

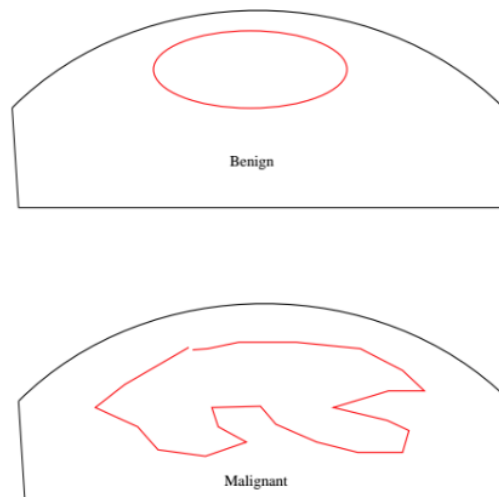
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CONCEPT: OVERVIEW OF CANCER

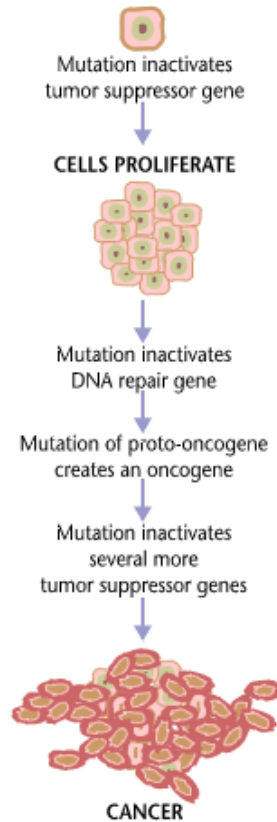
- Cancer is a disease that arises due to _____ cell growth and division
 - Unregulated **proliferation**, which is cell growth and division, causes cancer
 - Unregulated **apoptosis** (programmed cell death) also causes cancer
 - Multiple mutations within somatic cells leads to cancer
 - Cancers are genetically unstable, with a variety of mutations and chromosomal aberrations
 - There are two types of tumors
 - **Benign** tumors have abnormal proliferation, but remain in a single area
 - **Malignant** tumors **metastasize** to other areas of the body

EXAMPLE:



- **Tumorigenesis** is the development of a malignant _____
 - Requires more than one mutation
 - Affects **signal transduction pathways** which are regulation protein networks that control cell activities
- Cancer is **clonal** meaning that it derives from a single cell
 - Genetic aberrations are passed onto progeny cells
 - Cancer **stem cells** exist for some cancers, which proliferate and create more tumor cells
 - Stem cells have the ability to self-renew and produce more of themselves

EXAMPLE:

