

Micro160Lec 3: What is Cancer?



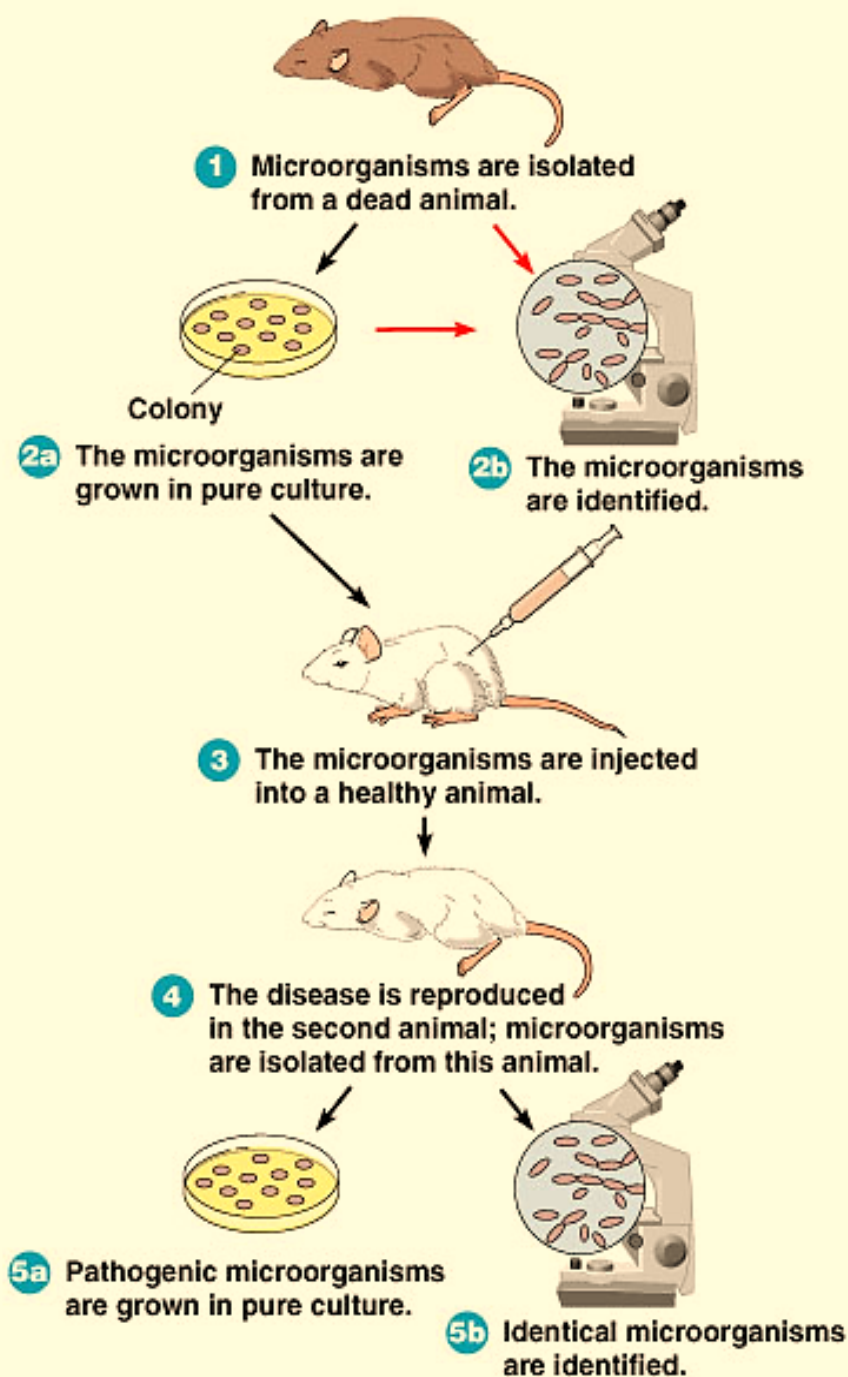
Crown gall- Bacterial infection leads to tumor : Plant cancer

Biology of Cancer and AIDS

Koch's Postulates

In 1876 Robert Koch provided definitive proof of the germ theory by isolating the cause of anthrax. From this came the development of Koch's Postulates, a set of rules for the assignment of a microbe as the cause of a disease.

1. Microorganism must be observed in every case of the disease
2. The pathogen must be isolated and grown in a pure culture
3. The pure cultures must cause the disease when inoculated into new host
4. The same pathogen must be recovered.

