

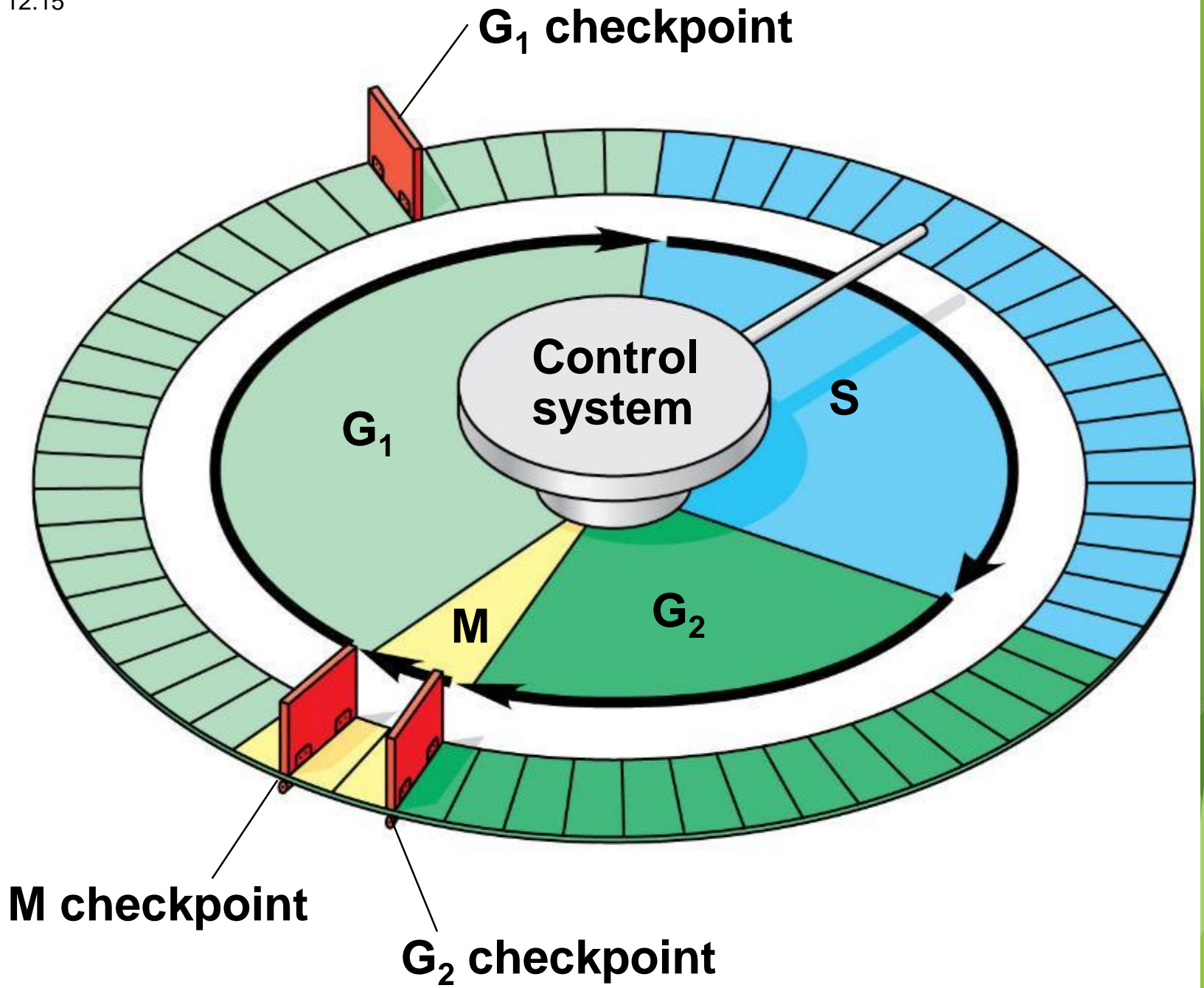
Topic 4: Cell Cycle Regulation

- ▶ By the end of this topic, you should be able to...
 - ▶ *Explain the role of cell regulation checkpoints*
 - ▶ *Explain what happens when the cell cycle control fails*

