ENDOCRINE FUNCTION OF THE HYPOTHALAMUS, PITUITARY GLAND

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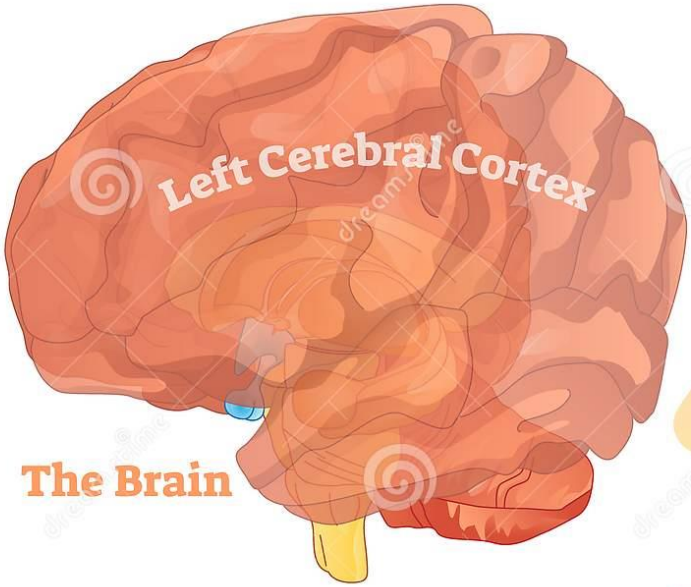
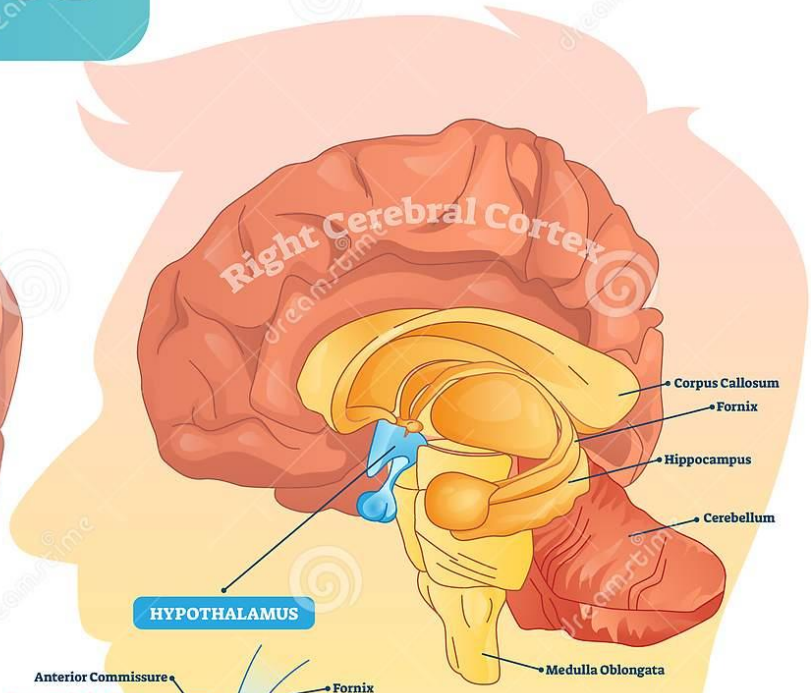
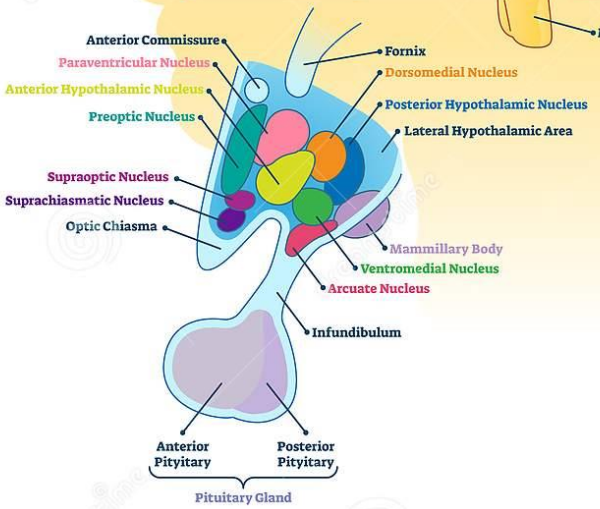
Charles University, Prague, 2022

HYPOTHALAMUS



The Brain





Hypothalamus Links the Nervous System to the Endocrine System via the Pituitary gland.