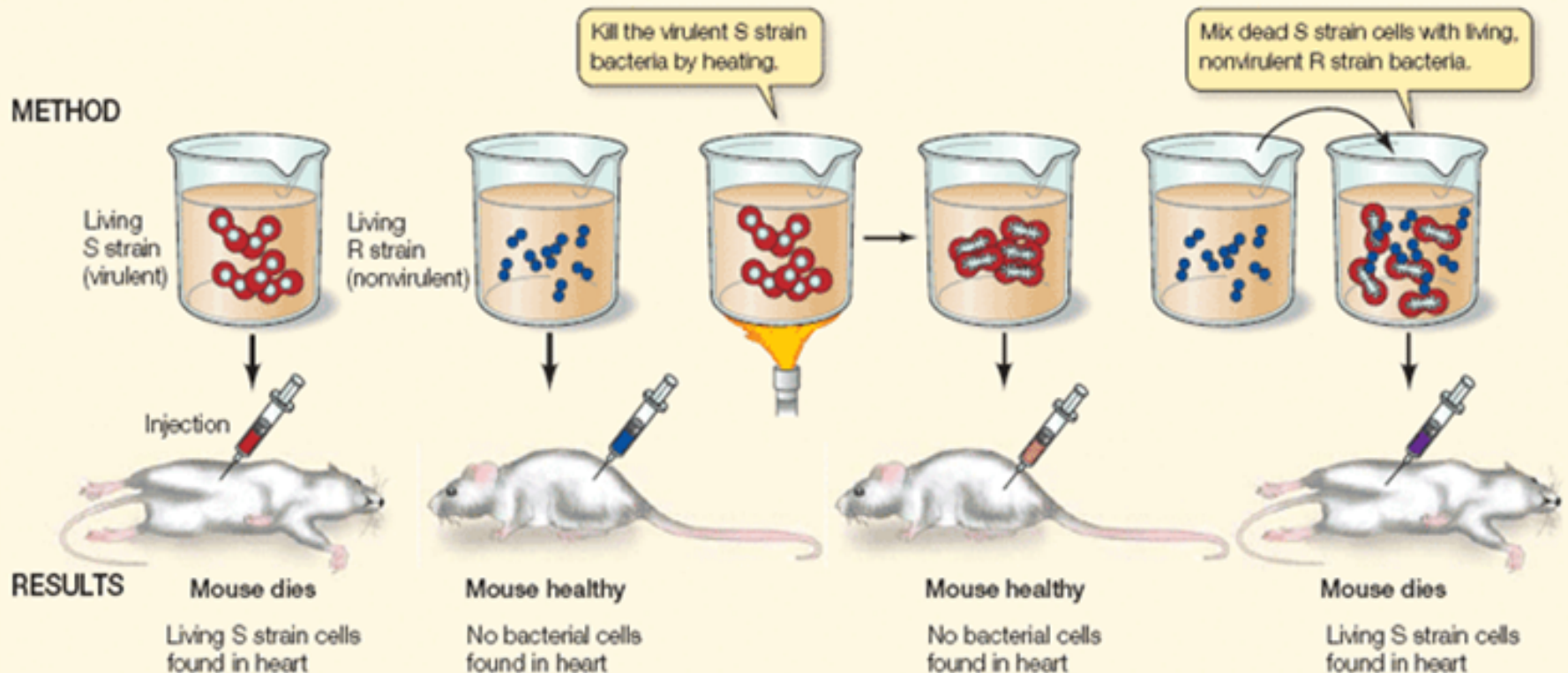


Griffith's Transforming Factor

EXPERIMENT

HYPOTHESIS: Material in dead bacterial cells can genetically transform living bacterial cells.

METHOD

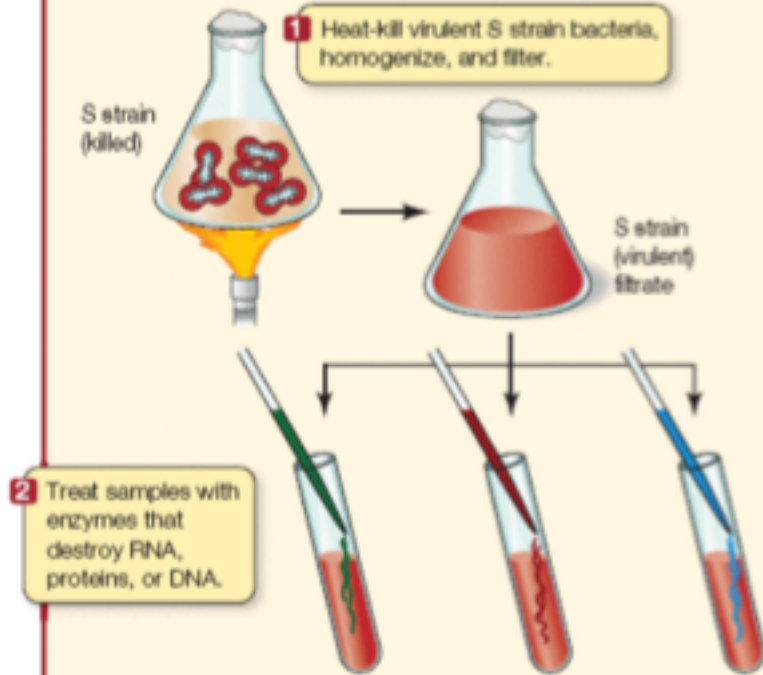


CONCLUSION: A chemical substance from one cell is capable of genetically transforming another cell.

EXPERIMENT

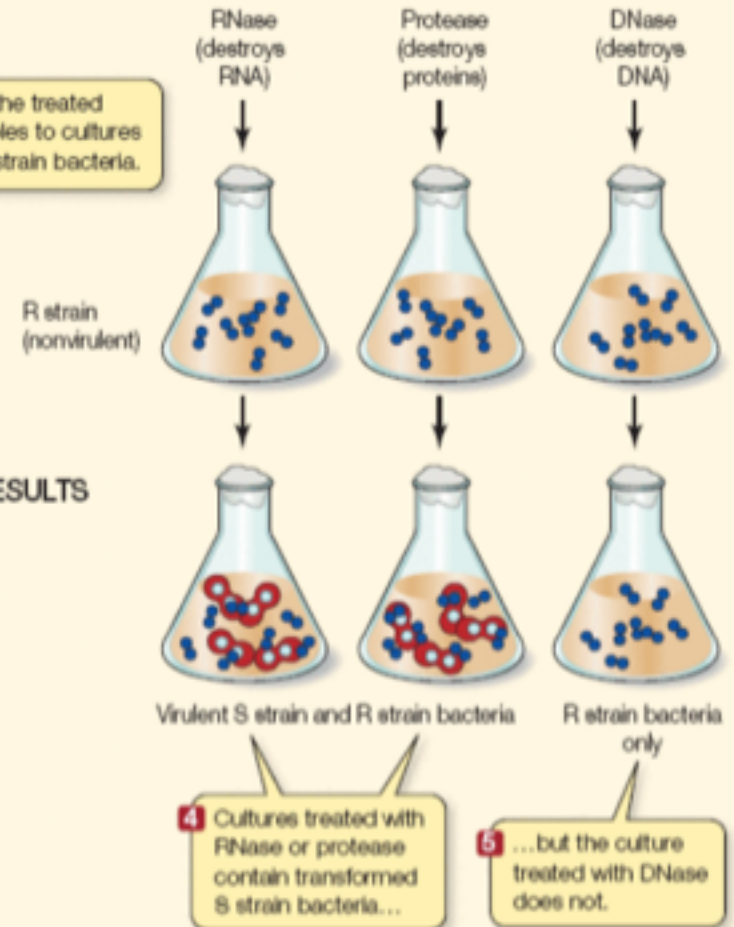
HYPOTHESIS: The chemical nature of the transforming substance from pneumococcus is DNA.

METHOD



Add the treated samples to cultures of R strain bacteria.

RESULTS



CONCLUSION: Because only DNase destroyed the transforming substance, the transforming substance is DNA.