Regulation of Cell Cycle

- **G1/S checkpoint**
- **G2/M checkpoint**
- Tumor suppressor genes can control these checkpoints
 - Tumor suppressor genes turn off or decrease rate of cell division

Figure 12.15



M checkpoint

G_2 checkpoint

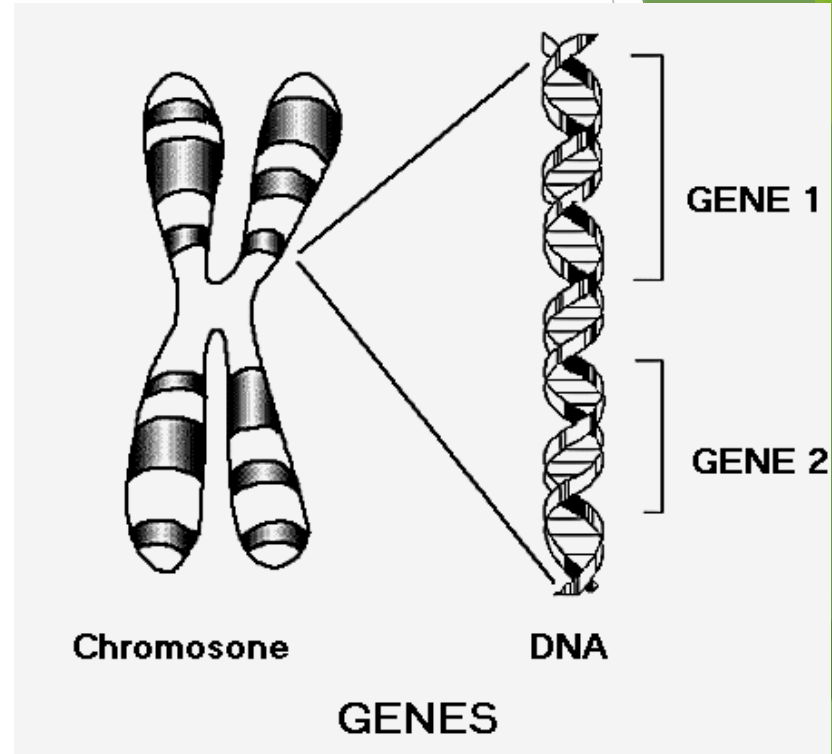
- ▶ For many cells, the G_1 checkpoint seems to be the most important
- ▶ If a cell receives a go-ahead signal at the G_1 checkpoint, it will usually divide
- ▶ If the cell does not receive the go-ahead signal, it will exit the cycle, switching into a nondividing state called the **G_0 phase**

Neighboring cells communicate with dividing cells to regulate their growth also.

