

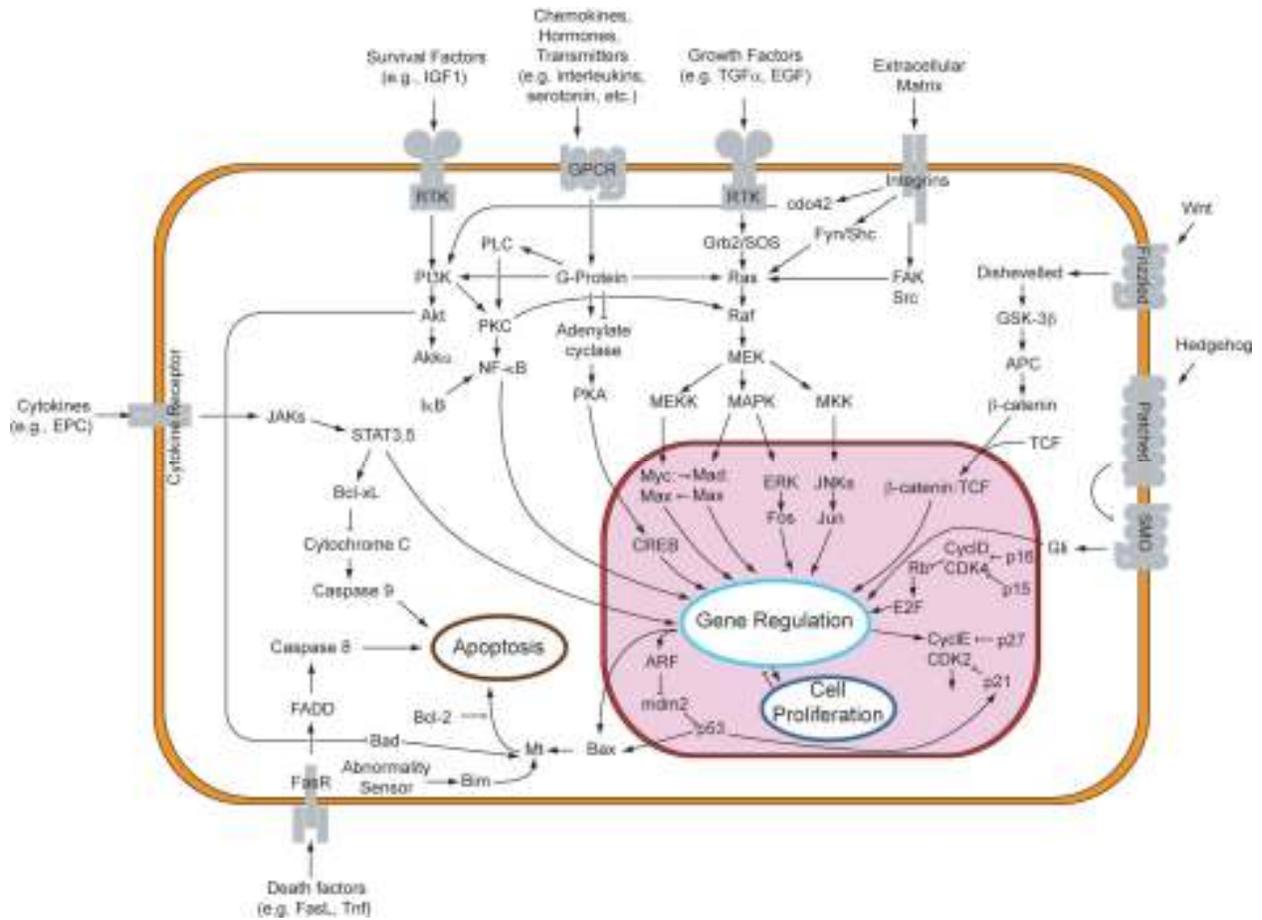
Apoptosis

Apoptosis is a process of cell death that is carried out by billions of cells in the human body each day. Apoptosis is a programmed process in which the cell dies through a series of steps, and for this reason apoptosis is also referred to as *programmed cell death*. There are numerous reasons why apoptosis occurs, including normal development of fingers and toes in the fetus, shedding of uterine lining cells at menstruation, and synapse formation. Apoptosis is also protective, leading to the death of immune cells that might otherwise attack the body's own cells (autoimmune), virus infected cells, cells with DNA mutations, and even cells that are cancerous.

Stimulation of tumor necrosis factors or Fas proteins externally induces apoptosis. TNF and Fas are death receptors that stimulate caspase-8, leading to a signaling event that results in phagocytosis of the cell. Internal induction of apoptosis results from blocking the cellular mitochondria surface protein known as Bcl-2, which blocks apoptosis. When Bcl-2 is blocked the mitochondria becomes damaged, allowing cytochrome c to leak out. This stimulates a signaling cascade that starts the process of cell death resulting in the activation of caspase-9, and as in internal stimulation, ultimately leads to phagocytosis of the cell. If a cell is damaged or diseased, it will stimulate its own cell death through the internal process, whereas external stimuli—like chemotherapy—may lead to apoptosis through the external process. Other factors involved in the apoptotic process include Bcl-XI and other Bcl family members, Bax, Bak, and BAD. Cell signaling is an incredibly complicated process, of which apoptosis is only a small aspect. The figure below demonstrates this complexity.

In cancer, overproduction of Bcl-2 or inactivation of factors in the apoptosis pathway results in cells that do not carry out apoptosis. Viruses that are capable of this include Epstein-Barr virus (EBV) and human papillomavirus (HPV), which are both known to stimulate cells to become cancerous.

When a cell is carrying out apoptosis, it will fragment its own DNA, produce blebs on its surface, and release cytochrome c from its degraded mitochondria. Additionally, the cell will shrink. Phagocytic cells are drawn to the area and consume pieces of the degraded cell.



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Sources:

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