

The image features two human figures, a woman on the left and a man on the right, rendered in a glowing cyan color. Their internal endocrine systems are highlighted in a vibrant red. The woman's system includes the hypothalamus, pituitary, thyroid, parathyroid glands, adrenal glands, and ovaries. The man's system includes the hypothalamus, pituitary, thyroid, parathyroid glands, adrenal glands, and testes. The background is dark with faint, glowing neural or vascular patterns.

REGULATING HOMEOSTASIS: THE ENDOCRINE SYSTEM

MR. GILLAMHOLY HEART

NERVOUS SYSTEM AND ENDOCRINE SYSTEM

- THE BODY SYSTEMS THAT FACILITATE CELLULAR COMMUNICATION AND CONTROL ARE THE NERVOUS AND ENDOCRINE SYSTEMS

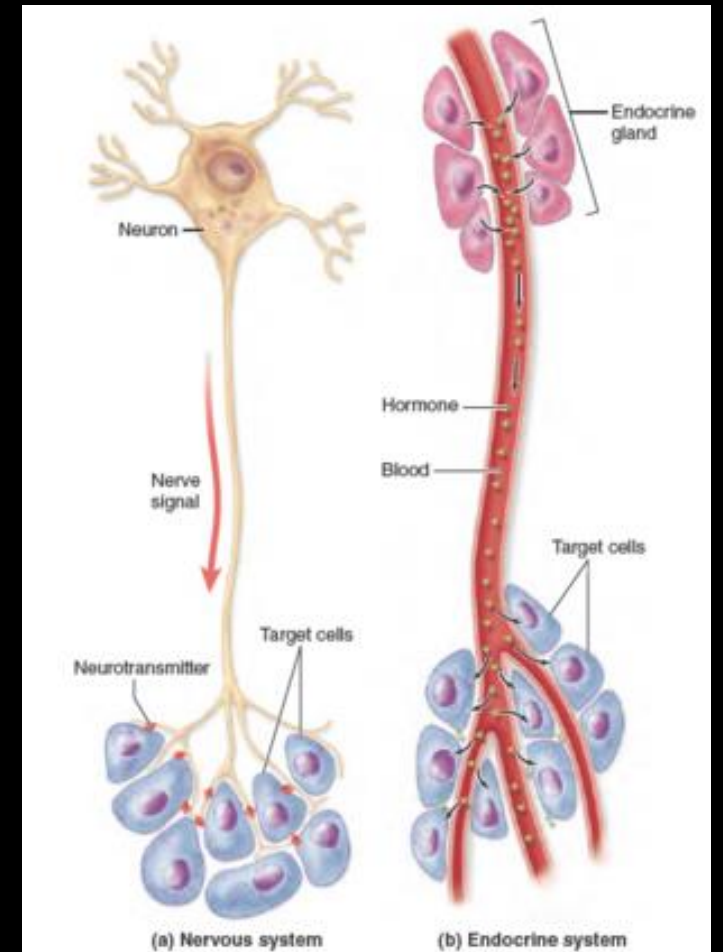


Figure 17.1 Nervous and Endocrine System Communication Methods. (a) In the nervous system, neurons release neurotransmitters into a synaptic cleft to stimulate their target cells. (b) In the endocrine system, hormones are secreted by endocrine cells. The hormones enter the blood and travel throughout the body to reach their target cells.



NERVOUS SYSTEM AND ENDOCRINE SYSTEM

- HOMEOSTASIS DEPENDS ON THE CLOSE RELATIONSHIP BETWEEN THE NERVOUS SYSTEM AND THE ENDOCRINE SYSTEM.
- SOME NERVOUS SYSTEM TISSUES SECRETE HORMONES, SUCH AS CELLS IN THE HYPOTHALAMUS, PITUITARY GLAND, AND ADRENAL GLANDS.
- SEVERAL CHEMICALS FUNCTION AS BOTH **NEUROTRANSMITTERS** AND **HORMONES**, DEPENDING ON THEIR LOCATION IN THE BODY. AN EXAMPLE IS **EPINEPHRINE**, WHICH ACTS AS A NEUROTRANSMITTER BETWEEN CERTAIN NEURONS IN THE NERVOUS SYSTEM, AND AS A HORMONE RELEASED BY THE ADRENAL GLANDS IN THE **FIGHT-OR-FLIGHT RESPONSE**.

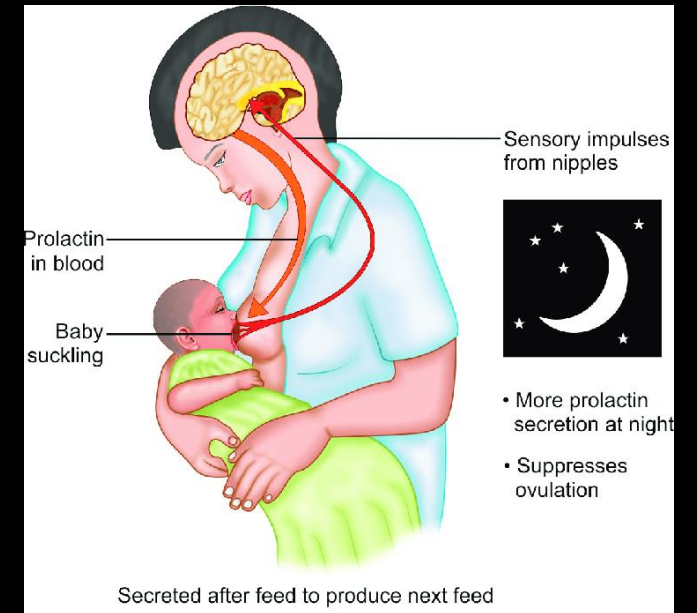


NERVOUS SYSTEM AND ENDOCRINE SYSTEM

- THE ENDOCRINE AND NERVOUS SYSTEMS BOTH INCLUDE RESPONSES THAT ARE REGULATED BY NEGATIVE FEEDBACK LOOPS.
- THE REGULATION OF SEVERAL PHYSIOLOGICAL PROCESSES INVOLVES BOTH THE NERVOUS AND ENDOCRINE SYSTEMS ACTING IN CONJUNCTION WITH EACH OTHER.



- FOR EXAMPLE, WHEN A **MOTHER BREASTFEEDS** HER BABY, THE BABY'S SUCKLING INITIATES A SENSORY MESSAGE IN THE MOTHER'S NEURONS THAT TRAVELS TO THE **HYPOTHALAMUS**, WHICH IN TURN TRIGGERS THE **PITUITARY TO RELEASE A HORMONE CALLED OXYTOCIN**. OXYTOCIN TRAVELS IN THE BLOODSTREAM TO THE **MAMMARY GLANDS OF THE BREAST**, CAUSING THE SECRETION OF MILK.





ENDOCRINE SYSTEM

- **ENDOCRINE SYSTEM** SYSTEM THAT WORKS IN PARALLEL WITH THE NERVOUS SYSTEM TO MAINTAIN HOMEOSTASIS BY RELEASING CHEMICAL HORMONES FROM VARIOUS GLANDS
- **ENDOCRINE GLANDS** SECRETE CHEMICAL MESSENGERS CALLED HORMONES DIRECTLY INTO THE BLOODSTREAM, WHICH TRANSPORTS THE HORMONES THROUGHOUT THE BODY.

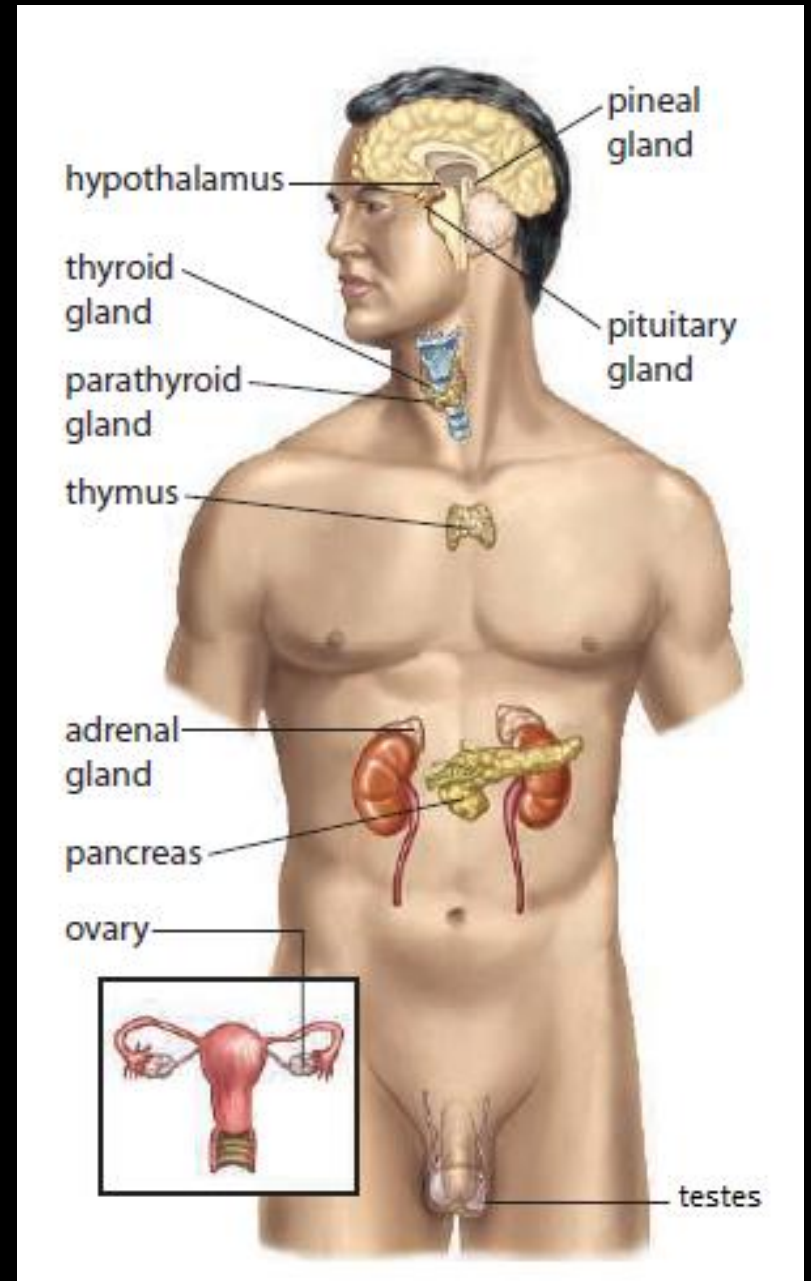


HORMONES

- **HORMONE** CHEMICAL MESSENGER SENT TO MANY PARTS OF THE BODY TO PRODUCE A SPECIFIC EFFECT ON A TARGET CELL OR ORGAN
- MANY OF THE HORMONES RELEASED FROM THE ANTERIOR PITUITARY AND THE HYPOTHALAMUS ARE CALLED *TROPIC HORMONES*, WHICH MEANS THAT THEIR TARGETS ARE OTHER ENDOCRINE GLANDS. TROPIC HORMONES STIMULATE ENDOCRINE GLANDS TO RELEASE OTHER HORMONES

ENDOCRINE GLAND LIST

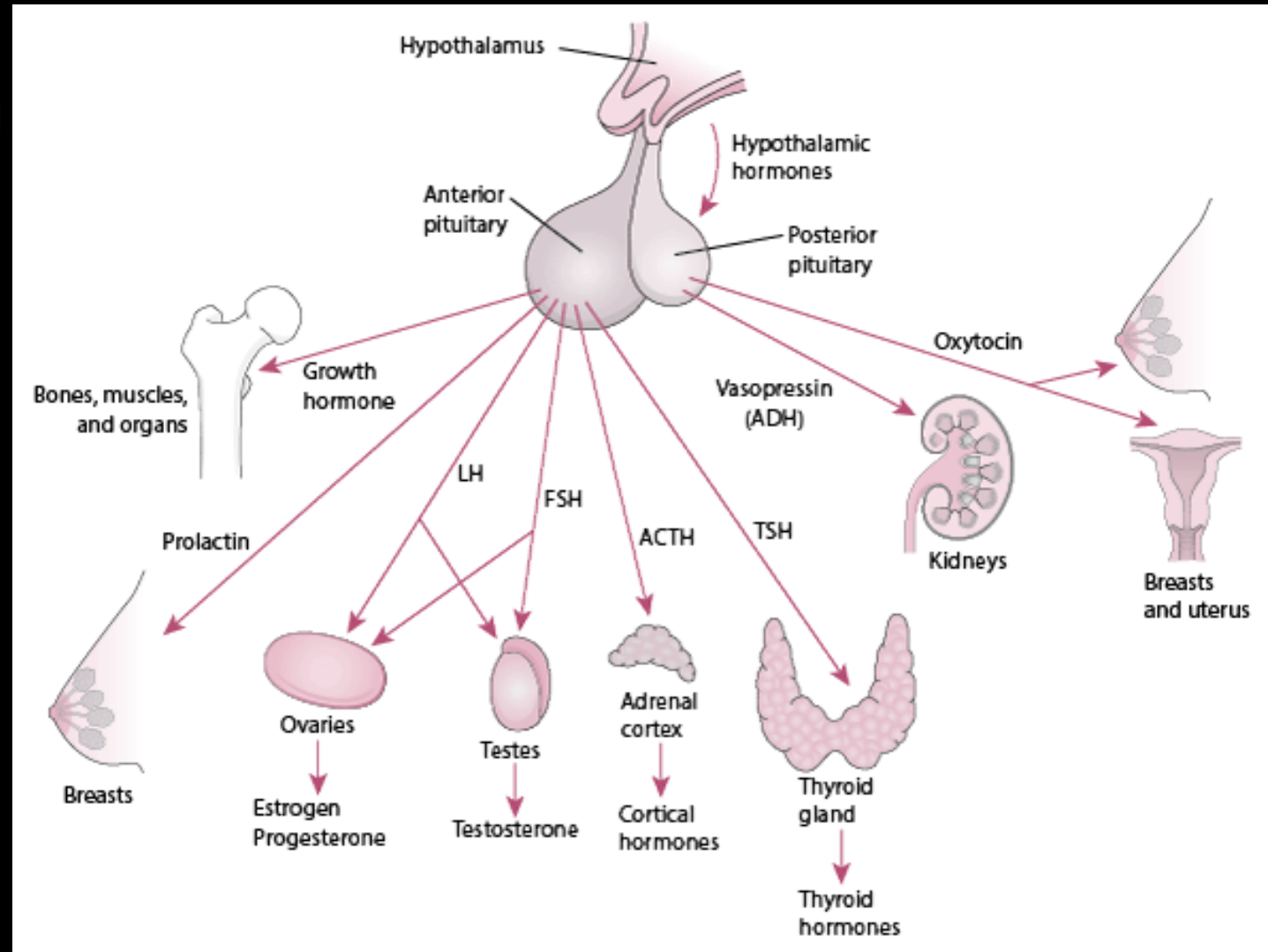
- HYPOTHALAMUS
- PINEAL
- PITUITARY
- THYROID
- PARATHYROID
- THYMUS
- ADRENAL
- PANCREAS
- OVARIES
- TESTES





