

ENDOCRINE SYSTEM.. L#1

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2nd STAGE

Physiology#II

□ Chemical signals

Chemical communication between cells can occur in number of ways:-

Hormones are chemicals transported through the blood system and secreted by endocrine glands. Unlike a nerve, which goes to specific cells, a hormone may act on many different cells distributed around the body.

[Neurohormones are hormones that are transported through modified neurons.]

Pheromones are external hormones carried in the air and acting on other individuals.

Paracrine chemicals are secreted by cells to act on surrounding cells. E.g. interleukins activate lymphocytes; somatostatin is secreted by g cells in the pancreas to inhibit secretion of the hormone insulin by nearby b cells.

Autocrine chemicals are secreted by cells to activate other cells of the same type.

E.g. activated platelets attract other platelets to form a temporary clot; contracting smooth muscle cause surrounding smooth muscle to contract.

Neurotransmitters transmit an impulse between 1 neuron and another.

Hormone receptors.

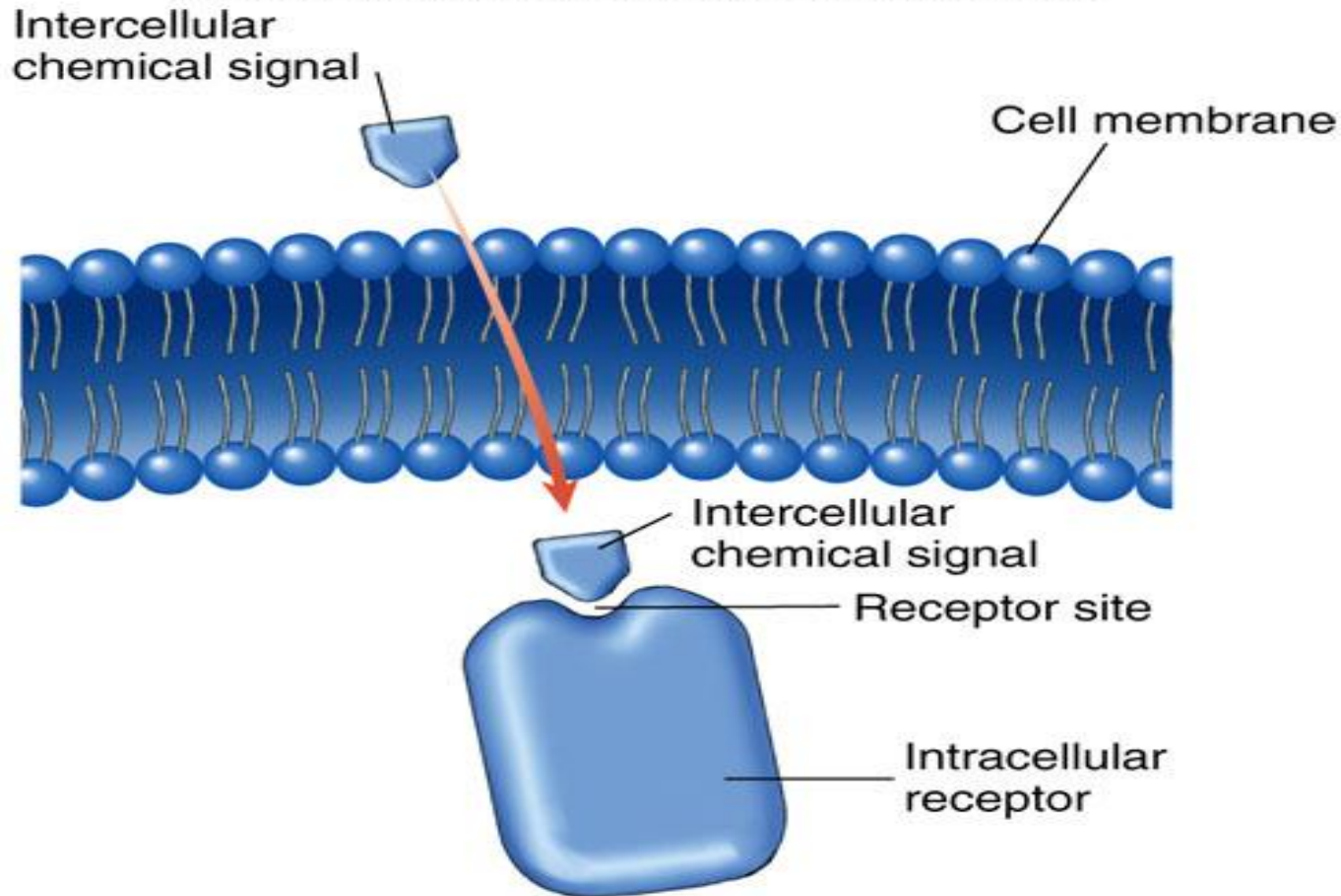
Hormones travel around the blood system, so that all cells are exposed to them, but to react to the hormone, the cell must have a **specific receptor**.

