

cell cycle.

Cell-cycle control systems are members of a family of protein kinases known as cyclin-dependent kinases. The most important of these Cdk regulators are proteins known as cyclins. Cyclins are named because they undergo a cycle of synthesis and degradation in each cell. The levels of the Cdk proteins, by contrast, are constant. Cyclical changes in cyclin protein levels result in the cyclic assembly and activation of the cyclin-Cdk complex at specific cell cycle stages.

A good example is the cell undergoes the checkpoint between G1/S phase by G1-Cdk which contains cyclin D, the cdk4 and the cdk6. The key function of G1-Cdk complexes in animal cells is to activate a group of gene regulatory factors called the E2F proteins. E2F-dependent gene expression is inhibited by an interaction between E2F and members of the retinoblastoma protein(Rb) family. When cells are stimulated to divide by mitogens, active G1-Cdk accumulates and phosphorylates Rb family members, reducing their binding to the E2F protein. Freeing the gene regulatory protein E2F activates the transcription of the G1/S gene, including the gene for a G1/S-cyclin(cyclin E) and S-cyclin(cyclin A). The resulting G1/S-Cdk and S-Cdk activities further enhance Rb protein phosphorylation, forming a positive feedback loop. As the repression of transcription is central to the mechanism of the retinoblastoma protein, if something happens to interfere with its function, this affects an important regulation step. The loss of both copies of the Rb gene leads to excessive proliferation of some cells in the developing retinal. Rb protein is also an example of tumor suppressor.

Cell death.

In most cases, cell death occurs by a programmed sequence of molecular events, in which the cell systematically destroys itself from within and is then eaten by other cells. This programmed cell death occurs by a process called apoptosis. It is triggered by the absence of trophic factors or the presence of extracellular signalling molecules. The process is too quick to cause an inflammation response. In contrast to apoptosis, animal cells that die in response to an acute insult, such as trauma or lack of blood supply, usually do so by a process called cell necrosis.

Apoptosis is triggered by members of a family of proteases called caspases(which have cysteine at their active site and cleave their target proteins at specific aspartic acids. Extracellular signal proteins binding to cell-surface death receptors trigger the extrinsic pathway of apoptosis. Death receptors are transmembrane proteins containing an extracellular ligand-binding domain called Fas ligand, and an intracellular death domain. Members of the TNF alpha protein family will induce the Fas ligand to bind to the Fas receptors. By binding with the Fas ligand, the death domains bind initiator caspases(primarily caspase-8), forming a death-inducing signalling complex(DISC)

Cells can also activate their apoptosis program from inside the cell, in vertebrate cells, these responses are governed by the intrinsic, or mitochondrial, pathway apoptosis. A key protein in the intrinsic pathway is cytochrome C, a water-soluble component of the mitochondrial electron-transport chain. The release of cytochrome C is controlled by a pro-apoptotic protein which Bcl2 family protein and the main effector proteins Bak or Bax. When an apoptotic stimulus triggers the intrinsic pathway, the pro-apoptotic effector Bcl2 family proteins become activated and aggregate to form oligomers in the mitochondrial outer membrane, inducing the release of cytochrome C and other intermembrane proteins by an unknown mechanism. Cytochrome c binds to an adaptor protein called Apaf1. Causes Apaf1 proteins to oligomerize and then recruit initiator Caspase-9 proteins. The activated caspase-9 molecules then active downstream executioner caspases to induce apoptosis.