TARGET TISSUES/ORGANS

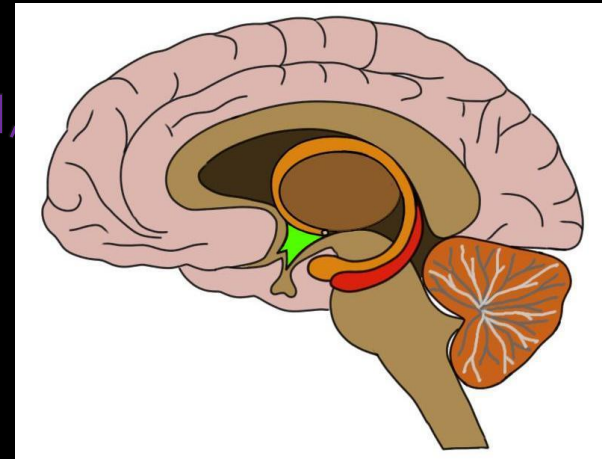
- A SPECIFIC ORGAN ON WHICH A HORMONE, DRUG, OR OTHER SUBSTANCE ACTS.





HYPOTHALAMUS

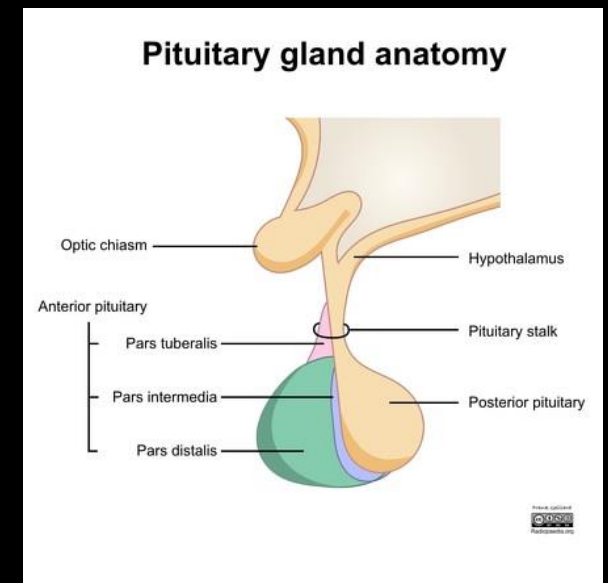
- HORMONES: HYPOTHALAMIC RELEASING- AND INHIBITING-HORMONES
- RELEASING: CRH, TRH, GNRH, GHRH
- INHIBITING: SOMATOSTATIN, PROLACTOSTATIN, RFRP-3, GNLH, FOLLISTATIN, MYOSTATIN
- **RELEASING HORMONES AND INHIBITING HORMONES ARE HORMONES** WHOSE MAIN PURPOSE IS TO CONTROL THE RELEASE OF OTHER HORMONES, EITHER BY STIMULATING OR INHIBITING THEIR RELEASE.
- FUNCTION: REGULATES ANTERIOR PITUITARY HORMONES





ANTERIOR PITUITARY

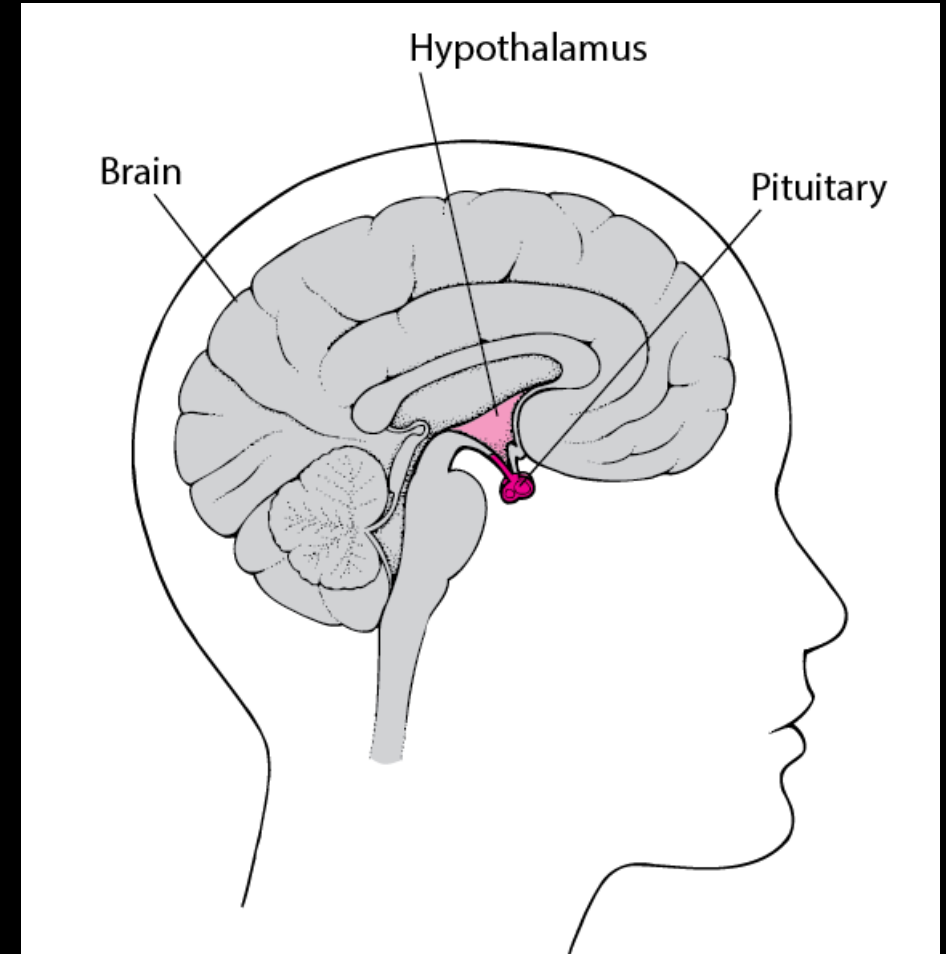
- THE **ANTERIOR PITUITARY** IS A TRUE HORMONE-SYNTHESIZING GLAND.
- ITS CELLS PRODUCE AND RELEASE SIX MAJOR HORMONES:
 - HUMAN GROWTH HORMONE (HGH)
 - THYROID-STIMULATING HORMONE (TSH)
 - ADRENOCORTICOTROPIC HORMONE (ACTH)
 - PROLACTIN (PRL)
 - FOLLICLE-STIMULATING HORMONE (FSH)
 - LUTEINIZING HORMONE (LH).





ANTERIOR PITUITARY

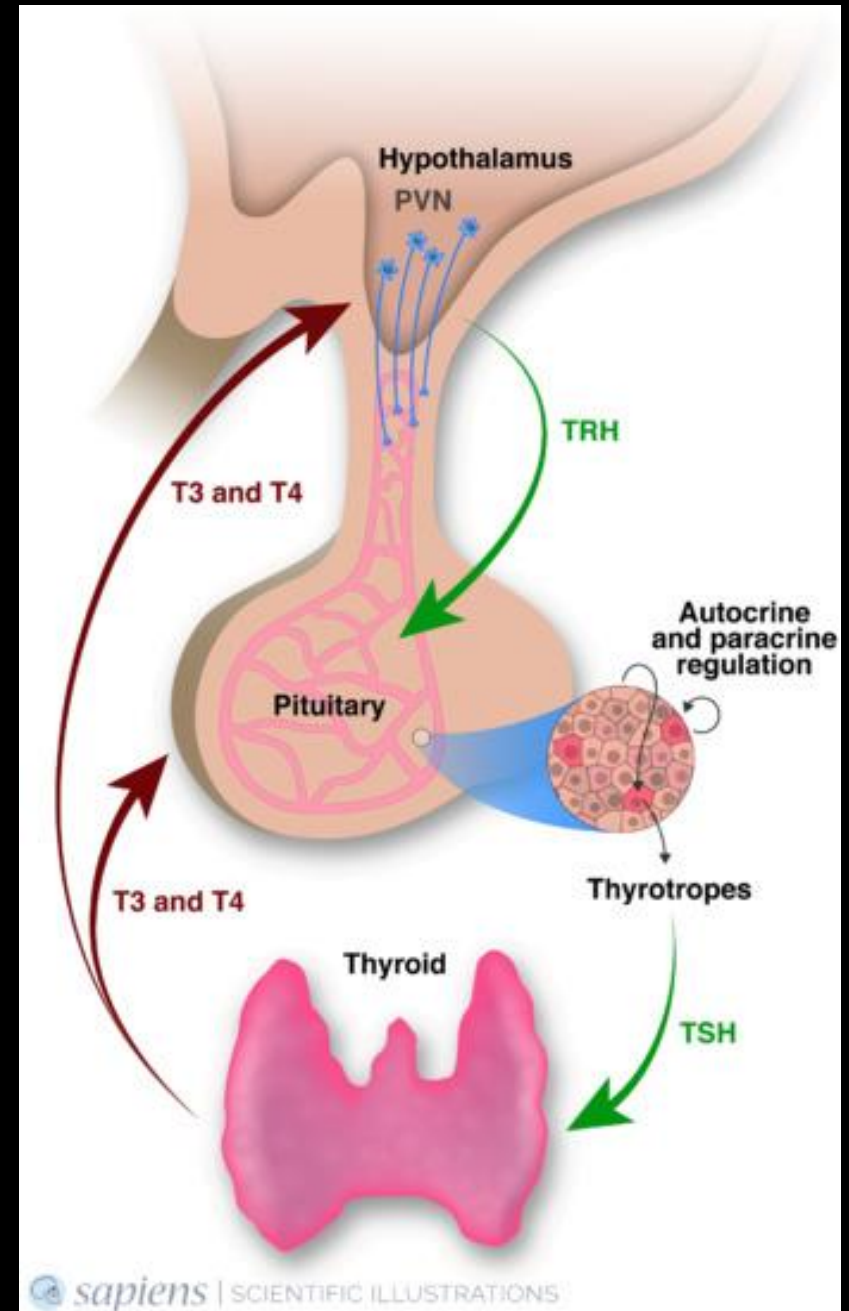
- HORMONE: HUMAN GROWTH HORMONE (HGH)
- FUNCTION: STIMULATES CELL DIVISION, BONE AND MUSCLE GROWTH, AND METABOLIC FUNCTIONS