Cells of the correct receptor are known as **target cells** for that hormone.

The receptor may be either:-

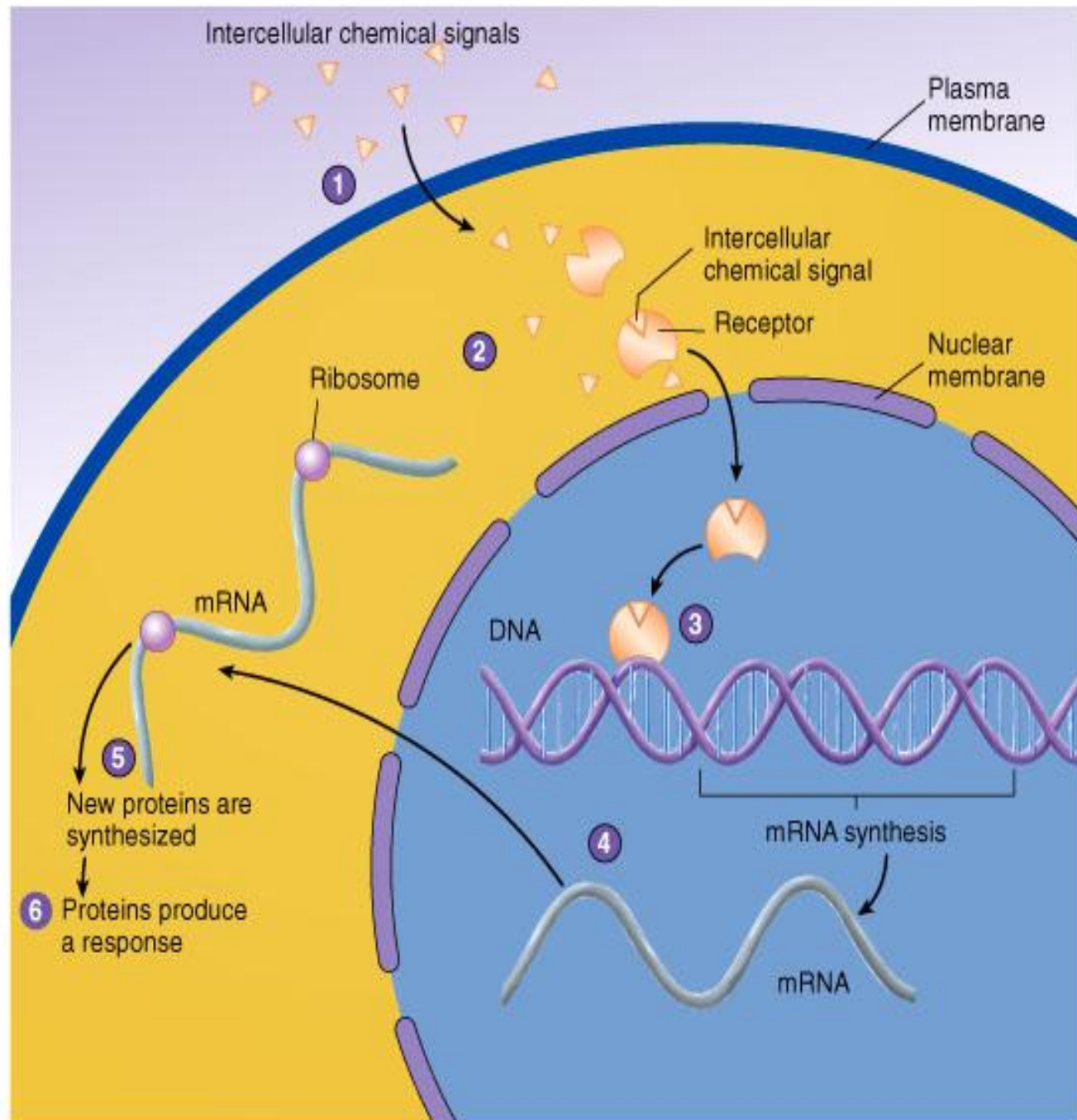
- **Intracellular.** These are usually found in the nucleus, but may be in the cytoplasm. The hormone thus must first pass through the plasma membrane, and so must be fat soluble.