Controls Body Temperature, Hunger, Important Aspects of Parenting and Attachment Behaviors, Thirst, Fatigue, Sleep, and Circadian Rhythms

Control functions of the hypothalamus

1. **Cardiovascular regulation**

Heart rate
Arterial pressure

(*posterior and lateral region - increase*
Preoptic area – decrease)

Effect transmited – through cardiovascular centers in pons and medulla

Control functions of the hypothalamus

2. Biological rhythms

Sleep - wakefulness
ACTH secretion
Melatonin secretion
Body temperature
Activity

(*suprachiasmatic nucleus*)

Control functions of the hypothalamus

3. Regulation of body water

Creating the sensation of thirst
Controlling the excretion of water into urine

(*Thirst centre in the lateral hypothalamus*
Renal excretion in supraoptic nuclei Axons project to the posterior pituitary gland)

Hormon **ADH (vasopresin)**

Control functions of the hypothalamus

4. Gastrointestinal and feeding regulation

Hunger center– *lateral hypothalamic area*
Stimulation – hunger, appetite, search for food
Damage – loss desire for food, lethal starvation

Satiety center – *ventromedial nuclei*
Stimulation – stop eating
Destruction bilaterally – hunger center is overactive.
Voracious appetite will result in enormous obesity

Control functions of the hypothalamus

4. Gastrointestinal and feeding regulation

Hormons
Nervous impulses from GIT
Chemical signals from blood about nutrients
Nervous signal from brain cortex

Anorexigennic signals – stomach distension
Cholecystokinin – gut
Inzulin – pancreas
Leptin – adipose tissue
Orexigennic signals
Ghrelin - stomach

Control functions of the hypothalamus

5. Body temperature

Posterior hypothalamus

Regulation of body temperature

Temperature
regulating centers

Temperature receptors

Regulation of body temperature

Temperature regulating centers

Posterior hypothalamus

Temperature receptors

1. **Peripheral**

Skin receptors (cold and warm)

Deep body temperature receptors

Spinal cord, abdominal viscera and great veins

2. Central

Temperature detectors in hypothalamus

Heat sensitive neurons, cold sensitiv neurons

Praeoptic area

Posterior hypothalamus integrates the central and peripheral temperature sensory signals

Control Heat-producing

Heat- conserving reaction of the body

Set-point – desired temperature level 37.1ºC

Feedback – when the temperature that is sensed falls below the set-point, heat loss is reduced and heat production is increased

Temperature-decreasing mechanisms

Sensed temperature rises above the set-point

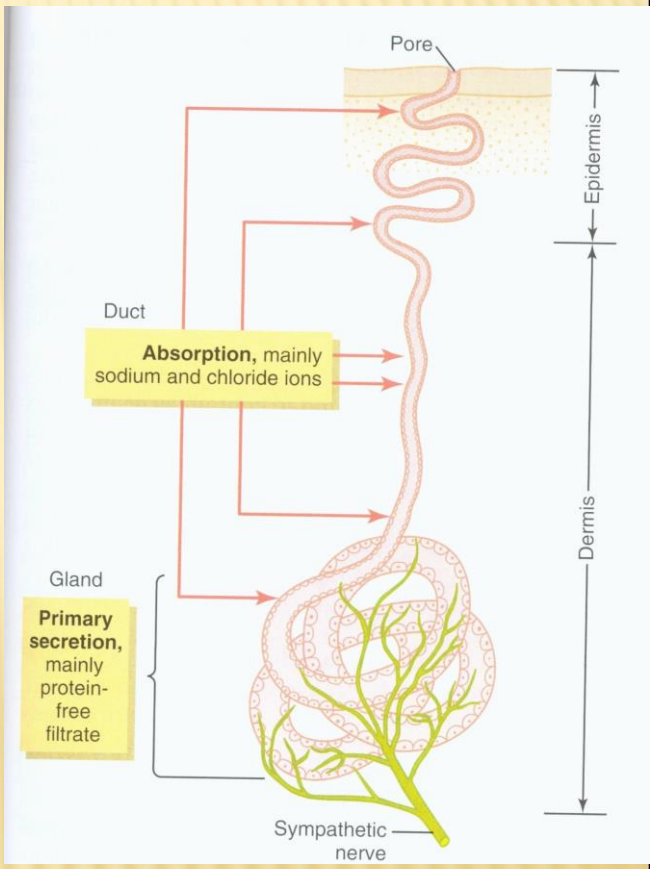
Vasodilation of skin blood vessels

Inhibition of the sympathetic centers in the posterior hypothalamus

Sweating

Praeoptic area, via autonomic pathways to the spinal cord

Sympathetic but cholinergic



Decrease in heat production

Inhibition of shivering and thermogenesis (behavioral responses)