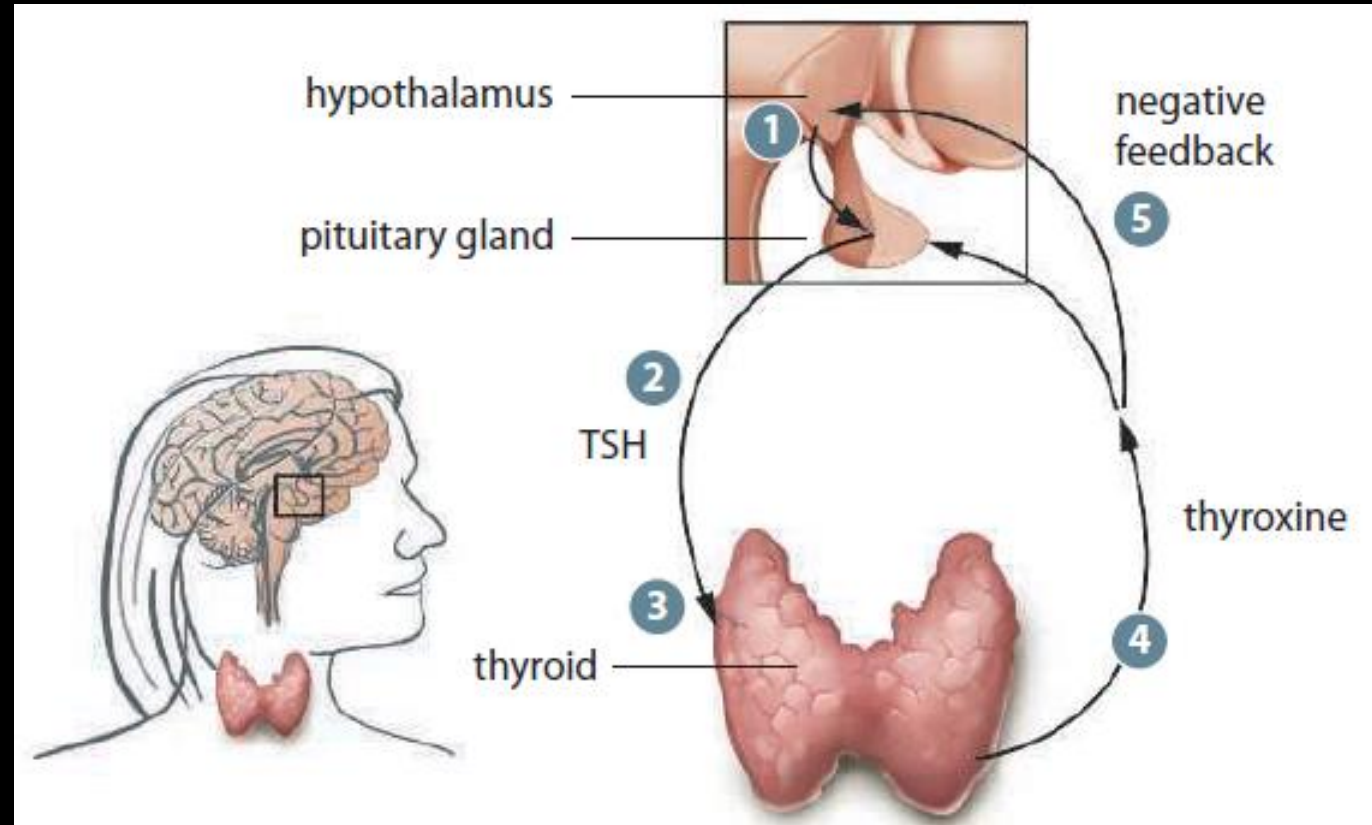
ANTERIOR PITUITARY

- HORMONE: THYROID-STIMULATING HORMONE (TSH)
- FUNCTION: STIMULATES THE THYROID GLAND



HYPOTHALAMUS, PITUITARY, THYROID

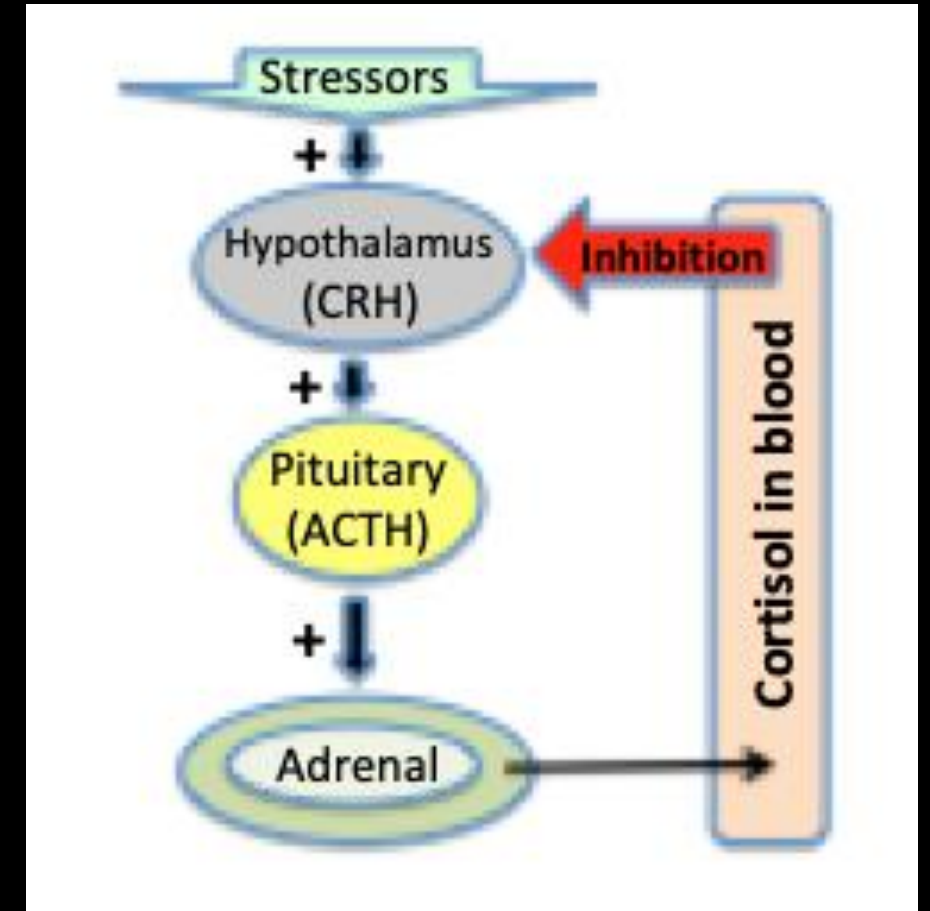
- THE REGULATION OF THE THYROID GLAND BY NEGATIVE FEEDBACK.
- (1) THE HYPOTHALAMUS SECRETES A **RELEASING HORMONE** THAT STIMULATES THE ANTERIOR PITUITARY GLAND.
- (2) THE ANTERIOR PITUITARY RELEASES **TSH** INTO THE BLOODSTREAM.
- (3) **TSH** TARGETS THE THYROID GLAND,
- (4) CAUSING IT TO SECRETE **THYROXINE** INTO THE BLOODSTREAM. **THYROXINE STIMULATES INCREASED CELLULAR RESPIRATION IN TARGET CELLS THROUGHOUT THE BODY.**
- (5) HIGH LEVELS OF THYROXINE CAUSE **NEGATIVE FEEDBACK** ON THE PITUITARY AND HYPOTHALAMUS, SHUTTING DOWN PRODUCTION OF TSH.





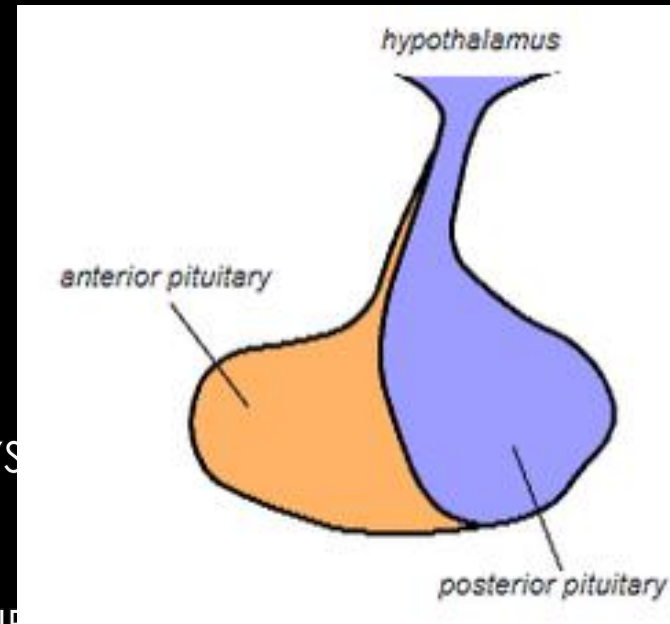
ANTERIOR PITUITARY

- HORMONE: ADRENOCORTICOTROPIC HORMONE (ACTH)
- FUNCTION: STIMULATES THE ADRENAL CORTEX TO SECRETE GLUCOCORTICOIDS



POSTERIOR PITUITARY

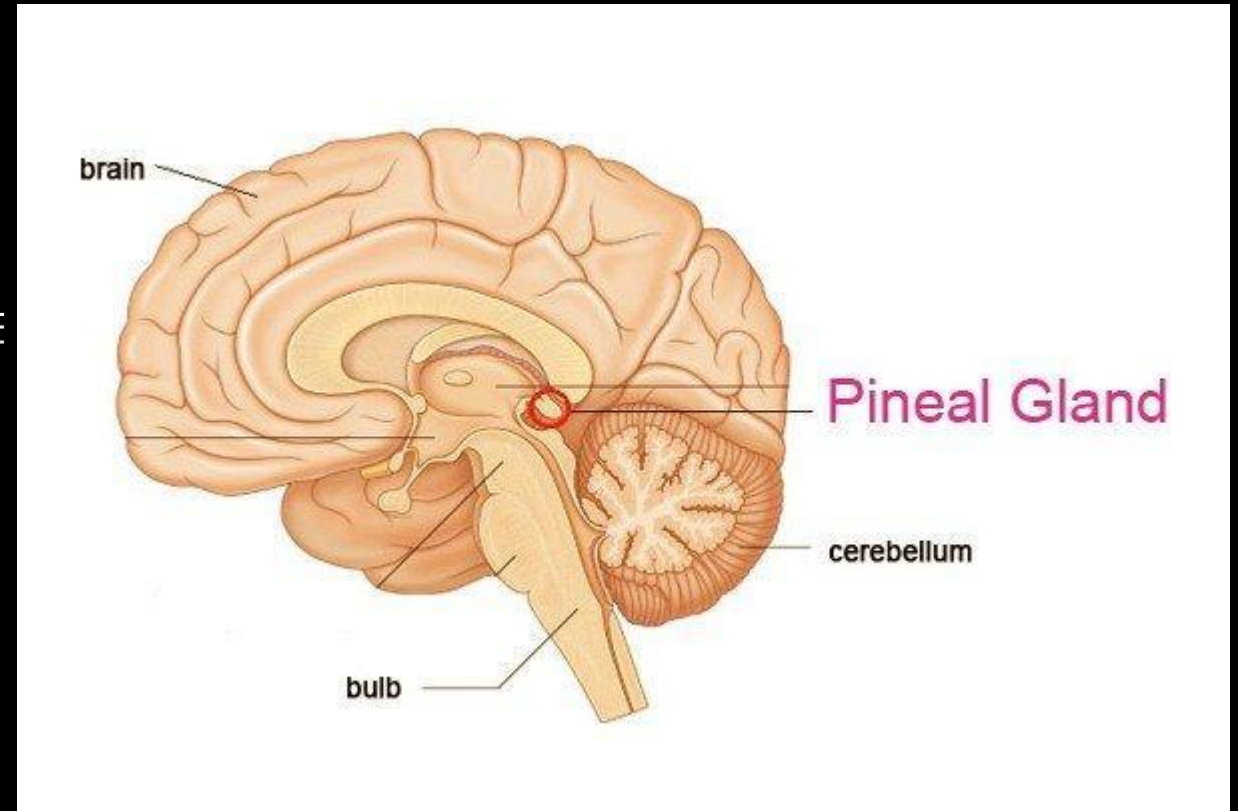
- HORMONE: ANTIDIURETIC HORMONE (ADH)
 - ADH IS MADE IN THE HYPOTHALAMUS AND STORED IN POSTERIOR PITUITARY
- FUNCTION: PROMOTES THE RETENTION OF WATER BY THE KIDNEYS
- ADH TARGETS THE NEPHRONS OF THE KIDNEYS, CAUSING THE TUBULES TO BECOME MORE PERMEABLE TO WATER. AS A RESULT, MORE WATER IS REABSORBED, THE BODY EXCRETES LESS (BUT MORE CONCENTRATED) URINE, AND BLOOD PRESSURE INCREASES. THE HYPOTHALAMUS DETECTS THIS AND SENDS A SIGNAL TO THE POSTERIOR PITUITARY TO STOP SECRETING ADH.





PINEAL GLAND

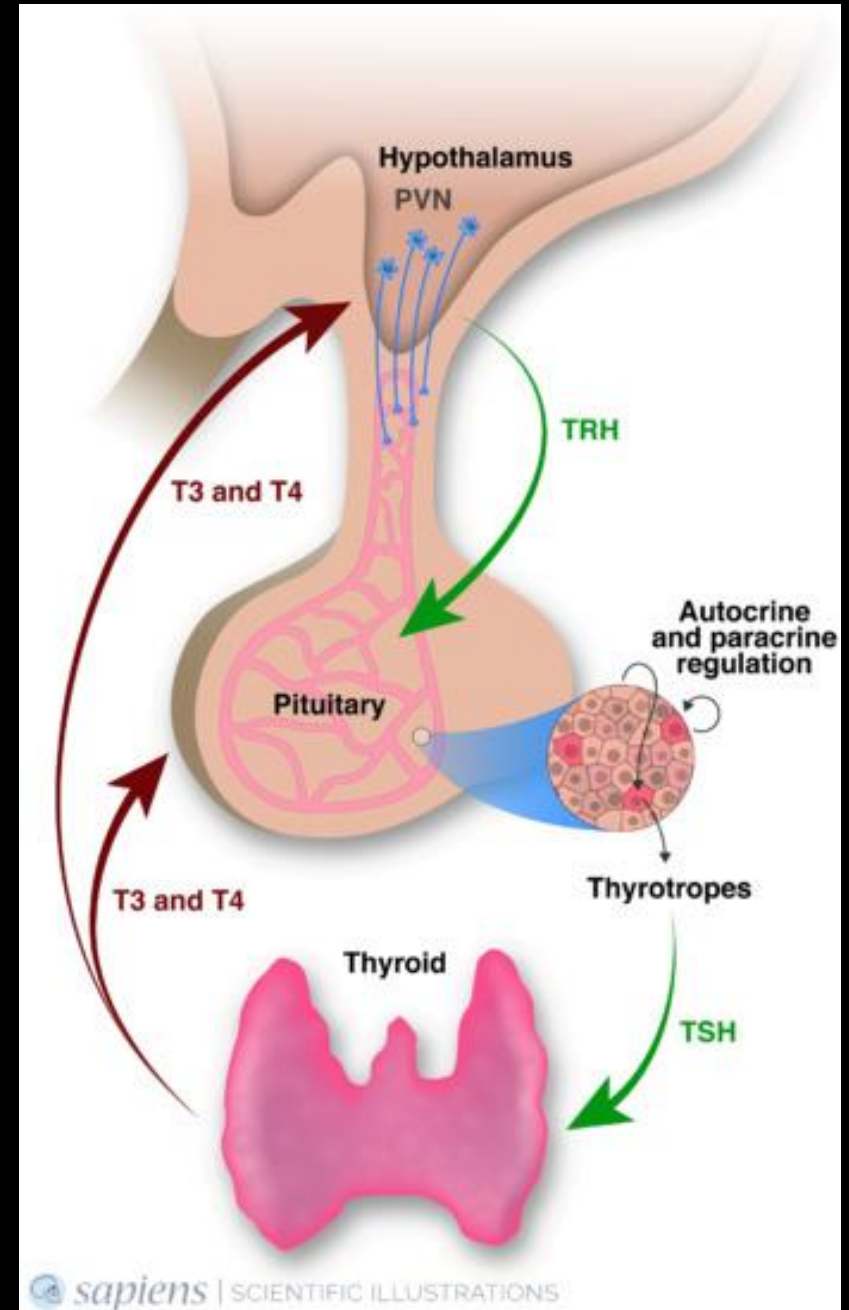
- HORMONE: MELATONIN
- FUNCTION: INFLUENCES THE BODY'S DAILY SLEEP/WAKE CYCLE; THOUGHT TO PROMOTE SLEEPINESS
- TARGET: VARIOUS TISSUES





