K2. Heart Beat Co-ordination

I. Characteristics of Cardiac Cells

Heart muscle tissue can contract on its own

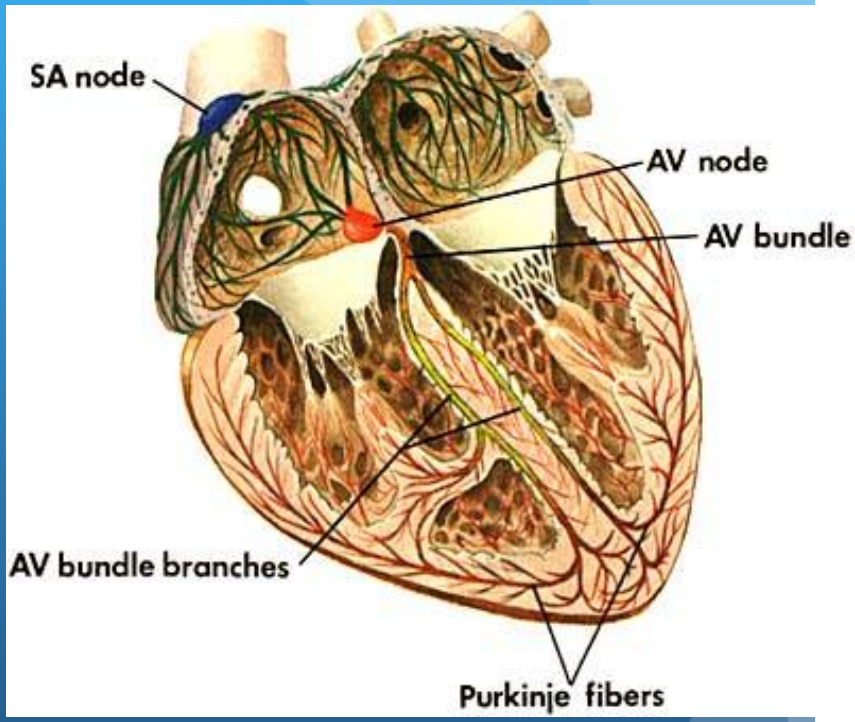
1. **Each cardiac cell can contract independently.**
2. **Will co-ordinate their contractions if the cells are touching.**

Video Clip – Dissection - Frog Heart Beating outside body

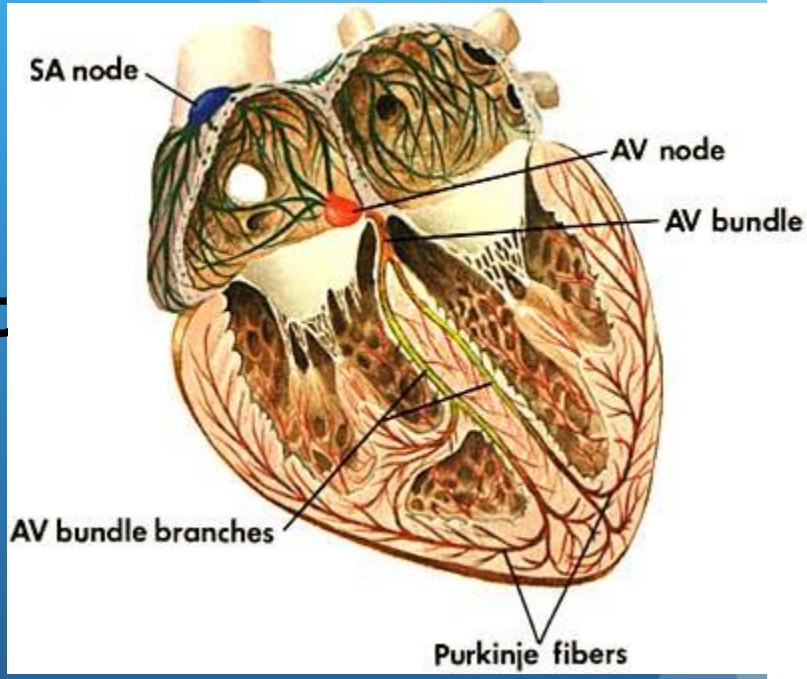
II. Heart Nervous Tissue

A. Heart contains NODAL TISSUE, which has characteristics of both nerve and muscle tissue to ensure rapid and coordinated heart contractions.

