Regulating the Cell Cycle - Notes 10.3
How fast do cells divide?

- Muscle cells and nerve cells **DO NOT DIVIDE AT ALL** once they have developed.
- Skin cells, cells in bone marrow that make blood cells, and cells of the digestive tract **DIVIDE RAPIDLY THROUGHOUT LIFE**.
- These cells may pass through a complete cell cycle within a **FEW HOURS**.
Controls of Cell Division

- When cells are grown in the laboratory, most cells will **DIVIDE UNTIL THEY COME INTO CONTACT WITH EACH OTHER**
- If cells are scraped away, the remaining cells **BEGIN DIVIDING AGAIN**
- This also happens in the body when there is a **CUT IN THE SKIN OR BROKEN BONE**
Cyclins

- Cyclins are **PROTEINS** that **REGULATE THE CELL CYCLE**
- First proteins to be discovered that regulate mitosis
Today we now know that the cell cycle is **REGULATED BY DOZENS OF REGULATORY PROTEINS BOTH INSIDE AND OUTSIDE OF THE CELL**

- **INTERNAL REGULATORS** respond to events that occur **INSIDE THE CELL**
- Allow the cell cycle to continue only when certain events have occurred
Regulatory Proteins

- **EXTERNAL REGULATORS** respond to events that occur **OUTSIDE OF THE CELL**
  - Direct cells to **SPEED UP** or **SLOW DOWN THE CELL CYCLE**
  - **GROWTH FACTORS** stimulate the growth and division of cells
    - Important during **EMBRYONIC DEVELOPMENT AND WOUND HEALING**
Cell Death

- Two ways for a cell to die:
  - **DIE BY ACCIDENT DUE TO DAMAGE OR INJURY**
  - **“PROGRAMMED” TO DIE**
    - The process of programmed cell death is called **APOPTOSIS**
      - Important because it plays a key role in development by **SHAPING THE STRUCTURE OF TISSUES AND ORGANS**
      - If too much Apoptosis occurs this can result in too much cell loss **SEEN IN AIDS AND PARKINSON’S DISEASE**
Cancer: Uncontrolled Cell Growth

- Cancer is **A DISORDER IN WHICH BODY CELLS LOSE THE ABILITY TO CONTROL GROWTH**
  - Occurs in **MULTICELLULAR ORGANISMS**
  - Cancer cells **DO NOT RESPOND TO SIGNALS THAT REGULATE THE GROWTH OF MOST CELLS**
  - Cells grow **UNCONTROLLABLY**
- This can form a mass of cells known as a **TUMOR**
  - **BENIGN TUMOR** - non cancerous
  - **MALIGNANT TUMOR** - cancerous
1. A cell begins to divide abnormally.

2. The cancer cells produce a tumor, which begins to displace normal cells and tissues.

3. Cancer cells are particularly dangerous because of their tendency to spread once they enter the bloodstream or lymph vessels. The cancer then moves into other parts of the body and forms secondary tumors, a process called metastasis.

Benign tumors are generally self-contained and localized and have a well-defined perimeter. They grow slowly, expanding outward from a central mass. They are dangerous when they compress surrounding tissues. A benign tumor near a blood vessel could restrict the flow of blood; in the abdomen it could impair digestion; in the brain it could cause paralysis.

Malignant tumors are not self-contained, and usually do not compress surrounding tissues. Their growth is an irregular invasion of adjacent cells. Although they may grow slowly, they are also capable of very rapid growth. They are not localized; in a process called metastasis they shed cells that travel through the bloodstream and infect tissues at other locations. They can even establish malignant growth in a different type of tissue; a breast cancer can spread to bone tissue, for example.
Cancer: Uncontrolled Cell Growth

- As cancer cells grow they:
  - **ABSORB NUTRIENTS** needed by other cells
  - **BLOCK NERVE CONNECTIONS**
  - Prevent organs they are invading **FROM WORKING PROPERLY**
  - Have the ability to spread throughout the entire body known as **METASTASIZING**
Causes of Cancer

- Caused by **DEFECTS IN GENES THAT REGULATE CELL GROWTH AND DIVISION**
  - Common defect in gene called \( p53 \) → which normally halts the cell cycle until all chromosomes are replicated

- Defects caused by:
  - **CARCINOGENS OR CANCER CAUSING AGENTS**
    - Viruses (HPV)
    - Radioactivity
    - Ultraviolet light
    - Chemicals in cigarettes (arsenic, benzene, formaldehyde)
    - Asbestos
Detecting Cancer

- **Self exams**
- **Biopsy**: a sample of tissue is taken from the body and then examined
- **X rays**: example is mammograms
- **MRI**: magnetic resonance imaging
- **Blood and DNA tests**: can help determine the likelihood of developing cancer
Cancer Treatments

- **Surgery** - operation to remove some or all of tumor
- **Chemotherapy** - use of drugs to destroy cells that divide rapidly
  - Can kill healthy cells that divide rapidly
  - Side effects are nausea, fatigue, vomiting, and hair loss
- **Radiation therapy** - using a beam of radiation to shrink the size of the tumor
- **Hormone therapy**?
- **Vaccine**?
Preventing Cancer

• **Don’t smoke** - tobacco is responsible for 30% of deaths due to cancer
• **Safeguard your skin** - wear sunscreen even on cloudy days and don’t go in tanning beds
• **Eat your veggies and cut the fat** - lots of fiber
• **Stay active and maintain a healthy weight** - Prevents obesity, teens should get 60 min. daily
• **Get regular medical checkups**