

Heart:

- Circulatory system includes the heart, blood vessels, and blood
 - responsible for transportation, protection, and regulation
- Cardiovascular system includes the heart and blood vessels
 - responsible for only the transportation of blood

Cardiovascular System:

- Pulmonary circuit- the right side of the heart, supplies blood to lungs to be oxygenated
- Systemic circuit- left side of the heart, supplies blood to all organs of the body

Heart:

- located in thoracic cavity and is contained by the mediastinum- the thick median partition of the thoracic cavity that separates one pleural cavity from the other
 - 4 inches wide, 5 inches long, 6 inches thick
 - weighs less than a pound

Heart walls:

Epicardium- largest branches of the coronary blood vessels travel through the epicardium

Myocardium- made up of cardiac muscle, is the thickest layer because it does the work of the heart, left is thicker than the right side

- cardiac muscle tissue is spiral or circular bundles that link all parts of the heart together
- fibrous skeleton*-framework of collagenous and elastic CT fibers
- functions: structural support, anchors cardiac muscle fibers, non conductor of electricity (limits the spread of action potentials)
- Endocardium*- lines the interior of the heart chambers, no adipose tissue, covers the valve surfaces and is continuous with the endothelium of the blood vessels

Pericardium:

- made of two walls
 - pericardial sac (parietal pericardium)
 - serous layer- deep and thin layer
 - fibrous layer- tough, superficial layer made up of dense CT
- epicardium (visceral pericardium)-formed by the serous layer turning inward at the base of the heart
- space between the parietal and visceral membranes is called pericardial cavity- and contains pericardial fluid
- functions: lubrication, reduce friction, protection, expansion of heart, and prevents excessive expansion

Cardiac Muscle Tissue:

- Has a single/central nucleus
- Mitochondria is 25% of the volume of the cell
- The sarcomeres are similar to skeletal muscle
- Sarcoplasmic reticulum is less developed (no terminal cisternae)
 - Has much larger T-tubules than skeletal muscle
 - admits calcium ions from ECF to activate muscle contraction
- Joined end to end by intercalated discs- complex steplike structure with 3 distinctive features not found in skeletal muscle

1. Interdigitating folds- looks like the bottom of an egg carton, interlock and increase the surface area of intercellular contact

2. Mechanical junction-

-*fascia adherens*- broad band in which actin of the thin myofilaments is anchored to the plasma membrane and each cell is linked to the next via transmembrane proteins

-*desmosomes*- patches of mechanical linkage between cells, prevent contracting cardiocytes from pulling apart

3. Electrical junction- gap junction that enables each cardiocyte to electrically stimulate its neighbors

-“functional syncytium” – though the heart is composed of many different cells, they all beat together and act as a single cell

Cardiac Muscle Metabolism:

-aerobic metabolism- needs oxygen in order to make ATP, not prone to fatiguing

-adaptable to organic fuels, at rest it is 60% fatty acids, 35% glucose, 5% other fuels

-can change metabolic pathways to use different substances for fuel (can even use lactic acid)

Cardiac Conduction System:

-Autorhythmic cells are modified cardiac muscle cells, 1% of total

-function independently but are influenced by ANS/hormones

-function as pacemakers and a conduction pathway

Depolarization Rate:

-SA node- (pacemaker)

-70-80 times/min

-AV node- acts as an electrical gateway to the ventricles

-40-50 times/min

-AV bundle and Purkinje fibers- AV bundle is the pathway by which signals leave the AV node, Purkinje fibers distribute electrical excitation to the cardiocytes of the ventricles

-20-40 times/min

Pacemaker Physiology of SA:

-Has an unstable resting membrane potential

-pacemaker potential- membrane potential starts at -60mV and drifts upward, gradual depolarization

Pictured on Graph:

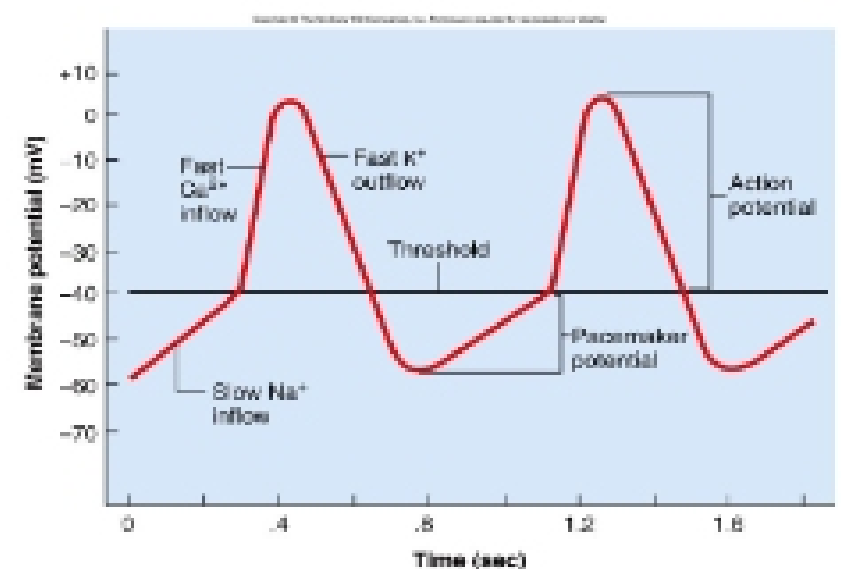
-Reduced K⁺ permeability

-Slow Na⁺ inflow

-Fast Ca channels

-Depolarization

-Fast K⁺ outflow



Impulse Conduction to the Myocardium:

