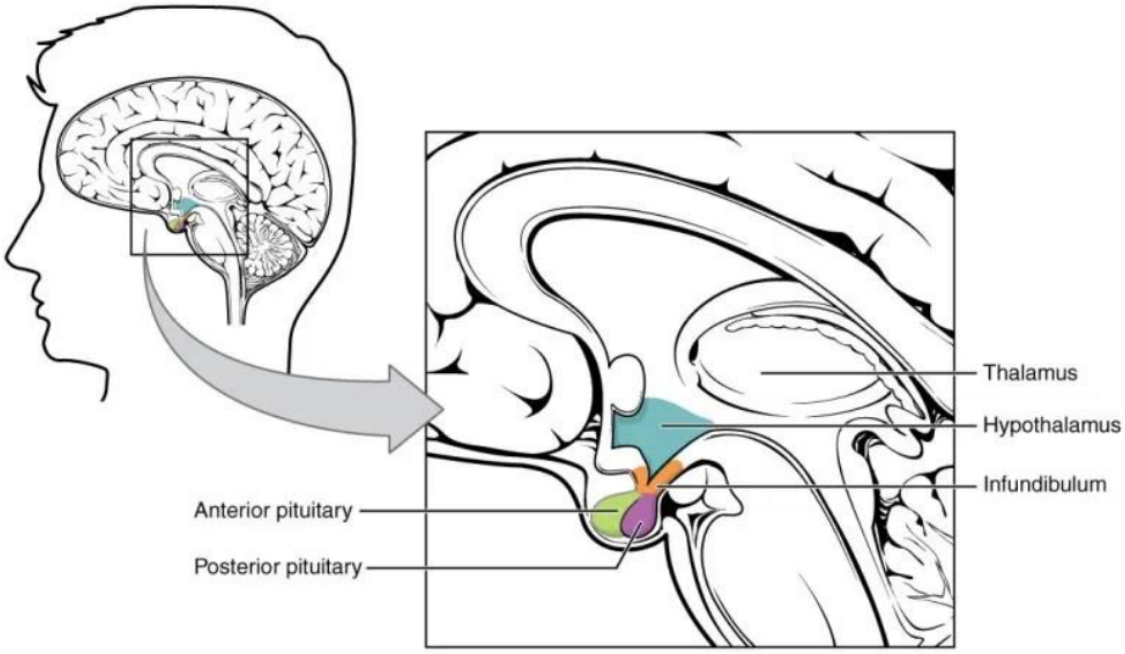
Hypothalamus is a very important part of the central nervous system present in the forebrain. It controls the firing of the autonomic nervous system as well as the functioning of the endocrine system. Thus, it plays a central role in controlling all the essential processes of life.



Structure:

I. Anatomical Features

In this section, we will discuss the location, structure, input and output fibres and blood supply of hypothalamus.

II. Location

According to the typical division of the brain into the forebrain, midbrain, and hindbrain, the hypothalamus is a **part of the forebrain**. It is considered to be a part of the diencephalon.

Hypothalamus is located just below the thalamus and forms the floor and the lower part of the lateral walls of the third ventricle. Anteriorly, it extends up to the optic chiasma and posteriorly it is continuous with the tegmentum of midbrain.

III. Structure

The **structure of the hypothalamus** is composed of a cluster of neurons that are arranged into nuclei. These nuclei send and receive fibres to other parts of the

brain. For the purpose of understanding, the nuclei are divided into two groups; medial zone and lateral zone.

The lateral Zone

The lateral zone of the hypothalamus contains the following nuclei:

- Part of the preoptic nucleus
- Part of suprachiasmatic nucleus
- Lateral nucleus
- Tuberomammillary nucleus
- Lateral tubular nuclei

Medial zone

The medial zone of the hypothalamus contains the following nuclei:

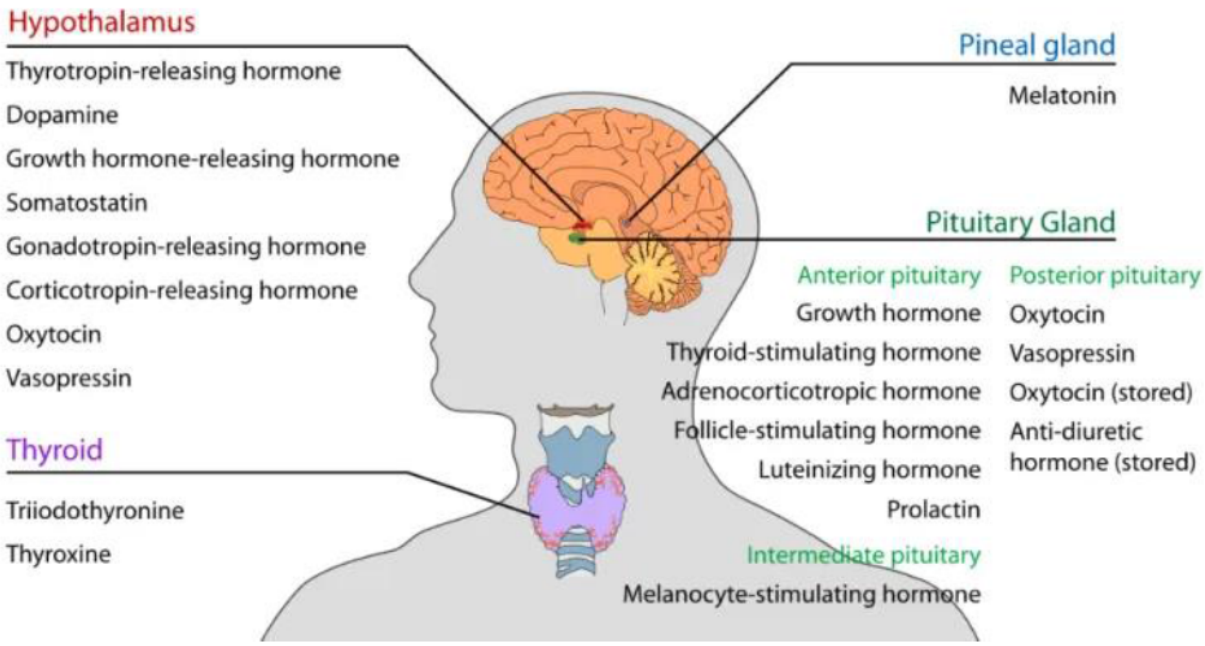
- Part of the lateral nucleus
- Part of suprachiasmatic nucleus
- Anterior nucleus
- Paraventricular nucleus
- Dorsomedial nucleus
- Ventromedial nucleus
- Infundibular nucleus
- Posterior nucleus

The **nuclei** such as the preoptic nucleus, suprachiasmatic nucleus and the mamillary nuclei are present in both zones of the hypothalamus.

IV . Communication of the Hypothalamus

Hypothalamus communicates with the rest of the body via three routes:

- Bloodstream
- Nervous connections
- Endocrine connections



i) Bloodstream connections

Hypothalamus receives blood mainly from the **hypophyseal artery**, a branch of the anterior cerebral artery. All the blood from the hypothalamus is drained into the hypothalamohypophyseal system of veins and distributed to the pituitary gland. From the pituitary gland, the blood is drained via the hypophyseal vein.

ii) Nervous connections

The nervous connections can be divided into afferent and efferent fibers.

Afferent fibers

Hypothalamus receives afferent fibers carrying somatic and visceral sensations as well as from special senses. Following are the important afferents of hypothalamus:

- **Somatic and visceral** afferents via lemniscal afferent fibers and nucleus of tractus solitarius, that reach the hypothalamus via reticular formation
- **Visual** afferents from the optic chiasma reach the suprachiasmatic nucleus
- **Olfactory** afferents are received through medial forebrain bundle
- **Auditory** afferents though not identified completely but are influenced by the hypothalamus
- **Hippocampo-hypothalamic** afferents reach via fornix to mamillary bodies
- **Tegmental** fibre from mid brain.
- **Thalamo hypothalamic** fibers from the midline and dorsomedial nuclei of the thalamus
- **Amygdalo-hypothalamic** fibers from the amygdaloid complex reach the hypothalamus via stria terminalis

Efferent fibers
The efferent connections of hypothalamic nuclei are also complex and numerous. Here, we will mention some important connections.