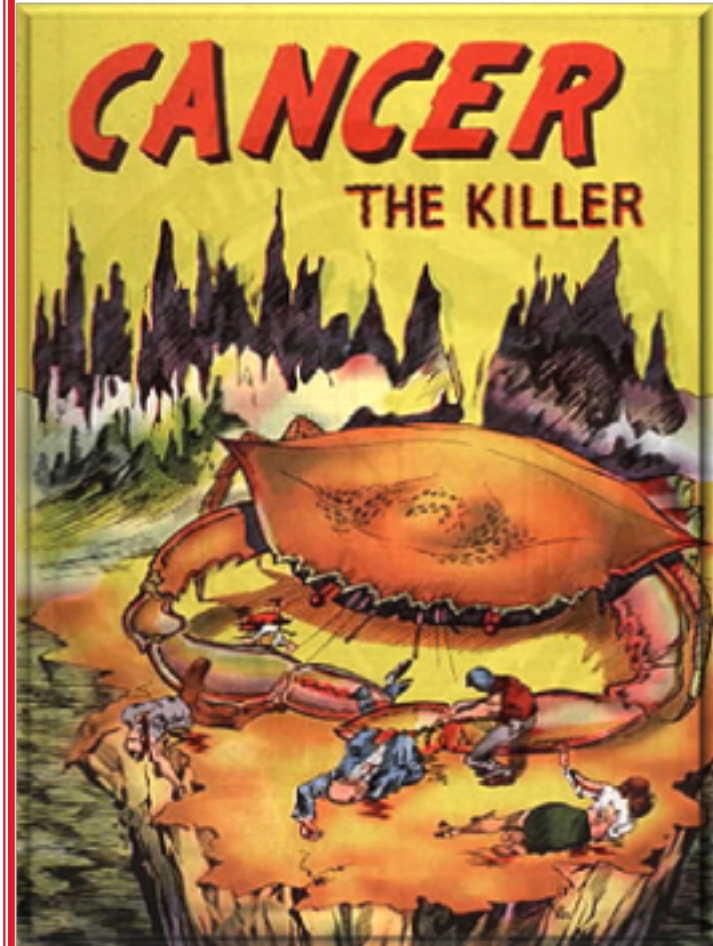
Cancer



Breast cancer in a mastectomy specimen (Left). The cancerous tumor (pale yellow) resembles the figure of a crab, giving the disease its name.

Characteristics of Cancer

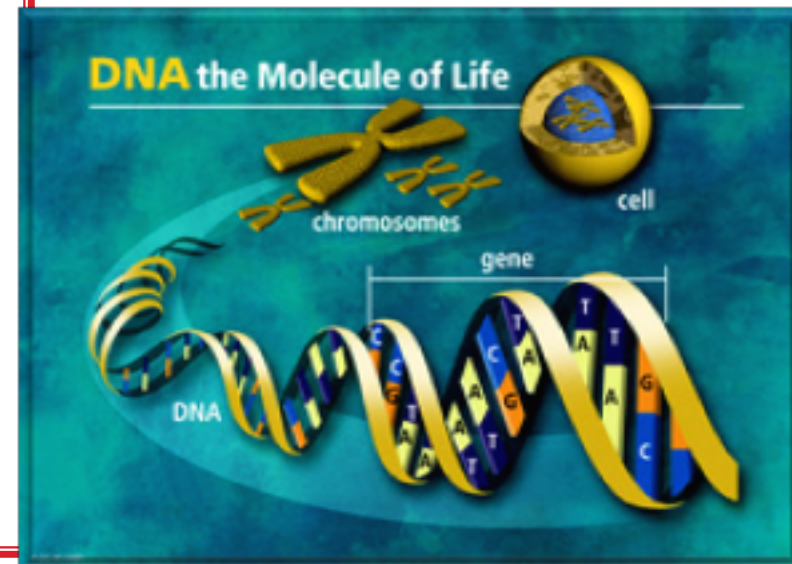
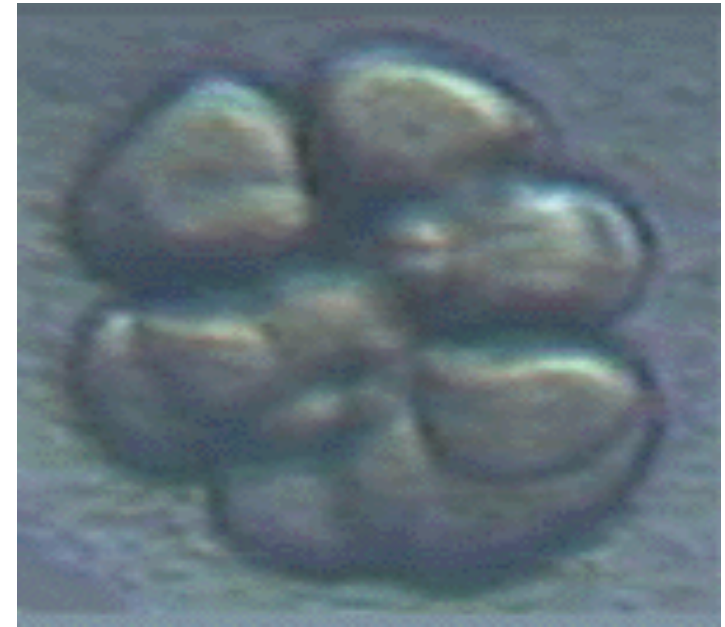
- ❑ Recognized by Egyptians (4–5K yrs)
- ❑ Hippocrates is credited with being the first to recognize the difference between **benign** and **malignant** tumors
- ❑ The swollen blood vessels around the malignant tumors reminded him of crab claws, so he called the disease karkinos (the Greek name for crab)
- ❑ “Cancer” is an **umbrella term** that refers to over 200 diseases that share two common characteristics:
 - 1). **An uncontrolled growth of cells**
 - 2). **The ability to invade and damage normal tissues either locally or at distant sites in the body**



Courtesy: National Library of Medicine.

