

# General Medical Information to Help You Manage Your Health and Healthcare

Richard Wendel MD, MBA Moderator  
An 8 week Spring OLLI in person and  
online course at VPC  
Course Number 2221  
Thursdays from 9:30-10:45 starting  
April 28, 2022  
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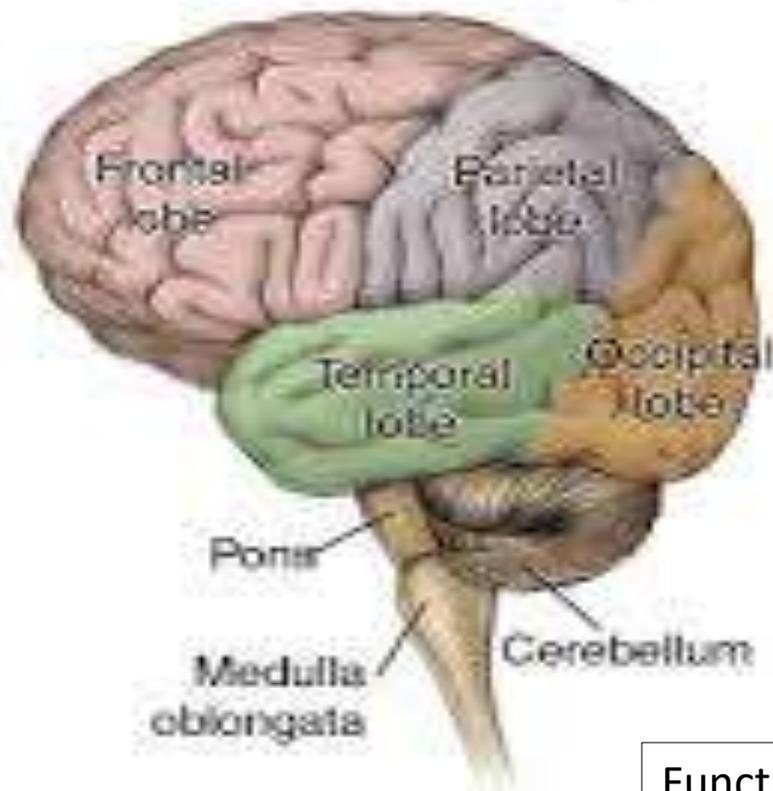
# Course syllabus

- 1.) April 28<sup>th</sup> and May 5<sup>th</sup>: The brain, central and peripheral nervous system.
- 2.) May 12<sup>th</sup> and 19<sup>th</sup>: The cell, genetics, and the immune system.
- 3.) May 26<sup>th</sup> and June 2<sup>nd</sup>: The cardiovascular system.
- 4.) June 9<sup>th</sup> and 16<sup>th</sup>: The senses: sight, hearing, smell, taste, and touch.

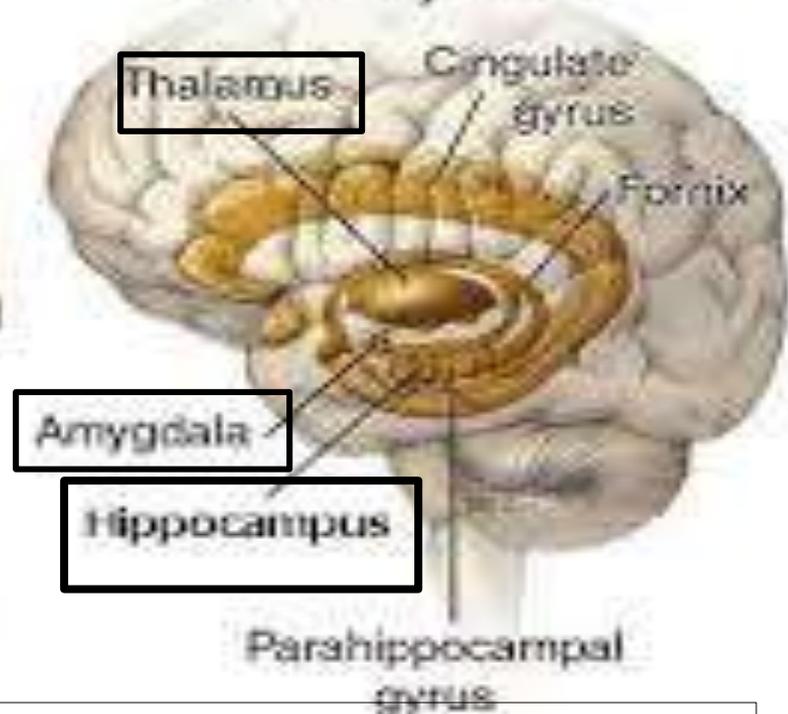
# Brain and Central Nervous System

## Gross Anatomy

### Anatomy of the Brain

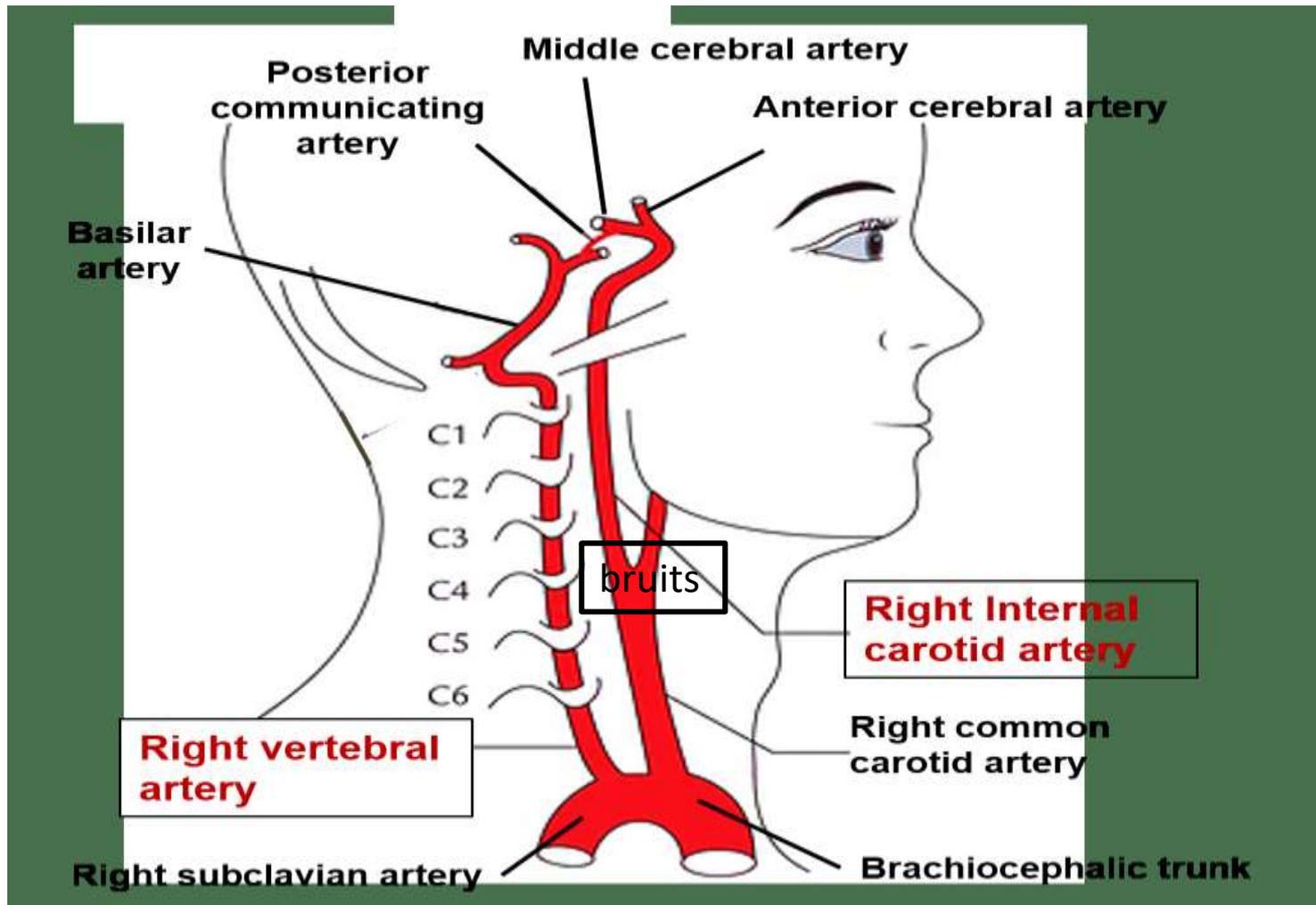


### Limbic System



Functional MRI and PET scanning as  
Research Tool

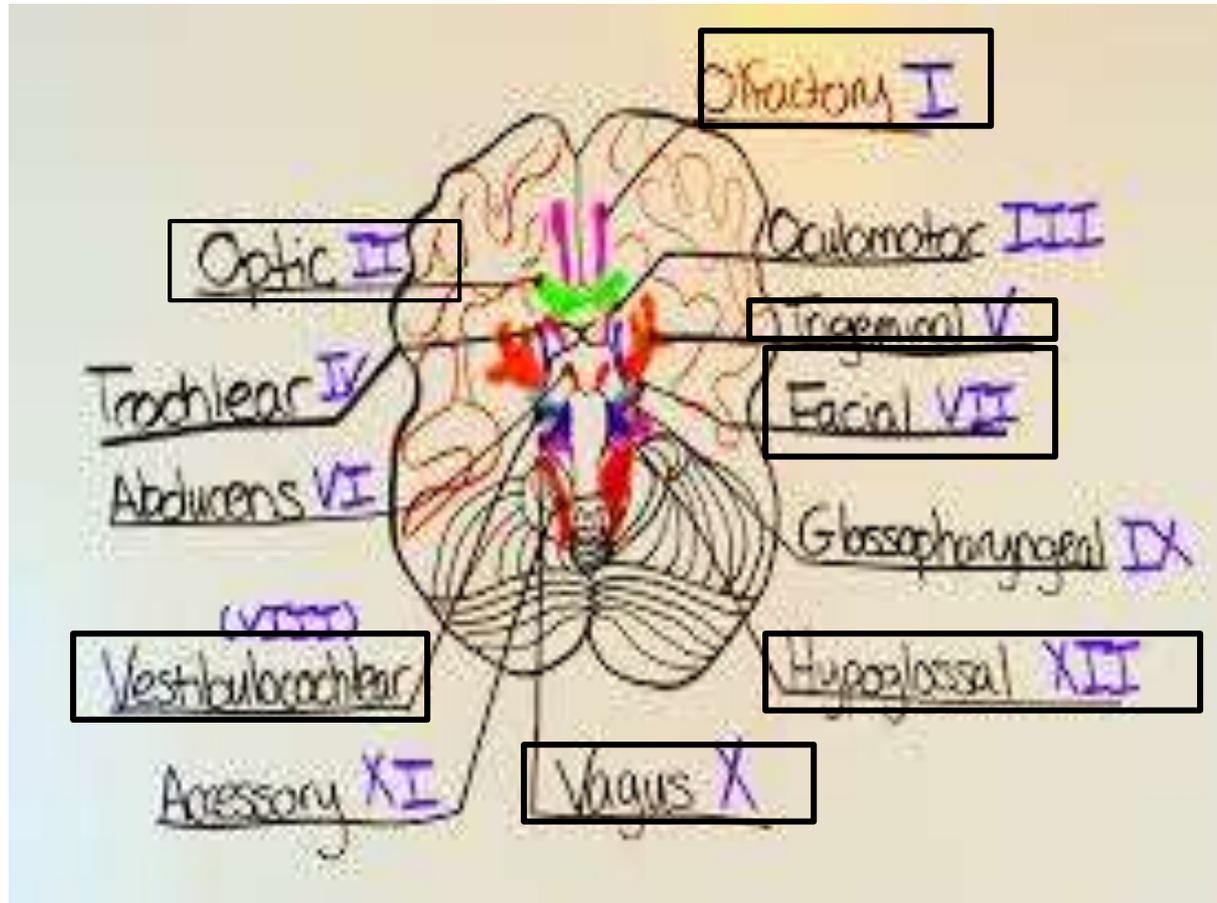
# Arterial Blood Supply to the Brain



# Neurotransmitters or molecules that carry impulses across synapses

- ❖ Dopamine (reward-motivation) Parkinson's, midbrain. L Dopa
- ❖ Serotonin (SSRIs-Prozac, Zoloft) Depression
- ❖ Acetylcholine (alpha adrenergic-parasympathetic)
- ❖ Norepinephrine (blood pressure and stress) (Beta adrenergic)
- ❖ Epinephrine/adrenalin (Beta adrenergic)
- ❖ GABA-(gamma-aminobutyric acid) (pain- Neurontin)

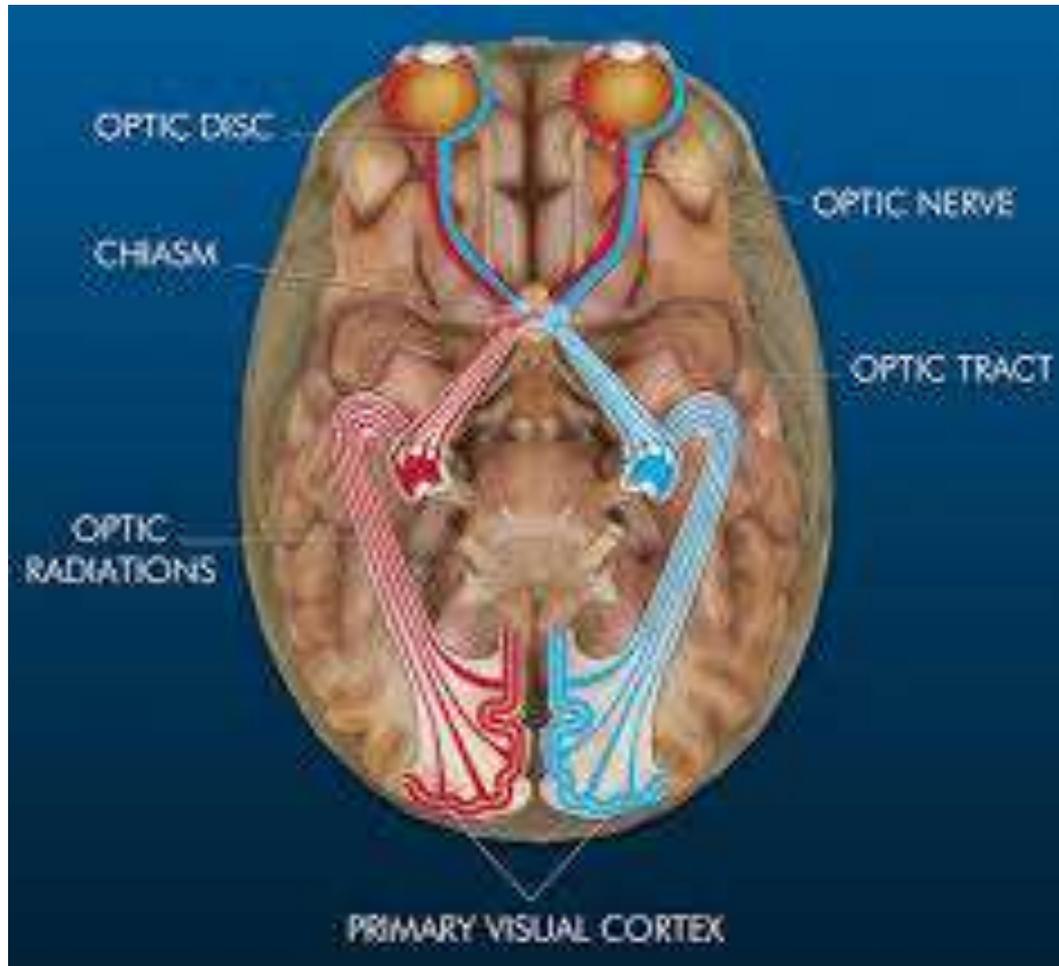
# Cranial Nerve Diagram: 12 altogether



# **Cursory Neurologic Exam when you go to see your Primary Care Physician**

- Sensorium and memory
- Pupils (R&R&RLA)
- Funduscopic exam to examine the retina
- Eyes movements
- Check Reflexes with reflex hammer
- Strength evaluation and proprioception
- Balance

# Optic Chiasm



# Right Brain versus Left Brain: Importance?

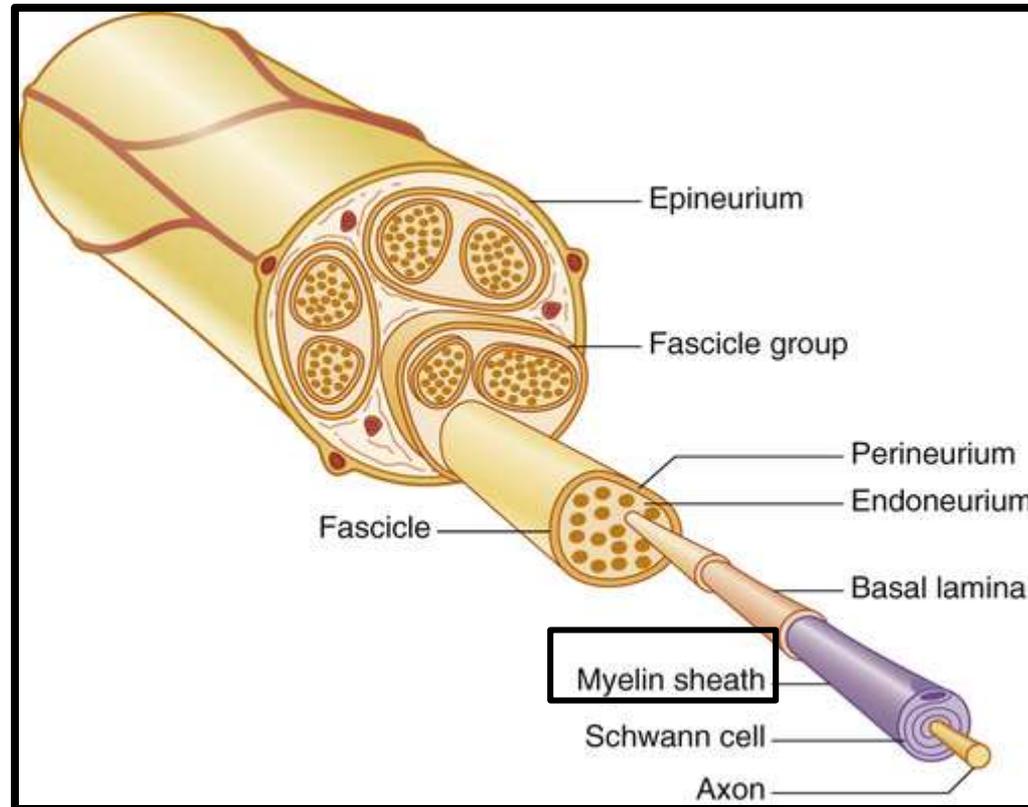
- Right brain more adept at spatial and nonverbal concepts and being more creative and emotional (a scientist or musician) imagination, holistic thinking, intuitive
- Left Brain are more analytical and methodical. They are better at things like reading, writing, and computations. (an accountant or author) logic

No proof that one is dominant but the differences do appear to be real between the two sides.

# Autonomic Nervous System or Involuntary nervous system

- ❖ Sympathetic nervous system: the 'fight or flight' response to stress mediated by adrenaline/epinephrine or nor-epinephrine/steroids. The response to stress includes pupil dilation, increased sweating, increased heart rate, increased strength and increased blood pressure. The adrenal gland and solar plexus secretes adrenalin and steroids.
- ❖ Parasympathetic nervous system; involuntary functions of the body such as peristalsis, slowing of the heart, constriction of the pupil. Mediated by acetylcholine. The Vagus nerve, the tenth cranial nerve, is a parasympathetic nerve trunk.

# A peripheral nerve



# Common Conditions of the CNS

Brain Cancers: meningioma, acoustical neuromas and, gliomas with the glioblastoma being the most common malignant primary brain tumor making up **54%** of all gliomas

- Even benign tumors of the brain like meningioma and acoustical neuromas are potentially malignant due to the confines of the skull with increasing intracranial pressure and compression of surrounding brain tissues, herniation of the brain stem.
- Treatment varies depending on location and usually consists of surgery, radiation and sometimes chemotherapy.
- Five year survival rate for glioblastoma is 9 percent with 18,000 deaths per year from brain cancer (3% of all cancers)

Mental Illness: poorly understood and difficult to diagnose and treat with a severe shortage of mental health professionals and a social stigma that acts as a barrier to treatment and delay in treatment.

- Three major **psychosis**: Schizophrenia, Bipolar and Psychotic Depression.
- An estimated one in 300 have schizophrenia, 2.8% have bipolar disorders and about 2.8% of adults experience severe depression at some time during their lives. **Depression is the most common cause for absenteeism**
- The DSM-5 coding system is a resource that can be used by many different health professionals to assist in the diagnosis of mental disorders

# Amyotrophic Lateral Sclerosis/Lou Gehrig's Disease

- Slowly progressive (5-8 years) but uniformly fatal **demyelinating** disorder (neural sheaths) of both upper and lower motor neurons with about **13,000** deaths per year. **Retain cognitive function**
- Onset between age 50 and 70: mean 55 and more common in men and 10 percent familial or genetic.
- Progressive Respiratory symptoms most devastating
- No known treatment; Riluzole a glutamate inhibitor can be given.

**Multiple Sclerosis; an autoimmune inflammatory demyelinating disease three to four time more common in females than males**

- Variable symptoms beginning between the ages of 20 and 40: slurred speech, fatigue, dizziness, tingling, altered sexual, bowel and bladder function, cognitive impairment.
- Common disorder with about 720,000 cases in US with variable course and **no diagnostic lab test** (MRI)
- FDA has approved 15 plus drugs for treatment (average cost per year \$80,000)-these drugs alter the immune response of lymphocytes.

# Inflammatory Conditions: Meningitis, Encephalitis, and Brain Abscess

- Viral meningitis is fairly common especially in young people due to enteroviruses (85-95% and seasonal)

**Presents with headache, stiff neck or nuchal rigidity**

- Encephalitis can be caused by the Herpes simplex virus and is treated with acyclovir and dexamethasone.
- **Lumbar puncture** with examination of cerebrospinal fluid is diagnostic
- In general, an MRI is better than CT scan for diagnostic purposes.

# Parkinson's and Parkinsonism that has a broad range of presentations

- Cause: Due to loss of Dopamine producing cells in the basal ganglia at the base of the brain
- Symptoms: tremors, **rigidity**, gait, mask face, mood change, hallucinations
- Early symptoms of anosmia, sleep disorders, constipation, depression, restlessness, anxiety, orthostatic hypotension (may occur many years before)
- Treatment: directed at increasing dopamine. Levodopa the mainstay but a whole array of meds prescribed by neurologists. Newer agents include monoamine oxidase B inhibitors, catechol-O-methyltransferase inhibitors, and adenosine A2A receptor antagonists.
- **Deep brains stimulation** of basal ganglia can be used and is often effective-do not know why this works.

# Dementias

- 1) **Alzheimer's disease:** 60% of patients (Beta-amyloid and Tau Protein with tangles)—cause unknown (APOE-e4 genetic link). No effective treatment although there is a new blood test for Tau protein that is 96% accurate in diagnosing Alzheimer's: Palliative Treatment with anticholinergics and NMDA (glutamate) receptor antagonists may delay the need for NH placement but no long term outcome benefits.
- 2) **Arteriosclerotic;** multiple mini-strokes, Transient Ischemic Attacks (TIAs)
- 3) **Temporal Frontal Lobe Dementia;** usually starts with difficult in speech and behavioral problems. More rapidly progressive.
- 4) **Lewy Body Dementia;** more behavioral problems and shorter course and hallucinations
- 5) **TDP- 23** deposition dementia in  $\frac{1}{4}$  over the age of 90

**For all dementias try to avoid too many meds; less is more and antipsychotic medications are not well tolerated.**

# A new controversial drug approved by the FDA.

- Aducanumab (Aduhelm), is a monoclonal antibody that reduces the buildup of amyloid plaques in the brain. The trials show a decrease in plaques but its long term benefits are unproven. Used only in early cases.
- It costs \$56,000 for a monthly intravenous infusion.

# Strokes; two types--ischemic and hemorrhagic (12 percent)

- **Unlike heart attack do not give aspirin because of possible intracranial bleeding**
- Cincinnati Criteria: *Facial droop, Arm drift, Slurred Speech: All three present = 87% chance of stroke.*
- Emergency CT scan to differentiate (takes little time)
- **Window of 3-4.5 hours from when symptoms first started** (with new angiography techniques can estimate amount of viable brain beyond stroke (flair and penumbra) and possible large vessel disease and in some cases extract the clot to retrain maximal function up to 24 hours.)
- IV anticoagulant and fibrinolytic: plasminogen activator (tPA) and Alteplase. Cannot give after 4.5 hours.
- Carotid bruit

# More on strokes: Risk factors

- Hypertension; target 130/80 and ACE, ARBs and diuretics more effective than in preventing strokes than Beta blockers and CA channel blockers in preventing strokes.
- Lipid LDL **cholesterol** (low density lipoproteins. **>100 treat** with statins; in high risk group shoot for <70 that decreases cardiovascular events: diet, statins and Ezetimibe
- Anti-platelet medications: ASA (baby), Plavix, and Ticagrelor (in acute phase ASA and Plavix in combination has survival benefits x 21 days)

# Migraine; 40 million Americans and second most disabling condition worldwide

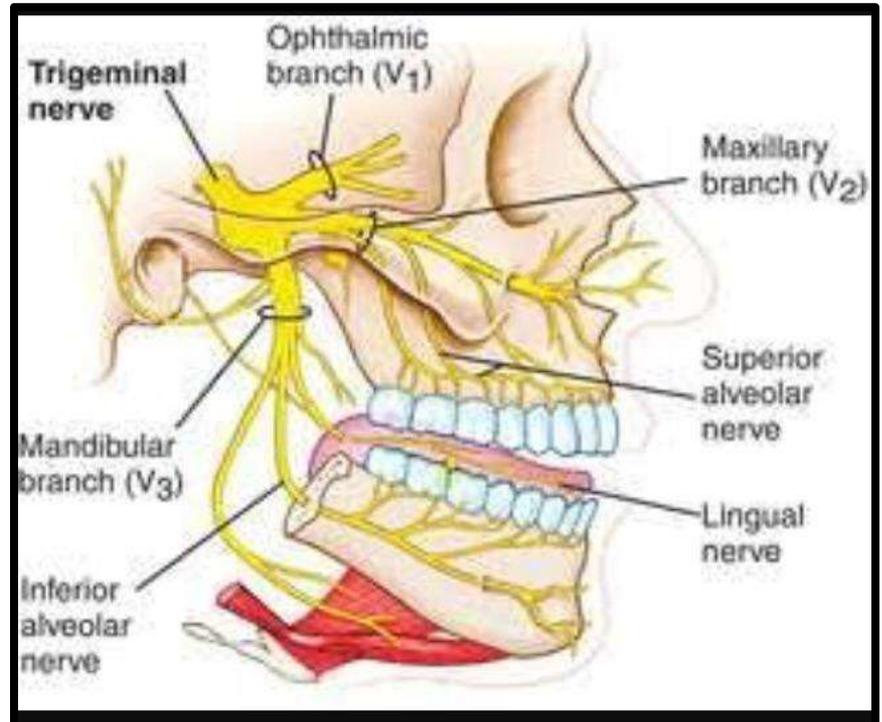
## **A disorder with many treatments; none curative**

- 1. Tryptans (effect on serotonin) and NSAIDS--moderately effective, mainstay of treatment
- 2. Calcitonin gene-related peptide receptor antagonists (vasodilator)—moderate to high effectiveness.
- 3. Dihydroergotamine (blocks vasospasm)—(traditional treatment) moderate to high effectiveness.
- 4. Acetaminophen-moderate effectiveness
- 5. Remote electric neuromodulation (stimulates upper arm peripheral nerves to modulate pain especially in adolescence)—moderate effectiveness
- 7. Noninvasive vagal nerve stimulation (mainly cluster headaches)-moderate
- 8. Botox (15 or more headaches per month, (It consists of 31 injections) Costly? And needs to be repeated every few months.

# Trigeminal neuralgia or tic douloureux (5<sup>th</sup> cranial nerve) and Bell's Palsy (7<sup>th</sup> cranial nerve)

- **Trigeminal neuralgia** is a rare disorder with no known cause characterized by unilateral intermittent shooting, stabbing facial pain (often debilitating)
- **Treatment:**
  1. anticonvulsants like Tegretol and gabapentin/Neurontin
  2. Complex surgery to destroy portions of the nerve.

**Bell's palsy** (40,000 individuals are diagnosed with Bell's palsy in the United States each year) is usually a painless condition with self limiting loss of 7<sup>th</sup> nerve function with drooping of the muscles of affected side of the face. It is felt to be related to the herpes virus and usually resolves within 3-6 months.



# Benefits of Sleep (just beginning to understand the need)

- Thought to play a critical role in immunity, sex drive, memory, learning, mood and avoidance of the Metabolic Syndrome of HPT, obesity, diabetes.
- Normally 5 or 6 **sleep cycles each night** lasts about 90 minutes apiece.
- **Dream sleep or rapid eye movement (REM) sleep** consumes about 90 minutes on an average night; heart rate and breathing increase and your limbs may even become paralyzed (REM may be induced by an increase dopamine)
- Need **between 7 and 9 hours** of sleep per night and people over 65 should also get 7 to 8 hours per night
- Why do we sleep? No definitive answer; but brain shrinks and may open the blood–cerebrospinal fluid barrier (BCSFB) or **glymphatic** system for excretion of waste products.

BRAIN DEATH IN ORGAN DONATION: historically an ethical dilemma with need for involvement of multiple physicians and the ethic committee and family

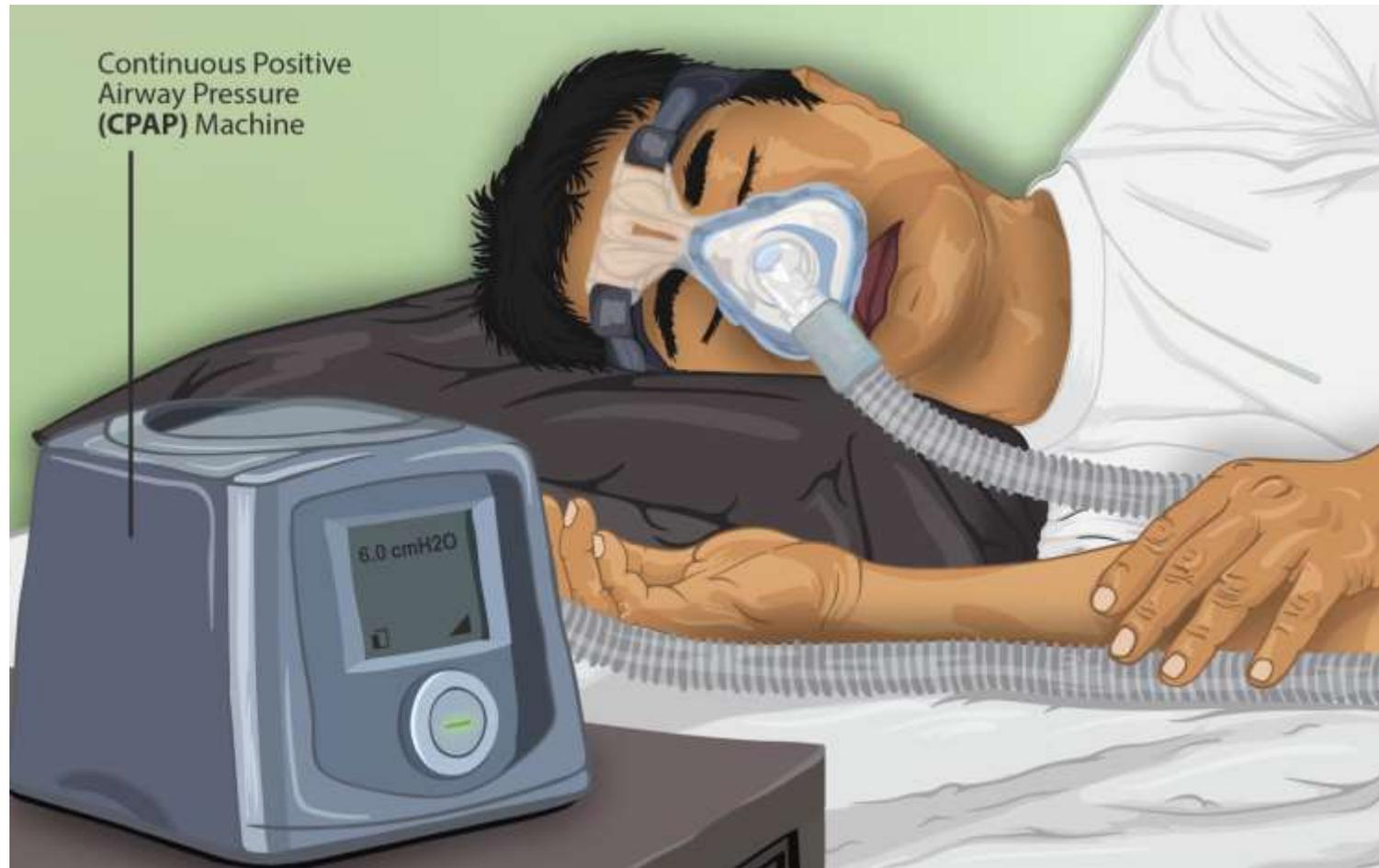
1. Comatose and unresponsive plus an EEG that revealed no brain wave activity

Now medical science has a nuclear scan that can reveal total brain blackout with no chance for recovery. This eliminates the need to rely on subjective clinical findings and expert opinions even though by law you need multiple expert opinions.