Temperature-increasing mechanisms

When the body is too cold

1. Vasoconstriction of skin blood vessels

Stimulation of the sympathetic centers in the posterior hypothalamus

2. Piloerection

via autonomic pathways to the spinal cord

Sympathetic stimulation causes

arrector pili muscles to contract

3. Increase in heat production, thermogenesis

Shivering, sympathetic excitation of heat production,

Thyroxin secretion

3. Increase in heat production, thermogenesis

Shivering

Primary motor center for shivering in the dorsomedial portion of the posterior hypothalamus
Excited by cold signals from the skin and spinal cord
Tr hypothalamoreticularis, hypothalamospinalis to spinal motoneurons
Non rhytmical signals, increase the tone of the skeletal muscles
Probably feedback oscillation of the muscle spindle stretch reflex

Sympathetic excitation of heat production

Chemical thermogenesis, E and NE uncouple oxidative phosphorylation, energy in the form of heat but do not cause ATP to be formed

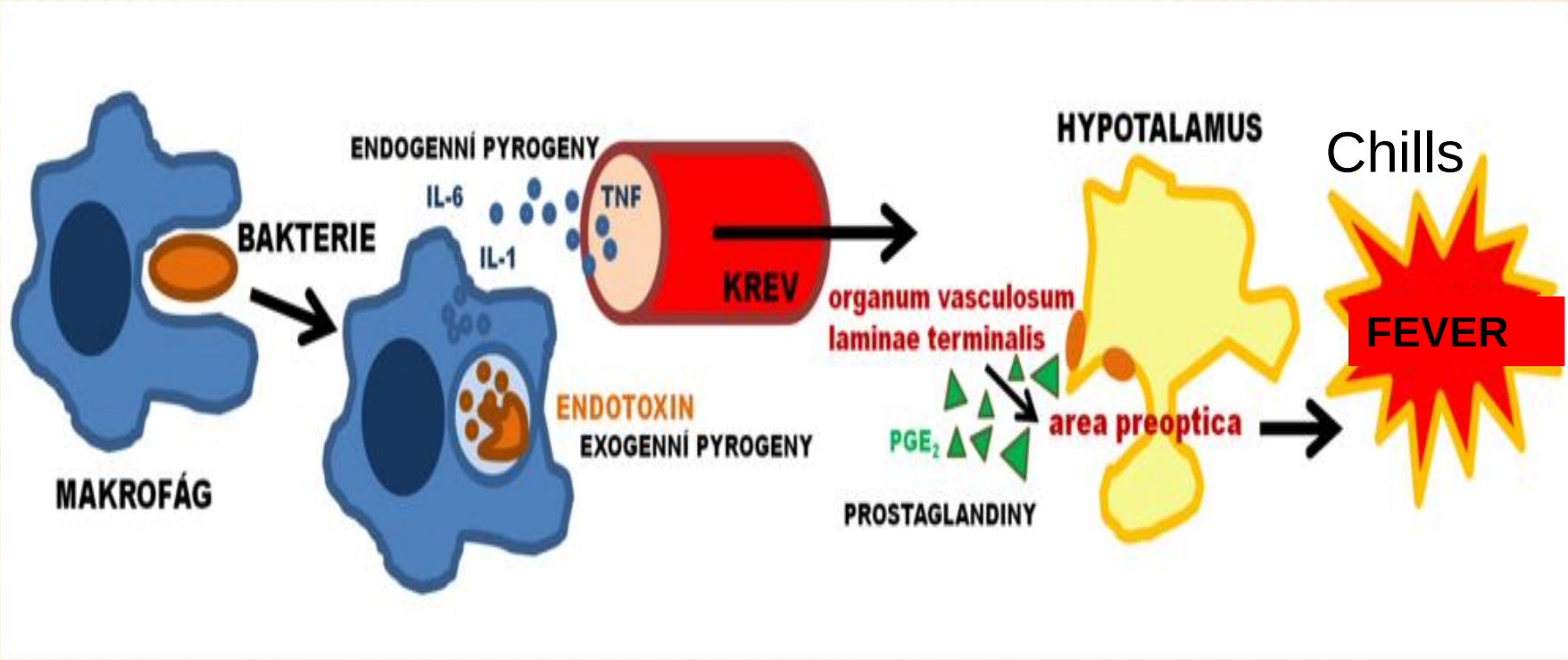
Thyroxin secretion

Sympathetic excitation of heat production

Chemical thermogenesis, uncoupling of oxidative phosphorylation, energy in the form of heat but do not cause ATP to be formed

Brown adipose tissue in newborn rabbit and baby

Fever


ENDOGENNÍ PYROGENY
IL-6
IL-1
TNF
BAKTERIE
KREV
HYPOTALAMUS
Chills
organum vasculosum
laminae terminalis
FEVER
ENDOTOXIN
EXOGENNÍ PYROGENY
PGE2
area preoptica
MAKROFÁG
PROSTAGLANDINY