THYROID

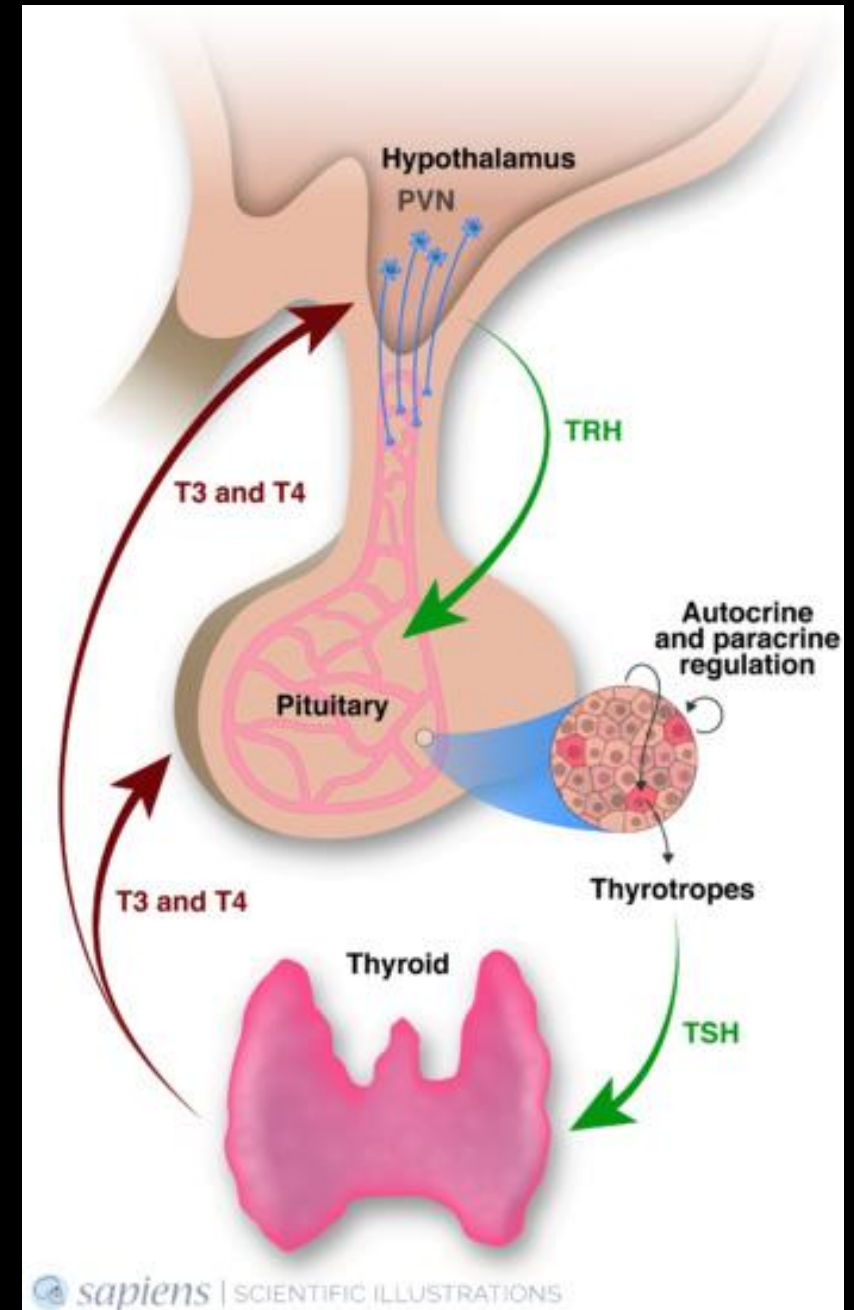
- HORMONE: **THYROXINE (T4)**
- FUNCTION: AFFECTS ALL TISSUES INCREASES METABOLIC RATE AND REGULATES GROWTH AND DEVELOPMENT





THYROID METABOLISM

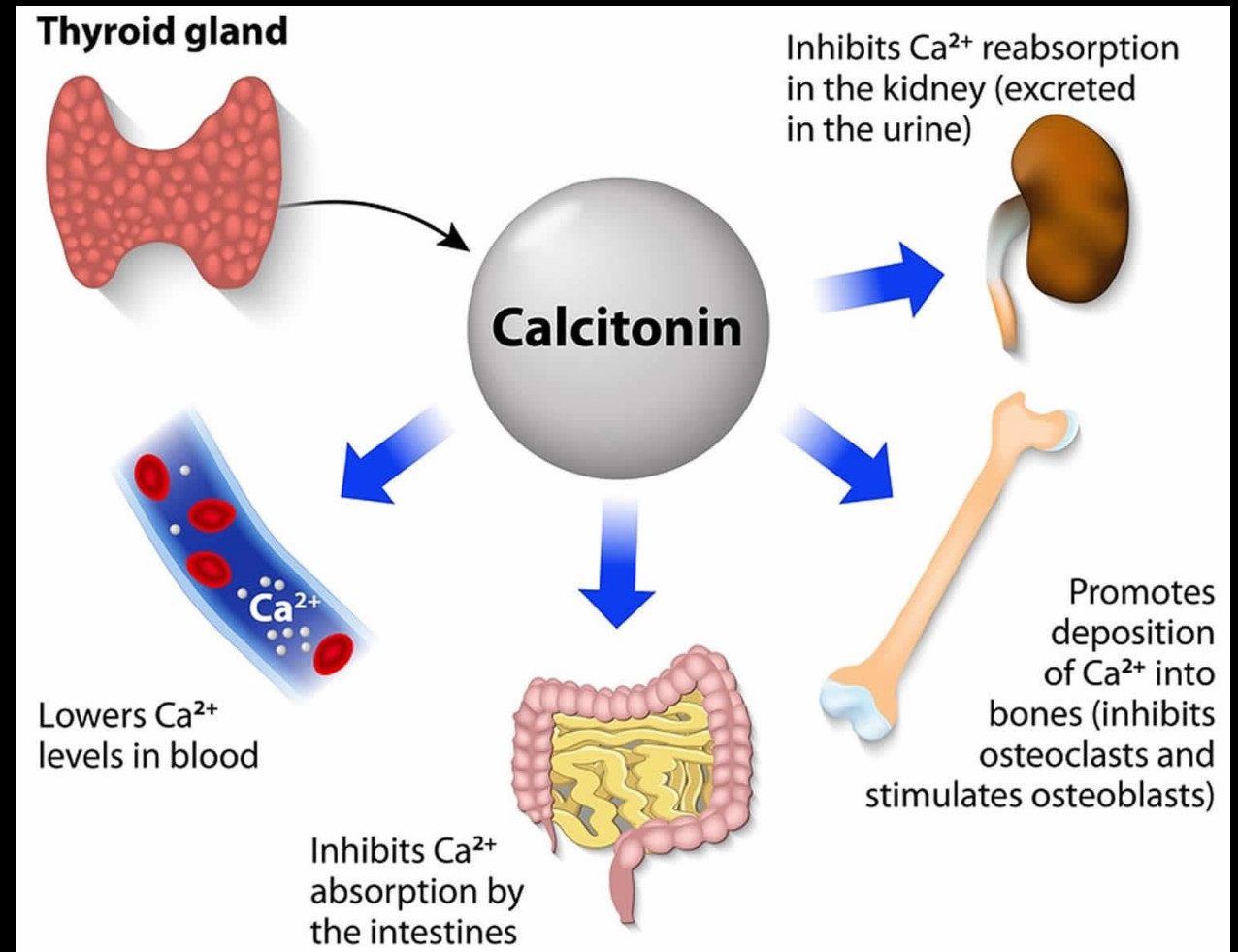
- THYROXINE (T4)
- THE PRIMARY EFFECT OF THYROXINE IS TO INCREASE THE RATE AT WHICH THE BODY METABOLIZES FATS, PROTEINS, AND CARBOHYDRATES FOR ENERGY.
- THYROXINE DOES NOT HAVE ONE SPECIFIC TARGET ORGAN, BUT ESPECIALLY STIMULATES THE CELLS OF THE HEART, SKELETAL MUSCLES, LIVER, AND KIDNEY TO INCREASE THE RATE OF CELLULAR RESPIRATION.
- THYROXINE ALSO PLAYS AN IMPORTANT ROLE IN THE GROWTH AND DEVELOPMENT OF CHILDREN BY INFLUENCING THE ORGANIZATION OF VARIOUS CELLS INTO TISSUES AND ORGANS.





THYROID

- HORMONE: **CALCITONIN**
- FUNCTION: TARGETS BONES AND KIDNEYS TO LOWER BLOOD CALCIUM BY INHIBITING RELEASE OF CALCIUM FROM BONE AND REABSORPTION OF CALCIUM BY KIDNEYS



- Calcium (Ca^{2+}) is essential for healthy teeth and skeletal development. This mineral also plays a crucial role in blood clotting, nerve conduction, and muscle contraction.

INVESTIGATION 10.C



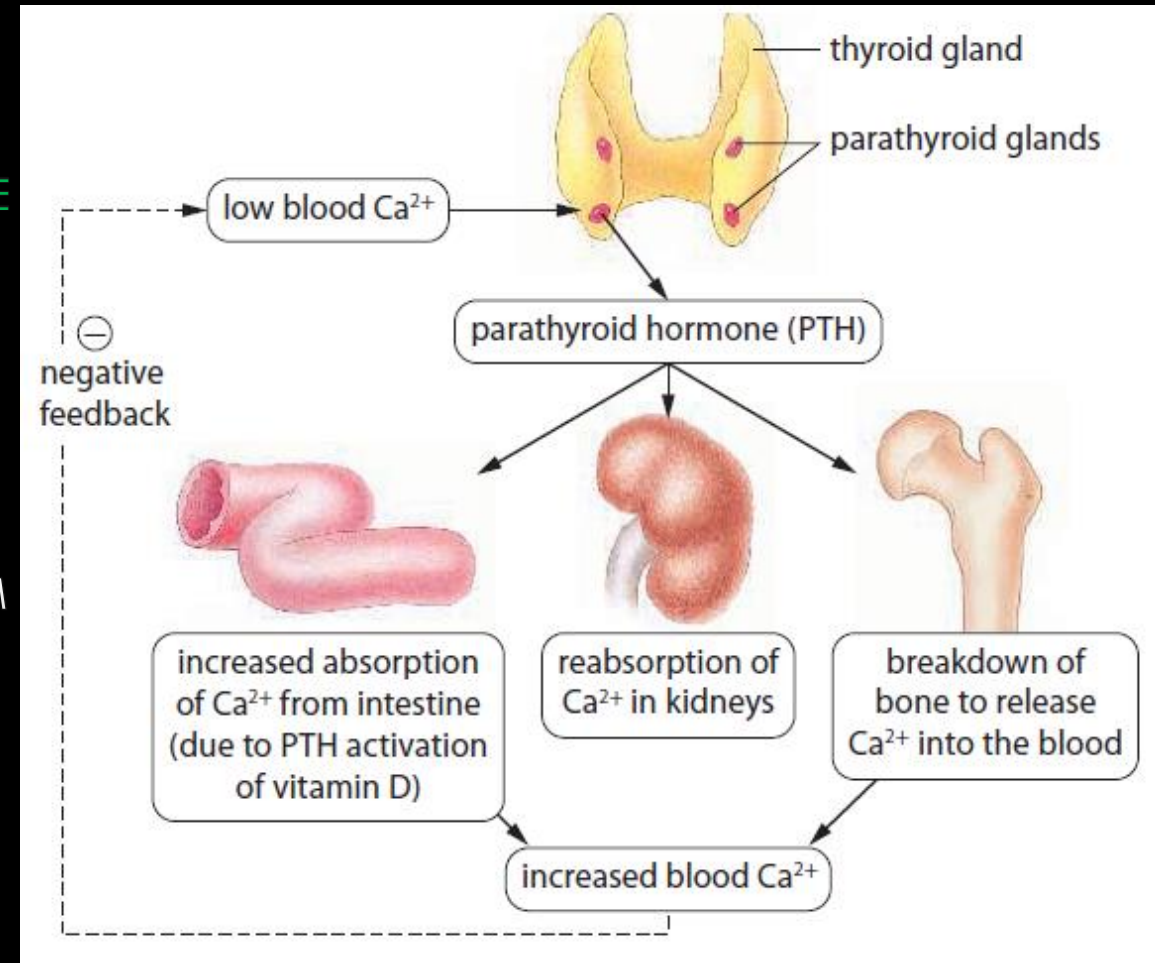
- RESEARCH INFORMATION ABOUT ENDOCRINE DISORDERS
- PITUITARY DWARFISM
- GIGANTISM
- ACROMEGALY
- DIABETES INSIPIDUS
- DIABETES MELLITUS
- ADDISON'S DISEASE
- HYPOTHYROIDISM
- HYPERTHYROIDISM
- GOITRE

