbers of organelles, the DNA then decondenses and the cells enter G1 of interphase.

Functions of the cytoskeleton during mitosis include motor proteins and microtubules moving organelles, the actin filaments forming the contractile ring and the intermediate filaments (known as the nuclear lamina) needing to disassemble before mitosis can occur.

During the cell cycle it is crucial that each step occurs at the right time, that it occurs only once per cycle and that each step goes to completion. In order to ensure this happens there are three key checkpoints the restriction point (at the end of G1), the G2-M transition (at the end of G2) and the meta-anaphase transition. The most important of these checkpoints is the restriction point, which controls the entry into mitosis and involves an environmental check (for growth factors,