

Introduction to Cancer Biology & Tumor Spread

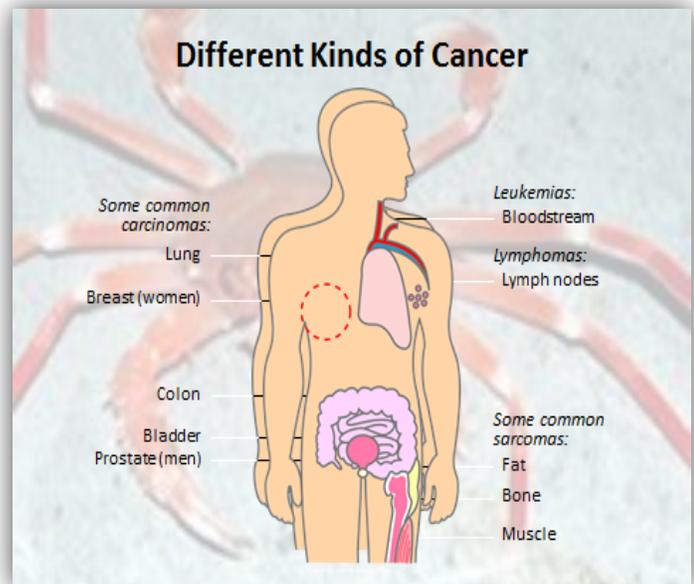
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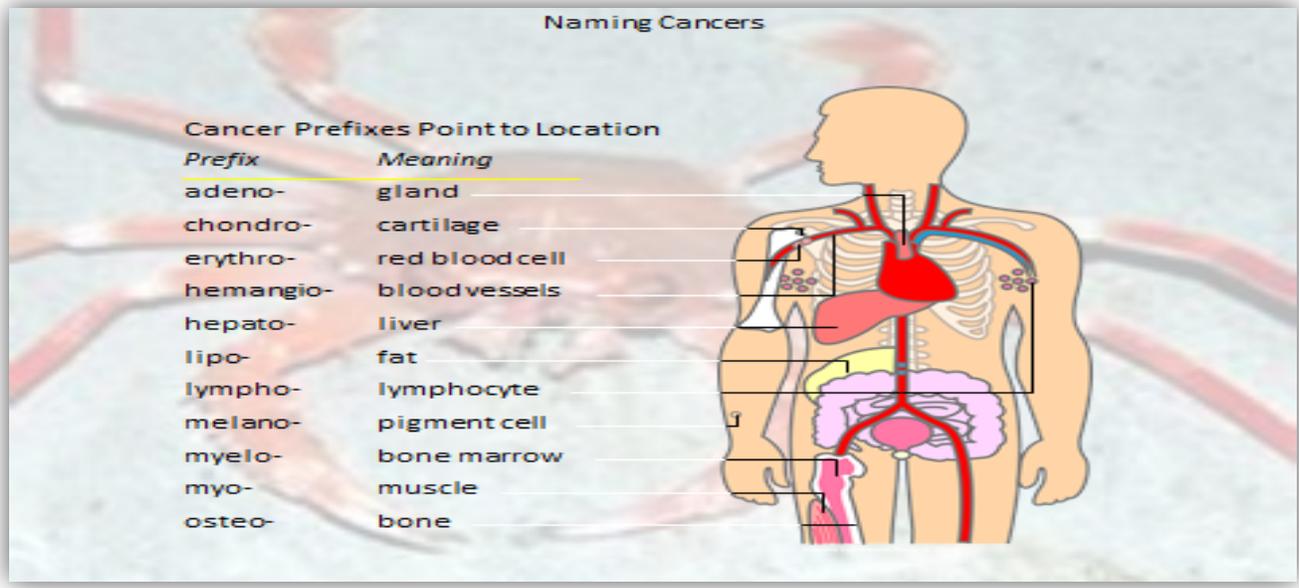
Cancer Biology