# Obstructive Sleep Apnea (OSA) and Central Sleep Apnea(CSA)

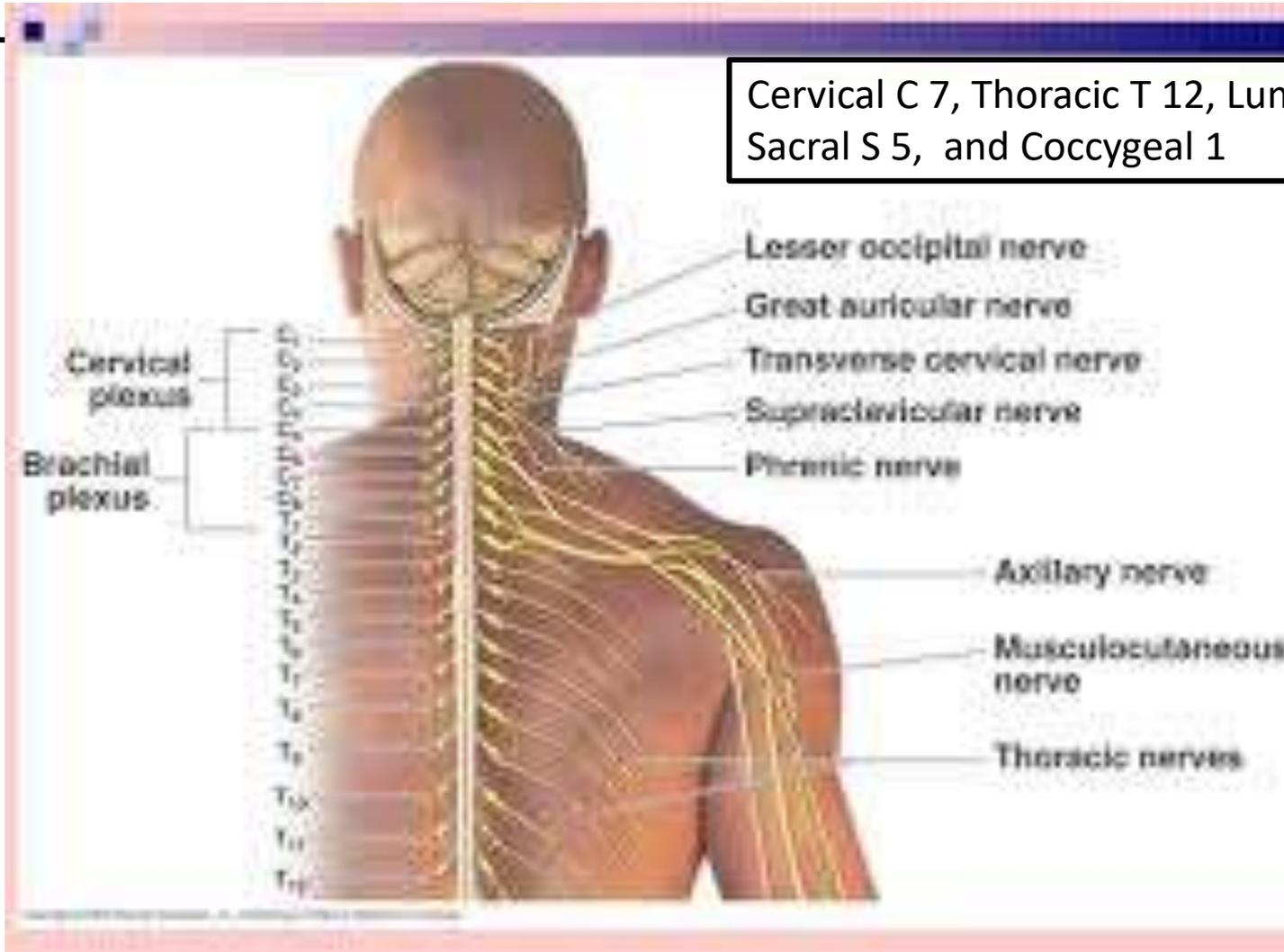
- An epidemic due in large part due to increasing BMIs/obesity (weight in kilograms divided by height in meters squared with normal range of 18.5 – 24.9 with 30 and above equaling morbid obesity) and the tongue relaxes and blocks the trachea.
- As high as 37% of men and 50% of women being afflicted
- Symptoms of snoring, gaps in breathing with intercostal attempts that can cause HPT, daytime drowsiness and even increase risk of stroke.
- Treatment CPAP (Continuous positive airway pressure)
- **Opioids greatly exacerbate the complications of OSA (sudden death)**

Patient is tied to a mask and the machine that produces continuous positive pressure to prevent the tongue from blocking the trachea



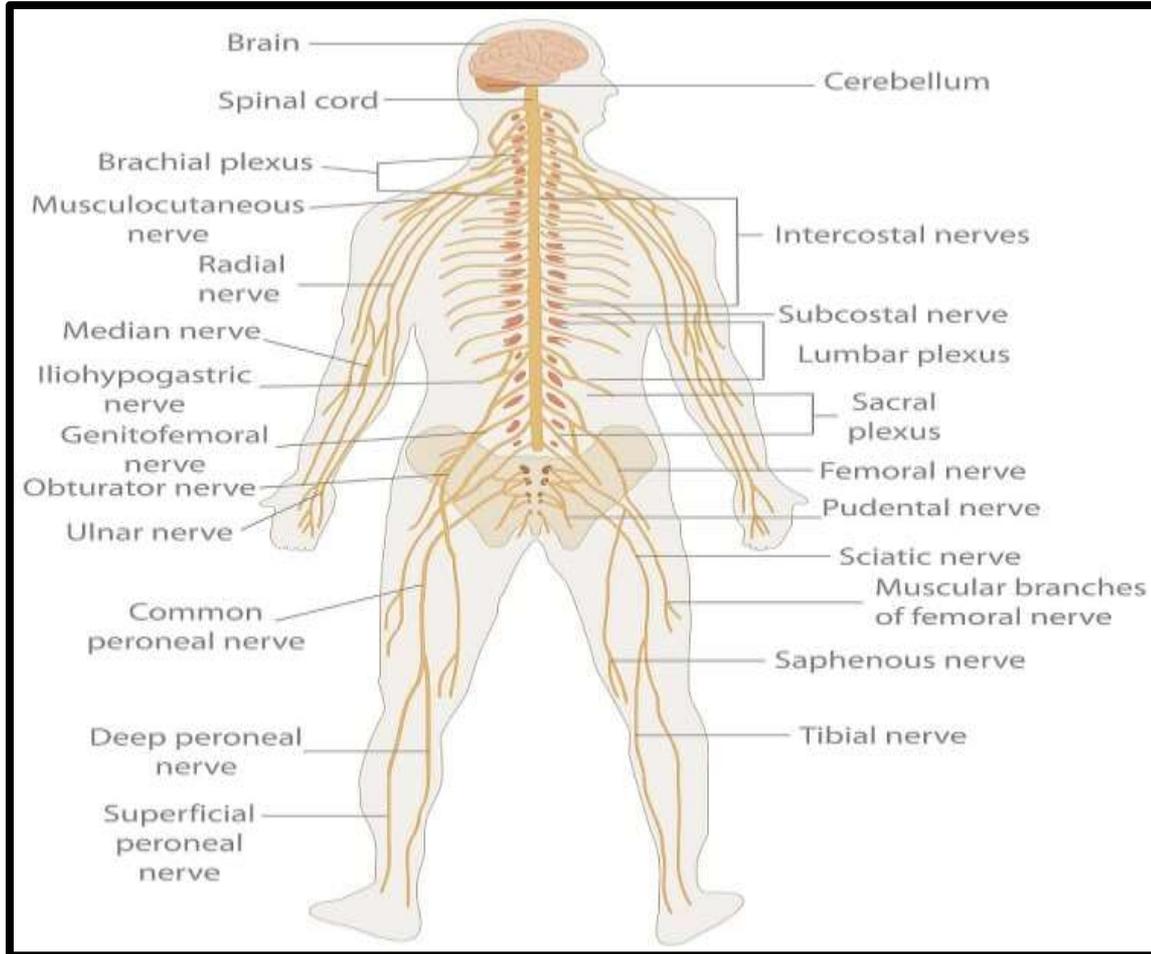
# Peripheral Segmental Nerves

Cervical C 7, Thoracic T 12, Lumbar L 5,  
Sacral S 5, and Coccygeal 1

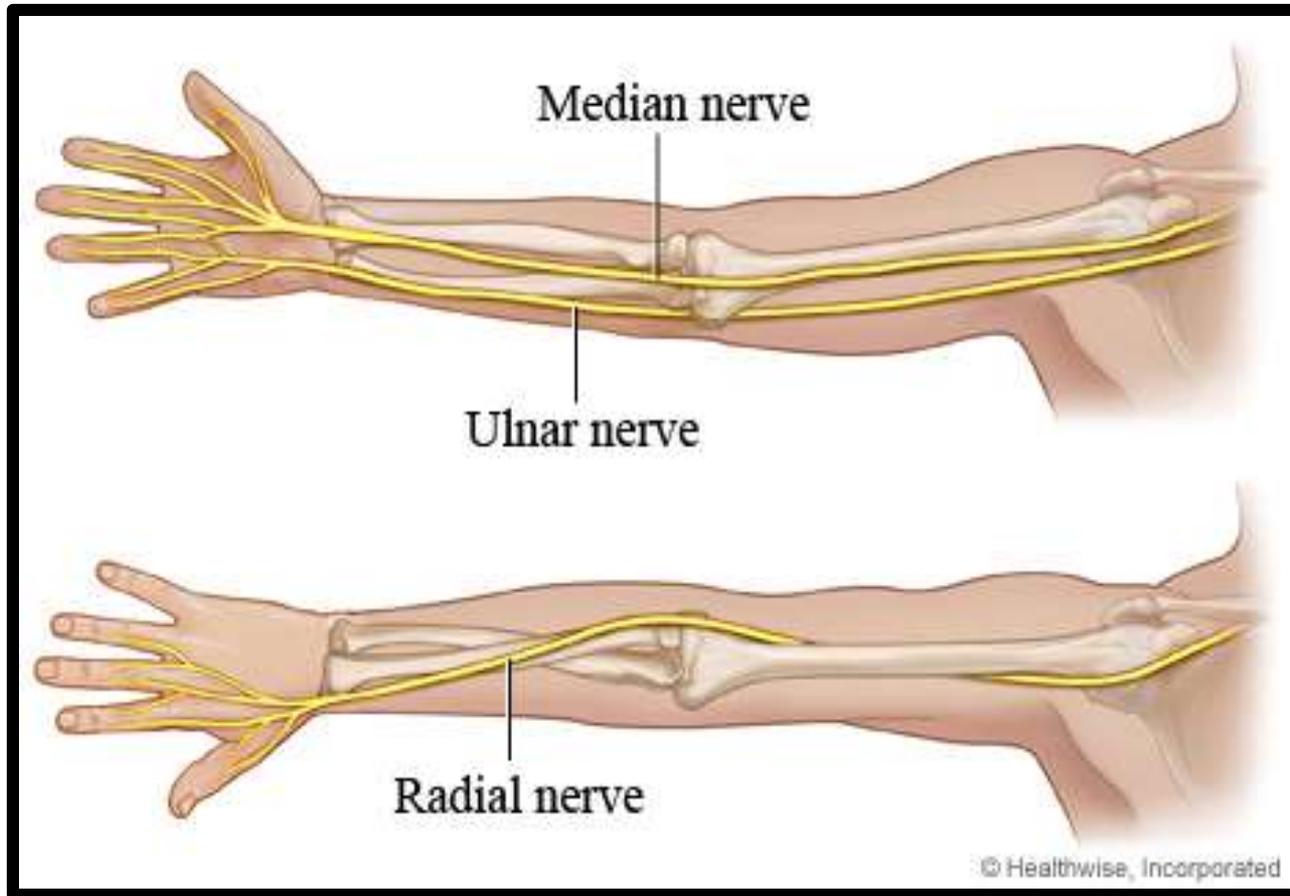


# Major Peripheral Nerves

Brachial plexus  
Lumbar plexus  
Sacral plexus



# Three nerves supplying the hand



# Peripheral Nerve Testing

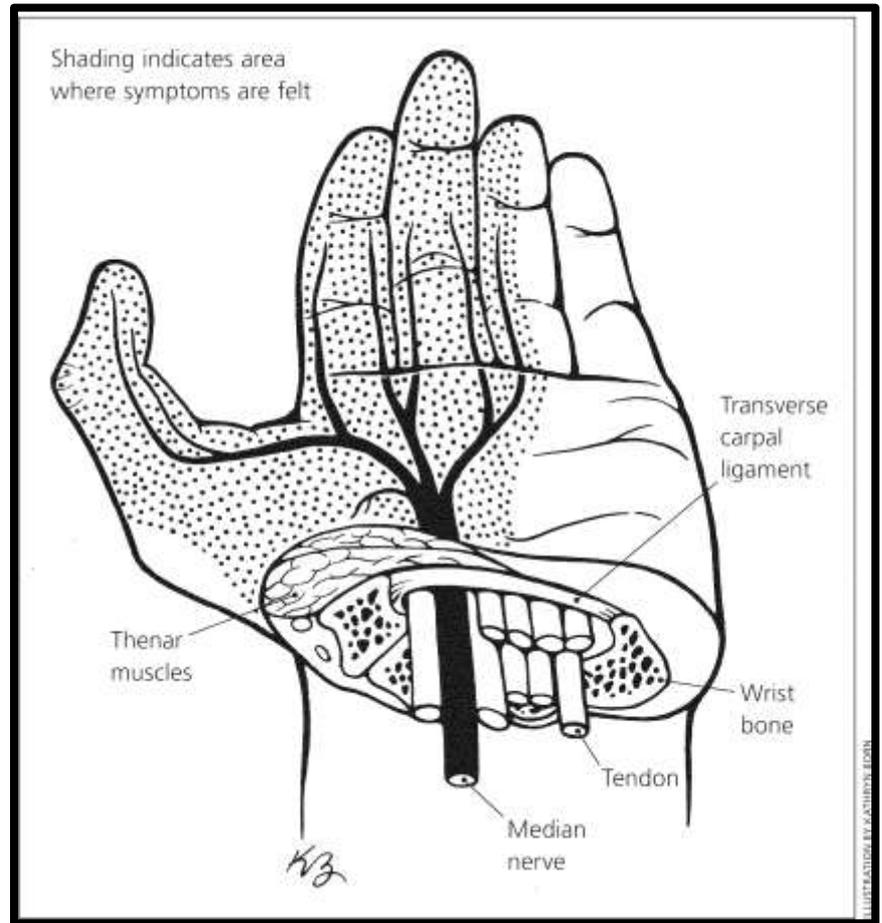
- Tendon Reflexes: ankle, knee, elbow
- Sensory for vibration with a tuning fork
- Pain pin prick
- Hot, Cold and light touch
- Proprioception: finger to nose with eyes closed
- EMG-electromyography

# Medical conditions of peripheral nerves

- Peripheral neuritis (age, diabetes, alcohol risk factors)
- Sciatica (most commonly occurs when a herniated disk, bone spur on the spine or narrowing of the spine (spinal stenosis) compresses part of the sciatic nerve. (L4, L5, S1, S2, and S3)
- Herniated disc disease
- Paraplegia and Quadriplegia
- Herpes Zoster

# Carpal Tunnel Syndrome

- **Heredity and repetitive hand use**
- Common condition that causes pain, numbness, and tingling in the hand and arm.
- Occurs when the median nerve is squeezed or compressed as it travels through the transverse carpal ligament.
- Treatment; splinting, NSAIDS, surgery



# Autism Spectrum Disorder/Asperger's syndrome: cause unknown and varies in severity

- Related to brain development that impacts how a person perceives and socializes with others, causing problems in social interaction and communication. The disorder also includes limited and repetitive patterns of behavior.
- ASD begins before the age of 3 years
- About 1 in 44 with a 4 to 1 ratio of boys vs girls
- Doctors look at the child's developmental history and behavior to make the diagnosis

## A few characteristics

- Avoids eye contact,
- Has little interest in other children or caretakers,
- Limited display of language (for example, having fewer words than peers or difficulty with use of words for communication)
- Getting upset by minor changes in routine

# Eating Disorders

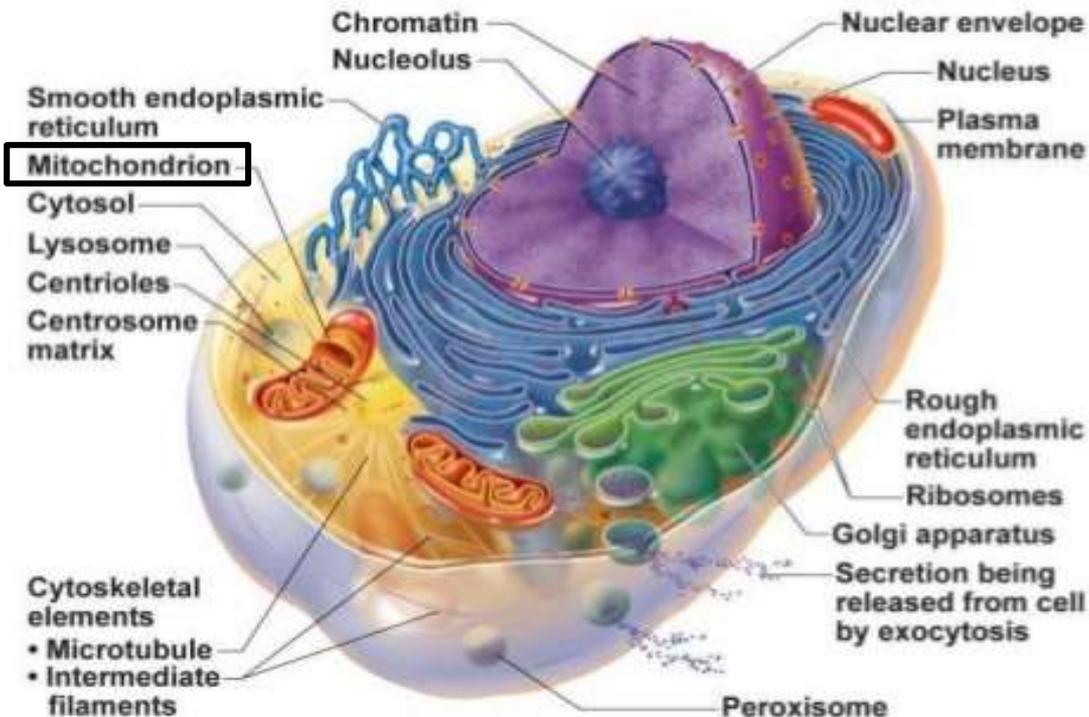
- Anorexia nervosa
- Bulimia
- Binge eating

Cause unknown but some familial predisposition.

The Cell; basic unit of you  
body with some 60 trillion  
individual cells

# The Cell Structure: amazingly complex

## CELL STRUCTURE



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# The basic cell ingredients; organelles

- The nucleus contains the hereditary DNA of the cell
- Ribosomes are granules that are the site of protein synthesis(contained in the rough endoplasmic reticulum)
- The mitochondria are the power plant that form ATP and converts glucose, fats and protein to energy
- *The nucleolus begins the assembly of ribosomes from proteins and RNA*
- *The rough endoplasmic reticulum manufactures proteins*
- *Smooth endoplasmic reticulum chemically modifies proteins, lipid and other molecules*
- *The Golgi apparatus processes and packages proteins and targets them*
- The centrioles are associated with cell division
- A cytoskeleton composed of microtubules and microfilaments support the cell and is involved in cell movement and organelle movement.
- *The plasma membrane regulates traffic of materials into and out of the cell*
- *Lysosome digests particles like food taken into the cell by phagocytosis.*
- *Peroxisome collect and expels toxic materials*

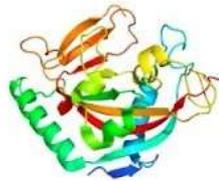
# How are your Telomeres: an index of aging? And what is Messenger RNA?

- Telomeres are repeated DNA sequences at the **end** of chromosomes. **Telomeres get** shorter each time a cell divides even as during cell division the important DNA stays intact. Eventually, **telomeres get** too short to **do** their job, causing our cells to **age** and stop functioning properly. Therefore, **telomeres** act as the **aging** clock in every cell.
- Messenger RNA (mRNA) is a single-stranded RNA molecule that is complementary to one of the DNA strands of a gene. The mRNA is an RNA version of the gene that leaves the cell nucleus and moves to the cytoplasm where proteins are made. During protein synthesis, an organelle called a ribosome moves along the mRNA, reads its base sequence, and uses the genetic code to translate each three-base triplet, or codon, into its corresponding amino acid.

# Apoptosis; programmed cell death or injury (necrosis)

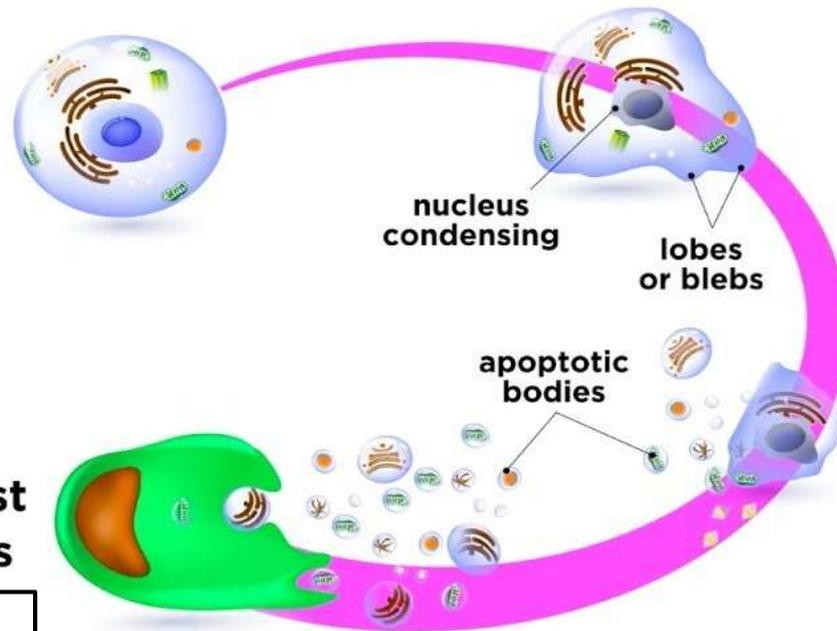
## apoptosis is programmed cell death

faulty enzymes must be digested or they can be incorporated in other cells



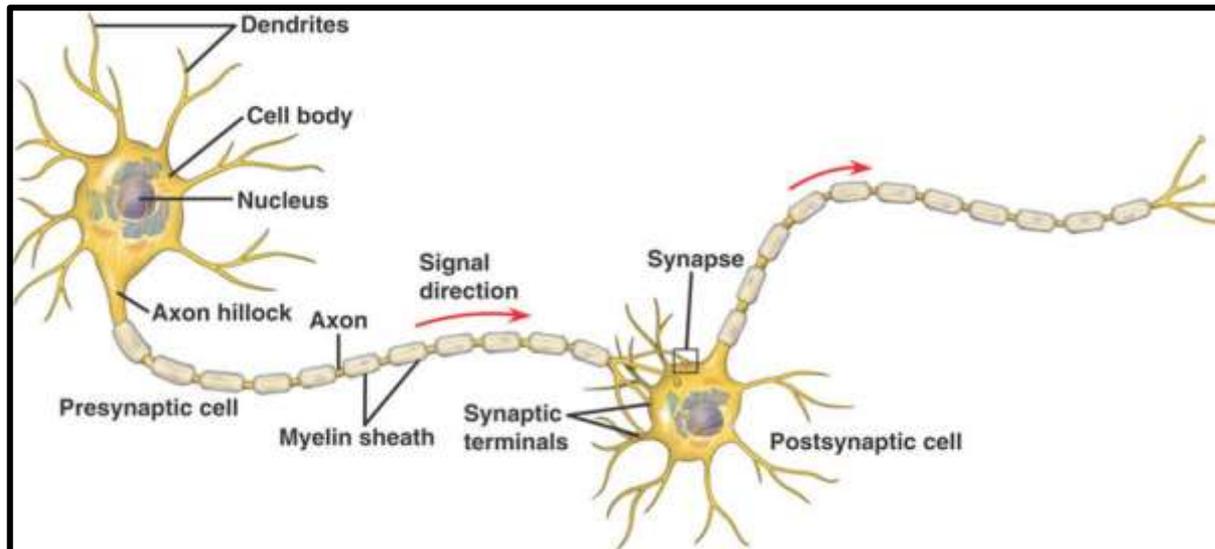
scavenger cells digest the apoptotic bodies

Macrophage, WBC



Neurons; new brain cells are created throughout the lifetime from stem cells and not just in children: this leads to the concept of neuroplasticity (continuous growth and reorganization in the brain)

**The Importance of stem cells as mature neurons and cardiac muscle cells probably do not exhibit mitosis or cell division**



# The Immune System: our intricate defenses that work behind the scenes.

- Most individuals have a frame of reference for the eye, ear, heart, skin etc. but limited knowledge about our body's defenses against infection, cancer, allergies, toxins, and how this immune system can go array in producing **autoimmune disease and inflammatory immune disease.**
- Today we will try to build a frame and familiarize you with some terminology.

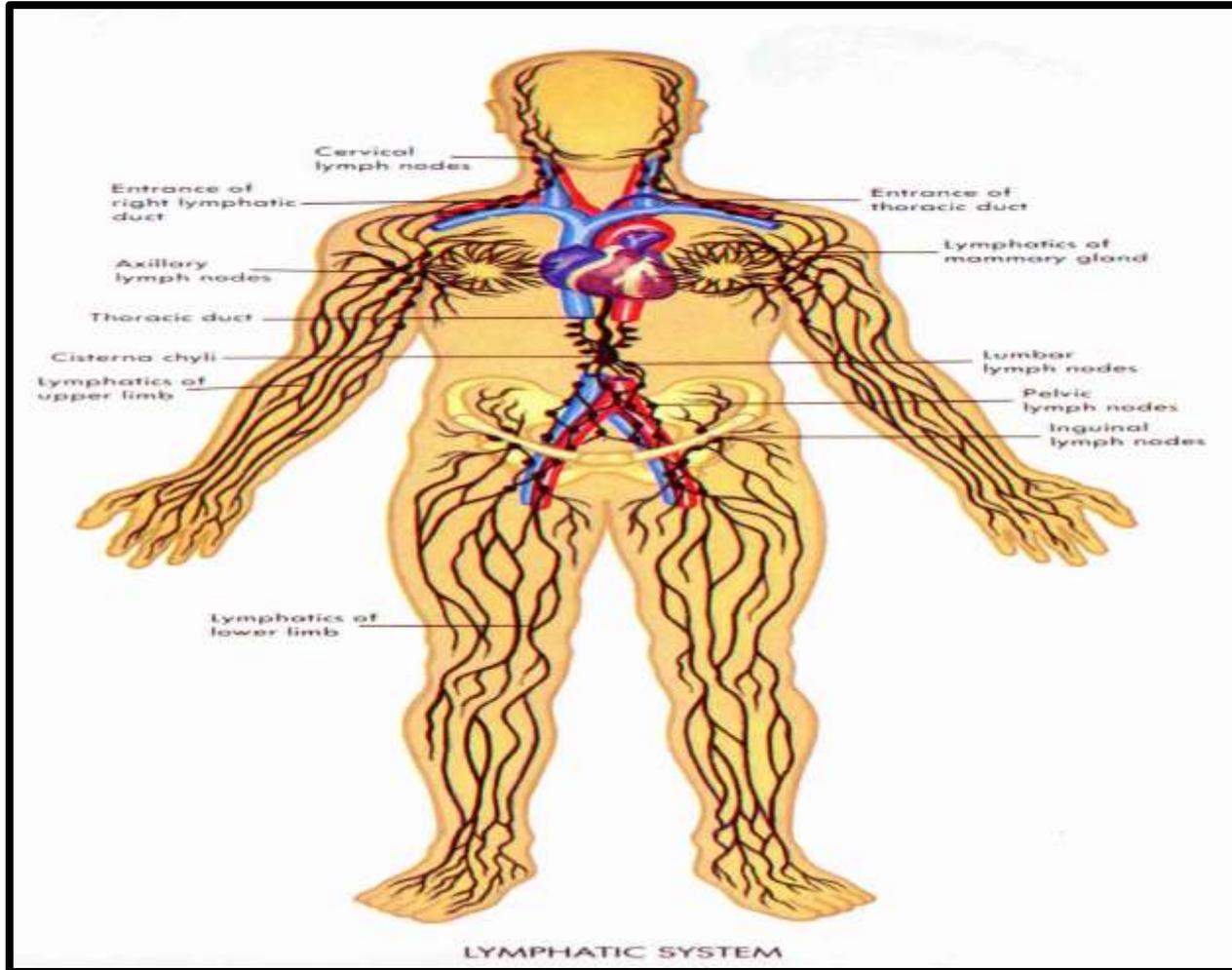
**Antigens** are foreign molecules capable of stimulating an immune response. Each antigen has distinct surface features, or epitopes, resulting in specific responses. (like the spike antigen in Covid-19)

**Antibodies (immunoglobulins)** are Y-shaped proteins produced by B cells of the immune system in response to exposure to antigens. Each antibody contains a paratope which recognizes a specific epitope on an antigen, acting like a lock and key binding mechanism. This binding helps to eliminate antigens from the body, either by direct neutralization or by 'tagging' for other arms of the immune system.

