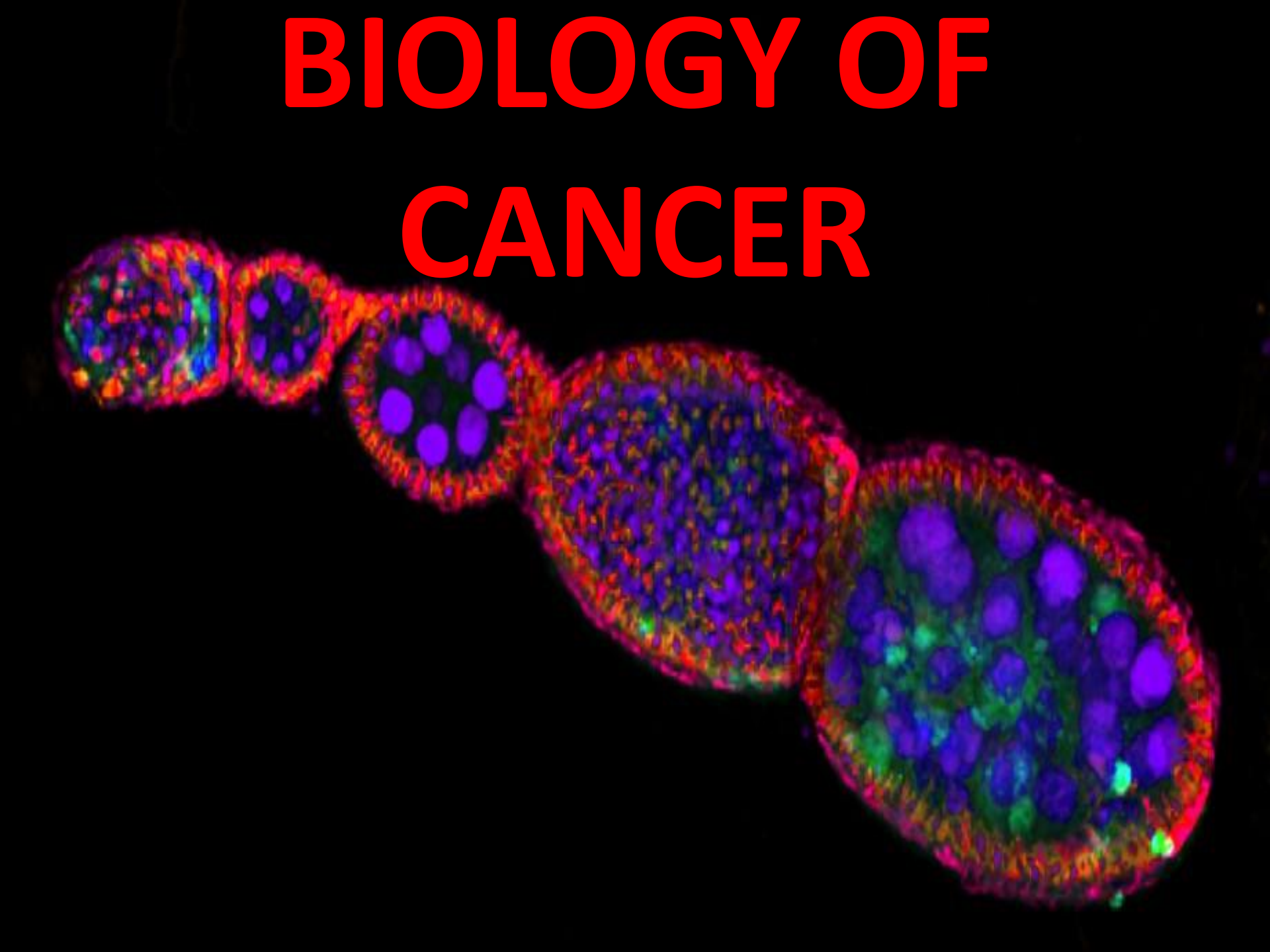
# Medical Biology

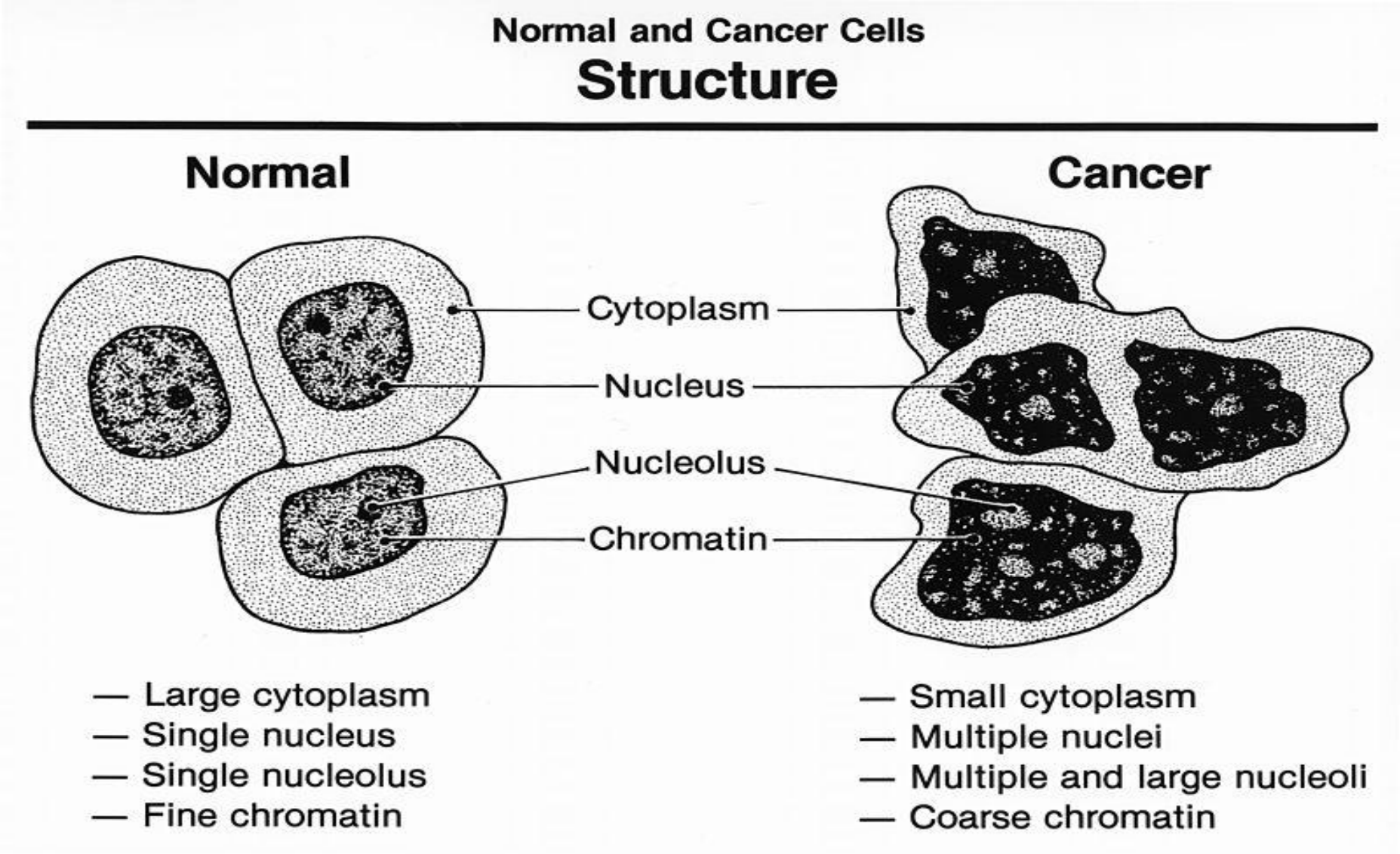
# BIOLOGY OF CANCER



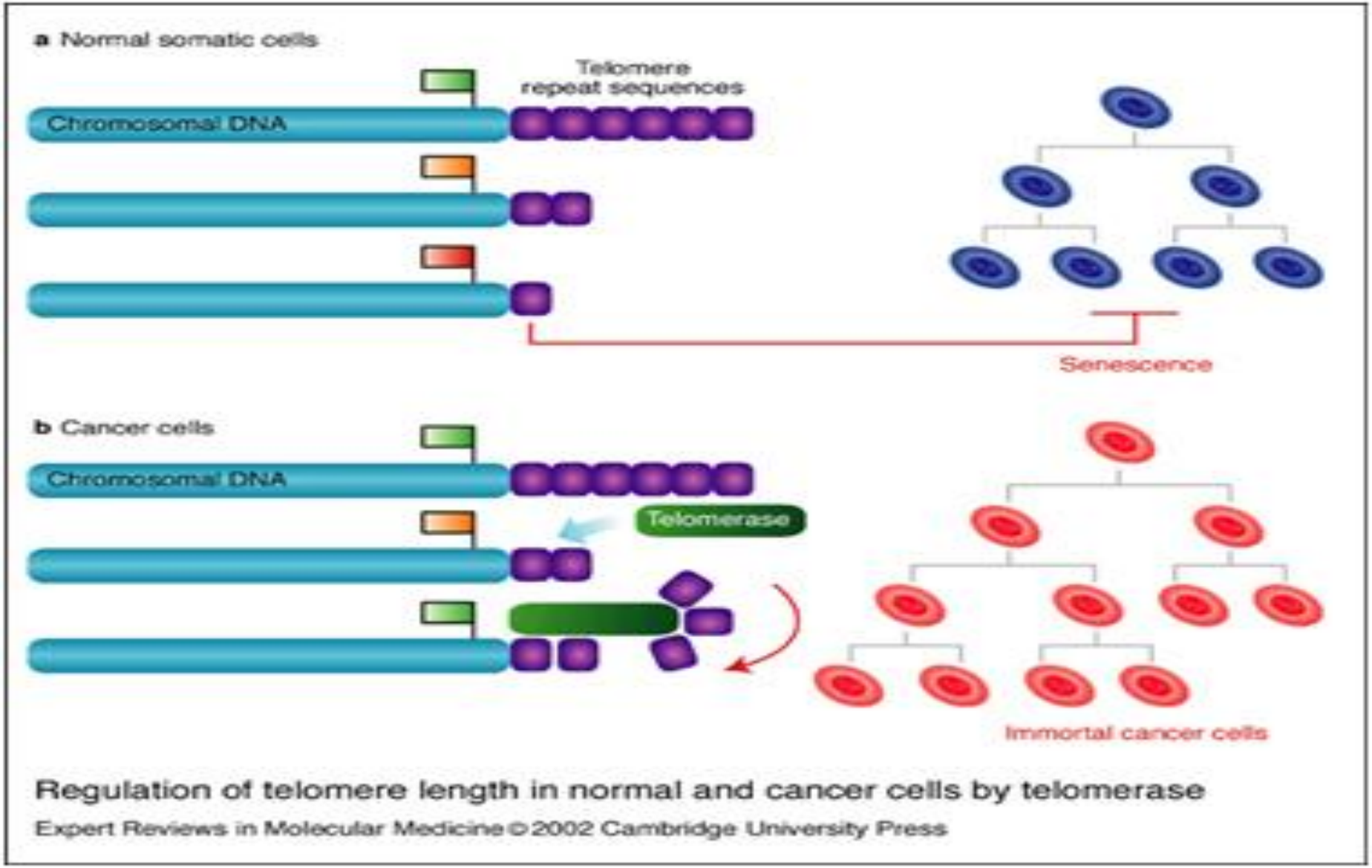
# Cancer is disease characterized by uncontrolled cell growth.

- Characteristics of Cancer Cells:
- 1) Lack of Differentiation
- Differentiation It is the process by which unspecialized cells acquire specialized structural and/or functional features that characterize the specialized cells.

