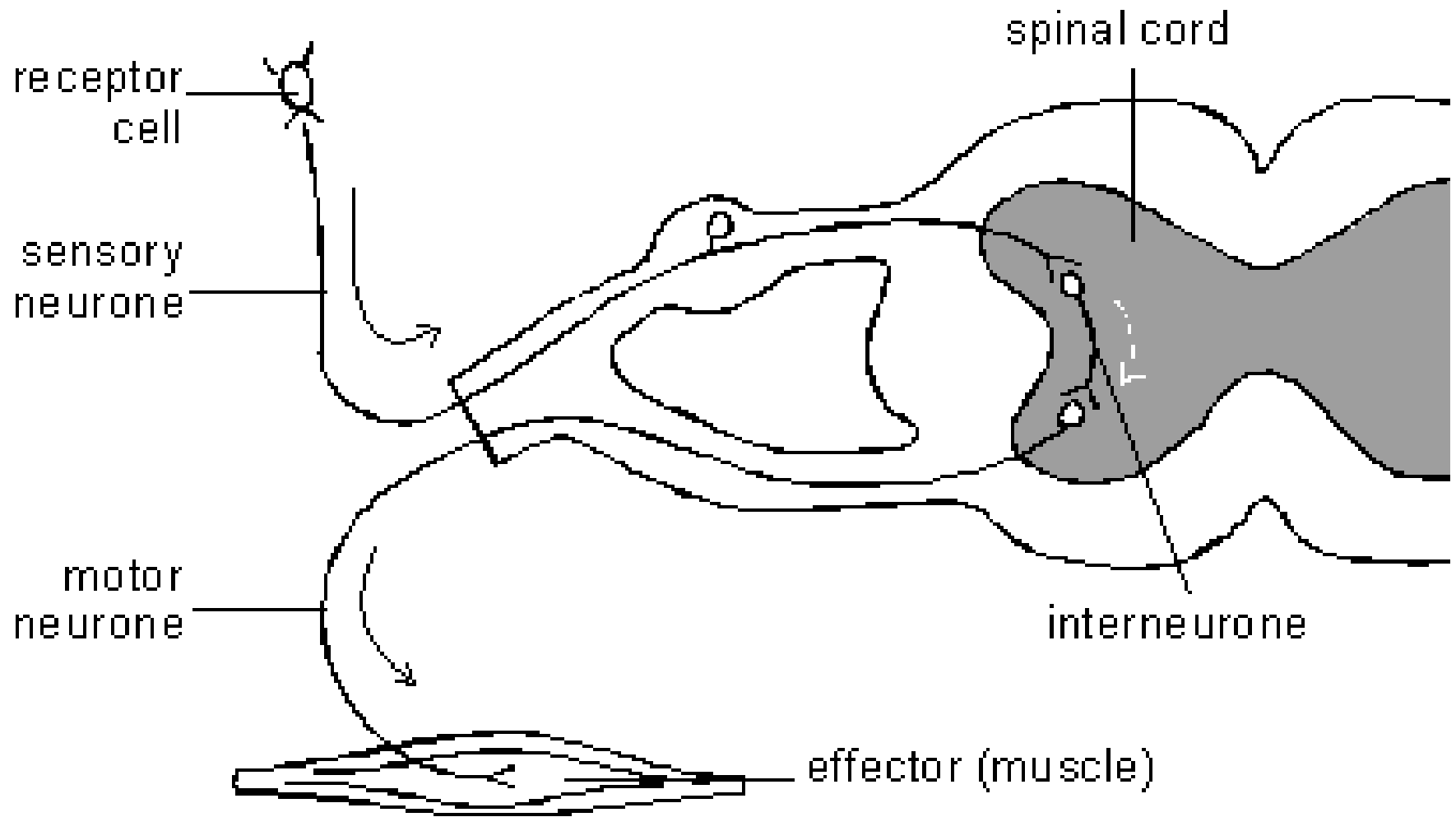


# **Nervous and chemical regulation** **heart –**

- **Myogenic heart when separated out from the body keep on beating on their own but when in the body the rate of heart beat is modified through various stimuli such as nervous and chemical stimuli.**
- **The main structure that regulates the heart beat is medulla oblongata.**
- **It has 3 types of reflexes cardiac reflex centre, Respiratory reflex centres, vasoconstrictor reflex centres.**