Control functions of the hypothalamus

6. Transmission of emotions from limbic system

Rage, anxiety and fear, joy, sadness

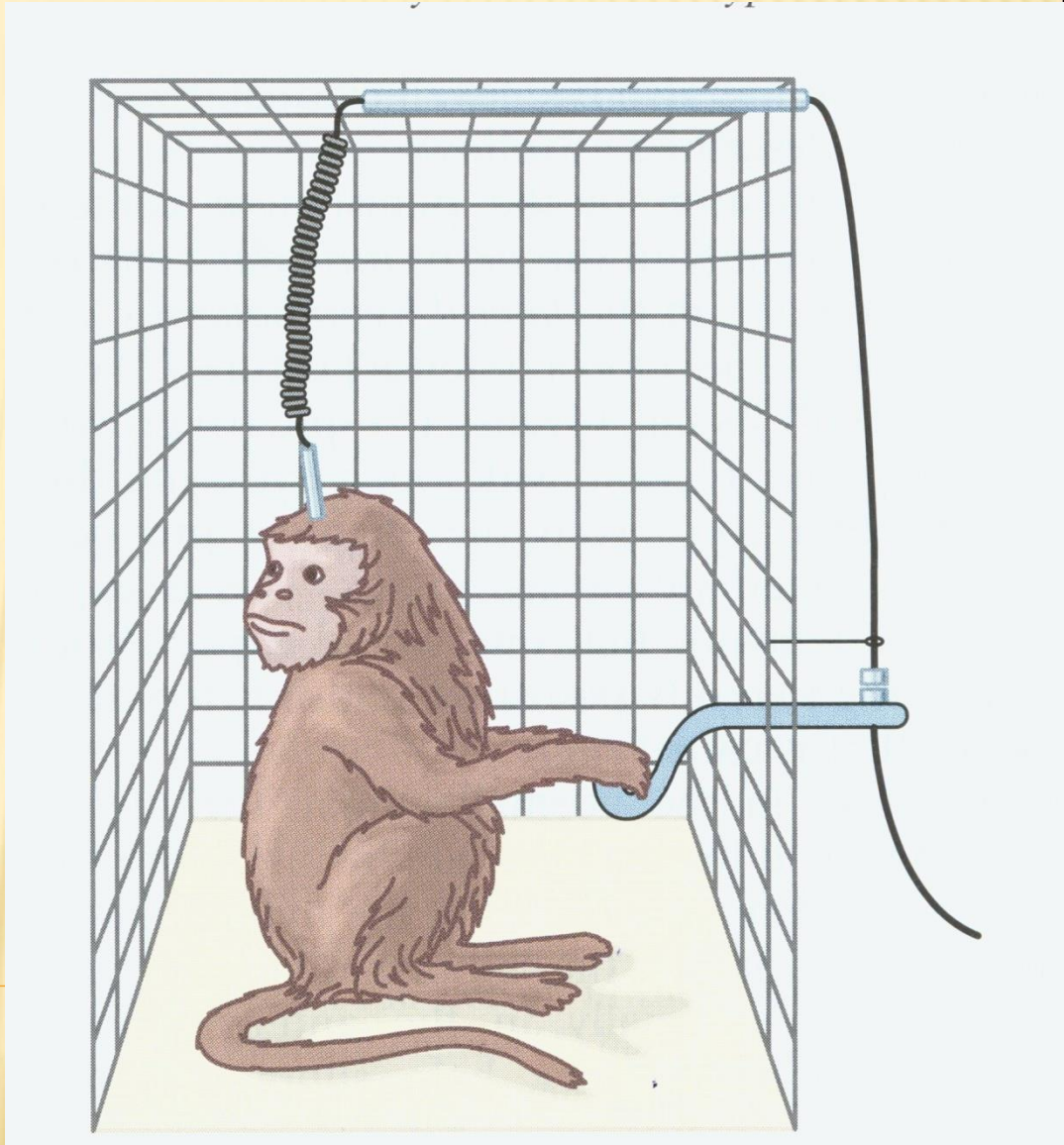
Is connected with visceromotor and somatomotor reaction

Heart rate, breathig rate, vasomotor reaction – pale or red skin, sweat glands, gastrointestinal motility and secretion, smooth muscle in skin, shivering

Reward centres

In 1953, James Olds and Peter Milner, of McGill University, observed that rats preferred to return to the region of the test apparatus where they received direct electrical stimulation to the septal area of the brain.

