

08 Health Science–Training Handout

by Karen L. Lancour

This event encompasses the **anatomy and physiology of the Nervous, and Circulatory Systems the effects of disease and drugs on their health.**

■ BASIC ANATOMY AND PHYSIOLOGY

- ❖ Nervous system
- ❖ Circulatory system
- ❖ Major diseases
- ❖ Effects of alcohol, nicotine, caffeine, methamphetamines, opiates, barbiturates
- ❖ Treatment and prevention of diseases and addiction

■ PROCESS SKILLS - observations, inferences, predictions, calculations, data analysis, and conclusions.

■ Event Parameters

- ❖ Non-programmable calculators
- ❖ No other resources are allowed

The following are suggested topics for state or regional contests. All topics will be used at the national level.

NERVOUS SYSTEM

All Competition Levels

- The Brain- basic function and identification of cerebral lobes, cerebellum, and brain stem, identification of simple encephalographic waveforms
- Neural Impulses- Action potential generation and propagation, ionic basis of the cellular membrane potential, cellular anatomy and physiology of neurons
- Central Nervous System- organization of the spinal cord, purpose/functions of sleep
- Peripheral Nervous System- neuroganglia, action of sensory and motor neurons, understand differences in and purposes of parasympathetic, sympathetic, somatic, and sensory systems
- Neural Impulses- Cellular anatomy and physiology of glial and supporting cells, synapses and neurotransmitters

National Competition Only:

- The Brain- anatomy and physiology of brain function including function and role of specific nuclei clusters and tracts, theories of dreaming, purpose and principles of MRIs and EEGs
- Neural Impulses- Retrograde signaling, neuromodulators, SSRI/MAOI antidepressants

CIRCULATORY SYSTEM

All Competition Levels:

- The Heart- chambers and valves of the heart, electrical stimulation of myocardio tissue
- Blood Vessels- arteries, arterioles, veins, venules, capillaries
- Blood- plasma, hematocrit, red blood cells, ABO-blood typing, Rhesus factor, oxygen transport, hemoglobin
- The Heart- pacemaker tissue, interpreting ECG (EKG) readings
- Measurement of the pulse rate and blood pressure
- Relevant calculations include systolic and diastolic pressure, mean arterial pressure, stroke volume and cardiac output
- Blood- platelets and blood clotting, regulation of blood plasma volume and acidity, MN-bloodtyping, basic genetics of ABO, Rh, and MN bloodtypes (ONLY) including paternity mysteries

National Level Only:

- Blood Vessels- continuous vs. fenestrated capillaries, blood brain barrier
- Lymphatic System- white blood cells, lymph nodes, lymph ducts, lymphatic capillaries, lymphoid organs (spleen, thymus), tissue fluid
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DRUGS, DISEASE AND TREATMENT

All Competition Levels –

- Narcolepsy, Epilepsy and Seizures, Sleep Deprivation, Iron-Deficient Anemia, Sickle-Cell Anemia. Neurodegenerative Diseases (Alzheimer’s Disease, Huntington’s Disease, and Parkinson’s Disease), Hemophilia, Arterial Sclerosis, Erythroblastosis Fetalis
- Drug/addiction induced changes in the circulatory system, on the brain and neurological system caused by nicotine, caffeine, alcohol, methamphetamines, opiates, or barbiturates.
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Diagnosis and treatments

- Technological tools for diagnosis
- Strategies for treatment
- Contemporary research for diagnosis/treatment (new research/therapies)

National Level Only –

Diseases

- Biological Basis of Schizophrenia, all diseases and disorders relevant to the nervous, and circulatory systems are potential topics for national finals, however primary emphasis will be on those listed above.
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Biological basis