B. Sinoatrial (SA) Node
   1. Located in the upper back wall of the right atrium.

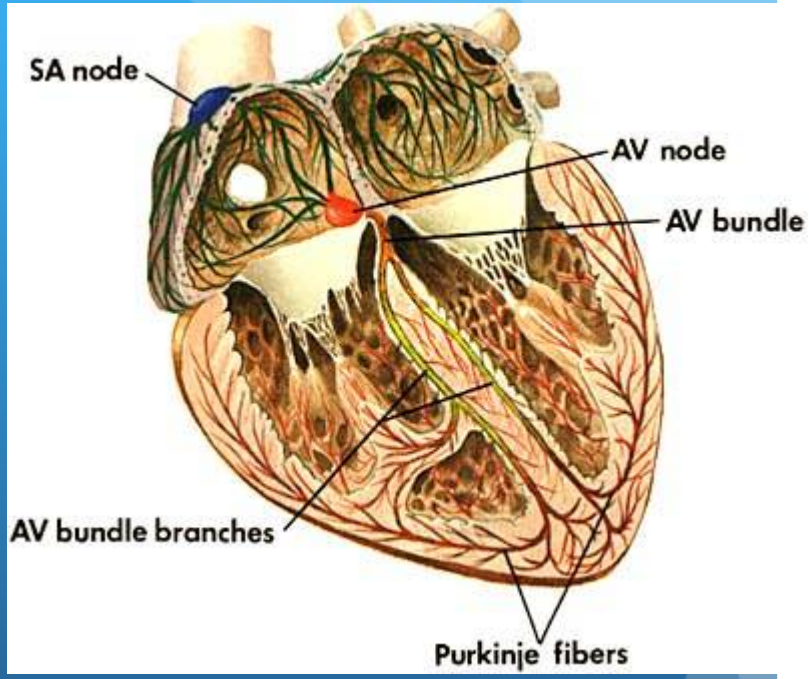


2. The SA node initiates the heartbeat by sending out a signal automatically about every 0.85 seconds to make the atria contract.
3. Called the "pacemaker" because it keeps the beat regular.
4. An implanted artificial pacemaker can send out an electric signal every 0.85 seconds to stabilize the heart rate if the SA node doesn't work.