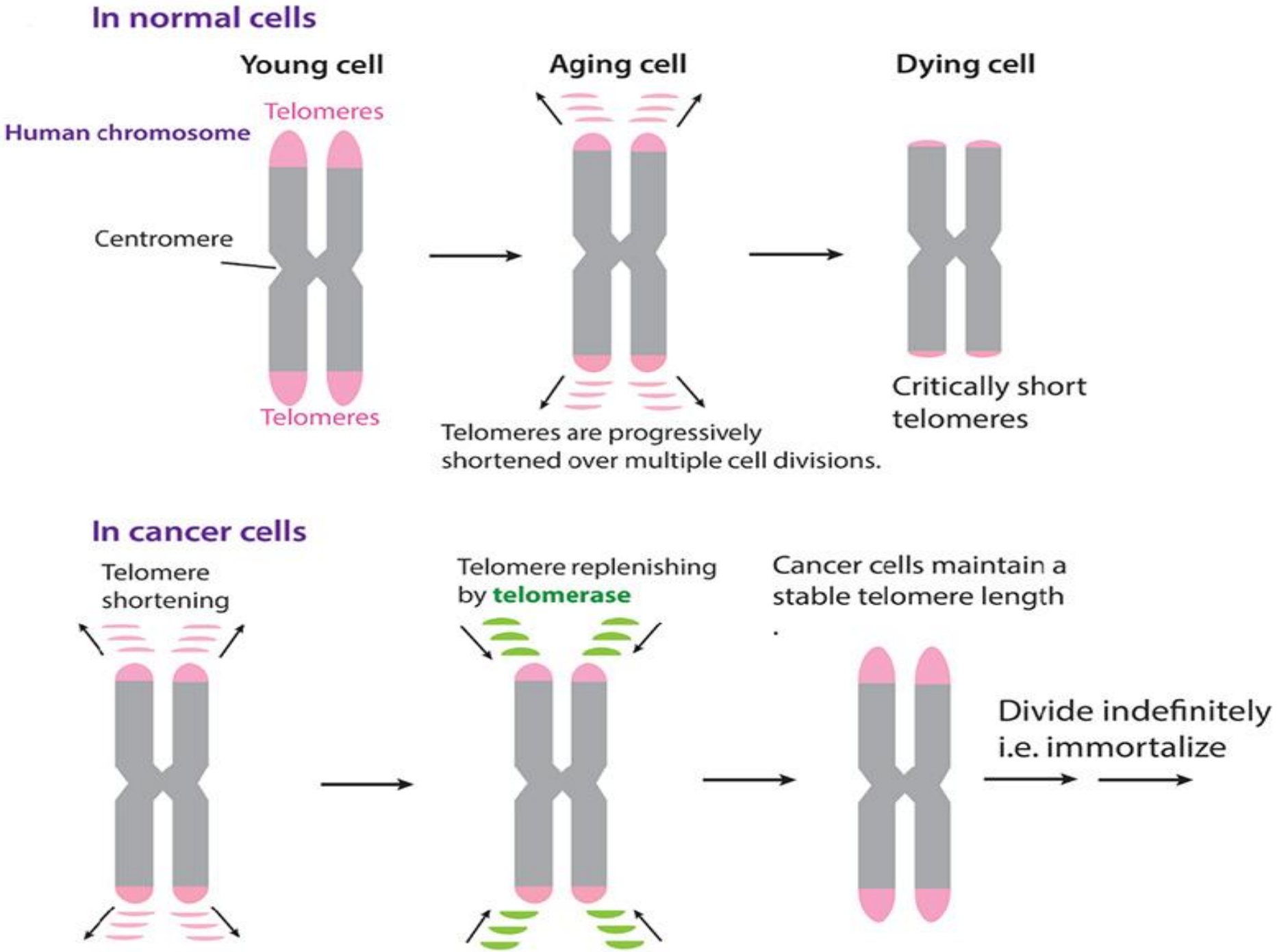
# 2) Abnormal Nuclei



# 3) Unlimited Replication Potential




Regulation of telomere length in normal and cancer cells by telomerase

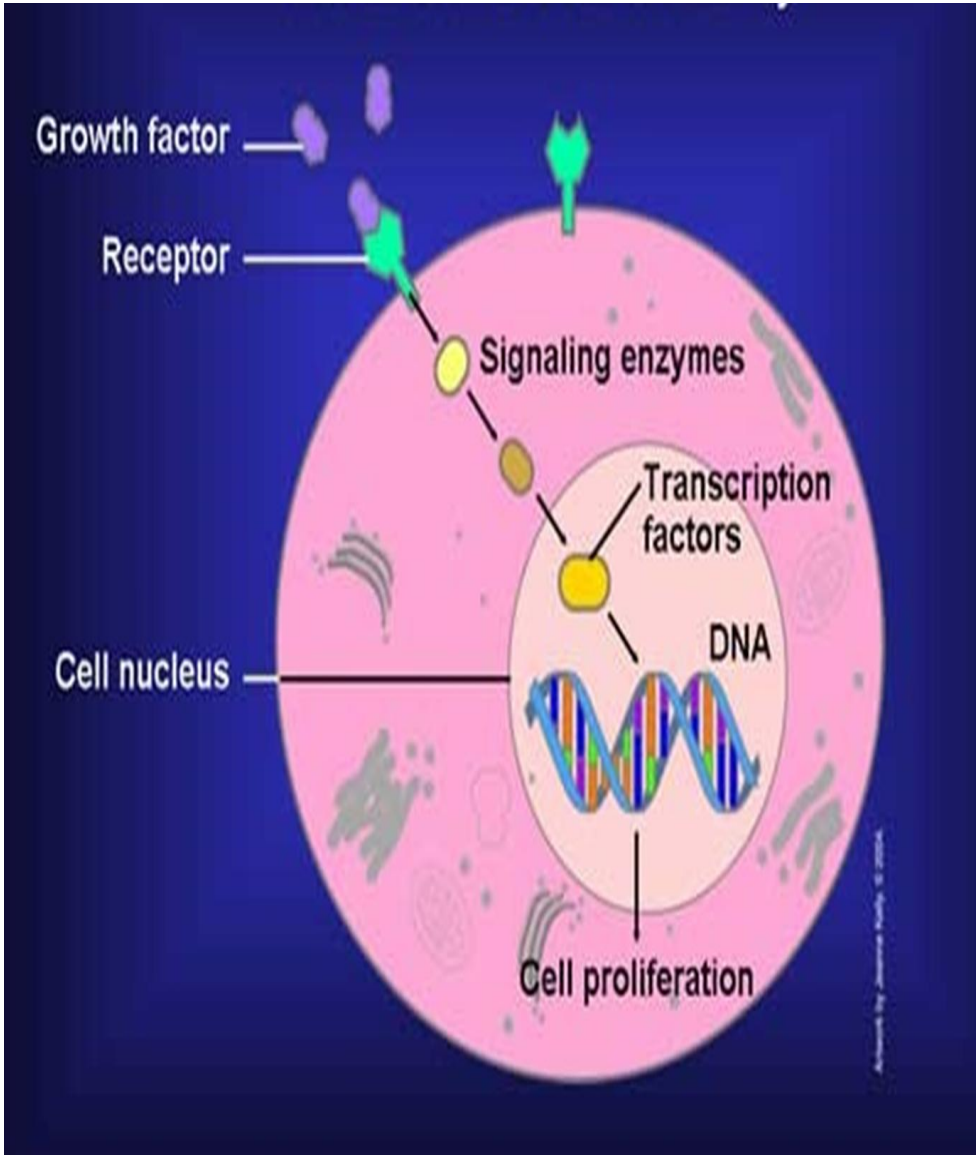

In normal cells
Young cell
Aging cell