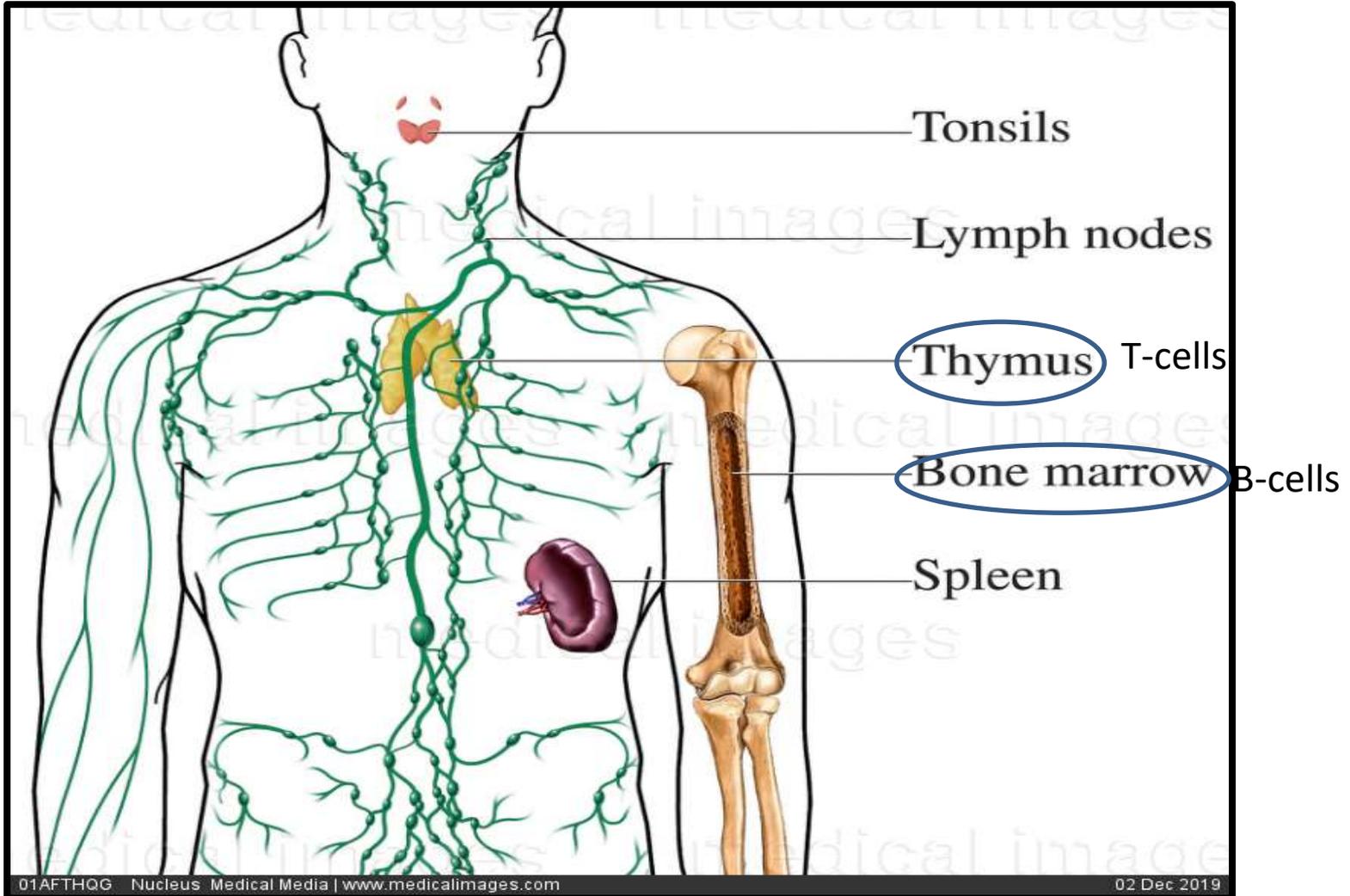
# The acute immune response to antigens and injury

- **Cytokines** are secreted by immune cells and act as **signaling proteins** reacting to injury, infections or insult. They include **Interferons** (some 20 or so), **Interleukins** (30 or more), **Growth factors**, **Tumor Necrosis factor**. (cytokine storm?)
- **Prostaglandins** (response to injury of which there are four (PG)  $E_2$  ( $PGE_2$ ), prostacyclin ( $PGI_2$ ), prostaglandin  $D_2$  ( $PGD_2$ ) and prostaglandin  $F_{2\alpha}$  ( $PGF_{2\alpha}$ ))
- **Leukotrienes** (response to allergy/asthma)

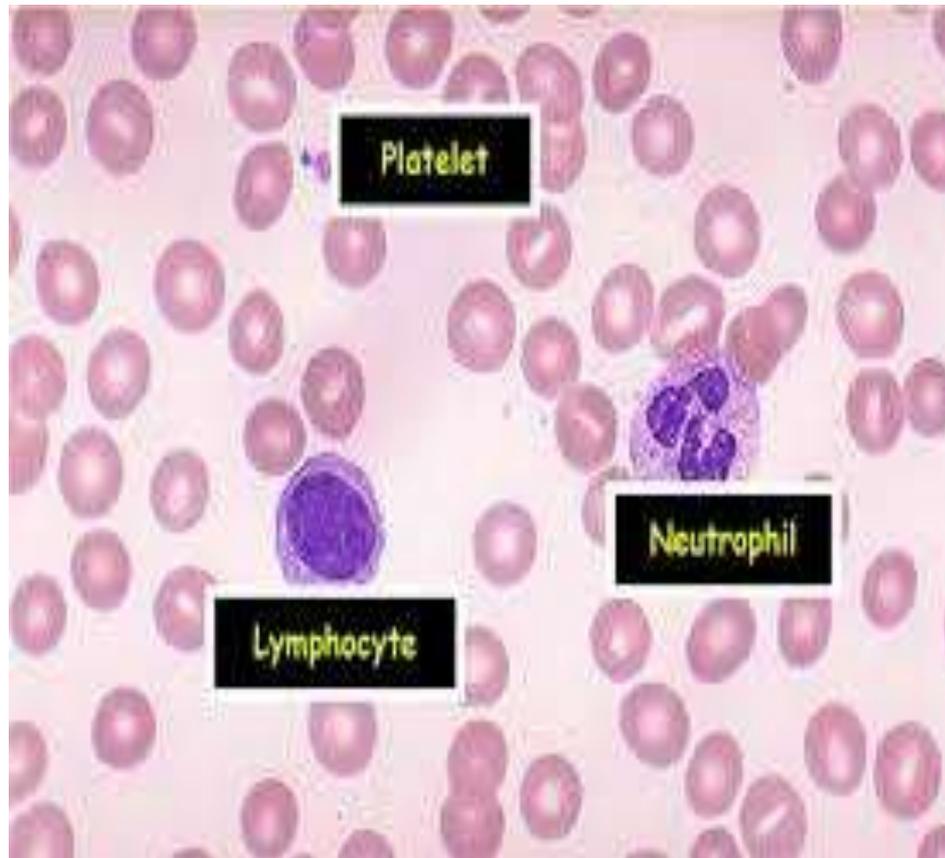
# The Lymphatic System: a parallel system to the vascular system



# Lymphatic System/lymphoid tissue



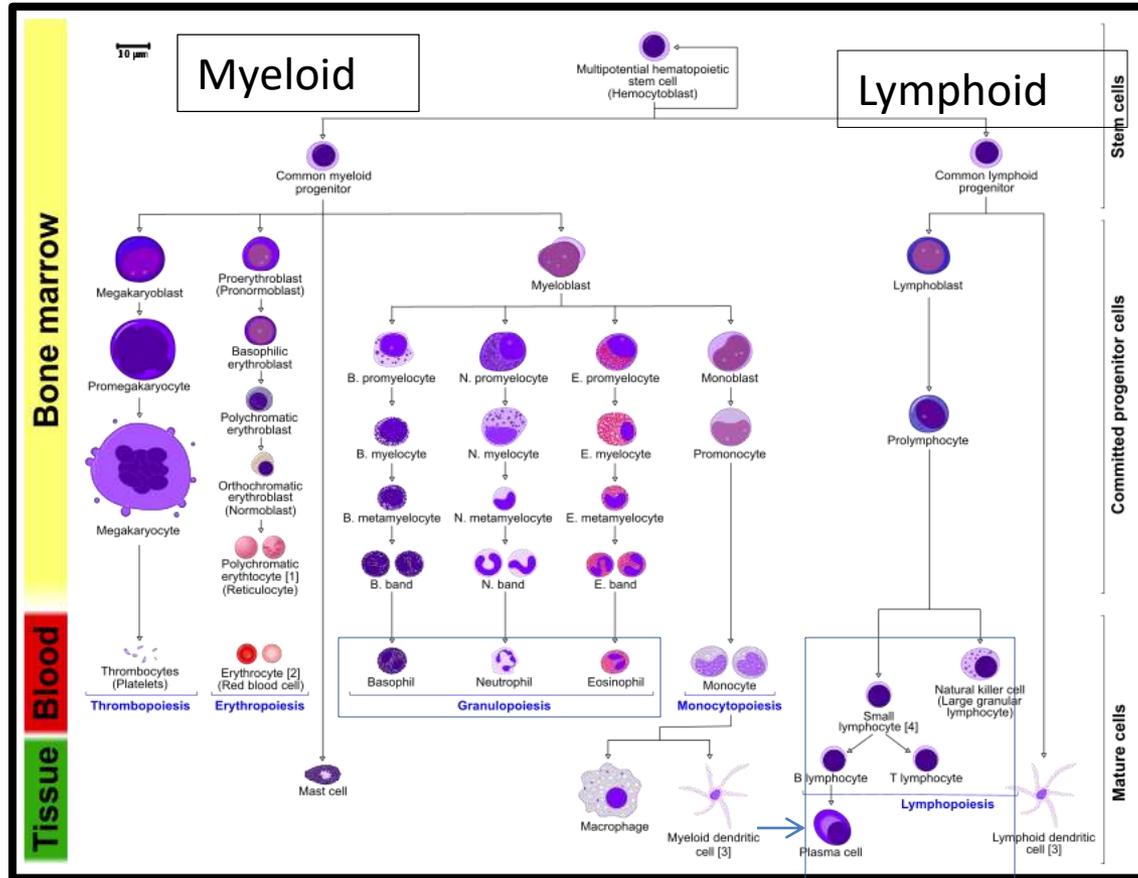
Peripheral Blood Smear: Neutrophils or polys or polymorphic nuclear leukocytes from the bone marrow circulate in the blood stream and are a major players in the body's defense against bacterial infections.



# CBC and Differential Blood Cell Count (WBC-5-10,000 normal)

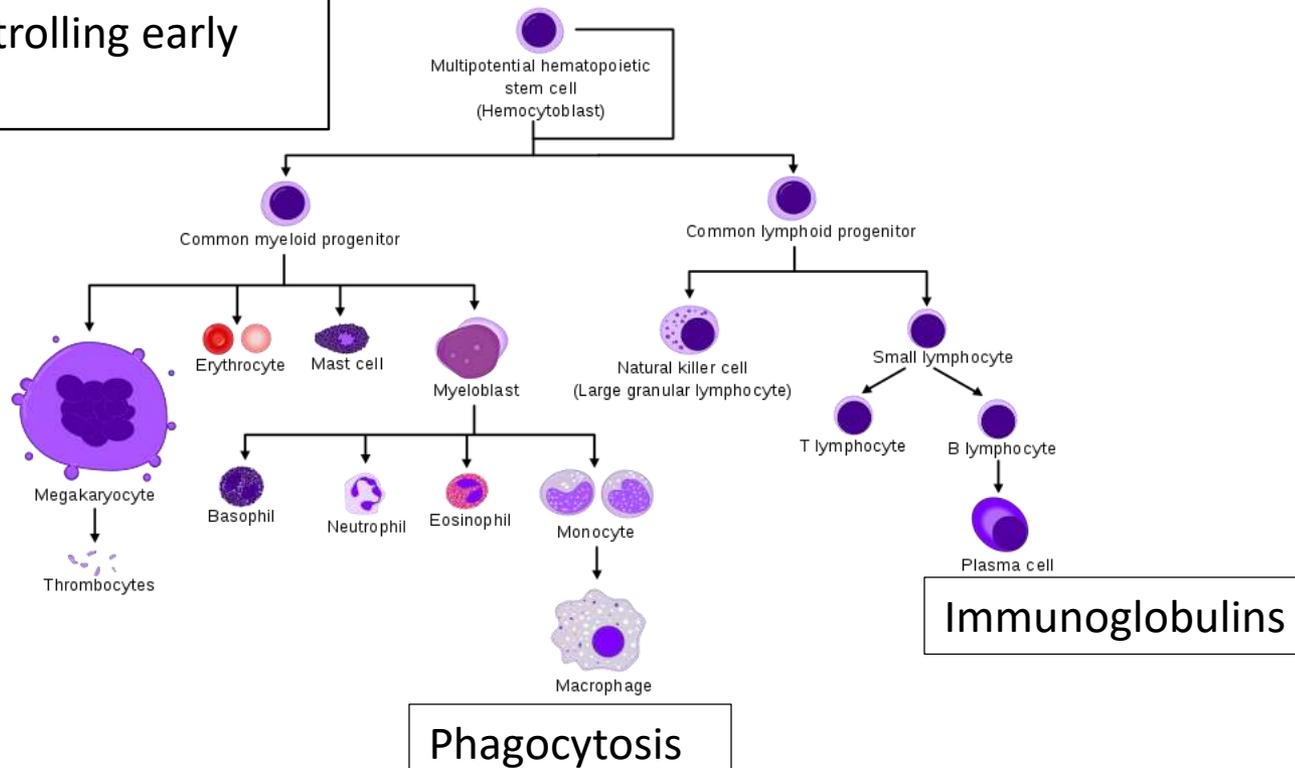
|                             |                                 |  |
|-----------------------------|---------------------------------|--|
| <b>Neutrophils Relative</b> | <b>37.0 %</b>                   | <i>bacterial infections</i>                              |
| <b>Lymphocytes Relative</b> | <b>53.0 %</b>                   | <i>immune system, leukemia</i>                           |
| <b>Monocytes Relative</b>   | <b>7.0 %</b>                    | <i>immune system, globulins, mature into macrophages</i> |
| <b>Eosinophils Relative</b> | <b>2.0 %</b>                    | <i>Allergic reactions, parasitic diseases</i>            |
| <b>Basophils Relative</b>   | <b>1.0 %</b>                    | <i>inflammation</i>                                      |
| <b>Neutrophils Absolute</b> | <b>3.3 <math>10^3/uL</math></b> | <i>1.5 - 7.8 <math>10^3/uL</math></i>                    |
| <b>Lymphocytes Absolute</b> | <b>4.7 <math>10^3/uL</math></b> | <i>0.8 - 3.9 <math>10^3/uL</math></i>                    |
| <b>Monocytes Absolute</b>   | <b>0.6 <math>10^3/uL</math></b> | <i>0.2 - 0.9 <math>10^3/uL</math></i>                    |
| <b>Eosinophils Absolute</b> | <b>0.2 <math>10^3/uL</math></b> | <i>0.0 - 0.5 <math>10^3/uL</math></i>                    |
| <b>Basophils Absolute</b>   | <b>0.1 <math>10^3/uL</math></b> | <i>0.0 - 0.2 <math>10^3/uL</math></i>                    |

# Blood Cell Formation

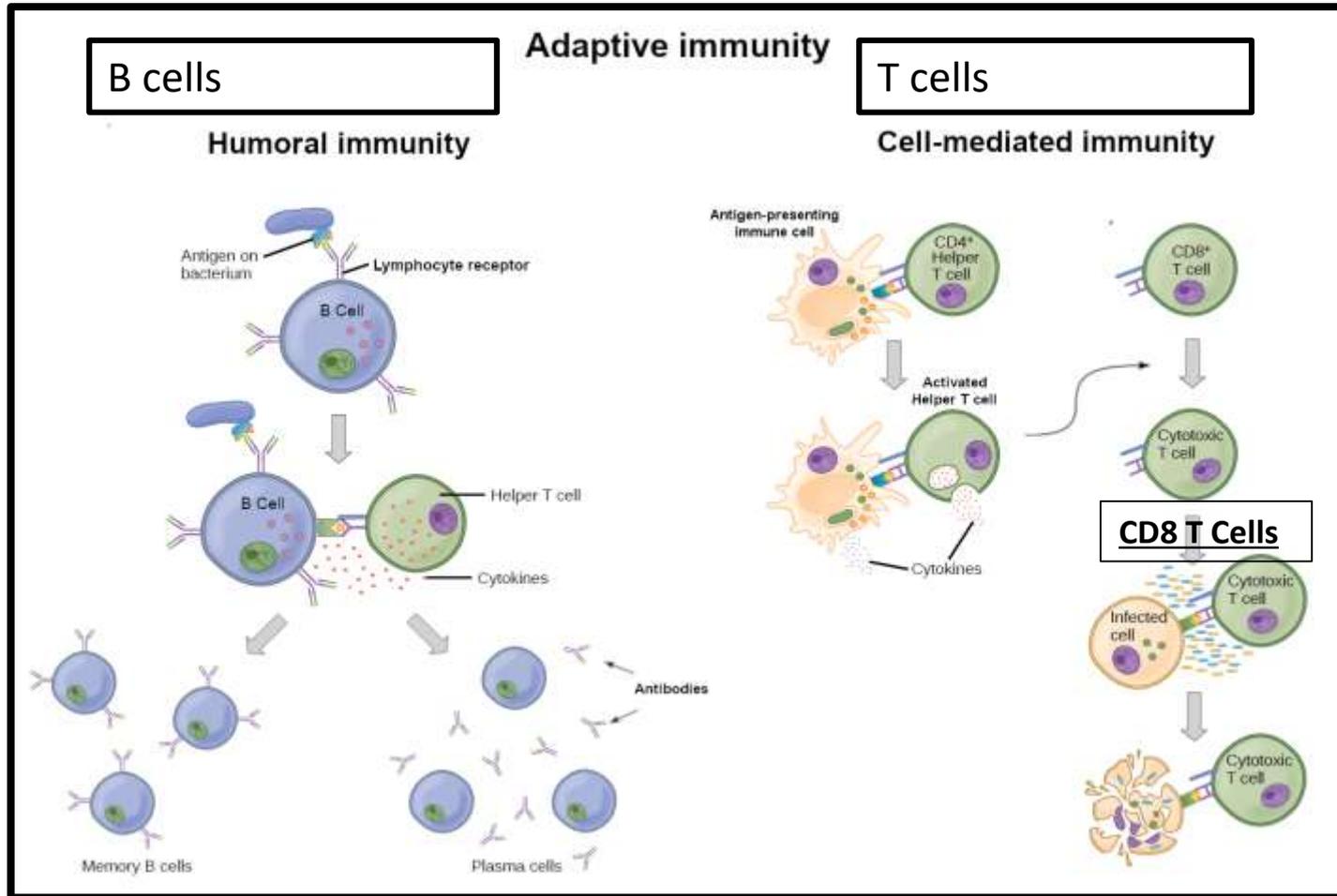


# Another Diagram of Immune Cells

NK cells are best known for killing virally infected cells, and detecting and controlling early signs of cancer.



# The Immune System; Lymphoid System and how it works



## Cytotoxic T Cells (CD8 T Cells)

Cytotoxic T cells kill their target cells, primarily by releasing cytotoxic granules into the cell to be killed. These cells recognize their specific antigen (such as fragments of viruses) when presented by **MHC (Hyman leukocyte antigens (HLA) Class I)** molecules that are present on the surface of all human nucleated cells.

MHC Class I molecules interact with a protein called CD8 on the cytotoxic T cells, which helps to identify this cell type. **Cytotoxic** T cells require several signals from other cells to be activated, such as from dendritic cells and T helper cells.

Their main function is to kill virally infected cells, but they also kill cells with intracellular bacteria or tumorous cells.

## T-Helper Cells (Th) (CD4 T Cells)

T helper cells have a wider range of effector functions than CD8 T cells and can differentiate into many different subtypes, such as **Th1, Th2, Th17** and regulatory T cells.

They become activated when they are presented with peptide antigens by MHC Class II molecules, which are expressed on the surface of APCs. **MHC Class II** molecules interact with a protein called CD4 on the T helper cells, which helps to identify this cell type.

The roles of a CD4 T cell may include activating other immune cells, releasing **cytokines**, and helping B cells to produce antibodies. They help to shape, activate and regulate the adaptive immune response.

## Memory T Cells

Following an infection, antigen-specific, long-lived memory T cells are formed. **Memory T cells** are important because they can quickly expand to large numbers of effector T cells upon re-exposure to the antigen and have a low threshold for activation.

They provide the immune system with memory against previously encountered antigens. Memory T cells may either be CD4+ or CD8+.

- There are several types of T cells based on their specific function: helper/effector, cytotoxic, memory, regulatory and gamma delta ( $\gamma\delta$ ) T cells

# Immunoglobulins

## (B lymphocytes/plasma cells)

- **Immunoglobulins**, also known as antibodies, are glycoprotein molecules produced mainly by plasma cells and initiate the immune response by specifically recognizing and binding to particular antigens, such as bacteria or viruses, and aiding in their destruction.
- Antibodies (immunoglobulins) are produced by B cells of the immune system in response to exposure to antigens. Each antibody contains a paratope which recognizes a specific epitope on an antigen, acting like a lock and key binding mechanism.

# Classes of Immunoglobulins

The five major antibody classes are:

- **Immunoglobulin G (IgG)**, 80%, is found in all body fluids and protects against bacterial and viral infections.
- **Immunoglobulin M (IgM)**, is the first antibody to be released by B cells during primary response
- Immunoglobulin D (IgD), important in B cell activation
- **Immunoglobulin A (IgA)**, which is found in high concentrations in the mucous membranes, particularly those lining the respiratory passages and gastrointestinal tract, and prevent attachment of pathogens to epithelial surfaces. Allergies
- **Immunoglobulin E (IgE)**, found on mast cells and basophils and triggers release of histamine which is associated mainly with allergic reactions (when the immune system overreacts to environmental antigens such as pollen or pet dander). It is found in the lungs, skin, and mucous membranes.

# Complement

- The complement system of which there are nine major components, are circulating proteins that function to help protect an organism from pathogens.
- The serum complement system is a series of dissolved proteins that protect against a variety of pathogens. Briefly, the classical pathway is activated by antibody that has bound to the surface of an invading cell. The membrane-bound antibody activates the first complement component, which activates eight additional complement proteins. The ultimate result is the formation of what is known as the membrane attack complex, a series of proteins that forms a pore in the membrane, resulting in the lysis of target cells.

# Immunizations

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are in bold.

| Vaccines   | Birth                | 1 mo                     | 2 mos                | 4 mos                | 6 mos                | 9 mos | 12 mos                   | 15 mos  | 18 mos | 19-23 mos                    | 2-3 yrs | 4-6 yrs              | 7-10 yrs | 11-12 yrs | 13-15 yrs            | 16-18 yrs                      |
|--|----------------------|--------------------------|----------------------|----------------------|----------------------|-------|--------------------------|---|--------|------------------------------|---------|----------------------|----------|-----------|----------------------|--------------------------------|
| Hepatitis B <sup>1</sup> (HepB)  | 1 <sup>st</sup> dose | ← 2 <sup>nd</sup> dose → |                      |                      |                      |       | ← 3 <sup>rd</sup> dose → |   |        |                              |         |                      |          |           |                      |                                |
| Rotavirus <sup>2</sup> (RV) RV1 (2-dose series); RV5 (3-dose series)                       |                      |                          | 1 <sup>st</sup> dose | 2 <sup>nd</sup> dose | See footnote 2       |       |                          |   |        |                              |         |                      |          |           |                      |                                |
| Diphtheria, tetanus, & acellular pertussis <sup>3</sup> (DTaP: <7 yrs)                     |                      |                          | 1 <sup>st</sup> dose | 2 <sup>nd</sup> dose | 3 <sup>rd</sup> dose |       |                          | ← 4 <sup>th</sup> dose →                                    |        |                              |         | 5 <sup>th</sup> dose |          |           |                      |                                |
| Tetanus, diphtheria, & acellular pertussis <sup>3</sup> (Tdap: ≥7 yrs)                     |                      |                          |                      |                      |                      |       |                          |   |        |                              |         |                      |          | (Tdap)    |                      |                                |
| Haemophilus influenzae type b <sup>4</sup> (Hib)   |                      |                          | 1 <sup>st</sup> dose | 2 <sup>nd</sup> dose | See footnote 5       |       |                          | ← 3 <sup>rd</sup> or 4 <sup>th</sup> dose. See footnote 5 → |        |                              |         |                      |          |           |                      |                                |
| Pneumococcal conjugate <sup>6</sup> (PCV13)  |                      |                          | 1 <sup>st</sup> dose | 2 <sup>nd</sup> dose | 3 <sup>rd</sup> dose |       |                          | ← 4 <sup>th</sup> dose →                                    |        |                              |         |                      |          |           |                      |                                |
| Pneumococcal polysaccharide <sup>6</sup> (PPSV23)  |                      |                          |                      |                      |                      |       |                          |   |        |                              |         |                      |          |           |                      |                                |
| Inactivated Poliovirus <sup>7</sup> (IPV) (<18 yrs)  |                      |                          | 1 <sup>st</sup> dose | 2 <sup>nd</sup> dose |                      |       | ← 3 <sup>rd</sup> dose → |   |        |                              |         | 4 <sup>th</sup> dose |          |           |                      |                                |
| Influenza <sup>8</sup> (IV; LAV) 2 doses for some: See footnote 8                          |                      |                          |                      |                      |                      |       |                          |   |        | Annual vaccination (IV only) |         |                      |          |           |                      | Annual vaccination (IV or LAV) |
| Measles, mumps, rubella <sup>9</sup> (MMR)   |                      |                          |                      |                      |                      |       |                          | ← 1 <sup>st</sup> dose →                                    |        |                              |         | 2 <sup>nd</sup> dose |          |           |                      |                                |
| Varicella <sup>10</sup> (VAR)  |                      |                          |                      |                      |                      |       |                          | ← 1 <sup>st</sup> dose →                                    |        |                              |         | 2 <sup>nd</sup> dose |          |           |                      |                                |
| Hepatitis A <sup>11</sup> (HepA)   |                      |                          |                      |                      |                      |       |                          | ← 2-dose series, See footnote 11 →                          |        |                              |         |                      |          |           |                      |                                |
| Human papillomavirus <sup>12</sup> (HPV2: females only; HPV4: males and females)           |                      |                          |                      |                      |                      |       |                          |   |        |                              |         |                      |          |           | (3-dose series)      |                                |
| Meningococcal <sup>13</sup> (Hib-Men-CY ≥ 6 weeks; MenACWY-D ≥ 9 mos; MenACWY-CRM ≥ 2 mos) |                      |                          |                      |                      |                      |       |                          |   |        |                              |         |                      |          |           | 1 <sup>st</sup> dose |                                |

Range of recommended ages for all children
  Range of recommended ages for catch-up immunization
  Range of recommended ages for certain high-risk groups
  Range of recommended ages during which catch-up is encouraged and for certain high-risk groups
  Not routinely recommended

This schedule includes recommendations in effect as of January 1, 2014. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Vaccination providers should consult the relevant Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations, available online at <http://www.cdc.gov/vaccines/hcp/acip-recs/index.html>. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (<http://www.vaers.hhs.gov>) or by telephone (800-822-7967). Suspected cases of vaccine-preventable diseases should be reported to the state or local health department. Additional information, including precautions and contraindications for vaccination, is available from CDC online (<http://www.cdc.gov/vaccines>) or by telephone (800-CDC-INFO [800-232-4636]).

This schedule is approved by the Advisory Committee on Immunization Practices (<http://www.cdc.gov/vaccines/acip>), the American Academy of Pediatrics (<http://www.aap.org>), the American Academy of Family Physicians (<http://www.aafp.org>), and the American College of Obstetricians and Gynecologists (<http://www.acog.org>).

**NOTE:** The above recommendations must be read along with the footnotes of this schedule.

# Adult Immunizations

Almost 1 out of every 3 people in the US will develop shingles in their lifetime (adult reactivation of chicken pox/varicella in nerves)

- Shingles vaccine, which protects against shingles and the complications from the disease (recommended for healthy adults 50 years and older) Two Shots/Expensive!
- Pneumococcal polysaccharide vaccine (PPSV23), which protects against serious pneumococcal disease, including meningitis and bloodstream infections (recommended for all adults 65 years or older, and for adults younger than 65 years who have certain health conditions)

# Leukemias and Lymphomas

- Acute Lymphocytic Leukemia (ALL)
- Acute Myeloid Leukemia (AML)
- Chronic Lymphocytic Leukemia (CLL--10 percent)
- Chronic Myeloid Leukemia (CML) translocation of chromosome 9 & 22 (Philadelphia chromosome) diagnosed with Karyotype, FISH, and PCR. New Rx. With tyrosine kinase inhibitors, good outcomes
- Chronic Myelomonocytic Leukemia (CMML)
- Polycythemia Vera--too many RBCs; JAK2 pathway, Dx. PCR and increase EPO. Thrombosis main issue. Phlebotomy, and Hydroxyurea.
- Essential thrombocytosis: JAK2, CALR and MPL mutations, too many platelets, usually asymptomatic
- Myelofibrosis; nasty disease, burned out bone marrow, allogeneic stem cell transplant with 18 month survival or less.
- Multiple Myeloma (10 percent second only to CLL)

# Multiple Myeloma: plasma cell dyscrasias

- More than 12,000 deaths per year
- Varying stages-early MGUS that you just observe that progresses.
- Plasma cells make abnormal proteins (M).
- Diagnosis based on increased CA+, renal insufficiency (CC<40), anemic <10 gms and lytic bone lesions. Bone marrow >60 percent plasma cells confirms the diagnosis.
- Improving therapies with >50% 5 year survival

# Autoimmune and Inflammatory Immune Diseases

- Rheumatoid Arthritis
- Psoriasis
- Multiple Sclerosis
- Crohn's Disease
- Ulcerative Colitis
- Type I diabetes/juvenile
- Addison's Disease
- Graves Disease
- Scleroderma (system sclerosis-limited and diffuse-vascular injury)  
Raynaud's Phenomena-mycophenolate, cyclosporin, prednisone. ANA  
+
- Lupus Erythematosus
- Pernicious Anemia
- Polyarthritits Nodosa
- Myasthenia Gravis

# SLE-SYSTEMIC LUPUS ERYTHEMATOSIS

- Rare (140/100,000) but more common in minorities and young women (9 females to 1 male) with a strong genetic predisposition. Related to deposition of C3 and C5 complement as an autoimmune disease.
- Treatment with Hydroxychloroquine, Steroids and Cyclophosphamide and now Rituximab.
- Symptoms; butterfly rash, Reynaud's phenomena, alopecia and depression
- Delay in diagnosis due to wide range of symptoms than mimic other disorders.

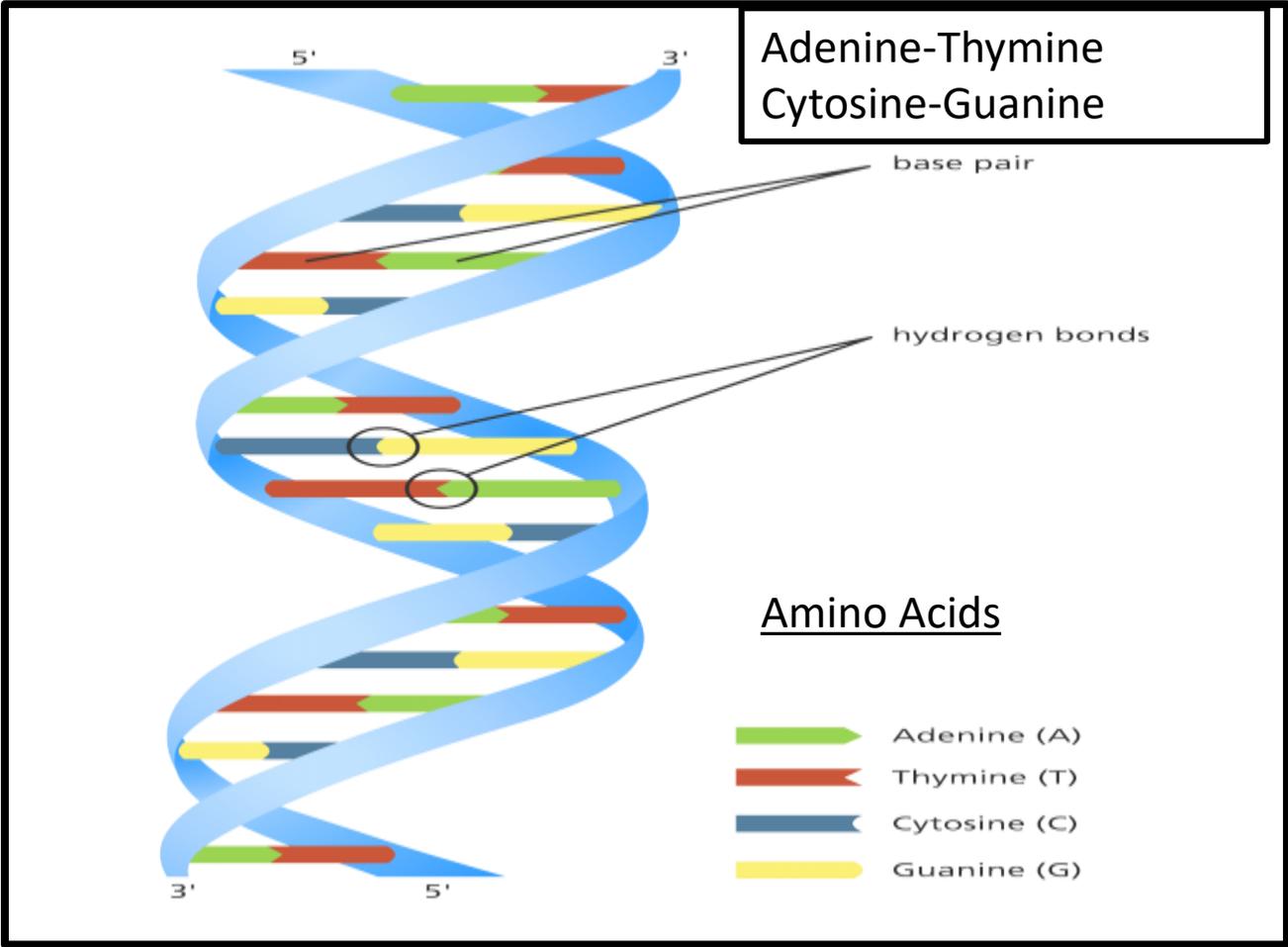
# Tests

- Antinuclear antibody (ANA)
- Rheumatoid factor (RF)
- CBC (White Blood Cell Counts)
- C-reactive protein (CRP)
- Erythrocyte sedimentation rate (ESR)
- Urinalysis
- Complement Fixation test

# When Genetics Came into View

- As recently as 1956, the double helix of genetic DNA (deoxyribonucleic acid) was reported by James Watson and Francis Crick.
- In 1966, the molecular make up of genes and chromosomes was found to consist of the sequencing of four amino acids: namely adenine, guanine, cytosine and thymine linked to a sugar deoxyribose and a phosphate backbone or linkage.
- There are 23 pairs of chromosomes that contain the genetic codes.
- The human genome consists of three billion of these nucleotides or “letters” and most all of the 60 trillion cells in the human body contain a complete copy of this genome.
- American College of Medical Genetics and Genomics (ACMG

# Genetics and Cellular Anatomy



# What is a chromosome?

- **Chromosomes** are the things that make organisms what they are. They carry all of the information used to help a cell grow, thrive, and replicate. **Chromosomes** are made up of DNA. Segments of DNA in specific patterns are called **genes**. ... You will find the **chromosomes** in the nucleus of all cells.
- Mitochondria also contain DNA.
- A **chromosome** contains hundreds to thousands of **genes**.
- The shortest DNA molecule found in humans are about 17,000 nucleotides long and the longest consists of over 100 million.

**Definition of an Allele:** An allele is any one of two or more genes that may occur alternatively at a given site (locus) on a chromosome. **Alleles** may occur in pairs, or there may be multiple **alleles** affecting the expression (phenotype) of a particular trait.

# Genes and Chromosomes

## Definitions

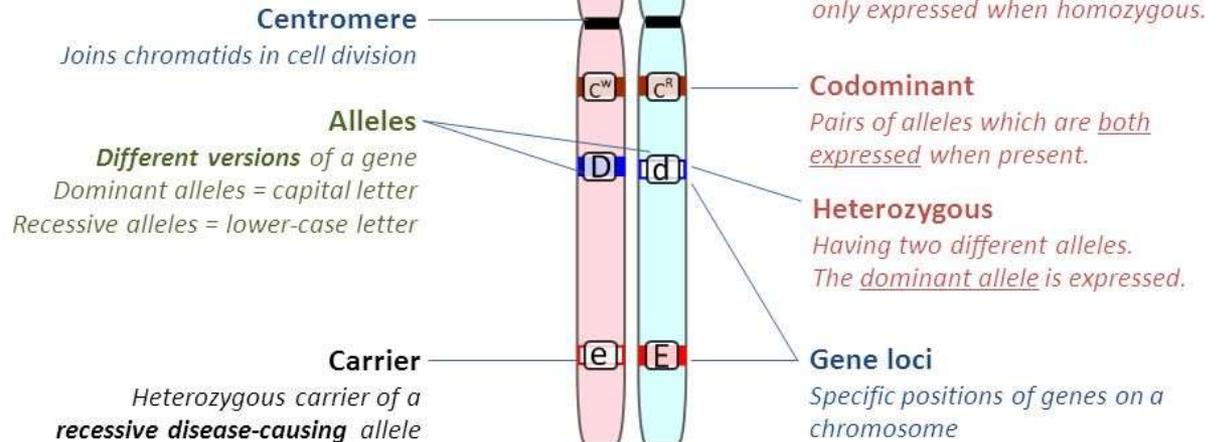
This image shows a pair of homologous chromosomes. Name and annotate the labeled features.