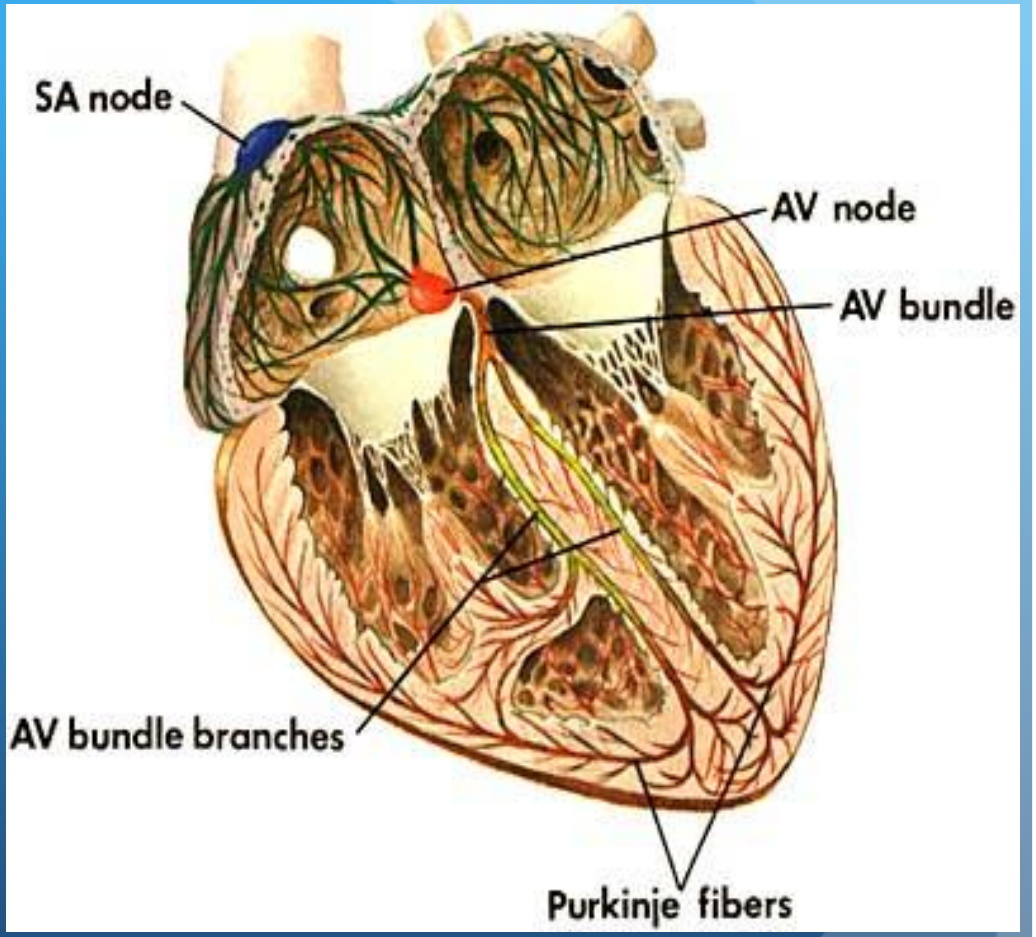


C. Atrioventricular (AV) Node

1. Located in the base of the right atrium near the septum.
2. Branches from the SA node are spread over the atria and also to the AV node.
3. When the pulse sent out by the SA node reaches the AV node, the AV node sends out a signal along special conducting fibers called AV bundle down the septum to the Purkinje fibres that spread through the ventricles.

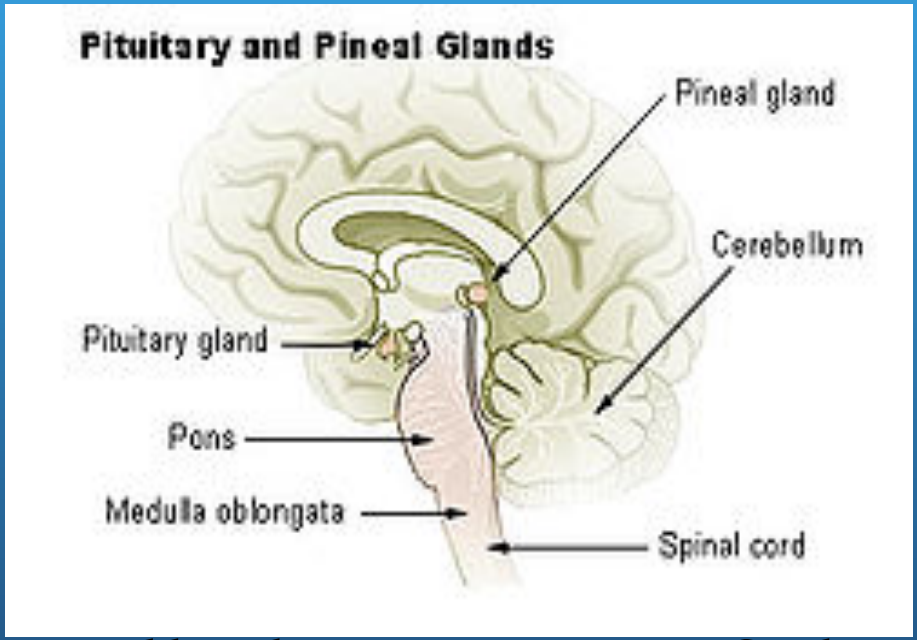


D. Purkinje fibers stimulate cardiac muscle at the base of the heart ventricles and moves up like a wave to cause the ventricles to contract.



