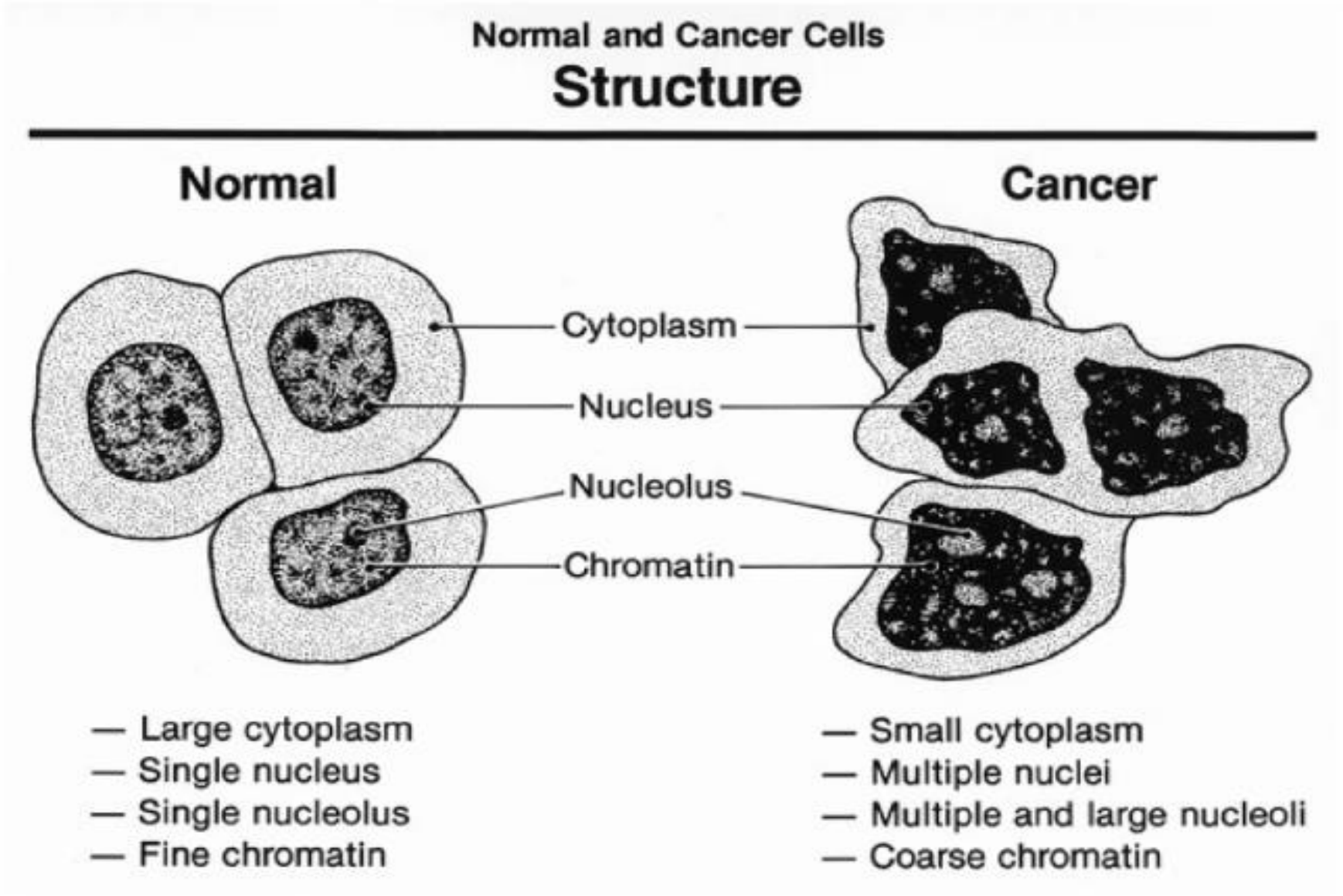
Tumour: Types and Causes



- Cell division is one of the most fundamental processes of all living things.
- The cell cycle control system ensures that cells divide only when needed, so as to maintain the correct shape, size of organs and tissues.
- Cancer is an abnormal growth of cells caused by multiple changes in gene expression leading to deregulated balance in cell proliferation and cell death and ultimately evolving into a population of cells that can invade tissues and metastasize to distant sites.
- For a cell to become cancerous, multiple mutations or a change in different set of genes is required which together allow the normal cell to escape regular control mechanisms.