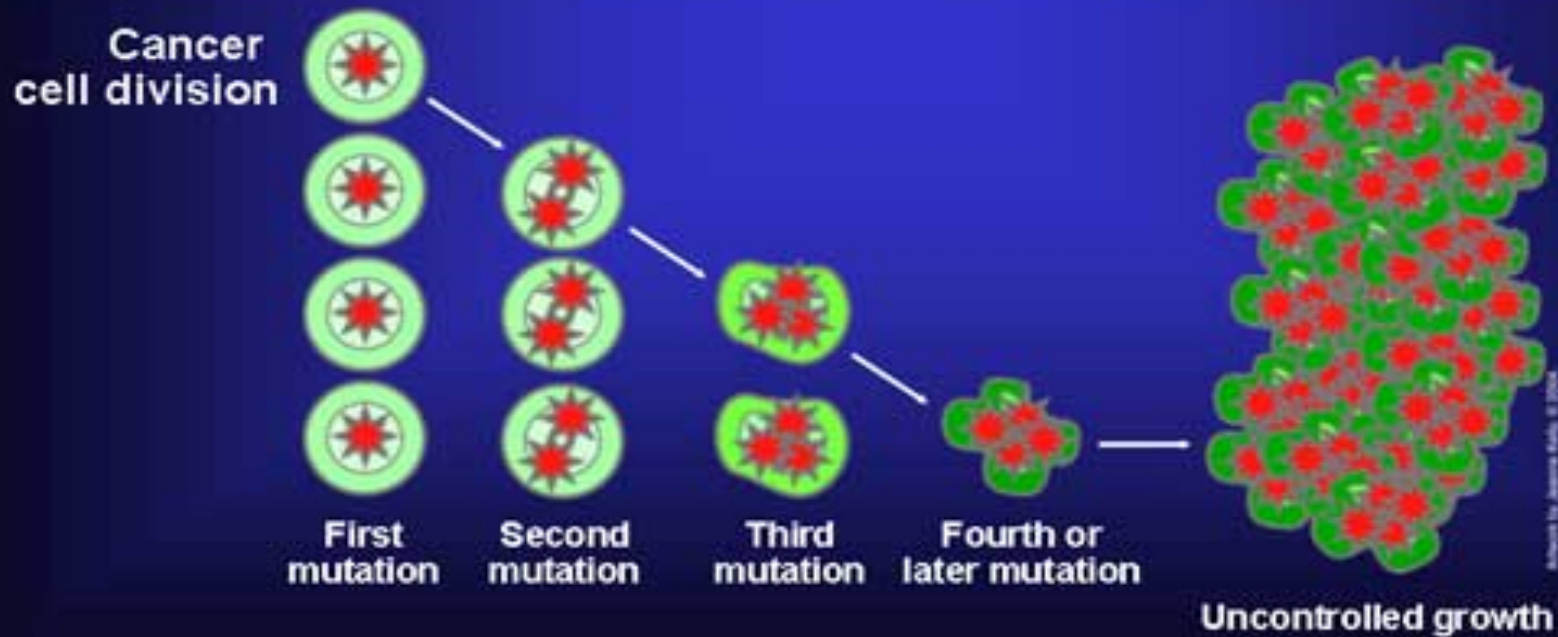
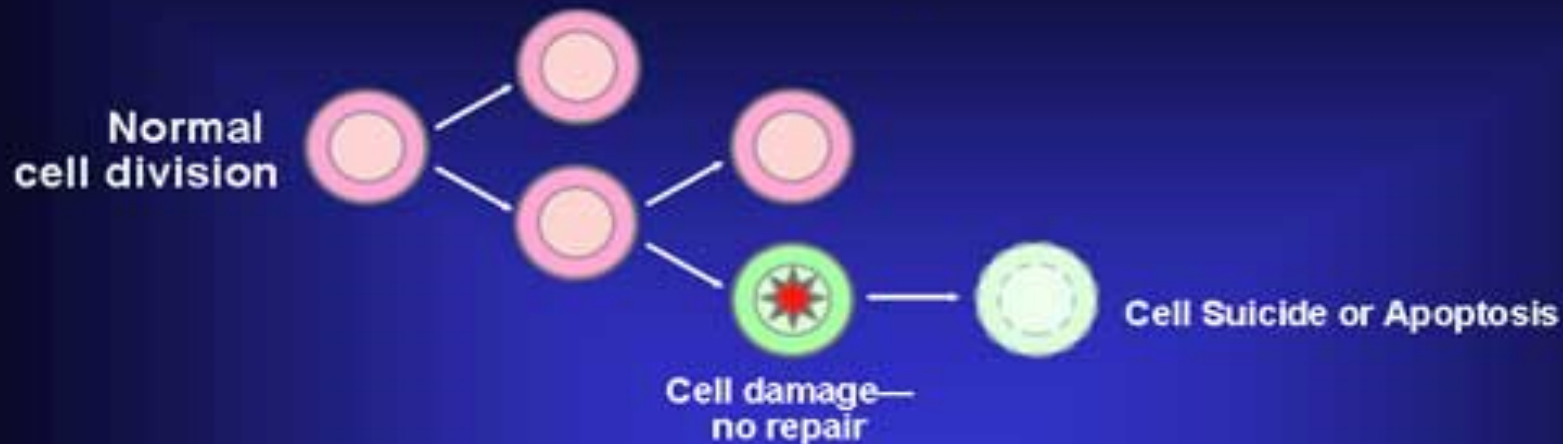
How Cancer Develops

- ❑ The body is made up of hundreds of different types of cells, which behave differently.
- ❑ Same genetic information (DNA) but performs completely separate roles.
- ❑ The life of each cell is mapped out in advance by coded instructions (genes) in its nucleus
- ❑ When the instructions relating to cell multiplication and dying are wrong, the cell may start dividing uncontrollably, and not die when it should.



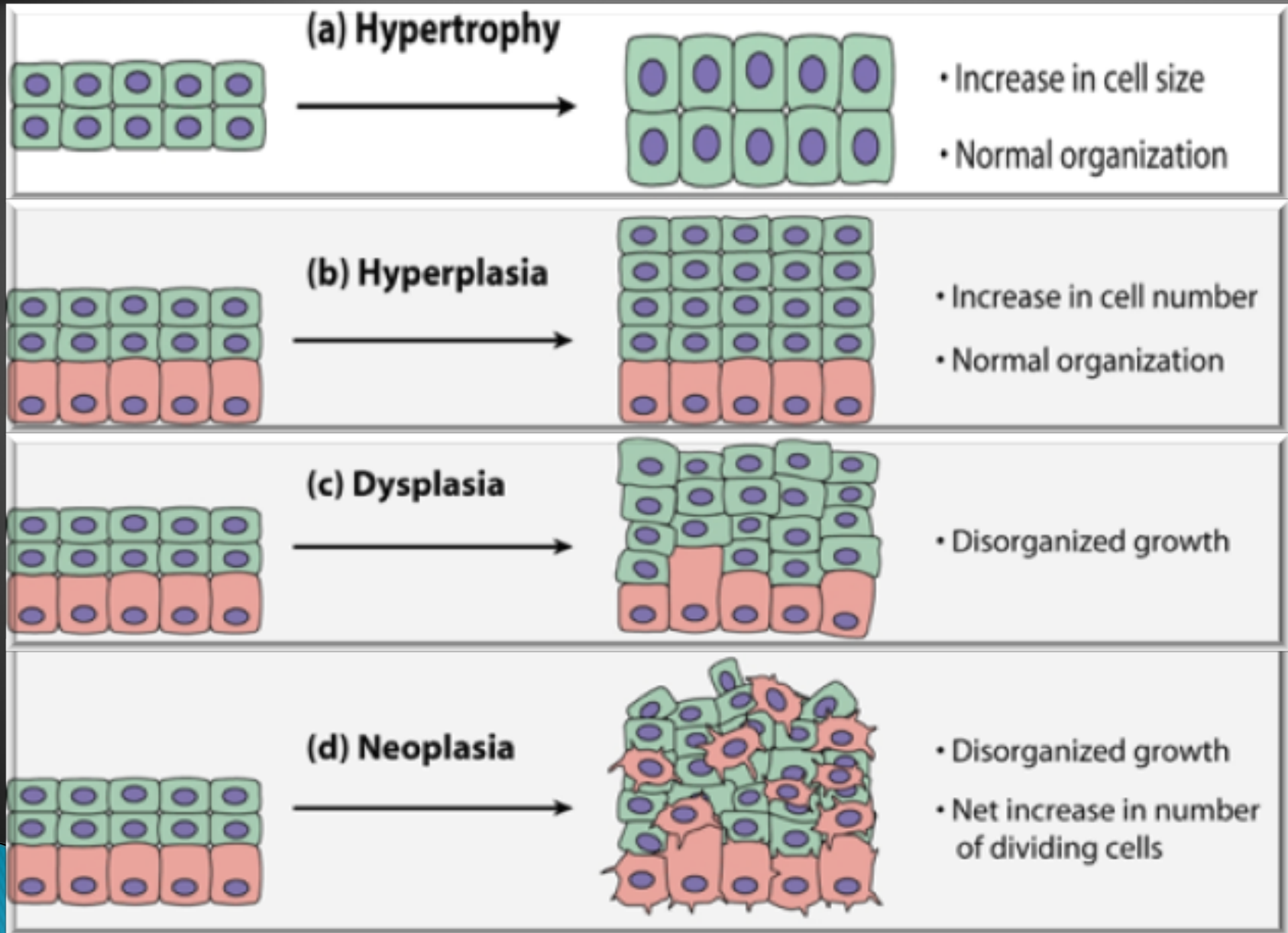
How Does Cancer Develop?