- Even though there are many types of cancers (over 200) – they are essentially cells dividing abnormally.
- Cancer could be defined as out-of-control cell growth.
- The normal cell division and growth in the body are accelerated and new tissue is formed.
- Neoplasm – new growth
 - Excessive multiplication of cells in a part of the body
- Primary site – original site of the tumor
 - kidney, prostate, breast, GI, cervix, ovary
- Secondary site – site that metastasizes to
- In normal physiology there are mechanisms which regulate cell division and the generation of new tissues.
- If these physiological mechanisms fail for any reason, cells will multiply at an increased rate.
- This will result in the presence of a greater number of cells.
- These cells take up space and usually form space occupying lumps or tumors.
 - Tumors can be benign or malignant

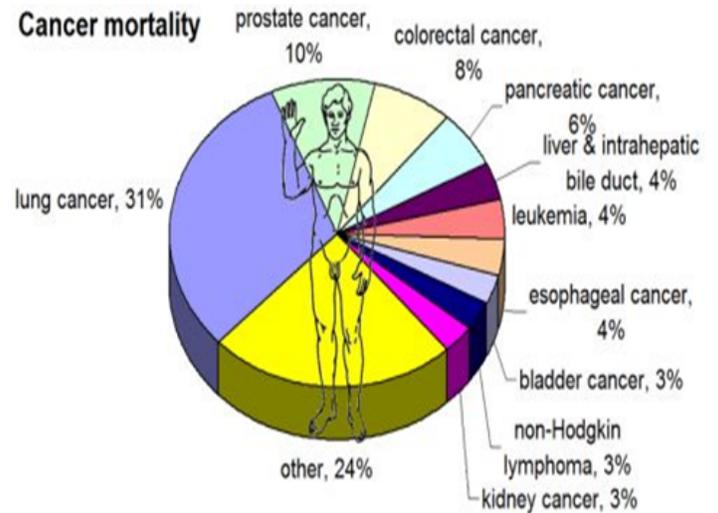
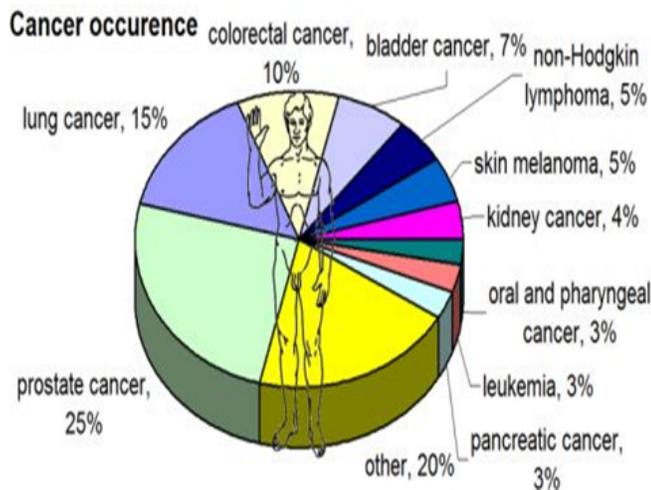
Cancer Names

- Carcinomas
 - Most common types of cancer, arise from the cells that cover external and internal body surfaces.
 - Lung, breast, and colon are the most frequent cancers of this type in the United States.
- Sarcomas
 - Cancers arising from cells found in the supporting tissues of the body such as bone, cartilage, fat, connective tissue, and muscle.
- Lymphomas
 - Cancers that arise in the lymph nodes and tissues of the body's immune system.
- Leukemias
 - Cancers of the immature blood cells that grow in the bone marrow and tend to accumulate in large numbers in the bloodstream.





