Ectothermic - poikilothermic
Endothermic - Homeothermic
Heterothermic - at times regulated well regulated body but at times more like the cold blooded mammals.

# Temperature Regulation. — Role of Hypothalamus.

The temperature of the body is regulated almost entirely by nervous feedback mechanism, and almost all of these operate through temperature regulating centres located in the hypothalamus. However, for these feedback mechanisms to operate, there must also exist temp. detectors, discussed to determine when the body temp becomes either too hot or too cold.

## Thermostatic detection of temp. in the Hypothalamus — Role of Ant. Hypothalamus — Preoptic area.

In recent yrs., experiment have been performed in which minute areas in the brain have been either heated or cooled by use of a so-called thermode. Using the thermode, the ant. hypothalamic - preoptic ~~area~~ area has been found to contain large no. of heat sensitive neurons and about a third as many cold-sensitive neurons that seem to function as temperature sensors for controlling body temperature. Heat sensitive neurons increase their firing rate as the temp. rises, twofold to ten fold with an increase in the body temp of 10°C.

When the pre-optic area is heated, the skin immediately breaks out into a profuse sweat, while at the same

time, the skin blood vessels over the entire body to loose heat, thereby helping to return the body temp. towards the normal level. In addition excess body heat production is inhibited.

Detection of temp. by Receptors in the skin and deep body tissue:→ In addition to hypothalamus which is extremely powerful in controlling body temp., receptors in others parts of the body also play imp. roles in temperature regulation. This is especially true of temp. receptors in the skin and in a few specific deep tissues of the body.

Role of the posterior Hypothalamus in integrating peripheral and central temp. signals. — Not to elaborate.

Neuronal effector Mechanisms that Decrease or increase body temp:-

When hypothalamic temp. centres detect that the body temp is either too hot or too cold, they institute appropriate temp decreasing or temp. increasing procedures.

Heat loss / Thermolysis

Temp. - decreasing mechanisms when body is too hot:- The temp. control system employs three important mechanisms to reduce body heat when the body temp. becomes too great.

1. **Vasodilation:** → In almost all areas of the body the skin blood vessels become intensely dilated. This is caused by inhibition of the sympathetic centres in the posterior hypothalamus that cause vasoconstriction.

2. **Sweating:** → Sharp increase in the rate of evaporative heat loss resulting from sweating when the body core temp rises above the critical temp. level of 37°c (98.6°F). An additional 1°c increase in body temp. causes enough sweating to remove ten times the basal rate of body heat production.

(3) **Decrease in heat production:** – Those mechanisms that causes excess heat production, such as shivering and chemical thermogenesis, are strongly inhibited.

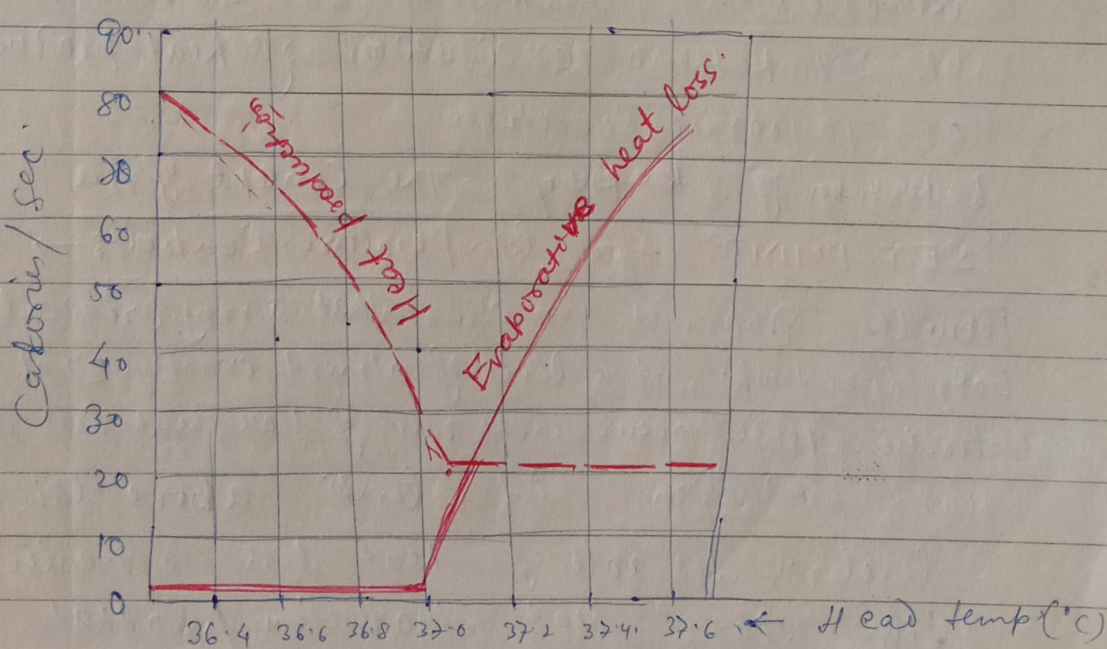


Fig: Effect of hypothalamic temp. on (1) evaporative heat loss from the body (2) Heat production caused primarily by muscular activity & shivering

Thermogenesis (Heat gain)

## Temperature - Increasing mechanisms

### When the body is too - Cold :→

When the body is too cold, the temp. Control system institutes exactly opposite procedures. These are :-

(Peripheral vasoconstriction)

① Skin vasoconstriction throughout the body :→ This is caused by stimulation of the posterior hypothalamic sympathetic centres.