- **To brain stem and spinal cord**: The hypothalamic nuclei send efferent fibers to nuclei present in the brainstem and spinal cord. In this way, they control the autonomic nervous system.
- **Mammillothalamic Tract:** This tract consists of fibers arising in the mamillary body and terminating in the anterior nucleus of thalamus.
- **Mammillotegmental Tract:** These fibers terminate in the reticular formation, present in the tegmentum of the midbrain.
- **Limbic System:** The nuclei in the hypothalamus also send efferent fibers to the various nuclei of the limbic system.

iii) Endocrine Connections

Hypothalamus uses the bloodstream to communicate with the **pituitary gland**. These connections of the hypothalamus are called the bloodstream or endocrine connections.

- The cells of the pituitary gland release hormones in response to the regulating factors or hormones released by the hypothalamus. These regulatory factors reach the pituitary gland via the hypophyseal portal system of veins.

Functions of the Hypothalamus

Anterior hypothalamus		*Posterior hypothalamus*	
Nucleus	*Function*	*Nucleus*	*Function*
Paraventricular nucleus	Oxytocin release	Ventromedial nucleus	Satiety and neuroendocrine control
Supraoptic nucleus	Vasopressin release	Lateral hypothalamic area	Thirst and hunger
Medial preoptic area	Bladder contraction, reduce heart rate, and blood pressure	Posterior hypothalamus	Increased blood pressure, pupillary dilation, shivering (cold)
Posterior preoptic and anterior hypothalamic areas	Temperature (heat) regulation, panting, sweating, thyrotropin inhibition	Perifornical nucleus	Hunger, increased blood pressure, rage
		Arcuate nucleus and periventricular zone	Neuroendocrine control, circadian rhythm

1.Autonomic Control

The most important function of the hypothalamus is to integrate the **endocrine system** and the autonomic nervous system. Hypothalamus acts as a higher center for controlling the autonomic functions of the brain stem and spinal cord.
The stimulation of the posterior and lateral nuclei of the hypothalamus has been shown to cause a sympathetic response. On the other hand, the stimulation of the

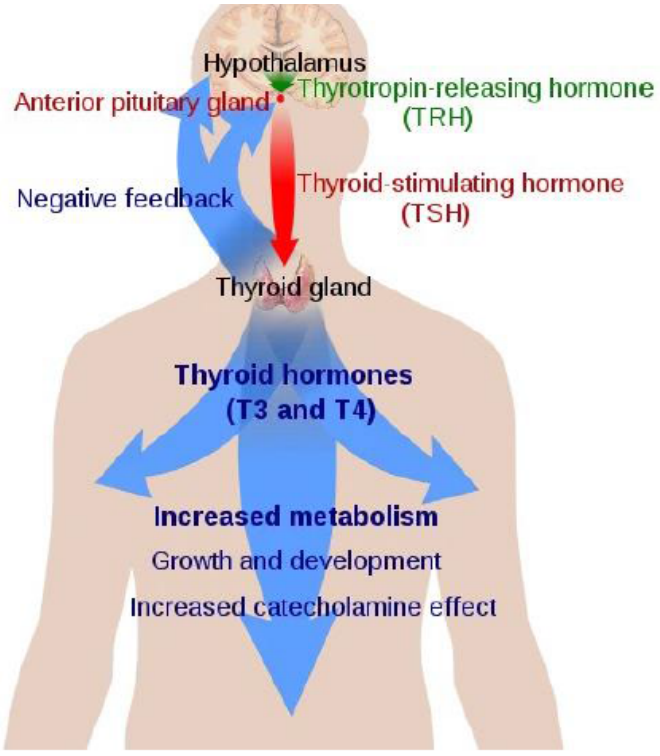
anterior nucleus and the preoptic area influences parasympathetic responses in the body.