Loss of Normal Growth Control



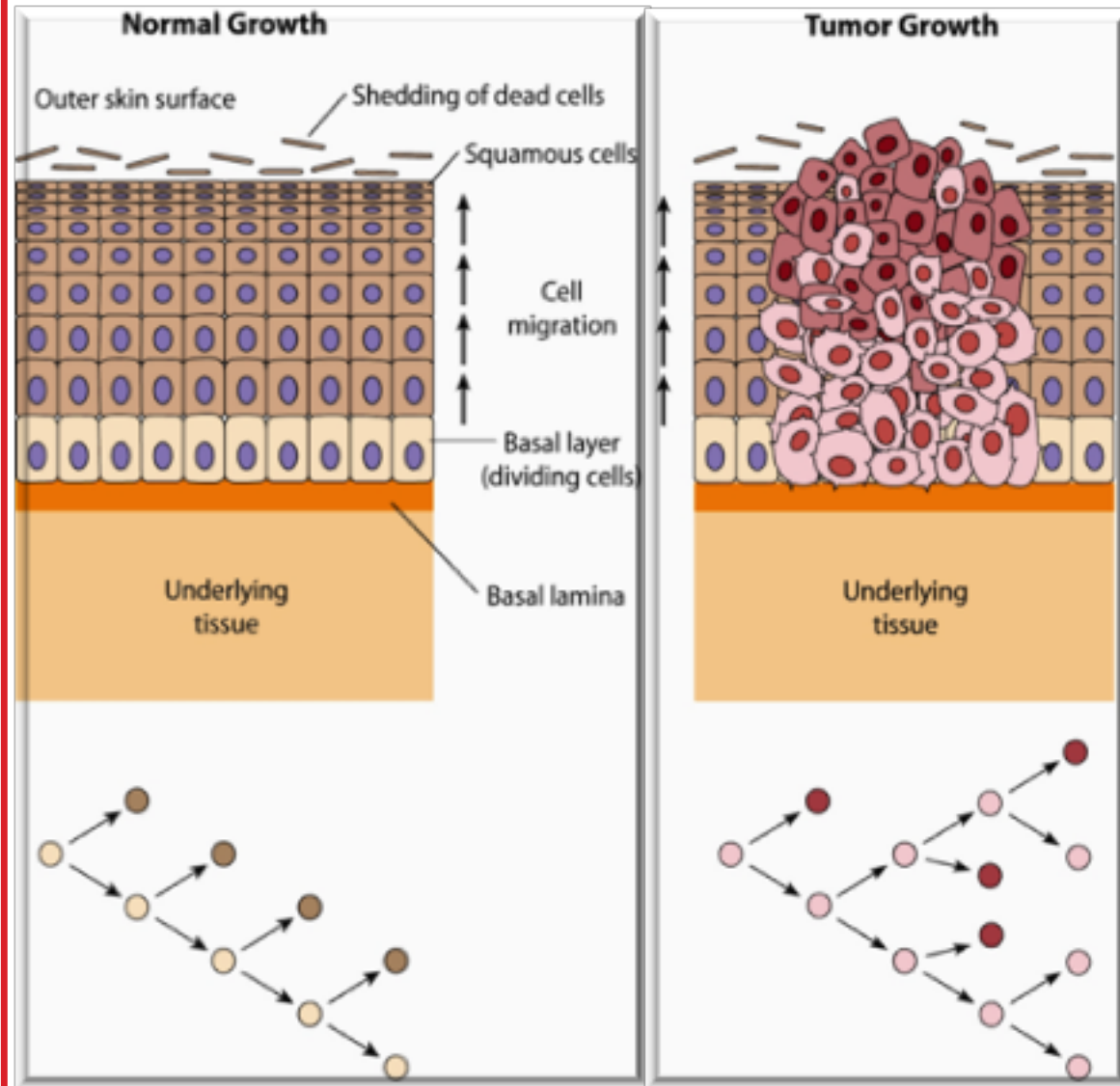
Adapted by Jennifer Kelly, © 2004

Major Types of New Tissue Growth

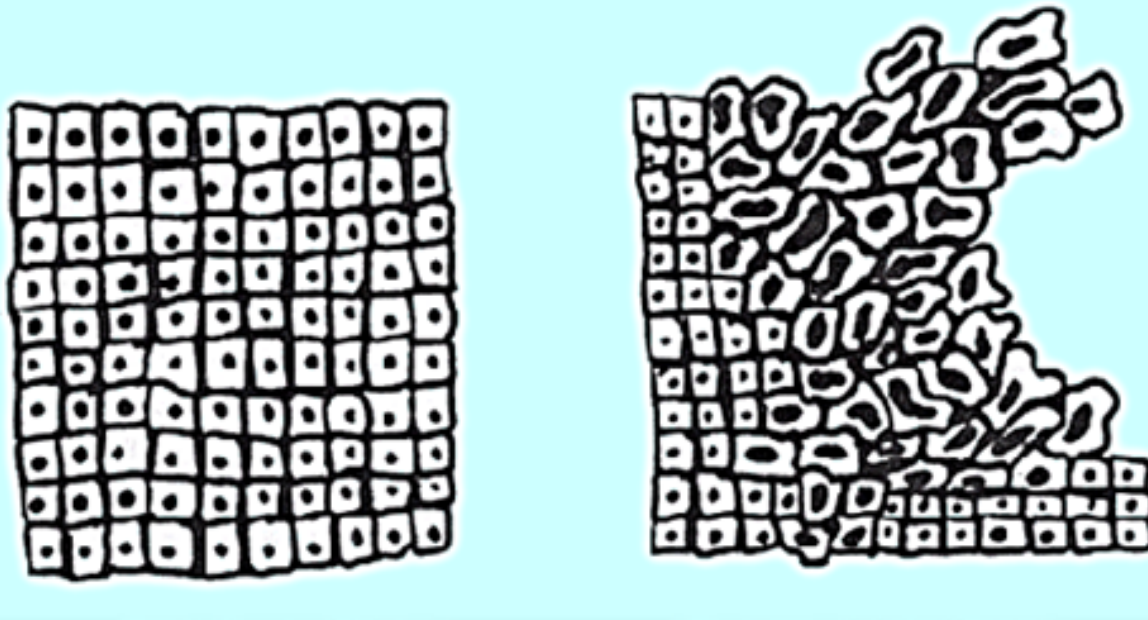


Tumor: Definitions and Development

- ❑ **Neoplasm**— abnormal tissue growth in which cells proliferate in an uncontrolled, autonomous fashion leading to a tumor
- ❑ **Tumor**— swelling caused by fluid build up or cell accumulation
- ❑ Can be **Benign** or **malignant**

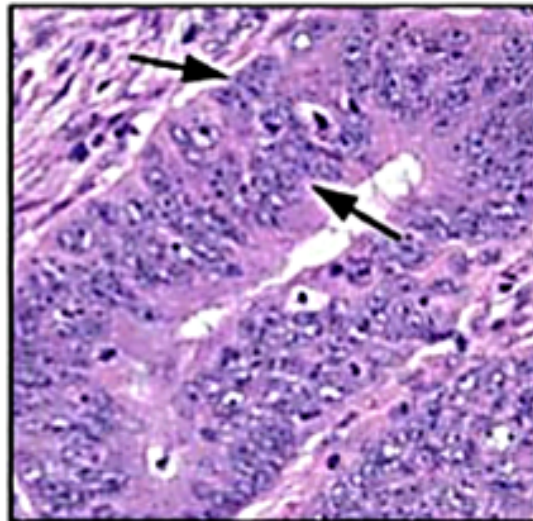
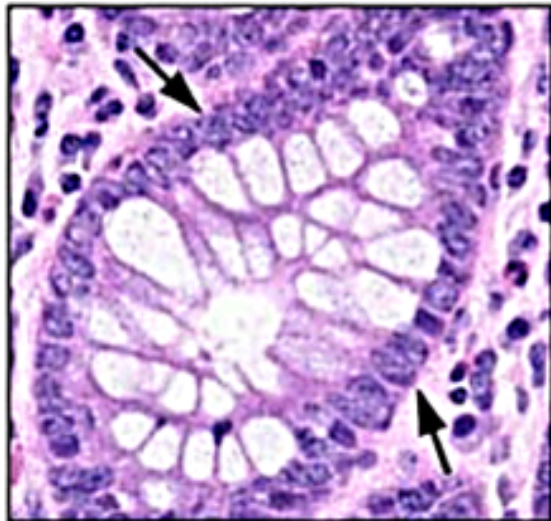


What does cancer look like?



Normal colon tissue

Cancerous colon tissue

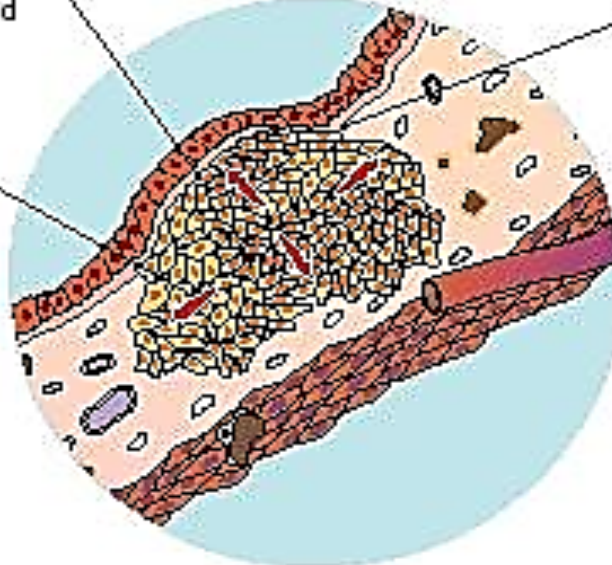


The image of the normal colon tissue, at left, shows well-formed oval-shaped glands, evenly lined with a single, organized layer of cells indicated by arrows. The image of the cancerous colon tissue, in contrast, shows highly disorganized cancer cells stacked upon each other in an apparently random fashion.