LAUNCH LAB: MODERN STRESS



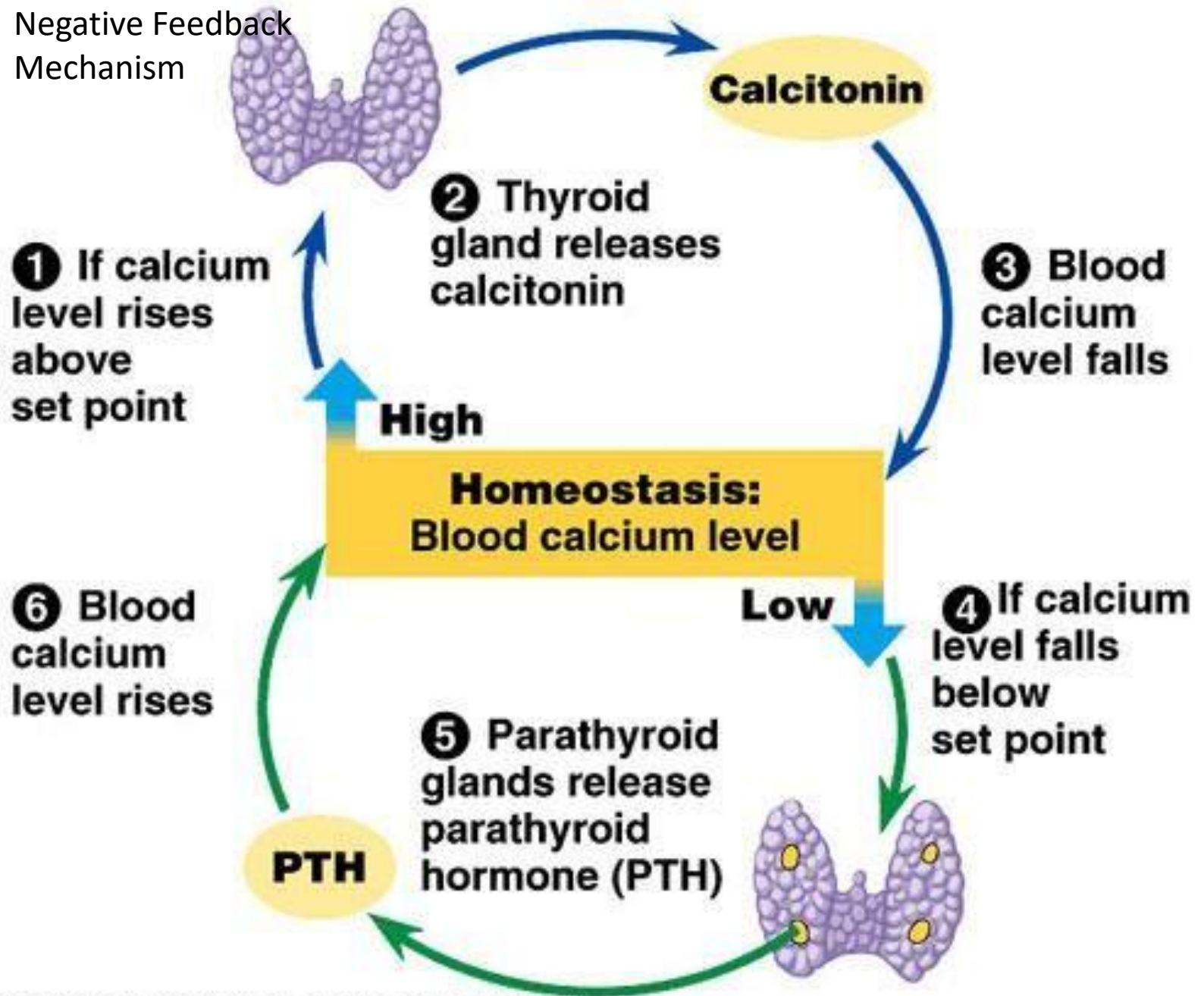
PARATHYROID

- HORMONE: PARATHYROID HORMONE (PTH)
- FUNCTION: RAISES BLOOD CALCIUM LEVELS BY STIMULATING THE BONE CELLS TO RELEASE CALCIUM, THE INTESTINE TO ABSORB CALCIUM FROM FOOD, AND THE KIDNEYS TO REABSORB CALCIUM





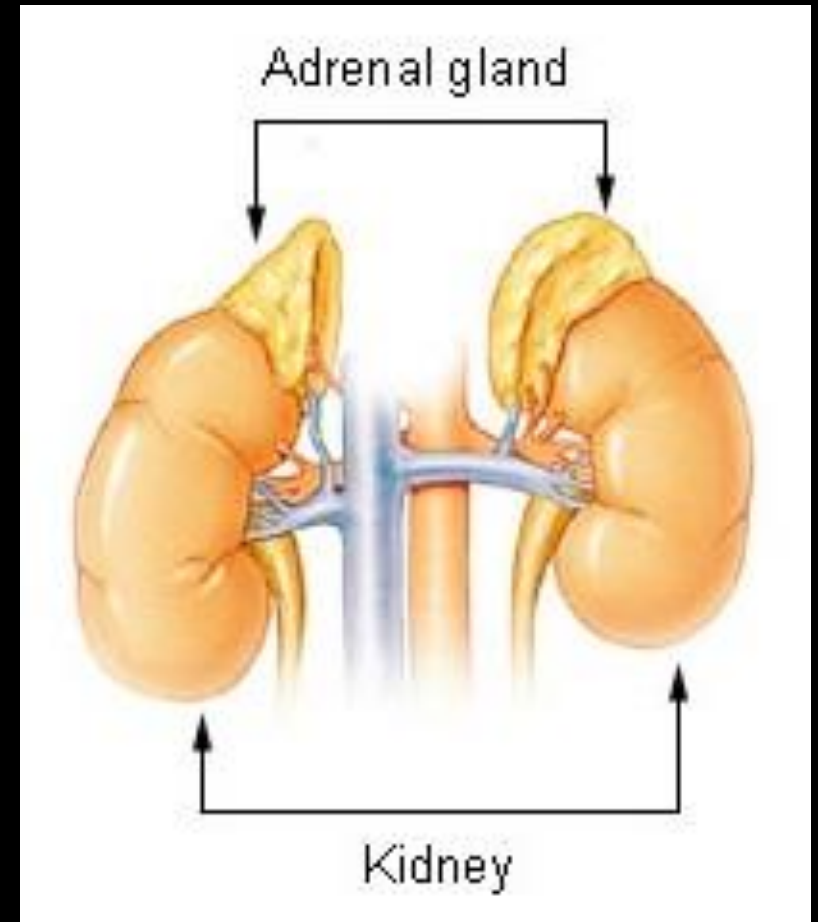
Negative Feedback Mechanism





ADRENAL GLAND

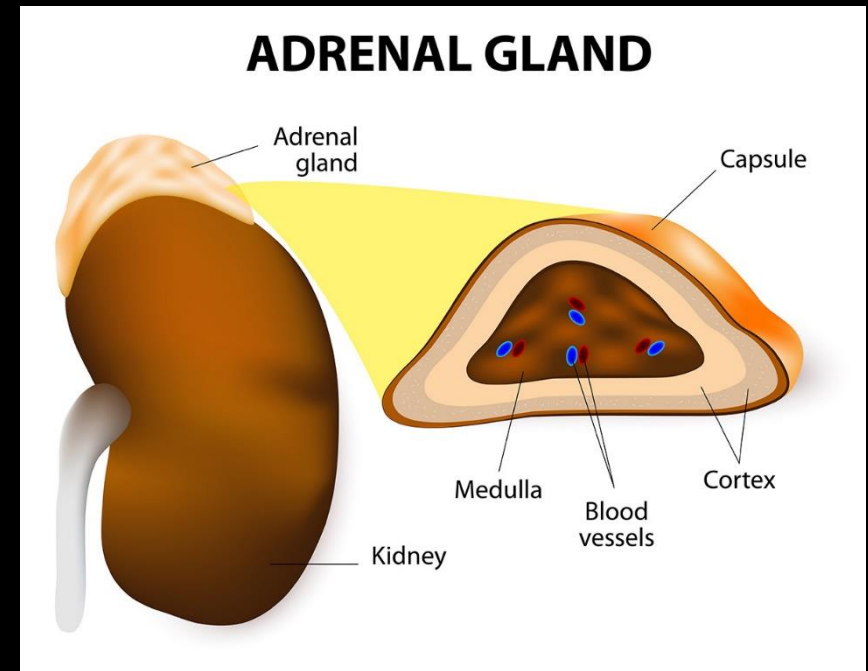
- ADRENAL CORTEX
- HORMONE: GLUCOCORTICOIDS (E.G., CORTISOL)
- FUNCTION: STIMULATE TISSUES TO RAISE BLOOD GLUCOSE AND BREAK DOWN PROTEIN





ADRENAL GLAND

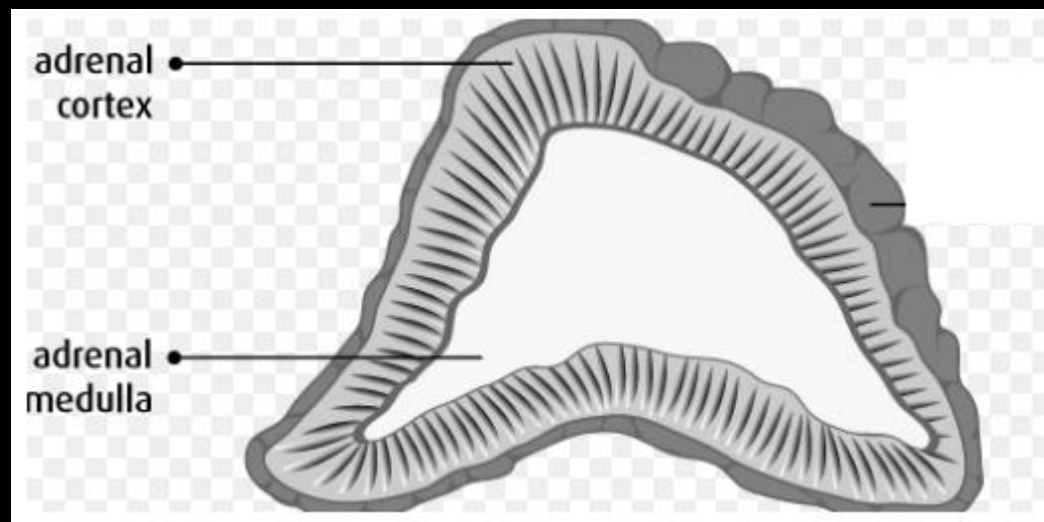
- ADRENAL CORTEX
- HORMONE: MINERALOCORTICOIDS (E.G., ALDOSTERONE)
- FUNCTION: PROMOTE REABSORPTION OF SODIUM AND WATER BY THE KIDNEYS





ADRENAL GLAND

- ADRENAL MEDULLA
- HORMONE: EPINEPHRINE AND NOREPINEPHRINE
- THESE HORMONES ARE ALSO CALLED ADRENALINE AND NORADRENALINE, RESPECTIVELY
- FUNCTION: FIGHT-OR-FLIGHT HORMONES, RAISE BLOOD GLUCOSE LEVELS