On combining with the receptor, it triggers the production of mRNA, which directs ribosomes in the cell to secrete proteins. Production of proteins may take several hours.



- (b) Small lipid-soluble intercellular chemical signals diffuse through the cell membrane and combine with the receptor sites of intracellular receptors. The combination of intercellular chemical signals and receptors produces a response.

1. The lipid-soluble intercellular chemical signal diffuses through the cell membrane and enters the cytoplasm of the cell.
2. The intercellular chemical signal combines with a receptor in the cytoplasm (or in the nucleus).
3. The receptor with the chemical signal bound to it interacts with DNA and increases the synthesis of specific messenger RNA (mRNA) molecules.
4. The mRNA molecule passes from the nucleus to the cytoplasm.
5. In the cytoplasm of the cell, the mRNA molecule combines with ribosomes, and new protein molecules are synthesized.
6. The new proteins produce the response of the cell to the chemical signal.



Functions of the Endocrine system

- 1-Metabolism and tissues maturation.
- 2-Iron regulation and ions regulation in the blood.
- 3-Water balance by controlling the solutes in the blood .
- 4- Immune system regulation ,control production of immune cells .
- 5-Heart rate and blood pressure regulation .
- 6-Control blood glucose and other nutrients .
- 7-Control the reproductive functions .
- 8-Uterine contraction and milk release in the lacting female.

The Pituitary gland.

The gland is attached to the hypothalamus of the brain, which controls its activities. It is divided into 2 parts :-

•**The anterior pituitary** is a normal endocrine gland secretes many hormones, many of which control other endocrine glands:

- Thyroid-stimulating hormone (TSH)** controls thyroxin from the thyroid gland.

- Adrenocorticotrophic hormone (ACTH)** controls cortisol by the adrenal gland.

- Luteinising hormone** controls testosterone by the testis.

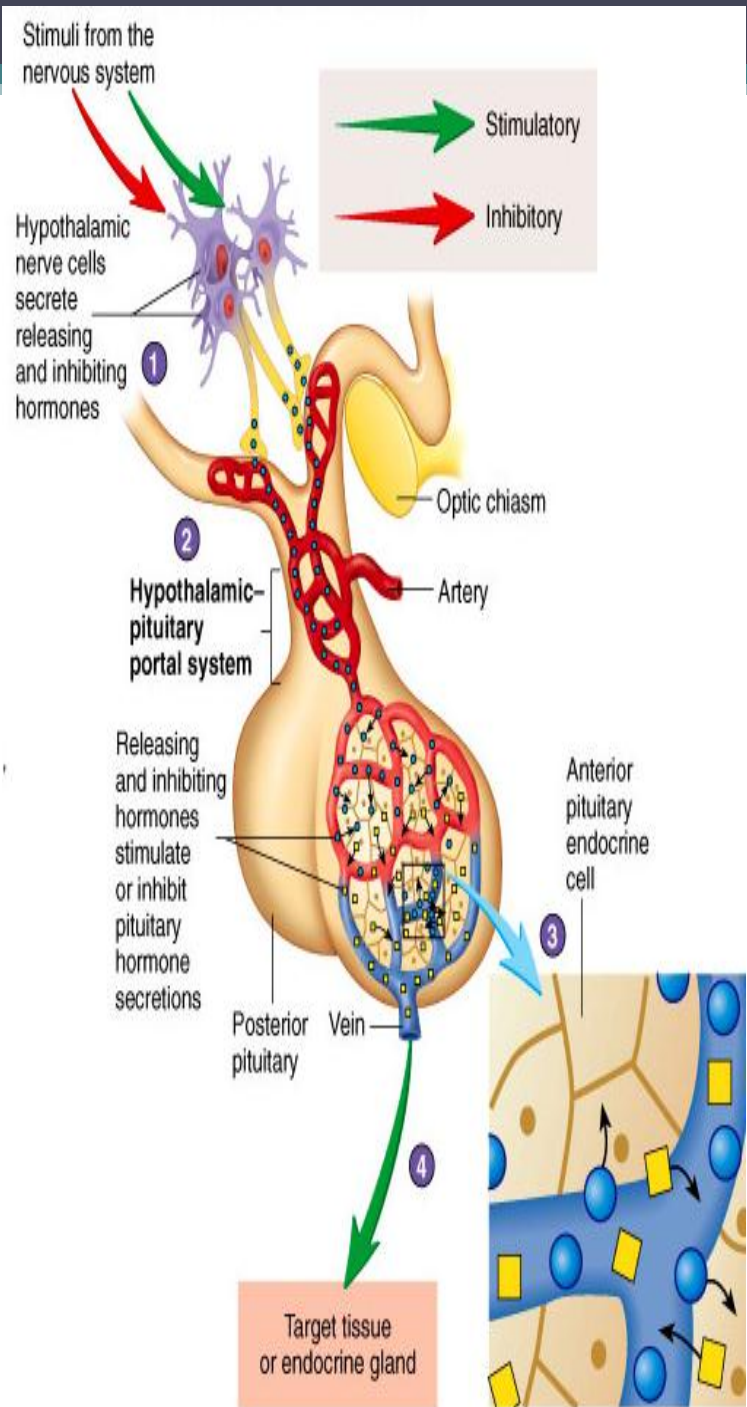
- Follicle-stimulating hormone (FSH)** controls oestrogen by the ovaries.