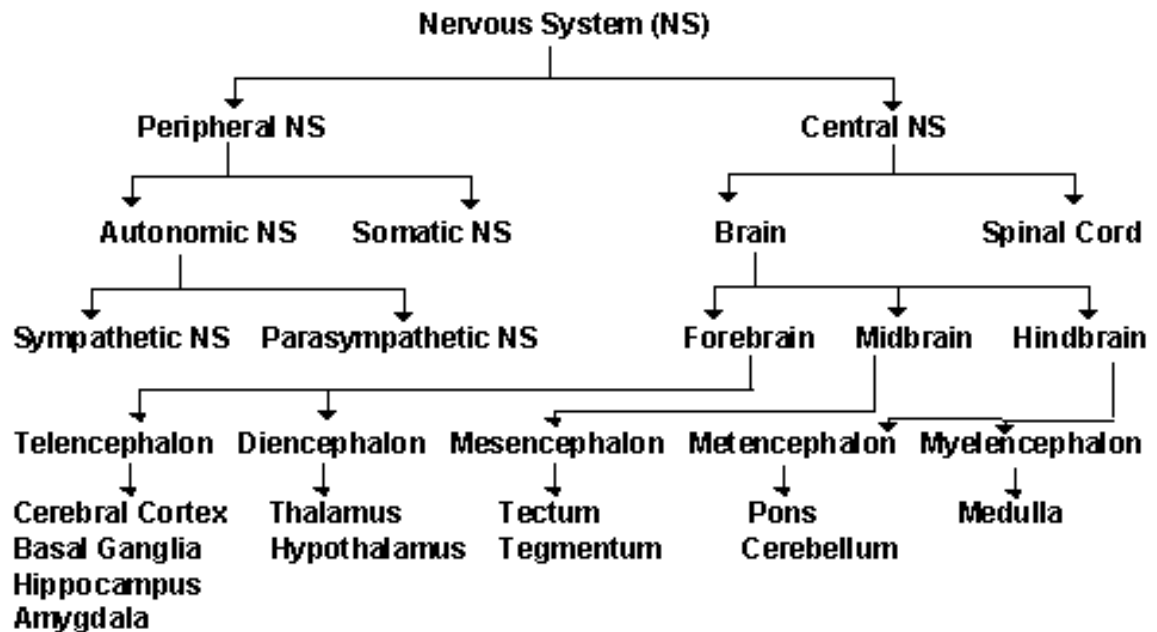
- Mechanisms and actions of drugs-e.g. secondary messenger systems
- Pharmacokinetics of drugs and the system-e.g., half-life, peaks and troughs
- Cardiac implications from prolonged use/abuse