- **In cardiac reflex centres there are 2 types of area in medulla oblongata which are diagrammatically represented below**
- **I) Activator area causing activation**
- **ii) Inhibition area causing inhibition.**

# The activator or inhibitor area diagrammatic



- **As shown in figure: in the activator and inhibitor area there are interneurons. The excitatory or inhibitory stimuli go to the corresponding areas from where motor stimuli causing excitation or inhibition are sent to the heart, through motor neurons or effector neurons.**
- **The motor neurons either bring about the change directly or through pacemakers.**
- **The cardiac reflex centres respond to various signals from cerebral hemispheres.**

- **In medulla oblongata there are also chemo receptors sensitive to blood O<sub>2</sub> , blood CO<sub>2</sub> and pH which directly affect the cardiac reflex centre.**
- **In the invertebrates with open circulatory system the heart is under control of cardiac ganglion which is governed by excitatory and inhibitory neurons from CNS.**

# Chemical control

- **There are various chemical substances affecting heart rate. As mentioned earlier dissolved O<sub>2</sub> in blood, CO<sub>2</sub> in blood and pH of blood affect the chemo receptors in medulla oblongata affect heart beat. They also have direct effect on heart beat.**

- **Low O<sub>2</sub> stimulates Heart beat**
- **Very low O<sub>2</sub> inhibits Heart beat**
- **And prolonged low O<sub>2</sub> causes heart failure.**
- **High CO<sub>2</sub> causes inhibition of heart beat.**
- **Low blood CO<sub>2</sub> causes excitation.**
- **Optimum pH should be 7.4 and acidic pH causes relaxation of heart and reduces strength of contraction.**

# **Transmitter substances and hormones**

- **Mainly Acetylcholine is secreted by parasympathetic pathway and causes inhibition heart.**
- **NE/E - Noradrenaline/Adrenaline are secreted by sympathetic pathways and cause excitation of heart rate.  
Adrenaline secreted by Adrenal makes the heart beat stronger and faster.**
- **Thyroxine secreted by thyroid increases the rate of heart beat.**



- **Inorganic ions -- in which K, Na and Ca are very important.**
- **If K is in excess it causes relaxation of heart and very high 'K' stops the heart in relaxed condition or flaccid condition. Effect is called as K-inhibition.**
- **When vagus nerve is stimulated it secretes high 'K' on heart muscles, causing inhibition.**
- **If Vagus nerve is stimulated for long time then the heart, which is inhibited, again starts functioning. This phenomenon is known as vagus escape.**

- **Excess 'Na' causes relaxation of heart muscles but this is due to antagonistic effect or action with calcium. When 'Na' excess it competes with 'Ca' so 'Ca' availability reduces and 'Ca' essential for contraction.**

- **‘Ca’ is important mainly for contraction of heart but its excess causes sudden contraction of heart but it stops in contracted state known as ‘Ca’ rigour.**
- **Ringer’s solution is having balance of Na, K, Ca. The solution has composition similar to blood. It is used for heart perfusion**

# Drugs

- **Digitalis – increases strength of heart muscles and accelerates heart rate. Used as drug for low B.P. and very high concentration can stop heart.**
- **Atropin – is a stimulatory drug which accelerates the heart rate by suppressing Acetylcholine and binding with 'K' ions, hence used as antidote against toxic effect many poisonous substances.**

- **Muscarin, Eserine, Pilocarpine cause inhibition of heart rate by mimicking Acetylcholine. Most of these were used as arrow poison to kill the animals and now –a-days also used as drug.**
- **Nicotine initially inhibits the heart rate and later on excites the heart rate.**