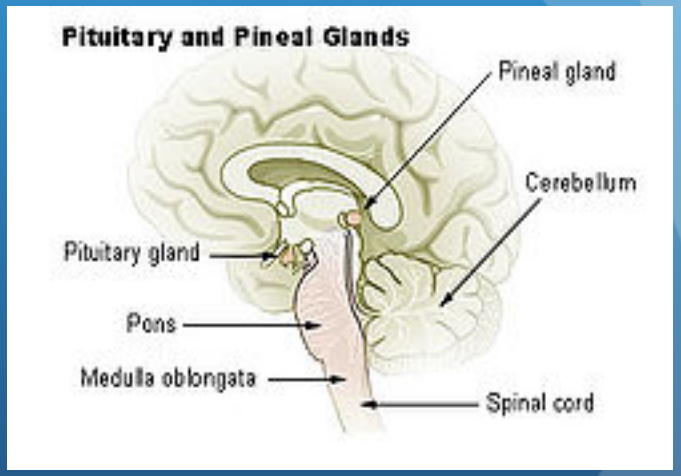
III. Control by the Brain

A. Nervous control controls the heart rate



A. Controlled in a part of the brain called the **MEDULLA OBLANGATA**

1. The medulla sends messages via the autonomic nervous system.
   a. Sympathetic nerve branches tells the heart to "SPEED UP!"
   b. Parasympathetic nerve branches tells the heart to "SLOW DOWN!"



2. Various factors, such as stress, oxygen levels, and blood pressure determine how the autonomic system will affect heart rate.

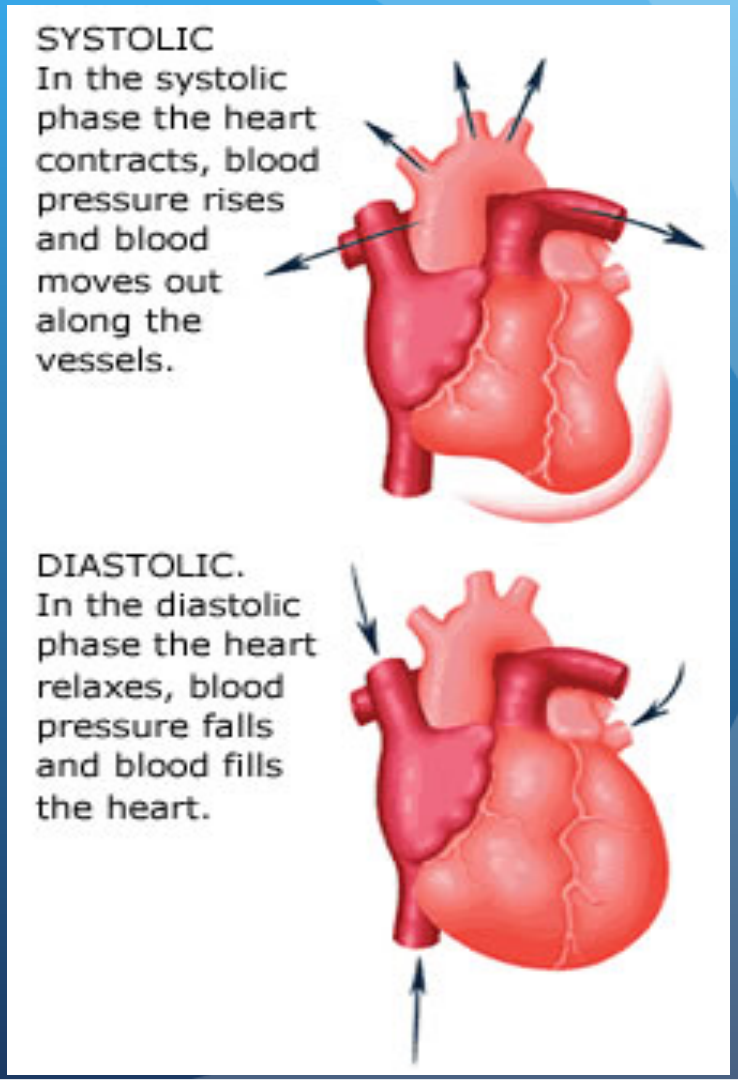
Systolic and Diastolic Pressures

I. Systole and Diastole

A. SYSTOLE = CONTRACTION of heart muscle.

B. DIASTOLE = RELAXATION of heart muscle.

TED-Ed Blood Pressure Animation



II. The Cardiac Cycle

A. Occurs about 70 times per minute.

B. Each heartbeat can be divided as follows:

Time (Duration)	Atria are in...	Ventricles are in...
0.15 SEC.	Systole	Diastole
0.30 SEC.	Diastole	Systole
0.40 SEC.	Diastole	Diastole