Malignant and Benign Tumors

Benign tumors are generally self-contained and localized and have a well-defined perimeter.

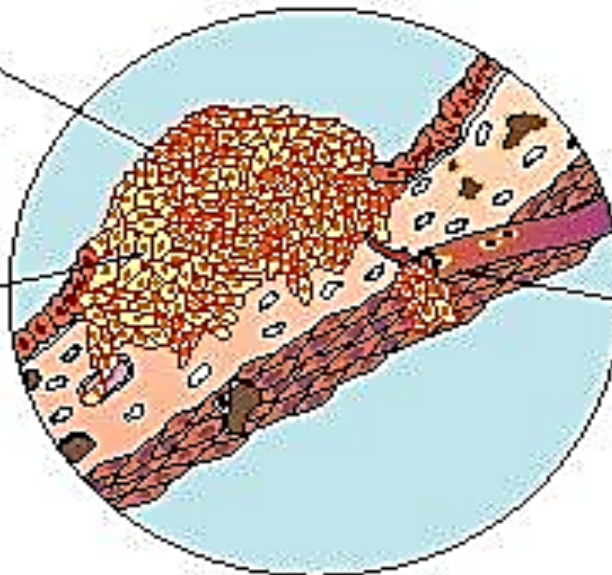
They grow slowly, expanding outward from a central mass.



They are dangerous when they compress surrounding tissues. A benign tumor near a blood vessel could restrict the flow of blood; in the abdomen it could impair digestion; in the brain it could cause paralysis.

Malignant tumors are not self-contained, and usually do not compress surrounding tissues. Their growth is an irregular invasion of adjacent cells.

Although they may grow slowly, they are also capable of very rapid growth.



They are not localized; in a process called metastasis they shed cells that travel through the bloodstream and infect tissues at other locations. They can even establish malignant growth in a different type of tissue; a breast cancer can spread to bone tissue, for example.