### Genotype

*The combination of alleles of a gene carried by an organism*

### Phenotype

*The expression of alleles of a gene carried by an organism*



# Difference between DNA & RNA

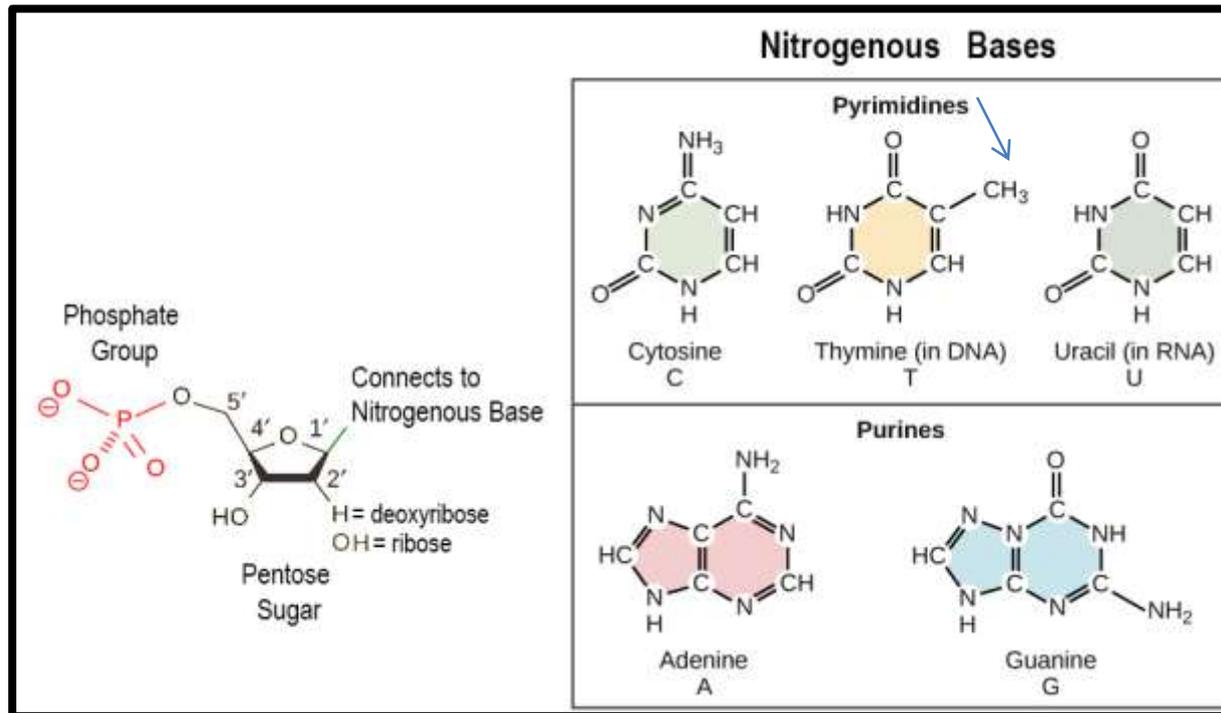
- **DNA** is a long polymer with deoxyribose (a sugar) and phosphate backbone. Having **four** different nitrogenous bases: adenine, guanine, cytosine and thymine.
- **RNA** is a polymer with a ribose (a sugar) and phosphate backbone. **Four** different nitrogenous bases: adenine, guanine, cytosine, and uracil.

Differences between DNA & RNA: **Thymine** is the pyrimidine base of the DNA, whereas **Uracil** is the pyrimidine base of the RNA. The occurrence of thymine and uracil is a crucial difference as thymine is only found in DNA and uracil is only found in RNA. **Methyl group** is absent in uracil whereas present in thymine at the C-5 position.

# What is the chemistry of cytosine, adenine, thymine and guanine made

- As a nitrogenous base, **cytosine** is full of nitrogen atoms (it has three). It also has one ring of carbon, which makes it a pyrimidine. A purine, on the other hand, has two rings of carbon. There are two pyrimidines, **cytosine** and thymine, and two purines, adenine and guanine, in DNA.

# Basic structure of DNA



# What is an amino acid?

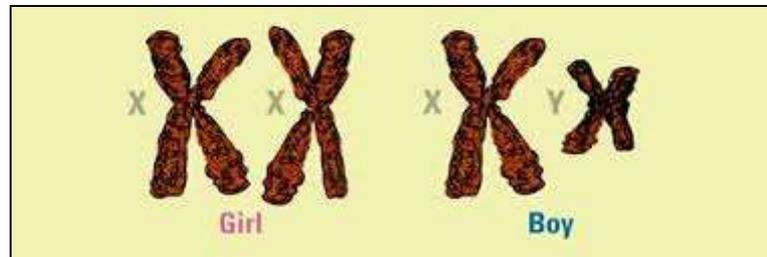
- An amino acid is an organic molecule that is made up of a basic **amino group** ( $-\text{NH}_2$ ), an acidic **carboxyl group** ( $-\text{COOH}$ ), and an organic R group (or side chain) that is unique to each amino acid. The term amino acid is short for  $\alpha$ -amino [alpha-amino] carboxylic acid

# Amino acids

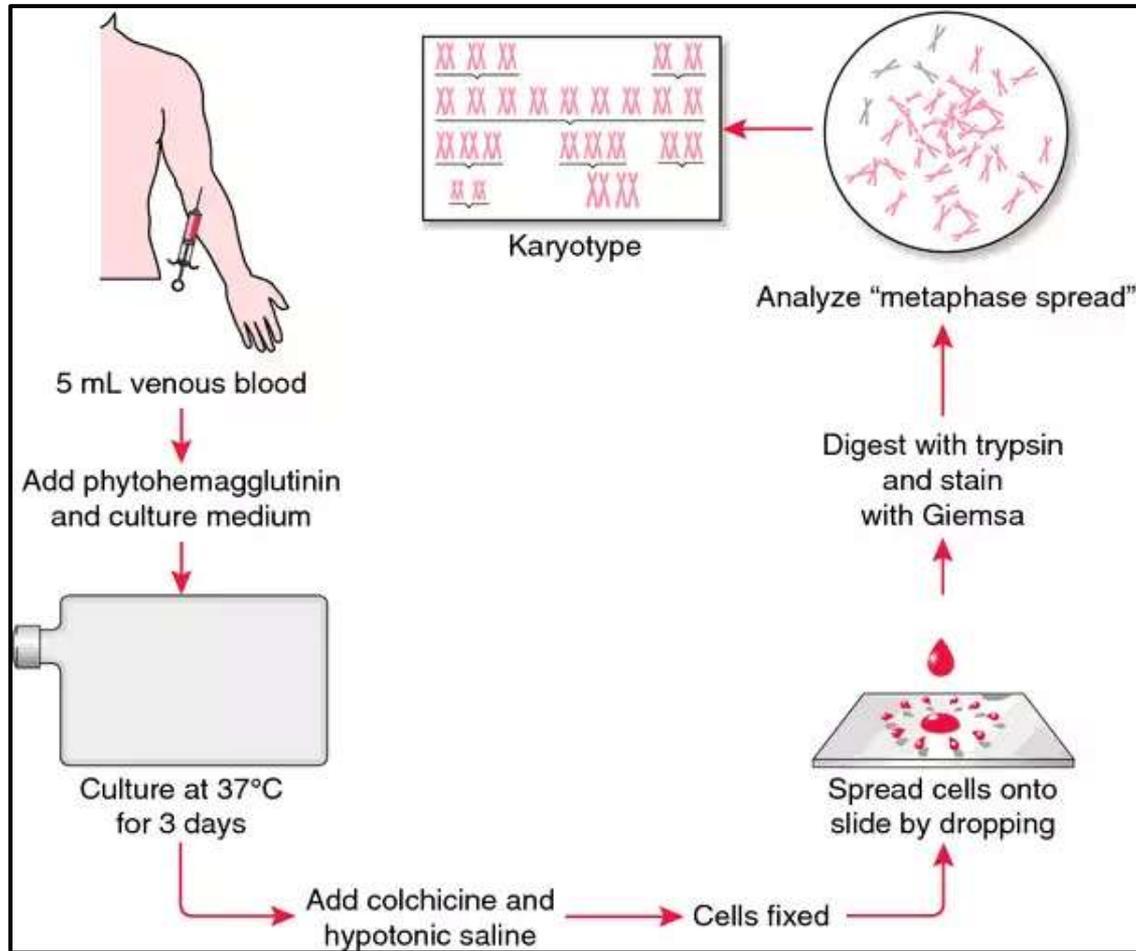
- ESSENTIAL AMINO ACIDS
- Essential amino acids cannot be made by the body. As a result, they must come from food.
- The 9 essential amino acids are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.
- Nonessential amino acids include: alanine, arginine, asparagine, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, and tyrosine.

# General Knowledge

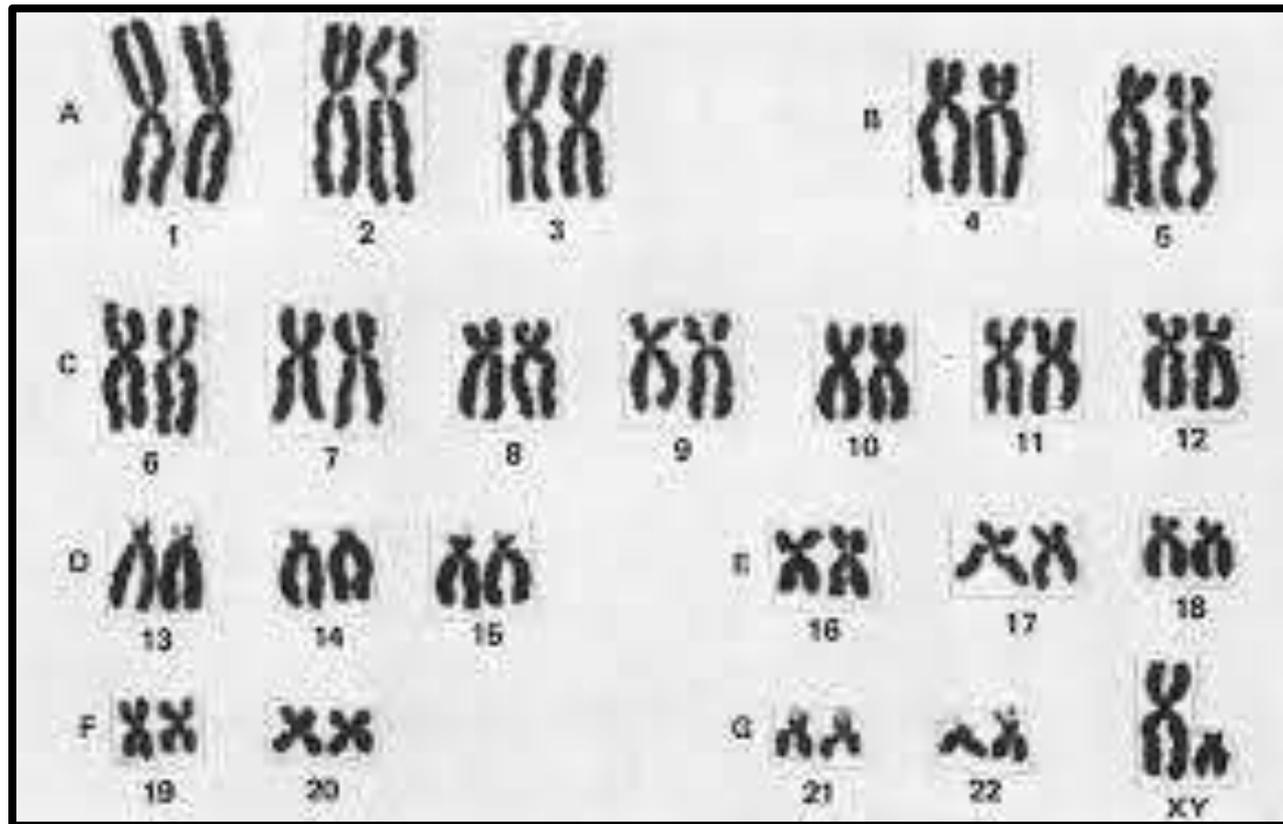
- In **humans**, each cell normally contains 23 pairs of **chromosomes**, for a total of 46. Twenty-two of these pairs, called autosomes, look the same in both males and females. The 23rd pair, the sex **chromosomes**, differ between males and females.



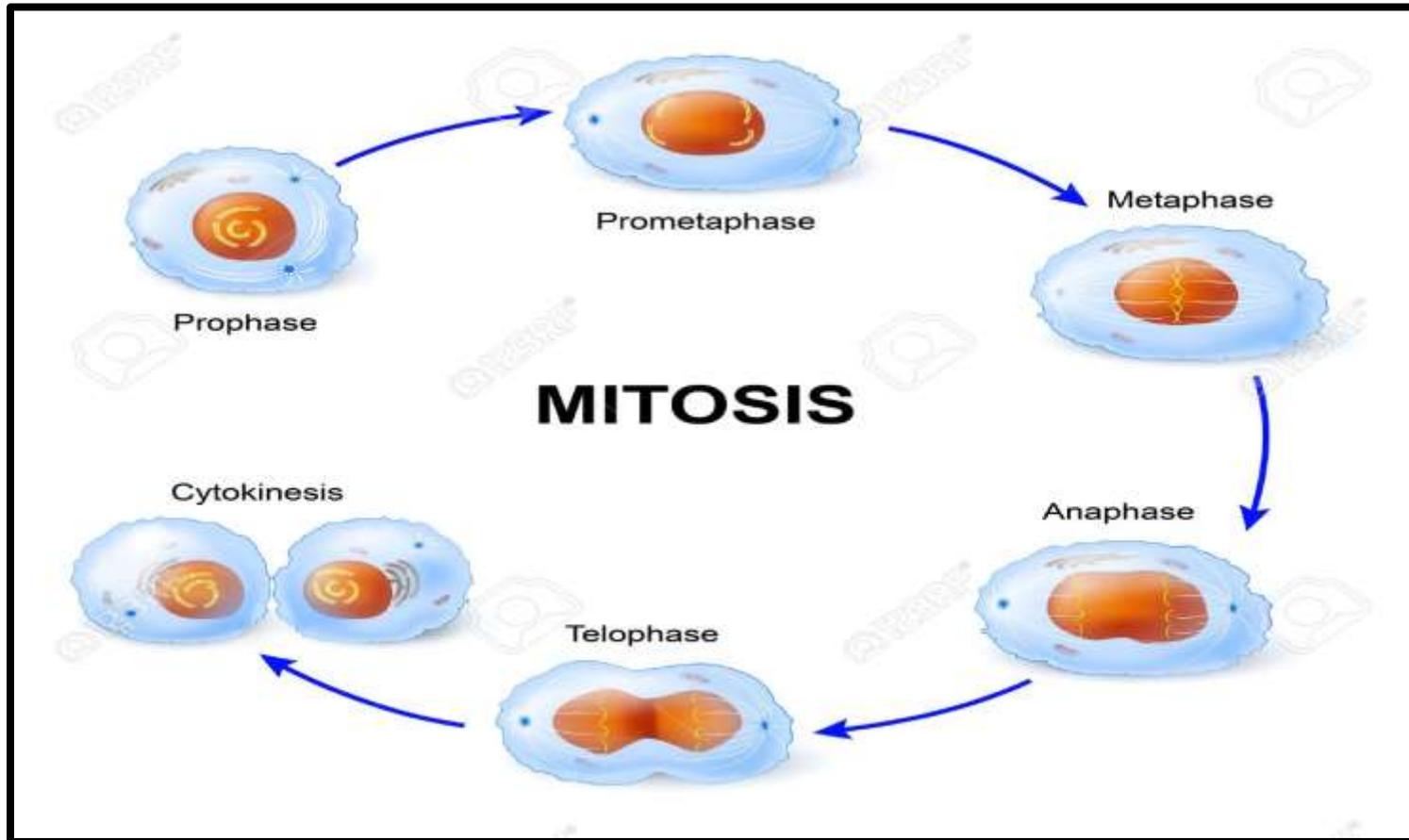
# Karyotyping



# The Karyotype of the Human Species

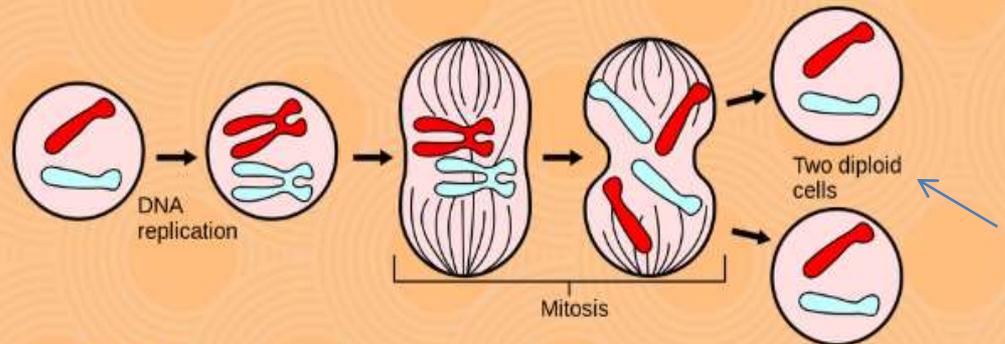


# Mitosis

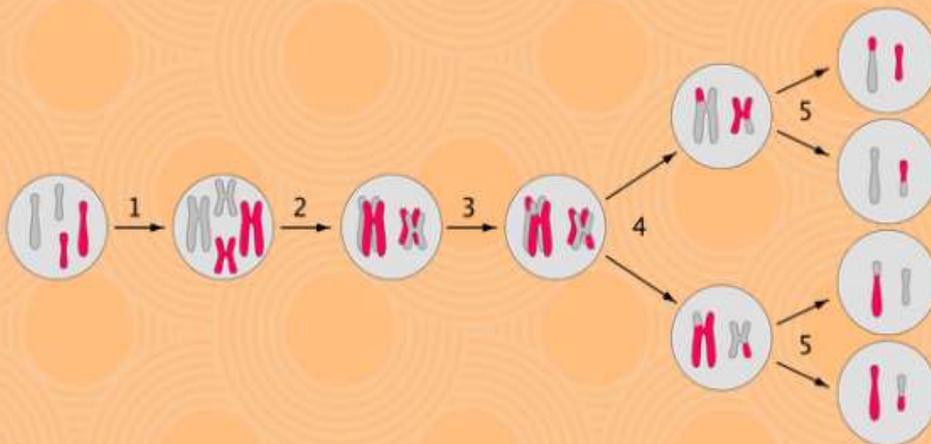


Meiosis split the DNA in two to produces the DNA of Sperm and Ova causing our offspring to be a combination of both parents

# Mitosis



-VS-

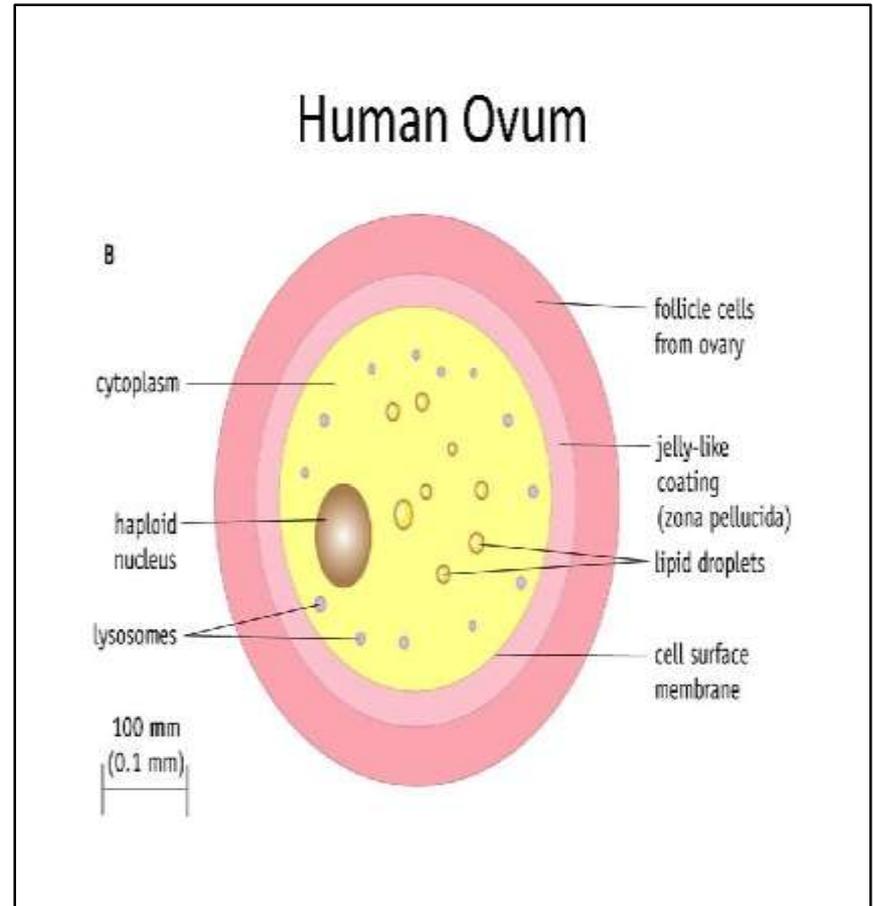
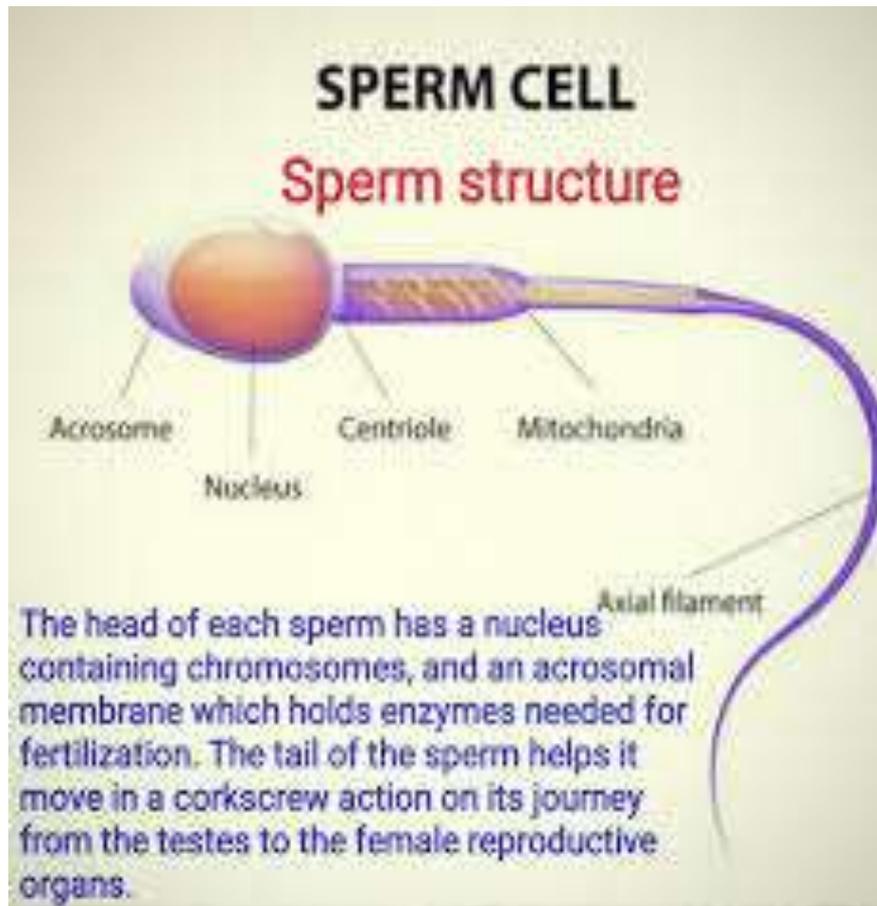


# Meiosis

# Replication of DNA and formation of MRNA

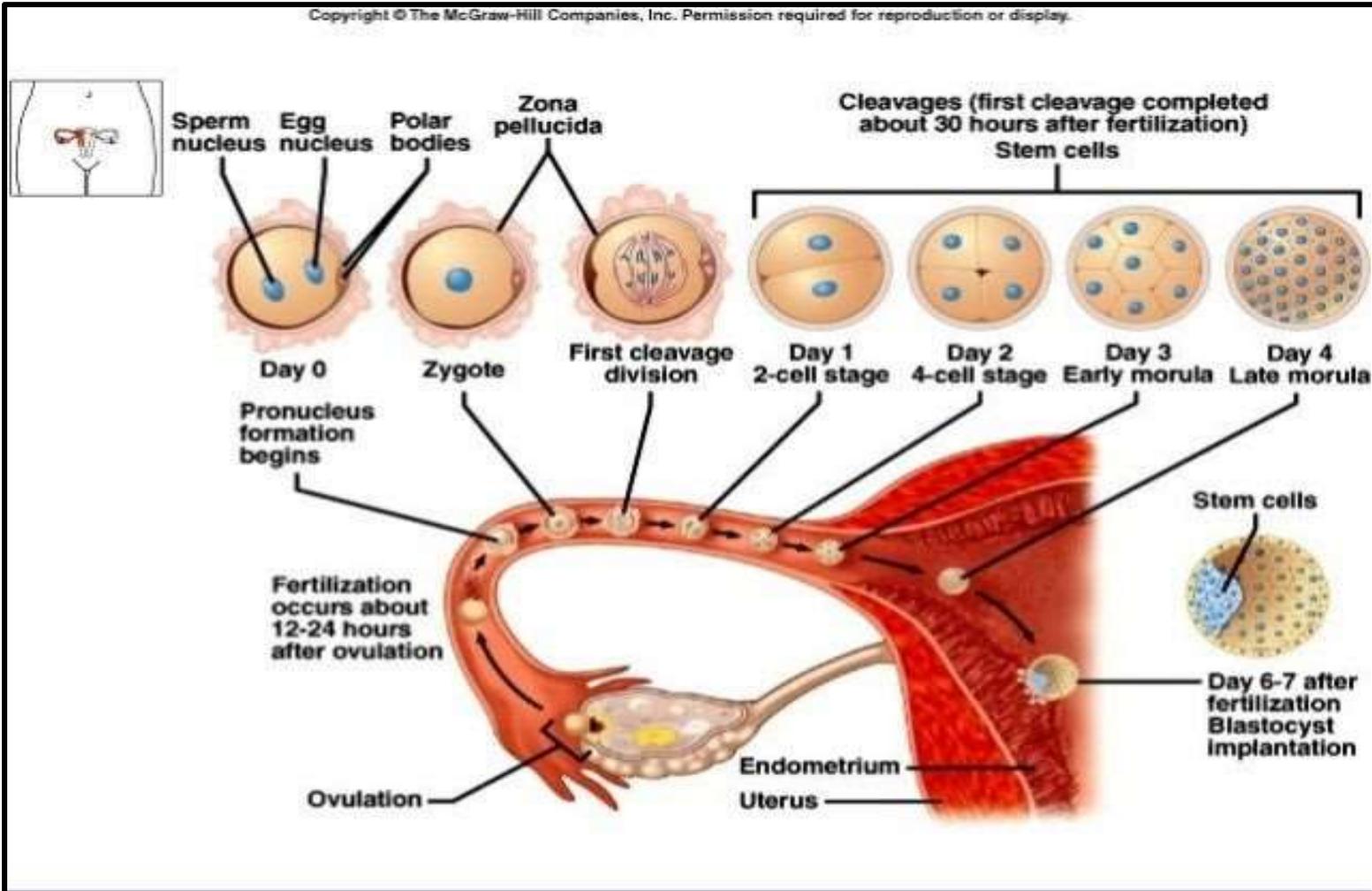
- DNA polymerase catalyzes the system of replication that works like a zipper that genetic DNA is the template with unzipping of the elements of the folded double helix.
- Helicase enzyme that causes unzipping.
- DNA always contains the same number of CS as GS, and AS as TS.
- AN RNA polymerase uses a DNA sequence as a template for a piece of RNA; every triplet of letters or codons
- This message is read by the ribosome and every triplet of letters in the MRNA tells the translation mechanism what amino acids to add to the triplet codons form MRNA.
- The Ribosome adds additional proteins and folds it into shape.

Sperm (120,000,000 per CC) and Ova (300,000 remain at puberty and of these, only 300 to 400 will be ovulated during a woman's reproductive lifetime



# The Travels of the fertilized ova

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When Should Someone have a Genetic test? **Pharmacogenomics** is coming of age with 25 genes identified as being important in drug interactions and efficacy.

- *At birth? Pregnancy?*
- *When you come down with a disease like cancer for **precision medical care?***
- *Reference and genetic guide for your decedents?*

#### Arguments to get it in the newborn period

1. Uncover repairable genetic defects (CRISPR-cas9 or gene replacement therapy on the horizon)
2. Predict predisposition for various illnesses
3. Guide drug treatment

# Arguments against

- Undue Worry caused by a low degree of penetration of a genetic variant.
- Most of the common disorders have underlying genetic risk that is spread across multiple genes and alleles.
- Gene evaluation at this point in time as it relates to disease is imprecise and very early in its evolution and linkage to disease.

## **Common Genetic Disorders that relate to an identifiable gene (in over 100 disorders just one gene)**

- Cystic Fibrosis
- Hemophilia (sex linked autosomal dominant X--Factor 8 and 3 types)
- Huntington's Chorea (single defective gene on chromosome 4-autosomal dominant)
- Neurofibromatosis (gene 17 and 22 (two types) dominant)
- Thalassemia
- Tourette syndrome (dominant gene)
- Von Willenbrands (autosomal dominant)
- Sickle Cell (chromosome 11) Trait and Disease; one in 11 African Americans have the trait.
- Down's (a third copy of a gene trisomy 21)

## **Cancer Genes: Most cancers have some genetic basis and are related to gene mutations**

- The **most commonly** mutated **gene** in people with **cancer** is p53 or TP53. More than 50% of **cancers** involve a missing or damaged p53 **gene**.
- BRCA1 and BRCA2: The **most common** cause of hereditary **breast cancer** (triple negative)
- **Prostate Cancer**: BRCA1, BRCA2, the mismatch repair **genes**, and HOXB13
- Lung Cancer: Somatic mutations in the TP53, EGFR, and KRAS **genes** are **common** in **lung cancers**

# Designer Babies and Curative Technique for genetic disorders?

- Gene Splicing techniques/problems (Crispr-Cas9)
- Eugenics/ethical considerations
- Role inheritance plays; nature vs. nurture
- Crack babies, smoking, need for prenatal care

# An Example of a rare genetic disease; Familial Mediterranean Fever

- Seen in patients with Middle East ancestry and hinges on 23 different gene mutations some of which are autosomal dominant and some recessive.
- Characterized by recurrent fever, arthritis and serosal inflammation (abdominal pain).
- Some succumb to amyloidosis with ESRD if not treated with colchicine which stabilizes the WBCs and overcomes inflammation.
- Four types have been identified TNT receptor, Hyperimmunoglobulinemia D, Cryopyrin and Mevalonate kinase deficiency.

# **Viruses and Vaccines**

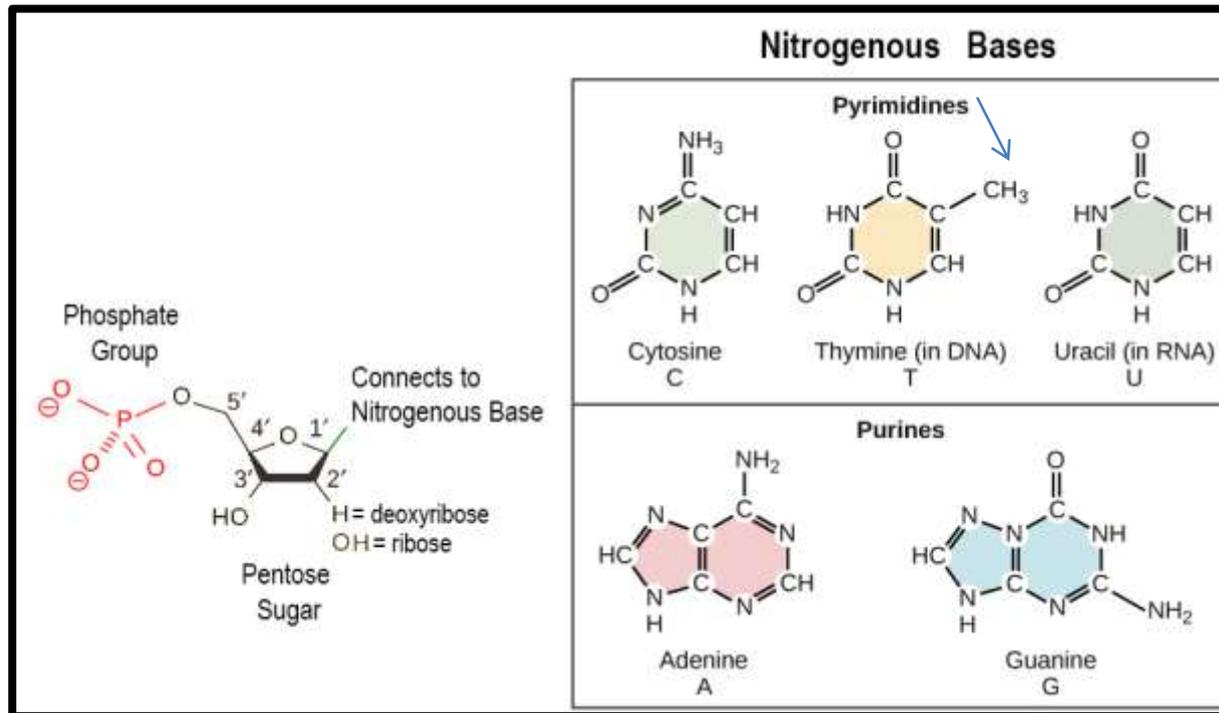
**Richard WENDEL md, mba**

# Difference between DNA & RNA

- **DNA** that is found in the cell nucleus/the genome and mitochondria is a long polymer ( large number of similar units bonded together) with **deoxyribose** (a sugar) and phosphate backbone. Having **four** different nitrogenous bases: adenine, guanine, cytosine and thymine.
- **RNA** is found in messenger RNA is a polymer with a **ribose** (a sugar) and phosphate backbone. **Four** different nitrogenous bases: adenine, guanine, cytosine, and uracil.

Differences between DNA & RNA: Thymine is the pyrimidine base of the DNA, whereas Uracil is the pyrimidine base of the RNA. The occurrence of thymine and uracil is a crucial difference as thymine is only found in DNA and uracil is only found in RNA. A **Methyl group** is absent in uracil whereas present in thymine at the C-5 position.

# Basic structure of DNA



Two Types of Viruses/phage particles: **Lytic/virulent** and **lysogenic/host cell survives** but produces virus particles

- DNA: single stranded or double stranded
- RNA: single stranded or double stranded

More than two-thirds of human viruses can also infect non-human hosts, mainly mammals, and sometimes birds.