Diagnosis and treatments

- Chemical treatment strategies

Nervous System

Nervous System



Regions of the Brain

Cerebellum – muscle coordination, muscle tone & balance

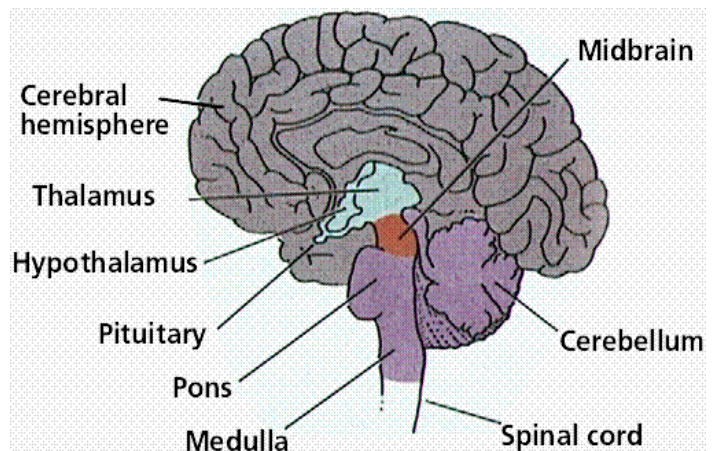
Cerebrum – conscious activity

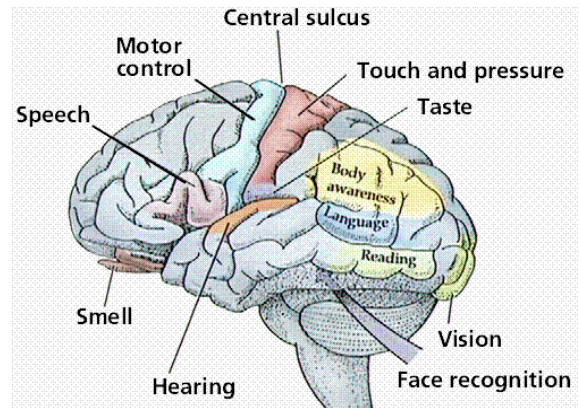
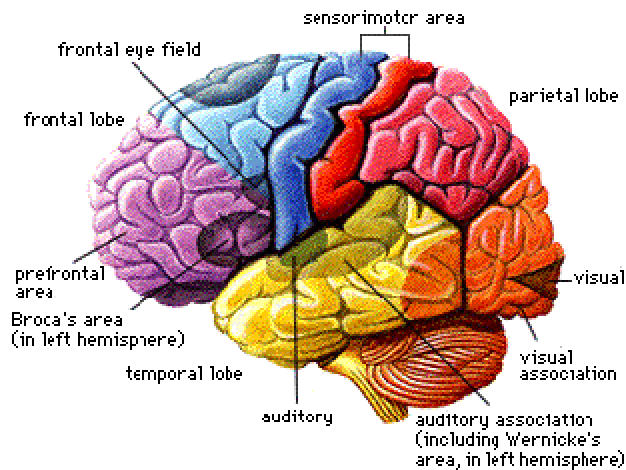
Thalamus – Brain’s switchboard

Medulla – vital reflexes as heart beat and respiration

brainstem – medulla, pons, and midbrain (involuntary responses)

Hypothalamus – hormones





Lobes of the Cerebrum

Frontal – motor area, emotions

Parietal – sensory area

Temporal – hearing, taste, smell, some memory

Occipital – visual center

Sense Organs

Eye

Cornea - the clear, dome-shaped tissue covering the front of the eye.

Iris - the colored part of the eye - it controls the amount of light that enters the eye by changing the size of the pupil

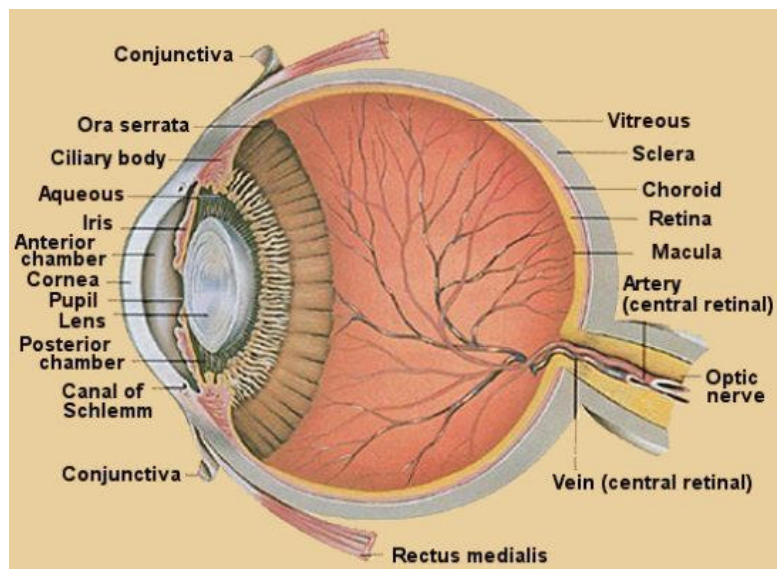
Lens - a crystalline structure located just behind the iris - it focuses light onto the retina

Optic nerve - the nerve that transmits electrical impulses from the retina to the brain

Pupil - the opening in the center of the iris- it changes size as the amount of light changes (the more light, the smaller the hole)

Retina - sensory tissue that lines the back of the eye. It contains millions of photoreceptors (rods and cones) that convert light rays into electrical impulses that are relayed to the brain via the optic nerve

Vitreous - a thick, transparent liquid that fills the center of the eye - it is mostly water and gives the eye its form and shape (also called the vitreous humor)