Properties of Malignant and Benign Tumors

	Benign	Malignant
Growth Pattern	Local growth only	Spreads by invasion and metastasis
Life threatening	Rarely	Often
Growth rate	Usually slow	May be rapid

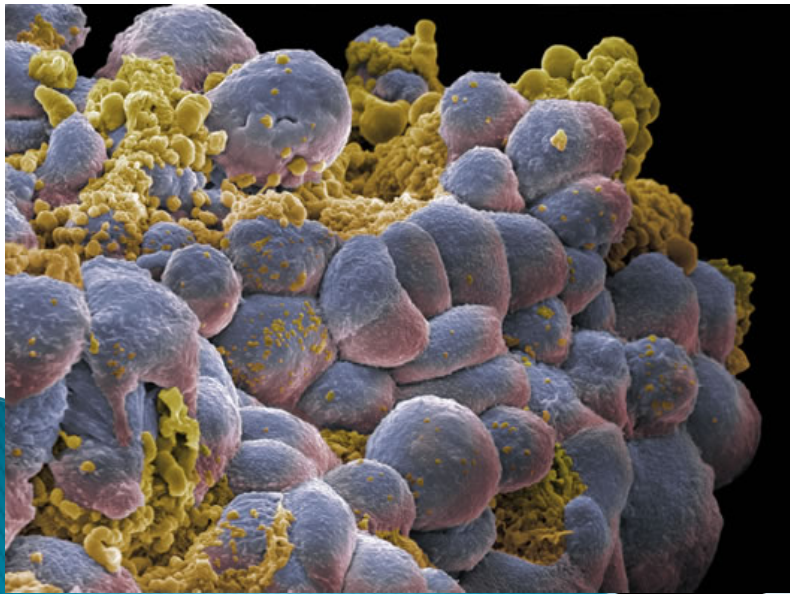


Table 1-4

Some Differences in the Microscopic Appearance of Benign and Malignant Tumors

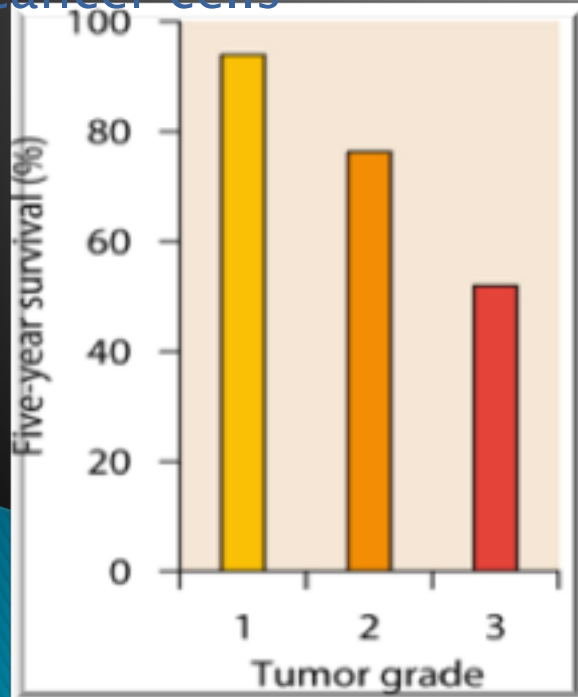
Trait	Benign	Malignant
Nuclear size	Small	Large
N/C ratio (ratio of nuclear size to cytoplasmic volume)	Low	High
Nuclear shape	Regular	Pleomorphic (irregular shape)
Mitotic index (relative number of dividing cells)	Low	High
Tissue organization	Normal	Disorganized
Differentiation	Well differentiated	Poorly differentiated (anaplastic)
Tumor boundary	Well defined ("encapsulated")	Poorly defined
	↓	↓
		

Tumor Grade and Cancer Survival

❑ If a tumor is suspected to be malignant, a doctor removes a sample of tissue or the entire tumor in a procedure called a biopsy

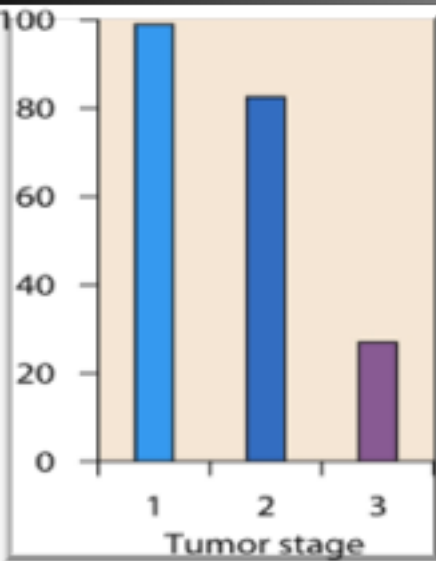
❑ **Tumor Grade:** Based on the microscopic appearance of cancer cells

❑ The American Joint Commission on Cancer recommends the following guidelines for grading tumors:



