**What is Cancer?**

* **Uncontrolled growth**
* **Neoplasm** (a new and abnormal growth of tissue in some part of the body, especially as a characteristic of cancer.)
* Tumours can be either **benign** (non-cancerous) or **malignant** (cancerous).
* Benign tumour cells **stay in one place**, do not spread usually not life-threatening.
* Malignant tumour cells are able to **invade** **nearby tissues** and spread to other parts of the body (**metastases**).
* malignant tumors consist of **undifferentiated**, or unspecialized, cells that show an atypical cell structure and do not function like the normal cells from the organ from which they derive.
* **lack contact inhibition**; cancer cells growing in laboratory tissue culture do not stop growing when they touch each other on a glass or other solid surface but grow in masses several layers deep.
* secondary effects, pressure on surrounding tissue
* **telomerase**, an enzyme that alters the telomere gene and allows the cell to continue to divide.
* competes with normal tissue for nutrients, eventually killing normal cells by nutritional deprivation.



Cancer cells behave differently from normal cells because they **don’t**:

* stop dividing
* obey signals from other normal cells
* stick together very well and can spread to other parts of the body
* specialize into mature cells (differentiate) but stay immature

Cancer cells usually can’t enter G0 and therefore begin to divide uncontrollably.



A – asymmetry

B – border irregularity

C – colour

D – diameter



**Main Categories** named for site of origin

* **Carcinoma** – begins in the skin or in tissues that line or cover internal organs.
* **Adenocarcinoma**, basal cell carcinoma, squamous cell carcinoma, and transitional cell carcinoma
* **Sarcoma** – begins in the connective or supportive tissues such as bone, cartilage, fat, muscle, or blood vessels
* **Leukaemia** – starts in blood forming tissue such as the bone marrow and causes large numbers of abnormal blood cells to be produced and go into the blood
* **Lymphoma and myeloma** – begin in the cells of the immune system

lung cancer that has spread to the brain is called metastatic lung cancer,

Carcinoma *in situ* refers to a cancer that has not spread.

**Most Common Causes of Cancer**

**Cumulative**

* **gene mutation**
	+ **inherited** or **acquired (**caused by **repeated** exposure **carcinogens)**:
* **Smoking**
* **Diet** - high fat, low fibre diet, lacking in fruits and veg (antioxidants)
* excessive **alcohol** consumption
* **Radiation** - leukemia in Hiroshima and Nagasaki
	+ - thyroid cancer after the Chernobyl nuclear disaster
		- **ultraviolet radiation** of sunlight.
* **Chemicals** from occupational hazards.
	+ asbestos 🡪lung and colon cancer

**Susceptibilities**

* dose of carcinogens
* biologic susceptibility:
	+ age,
	+ sex,
	+ immune status,
	+ nutritional status,
	+ genetics - 5% thought to be inherited genetic mutations.
	+ BRCA1 and BRCA2 genes that increase breast cancer risk and the
	+ HNPCC gene that is linked with colon cancer
	+ ethnicity - African Americans have comparatively higher cancer rates and cancer mortality rates.

**Types of cancer genes (3)** the main causes of cancer-related mutations,

which may make them more likely to develop a particular type of cancer.

### **Oncogenes**

* damaged versions of normal genes called **proto-oncogenes**,
* activated by a mutagen
* Most normal cells will undergo a programmed form of rapid cell death (apoptosis) when critical functions are altered.
* Activated oncogenes cause those cells designated for apoptosis to survive and proliferate instead
* Oncogenes produce growth factors, signalling cell to grow and divide

### **Tumour suppressor genes**

* genes that normally protect against cancer
* Eg. p16, p53, and BRCA1 genes normally produce a negative growth factor that tells a cell when to stop dividing.
* If they get damaged, cell growth, cell division and cell death (apoptosis) may not be controlled.
* **TP53** is a tumour suppressor gene that triggers cell death, commonly damaged or missing in many types of cancer.

### **DNA repair genes**

* responsible for repairing damaged genes.
* fix mistakes (mutations) that commonly occur when DNA is being copied.
* When damaged, mutations may not be repaired and **will build up**.
* may also be considered a type of tumour suppressor gene.

**Tumor development**

* There is usually a **latency period** of years or decades between exposure to a carcinogen and the appearance of cancer.
* **Initiation**
	+ gene mutations
	+ translocations
		- cell must spot these mutations and either fix them or undergo
		- failure to do so may result in cancer
	+ ***Initiators*** - carcinogens, such as chemicals, smoking or radiation
* **Promotion**
	+ Further and repeated damage needs to occur before cancer develops.
	+ **Promoters** (hormones or some drugs)
	+ repeated insults eventually result in mutations or **altered gene** **expression** in oncogenes and tumor-suppressor genes
* **Progression**
	+ The change (**transformation**) in a normal cell causes it to behave, grow and function differently and turn into a cancer cell.
	+ Cell keeps growing and reproducing itself.
* some develop their own blood vessels (**angiogenesis**) and begin to grow and spread

**Staging**

* based on **location** of the **primary** tumor, **size**, number, **spread** to nearby lymph nodes.

**Tumour Grading**

* Based on appearance and behavior
* **Well-differentiated** - look and behave like the normal
	+ slow growing and less aggressive.
* **Undifferentiated** or **poorly differentiated** - look and behave quite differently from normal cells in the tissue they started to grow in.
	+ look immature or undeveloped
	+ often do not resemble the tissue of origin at all.
* depends on the type of cancer.
* 1, 2, 3, or 4, depending on the amount of abnormality.
* Grade 1 tumors, cells and the organization appear close to normal.
	+ grow and spread slowly.
* Grade 3 and Grade 4 tumors do not look like normal cells and tissue.
	+ grow rapidly and spread faster than tumors with a lower grade.

Grading an Unspecified tumor:

* GX: Grade cannot be assessed (undetermined grade)
* G1: Well differentiated (low grade)
* G2: Moderately differentiated (intermediate grade)
* G3: Poorly differentiated (high grade)
* G4: undifferentiated (high grade)