- Genes involved in tumourigenesis include:

  -Proto-oncogenes

  - Oncogenes

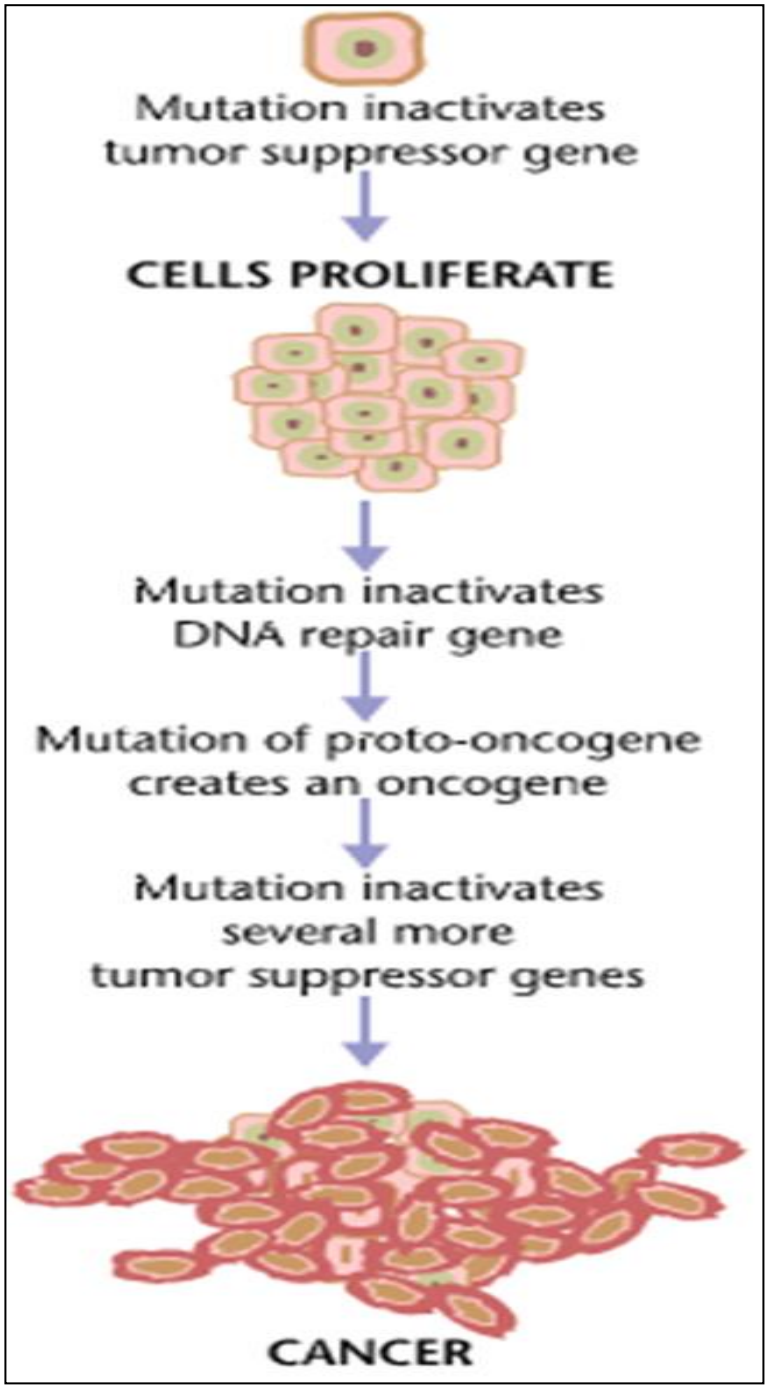
  -Tumor suppressor genes

  -Genes regulating apoptosis

  -DNA repair genes

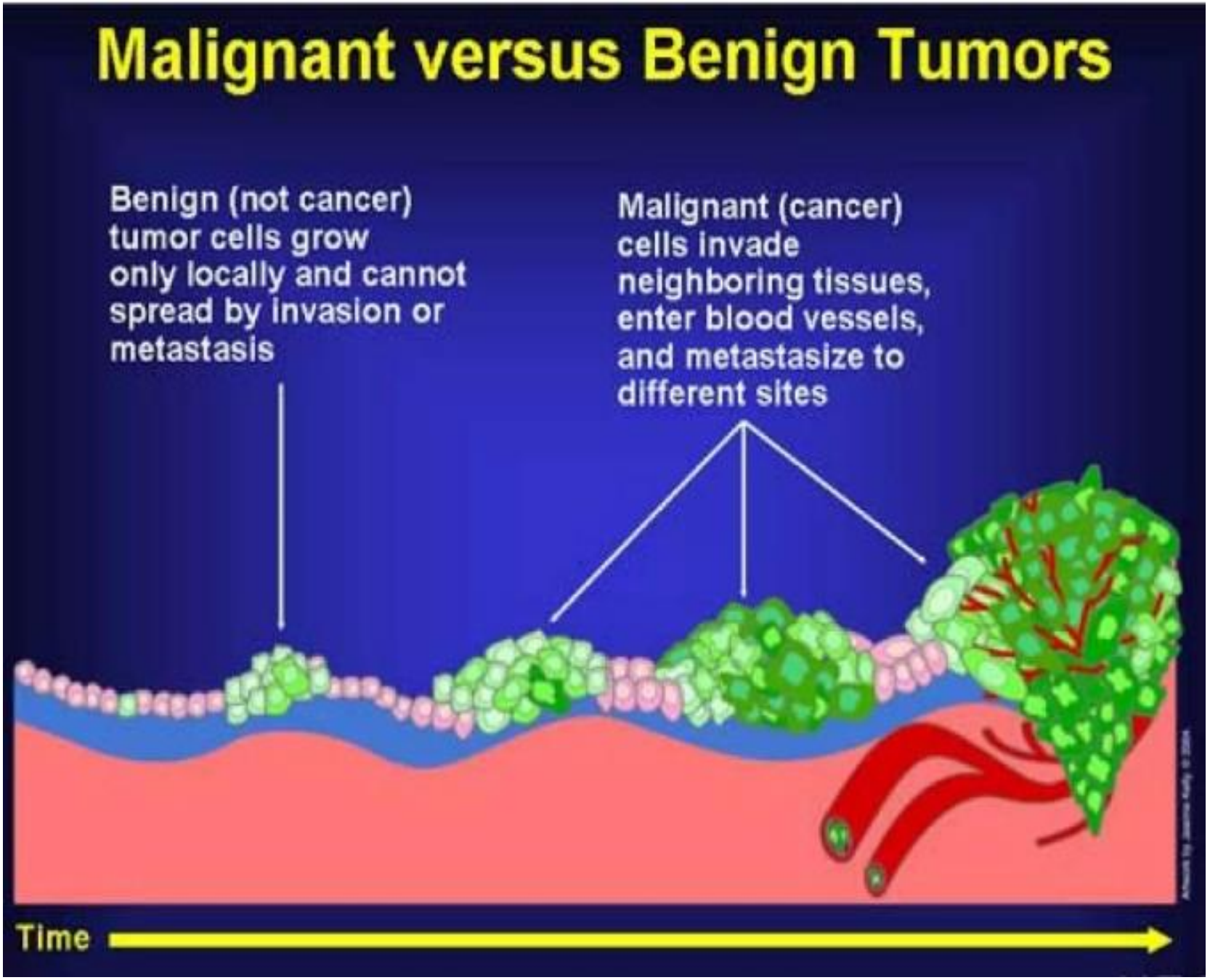
- Proto-oncogenes encode proteins that are involved in the control of cell growth. Alteration in the structure and/or expression of proto-oncogenes can activate them to become oncogenes which are involved in the expression of malignancy.
- Tumor suppressor genes normally act as cell's brake by encoding proteins that inhibit cell growth, preventing tumor formation. Mutations in these genes result in a loss of function of one or more tumor suppressor genes making them inactive, hence, cells no longer show normal inhibition of growth and division.