Other hormones include:

- Prolactin** stimulates milk production by the breasts.

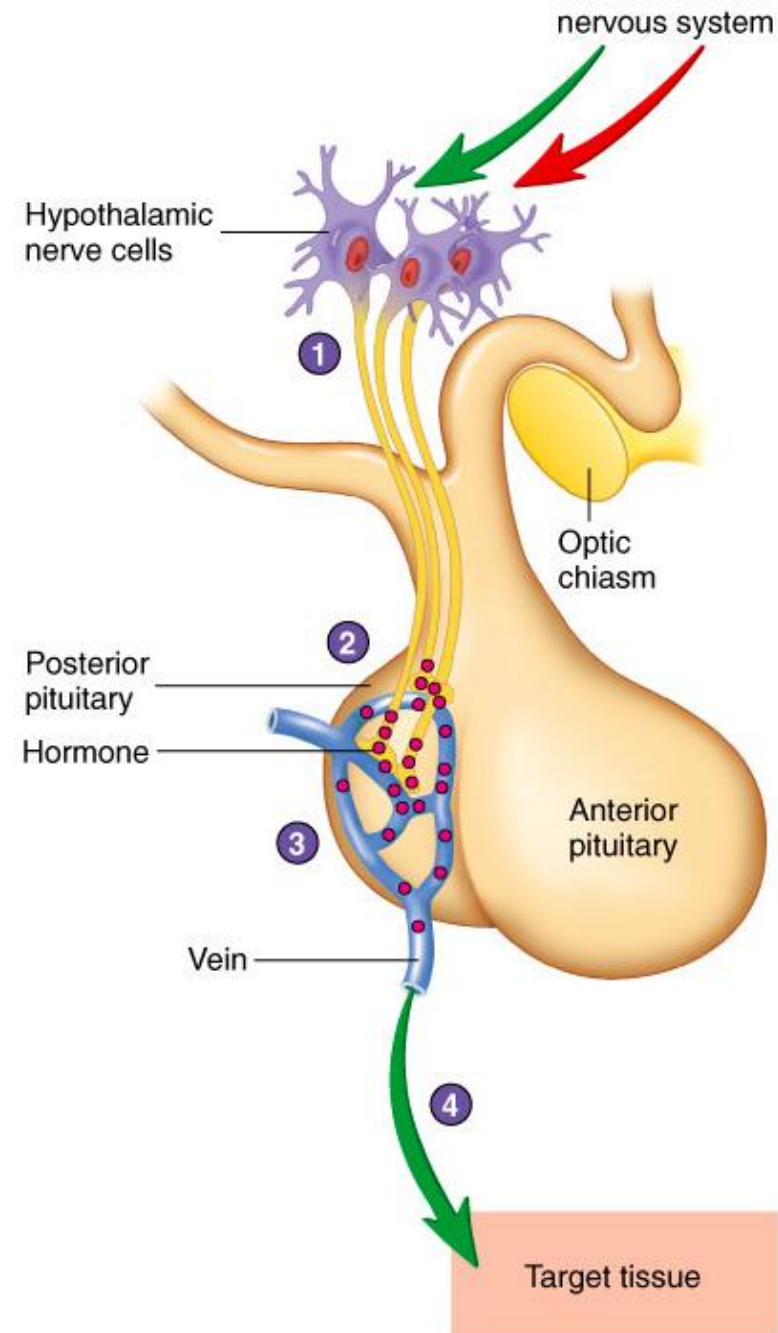
- Melanocyte stimulating hormone** causes darkening of the skin by producing melanin

- Growth hormone** increases protein synthesis to stimulate growth (which mainly occurs during sleep), and also during fasting, it promotes fat breakdown to increase blood glucose, rather than protein breakdown.