EAR

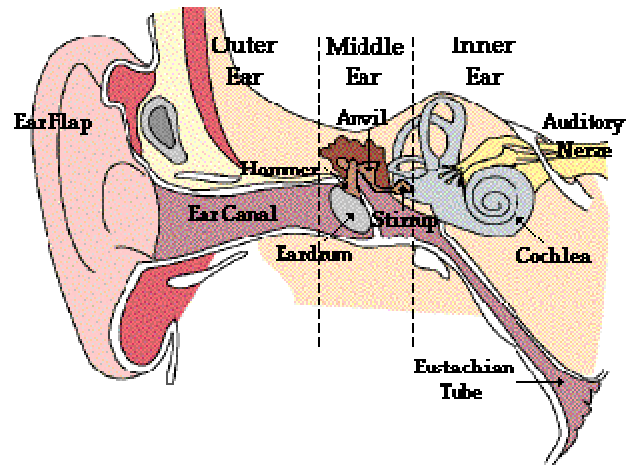
Outer Ear & ear canal – brings sound into eardrum

Eardrum – vibrates to amplify sound & separates inner and middle ear

Ossicles = anvil, stirrup, stapes – amplify sound (small bones)

Eustachian tube – connects middle ear to throat and equalizes pressure on eardrum

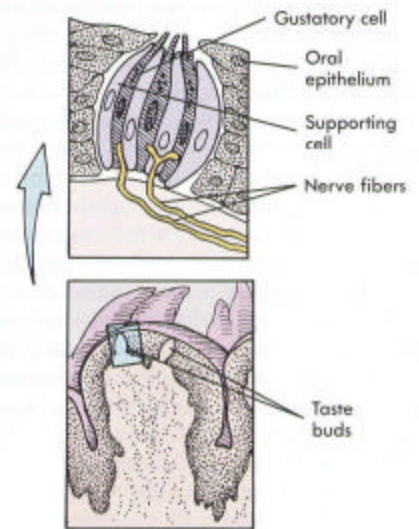
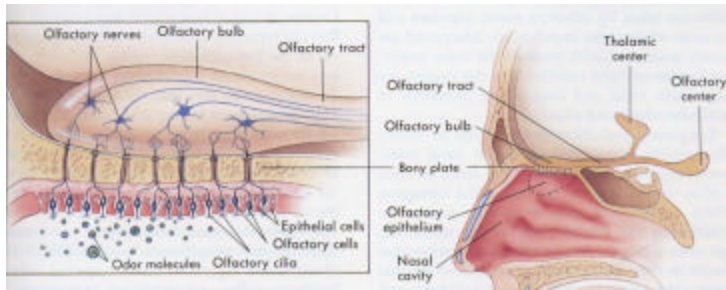
Cochlea – in inner ear – has receptors for sound & sends signals to brain via Auditory Nerve.



Taste and Smell – Chemical Receptors

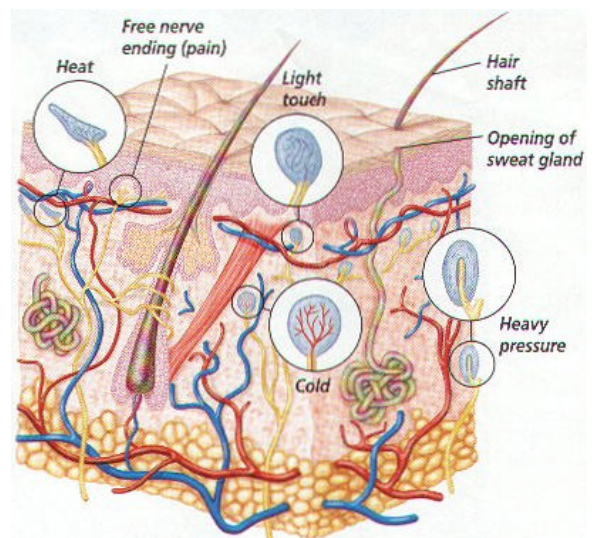
Taste – Sweet, Sour, Bitter, Salty, MSG

Smell Receptors - top of nasal cavity, very sensitive, and easily fatigued so you do not notice smells