- Substances/agents that causes cancer are called carcinogens. These include: radiation e.g. UV-rays, X-rays, gamma radiation, etc.; chemicals e.g. benzo(a)pyrene, aflatoxin, benzene, dimethylnitrosamine, etc.; and viruses such as Hepatitis B and C viruses.
- For a cell to become cancerous, multiple mutations or changes in many genes are required which together allow the cell to escape normal control mechanisms which usually result from mutations in genes that regulate cell division.



- Cells that inherit the tendency to proliferate without responding to regulation and expand indefinitely to develop as a lump, which is commonly referred to as a tumor.
- Defects in the synthesis, regulation or recognition of growth factors may also be involved in developing a tumor.
- Tumors are of two types, the slowly growing '**benign**' and the rapidly growing '**malignant**' forms (Vincent, 1985).
- Benign tumors do not grow in an unlimited or aggressive manner and do not show invasiveness and metastasis.
- A malignant tumor on the other hand is atypical in tissue structure, grows rapidly and does not remain encapsulated; displays many abnormal nuclear divisions and chromosomes and invades the surrounding tissues shedding cells that have the ability to colonize new sites.
- Cancer is defined as a malignant neoplasm.

Malignant versus Benign Tumors



benign tumors

- benign tumors are generally slow growing
- depending upon the location, may retain asymptomatic or may produce serious symptoms