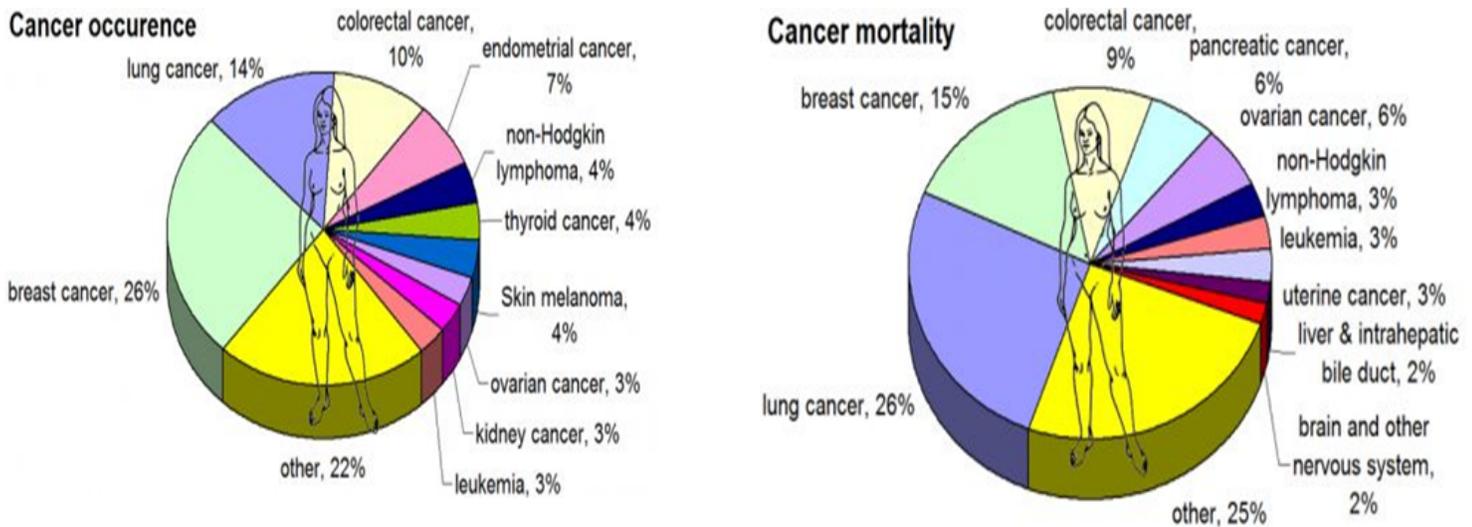
Cancer in Men



Reasons for increased incidence

- Increased environmental toxins
 - Over 100,000 new chemicals in the past century
- Radiation from sun, x-rays and nuclear waste
- Sedentary society
- Poor dietary habits
- Smoking effects
 - 400,000 deaths per year in the USA are directly related
- Alcohol abuse
- Increased incidence of STD
- Stress and personality factors
- Longer life-spans mean longer exposures
- Electromagnetic fields

Cancer in Women



Types of Cancer

- Carcinomas are cancers of the cells that line the inner and outer surfaces of the body – 86%
- Sarcomas are cancers of the cells in connective tissue – in muscles, bones, cartilage, fat, fibrous tissue, synovial tissue – 2%
- Leukemias - cancers of the white blood cells – 7%
- Misc. cancers are of the endocrine glands, sense organs, brain, nervous tissue – 5%

Most Common USA Cancers

- Skin cancer – 600,000 new cases per year
- Breast cancer – 200,000 new cases
 - 87% five year survival rate
- Lung cancer – 170,000 new cases
 - 12% five year survival rate
- Colon and rectal cancer – 160,000 new cases
 - 70% five year survival rate
- Prostate cancer – 130,000 new cases
 - 70% five year survival rate
- Cervical and uterine cancer – 100,00 new cases
 - 50% carcinoma insitu, 50% invasive cervical and uterine cancer

Four Personality Types & Cancers

- Psychological and personality factors
- Type I
 - Very controlled, rational and non-emotional approach to life events
 - When stressed, they do not express feelings like anger or fear
 - This is the cancer prone personality
- Type II
 - React to stress with anger, frustration and aggression
 - Do not handle stress well

Four Personality Types & Cancers

- Type III
 - Personalities have no consistent reaction to life events
 - Shift back and forth between anger and repression depending on the level of the stress
- Type IV
 - Strong sense of autonomy, personal control and well-being
 - Are the most psychologically healthy

Effects of the Personality Types

- Type I – 45% died of cancer
 - Few died of heart disease
- Type II – 5% of those who passed away died of cancer
 - Most died of heart disease
- Type III – 5% died of cancer
- Type IV – 2.5% of those died of cancer
- Conclusion was that things can happen inside of people who repress their true feelings about life that may prove to be cancer-prone