Dying cell
Human chromosome
Telomeres
Centromere
Telomeres
Telomeres are progressively shortened over multiple cell divisions.
Critically short telomeres
In cancer cells
Telomere shortening
Telomere replenishing by telomerase
Cancer cells maintain a stable telomere length
.
Divide indefinitely i.e. immortalize

# 4) Tumours Formation

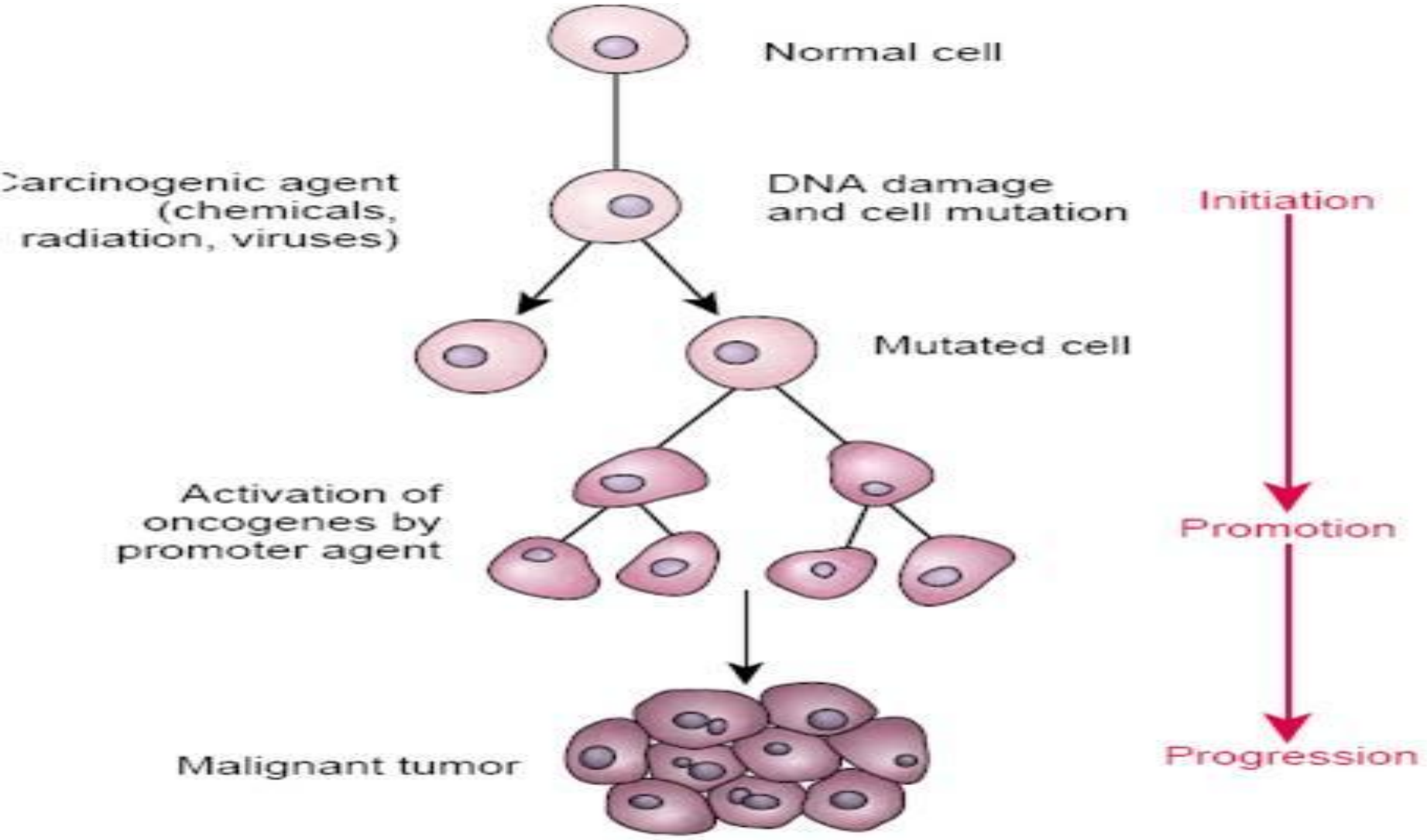
- *Contact inhibition*
- Cancer cells have lost all restraint. They pile on top of one another and grow in multiple layers, forming a tumour.