The anterior pituitary is controlled by the **hypothalamus**, which is connected to it by a **blood portal system**. The modified neuron in the hypothalamus release neurohormones into the portal capillaries and the neurohormones are then carried by the portal vein to the anterior pituitary.

The **neurohormones** may be of 2 types: **releasing hormone** stimulate the release of a specific hormone (thus TSH releasing hormone controls the release of TSH); **inhibitory hormones** prevent the release of a specific hormone



The posterior pituitary does not produce its own hormones, but **stores and releases neurohormones** that it receives from the **hypothalamus**.

These neurohormones are transported through modified axons in to the posterior pituitary, where the hormones are stored in the axon endings. When needed, they are then released from the axons into blood capillaries.

Anti-diuretic hormone (ADH) controls water reabsorption in the kidney.

Oxytocin contracts smooth muscles, e.g. in the uterus during birth and in the breasts during lactation.

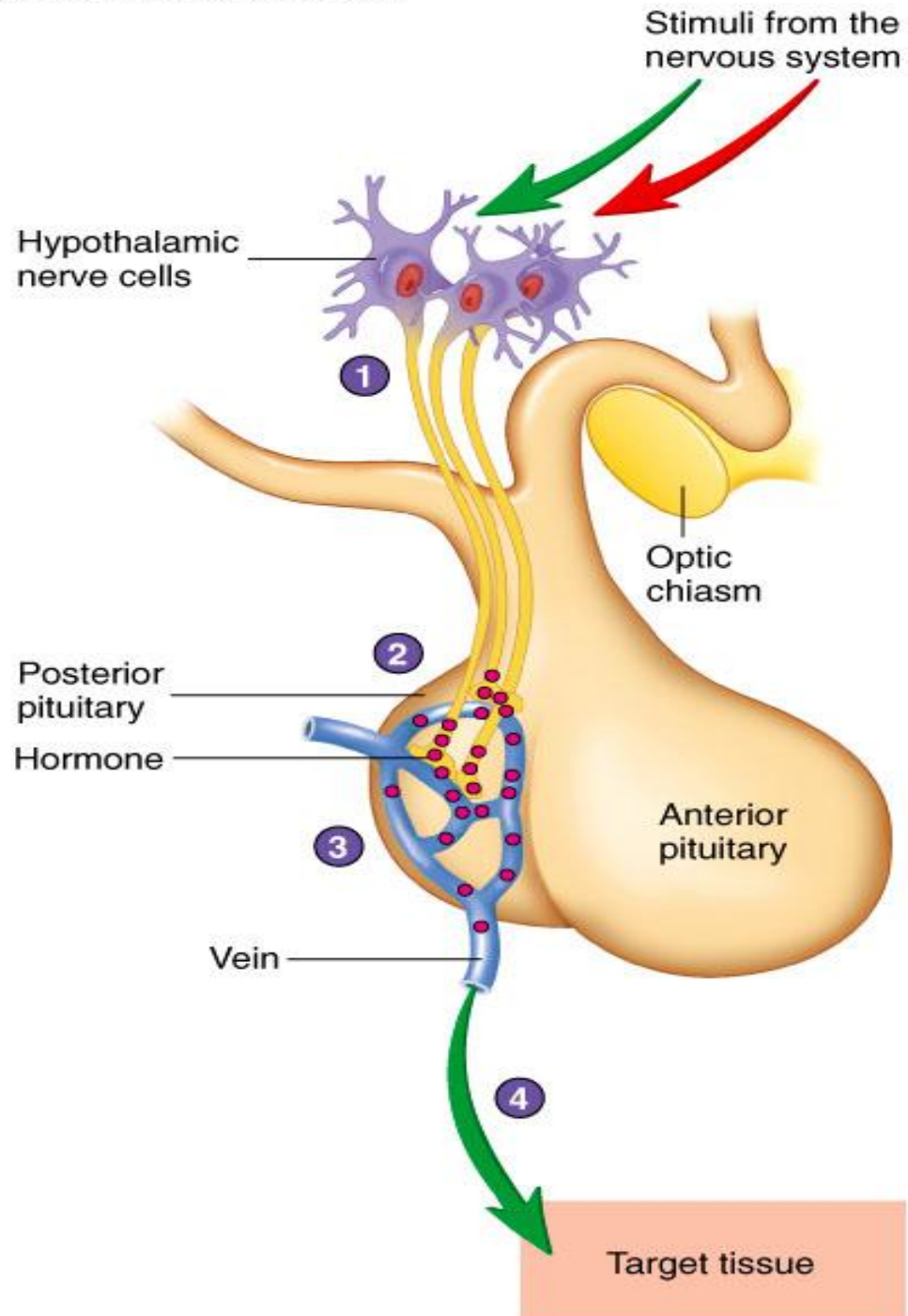
THE RELATIONSHIP AMONG THE HYPOTHALMUS, POSTERIOR PITUITARY AND TARGET TISSUES .