Intracranial self-stimulation

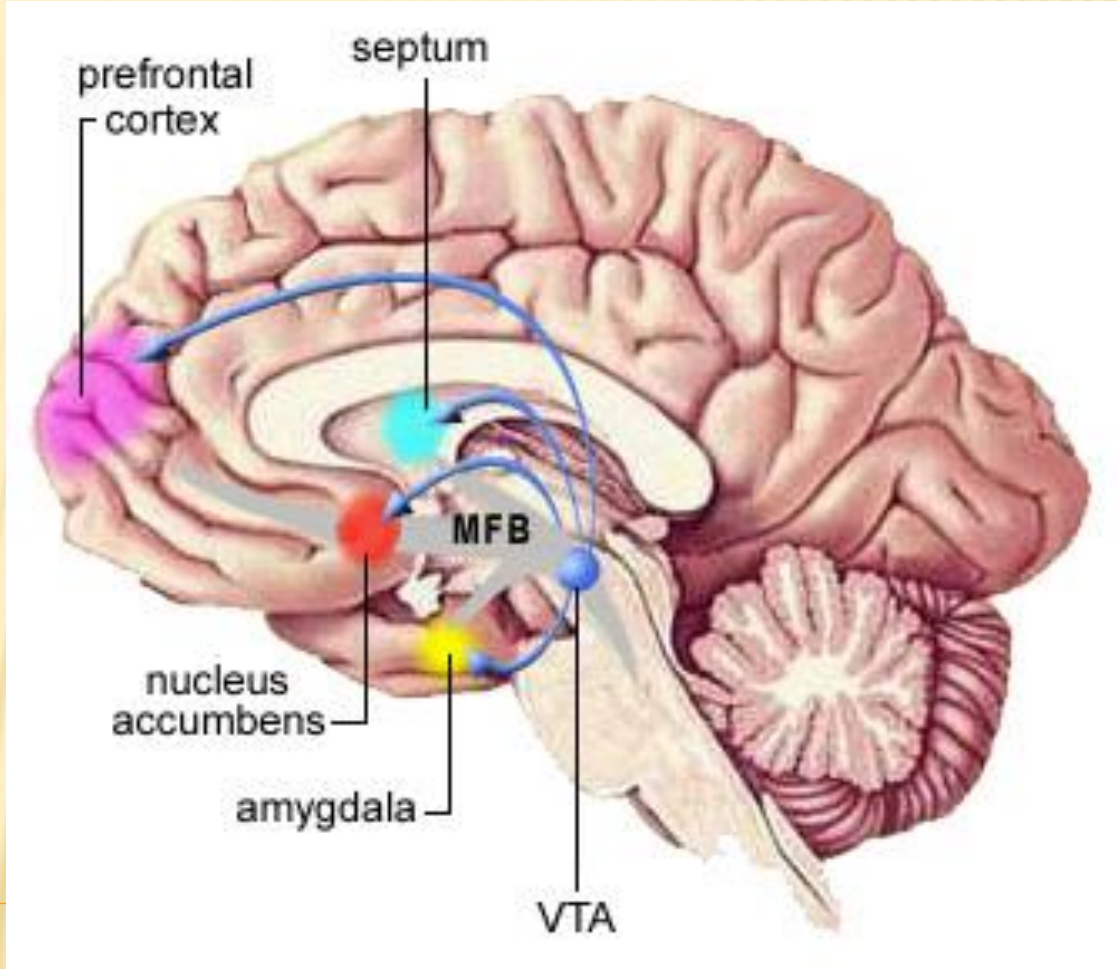


Reward centres

Anatomy of reward

Medial forebrain bundle

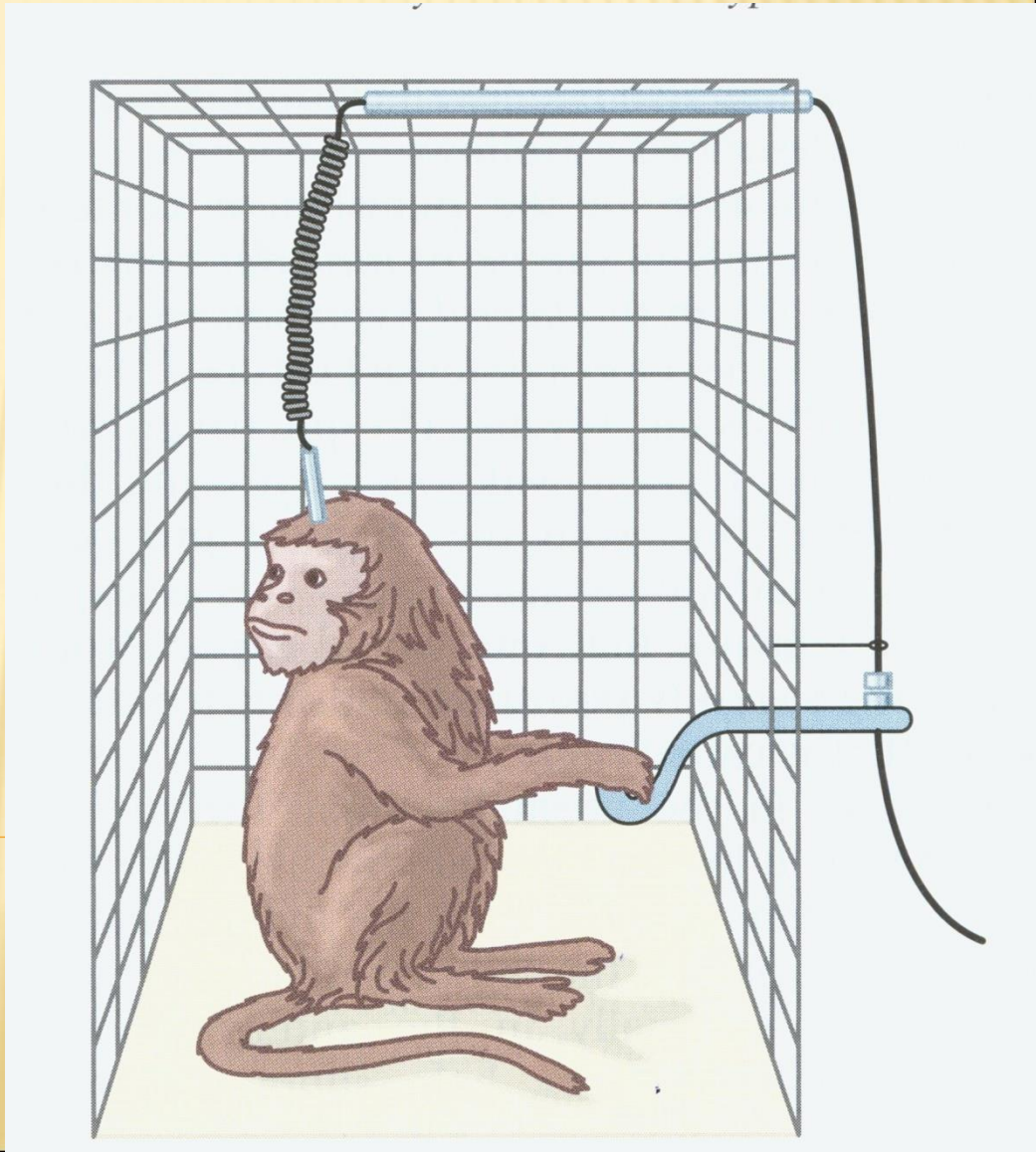
it is the main tract for the ascending dopamine fibers, and it functions to relay information from the ventral tegmental area (midbrain) to the nucleus accumbens (basal forebrain)



Punishment centres

Aqueduct of Sylvius in mesencephalon

Periventricular zones of hypothalamus and thalamus



Control functions of the hypothalamus

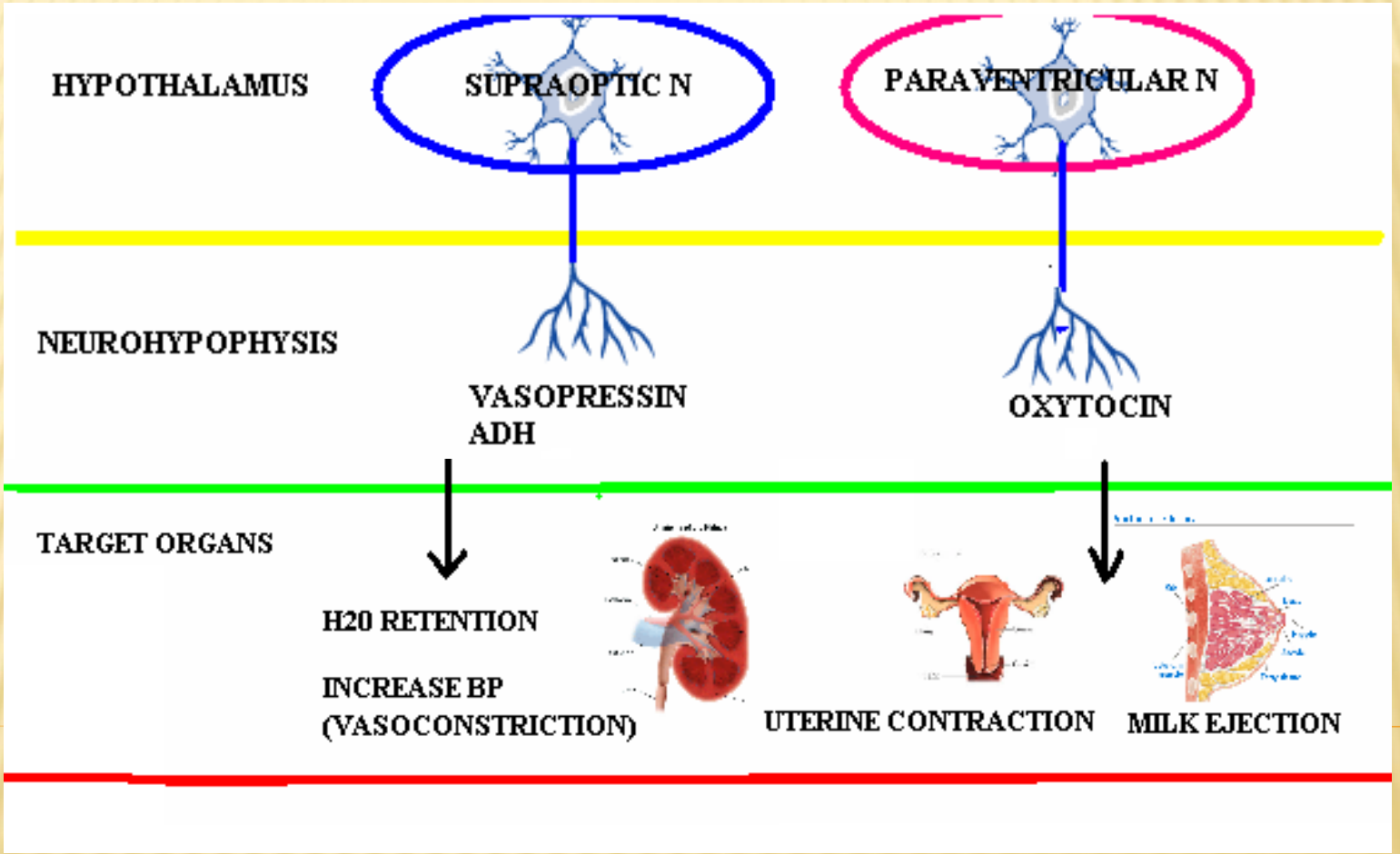
7. Uterine contractility and Milk ejection from the breast