The Cytology of Cancer Development

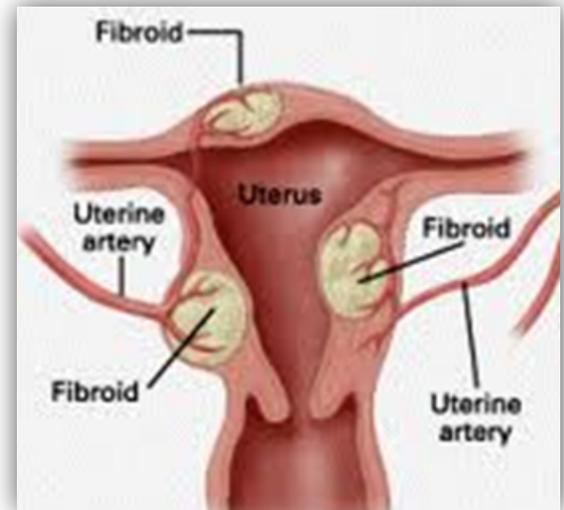
- Cancer cells develop from normal cells through a process called transformation
- 1st step – initiation
 - Normal cells undergo genetic changes which can be caused by environment, behavior, personality, stress
- 2nd step – promotion
 - Often due to the loss of a suppressor gene, which causes the promotion of initiation cells to form cancer cells
- 3rd step – immune system failure
 - In this final step, the immune system fails to destroy the newly-formed cancer cell

Cancer Epidemiology

- 1.3 million new cases per year
- 600,000 deaths per year
- 1:2 men and 1:3 females
- Big four (lung, breast, prostate, colorectal) cause 55% of all cancers and all cancer deaths
- Lung cancer has increased 25X in the last century
- Prostate, breast and colon cancer are more common in the USA than Asia or Africa
- Bladder, liver and bile duct cancer are more common in Africa and Asia due to parasites

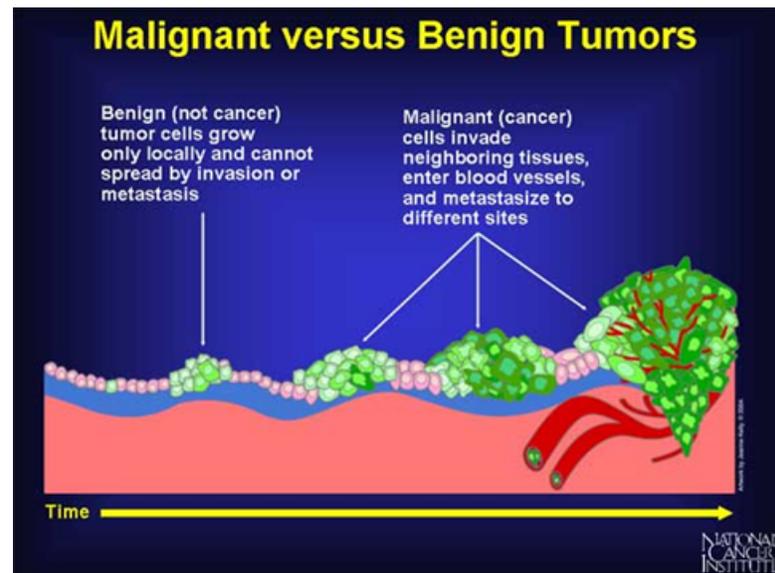
Benign Tumors

- Grows locally, does not spread.
- The growth rate is usually very slow.
 - Growth is usually spherical and rounded.
- They do not invade tissue, but they can put pressure on local tissue.
- The well-defined borders make them easy to excise and remove.
- Rarely have systemic effects.



Malignant Tumor

- Spreads and grows to other parts of the body.
- The growth rate is usually very fast. The metabolic rate is very fast.
- They invade and penetrate local tissues.
- They stop making adhesion molecules, which is how cells stick together. Without these molecules, the malignant cells easily move and float away into blood, lymphatics and body cavities.
- Because the borders are ill-defined, surgical removal is a wide excision.
- Often malignant cells can be left behind after surgery which can rapidly grow and metastasize.