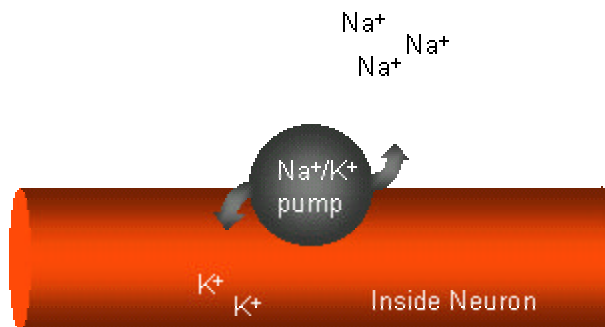
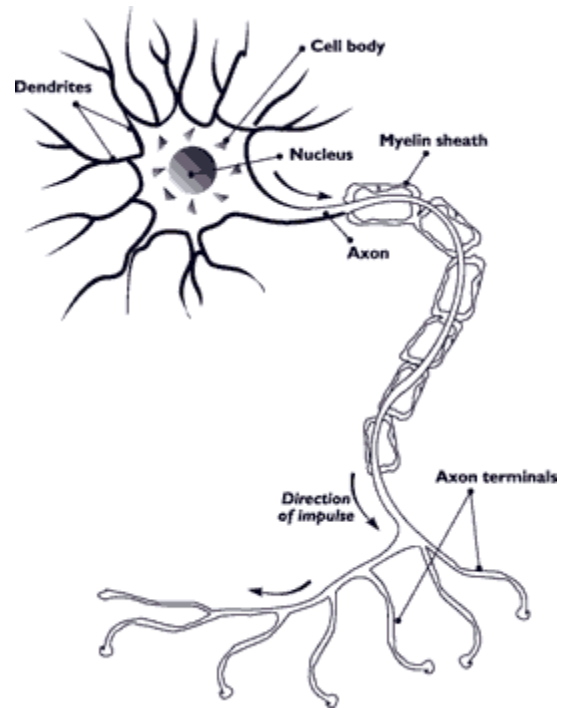
Skin receptors:

- Heat
- Cold
- Light Touch
- Heavy Pressure



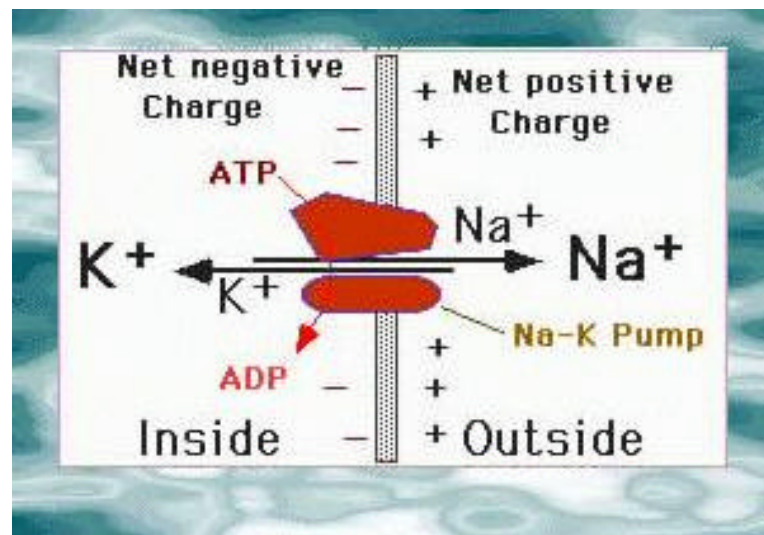
Neuron and Nerve Pulse Mechanism

- Basic functional cell of nervous system
- Transmits impulses
- Three types
 - Sensory neurons
 - Motor neurons
 - Interneurons