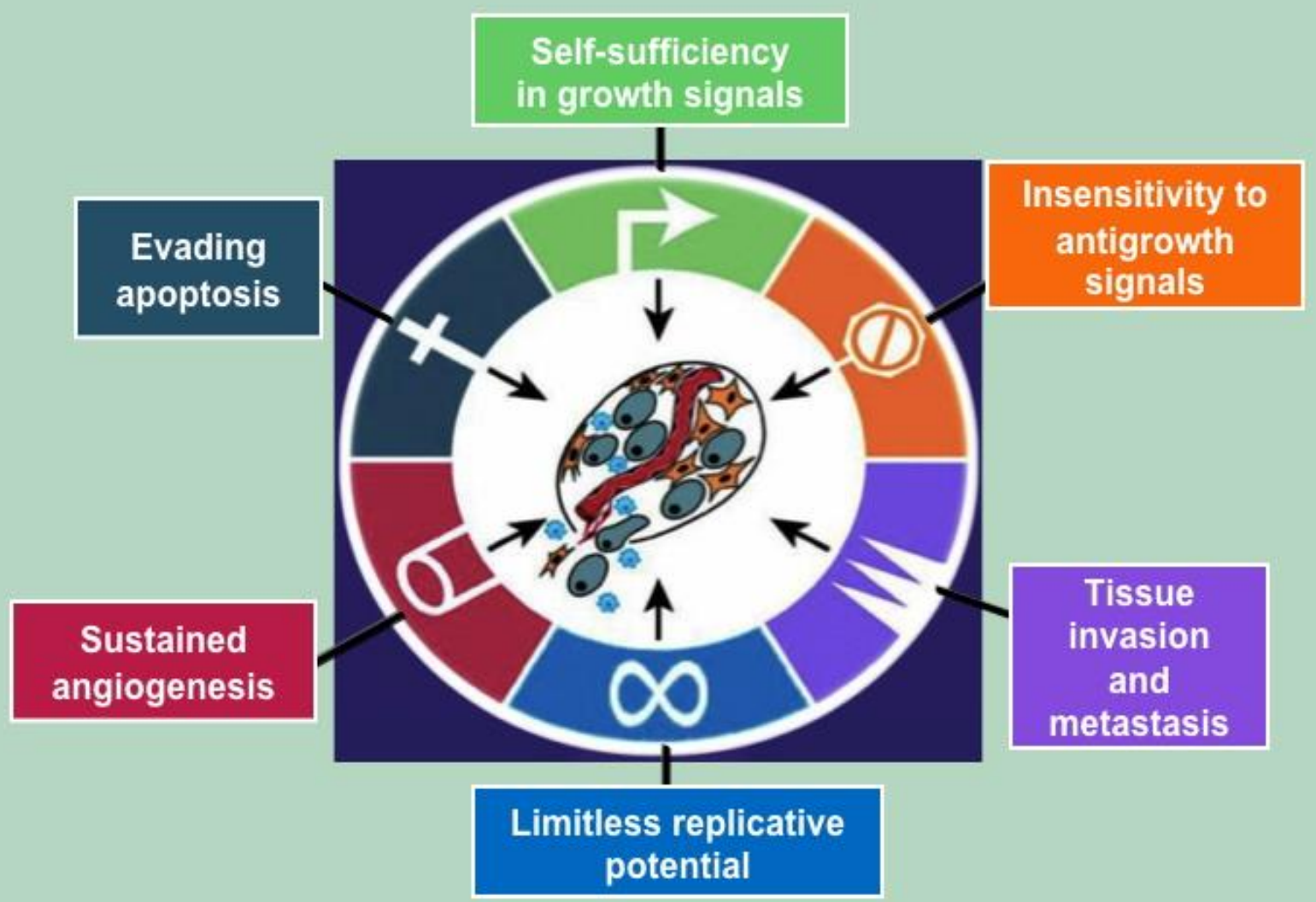
malignant tumors

- grow rapidly
- may ulcerate on the surface
- invade locally into deeper tissues
- may spread to distant sites (metastasis)
- also produce systemic features as such as weight loss, anorexia and anemia.
- two of the cardinal clinical features of malignant tumors are: Invasiveness and metastasis.

- generally spherical or ovoid
- encapsulated or well-circumscribed
- freely movable
- more often firm and uniform, unless secondary changes like hemorrhage or infarction supervene.

- usually irregular in shape
- poorly-circumscribed and extended in to the adjacent tissues. Secondary changes like hemorrhage, infraction and ulceration are seen more often.

The Hallmarks of Cancer



Hanahan & Weinberg, Cell 2000.

Classification of cancer

- **Carcinomas-** Cancers of epithelial cells of ectodermal or endodermal origin; the skin and inner membrane surfaces of the body, glands. Carcinomas account for approximately 80-85 % of human cancers.
- **Sarcomas-** Cancers arising from connective tissue (i.e., bone, cartilage, fat, nerve), each of which develop from cells originating in mesenchymal cells outside the bone marrow. They constitute only about 5 % of human cancers.
- **Lymphomas/Leukemia's-** Cancers arising from haematopoietic cells that leave the marrow and tend to mature in the lymph nodes and blood, respectively. They constitute about 10 % of human cancers.

Cancer therapy

- **Surgery**- Surgery is the most effective and fastest treatment for tumors and can lead to a permanent recovery.
- **Radiotherapy**- It is also called as X-ray therapy, radiation therapy or irradiation therapy uses ionizing radiation to kill cancer cells and shrink tumors.
- **Hormone therapy**- This is generally used after surgery to prevent the production of hormones related to some cancer.
- **Chemotherapy**- It is an effective treatment against cancers either singly or in combination with surgery and/or radiotherapy. Some clinically used common cancer chemotherapeutic drugs include cisplatin, doxorubicin, carmustine, chlorambucil, cyclophosphamide, 5-fluro-uracil, melphalan, carboplatin, mitomycin C, gemcitabine, etc., (Black and Livingston, 1990).