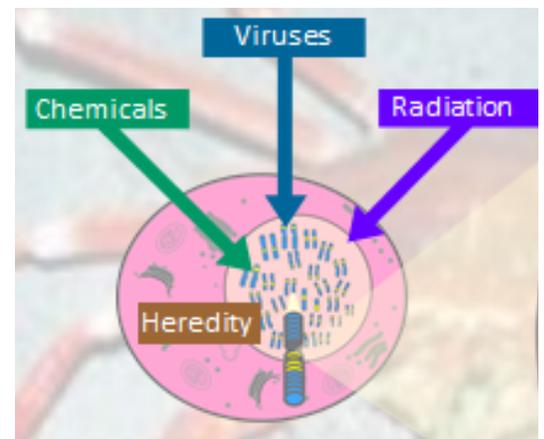


Cancer Etiology

- Mutations
- Chemical carcinogens
- Free radicals
- Radiation
- Oncogenic viruses

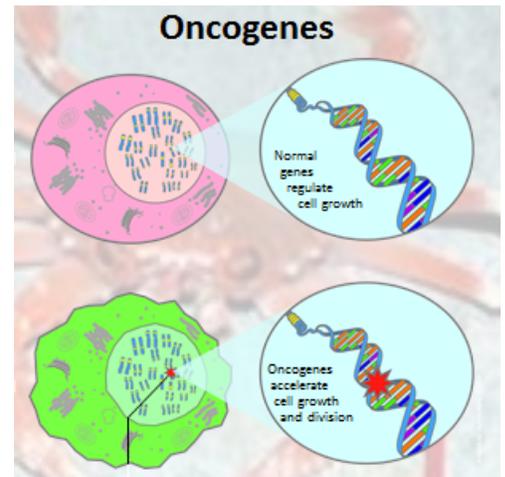
Mutations

- Any alteration in the cell's genetic material
 - IE – cancer is a genetic disease, not from inheritance, but from the cell's genetic code
- Something goes wrong in the cell which causes a hyperplasia
- Many neoplasms develop from a single mutated cell
- When the genetic material is damaged, cells normally die
- Some mutations arise from oncogenes
- Other mutations arise in genes that inhibit cell division called tumor suppressor genes



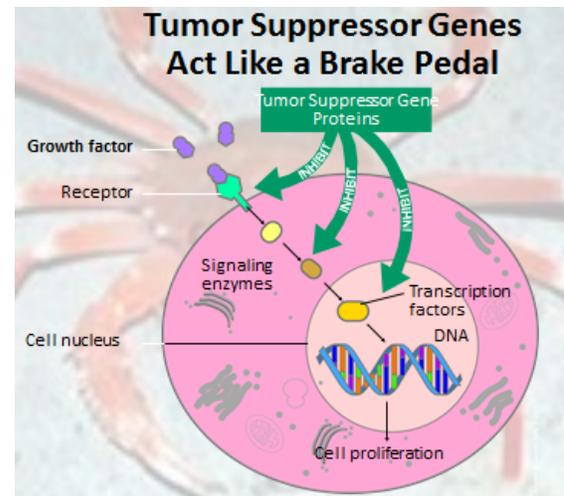
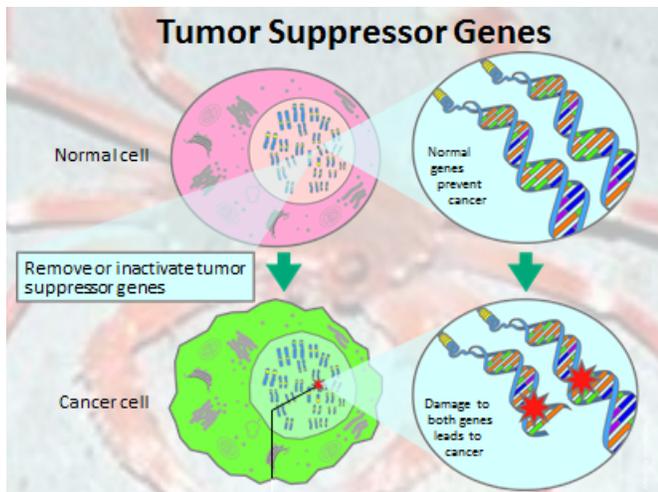
Oncogenes

- Oncogenes are genes whose PRESENCE in certain forms and/or over-activity can stimulate the development of cancer.
- When oncogenes arise in normal cells, they can contribute to the development of cancer by instructing cells to make proteins that stimulate excessive cell growth and division.