# 5) Disregard of Growth Factors

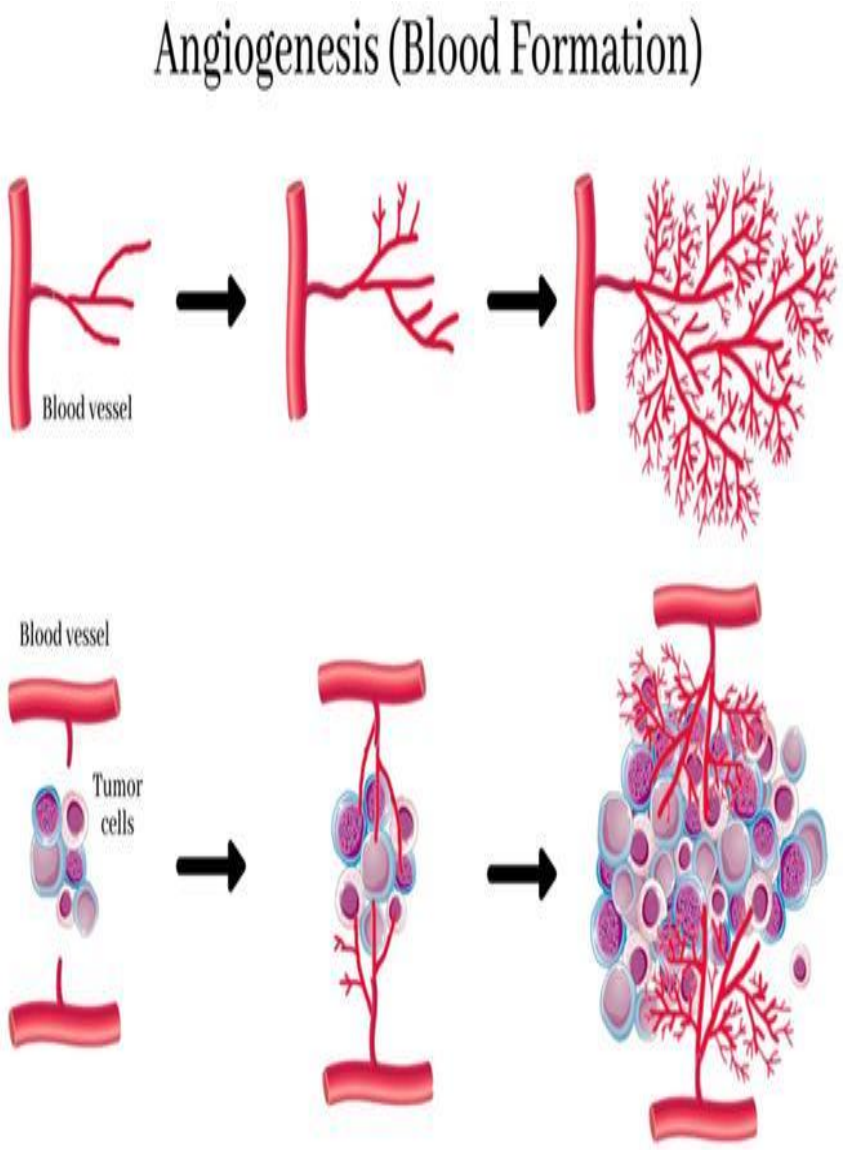
- Growth factors are chemical signals between cells that tell them whether or not they should be dividing.
- stimulatory growth factors and inhibitory growth factors.