Impulses at Synapse

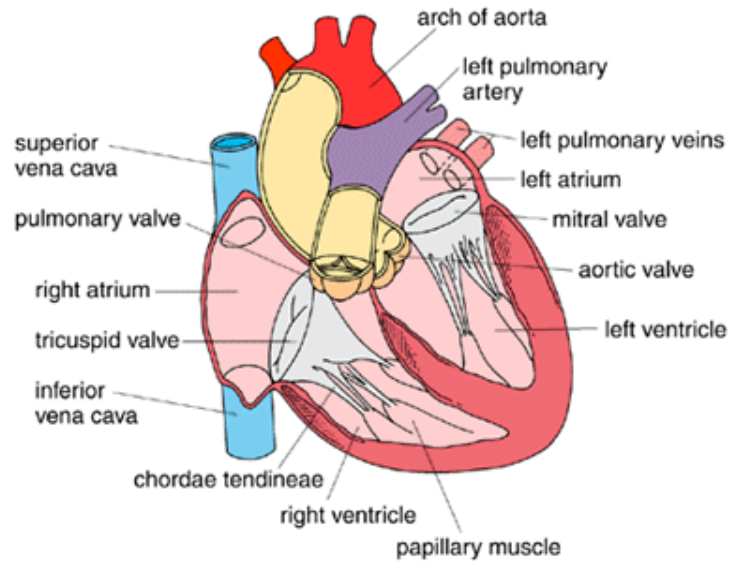
- Impulse
 - Self propagating
 - Mechanism – Na⁺ pump
- Synapse
 - Junction between neurons
 - Neurotransmitters
 - Excitatory
 - Inhibitory



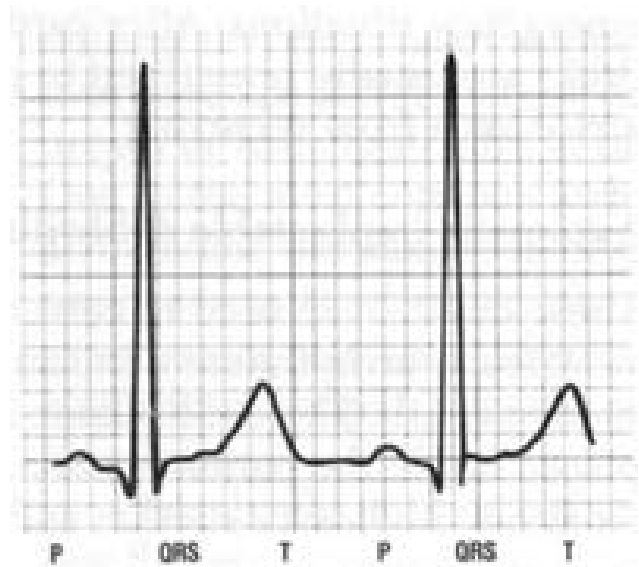
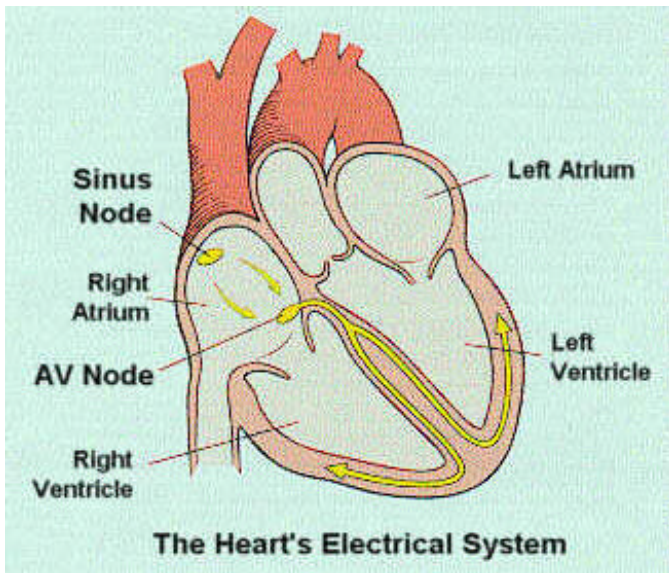
Circulatory System