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1. Stimuli within the nervous system stimulate hypothalamic nerve cells to produce action potentials.
2. Action potentials are carried by axons of nerve cells to the posterior pituitary. The axons of nerve cells store hormones in the posterior pituitary.
3. In the posterior pituitary gland, action potentials cause the release of hormones (*red balls*) from the axons into the circulatory system.
4. The hormones pass through the circulatory system and influence the activity of their target tissues (*green arrow*).



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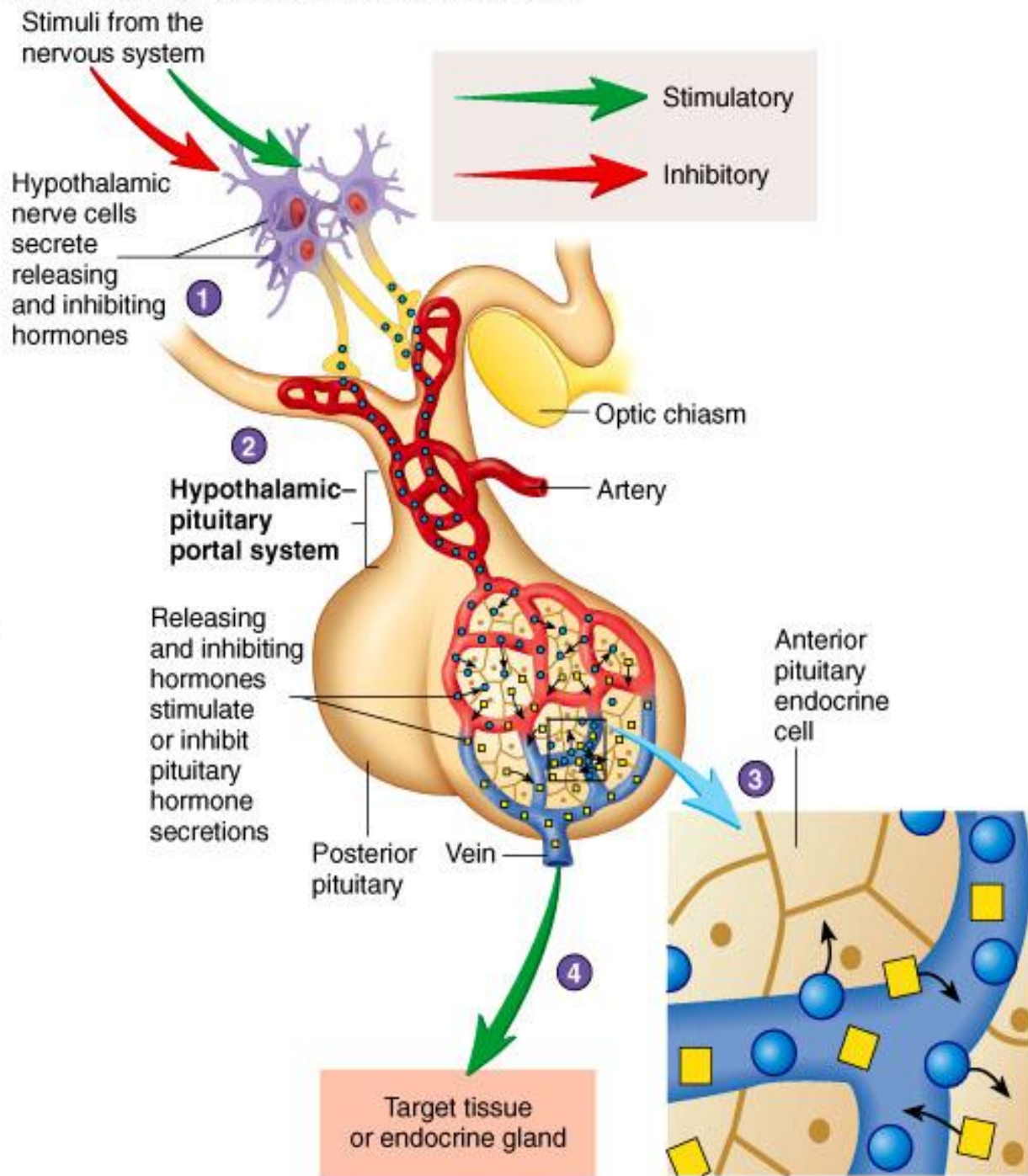
inhibitory hormones prevent the release of specific hormone.