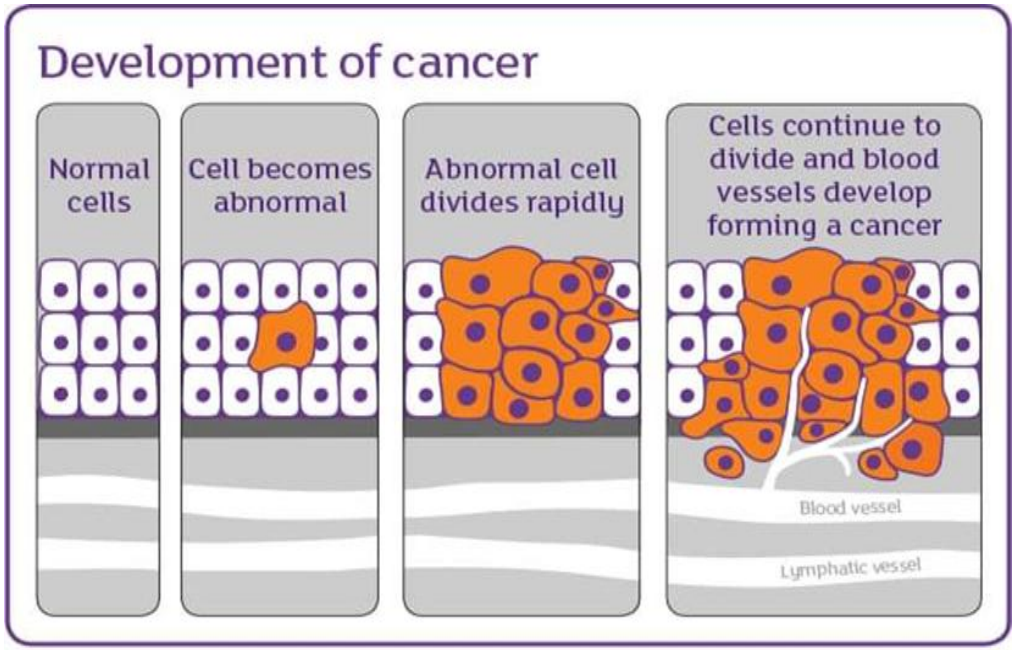


# 6) Cancer Cells Gradually Become Abnormal



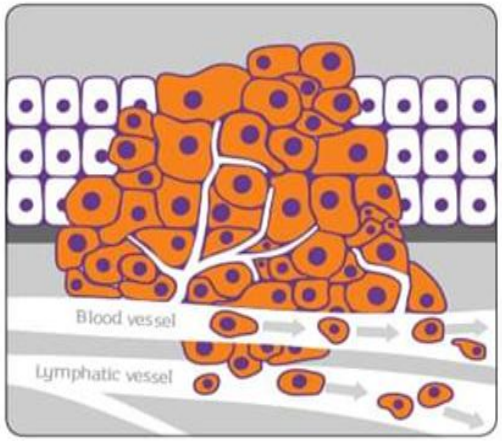
# 7) Angiogenesis and Metastasis



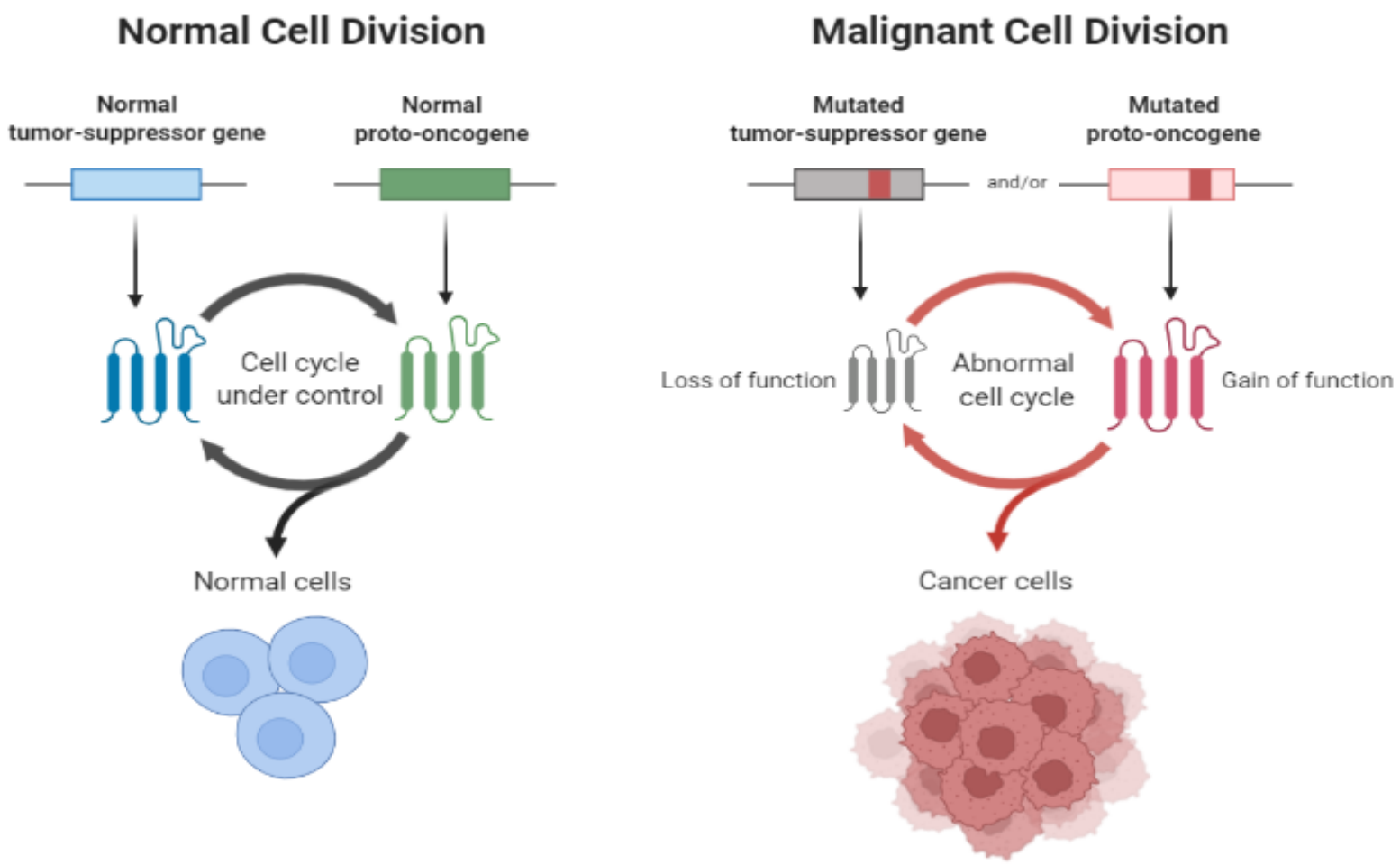




## Metastasis

In some cases, abnormal cancer cells spread to other parts of the body through blood or lymphatic vessels. This is called **metastasis**.



# Correlation between Gene Mutation & Cancer Development



# Mutation of Proto-Oncogenes

"gain-of function," or dominant

Cyclin D is a proto-oncogene that codes for cyclin directly. When this gene becomes an oncogene, cyclin is readily available all the time.

# Mutation of Tumor Suppressor Genes

- "loss-of-function," or recessive

## Tumor Suppressor Genes

**Tumor Suppressor Gene** = gene in normal cells

Mutation (e.g. Point Mutation) →

**Inact. Tumor Suppressor Gene** = new mutated gene (loss-of-function)

Function:
slowing down cell division,
DNA repair machinery

-> promotes cancer