Tumor Suppressor Genes

- Tumor suppressor genes are normal genes whose ABSENCE can lead to cancer.
- In other words, if a pair of tumor suppressor genes are either lost from a cell or inactivated by mutation, their functional absence might allow cancer to develop.



Chemical Carcinogens

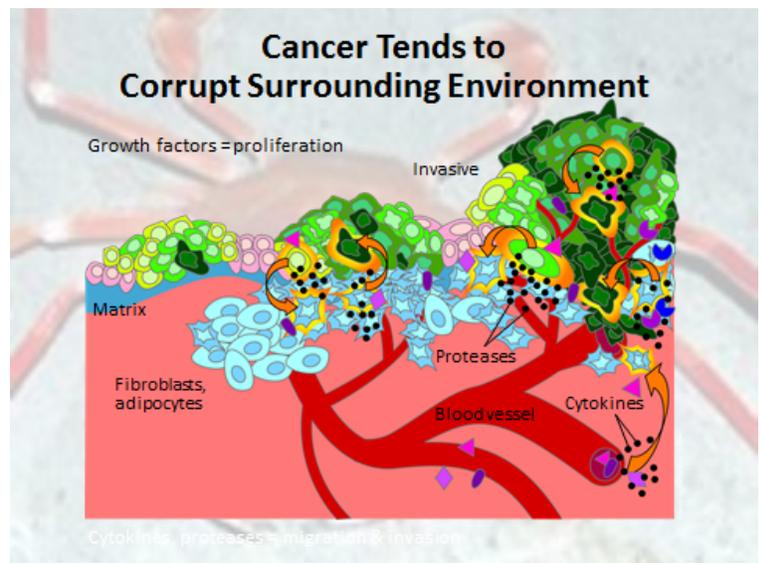
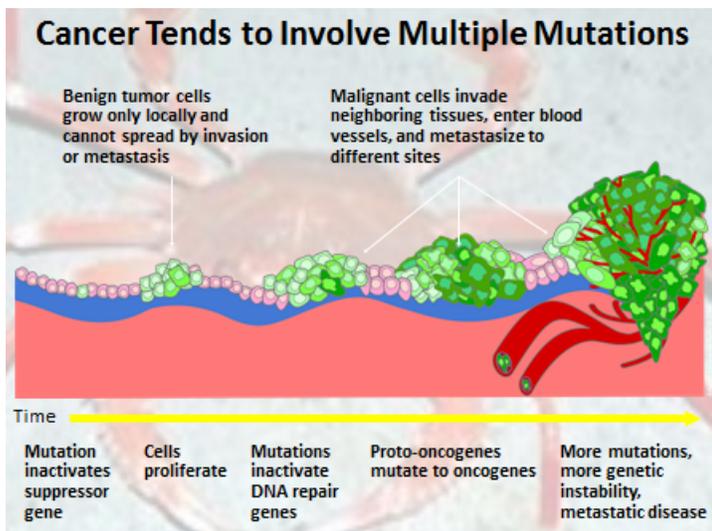
- Most works by altering the chemical composition of the DNA, which causes a DNA mutation
- Direct carcinogen – will always cause cancer as soon as the body is exposed to the carcinogen
 - Example – dioxins, benzenes
- Indirect carcinogen – a chemical that becomes a carcinogen only after it has been processed metabolically by the body.