2.Endocrine Control

Hypothalamus produces **releasing factors** or **inhibitory factors** for controlling the hormones released by the pituitary gland. These factors include:

- Growth hormone-releasing hormone and inhibiting hormone also called somatostatin
- Prolactin releasing hormone and inhibiting hormone
- Corticotropin-releasing hormone
- Thyrotropin-releasing hormone
- Luteinizing hormone-releasing hormone

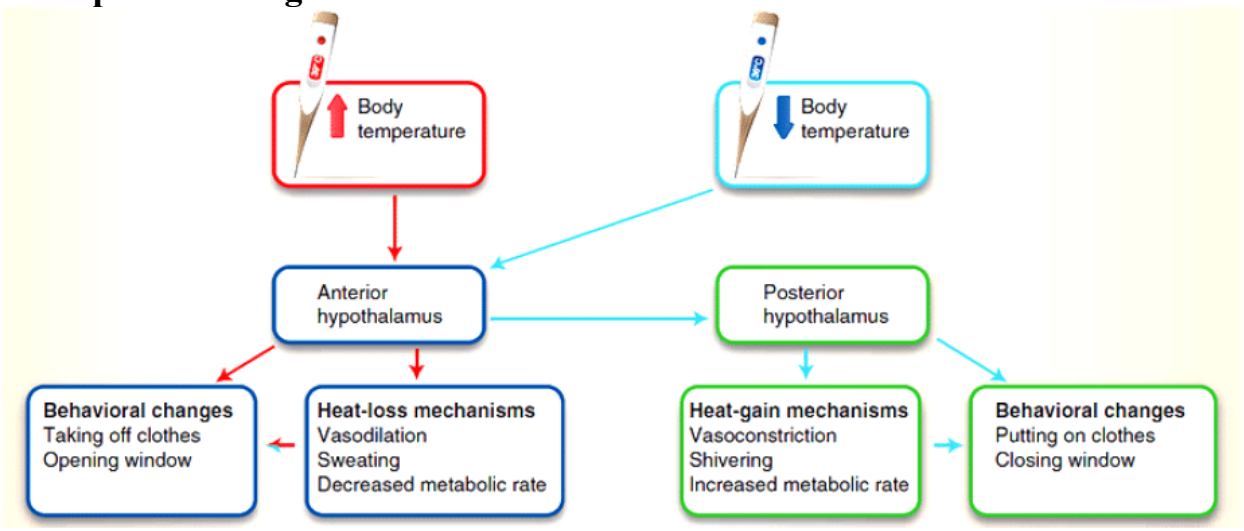
These factors promote or inhibit the release of hormones from the **anterior pituitary**. The release of these factors from the hypothalamus is controlled by positive and negative feedback mechanisms depending on the levels of a particular hormone in blood.



3. Secretion of Hormones

Hypothalamus not only secretes the regulating factors but also secretes two important hormones; **vasopressin** and **oxytocin**. Although these hormones are released from the posterior pituitary, they are actually produced by the neurons in the hypothalamus and are stored in the axonal endings present in the posterior pituitary

4.Temperature Regulation



Temperature regulation is another important function of the hypothalamus.

The anterior part of the hypothalamus controls processes that dissipate heat from the body. Its stimulation causes dilation of blood vessels and sweating, which causes a decrease in body temperature.

Contrary to this, stimulation of the posterior part of the hypothalamus results in vasoconstriction of the skin blood vessels and inhibition of sweating resulting in conservation of body temperature.

5.Controlling Emotions and Behaviour

Being a part of the **limbic system hypothalamus** also controls the emotions and behaviour of a person. It is believed that the hypothalamus integrates all the afferent information from other areas of the brain and brings about the physical expression of emotion.

Stimulation of the lateral area of the hypothalamus is associated with the feelings of rage whereas the stimulation of the medial area results in feelings of passivity.

6.Regulation of Food and Water Intake

Hypothalamus is also the site of the **hunger center** and satiety center in the brain. The stimulation of the lateral region of the hypothalamus stimulates hunger and results in the intake of food. This region is termed as hunger center.

On the other hand, stimulation of the medial region of the hypothalamus inhibits eating and results in reduced food intake. This is termed as the satiety center of the brain.

7. Potential Problems with the Hypothalamus

Any lesion of the hypothalamus due to inflammation, tumor, vascular disorder or physical trauma can result in the following clinical disorders.

- Unusually high/low blood pressure
- Fluctuations in body temperature (Hyperthermia or Hypothermia)
- Unintentional weight gain/loss
- Sudden changes in appetite
- Insomnia
- Infertility
- Delayed onset of puberty
- Stunted growth
- Excessive dehydration
- Frequent urination
- Obesity and wasting
- Sexual disorders
- **Emotional disturbances** like weeping, laughter, uncontrollable rage, excessive maniac outbursts and depressive reactions etc.