There are 219 **virus** species that are known to be able to infect **humans**

Viruses are entirely dependent on the host for replication and they are roughly one-hundredth the size of a bacteria

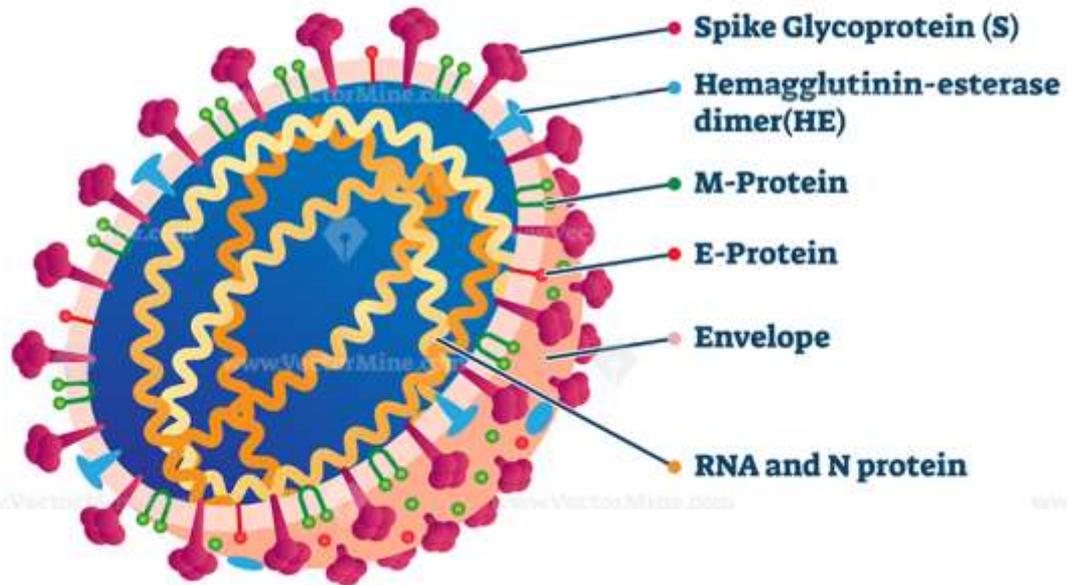
They consist of two or three distinct parts:

1. genetic material, either DNA or RNA
2. a protein coat, or capsid, which protects the genetic information
3. a lipid envelope is sometimes present around the protein coat when the virus is outside of the cell

# Corona Virus

M, E, N proteins are envelope proteins

## CORONA VIRUS STRUCTURE



Only a small part of the total diversity of viruses has been studied. As of 2019, 4 realms, 9 kingdoms, 16 phyla, 2 subphyla, 36 classes, 55 orders, 8 suborders, 168 families, 103 subfamilies, 1,422 genera, 68 subgenera, and 6,589 species of viruses have been defined by the ICTV.(International Committee on Taxonomy of Viruses)

Coronaviruses are a large family of viruses found in both animals and humans, and are known to cause the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS), Severe Acute Respiratory Syndrome (SARS), and Novel Coronavirus (COVID-19). The COVID-19 virus attacks **angiotensin 2 receptors present in virtually all human cells and thus attacks multiple organ systems as well as the lungs**

# Covid-19; just a few pointers

A multisystem disease (Angiotensin 2 receptors) that is much more lethal than the flu with 'long haul' symptoms. Protect yourself and listen to the medical experts.

## Therapy:

- Ventilation with PO<sub>2</sub> of greater than 60% not SOB, Intubation as late as possible, use of prone position
- Antiviral treatment early Remdesivir (other monoclonal antibodies)
- Steroids (hydroxydexamethasone) 10% reduction in mortality
- Convalescent Serum-if given early in lesser sick patients.
- Anticoagulation with LMWH (Low Molecular Weight Heparin) to prevent DVT and strokes.

# Common Gastroenteritis Viruses

- Norovirus which is highly infectious (stool contamination) and has caused serious problems aboard cruise ships.
- Rotavirus- most common virus causing gastroenteritis in children.

# Aids; HIV

- A retro virus that infects CD4-T cells causing a decline in their numbers. Less than 200 is critical level.
- 1.1 million infected in US and no longer considered fatal but a chronic disease with no complete cure and need for lifelong medication.
- Screening of high risk individuals (after 45 days from inoculation this detects 99% of cases).
- When treatment leads to no detectable virus, there is no chance of transmission.
- Three classes of new drugs for treatment; mainstay Truvada and Descovy (15,000/yr ). Problems with compliance.
- These drugs may be taken to prevent infection in high risk individuals.
- 4<sup>th</sup> generation assays can detect infections as early as 2 weeks. (later PCR, RNA, and HIV)

Types of Vaccines: **All vaccines work by exposing the body to molecules from the target pathogen (antigens) to trigger an immune response (antibodies) but the method of exposure varies. Here's how viral vector-based vaccines work.**

- Inactivated vaccines; weakened (attenuated) or deactivated form of the pathogen that causes a disease to trigger protective immunity to it. (measles, mumps, rubella (MMR), cowpox, yellow fever)
- Live-attenuated vaccines-polio and measles (working on a virus for Covid that hooks onto the Angiotensin 2 site and block it for the virulent strain).
- **mRNA vaccine is a stranded RNA molecule that is complementary to one of the DNA strands of a gene of the virus (give instructions for our cells to make a harmless piece of what is called the “spike protein” of the Covid virus.**

# More Vaccines Vehicles

- T Subunit: effective T-cell-inducing vaccines against viral and parasitic diseases such as HIV and malaria
- **Recombinant: inserting the DNA encoding an antigen (such as a viral spike protein) that stimulates an immune response into bacterial or mammalian cells, expressing the antigen in these cells and then purifying it from them.**
- Polysaccharide: only the sugar part of the bacteria, the capsule, is included as the antigen to stimulate the immune response.
- Conjugate vaccine: is a substance that is composed of a polysaccharide antigen fused (conjugated) to a carrier molecule
- Toxoid vaccines: contain a toxin or chemical made by the bacteria or virus
- Viral vector vaccine using a modified virus (the vector) to deliver genetic code for antigen, use the body's own cells to produce them.

# Current Vaccines use for Covid 19

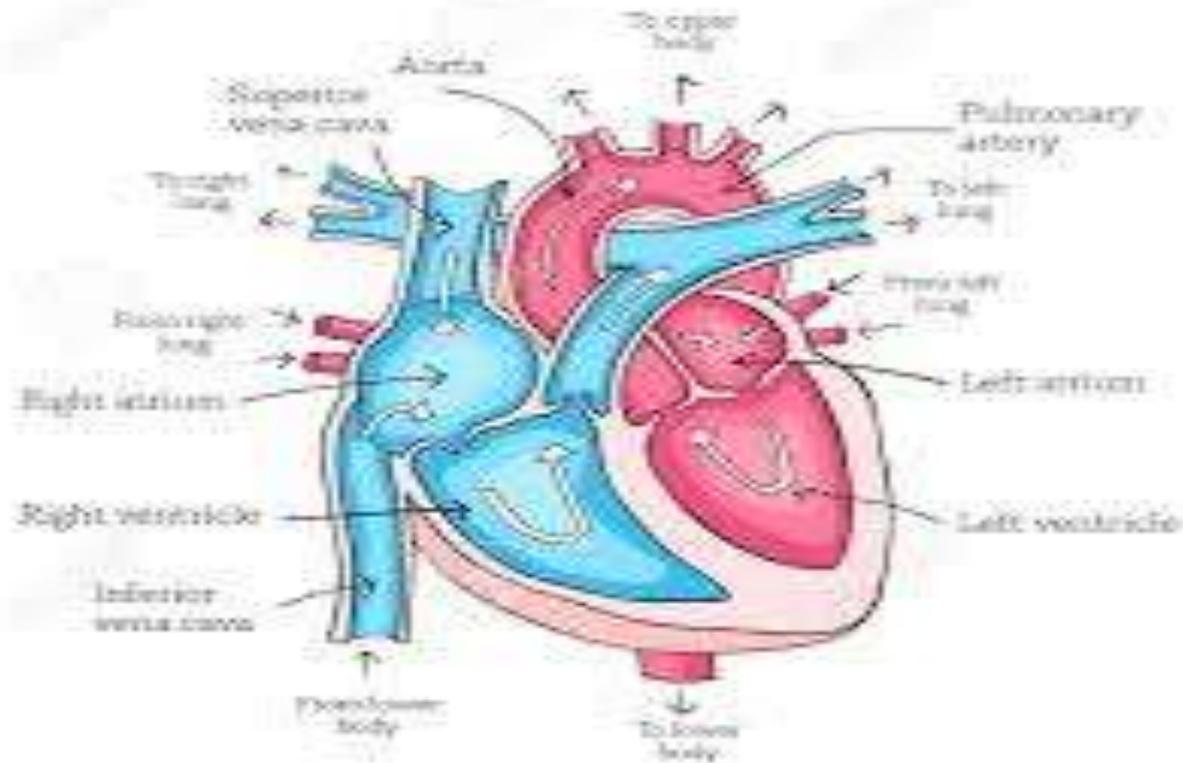
- AstraZeneca and Johnson and Johnson's vaccines (one shot) are recombinant vector vaccines. The viral vector used is the adenovirus, a common type of virus that typically causes mild cold symptoms.
- Moderna and Pfizer-BioNtech are mRNA vaccines. mRNA vaccines teach our cells how to make a protein—or even just a piece of ... is what protects us from getting infected if the real virus enters our bodies. (The WHO released the genome of the Covid 19 virus very early for countries to start making vaccines; the first try by our CDC was not successful)

# What is Herd Immunity

- Herd Immunity: resistance to the spread of an infectious disease within a population that is based on pre-existing immunity of a high proportion of individuals as a result of previous infection or vaccination. The level of vaccination needed to achieve herd immunity varies by disease but ranges from 83 to 94 percent. This is why the new variants of Covid that are more infectious are troublesome.

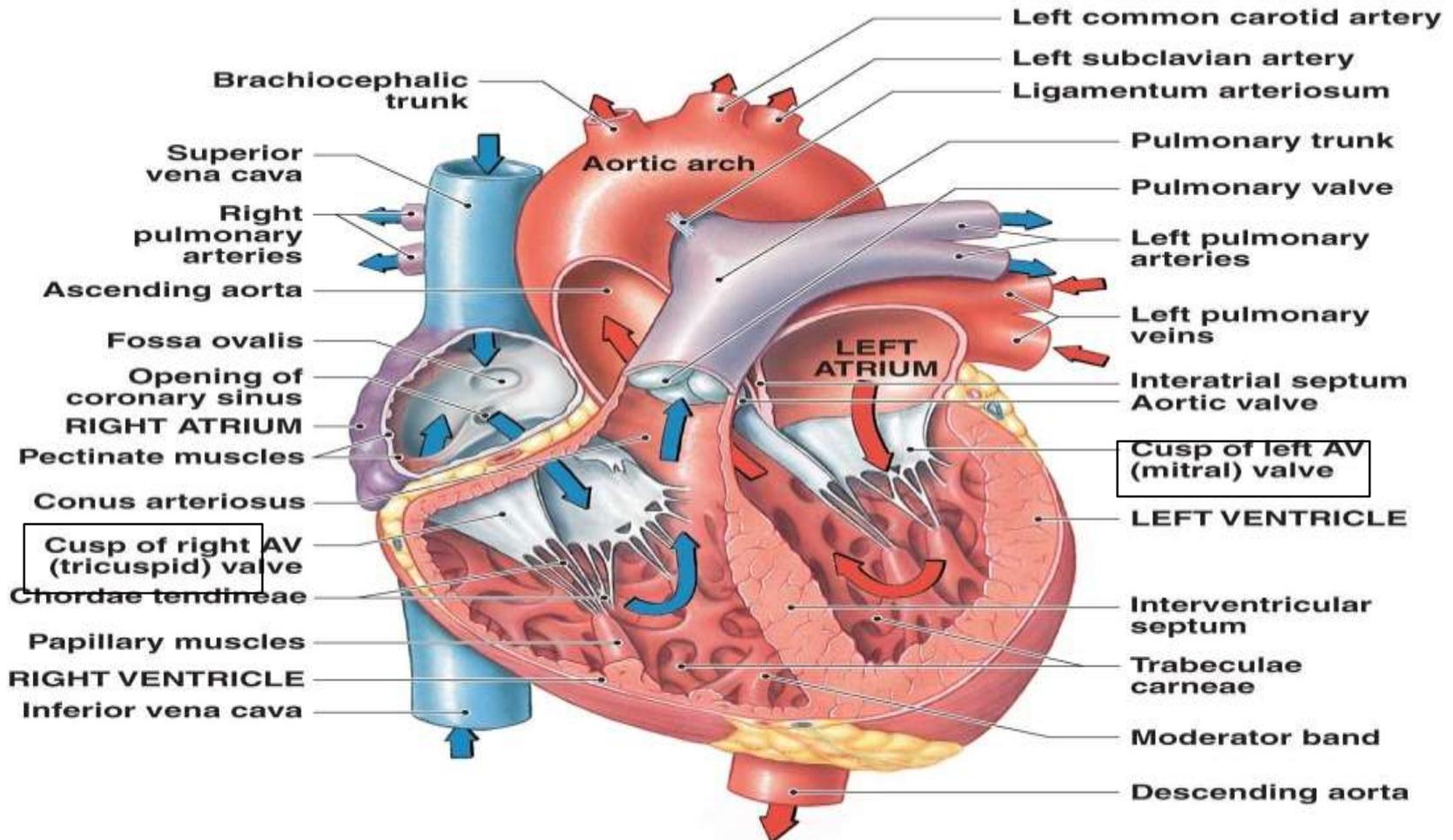
# Cardiovascular System

# Cardiovascular System



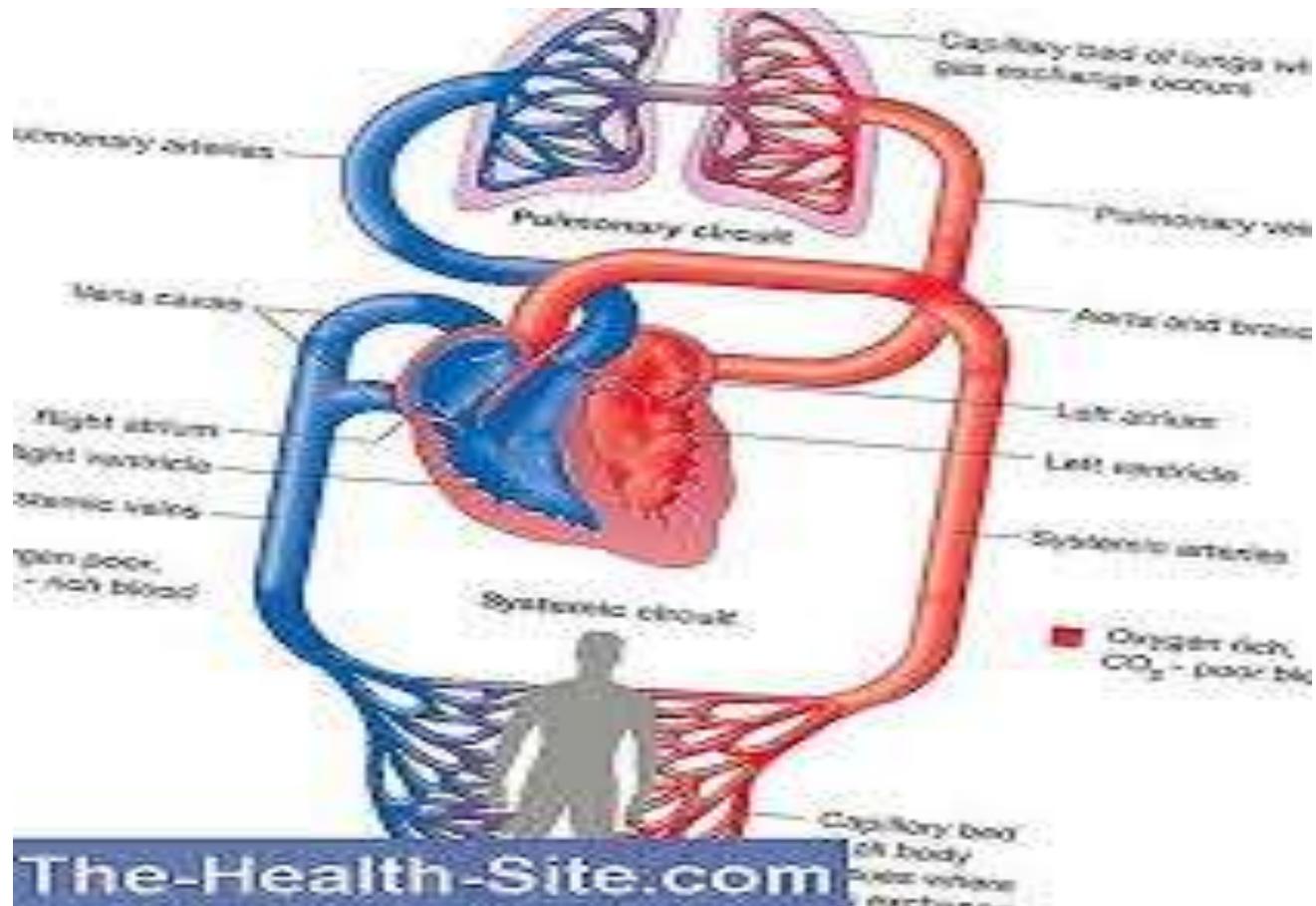
THE HUMAN HEART

# Human Heart with four chambers

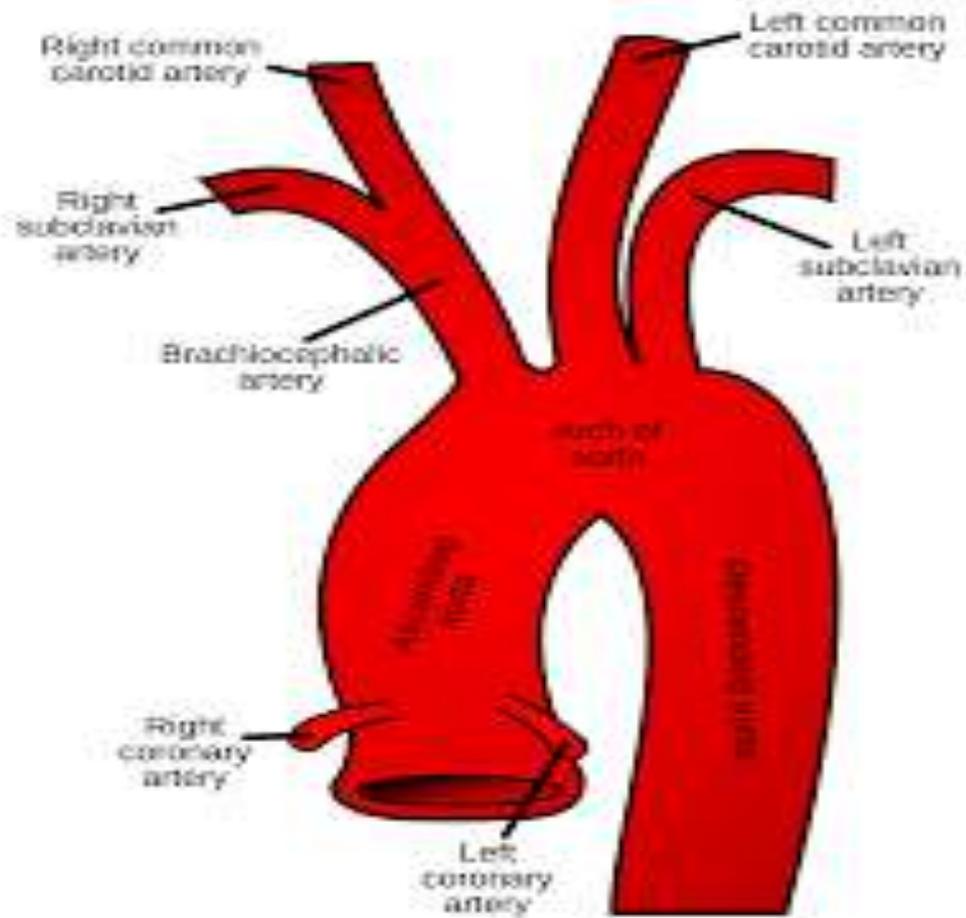


(a) Frontal section through the heart

# Overview of Circulation



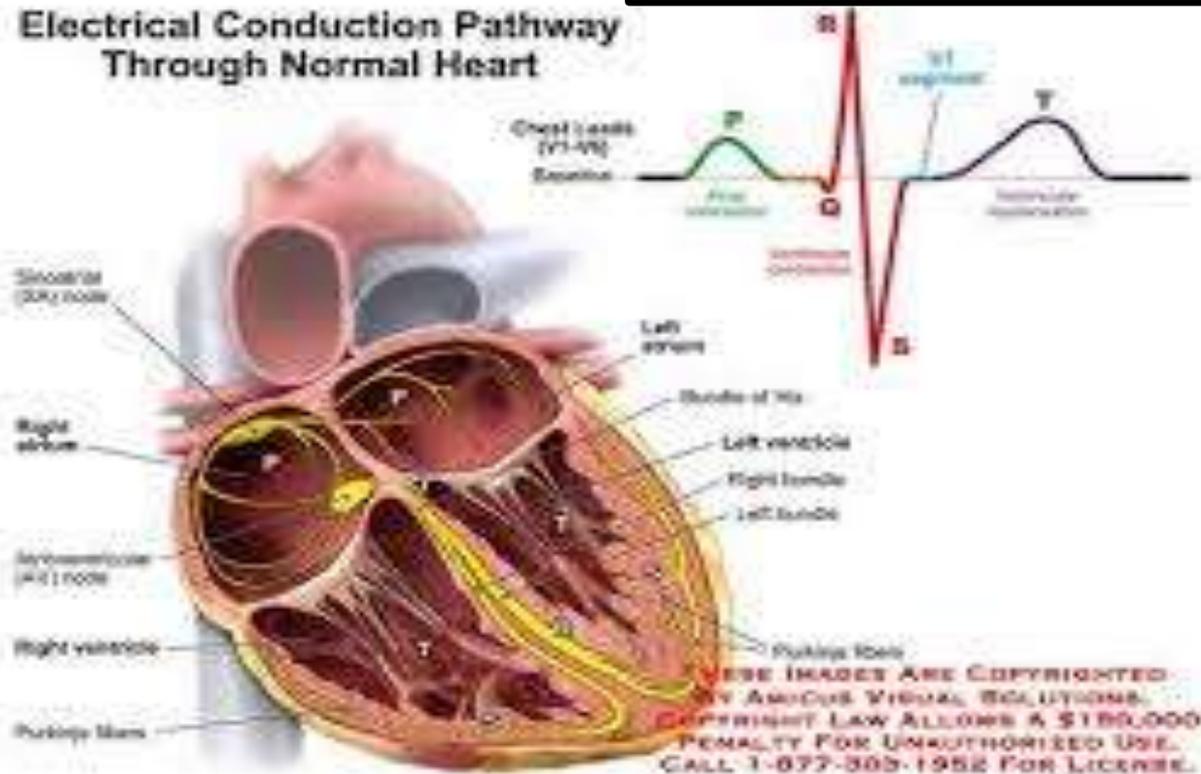
# The Arch of the Aorta



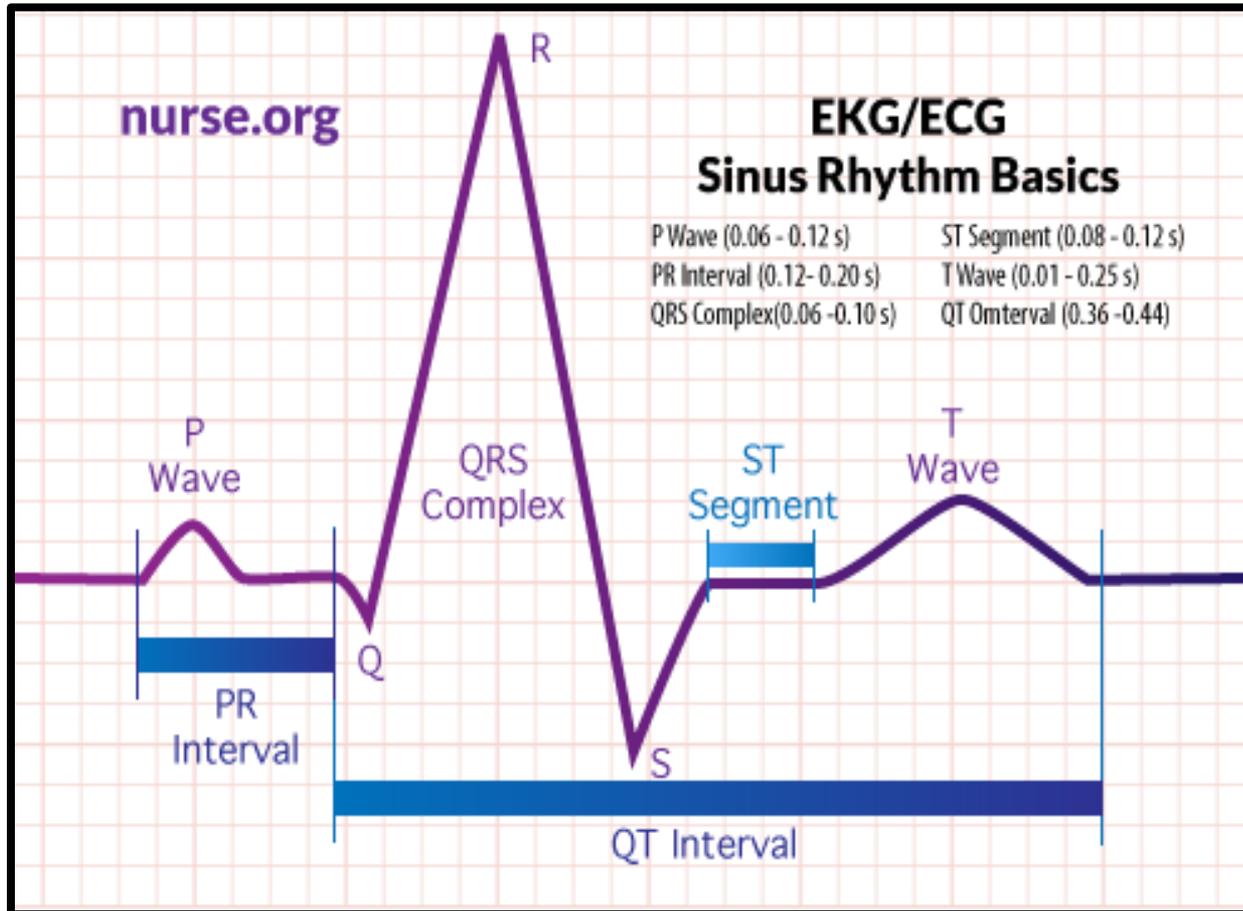
# Cardiac Electrical System

Electrocardio physiologist/heart mapping

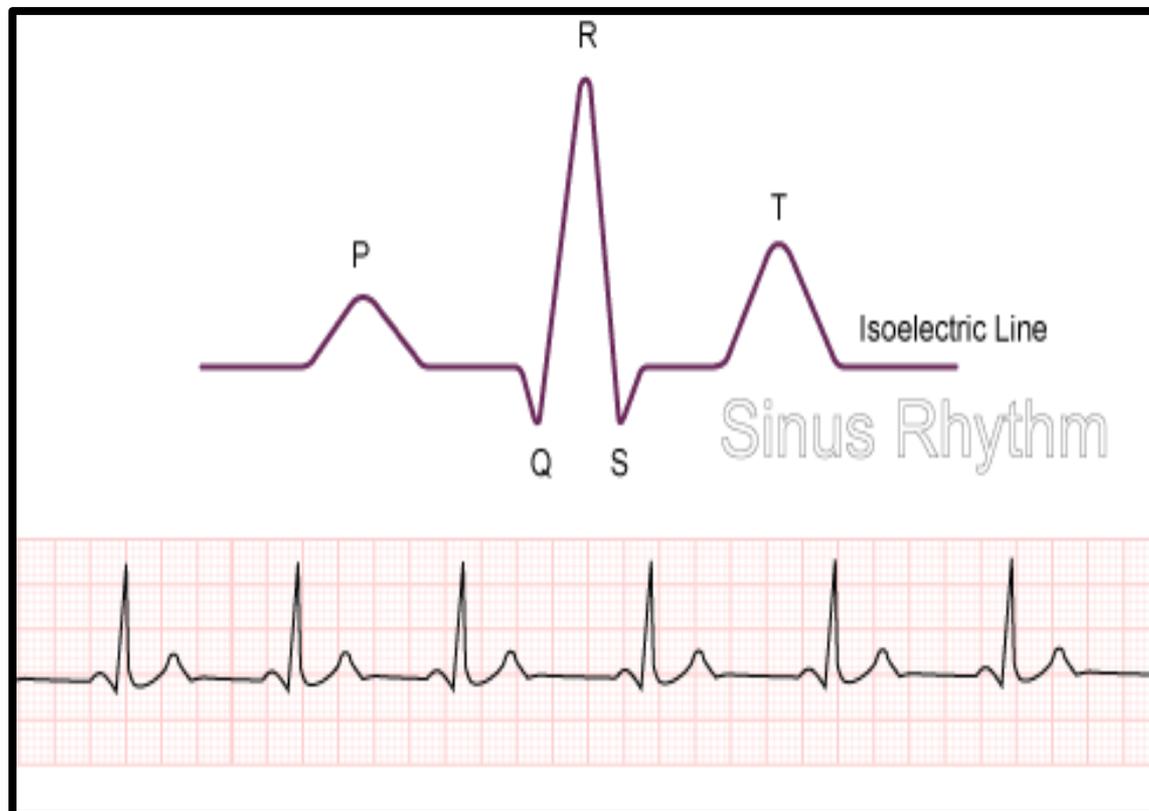
Electrical Conduction Pathway Through Normal Heart



