

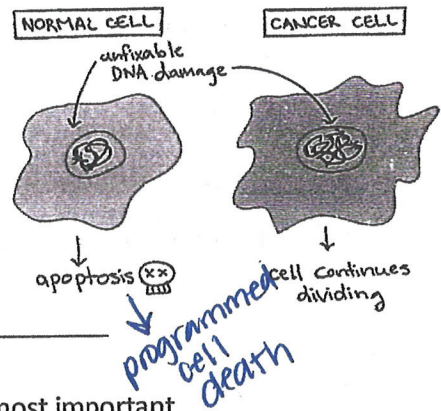
## Unit 5, Topic 4: Cell Cycle Regulation

at the end of this topic, you should be able to...

- Explain the role of cell regulation checkpoint
- Explain what happens when the cell cycle controls fail

### Cell Regulation Checkpoints

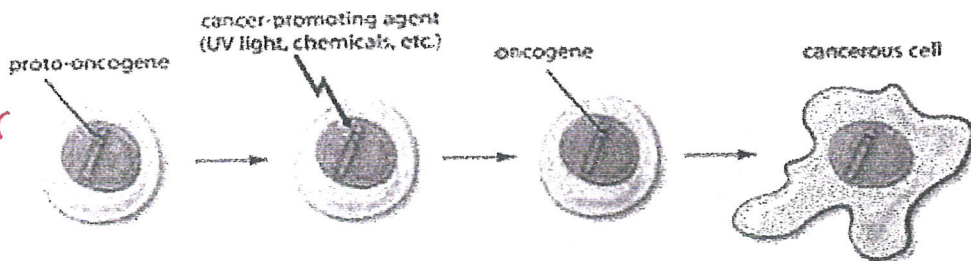
- G1/S checkpoint
- G2/M checkpoint
- Tumor suppressor genes can control these checkpoints
  - Tumor suppressor genes turn off or decrease rate of cell division
- For many cells, the G<sub>1</sub> checkpoint seems to be the most important
  - If a cell receives a go-ahead signal at the G<sub>1</sub> checkpoint, it will usually divide
  - If the cell does not receive the go-ahead signal, it will exit the cycle, switching into a nondividing state called the G<sub>0</sub> phase
- Neighboring cells communicate with dividing cells to regulate their growth also.



### Proto-Oncogenes

- Proto-oncogenes encode proteins that function to stimulate cell division
- Important for normal human development and for the maintenance of tissues and organs.
- Sometimes a proto-oncogene undergoes a mutation and becomes an oncogene
  - When mutated into an oncogene it may produce a large amount of these growth proteins, resulting in excessive / uncontrolled cell division
  - When a cell can no longer regulate its rate of cell division it becomes a CANCER CELL.

*ONCO = cancer  
Oncology = study of cancer*



- Because there are several genes that act as proto-oncogenes it may take 3-4 mutations to cause harm.
  - Anything that can damage genes can cause these harmful mutations.
  - These are called carcinogens or mutagens

### Cancer

- Cancer is a disease of the cell cycle. Some of the body cells divide uncontrollably and tumors form.
- Mutations may be caused by: radiation, smoking, pollutants, chemicals, viruses
- Due to DNA mutations, cancer cells ignore the chemical signals that start and stop the cell cycle.
- Due to DNA mutations, cancer cells cannot communicate with neighboring cells. Cells continue to grow and form tumors.

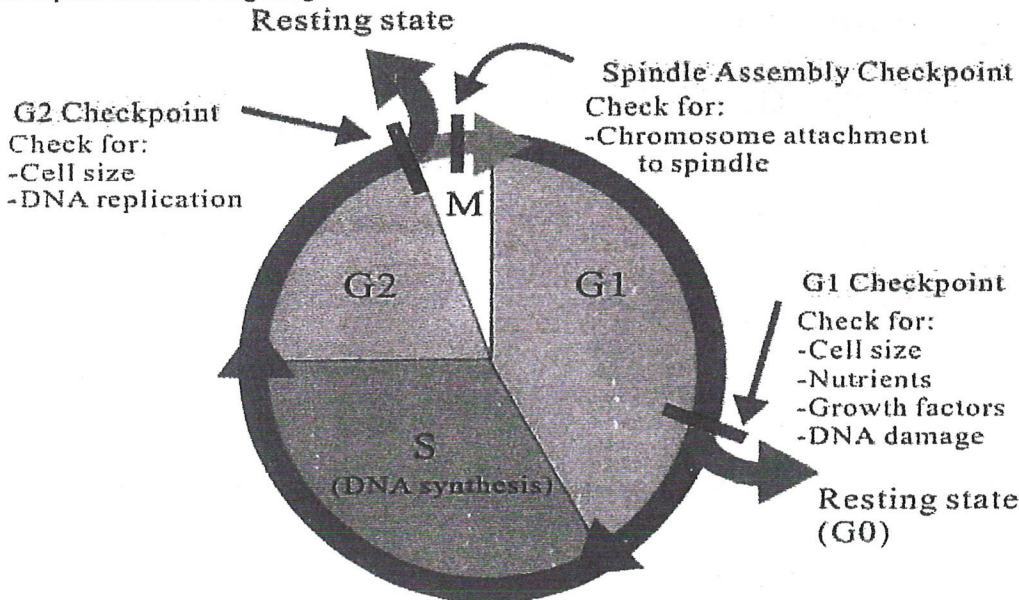
Normal Cell	Cancer Cell
DNA is replicated <u>properly</u>	Mutations occur in the <u>DNA</u> when it is <u>replicated</u>
<u>Chemical signals</u> start & stop the cell cycle	Chemical signals that start & stop the cycle are <u>ignored</u>
Cells <u>communicate</u> with each other to avoid becoming <u>overcrowded</u>	Cells DO NOT <u>communicate</u> with each other and <u>tumors</u> form

**Cancer Vocabulary**

- Tumor = loss of cell cycle control = abnormal growth of cells
- Benign = non-spreading
- Malignant = spreading
- Metastasis = spread rate of a malignant cancer to locations other than their origin
  - tumor cells enter blood vessels and travel to other parts of the body

[[Language Target for Topic 4: I can identify the cell cycle checkpoints on a diagram; I can explain in writing how cancer relates to the cell cycle.]]

1. Explain the following image:



2. What stage of the cell cycle do normal cells spend the majority of their time in? \_\_\_\_\_
3. Comparing cancer cells to normal cells, how does your answer for number 2 change for cancerous cells? \_\_\_\_\_
4. What can cause cancer? \_\_\_\_\_
5. Why don't all cells with mutated DNA cause cancer? \_\_\_\_\_  
(think of what happens at certain points in the cell cycle for normal cells- see #1).