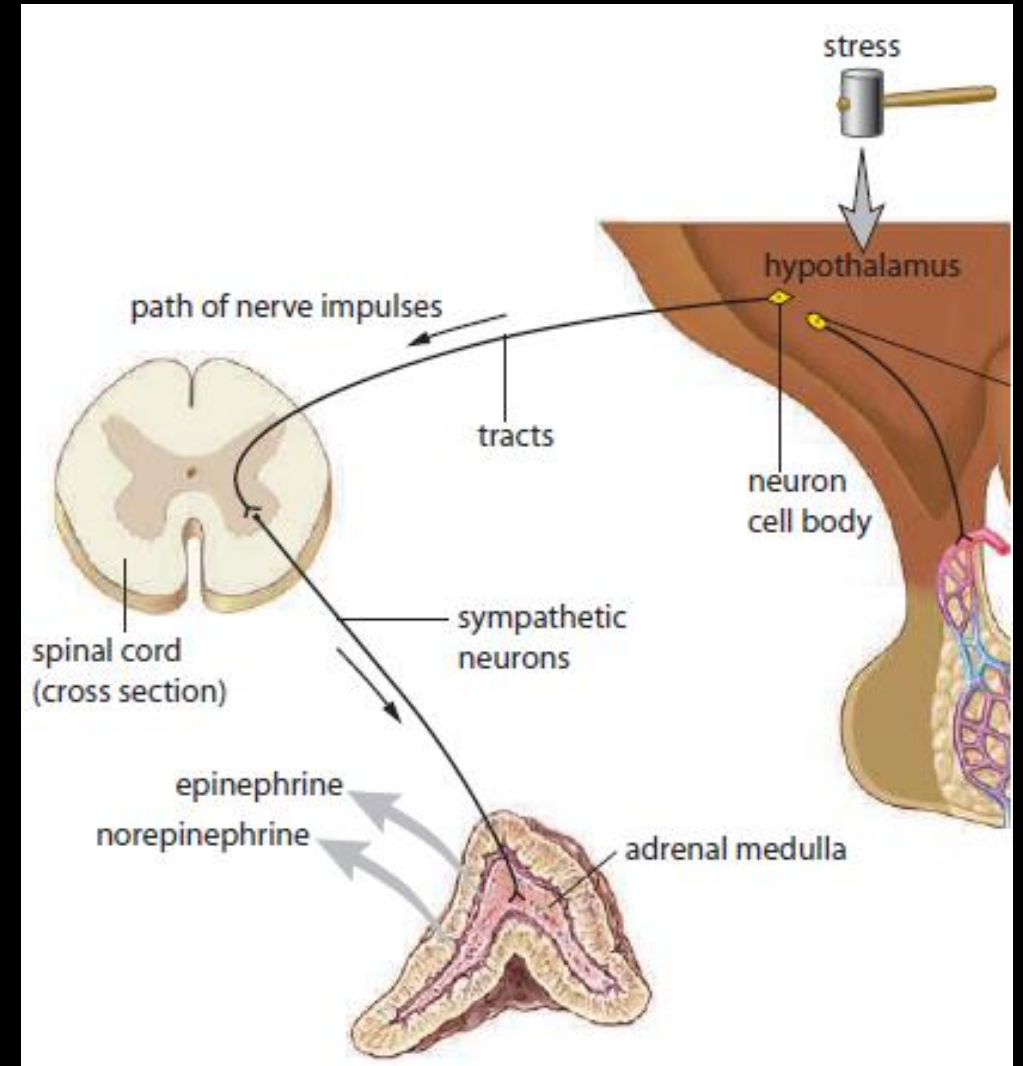


STRESS RESPONSE IN THE NERVOUS SYSTEM AND ENDOCRINE SYSTEM

- IN RESPONSE TO STRESSORS,
- 1.) THE SYMPATHETIC NERVOUS SYSTEM INITIATES STRESS RESPONSES. THE SHORT-TERM STRESS RESPONSE (**FIGHT-OR-FLIGHT RESPONSE**) INCLUDES INCREASES IN HEART RATE, BLOOD PRESSURE, AND BLOOD GLUCOSE.
- 2.) IN RESPONSE TO A PERCEIVED THREAT, THE HYPOTHALAMUS SENDS NERVE SIGNALS TO THE ADRENAL MEDULLA, WHICH RELEASES THE SHORT-TERM STRESS HORMONES **EPINEPHRINE AND NOREPINEPHRINE**.

ADRENAL GLAND AND STRESS RESPONSE

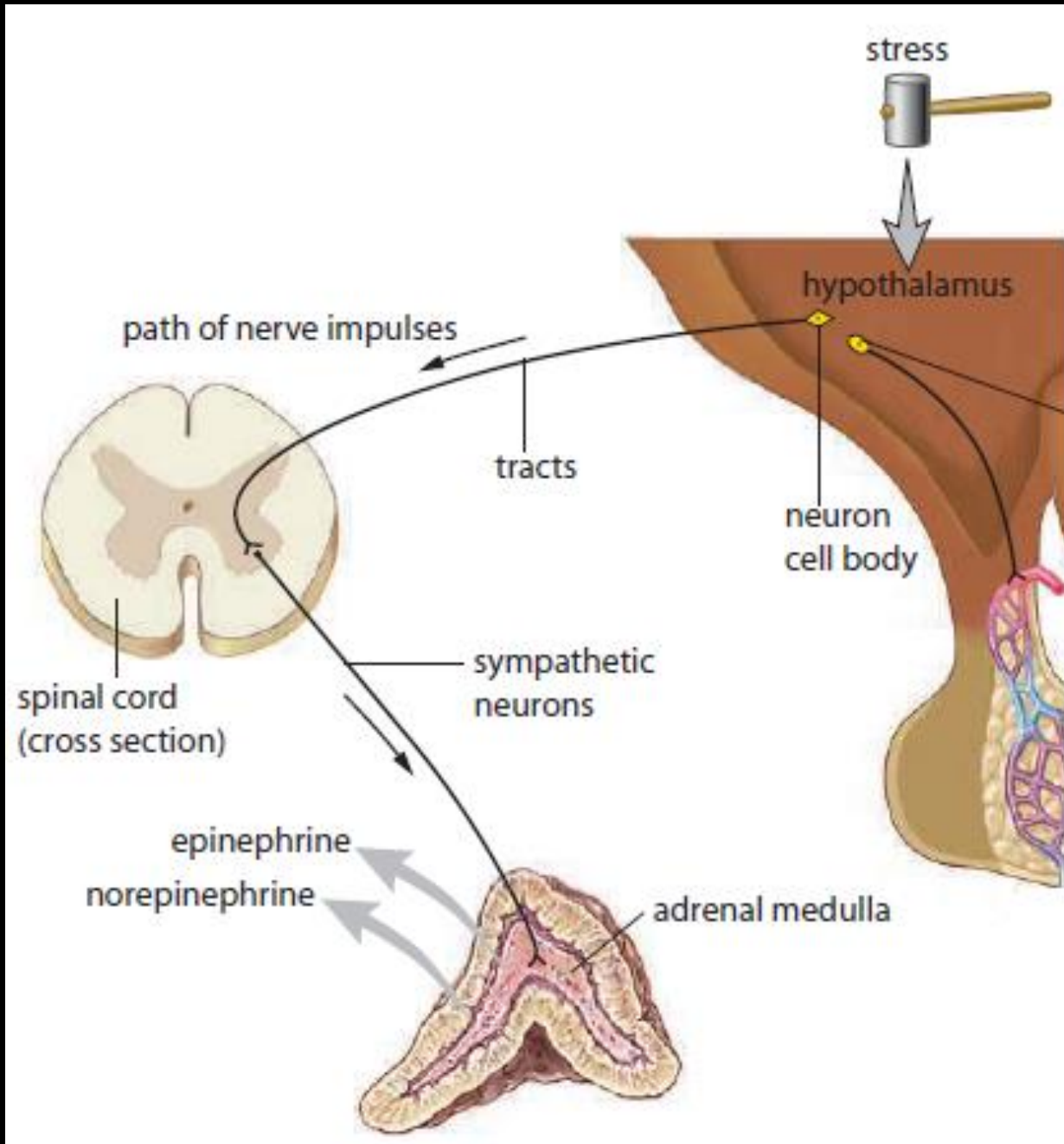
- THE **ADRENAL MEDULLA** PRODUCES TWO CLOSELY RELATED HORMONES: **EPINEPHRINE AND NOREPINEPHRINE**. (THESE HORMONES ARE ALSO CALLED ADRENALINE AND NORADRENALINE, RESPECTIVELY.)
- THESE HORMONES REGULATE A *SHORT-TERM STRESS RESPONSE* THAT IS COMMONLY REFERRED TO AS THE *FIGHTOR-FLIGHT RESPONSE*. THE EFFECTS OF THESE HORMONES ON THE BODY ARE SIMILAR TO THOSE CAUSED BY STIMULATION OF THE **SYMPATHETIC NERVOUS SYSTEM**.





ADRENAL GLAND AND SHORT-TERM STRESS RESPONSE

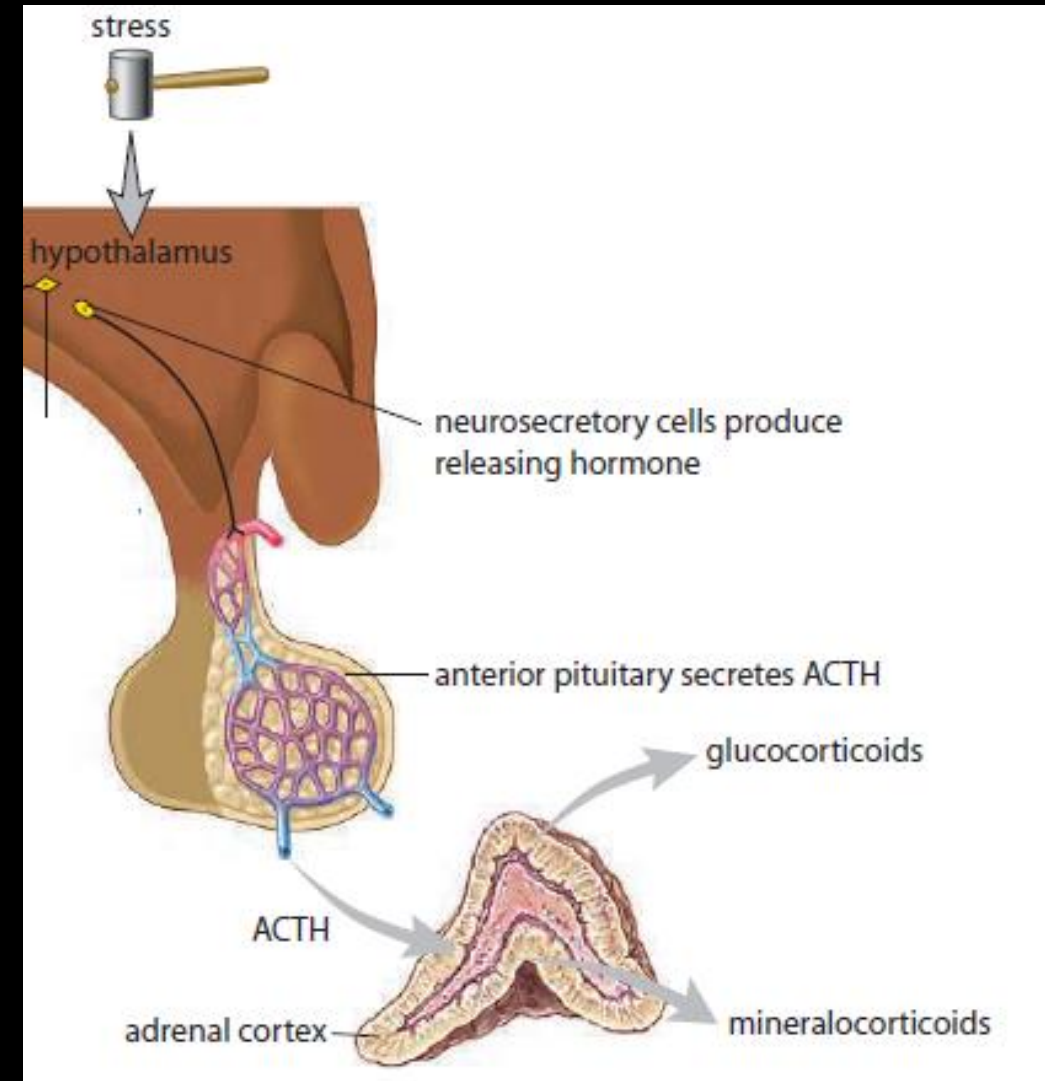
- LIKE THE SYMPATHETIC NERVOUS SYSTEM, THE HORMONES OF THE ADRENAL MEDULLA PREPARE THE BODY FOR **FIGHT-OR-FLIGHT** BY INCREASING METABOLISM.
- 1.) IN RESPONSE TO A STRESSOR, NEURONS OF THE SYMPATHETIC NERVOUS SYSTEM CARRY A SIGNAL FROM THE HYPOTHALAMUS DIRECTLY TO THE ADRENAL MEDULLA.
- 2.) THESE NEURONS (RATHER THAN HORMONES) STIMULATE THE ADRENAL MEDULLA TO SECRETE EPINEPHRINE AND A SMALL AMOUNT OF NOREPINEPHRINE.
- 3.) THESE HORMONES TRIGGER AN INCREASE IN BREATHING RATE, HEART RATE, BLOOD PRESSURE, BLOOD FLOW TO THE HEART AND MUSCLES, AND THE CONVERSION OF GLYCOGEN TO GLUCOSE IN THE LIVER. AT THE SAME TIME, THE PUPILS OF THE EYES DILATE AND BLOOD FLOW TO THE EXTREMITIES DECREASES. EPINEPHRINE ACTS QUICKLY.
- THIS IS WHY **EPINEPHRINE INJECTIONS** CAN BE USED TO TREAT DIFFERENT LIFE-THREATENING CONDITIONS. FOR EXAMPLE, IT CAN BE USED TO **STIMULATE THE HEART TO START BEATING IN SOMEONE WITH CARDIAC ARREST**. IN CASES OF **ANAPHYLACTIC SHOCK** CAUSED BY SEVERE ALLERGIES, INJECTED EPINEPHRINE WILL OPEN UP THE AIR PASSAGES AND RESTORE BREATHING





ADRENAL GLAND AND LONG-TERM STRESS RESPONSE

- IN THE LONG-TERM STRESS RESPONSE, THE
- 1.) THE HYPOTHALAMUS SECRETES ADRENOCORTICOTROPIC HORMONE (ACTH),
- 2.) THE ADRENAL CORTEX TO SECRETES CORTISOL.
- 3.) THE ADRENAL CORTEX ALSO SECRETES ALDOSTERONE, WHICH INCREASES BLOOD PRESSURE AND BALANCES ELECTROLYTES IN THE BLOOD.