Paraventricular nuclei

Hormon: **oxytocin**

Parturition – positive feedback – uterus - hormon

Hypothalamic hormones
Neurohypophysis



QUESTION

- PATIENT :
  - EXTREME THIRST
  - EXCESSIVE DILUTED URINATION DAY AND NIGHT
  - DEHYDRATION

WHATS THE DIAGNOSIS?

QUESTION

- PATIENT :
  - EXTREME THIRST
  - EXCESSIVE DILUTED URINATION DAY AND NIGHT
  - DEHYDRATION

WHATS THE DIAGNOSIS?

DIABETES INSIPIDUS

ADH DEFICIENCY

Control functions of the hypothalamus

8. Memory

Mammilary body –
Storage of memory (engram) –

lesion - confabulation

Control functions of the hypothalamus

9. Sexual behavior
Preoptic area – SDN sexually dimorphic nucleus

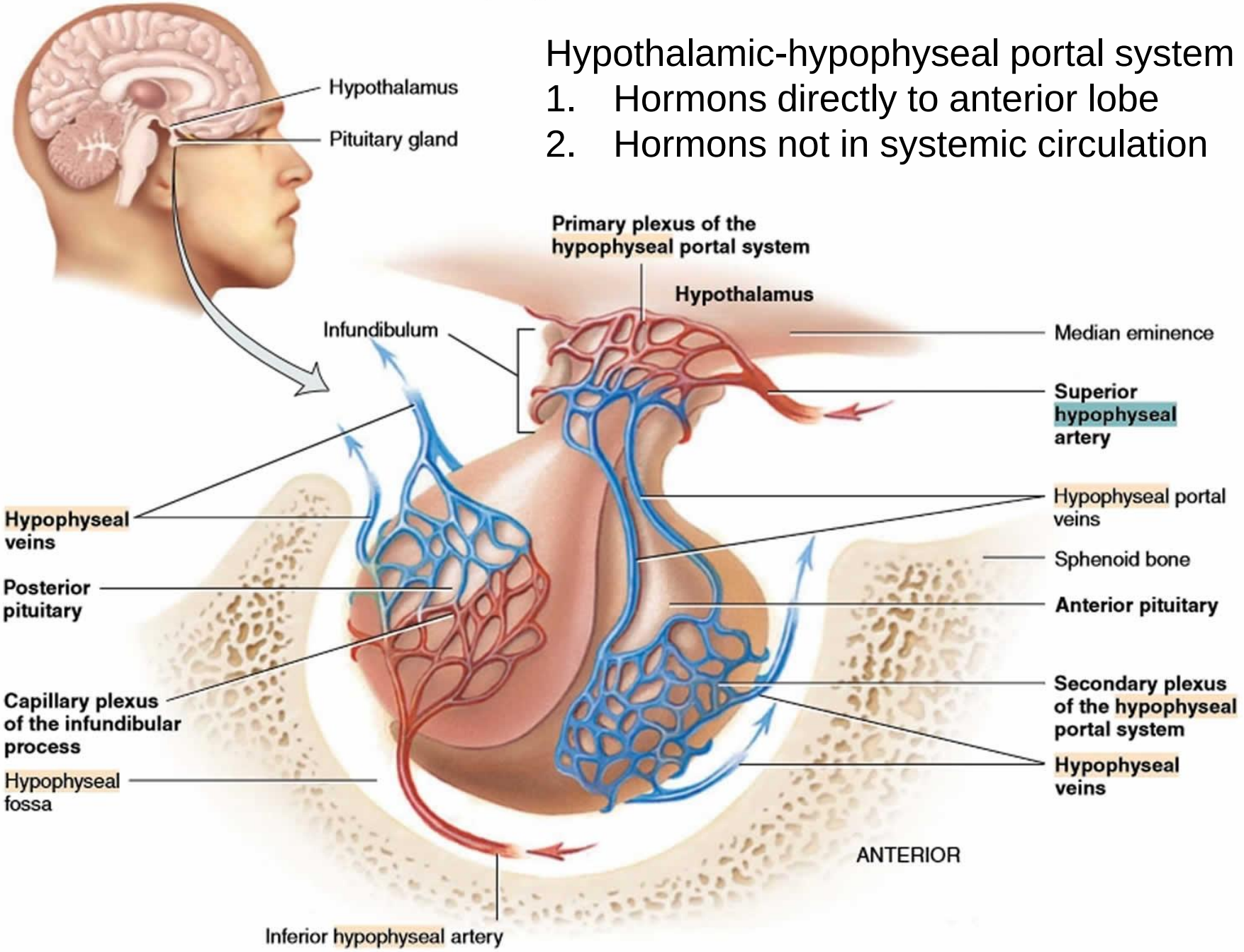
development of sexual orientation??