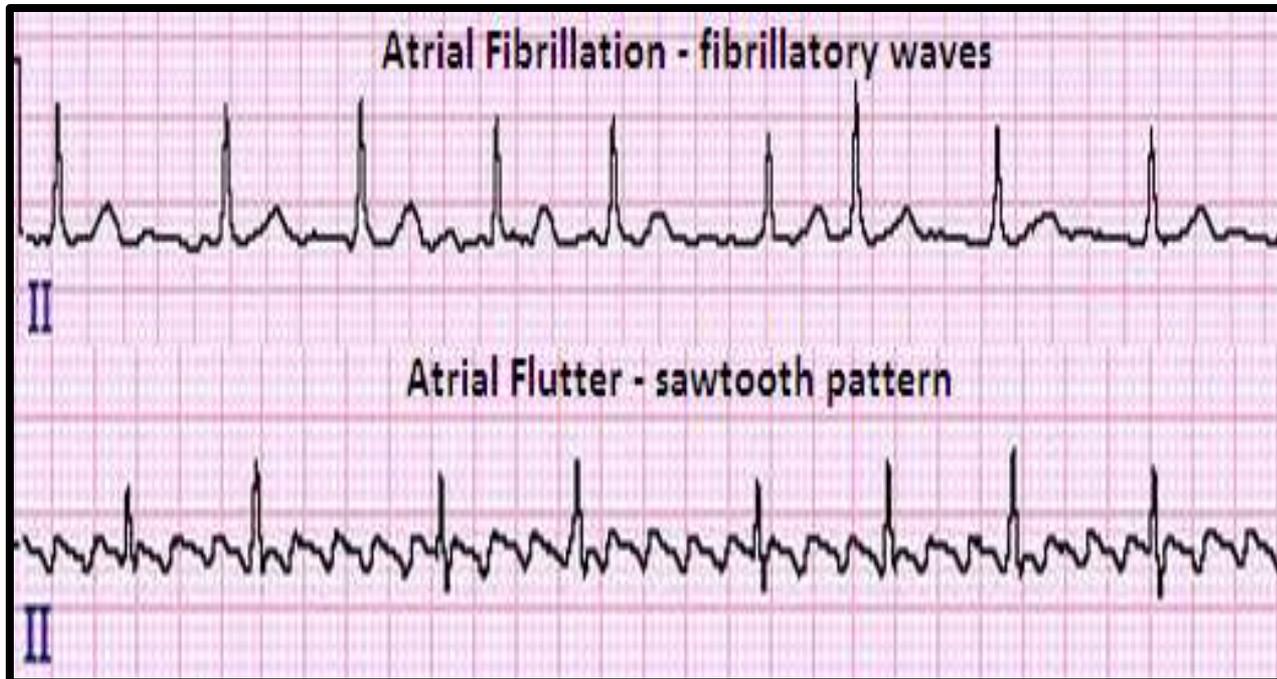
# Normal EKG elements



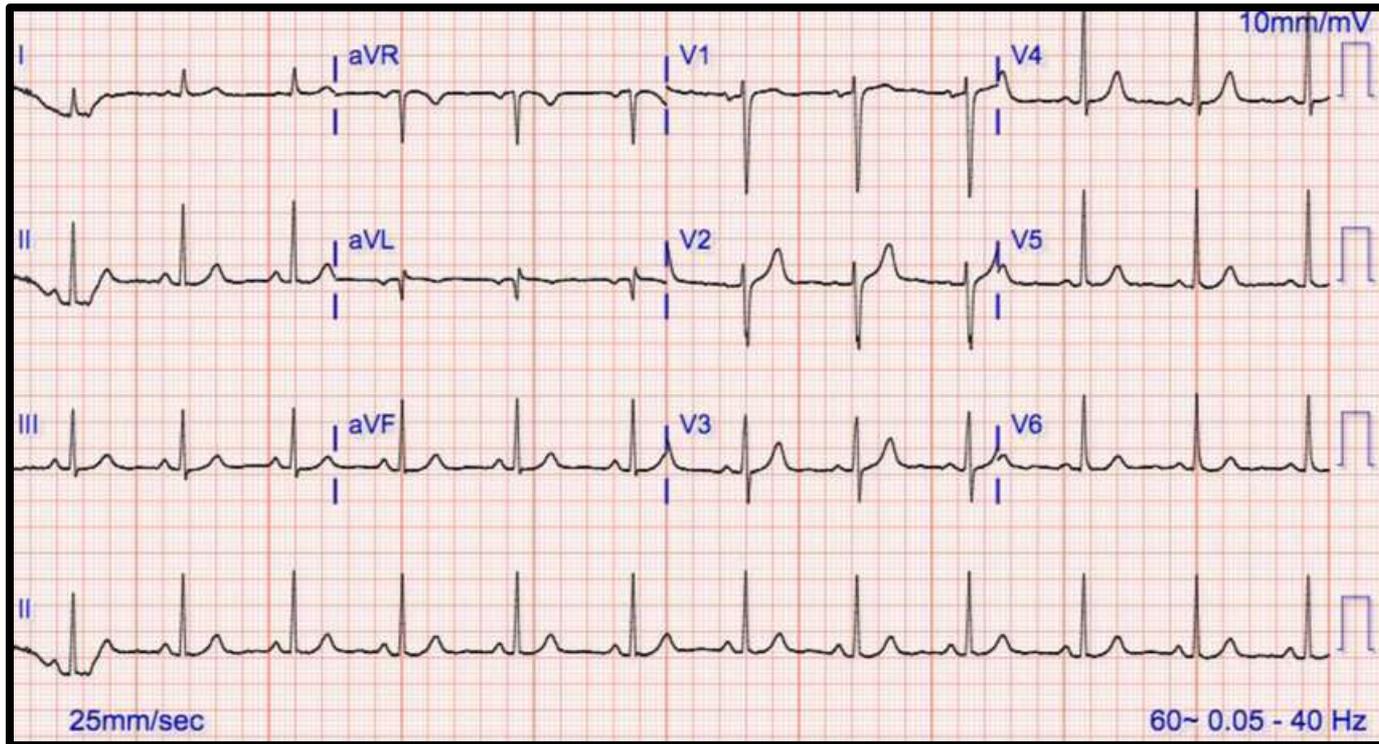
# Sinus Rhythm



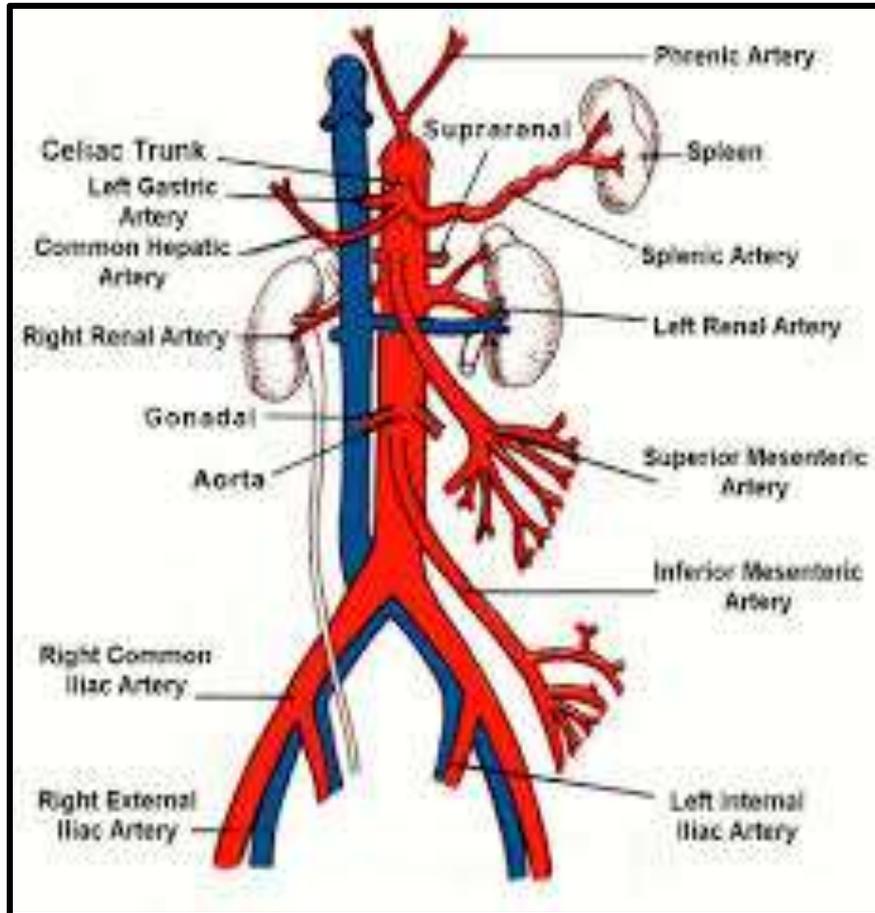
# Atrial Fibrillation and Flutter



# 12 lead EKG



# Abdominal Aorta and Vena Cava



# Heart Conditions

- Arrhythmias (atrial fib, atrial flutter, heart blocks, ventricular tachycardia, and fibrillation) (AED-automatic external defibrillators)
- CHF (two types)
- HPT
- Congenital defects, atrial septal defects common (patent fossa ovala)

# Myocardial Infarction/Acute Coronary Syndromes and Angina

1. One and a half million cases in US yearly (STEMI vs Non STEMI) Often the cause of SCD (sudden cardiac death)
2. Usually presents with crushing central chest pain that can radiate into the neck and down the arm with profuse sweating, dizziness, hypotension. Some atypical presentations, especially in women.
3. A true emergency; **1.Call 911**-and EMS squads have monitoring equipment, medications, means to treat cardiac arrest (AED/Automated External Defibrillator), arrhythmias, hypotension, and can alert ER to prepare for **PCI** in the cardiac cath lab (85 percent of cases treated with PCI, only 15% open coronary artery bypass surgery)**2. Give aspirin.**
4. PCI or Percutaneous Cardiac Intervention (window of several hours)
5. tPA/ tissue plasminogen activator sometimes used in reversing coronary artery occlusion.
6. Need to be transported to a hospital with a 24/7 cardiac cath lab for PCI
7. Acute MI due to unstable plaque disruption that causes **inflammation** and clot formation. (control of cholesterol may reverse)

# Atrial Fibrillation

- Irregular irregularity of the pulse; often intermittent but if persists needs to be treated.
- Fast heart rate generally in the range from 100 to 175 beats a minute (with atrial flutter pulse is regular and usually higher rate)
- Why is it serious; less efficiency of the heart, clots in atrial appendage can migrate causing strokes and emboli to other organs.
- Risk Factors: age (about  $\frac{1}{4}$  will develop—an epidemic), hypertension, European ancestry, Diabetes, heart failure, Ischemic heart disease, Hyperthyroidism, open heart surgery, moderate to heavy alcohol use
- Nine percent of people age 65 have Afib.

# Treatment of Atrial Fibrillation

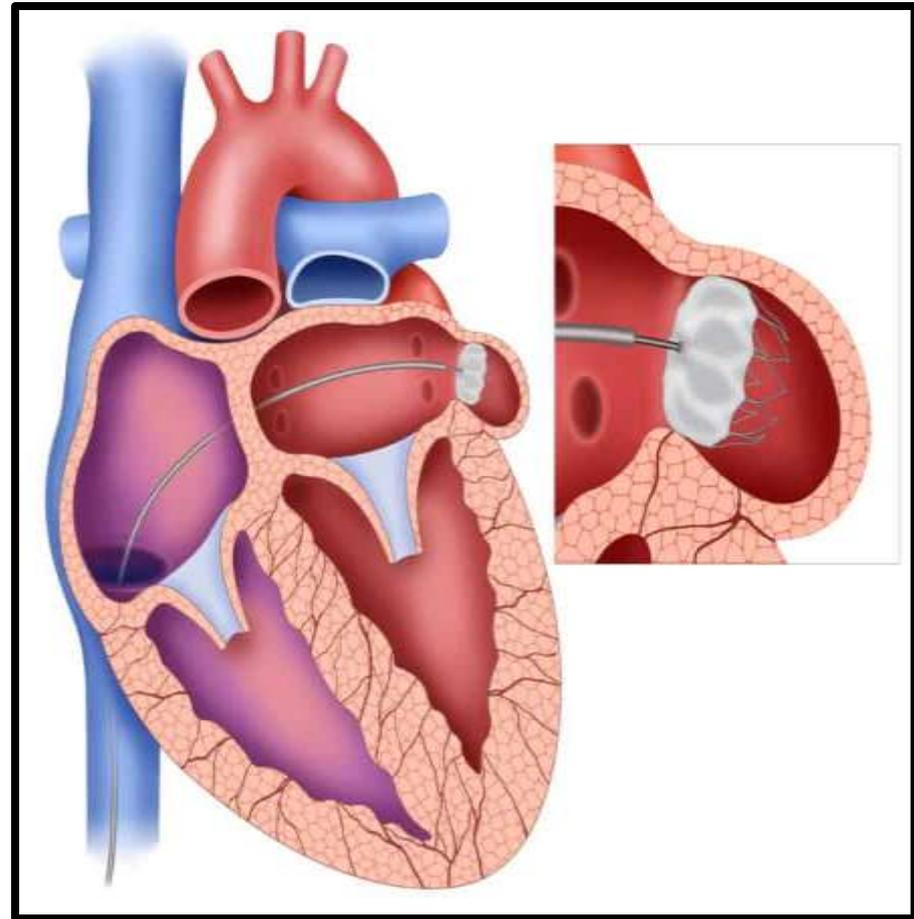
- Cardioversion if sustained (within 48 hours)-often reverts to normal sinus rhythm spontaneously.
- Anticoagulation before and after Cardioversion
- Antiarrhythmic drugs (several classifications)  
Main objective is to slow the heart rate and make the electrical system of the heart less irritable.
- Atrial ablations based on cardiac electrical mapping (destroys aberrant pacemakers in the pulmonary veins)

The Watchman device or tying off the left atrial appendage where most emboli originate.

# The Left Atrial/Auricular Appendage: the source of thrombi that cause strokes

Treatment to prevent stroke other than anticoagulation

- The Watchman Device
- Surgical Ligation



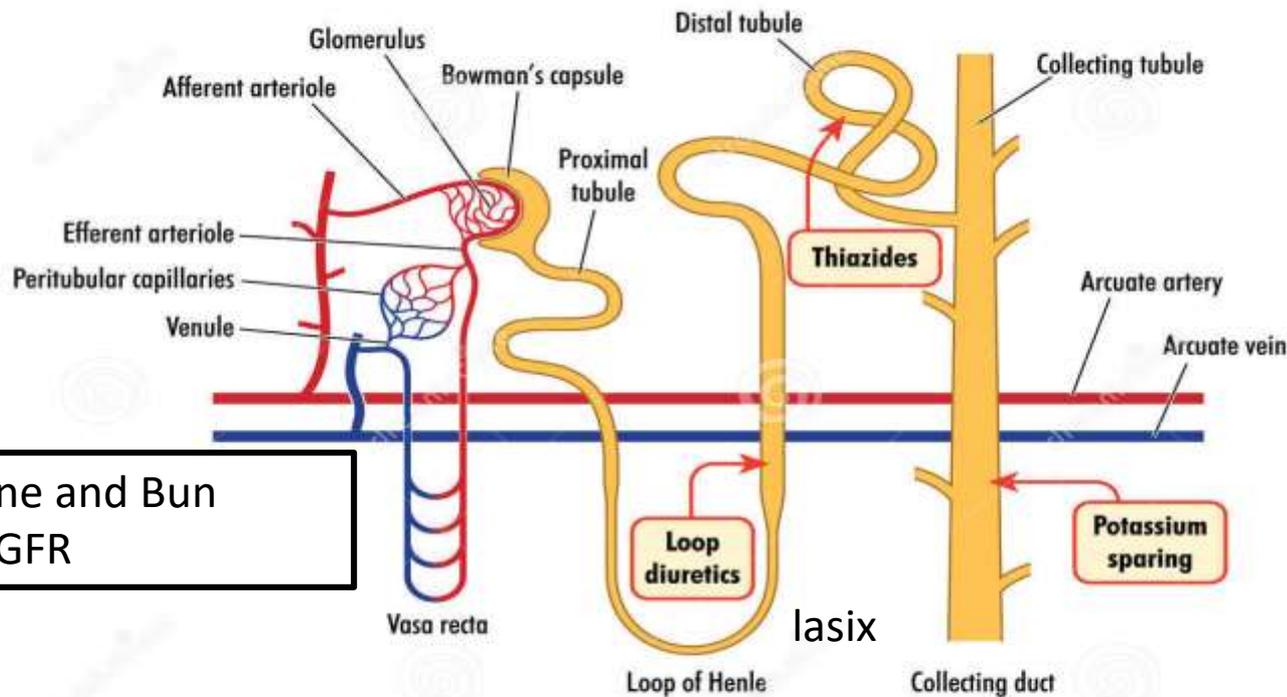
# Heart Failure: EF <40%

- **An Epidemic due to an aging population**; 36/100,000 /year with improving results due to treatment: 80% 5 year survival.
- Two types of Left Ventricular Heart Failure: Normal and Low Ejection Fraction Failure: One is a large heart with ventricular hypertrophy and low EF, the other is normal EF with normal heart size and wall rigidity (restrictive)
- Symptoms of SOB, Dyspnea on exertion, orthopnea, peripheral edema. Possibly coronary syndrome pain.
- Atrial fibrillation under the condition of heart failure due to rigidity decreases efficiency by about 30 percent.
- Pulmonary Hypertension: (>25 mm Hg/cor pulmonale) due to hereditary, COPD and other pulmonary diseases, Left sided heart failure, multiple pulmonary emboli, Obstructive Sleep Apnea.

# Treatment of CHF to target HPT, fluid retention and heart rhythm

- Beta Blockers (lower BP and slows the heart)
- ACE inhibitors (Angiotensin-converting enzyme) problems with cough
- ARB (Angiotensin II Receptor Blockers)
- ARNI (Angiotensin Receptor-Neprilysin Inhibitor)
- SGLT2
- Diuretics (Lasix) relieve symptoms but no survival benefit
- Digoxin—no long term benefit
- Better fluid and electrolyte regulation through device tele-monitoring; Jugular vein pressure and symptoms such as orthopnea
- Cardiac Assisting Devices (CAD)
- Heart Transplantation
- Stem cell research may show promise

# Diagram of Renal Tubule/Nephron



Creatinine and Bun  
Values: GFR



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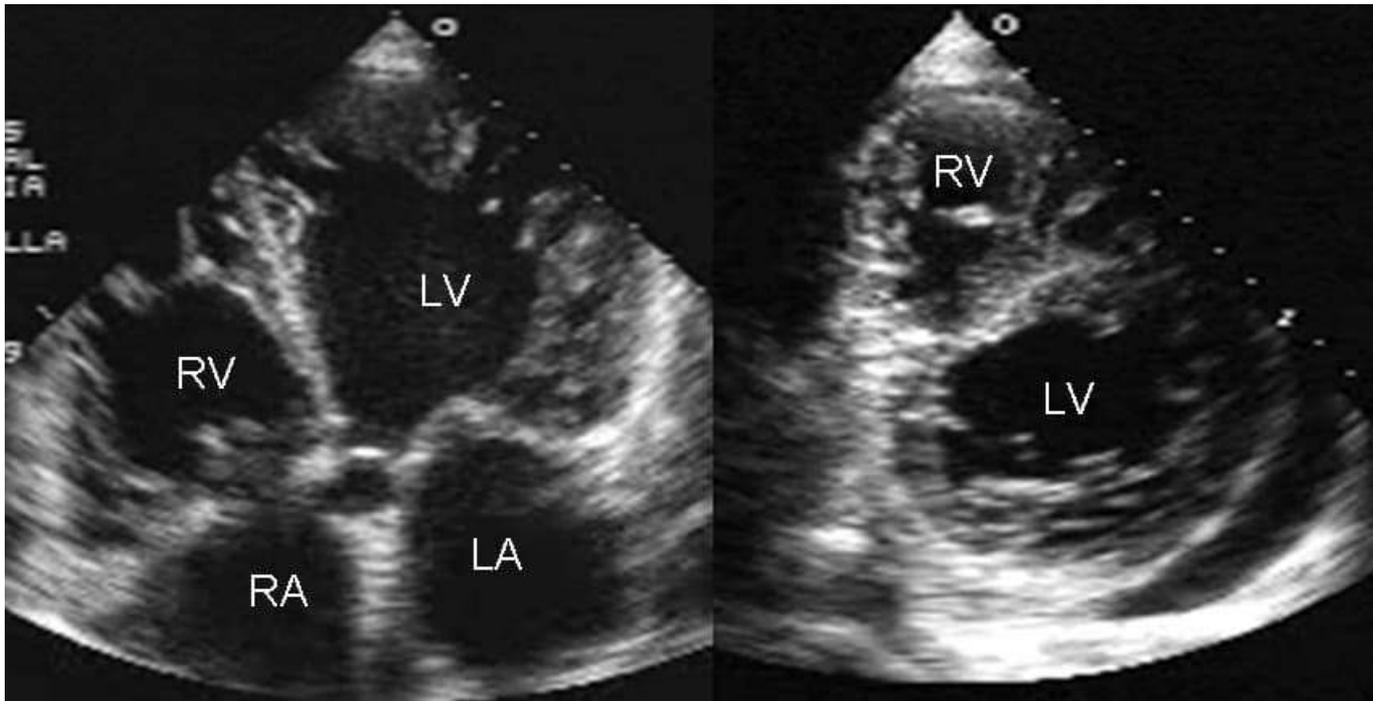
# Diuretic Management of Congestive Heart Failure (routine and Novel)

- Loop Diuretics: Furosemide or Lasix, Bumetanide—effect just over 6 hours
- Thiazides (HTCZ or Hydrochlorothiazide and Metolazone (Zaroxolyn): they work on distal convoluted tubule (potential to lower serum Na<sup>+</sup> and K<sup>+</sup>)
- Proximal Tubules diuretics: Acetazolamide (Carbonic anhydrase inhibition), SGLP2 Inhibitors (adult onset diabetes and glucose reabsorption is coupled with Na reabsorption)
- K<sup>+</sup> sparing diuretics—Spironolactone
- Vasopressin Antagonists

# The ECHO/echocardiogram and Holter Monitoring

- ECHO cardiogram (ultrasound scan)- checks size, configuration, and elasticity of heart chambers as well as cardiac valves and evaluates how blood flows through the heart and checks **Ejection Fractions (normal ejection fraction is 50% to 75%).**
- Holter monitor is a device worn to track cardiac rhythms over a 24 hour period, often used to see if you have episodes of Afib

# ECHO cardiogram



# Cardiac Pacemakers

- PM and defibrillator in a single implantable device
- Temporary or permanent. Temporary PMs are used to treat short-term heart problems,
- Permanent PMs are used to control long-term heart rhythm problems like heart block, sick sinus syndrome, bradycardia
- PM, (III) biventricular PMs-BiV, also called cardiac resynchronization therapy (CRT usually for Congestive Heart Failure).

## **Anti-coagulants: Some Indications**

**DVT, atrial fib, heart valves, prevent stroke, emboli, massive obesity, cancer, post-op major surgery and renal failure**

- Warfarin or Coumadin with goal of INR (calculation based on results of a PT) in 2-3 range. (inexpensive at \$39 per month but monthly INR blood drawings to regulate)
- Factor Xa inhibitors or DOAC (direct oral anticoagulants such as Eliquis, Pradaxa and Xarelto (average cost per month \$235))
- Aspirin
- Plavix
- NSAIDS
- Heparin
- Low Molecular Weight Heparin (lovenox)

# Tests to evaluate cardiac function and the cardiac syndrome

- Cardiac angiograms at time of PCI for stent placement or coronary artery dilatation.
- Chest X-ray
- Echocardiogram (TEE is very useful in assessing valvular disease)
- Treadmill or drug induced Stress Test
- Electrical cardiac mapping and Ablations
- Blood Tests for Myocardial Damage
  - Troponin (now High Sensitivity)
  - CPK
  - Natriuretic peptide BNP and .

# CT angiography (CTA) of the Heart

- With advanced equipment (64 t 128 detectors) can visualize coronary vessels 1.5 mm and above.
- If normal, there is 99% negative predictive value and 10 year warranty that you will not die of a cardiac event.
- Indications: Chest pain, Equivocal Stress test, screening before valvular surgery, new onset of CHF and cardiomyopathy, coronary anomalies, bypass surgery, stint patency.

**Subacute and Acute Bacterial Endocarditis** (infections/vegetations on the valve leaflets) commonly due to staph aureus and enterococcus in acute and strep viridans and enterococcus in SBE

- Risk Factors: Mitral value prolapse (20 % of young women), congenital defects, enlarged hearts, rheumatic fever, prosthetic heart valves, bicuspid aortic valves and stenosis in older men, HIV and most common today IV Drug use.

These predisposing conditions are one of the reasons for prophylactic antibiotics prior to some surgeries such as dental procedures and bowel surgery.

- Diagnosis via blood cultures and ECHO cardiogram (Transesophageal ECHO 85-90 percent diagnostic)
- SBE is generally slow in onset whereas Acute progresses quickly.
- Treatment; need high doses of bactericidal antibiotics such as Ceftriaxone and Vancomycin
- One very concerning complication is mycotic emboli to the brain causing stroke.

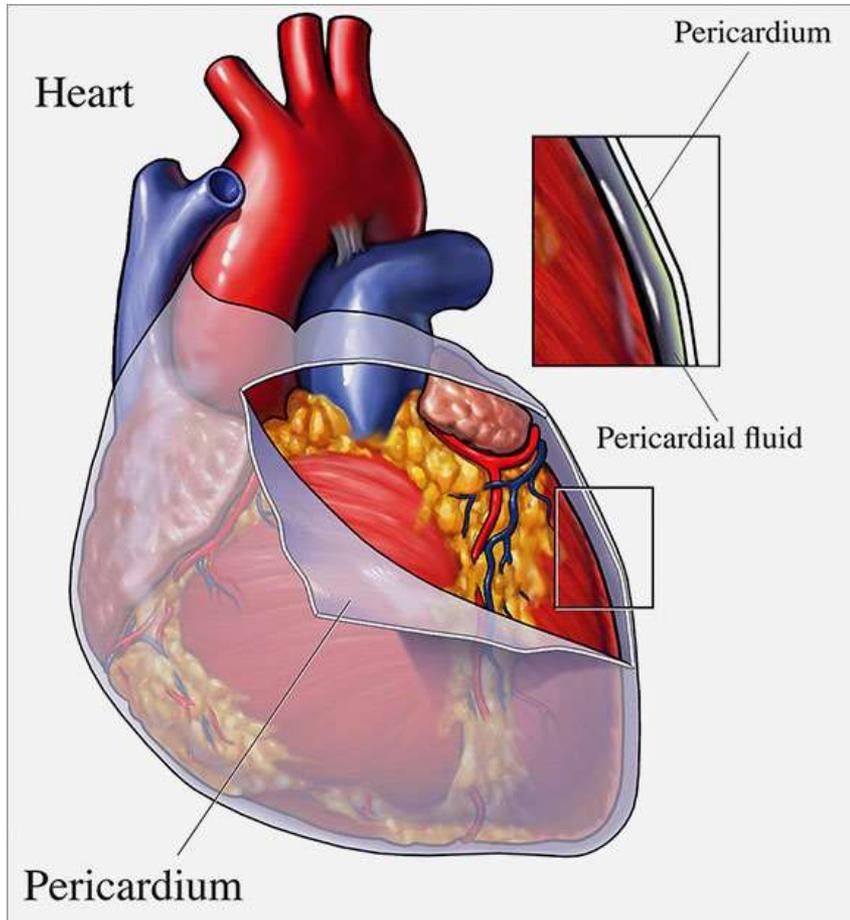
# Cardiac Valvular Disease

- **Mitral regurgitation** common (10 percent over the age of 75) Rx if EF is less than 50% and even between 50 and 50%. Can cause pulmonary hypertension.

Two types; valvular abnormalities (Mitral Valve Prolapse), and secondary to LVH or ventricular abnormalities. The former treat with replacements or mitral clips

- **Aortic stenosis** due to arteriosclerosis. Bicuspid aortic valve present serious problem and symptomatic individuals have low survival rates. Open permanent surgical replacement in young and percutaneous dilatation and prosthesis in poorer surgical risk patients.
- Need for anticoagulation and prophylactic antibiotics with dental procedures.

# Pericarditis: Inflammation of the sac that surrounds the heart: if severe can lead to cardiac tamponade



- Causes are viral, bacterial, fungal, iatrogenic, connective tissue diseases, cancer
- Trans-Tracheal ECHO to diagnose (TTE or TEE)
- Treatment;

ASA

Nonsteroidals like Advil

Steroids

Colchicine

Pericardiocentesis and Surgical window in a few cases.

# Myocarditis

- Myocarditis is rare, but when it occurs, it is most commonly caused by an infection in the body. Infections from viruses (most common, including those that cause the common cold, influenza or COVID-19—rare post vaccination, in infected patients the risk was highest among adults aged  $\geq 75$  years (0.238%) and among children aged  $< 16$  years (0.133%).), bacteria, fungus or parasites can lead to myocardial inflammation.
- Autoimmune diseases such as lupus, sarcoidosis and others can also cause myocarditis because the immune system can attack any organ in the body, including the heart, causing inflammation. Drugs ( especially chemotherapeutic drugs) or other environmental or toxic exposures can lead to myocarditis as well.
- The classic presentation of myocarditis is chest pain occurring 1-2 weeks after a viral infection of the upper respiratory or gastrointestinal tract. The classic presentation of myocarditis is chest pain occurring 1-2 weeks after a viral infection of the upper respiratory or gastrointestinal tract. The classic presentation of myocarditis is chest pain occurring 1-2 weeks after a viral infection of the upper respiratory or gastrointestinal tract. Coxsackie B virus

# Giant Cell Arteritis/Temporal Arteritis

- Headache and fever of unknown origin in older folks
- Jaw claudication, tenderness over temporal region and visual loss
- Can involve all large arteries and .5 to 1 percent of population.
- Effective treatment with steroids and new monoclonal antibodies.

# The Metabolic Syndrome

## **The Epidemic Complex of**

- a. Obesity
- b. Hypertension
- c. Hypercholesterolemia
- d. Hyperlipidemia
- e. Adult Onset of Diabetes Mellitus (Hgb A1C >6 or 6.5.)

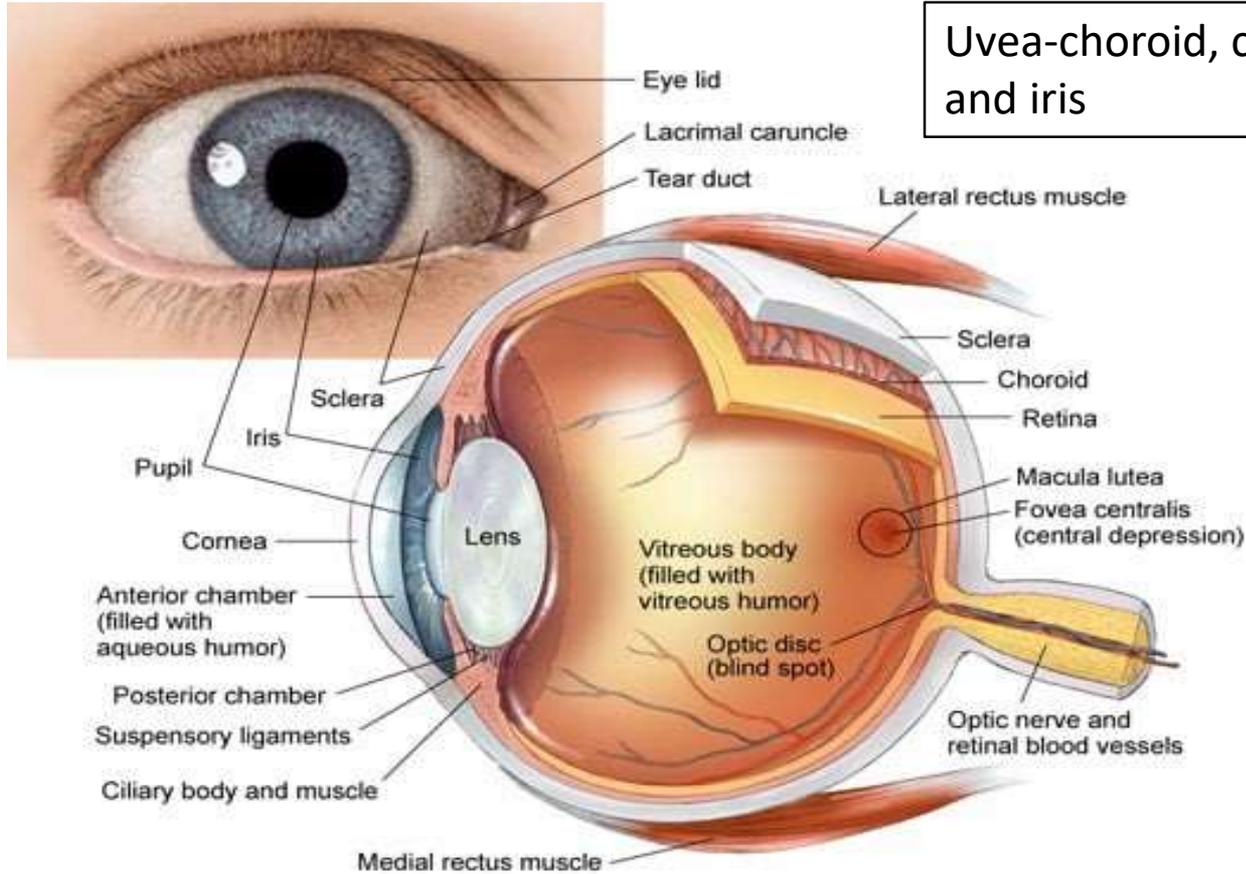
# Major Classifications of Antihypertensive Medications

- ACE (angiotensin converting enzyme inhibitors)
- ARBs (Angiotensin II receptor blockers)
- Calcium Channel Blockers
- Beta-blockers
- Diuretics (Thiazides, Loop Diuretics, K<sup>+</sup> sparing)

# The Senses

- Sight
- Hearing
- Taste
- Smell
- Touch

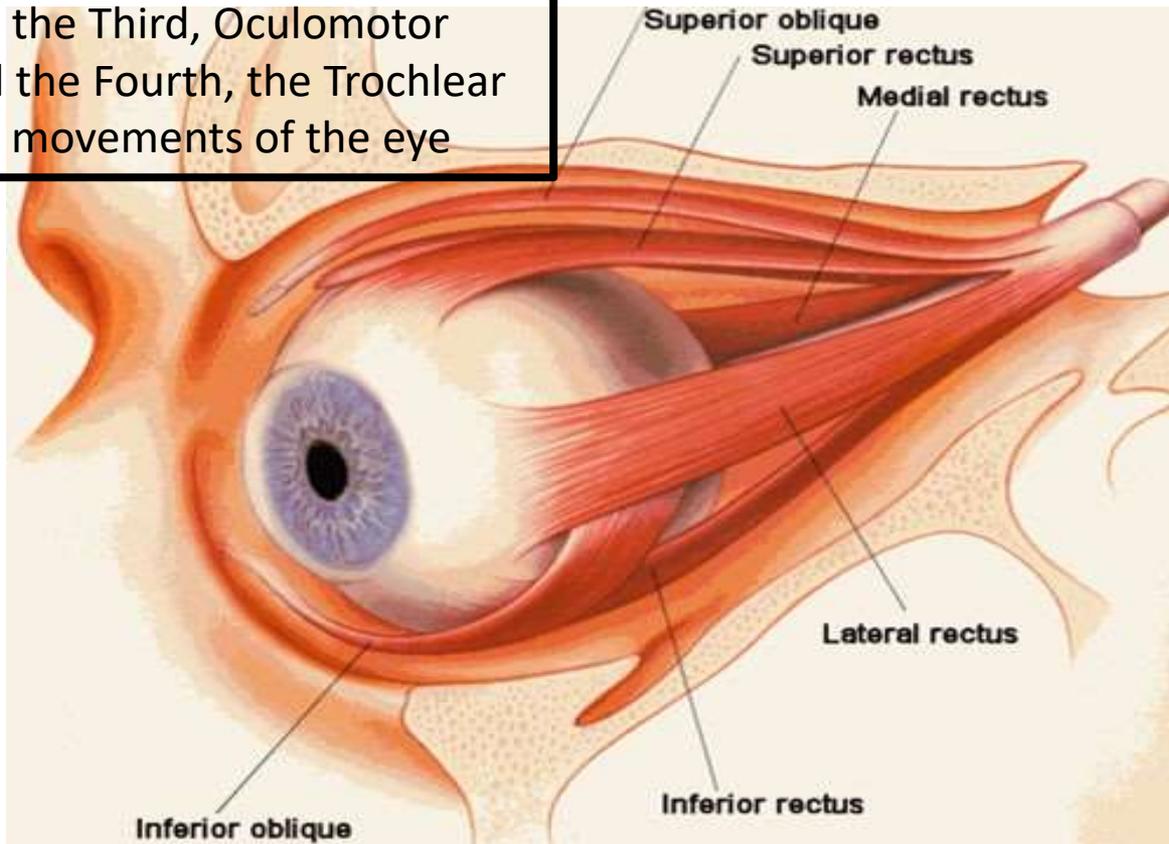
# Vision/The Eye



Uvea-choroid, ciliary body and iris

Right Eye (viewed from above)