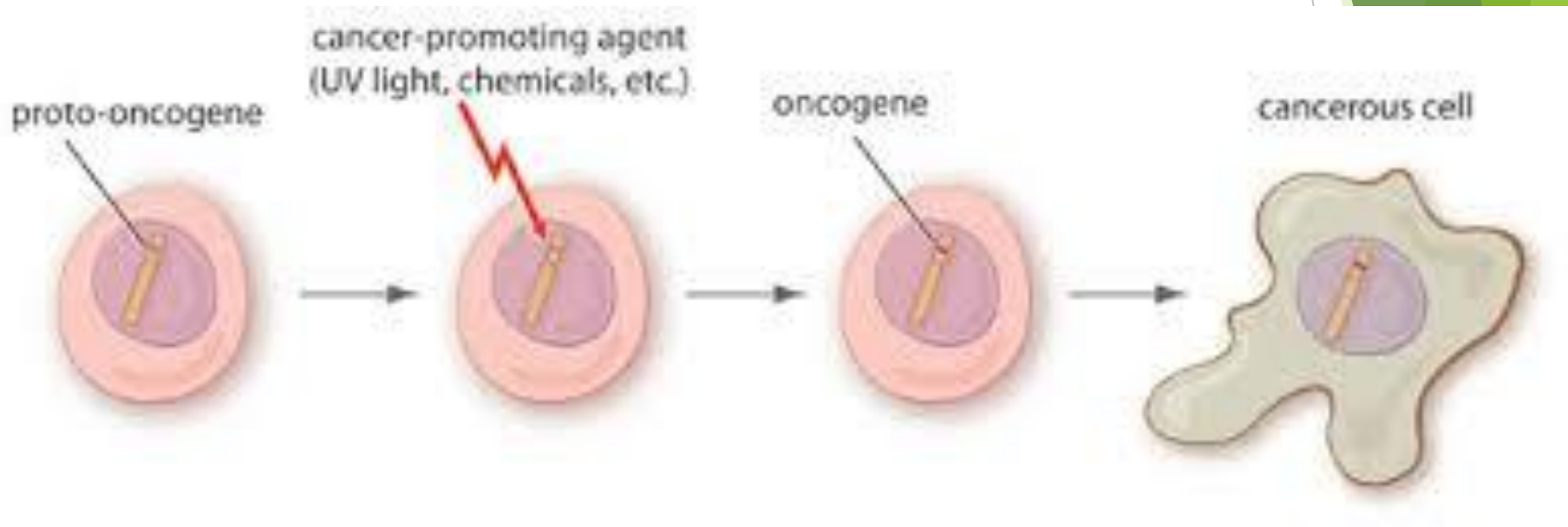


Some of the genes that control cell division are called Proto-oncogenes

- ▶ Proto-oncogenes encode proteins that function to stimulate cell division
- ▶ Important for normal human development and for the maintenance of tissues and organs.



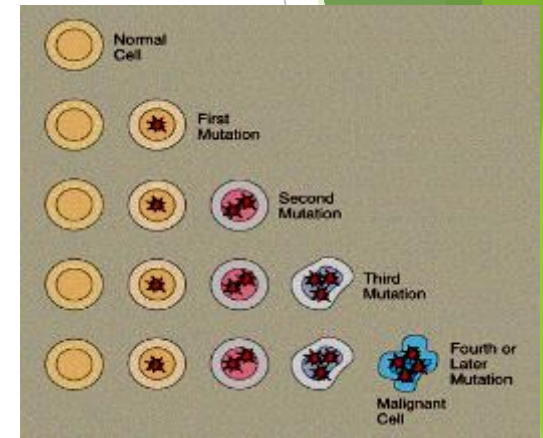
Sometimes a proto-oncogene undergoes a mutation and becomes an oncogene



Oncogenes and Cancer Cells

- ▶ When mutated into an oncogene it may produce a large amount of these growth proteins, resulting in **excessive** cell division.
- ▶ When a cell can no longer regulate its rate of cell division it becomes a Cancer Cell.

- ▶ 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 is a disease of the cell cycle. Some of the body cells divide uncontrollably and tumors form.