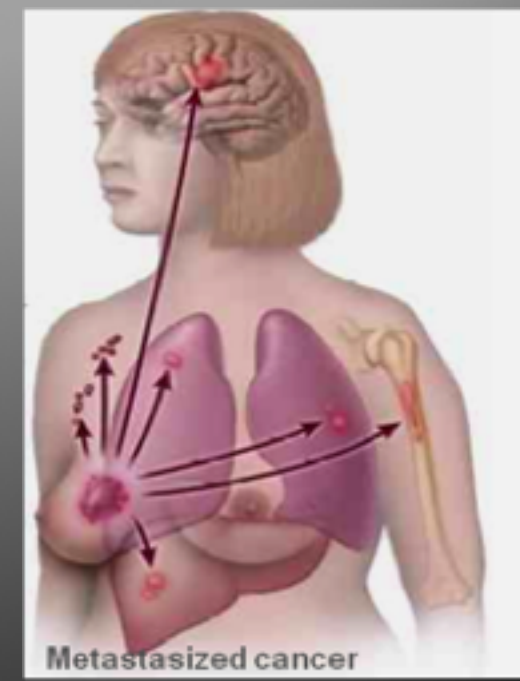
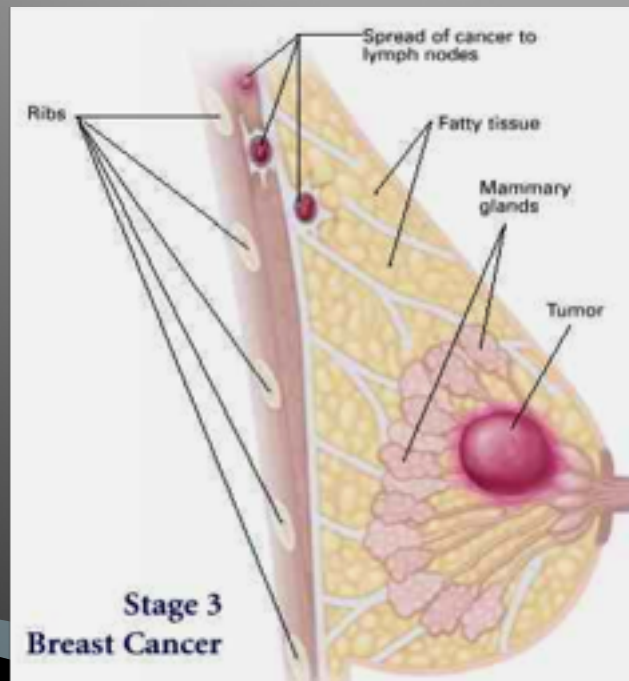
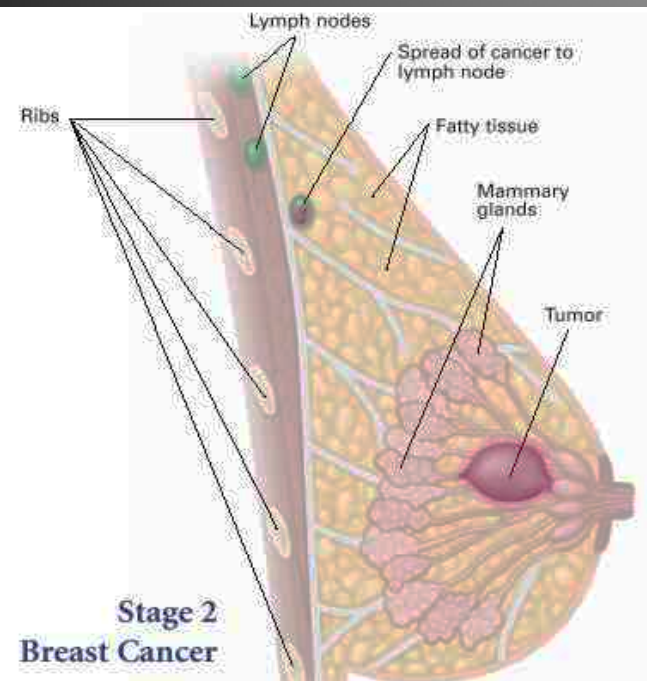
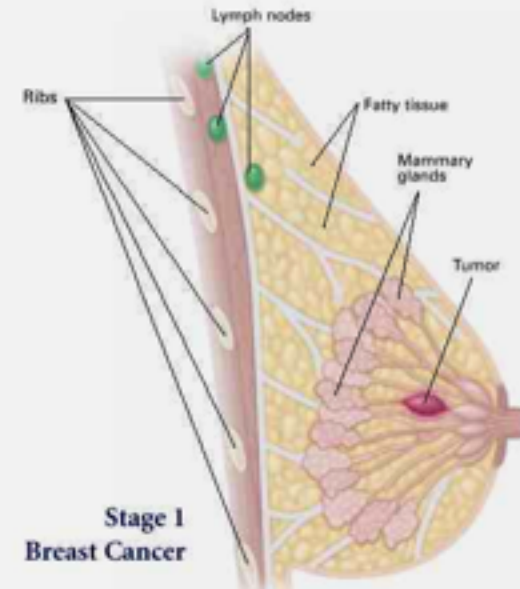
Grade	Description
GX	Grade cannot be assessed (Undetermined grade)
G1	Well-differentiated (Low grade)
G2	Moderately differentiated (Intermediate grade)
G3	Poorly differentiated (High grade)
G4	<u>Undifferentiated</u> (High grade)

Effect of Tumor Stage on Survival Rates



❑ **Tumor Stage**: how large tumor has grown & how far it has spread

❑ Based on location of the **primary tumor**, tumor size, number of tumors, and **lymph node** involvement (spread of cancer into lymph nodes).



Five Year Survival and Cancer Stage

Five-year Relative Survival Rates* (%) by Stage at Diagnosis, 1999-2005

	All Stages	Local	Regional	Distant		All Stages	Local	Regional	Distant
Breast (female)	89	98	84	23	Ovary	46	94	73	28
Colon & rectum	65	91	70	11	Pancreas	6	22	9	2
Esophagus	17	37	19	3	Prostate	100	100	100	31
Kidney†	68	90	62	10	Stomach	26	63	27	3
Larynx	62	78	42	32	Testis	95	99	96	71
Liver‡	13	26	9	2	Thyroid	97	100	97	59
Lung & bronchus	16	53	24	4	Urinary bladder	80	74	36	6
Melanoma of the skin	91	98	62	15	Uterine cervix	71	92	58	17
Oral cavity & pharynx	61	83	54	32	Uterine corpus	83	96	67	17

* Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 17 areas from 1999-2005, followed through 2006.

† Includes renal pelvis. ‡ Includes intrahepatic bile duct.

Local: an invasive malignant cancer confined entirely to the organ of origin. **Regional:** a malignant cancer that 1) has extended beyond the limits of the organ of origin directly into surrounding organs or tissues; 2) involves regional lymph nodes by way of lymphatic system; or 3) has both regional extension and involvement of regional lymph nodes. **Distant:** a malignant cancer that has spread to parts of the body remote from the primary tumor either by direct extension or by discontinuous metastasis to distant organs, tissues, or via the lymphatic system to distant lymph nodes.

Source: Horner MJ, Ries LAG, Krapcho M, et al. (eds). *SEER Cancer Statistics Review, 1975-2006*, National Cancer Institute, Bethesda, MD, seer.cancer.gov/csr/1975_2006/, 2009.

American Cancer Society, Surveillance and Health Policy Research, 2010

Types of Cancers

Leukaemias and lymphomas make up about 5% of all types of cancer.

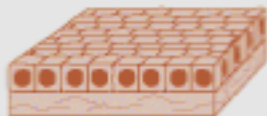


Lymphomas



Leukaemias

'Epithelial' tissue is basically skin tissue that covers and lines the body. Most cancers are cancers of the epithelial cells. Cancers of the epithelial cells are called 'carcinomas'.



Cuboidal cells



Squamous cells

EPITHELIAL TISSUE

Connective tissue cancers are called 'sarcomas'. Sarcomas can develop from bones, cartilage and muscle.



Chondroblasts



Osteocytes

The majority of cancers, ~ 85% , are carcinomas

Types of Carcinomas

- ❑ **squamous cells** – that line different parts of the body, such as the mouth, esophagus and the airways
- ❑ **adeno cells** – form the lining of all the glands in the body and can be found in organs such as the stomach, ovaries, kidneys and prostate
- ❑ **transitional cells** – are only found in the lining of the bladder and parts of the urinary system
- ❑ **basal cells** – that are found in one of the layers of the skin.

What is cancer?
A good summary

<https://www.youtube.com/watch?v=h8X8beT44iQ>