Control functions of the hypothalamus

10. Hypothalamic control of endocrine hormone secretion by the pituitary gland

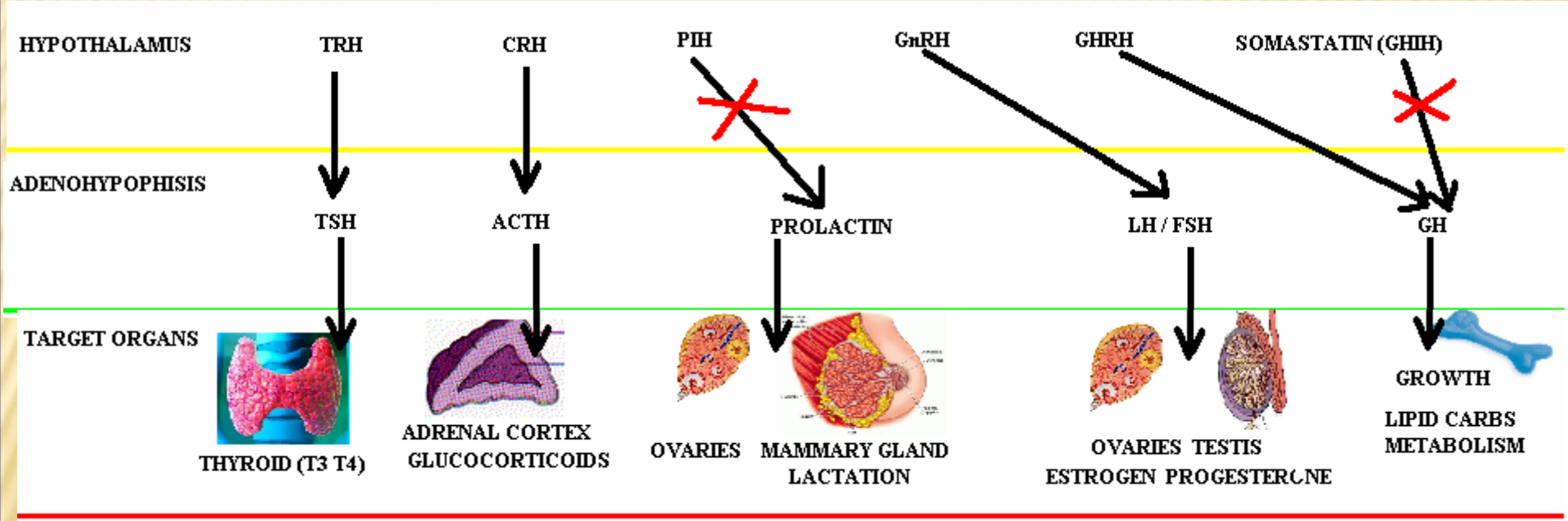
Hypothalamic-hypophyseal portal system

1. Hormons directly to anterior lobe
2. Hormons not in systemic circulation



Relationship of the hypothalamus to the pituitary gland

Hypothalamic hormones
Adenohypophysis



Control functions of the hypothalamus

1. Cardiovascular regulation
2. Biological rhythms
3. Regulation of body water
4. Gastrointestinal and feeding regulation
5. Body temperature
6. Transmission of emotions from limbic systém
7. Uterine contractility and milk ejection from the breast
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