C. Each contraction will force 70 mL of blood to be circulated.

1. Results in a total blood volume pumped per minute of ≈ 5L.

2. Entire body's blood volume is circulated each minute.

D. **PULSE** is the alternate expanding and recoiling of an arterial wall that can be felt in any artery that runs near the surface of the body. Animation

1. Radial artery in wrist, carotid artery in neck are common places to check.

2. Pulse rate indicates the rate of **heartbeat**.

III. Blood Pressure

1. **Pressure of the blood against the wall of a blood vessel.**
2. **Created by the pumping action of the heart.**
3. **When the heart contracts, the blood is forced into the arteries under a great deal of pressure.**

IV. Measuring Blood Pressure

A. Measured by a sphygmomanometer.

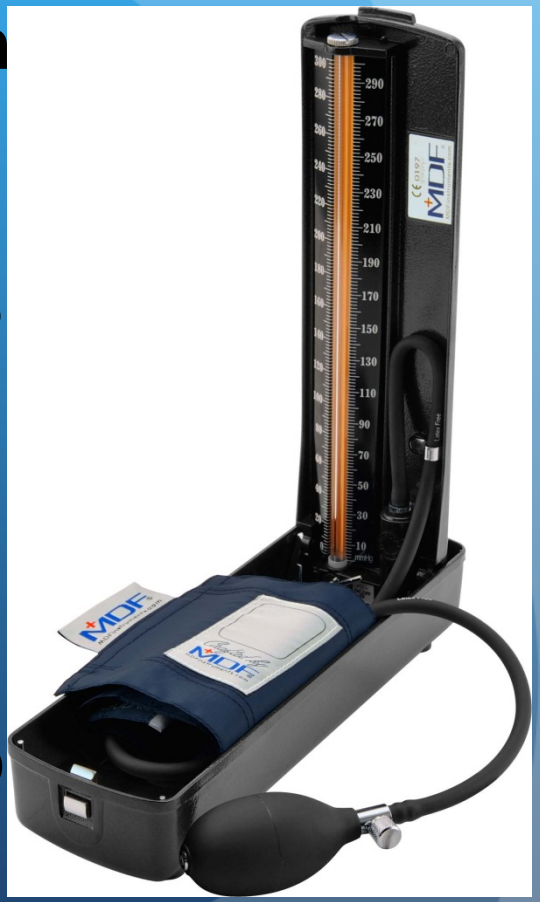
B. SYSTOLIC BLOOD PRESSURE is the highest arterial pressure reached during ejection of blood from the heart

C. DIASTOLIC BLOOD PRESSURE is the lowest arterial pressure when the ventricles are relaxing.

D. Blood pressure decreases with distance from left ventricle.

E. Normal resting blood pressure is 120 mm Hg over 80 mm Hg in brachial artery of arm.

1. 120 mm Hg is how high a column of mercury would be pushed as soon as the ventricles contract.
2. As the ventricles relax, pressure decreases down to 80 mm Hg.
3. It would continue to decrease except that at this time the ventricles fill up and contract again pushing the pressure up to 120 mm Hg (again).



4. The drop in pressure from 120 mm Hg to 80 mm Hg is due to:

    a. Elastic nature of the arteries.
    b. Blood being distributed throughout the body.
    c. Blood pressure drops as the blood is distributed to a "low" of about 10 mm Hg in the capillaries.

F. By the time the blood reaches the venules and veins it does not have enough pressure to reach the heart on its own.

1. Minute contractions of the skeletal muscle will push the blood back to the heart.
2. Valves prevent backward flow.

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