Know:

Flow of blood through system
Electrical system of the heart
Control of heart and activities
Blood flow, blood pressure
Blood vessels and their differences
Blood chemistry
Blood genetics
Lymph system



Electrical System of the Heart



Electrocardiogram (ECG or EKG) = record of spread of electrical activity through the heart

P wave = caused by atrial depolarization (contraction)

QRS complex = caused by ventricular depolarization (contraction) and atrial relaxation

T wave = caused by ventricular repolarization (relaxation)

ECG = useful in diagnosing abnormal heart rates, arrhythmias, & damage of heart muscle

Relevant Formulas

Stroke volume (SV) = milliliters of blood pumped per beat

Heart rate (HR) = number of beats per minute

Cardiac output (CO) = heart rate times stroke volume

$$CO = HR \times SV$$

Pulse pressure (PP) = the difference between systolic pressure (SP) and diastolic pressure (DP)

$$PP = SP - DP$$

Mean Arterial Pressure (MAP) (2 equations):

Formula 1: MAP = diastolic pressure + 1/3 pulse pressure

Formula 2: MAP = 2/3 diastolic pressure + 1/3 systolic pressure

Blood Vessels

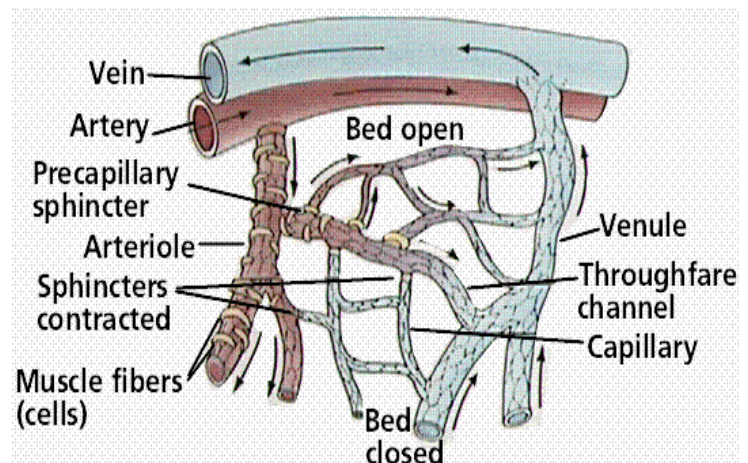
Arteries – largest vessels – carry blood from the heart.

Arterioles- smaller version of arteries, carry blood to the capillaries

Capillaries – smallest vessels, one cell thick, transfer materials to and from blood

Venules – small version of veins, carry blood from capillaries to veins

Veins – carry blood back to heart, have valves to stop backflow



Blood – Functions

- Transportation:
 - oxygen & carbon dioxide
 - nutrients
 - waste products (metabolic wastes, excessive water, & ions)
- Regulation - hormones & heat (to regulate body temperature)
- Protection - clotting mechanism protects against blood loss & leucocytes provide immunity against

Disorders and Their Treatment

- **Narcolepsy** – brain disorder – sleep too much in day – medications
- **Epilepsy and Seizures** – brain disorder causing seizures – anti-seizure medications
- **Sleep Deprivation** – sleep disorder
- **Iron-Deficient Anemia** – not enough iron in blood , dietary supplements
- **Sickle-Cell Anemia** – genetic disorder – RBC’s collapse, many secondary problems
 - medications, severe cases – blood transfusions
- **Hemophilia** – genetic disorder – blood does not clot
- **high blood pressure** – hypertension
- **Arterial sclerosis** – hardening of the arteries
- **erythroblastosis fetalis** – mom’s antibodies cause baby’s blood to clump in its veins
- **high cholesterol** – can cause deposits on walls of blood vessels

Drugs, Their Physiology, Effects, Symptoms, Treatment and Prevention

- **Nicotine**
- **Caffeine**
- **Alcohol**
- **Methamphetamines**
- **Opiates**
- **Barbiturates**