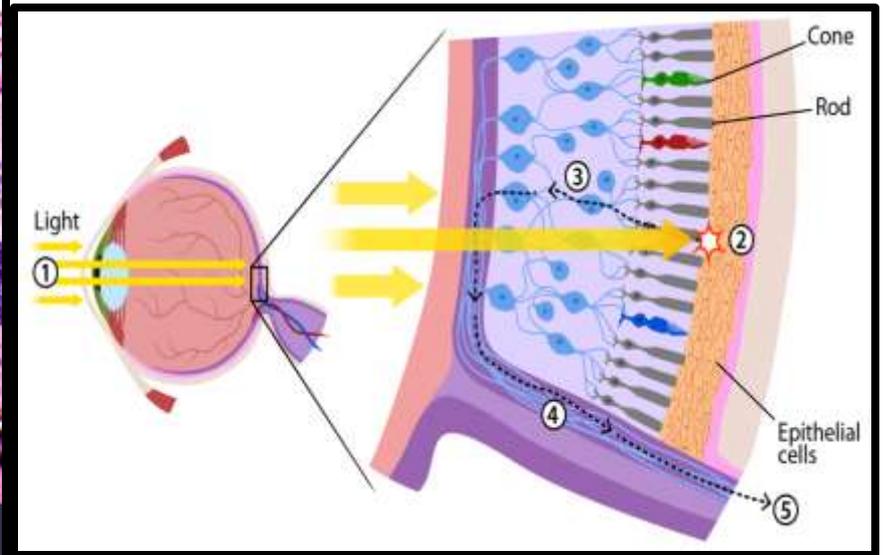
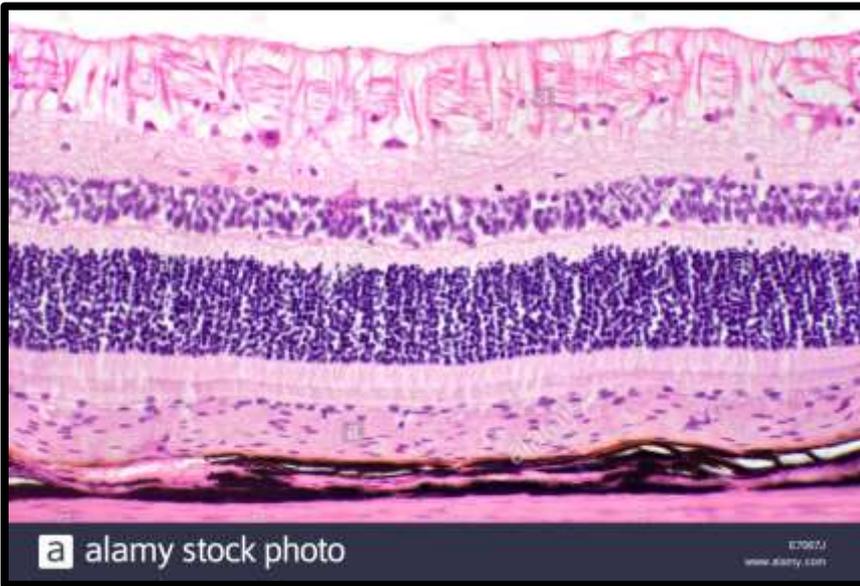
The Sixth Cranial nerve, the Abducens, the Third, Oculomotor nerve, and the Fourth, the Trochlear supply the movements of the eye



**Rods** are responsible for vision at low light levels (scotopic vision). They do not mediate color vision, and have a low spatial acuity (night vision)

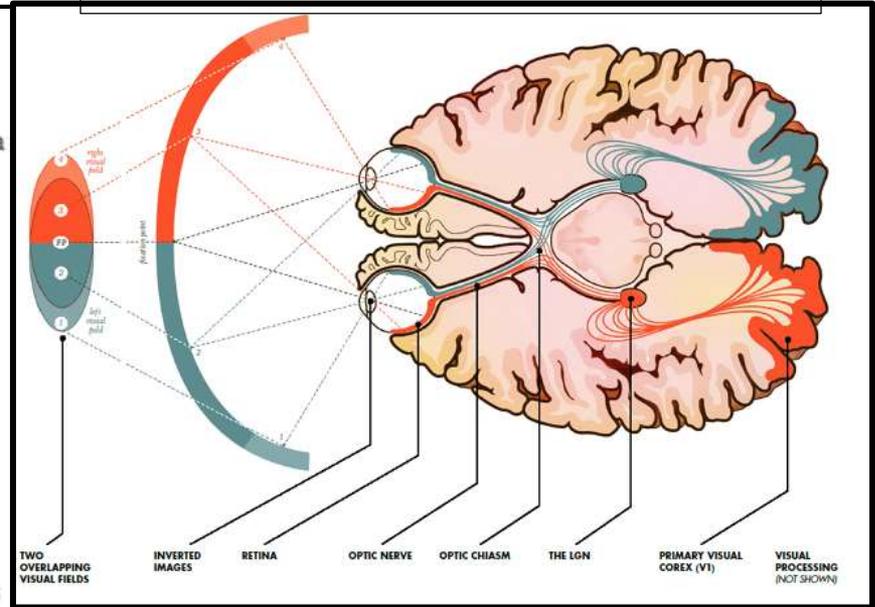
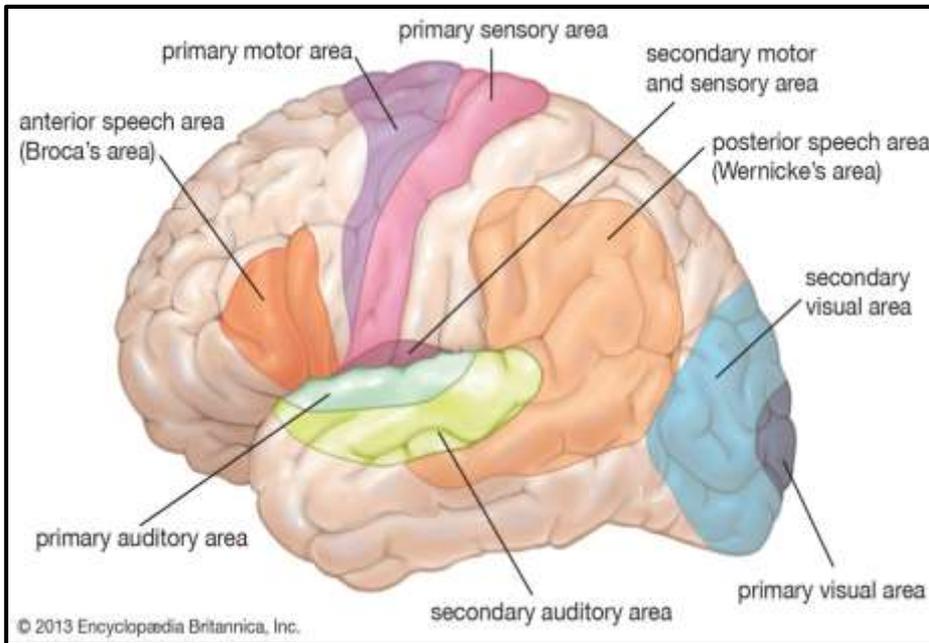
**Cones** are active at higher light levels (photopic vision), are capable of color vision and are responsible for high spatial acuity. The central fovea is populated exclusively by **cones**.

# The Retina



# Primary Pathway of sight in the brain.

The **lateral geniculate nucleus** is a relay center in the thalamus for the visual pathway .



# Diseases of the Eye

- **Age-Related Macular Degeneration (wet and dry).**
- **Cataract.**
- **Diabetic Retinopathy.**
- **Glaucoma.**
- **Amblyopia/strabismus: lazy eye** is an imbalance in the muscles, common and can result in loss of vision in weak eye. Good treatment.

# Macular Degeneration

- Leading cause of severe, permanent vision loss in people over age 60. It happens when the small central portion of your retina, called the **macula**, wears down.

## **Wet vs. Dry Macular Degeneration**

- **Dry:** People with this may have yellow deposits, called Drusen bodies, blind spots in the center of your vision. As that gets worse, you might lose central vision.
- **Wet: Blood** vessels grow from underneath your macula blind spots in the center of your vision. As that gets worse, you might lose central vision.

## **Symptoms:**

- Worse or less clear vision. Your vision might be blurry, and it may be hard to read fine print or drive.
- Dark, blurry areas in the center of your vision
- Rarely, worse or different color perception

# Treatments: Reserved for those 10-15 percent of patient with wet MD.

- **Anti-angiogenic drugs.** Your doctor injects these medications into your eye. They stop new blood vessels from forming and block the leaking from the abnormal vessels that cause wet macular degeneration.
- **Laser therapy.** Your doctor may suggest a treatment with high-energy laser light that can sometimes destroy actively growing abnormal blood vessels.
- **Photodynamic laser therapy.** It's a two-step treatment that uses a light-sensitive drug to damage your abnormal blood vessels.
- **Conservative:** supplement formula that has vitamins C and E, beta-carotene, zinc, and copper.

# Coping with Macular Degeneration

- **Ask your eye doctor to check your eyeglass prescription.** If you wear contacts or glasses, be sure your prescription is up to date. If new glasses don't help, ask for a referral to a low vision specialist.
- **Use magnifiers.** A variety of magnifying devices can help you with reading and other close-up work, such as sewing. Such devices include hand-held magnifying lenses or magnifying lenses you wear like glasses.
- You may also use a closed-circuit television system that uses a video camera to magnify reading material and project it on a video screen.
- **Change your computer display and add audio systems.** Adjust the font size in your computer's settings. And adjust your monitor to show more contrast. You may also add speech-output systems or other technologies to your computer.
- **Use electronic reading aids and voice interface.** Try large-print books, tablet computers and audio books. Some tablet and smartphone apps are designed to help people with low vision. And many of these devices now come with a voice recognition feature.
- **Select special appliances made for low vision.** Some clocks, radios, telephones and other appliances have extra-large numbers. You may find it easier to watch a television with a larger high-definition screen, or you may want to sit closer to the screen.
- **Use brighter lights in your home.** Better lighting helps with reading and other daily activities, and it may also reduce the risk of falling.
- **Consider your transportation options.** If you drive, check with your doctor to see if it's safe to continue doing so. Be extra cautious in certain situations, such as driving at night, in heavy traffic or in bad weather. Use public transportation or ask a friend or family member to help, especially with night driving. Make arrangements to use local van or shuttle services, volunteer driving networks, or rideshares.
- **Get support.** Having macular degeneration can be difficult, and you may need to make changes in your life. You may go through many emotions as you adjust. Consider talking to a counselor or joining a support group. Spend time with supportive family members and friends.

# Cataracts; that ubiquitous condition that makes ophthalmologists wealthy

Age related and by the age of 75 the number rises to half the U.S Population. A hereditary predisposition with risk factors of diabetes, HPT, obesity and smoking.

Symptoms:

- Blurred vision
- Double vision
- Seeing halos
- Changes in night vision and depth perception
- Sensitivity to sunline causing your vision to decrease
- Difficulty distinguishing colors
- Difficulty reading

# Treatment of cataracts

- Cataract surgery is outpatient microsurgery with topical anesthesia. The surgery only takes a few moments and for most, no stitches are required, and recovery is swift with only eye drops for a two weeks and restricted activity for 10-14 days. The lens implants block ultraviolet light.
- After cataract surgery, most need reading glasses unless they choose a presbyopia-correcting IOLs or different focal length lenses in each eye (one correcting for close and one for distant vision).

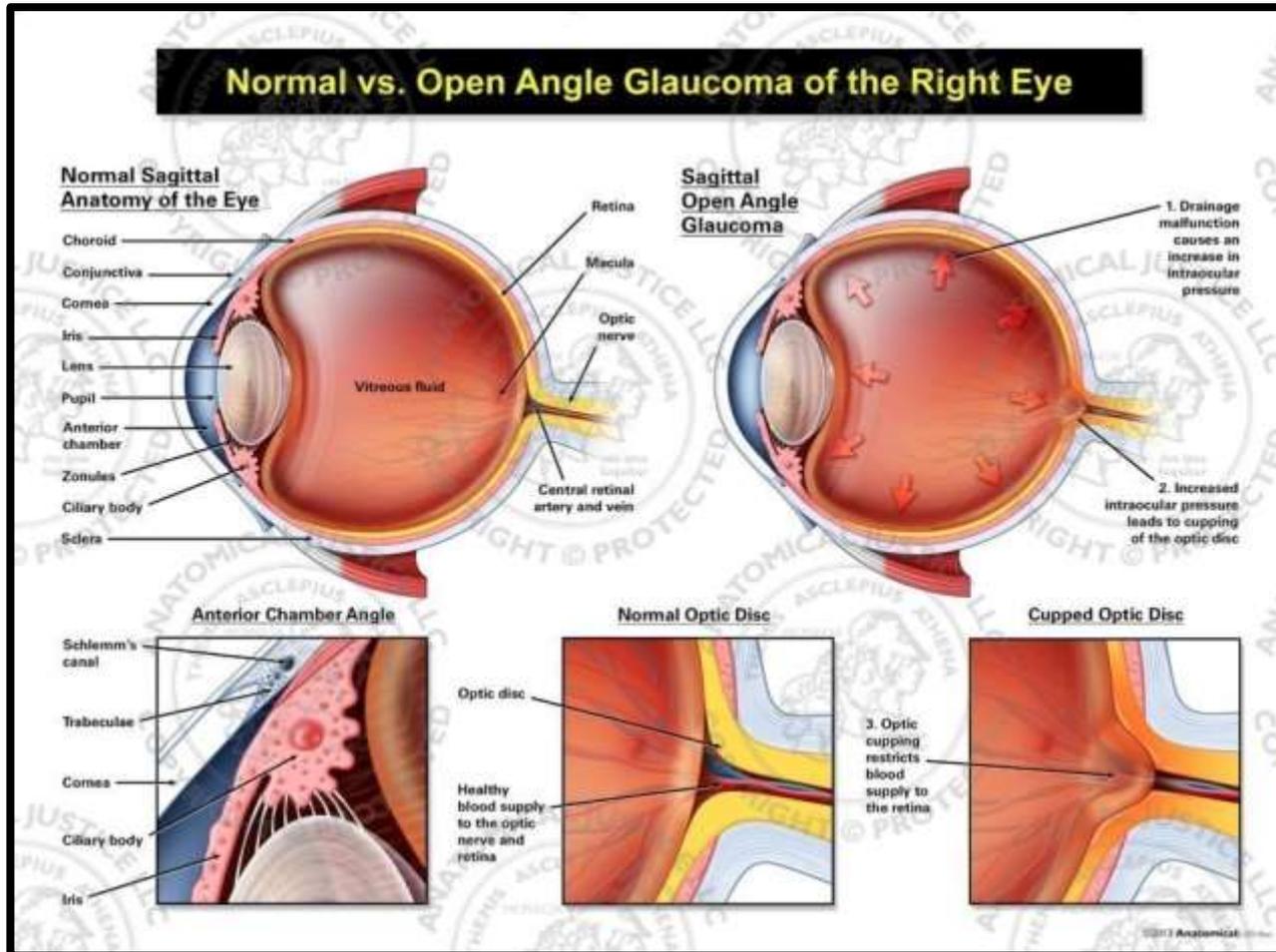
**Everyone needs glasses: accept your fate.** Reading glass power is measured in units called diopters. The lowest strength is usually 1.00 diopters. Glasses go up in strength by factors of . 25 (1.50, 1.75, 2.00). The strongest glasses are 4.00 diopters.

- A nearsighted/myopic person sees near objects clearly, while objects in the distance are blurred.
- A farsighted/hyperopic person sees faraway objects clearly, while objects that are near are blurred.
- Most everyone suffers from presbyopia or farsightedness due to aging

# Glaucoma; open angle, closed-angle and acute glaucoma (true emergency)

- Age >60 and family history are risk factors and high intraocular pressure can cause damage to the optic nerve that is irreversible and can go unrecognized or silent and this fact encourages patients to see their ophthalmologist or optometrist on a regular basis.
- Treatment; a wide range of eye drops, and number of types of surgery (trabeculectomy, laser, tubes)

# The Anatomic cause of glaucoma and effect: (normal intraocular pressure is 12 to 22 mm Hg)

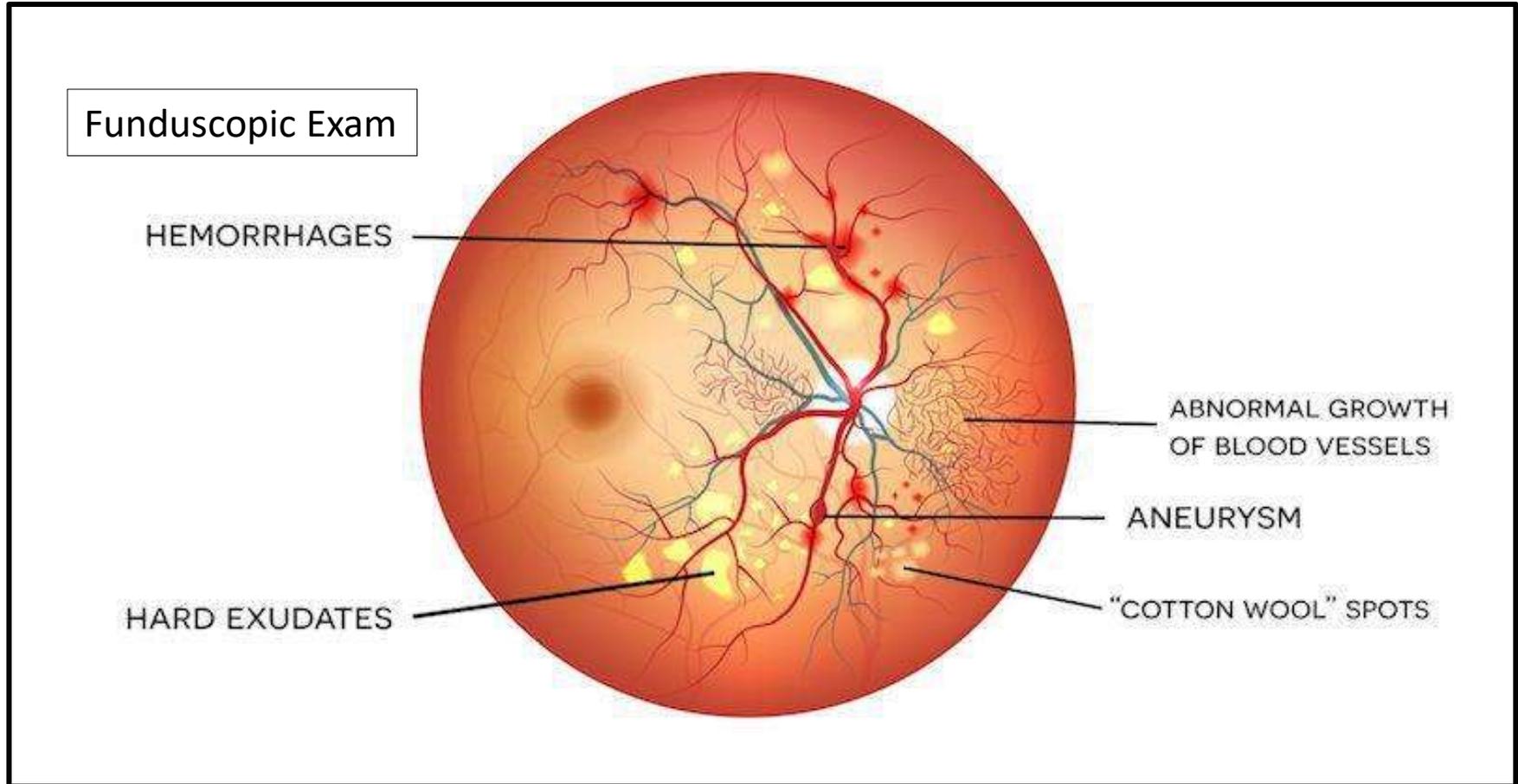


**Retinal detachment** describes an emergency situation (rapid onset) in which a thin layer of tissue (the **retina**) at the back of the eye pulls away from the layer of blood vessels that provides it with oxygen and nutrients. **Retinal detachment** is often accompanied by flashes and floaters in your vision, blurred vision, gradually reduced side (peripheral) vision and a curtain-like shadow over your visual field

**Predisposing causes**; aging, family history, extreme myopia, previous eye surgery or trauma, traction due to scar tissue and exudates.

**Treatment**: Many complex interventions; early use of laser, freezing and injecting a bubble of air. Repair is very successful in the majority of patients especially if it is caught early.

Diabetic Retinopathy is caused by damage to the blood vessels in the retina (Diabetics have an increased incidence of cataracts and glaucoma)



# Nystagmus and Scotomata

## What Causes Nystagmus?

It may be a sign of another eye problem or medical condition. Nystagmus is caused by many different things, including:

- Hereditary
- Cataracts or strabismus
- Strokes, MS, or Meniere's disease
- Head injuries
- Inner ear problems and some medications

**Scintillating scotomas (flashing lights)** as an aura for migraine, and scotomas can occur in a wide range of neurologic disorders.

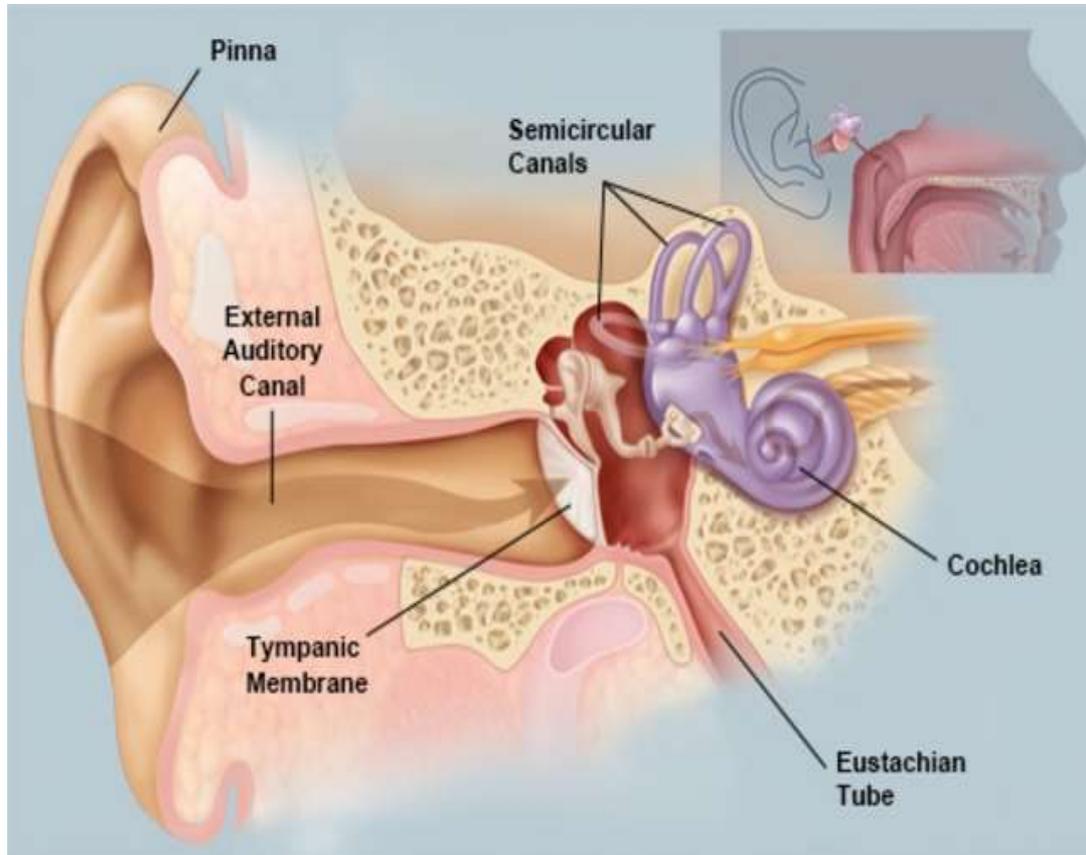
# Tests for sight

- Routine exam; eye movements, pupils round and regular and react to light and accommodation, nystagmus
- A refraction assessment determines if you have vision problems such as nearsightedness or farsightedness, astigmatism (evenly) , or presbyopia. Twenty/twenty vision normal (the first 20 is you are standing 20 feet away from the eye chart)
- **Tonometry**: A standard eye test that is done to determine the fluid pressure inside the eye. **normal pressure range** is 12 to 22 mm Hg
- Visual fields
- Funduscopic examination

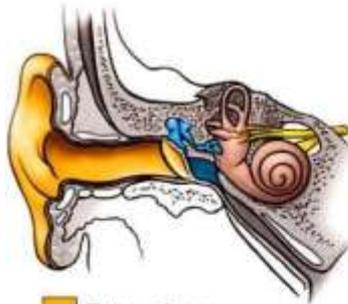
# Hints for protecting your vision

- Carrots, which contain vitamin A, are good for the eyes. But fresh fruits and dark green leafy vegetables, which contain more antioxidant vitamins such as C and E, are even better for eye health.
- The American Academy of Ophthalmology recommends oversized or wraparound sunglasses. They should be labeled 99 percent or 100 percent UV **protection**, or "UV400." These lenses are effective in absorbing UV-A and UV-B radiation. Additionally they should screen out 75% to 90% of visible light and ideally have lenses that are gray for proper color recognition

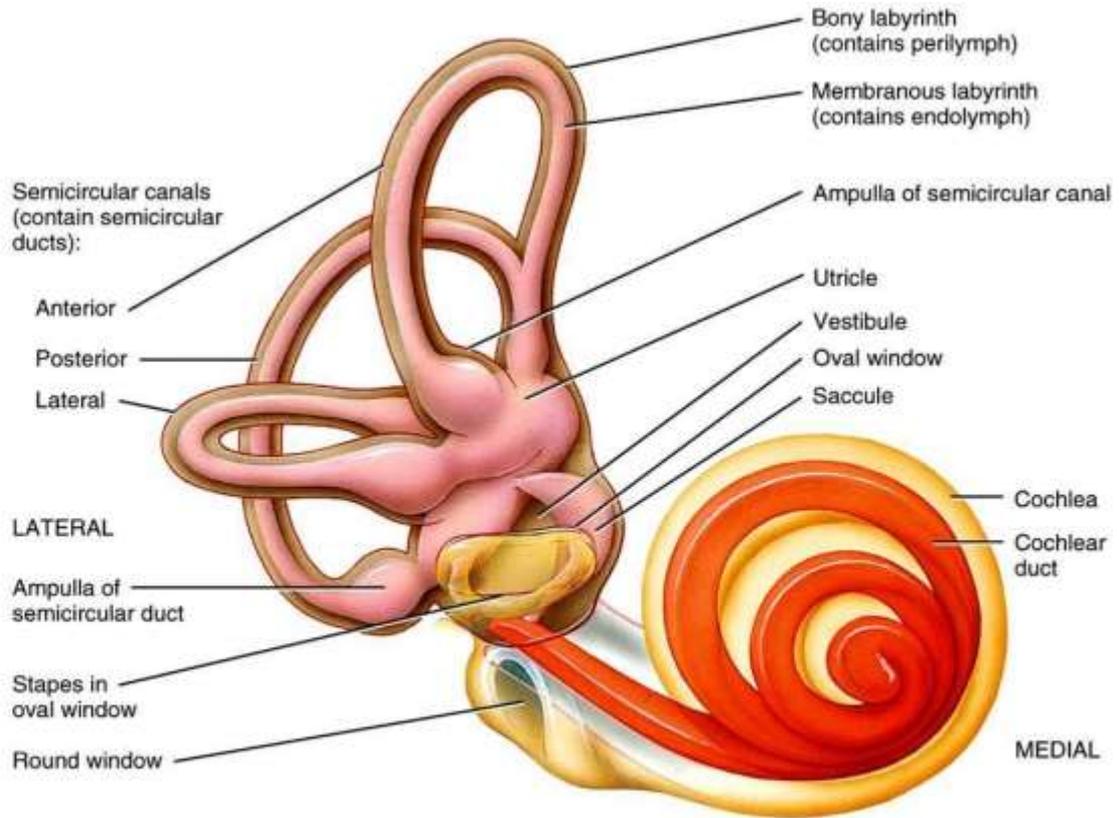
# The External, Middle and Internal Ear



# The Internal Ear



- External ear
- Middle ear
- Internal ear



(a) Components of the right internal ear

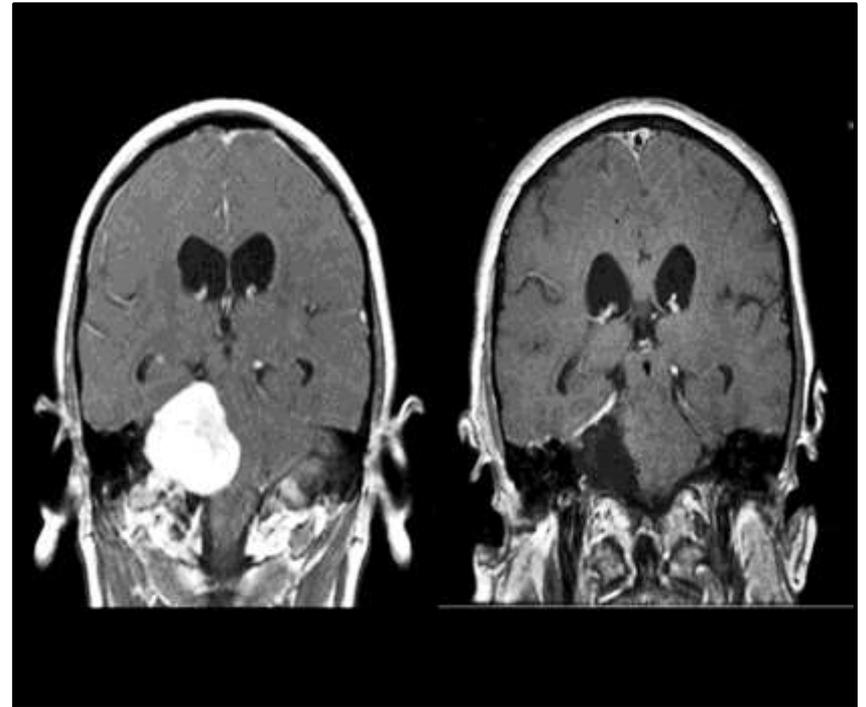
Cochlea the spiral cavity of the inner ear containing the organ of Corti, which produces nerve impulses in response to sound vibrations.

# Ear infections: Otitis Media

- Most common illness in infants and young children (aside from the common cold)
- Ear pain, especially when lying down, tugging or pulling at an ear, trouble sleeping, crying more than usual, fussiness
- Many can get better without antibiotics
- Call doctor if fever lasts more than two days (amoxicillin most commonly prescribed)
- In chronic otitis, occasionally tubes can be inserted or adenoidectomy performed. Rare Cholesteatomas develop. Tonsillectomy no longer common except for Obstructive Sleep Apnea in children or adults
- For pain relief, over-the-counter acetaminophen (Tylenol®) or ibuprofen (Advil®, Motrin®)
- Never give aspirin to children. Aspirin can cause a life-threatening condition called Reye's Syndrome

# Cancers of the Ear

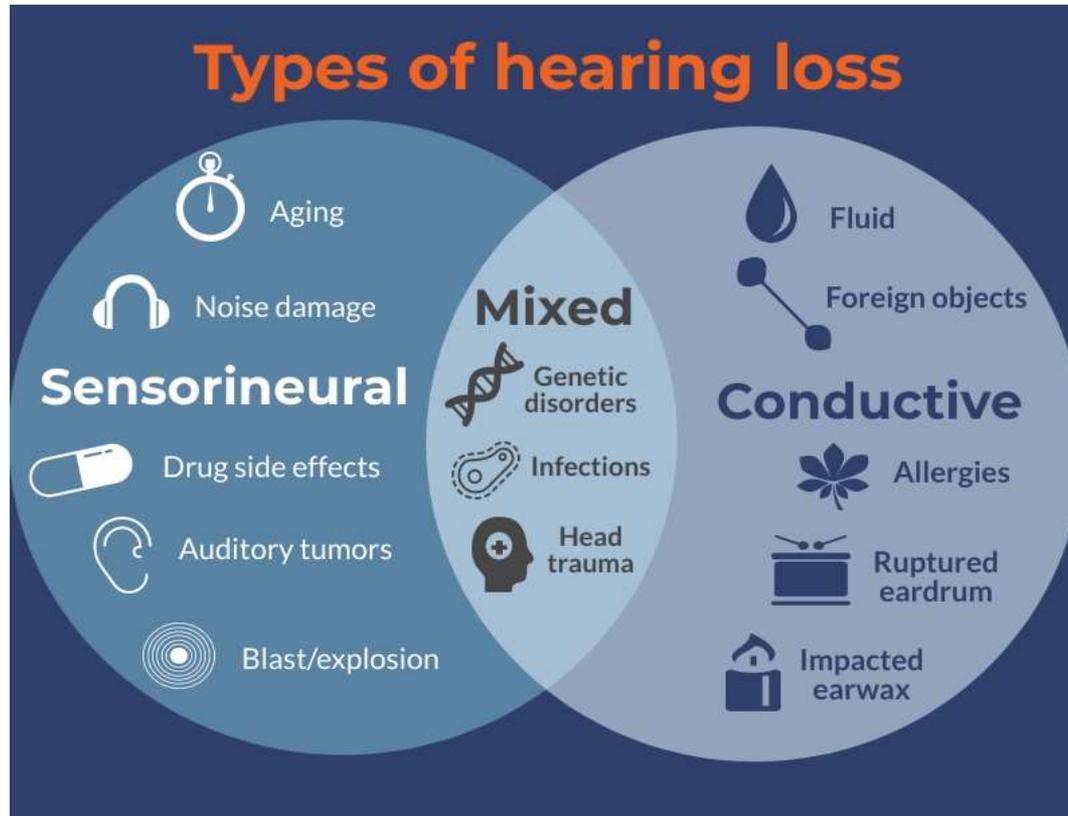
- Mainly Basal Cell and Squamous Cell of the skin.
- Also Acoustic Neuroma of the 8<sup>th</sup> Auditory Nerve that is benign but may grow and cause compression of the ventricles within the brain and hydrocephalus. Observation is an option, but surgical removal by craniotomy is needed for large tumors.



The **vestibulocochlear nerve (auditory vestibular nerve)**, known as the eighth cranial nerve transmits sound and equilibrium (balance) information

- **There are four types of hearing loss:**
- Auditory Processing Disorders
- Conductive– air and bone conduction
- Sensorineural
- Mixed.

# Types of hearing loss



# Quantification of hearing loss

20 Hz to 20 kHz maximum human hearing range



Every increase of 10 dB on the decibel scale is equal to a 10-fold increase in sound pressure level (SPL).