1. Stimuli within the nervous system cause releasing and inhibiting hormones (*blue balls*) to be secreted from nerve cells of the hypothalamus.

2. Releasing and inhibiting hormones pass through the hypothalamic-pituitary portal system to the anterior pituitary.

3. Releasing and inhibiting hormones leave capillaries, bind to membrane-bound receptors, and influence the secretion of hormones from anterior pituitary cells.

4. Anterior pituitary hormones (*yellow squares*) are carried in the blood to their target tissues (*green arrow*), which, in some cases, are other endocrine glands.



hormones of anterior pituitary gland:

1-Growth hormone or somatotropin

It is a protein.

- 1-stimulates growth in most tissues
- 2-increases amino acids uptake and protein synthesis .
- 3-increases breakdown of lipids release of
- Free fatty acids for energy .
- 4-increases glycogen synthesis and increases blood glucose level .

- GH play important role in regulating blood nutrient level after a meal and during fasting period.
- Low blood glucose level and stress stimulate secretion of GH .
- High blood glucose cause decreased secretion of GH .
- GH secretion rhythm occurs: daily peak level of GH correlated with deep sleep .
- Decreased blood glucose causes increased Secretion of GH .
- Increased blood glucose causes decreased secretion of GH .

Pathological conditions & disorders

- Pathological conditions are associated with abnormal GH secretion, in general hyposecretion or hypersecretion are the result of tumor in hypothalamus, pituitary, synthesis of abnormal GH and lack of receptors in the target tissues .
 - 1-Chronic hyposecretion of GH in infant and children cause **DWARFISM** .
 - 2-Chronic hypersecretion of GH lead to **gigantism (acromegaly)** .

2-Thyroid stimulating hormone (TSH):

- A glycoprotein
- Stimulates thyroid gland to synthesize and secrete of thyroid hormones .
- TRH \longrightarrow TSH \longrightarrow THYROID HORMONES
- TSH is controlled by TRH from the hypothalamus and thyroid hormones from thyroid gland .

3-Adrenocorticotrophic hormone (ACTH) :

- Peptide hormone
- Stimulates the secretion of cortisol from the adrenal cortex .
- ACTH and MSH bind to melaonocytes in the skin pigmentation .
- CRH \longrightarrow ACTH \longrightarrow CORTISOL

4-Melanocyte stimulating hormone (MSH) :

- Bind to membrane bond receptors on skin melanocytes and stimulate increase secretion melanin in the skin .
- 5-Prolactin :
- A protein
- Play important role in milk production in the mammary gland of lacting females .
- Enhance progesterone secretion of the ovaries after ovulation .Unknown in male .
- Prolactin is controlled by PRH and PIH .

6-Gonadotropins hormones

- Glycoprotein hormone .
- Promote the growth and function of gonads(ovaries and testes)
- The 2 major important hormones are:
- Luteinizing hormone (LH)
- Follicle stimulating hormone (FSH)
- Stimulate the production of gametes sperms in the testes ,oocytes in the ovaries

LH ,FSH control the production of reproductive hormones: •

- 1-Estrogen and progesterone in the ovary
- 2-testosteron in the testes .
- LH and FSH are controlled by the hypothalamic releasing hormones (GnRH)
- GnRH \longrightarrow LH and FSH \longrightarrow estrogen ,teststeron

To be continued ...