Internal and External Factors Regulate Cell Division

**External factors** come from outside the cell, could be from other cells or from another part of the body.

**Physical Signals**
- cell to cell contact
- when mammal cells are grown in a culture dish they form a single layer of cells on the bottom and then stop dividing.

**Chemical Signals**
- cells release chemicals that tell other cells to grow.
  - Growth Factors- broad group of proteins that stimulate cell division.
  - they bind to receptors that activate specific genes to trigger cell growth
  - cells grow and divide in response to a combination of growth factors

- Growth factors affect many different types of cells.
- Platelets are sticky fragments of bone marrow cells.
- Form clots to stop bleeding
- Store a type of growth factor that helps your body repair wounds.

- Other growth factors are target specific
  - Erythropoietin stimulates the production of red blood cells
  - Red blood cells carry oxygen
  - If you moved from the coast to the mountains your blood oxygen levels would be lower because the air pressure is lower at higher altitudes. So your body would produce more erythropoietin to increase the number of red blood cells and increase the amount of oxygen.

- Growth hormones results in bone growth and affect your protein and fat metabolism.
Normal cell growth

Cancerous cell growth
Internal Factors- come from inside the cell and include several types of molecules found in the cytoplasm.

1. Kinases- enzymes that transfers a phosphate group from one molecule to a specific target molecule.
   -this increases the energy or changes the shape of the target molecule
   -kinases that control the cell cycle are activated by cyclins.

2. Cyclins- group of proteins that are rapidly made and destroyed at certain points in the cell cycle.
Apoptosis- programmed cell death.

- Internal or external signals activate genes to help produce self-destructive enzymes.
  - The nucleus shrinks and breaks apart and the cell is then gobbled up by specialized cells in the immune system.

Example:

Human embryos have webbing between their fingers and toes. Before the baby is born the cells undergo apoptosis and they are born with unwebbed fingers and toes.

Deciduous trees lose their leaves in the fall due to apoptosis.
Cancer

- class of diseases characterized by uncontrolled cell division
  - occurs when the regulation of the cell cycle breaks down
  - Unlike healthy cells that stop growing once they are surrounded by other cells, cancerous cells continue to divide.
  - they also divide without many of the growth factors required for cell division, so they divide more often.

Cancerous cells form disorganized clumps called tumors.

  Benign Tumors- cancer cells typically remain clustered together, which means they are usually harmless because they can be cured by removing it.

  Malignant Tumors- some of the cancer cells can break away and metastasize.

  Metastasize- cells are carried to the bloodstream or lymph system to other parts of the body.
  - once a tumor metastasizes it is much more difficult to rid the entire body of the tumors.
Why are tumors so harmful?

-Cancer cells do not perform the specialized functions needed by the body.

Example: Lung Cancer- the cancerous cells do not exchange the carbon dioxide and oxygen needed for breathing.

Brain- They do not transmit the carefully ordered electrical messages needed to interpret information.

So, your body develops these lumps of cells that need nutrients and blood supply from your body, but give your body nothing in exchange.

Also, a growing tumor can apply a great amount of pressure on surrounding organs.

Example- a tumor in the skull will cramp the brain for space, causing areas of the brain to not be able to function.

If cancer cells continue to grow unchecked, death can result.
Causes:

Cancer cells come from normal cells that have damage to the genes that control cell-cycle regulation.

Most cancer cells contain mutations in two types of genes.

1. Oncogenes- accelerate the cell cycle

2. The second type puts the brakes on the cell cycle.

Mutations in these genes can be inherited.
   Example- some breast cancers appear to be caused by inherited errors in specific genes.

Other mutations are caused by exposure to radiation or chemicals.

Skin cancer- caused by damage to DNA by UV radiation from sunlight.

Carcinogens- substances known to produce or promote the development of cancer.
   -smoking and certain types of air pollution

Some cancers can be caused by viruses like cervical cancer.
   (vaccine to prevent it)
Cancer Treatment

1. Radiation therapy- uses radiation to kill cancer cells and shrink tumors. 
   -usually localized because it can hurt healthy cells.

2. Chemotherapy- uses certain combinations of drugs to kill actively dividing cells.
   -Like radiation it kills both healthy and cancerous cells.
   -the drugs are systemic- meaning they travel through the entire body

Medical Researchers use lab grown cancer cells in their search for treatments.

HeLa cells were obtained from Henrietta Lacks in 1951 from a cervical tumor and much of what is known about the cell cycle was learned from these cells. This same line is still used today. Scientist's do not know why her cells have never died.

Interesting Info- Henrietta Lacks was a black tobacco farmer whose family lived in poverty. Her cells were obtained illegally and used to develop the polio vaccine and were the first cells in space.