Short list of common sounds and how they measure up:

- Normal conversation – 60 dB
- Heavy city traffic – 85 dB
- Lawn mower – 90 dB
- MP3 player at maximum volume – 105 dB
- Sirens – 120 dB
- Concerts – 120 dB
- Sporting events – 105 to 130 dB (depending upon the stadium)
- Firearms – 150 dB

## Sound measuring: NIOSH has released a free smartphone sound measurement app for iOS devices

The NIOSH Sound Level Meter (SLM) app combines the best features of professional sound levels meters and noise dosimeters into a simple, easy-to-use package. The app was developed to help workers make informed decisions about their noise environment and promote better hearing health and prevention efforts.

Damage can occur either from acute or chronic levels of intense sound.

85 decibels over 8 hours are considered hazardous

100 decibels for more than 15 minutes per day is considered hazardous

110 decibels for shorter periods is harmful.

The message is that when in doubt about high exposure to loud sound; wear ear protection. (cutting the lawn, vacuuming, using work shop tools etc.)

# The aging ear

- **Presbycusis** (a type of hearing loss known as sensorineural) is the loss of hearing that gradually occurs in most individuals as they grow older. About 30-35 percent of adults age 65 and older have a hearing loss. It is estimated that 40-50 percent of people 75 and older have a hearing loss. Otosclerosis afflicts some younger individuals
- **At** low frequencies, between **250 and 1,000 Hz**, the **loss of hearing** is almost identical among men and women. In these frequencies the average **hearing loss** increases from 22-25 dB among those aged between 60 and 64 -----to 38-48 dB in the highest age group. At age 60 the hearing loss at 4,000 Hz (higher pitches) among men is almost 20 dB greater than the hearing loss among women of the same age.

# Tests for Hearing Loss

- Physical exam; otoscope
- Tuning fork to differentiate between bone and air conduction.
- Audiometry

# Audiometer Testing; fairly simple non-invasive test;

- There are a few tests involved in audiometry. A pure tone test measures the quietest sound you can hear at different pitches. It involves using an audiometer, which is a machine that plays sounds via headphones. Your audiologist or an assistant will play a variety of sounds, such as tones and speech, at different intervals into one ear at a time, to determine your range of hearing. The audiologist will give you instructions for each sound. Most likely, they'll ask you to raise your hand when a sound becomes audible.

# When to get tested?

- Unlike periodic visits to the eye doctor; routine audiometer testing is not a screening test.
- Usually your mate and friends will give you hints and clues that result in your visit to your primary care physician for referral to a audiometrist or ENT doctor for evaluation

## **Before you buy a hearing aid:**

**Get a checkup.** See your doctor to rule out correctable causes of hearing loss, such as earwax or an infection. And have your hearing tested by a hearing specialist (audiologist).

**Seek a referral to a reputable audiologist.** If you don't know a good audiologist, ask your doctor for a referral. An audiologist will assess your hearing, help you choose the most appropriate hearing aid and adjust the device to meet your needs. If you have hearing loss in both ears, you will get best results with two hearing aids.

**Ask about a trial period.** You can usually get a hearing aid with a trial period. It may take you a while to get used to the device and decide if it's right for you. Have the dispenser put in writing the cost of a trial, whether this amount is credited toward the final cost of the hearing aid and how much is refundable if you return the hearing aid during the trial period.

**Think about future needs.** Ask whether the hearing aid you've chosen is capable of increased power so that it will still be useful if your hearing loss gets worse. Hearing aids do not function indefinitely, but they should last about five years.

**Check for a warranty.** Make sure the hearing aid includes a warranty that covers parts and labor for a specified period. Some dispensers may include office visits or professional services in the warranty.

**Beware of misleading claims.** Hearing aids can't restore normal hearing or eliminate all background noise. Beware of advertisements or dispensers who claim otherwise.

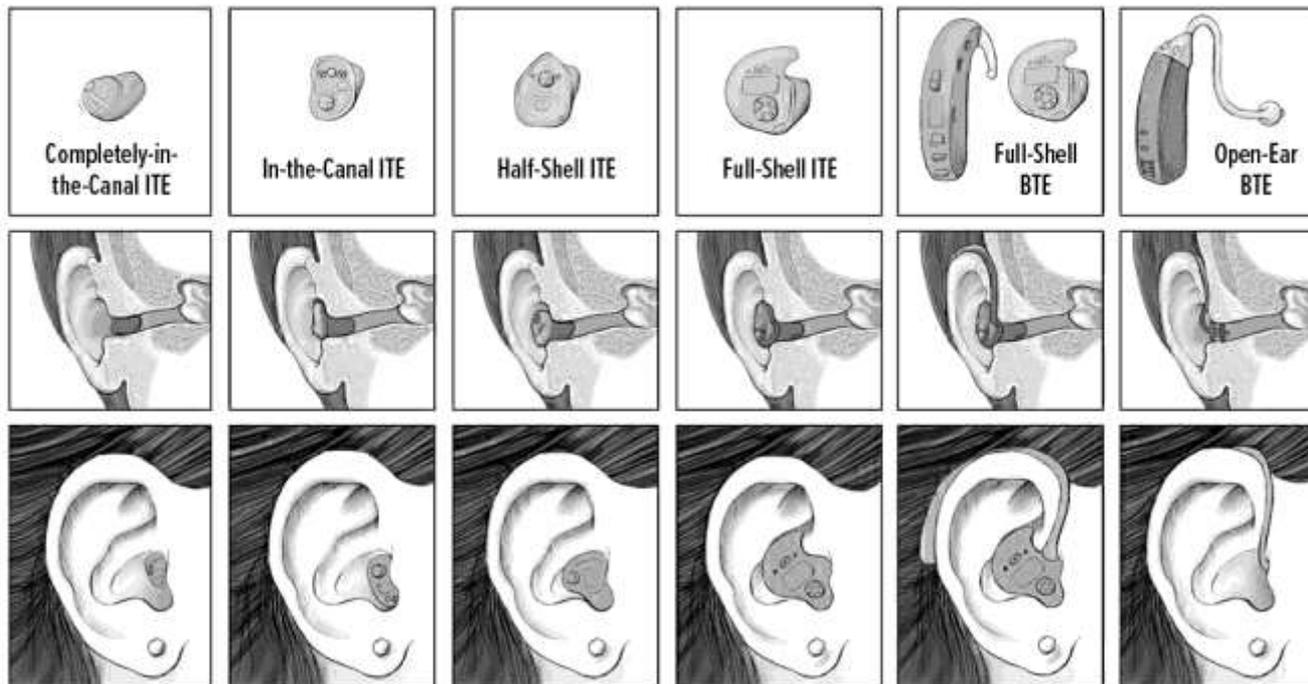
**Plan for the expense.** The cost of hearing aids varies widely — from about \$1,500 to more than a few thousand dollars each. Professional fees, remote controls, hearing aid accessories and other hearing aid options may cost extra. Talk to your audiologist about your needs and expectations.

# Types of Hearing Aids

- ❖ In-the-ear (ITE) hearing aids (custom fit)
- ❖ *half-shell* designs that fill half the bowl of the outer ear to *full-shell* designs that fill almost the entire outer ear bowl, directional microphones and manual controls
- ❖ Invisible in the canal (IIC) small, requires manual dexterity, invisible, with string to retrieve  
Completely in the canal (CIC) larger, longer battery life,
- ❖ Behind-the-ear (BTE) hearing aids (does not occlude entire canal) Receiver in the ear (RITE), rechargeable battery option , telecoil option that allows you to shut out unwanted background noise, and applies to all degrees of hearing loss, including profound hearing loss

# Types of Hearing Aids

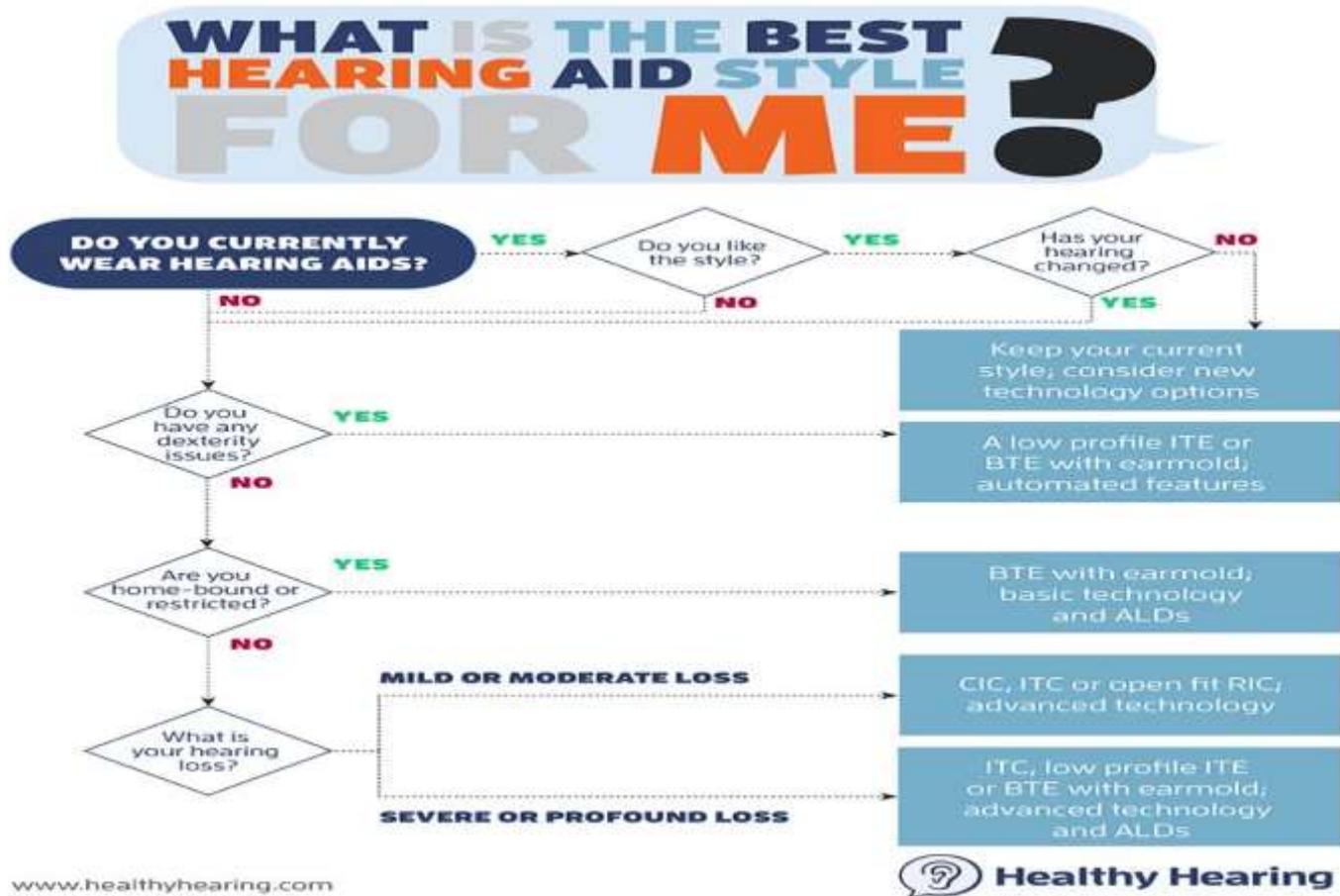
## Hearing Aid Types



In-the-Ear (ITE) Hearing Aids

Behind-the-Ear (BTE)  
Hearing Aids

# Things to Consider



www.healthyhearing.com

 **Healthy Hearing**

**Assistive Listening Devices (ALD)**

# More on Hearing Aids

- **Analog and digital** hearing aids (digital clarify sound)
- **Directional microphone** ( signal-to-noise ratio (SNR) Hearing aids using standard (omnidirectional) microphones, while effective at increasing audibility for speech and other sounds, are largely ineffective in improving inadequate SNR.
- **T-coil (Telephone switch)** allows you to switch from the normal microphone setting to a "T-coil" setting in order to hear better on the telephone. The voice of the speaker, who can be some distance away, is amplified significantly more than any background noise
- **Direct audio input FM Systems** One part is a microphone that the speaker wears. The microphone sends a signal to a receiver. You wear the receiver on your ears or in your hearing aids.
- **Feedback suppression:** the **feedback** cancellation filter adapts on the **hearing-aid** input signal, and signal cancellation and coloration artifacts can occur for a narrowband input. This helps suppress squeals when a hearing aid gets too close to the phone or has a loose-fitting ear mold.

# Cost: Computers in the Ear

- The **average** cost of a **hearing aid** is \$1,000 to \$4,000.
- The average price of a single hearing aid is \$2,300, according to a 2015 report from the President's Council of Advisors on Science and Technology. And most people need two. (Six global manufacturers control 90 percent of the market—this partly explains the high cost)

According to the website Exposing Hearing Aids, a provider information portal that also connects patients with providers, a typical hearing aid pricing model breaks down as follows:

Total patient price: \$4,600

Manufacturer costs (materials and research): \$1,400

Retailer costs (operating costs, salaries, marketing, continuing education):  
\$2,236

Service costs for the life of the hearing aids (adjustments, cleaning, repairs, batteries): \$574

Potential pretax profit: \$350

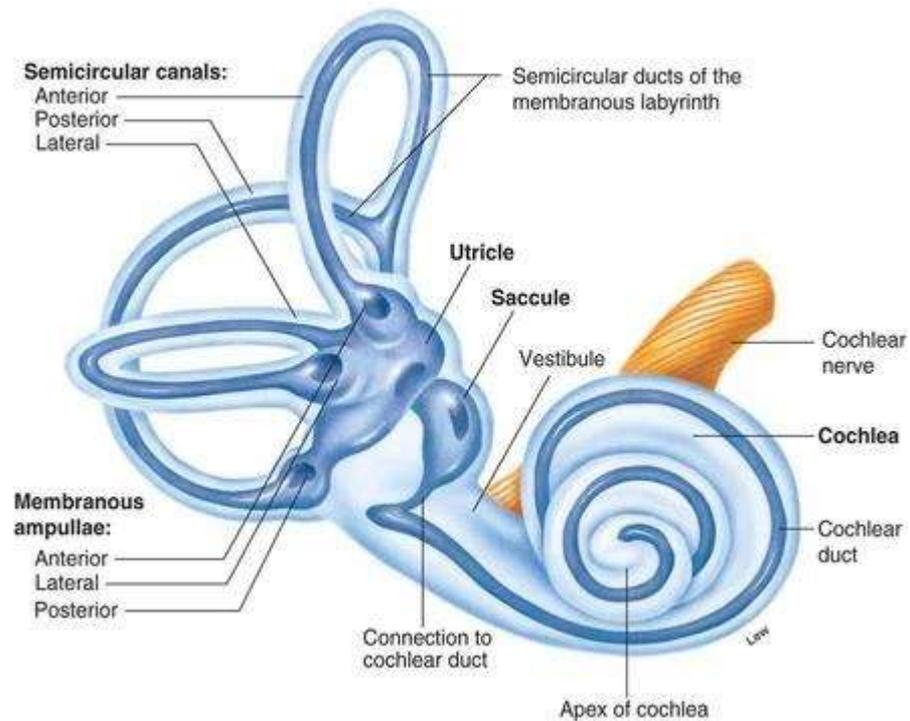
# Cochlear Implants

- **What is a cochlear implant?**
- Cochlear implants are complex medical devices that work differently than hearing aids. Rather than amplifying sound—which helps a person with residual hearing ability—a cochlear implant provides the sense of sound by stimulating the auditory nerve directly.

Adult candidates are generally eligible for an implant if they:

- Have severe or profound hearing loss in both ears.
- Get little or no benefit from hearing aids.
- Have no medical problems that could put them at risk during surgery.
- Have a strong desire to be part of the hearing world and communicate through listening, speaking and speechreading.

# The Semicircular Canals



# Semicircular Canals

- Your **semicircular canals** are three tiny, fluid-filled tubes in your inner ear that help you keep your balance. When your head moves around, the liquid inside the **semicircular canals** sloshes around and moves the tiny hairs that line each **canal** sending signals to the brain about balance.

# Other factors in balance

- Proprioception is the sense through which we perceive the position and movement of our body, including our sense of equilibrium and balance.

Conscious proprioception is relayed mostly by the dorsal column and in part by the spinocervical tract. Finally, the organ of perception for position sense is the sensory cortex of the brain.

- The cerebellum receives information from the sensory systems, the spinal cord, and other parts of the brain and then regulates motor movements. The cerebellum coordinates voluntary movements such as posture, balance, coordination, and speech, resulting in smooth and balanced muscular activity.

# Vertigo (the sensation that the room is spinning)

- **BPPV.** These initials stand for benign paroxysmal positional vertigo. BPPV occurs when tiny calcium particles (canaliths) clump up in canals of the inner ear. Usually disappears with time. Canalith repositioning procedures can move these particles to a part of your ear where they won't cause dizziness.
- **Meniere's disease:** inner ear disorder thought to be caused by a buildup of fluid and changing pressure in the ear causing tinnitus, hearing loss and vertigo. The episodes can last anywhere from 20 minutes to four or more hours
- **Vestibular neuritis or labyrinthitis.** This is an inner ear problem usually related to infection (usually viral). Most resolve with time..

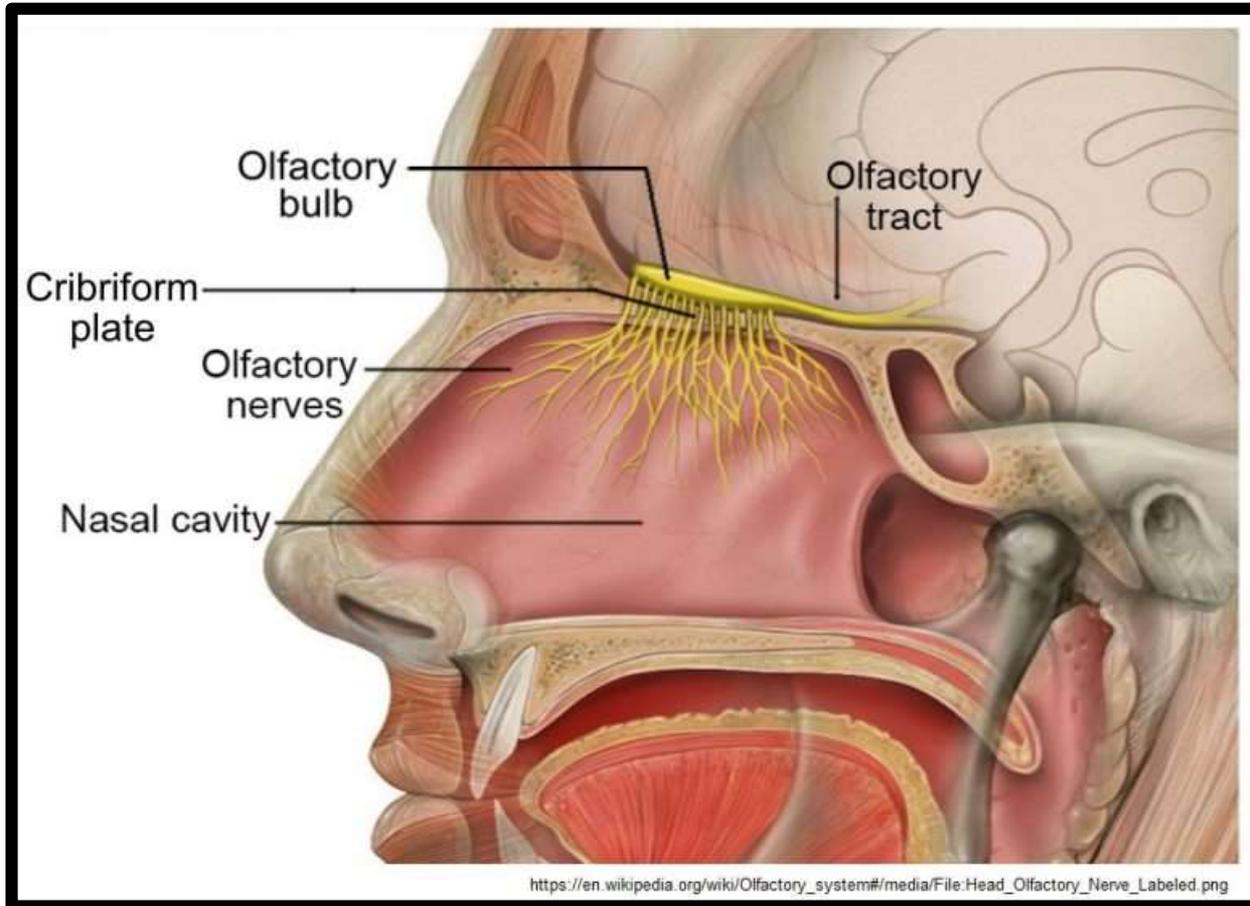
# Tinnitus

- **Tinnitus** is the perception of noise or ringing in the ears. It is a common complaint that affects about 15 to 20 percent of people. **Tinnitus** isn't a condition itself — it's a symptom of an underlying condition, such as age-related hearing loss, ear injury or a circulatory system disorder.
- Although bothersome, tinnitus usually isn't a sign of something serious and in most instances the cause is never found.

# Balance problems and Falls: multiplicity of causes

- Often cause hip fracture that may be a terminal event. In usual care, the reported 1-year mortality after sustaining a hip fracture has been estimated to be 14% to 58%. Major cause of in-hospital accidents with prolonged hospital stays.
- Make your home safer and avoid doing things that are risky; do not go out on the roof.
- Use canes, walkers, wheel chairs, attendants
- Practice transfers
- Physical and occupational therapy: strength and balance training
- Treat osteoporosis and other underlying conditions.

**Smell;** the Olfactory Lobe (first cranial nerve): most primitive sense (limbic system) but loss of smell a rare presenting complaint; but common in Covid infections



4 million smell cells in our noses, divided into about 400 different types (specific smells) and great variation between individuals .

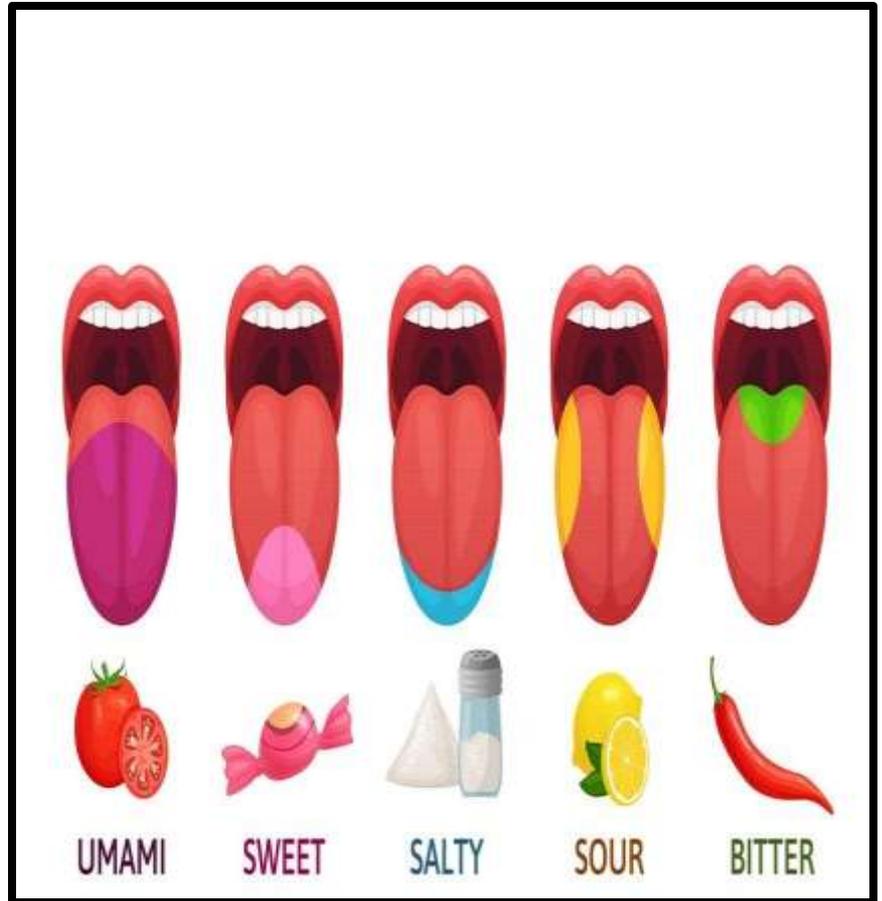
- Pheromones, unlike most other hormones, are ectohormones that are secreted on the exterior surfaces of the body to influence the behavior of another individual.
- Frequent loss of smell 4-5 days after onset of other symptoms of Covid 19. (generally reversible)
- Alzheimer's disease, Parkinson's disease (90% but rare complaint), Huntington's disease, and multiple sclerosis (MS) often have smell disorders

Taste: sweet, sour, bitter, salty, umami (savory-glutamate) and possibly fatty

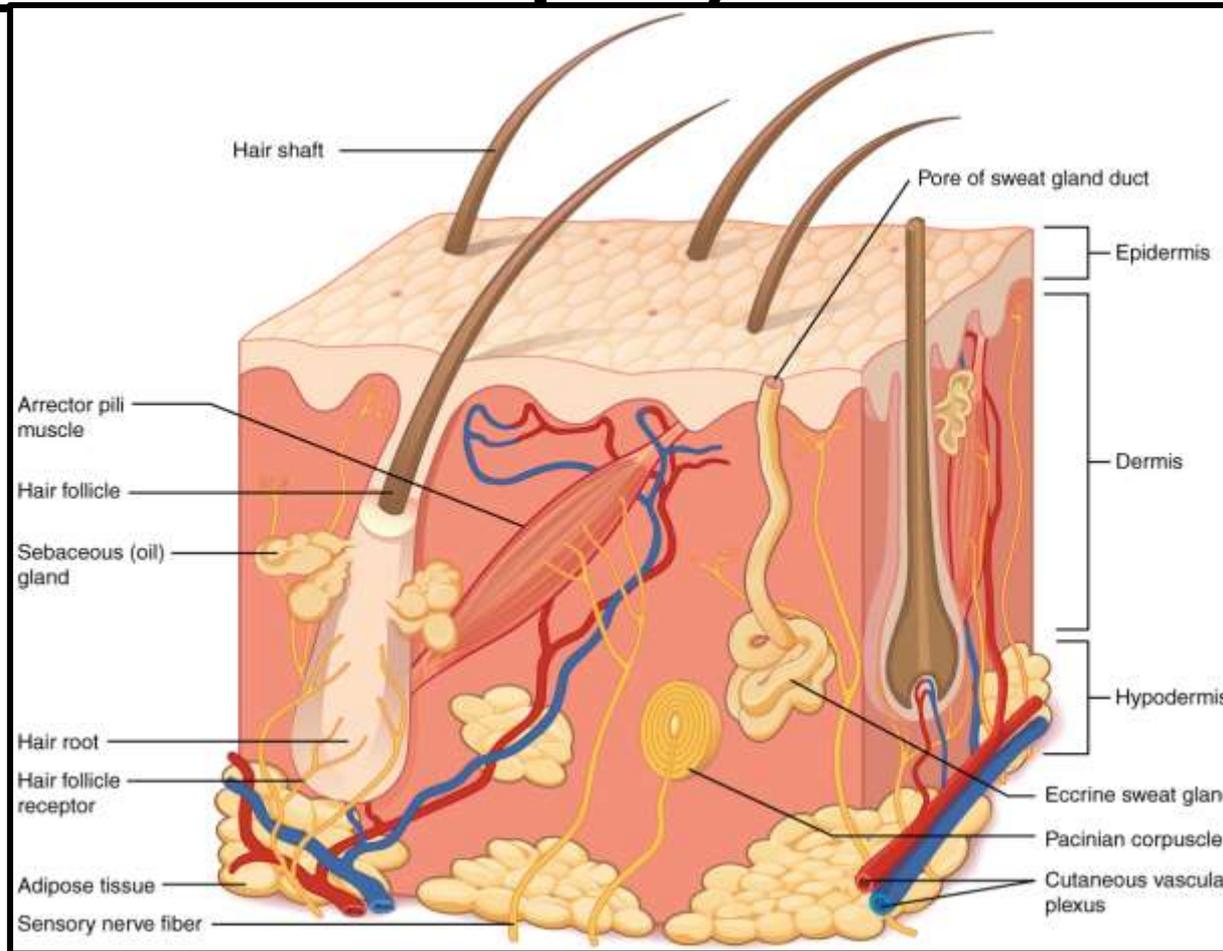
- Capsaicin (spicy) and texture directly activate our tongue's touch, rather than taste-bud, receptors (trigeminal nerve)
- The three nerves associated with taste are the facial nerve (cranial nerve VII), which provides fibers to the anterior two-thirds of the tongue; the glossopharyngeal nerve (cranial nerve IX), which provides fibers to the posterior third of the tongue; and the vagus nerve (cranial nerve X), which provides fibers to the epiglottis region.
- XII. The Hypoglossal nerve enervates the muscles of the tongue.

# Why do Docs examine the tongue

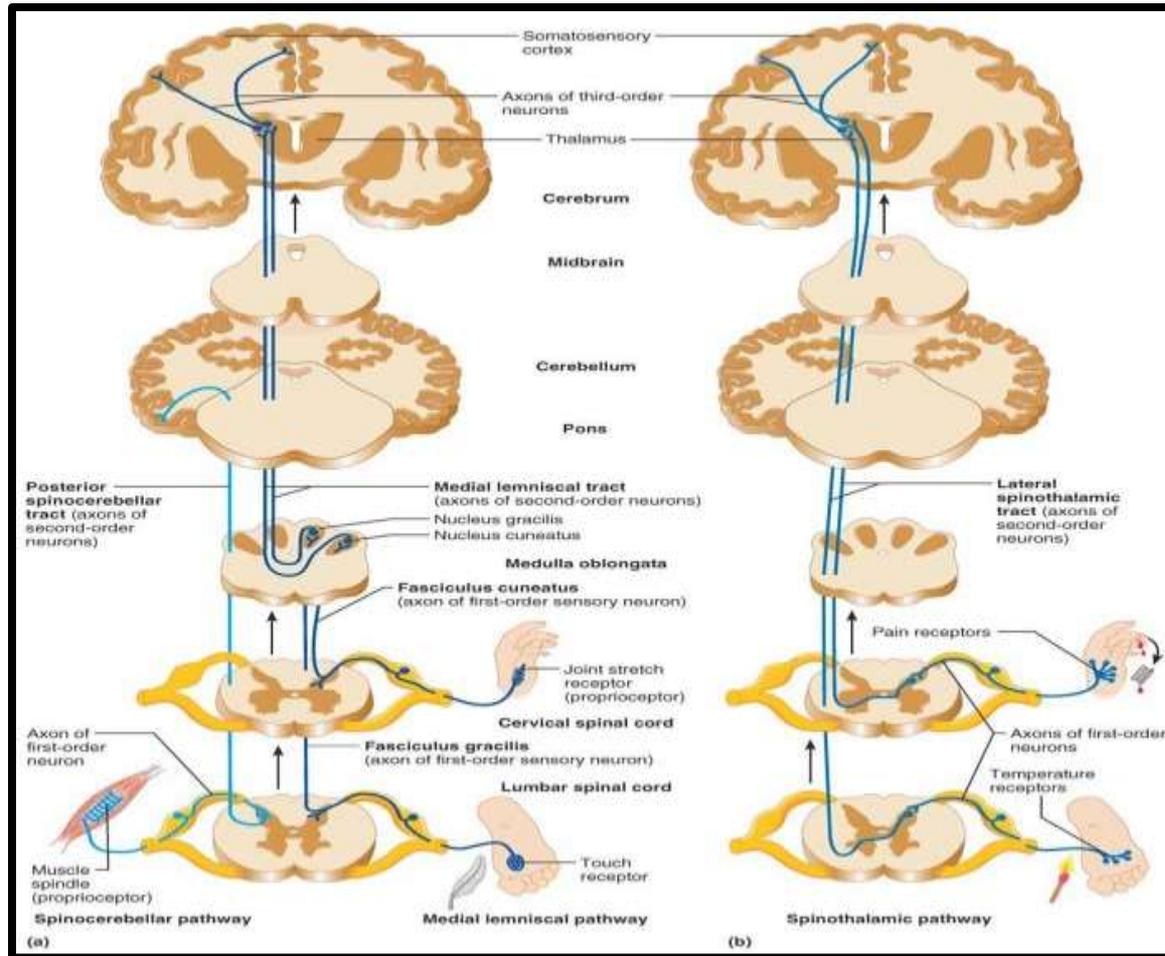
- Cold sores; causes by Herpes simplex type 1.
- Thrush: yeast, candida
- Vitamin deficiency (Fe, Vit B 12)
- Trauma and cancer (cigar smokers)
- Exam of tongue: a sign of general health and often important in Chinese medicine.



# Skin; touch, pain, temperature, proprioception, and pressure (somatic pain)



# Sensory Nerve impute to the brain



## Types of Sensory Nerves

- “Very rapidly adapting” such as Pacinian corpuscle
- “Rapidly adapting” such as Meissner corpuscle and hair follicles
- “Slowly adapting” includes Ruffini corpuscle, Merkel receptors, and tactile discs

# More on types of sensory nerves.

- Group I or A-alpha fibers: Ia from primary endings of muscle spindles (proprioception); Ib from Golgi tendon organs (proprioception)
- Group II or A-beta fibers: from secondary endings of muscle spindles (proprioception); from specialized receptors in the skin and deep tissues (touch, pressure)
- Group III or A-delta fibers: from free and specialized endings in muscle and joints (pain); from the skin (sharp pain, heat, cold, and some touch and pressure); visceral afferents
- Group IV or C fibers from skin and muscle (slow-burning pain); visceral pain

# Visceral Pain

- injuries to internal organs, such as the gallbladder, intestines, bladder, or kidneys
- damage to the core muscles or abdominal wall
- Pleural or peritoneal irritation
- acid indigestion
- Obstruction of bowel, ureter or common bile duct
- infections in the digestive and renal systems
- problems in specific organs such as the pancreas or liver
- cancer that affects internal organs such as stomach cancer
- endometriosis
- menstrual pain
- prostate damage