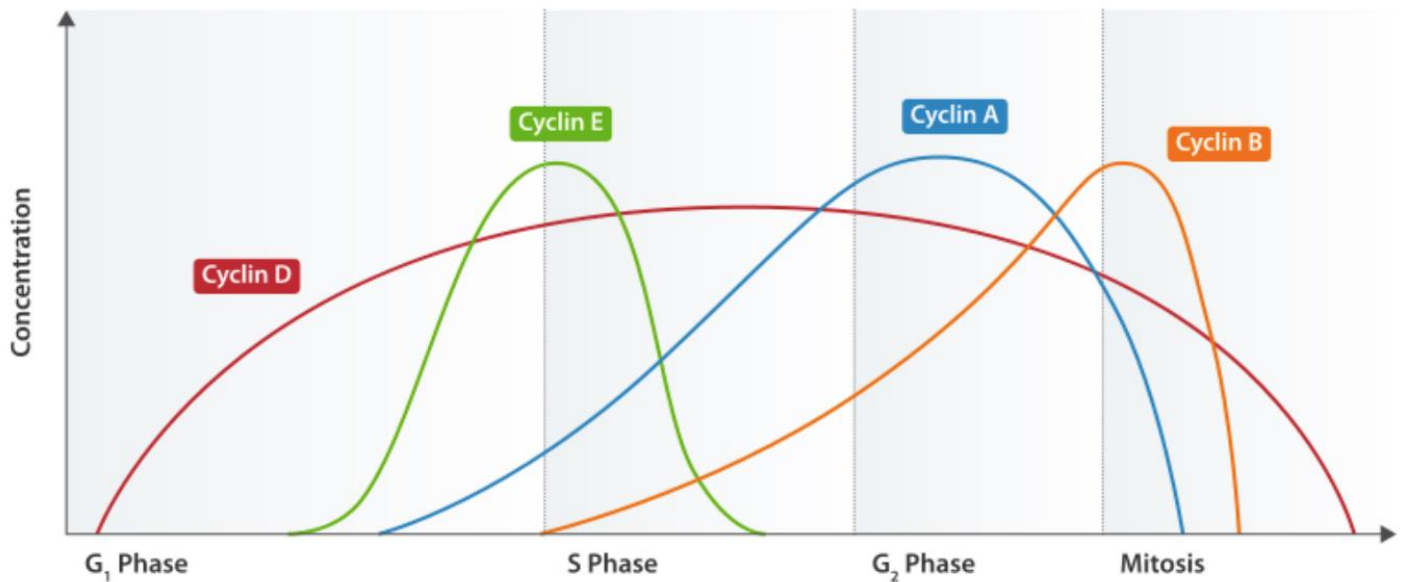


Causes of Cancer

- Cancerous mutations can develop through many _____
 1. Viruses can introduce mutations or aberrant genes that activate cancer causing genes
 - Human papillomavirus E6 and E7 proteins can lead to cancer
 2. Epigenetic changes to the chromatin histone proteins can cause gene misregulation
 - Cause over-activation or under-activation of important regulatory genes
 3. Environmental substances can lead to mutations (Ex: cigarette smoke)

- Misregulation of the cell cycle is one way these mutations can _____ in a single cell
 - The cell cycle has uses **cyclins** and **cyclin-dependent kinases** to regulate the cell cycle
 - These proteins control passage through cell cycle *checkpoints*
 - Important cell cycle checkpoints include:
 - G₁ to S transition – which is partially controlled through *retinoblastoma*
 - This checkpoint ensures DNA damage is repaired before replication
 - G₂ to M transition – is controlled through CDC2 cyclin dependent kinase and cyclinB
 - This checkpoint ensures DNA replication has gone correctly

EXAMPLE:

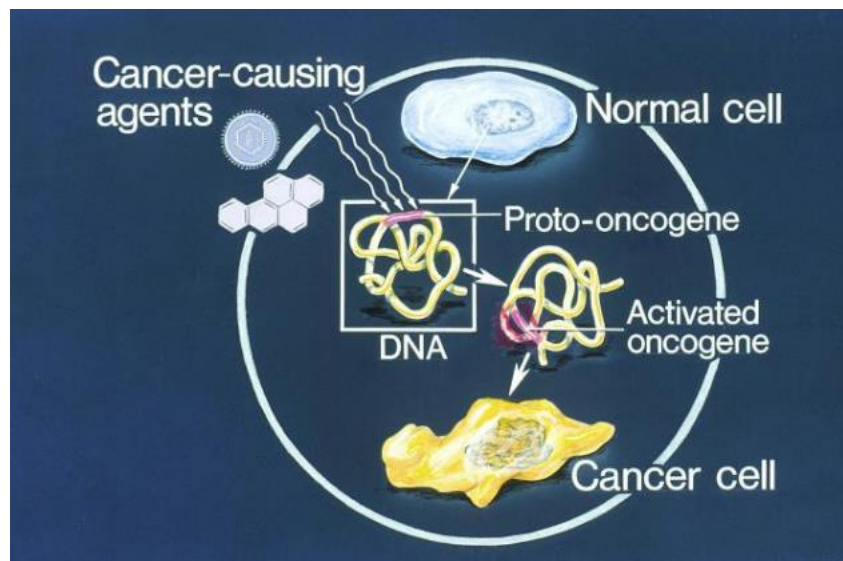


3. Which of the following are enzymes are responsible for controlling the cell cycle?
- a. G₁ cylases
 - b. Cyclin-dependent kinases
 - c. Bypass polymerases
 - d. Ligases

CONCEPT: CANCER MUTATIONS

- Cancer develops after multiple _____ accumulate in one cell
 - **Passenger mutations** have no direct contribution to the cancer
 - **Driver mutations** provide the cancer cell a way to grow aberrantly
- There are two classes of cancer mutations
 - **Oncogenes** are mutant alleles that act dominantly
 - **Proto-oncogenes** are the wild-type alleles that become oncogenes when mutated
 - Ex: *Ras* GTPase, and Human Papillomavirus E6 and E7 proteins
 - **Tumor suppressors** are alleles whose normal function is to stop cell division
 - Ex: Retinoblastoma, p53 transcription factor

EXAMPLE:



PRACTICE:

1. A mutation in a tumor suppressor gene causes what to happen?
 - a. The mutated tumor suppressor acts to suppress the tumor
 - b. The mutated tumor suppressor can no longer act to suppress the tumor, and allows tumor growth
 - c. The mutated tumor suppressor has no direct contribution to the cancer

2. True or False: Proto-oncogenes are mutated versions of oncogenes
 - a. True
 - b. False

3. Which of the following proteins is an example of a tumor suppressor?
- a. *Ras* GTPase
 - b. HPV E6 protein
 - c. p53 transcription factor