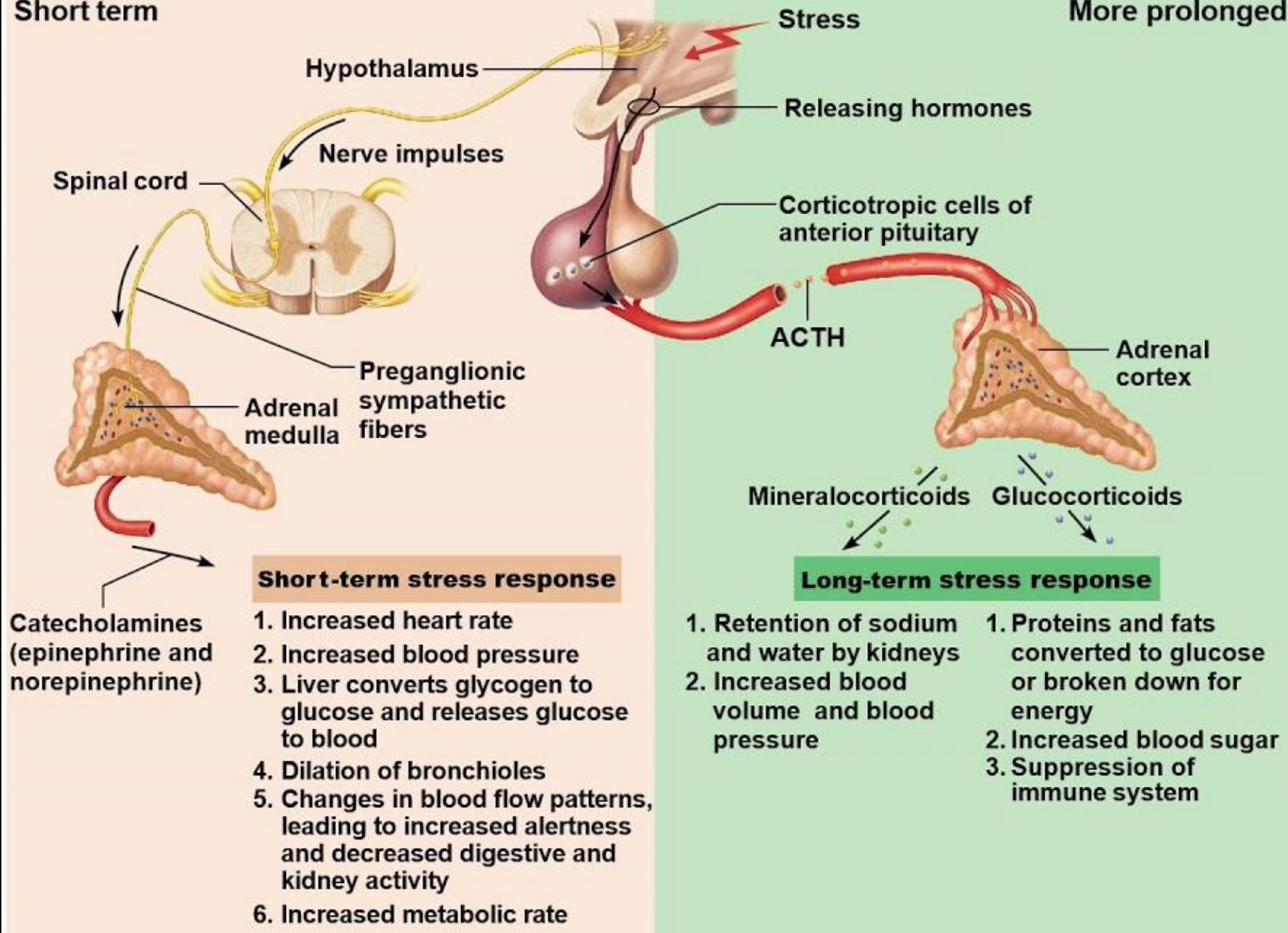
ADRENAL GLAND AND LONG-TERM STRESS RESPONSE

- **STRESS RESPONSE IS LONG-TERM**
- KIDNEY ABSORBS SODIUM IONS AND WATER, AND BLOOD VOLUME AND PRESSURE INCREASE
- PROTEIN AND FAT METABOLISM STIMULATED, WHICH RELEASES GLUCOSE
- INFLAMMATION IS REDUCED AND IMMUNE CELLS SUPPRESSED



Short term

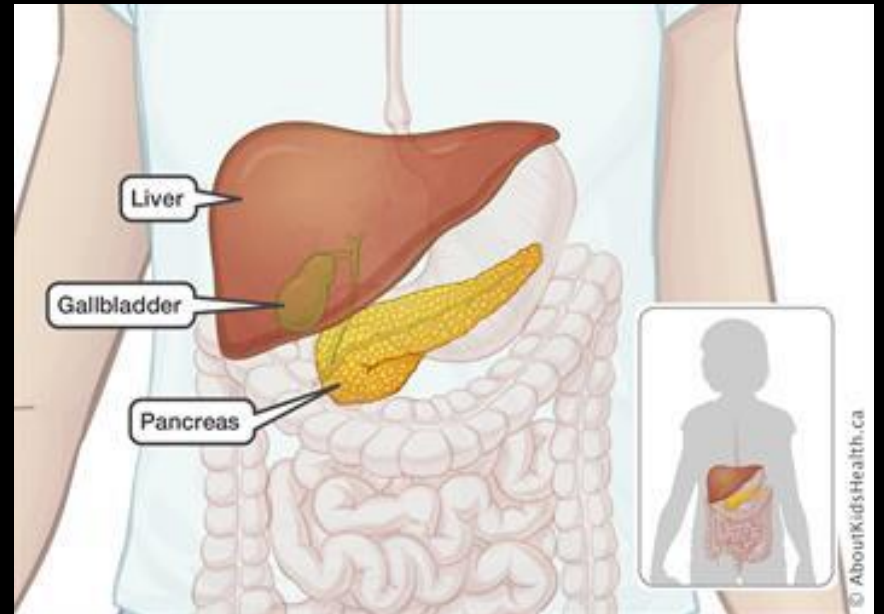
More prolonged





PANCREAS

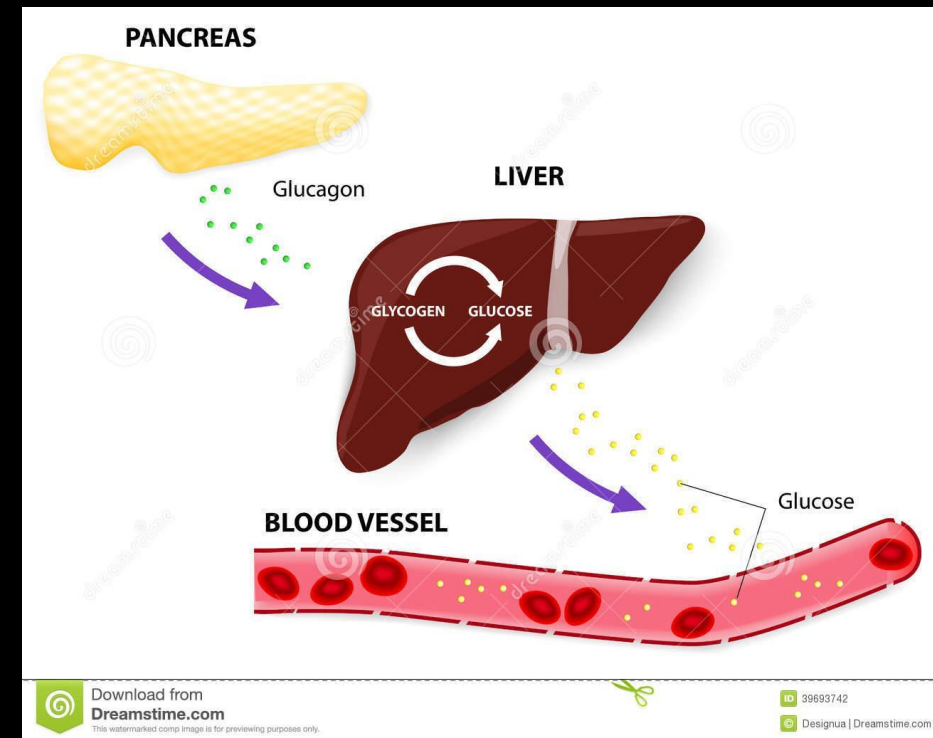
- **PANCREAS** SMALL GLAND IN THE ABDOMEN THAT SECRETES DIGESTIVE ENZYMES; ALSO SECRETES THE HORMONE INSULIN
- HORMONE: **INSULIN**
- FUNCTION: A HORMONE SECRETED BY THE **BETA** CELLS OF THE ISLETS OF LANGERHANS IN THE PANCREAS **TO MAKE TARGET CELLS MORE PERMEABLE TO GLUCOSE - WHICH DECREASES THE LEVEL OF BLOOD GLUCOSE.**
- **ISLET OF LANGERHANS** CLUSTER OF ENDOCRINE CELLS FOUND THROUGHOUT THE PANCREAS