**p53, activates DNA repair enzymes. At the same time, p53 turns on genes that stop the cell cycle from proceeding.**

**p53** – "Guardian of the genome"


Cell is no longer able to produce p53

-> **no** DNA repair, **no** apoptosis of damaged cells and **no** cell cycle arrest
-> p53 mutation in 50% of human cancers

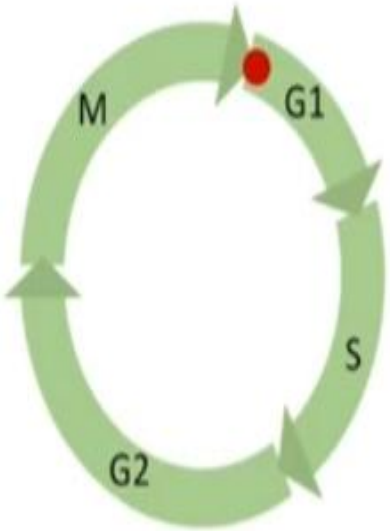
- **The BRCA1 gene codes for another DNA repair enzyme, it works very closely with the p53 protein. BRCA1 mutations prevent the body from recognizing DNA damage, allowing the cells to progress through the cell cycle unchecked. BRCA1 mutations are associated with a number of cancers, including breast cancer.**

# Oncogenes

At first Proto Oncogenes
(promote cell cycle)

Gain-of-function mutation

Accelaration of the cell cycle




# Tumor Suppressor Genes

At first genes that slow down cell cycle

Loss-of-function mutation

no repair DNA, no inititation of apoptosis, no cell cycle arrest

-> uncontrolled cell proliferation


Thank you!