Blood Pressure:

Blood pressure is the lateral pressure exerted by blood on the vessel walls while flowing through it. It means it equals the *force exerted by the blood against any unit area of the vessel wall*. Blood pressure is measured in millimeters of mercury (mm Hg) using **a sphygmomanometer**. Blood pressure is determined by two factors:

1. **Cardiac output:** is the amount of blood pumped by either ventricle each minute. It is expressed as follows:

   Cardiac output = stroke volume × heart rate.

   Stroke volume: is the volume of blood ejected from the ventricles during each contraction.
   Heart rate: is the number of times the heart beats per minute. Heart rate is determined by four factors:

   i. **Intrinsic rate**: The natural rate of discharge of cardiac tissue in the absence of other factors.
   ii. **Sympathetic activity**: Increases heart rate.
   iii. **Parasympathetic activity**: Decreases heart rate.
   iv. **Pharmacologic**: Increases or decreases heart rate depending on the drug.

2. **Peripheral Resistance:** It is the resistance of the arteries to blood flow. As the arteries constrict, the resistance increases and as they dilate, resistance decreases.
   Peripheral resistance is determined by three factors:
   a) **Autonomic activity**: sympathetic activity constricts peripheral arteries.
   b) **Pharmacologic agents**: vasoconstrictor drugs increase resistance while vasodilator drugs decrease it.
   c) **Blood viscosity**: increased viscosity increases resistance.

Systolic pressure (SP): The maximum pressure during systole. Normal systolic blood pressure is 120 mm Hg or below.

- It undergoes considerable fluctuations. Excitements, exercise, males, etc. increase it, while sleep, rest, etc. diminish it.
- The height of systolic pressure indicates:

(a) The extent of work done by heart,
(b) the force with which the heart is working,
(c) the degree of pressure which the arterial walls have to withstand.

Diastolic pressure (DP): The minimum pressure during diastole. . Normal diastolic blood pressure is 80 mm Hg or below.

- It undergoes much less fluctuations in health and remains within a limited range.
- Consequently, variations of diastolic pressure are of greater prognostic importance than those of systolic.

- Diastolic pressure is the measure of peripheral resistance. It indicates the constant load against which heart has to work.

Pulse pressure (PP): The difference between systolic and diastolic pressure.

Physiological Significance of Blood Pressure:

1. Blood pressure maintain a sufficient pressure head to keep the blood flowing.
2. Blood pressure provides motive force of filtration at the capillary bed, thus assuring nutrition to the tissue cells, formation of urine, lymph and so on.
So the range of blood pressure gives correct information's about the state of the circulatory system as a whole and also about the functional condition of the tissue cells and organs.

Regulation of Arterial Pressure

1. Neural Regulation of Arterial Pressure
   Baroreceptor Reflex: The baroreceptor reflex allows the body to compensate rapidly for changes in arterial pressure. It is mediated by receptors sensitive to mechanical stretch that are located in the carotid sinuses and in the walls of the aortic arch.

2. Hormonal Control of Arterial Pressure:
   Renin–Angiotensin−Aldosterone System: The renin–angiotensin−aldosterone system (RAS) is involved in the longer-term regulation of arterial pressure by modulating blood volume.
   The response of the RAS to a decrease in arterial pressure is as follows:
   – A decrease in arterial pressure causes a subsequent decrease in renal perfusion pressure and an increase in sympathetic stimulation of the kidney. Both influences stimulate juxtaglomerular cells of afferent arterioles to secrete the enzyme renin.
   – Renin is secreted into the bloodstream, where it catalyzes the conversion of angiotensinogen to angiotensin I.
   – Angiotensin I is transported throughout the peripheral vasculature, where it is converted to angiotensin II by the action of angiotensin-converting enzyme (ACE). Angiotensin II is physiologically active and causes vasoconstriction of arterioles, which increases arterial pressure
   – Increased synthesis and secretion of aldosterone by the adrenal cortex. Aldosterone increases Na + (and water) reabsorption in the distal nephron. This increases arterial pressure by expanding blood volume, which increases CO.
   – Increased reabsorption of Na + and water by promoting Na +−H+ exchange in the proximal tubule.

3. Cerebral Ischemia: Severe ischemia of the vasomotor centers (e.g., due to extremely low arterial pressure or to cerebral edema that compresses cerebral blood vessels) can excite the vasomotor centers directly. The result is a sharp rise in arterial pressure, known as the Cushing reflex.

4. Chemoreceptors in carotid and aortic bodies:
   - carotid and aortic bodies contain sensory receptors that are sensitive to a reduction in the partial pressure of oxygen (PO_2).

- When PO2 falls, impulses from these receptors are relayed to the vasomotor center, which increase sympathetic outflow. This leads to vasoconstriction of arterioles causing an increase in TPR and arterial pressure.

5. Antidiuretic Hormone: ADH
   - It is released by the posterior pituitary when arterial pressure or blood volume falls too low, such as with severe hemorrhage.
   - It acts via V1 receptors to cause direct arteriolar vasoconstriction, thus increasing TPR and arterial pressure.
   - It also acts via V2 receptors to promote the reabsorption of water in the collecting duct of the kidney. This increases blood volume, which, in turn, slowly increases CO and arterial pressure.

6. Atrial Natriuretic Peptide Atrial natriuretic peptide (ANP):
   ■ It is released from the atria in response to an increase in blood volume and atrial pressure.
   ■ causes relaxation of vascular smooth muscle, dilation of arterioles, and decreased TPR.
   ■ causes increased excretion of Na+ and water by the kidney, which reduces blood volume and attempts to bring arterial pressure down to normal.

Venous Pressure: It is the pressure which is exerted by the blood within the veins. Average venous pressure of human being in recumbent position is about 60-120 cm of H20. The venous pressure can be measured by inserting a needle directly into the antecubital vein and by connecting the needle to a water manometer. Venous pressure is a valuable index in determining the efficiency of the heart.