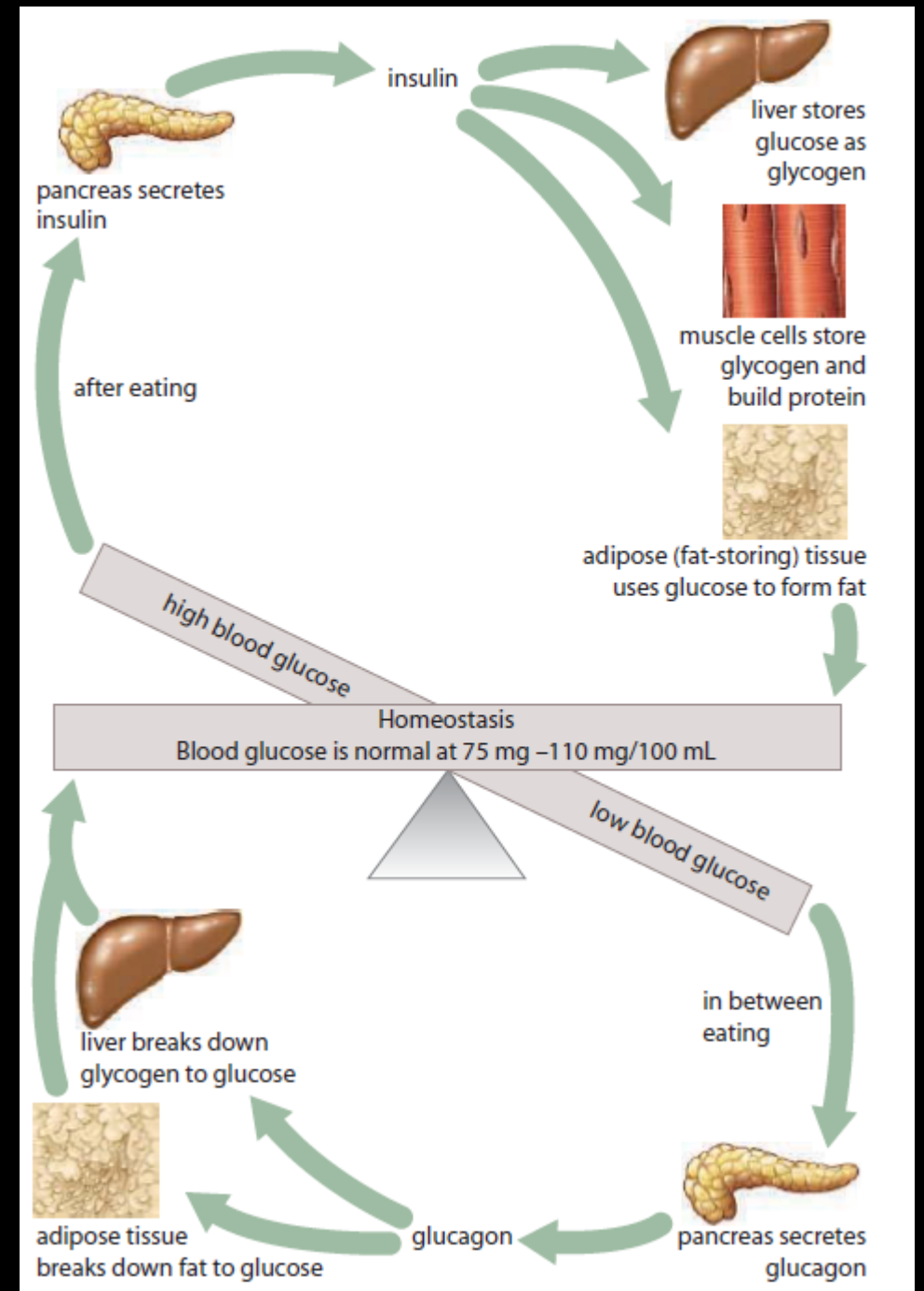
PANCREAS

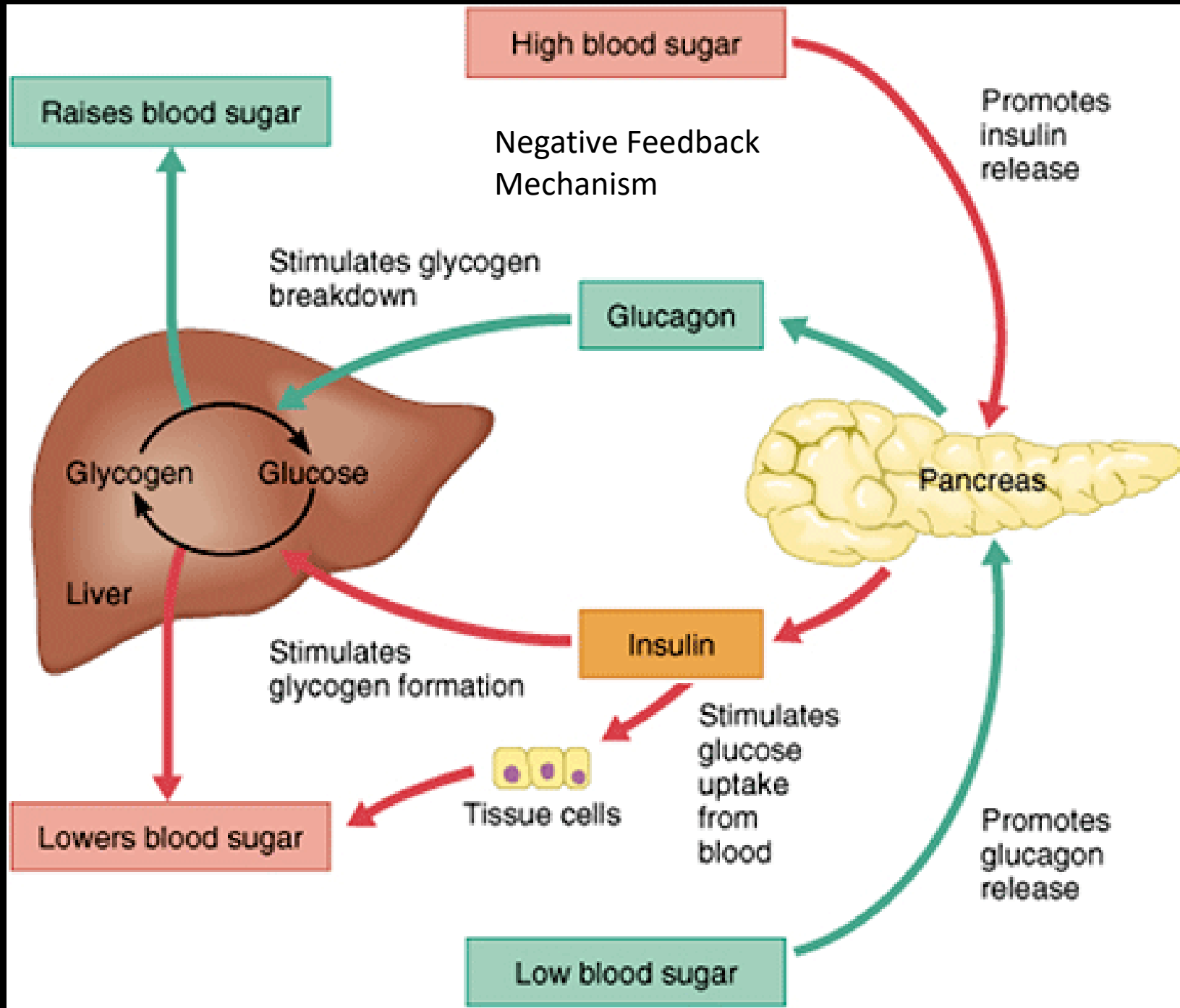
- HORMONE: **GLUCAGON**
- FUNCTION: HORMONE PRODUCED BY THE ALPHA CELLS OF THE ISLETS OF LANGERHANS IN THE PANCREAS TO STIMULATE THE LIVER TO CONVERT GLYCOGEN BACK INTO GLUCOSE – **INCREASES BLOOD GLUCOSE LEVELS**
- **GLYCOGEN** THE STORAGE POLYSACCHARIDE FOUND IN ANIMAL CELLS.



GLUCOSE REGULATION

- NEGATIVE FEEDBACK REGULATES BLOOD GLUCOSE LEVELS WITHIN A VERY NARROW RANGE. 75-100MG/100ML
- THE HORMONES OF THE PANCREAS ACT **ANTAGONISTICALLY** TO REGULATE BLOOD GLUCOSE LEVELS. THE BETA CELLS OF THE ISLETS OF LANGERHANS SECRETE INSULIN, WHICH LOWERS BLOOD GLUCOSE. THE ALPHA CELLS SECRETE GLUCAGON, WHICH RAISE BLOOD GLUCOSE.
- **HORMONES THAT DO OPPOSITE THINGS ARE SAID TO BE ANTAGONISTIC**

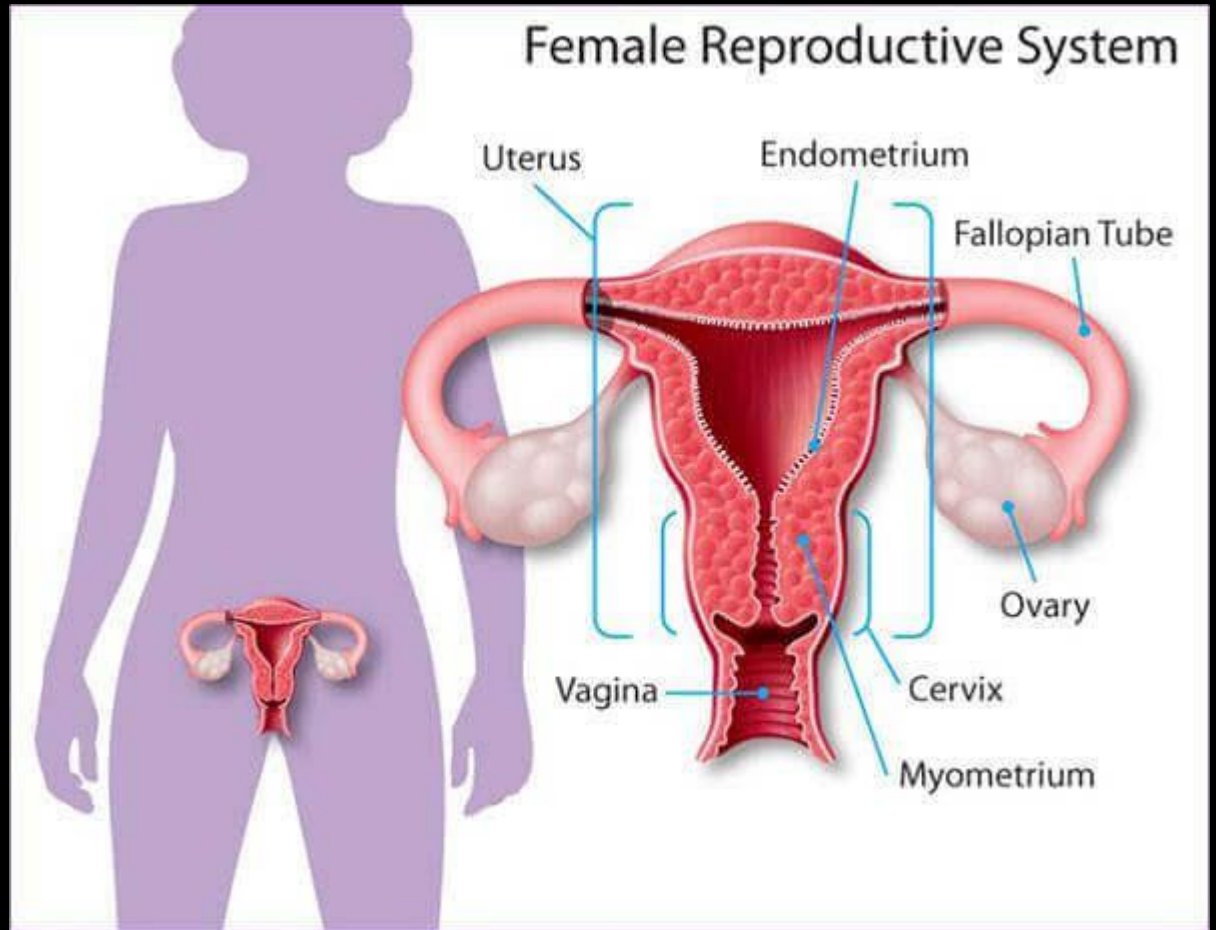






OVARIES

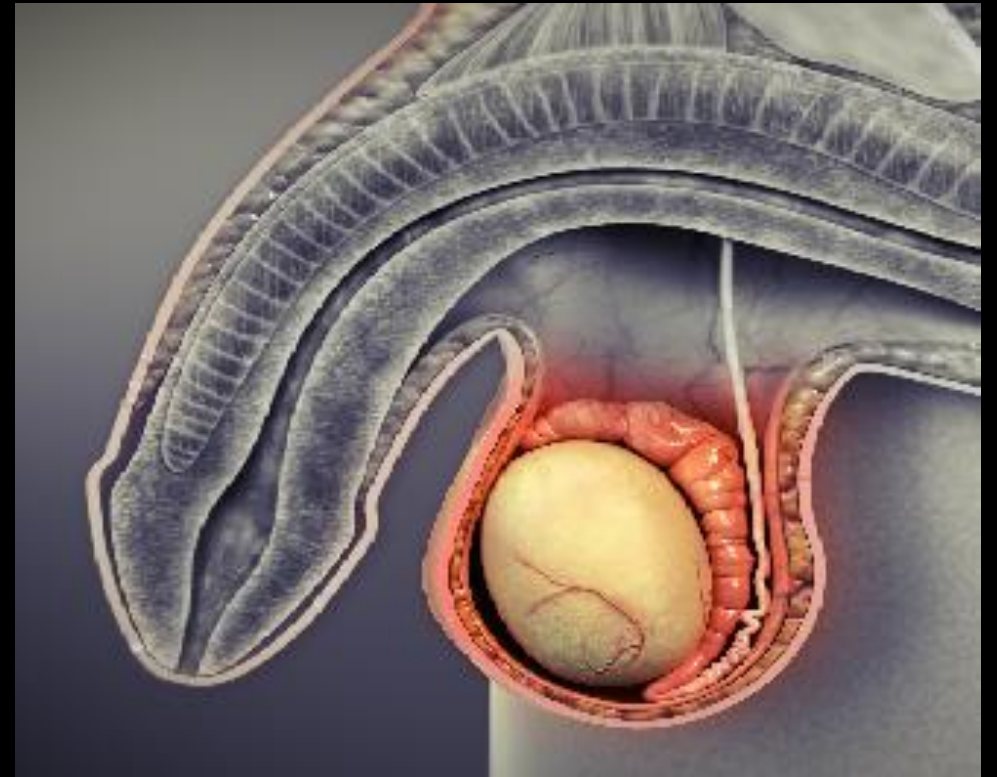
- HORMONE: **ESTROGEN**
- FUNCTION: STIMULATES UTERINE LINING GROWTH AND PROMOTES DEVELOPMENT OF THE FEMALE SECONDARY SEXUAL CHARACTERISTICS





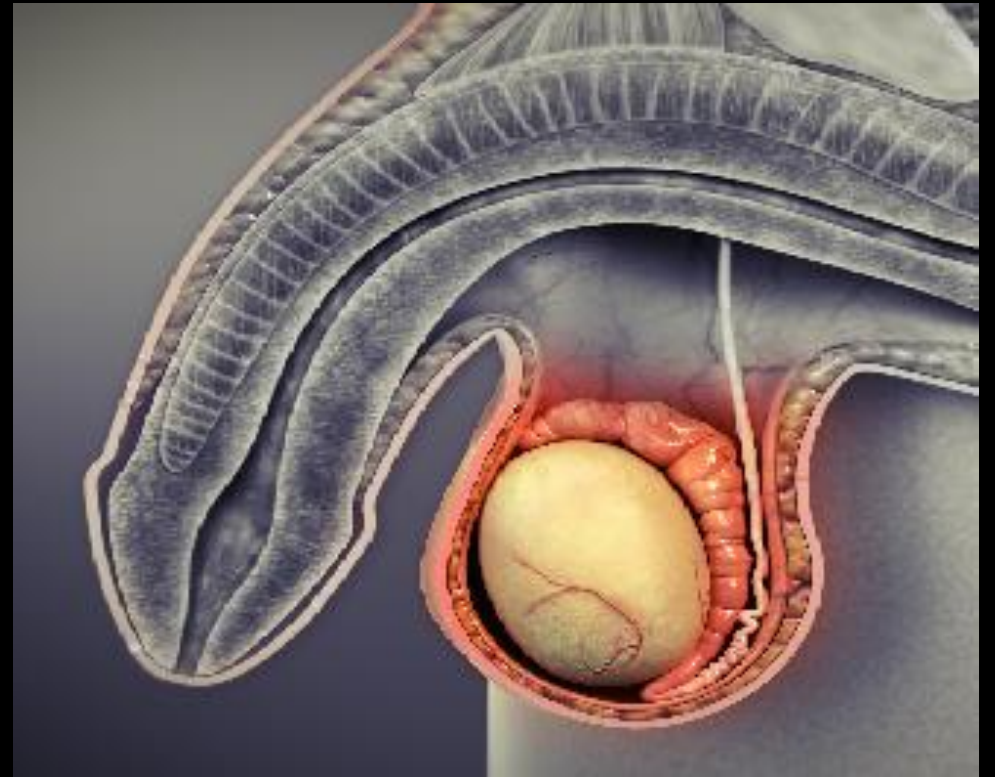
TESTES

- HORMONE: **TESTOSTERONE**
- FUNCTION: PROMOTES SPERM FORMATION AND DEVELOPMENT OF THE MALE SECONDARY SEXUAL CHARACTERISTICS





- INVESTIGATION 10B: EVALUATING POTENTIAL USES FOR HUMAN GROWTH HORMONE





- ACTIVITY 10.1 BLOOD GLUCOSE REGULATION AND HOMEOSTASIS