-Cardiac conduction system: stimulus is required to initiate the action potential

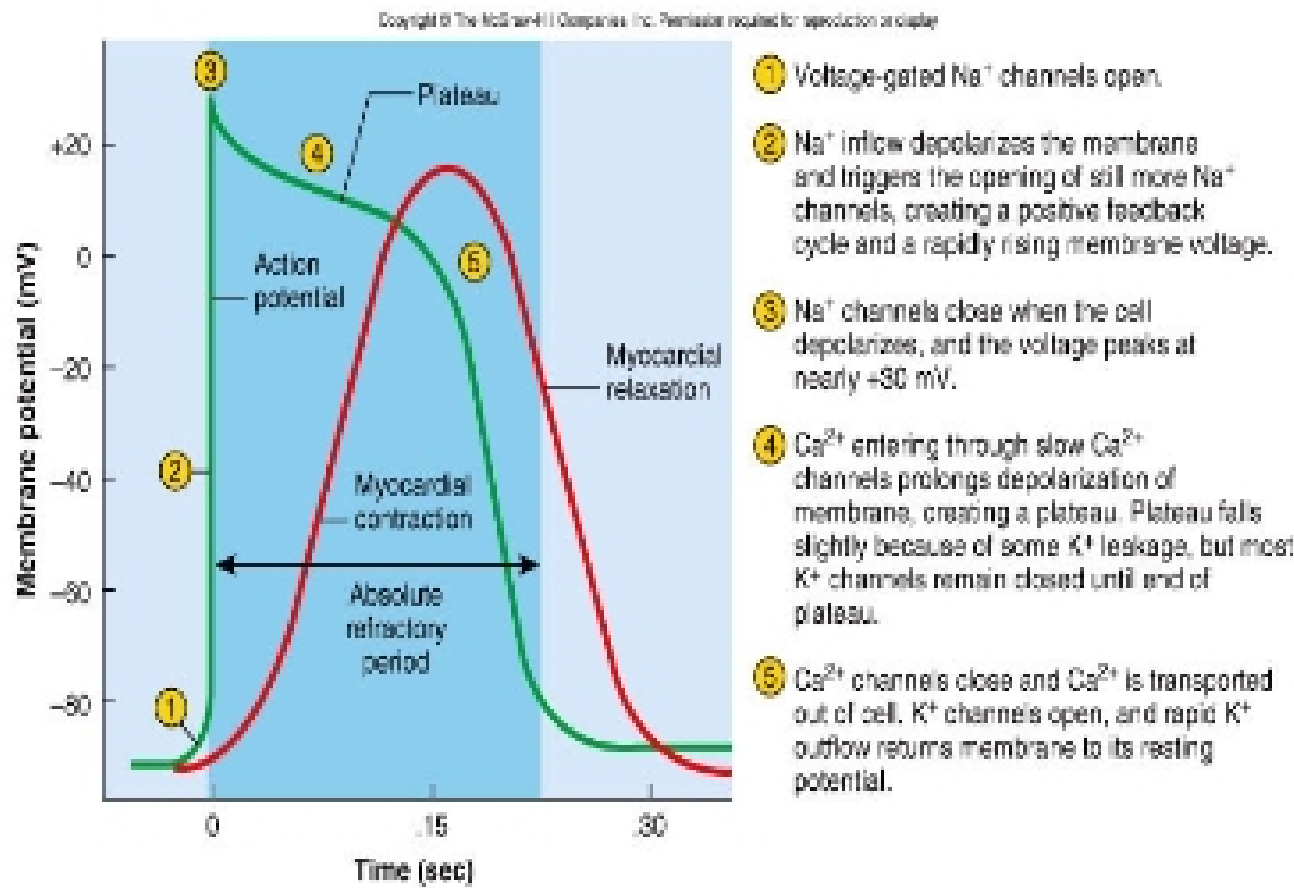
-“All or none”- either whole organ contracts or none of it does

-The artia and ventricles are not electrically connected, they experience functional syncytium (contract together no matter what)

- Purkinje Fibers are the fastest conducting fibers in the system
- supply the papillary muscles to contract and take up slack in the tendinous cords

Electrical Behavior of Myocardium:

- Individual contractile cardiac myocyte- aka cardiocyte
- resting membrane potential of -90mV
- normally depolarize only when stimulated, unlike cells of the SA node



Graph:

- Rapid depolarization- a stimulus opens voltage gated sodium channels, causing a Na^+ inflow
- Plateau phase- action potentials open slow calcium channels which admits Ca^+ to flow in
- Repolarization- Ca^+ channels close and K^+ channels open, membrane voltage drops and muscle tension declines soon after
- Absolute Refraction-longer than skeletal muscle, prevents wave summation and tetanus (would stop pumping action of heart)