Tobacco smoke as a carcinogen

- Smoking can cause cancer in the tissues it comes in contact with
- 1 to 14 cigarettes per day = 8x greater risk of dying from lung cancer
- 25 cigarettes per day = 25x greater risk
- Systemic absorption – carcinogens from blood can get into blood and circulate
 - This is why they are more prone to pancreatic cancer
 - Kidneys filtering out the toxins can settle carcinogens in the bladder

Initiation and Promotion

- Most cancers need to be initiated and then promoted
- Exposure to some carcinogens results in a rapid genetic mutation causing cancer initiation
- These chemicals are called initiating carcinogens
 - This alone does not cause malignant changes
 - The initiated cells only become malignant if they are subsequently exposed to a promoting carcinogen
 - This will act on changes already initiated, leading to the development of cancer
 - The “potential cancer” from the initiation can be 10-40 years in the past
- If cells are exposed to promoters, without having been exposed to an initiating carcinogen, malignant changes WILL NOT develop.
- Promoters work by stimulating increased rates of mitosis in cells already initiated.
- Some tumors only emerge after continued ongoing exposure to promoters
 - Example – if a person stops smoking, they will no longer be exposed to the promoters in the smoke and the chances of developing cancer declines
- A promoting carcinogen can be exposed many times over the years only increases the chance of cancer.
 - Example – peptic juice from GERD can go into the esophagus and cause esophageal metaplasia.
 - Several prior infections in an area weakens the cells and tissues.



Free Radicals

- Highly reactive molecules that are generated by the metabolic processes of cells.
- The more highly the metabolism of the cell, the higher the amount of free radicals.
- Free radicals have the potential to oxidize other molecules because they are unstable waste product chemicals.
- Free radicals can attach to DNA molecules, which oxidizes the DNA and creates a mutation.
 - IE – free radicals can cause mutation and some mutations can give rise to cancer.

Ionizing Radiation

- The radiation can physically change the DNA molecule which causes a mutation.
- The other thing that radiation does is that it passes through the cells, it increases the free radicals of the cells.
- UV radiation does not go through the body, but it does go into the skin.
- Radiation damage is cumulative over a lifetime.
- Possible outcomes of DNA damage

Oncogenic Viruses

- Viruses that can cause cancer
- Hepatitis B or C
 - Causes enough change that a person is more pre-disposed to getting liver cancer (hepatocellular carcinoma)
 - The chronic inflammatory process sets this up
- HPV – Human Papilloma Virus
 - Can cause 90% of cervical cancers
 - The vaccine is only effective of the 2-3 most common strains, even though over 70 have been indentified
- Bacteria (*H. pylori*) can also cause ulcers and they are more prone to develop gastric cancer or duodenal cancer

Cancer and Immunity

- Some cancers, such as lymphoma, are more common when immunocompromised
- Cancers cells have similar antigens as normal cells
- This means the immune system is often unable to identify the cancer cell as being different from a normal body cell.

Cancer and Hormones

- Some hormones can stimulate some tissues as promoters.
 - Hormones increase cell activity which increases mitosis which increases the chance for a mistake to occur.
 - Testosterone seems to promote testicular and prostate cancer
 - Estrogen seems to promote breast cancer
 - Also consider xenoestrogenes

Cancer and Age

- Most cancers are more common with increasing age.
 - Especially esophagus, stomach, rectum, prostate, pancreas
 - Exceptions
 - Lymphocytic leukemia in young
 - Testicular cancer in young 20-30 year olds

Cancer and Genetics

- Certain cancers have a clear genetic link
- Retinoblastoma is autosomal dominant
- BRCA-1 and BRCA-2 genes
 - 80% more likely to develop breast cancer in their lifetime
 - 60% more likely to develop ovarian cancer

Cancer Prevention

- No tobacco
- Limit alcohol intake
- Diet
- Antioxidants to neutralize free radicals
- Prevent obesity
- Be physically active
- Avoid UV radiation
- Avoid carcinogens
- Vaccination
- Eradicate *Helicobacter pylori*
- Treat GERD
- Promote immune function

SunSmart Code

- **S**tay in the shade from 11-3
- **M**ake sure you never burn
- **A**lways cover with a hat, shirt and sunglasses
- **R**emember to take extra care with children
- **T**hen use lots of SPF 15 or higher sunscreen