Tumors in Liver



Tumor in Colon



Treatment of colon cancer depends on the stage, or extent, of disease



Stage I



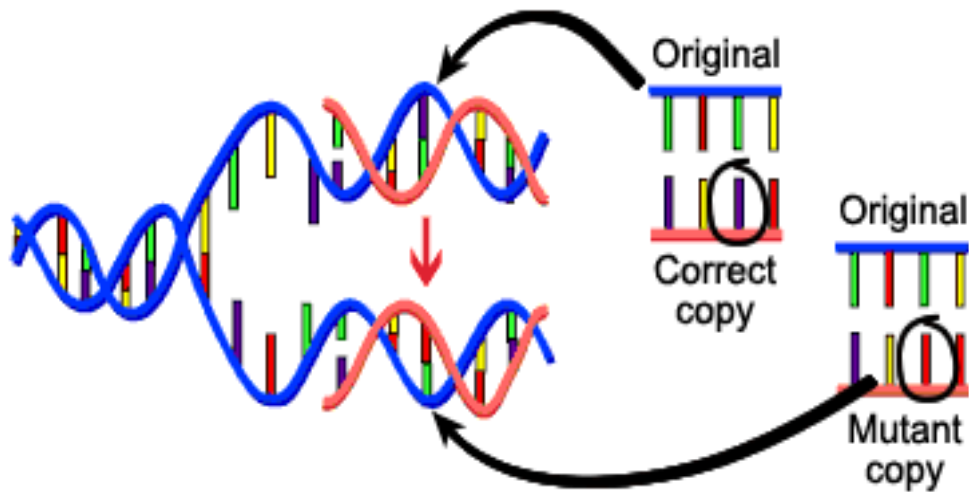
Stage II



Stage III

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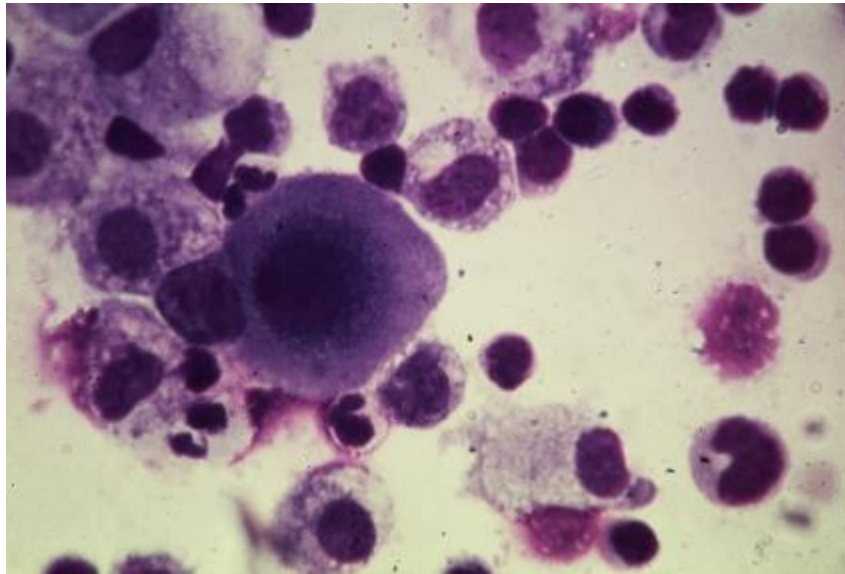
DNA mutations disrupt the cell cycle.



Mutations may be caused by:

1. radiation
2. smoking
3. Pollutants
4. chemicals
5. 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.



Skin cancer

SUMMARY

Normal Cell Division

1. DNA is replicated properly.
2. Chemical signals start and stop the cell cycle.
3. Cells communicate with each other so they don't become overcrowded.

Cancer Cells

1. Mutations occur in the DNA when it is replicated.
2. Chemical signals that start and stop the cell cycle are ignored.
3. Cells do not communicate with each other and tumors form.

Cancer

- ▶ 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)

Environment and Cancer

- ▶ Solid relationship exists between environmental factors and cancer
- ▶ **Cancer cluster:** Large number of cases in restricted area
 - ▶ Epidemiologists examine environment for link
- ▶ Cancer cluster in Woburn, Massachusetts,
 - ▶ Environmental trigger, industrial solvents from contaminated well water

Skin Cancer

- ▶ ~1 million new cases in U.S. per year
- ▶ Almost all cases related to UV light exposure from sun or tanning lamps
- ▶ Lightly pigmented people higher risk
 - ▶ genetic characteristics can affect the susceptibility

Skin Cancer

- ▶ Ozone depletion also contributes to increased UV exposure and risk
- ▶ In spite of risk, some choose low SPF suntans and only 25% of Americans consistently use sunscreen

Smoking

- ▶ Related to cancers of oral cavity, larynx, esophagus, and lungs
 - ▶ Accounts for 30% of all cancer deaths
 - ▶ Most have very low survival rate (e.g. 13% lung cancer sufferers survive beyond 5 yrs)

Case Study Response

- ▶ Hypothesis: If _____, then _____
- ▶ Cite **all** pieces of evidence used by Tina's doctor in her diagnosis
 - ▶ Tie in information from page 1 (background info)
- ▶ Use information written in the brainstorming section to put Tina's case all together