2. Piloerection. means hairs "standing on end". Sympathetic stimulation causes the arrector pili muscles attached to the hair follicles to contract, which brings the hairs to an upright stance. This is not important in human beings.

3. Increase in heat production :→ Heat production by the metabolic systems is increased by promoting (a) shivering (b) Sympathetic excitation of heat production (c) Thyroxine secretion

### ~~Reduction of temp by~~ The Concept of a "SET-POINT" for temperature Control :→

From the graph, it is clear that a very critical body core temp., at a level of almost exactly 37.1 °C, drastic changes occur in the rate of both heat loss and heat production. At temp. above this level, the rate of heat loss is greater than that of heat production, so that the body temp. falls and reapproaches

the 37.1°C level. At temp. below this level, the rate of heat production is greater than the heat loss, so that now the body temp. rises and again approaches the 37.1°C level. Therefore, this critical temp. level is called the "Set point" of the temp. control mechanism. That is all the temp. control mechanisms continually attempt to bring the body temperature back to this set point.

## The feedback gain for Body temp. Control.

Experiments have shown that the body temp. of man changes about 1°C for each 25°C to 30°C change in environmental temperature. Therefore the feedback gain of the total mechanism for control of body temperature averages about 27, which is an extremly high gain for a biological control system.

(x) Peripheral vasoconstriction – Conservation of heat is also achieved by peripheral vasoconstriction i.e., constriction of skin blood vessels. It reduces the amount of blood flowing through the skin and therefore the heat loss from the skin surface is reduced. Vasoconstriction usually takes place in covered parts of the body.

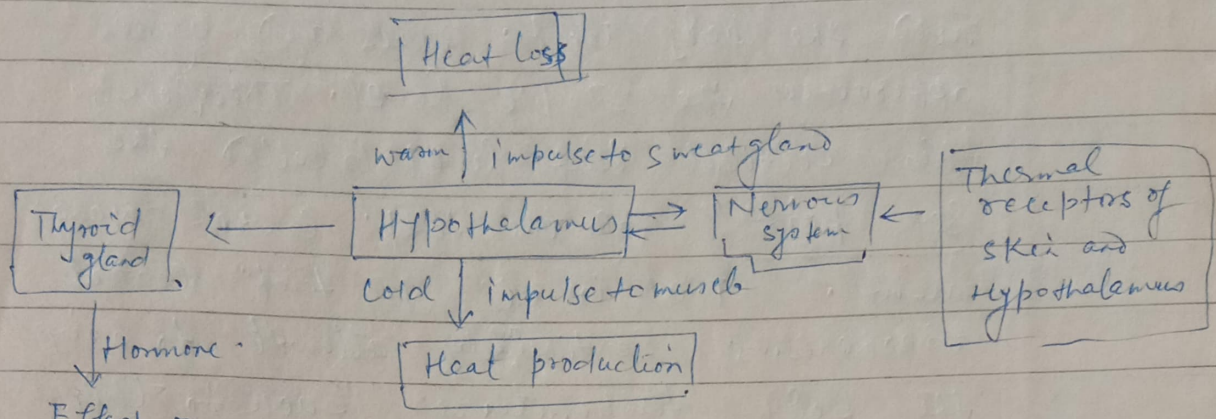


Fig - Role of Hypothalamus in temp. regulation, Feedback response.

<u>Counter current heat exchanger</u>:- The counter current heat exchanger (Scholander, 1955) is based on a particular arrangement of the circulatory vessels in which blood flows in opposite direction. In the peripheral vessels of the body e.g., the arterial blood at the higher core temp. flows to a region of lower temp. (to transfer the heat).

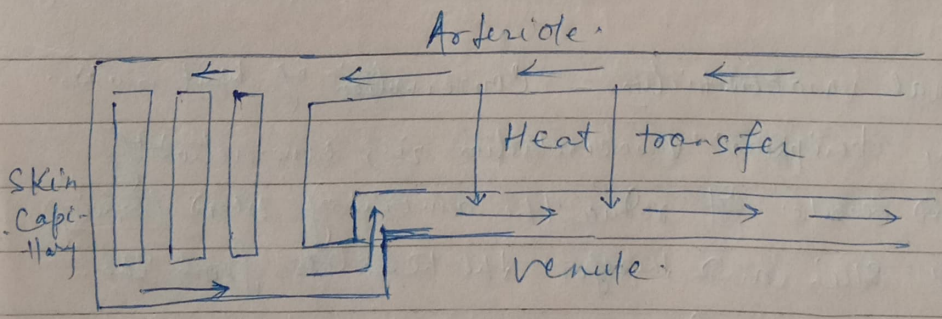


Fig - Diagramatic representation of the thermal counter current exchange system