

Lecture 21 Endocrine System and Nervous System

§1 Hormones

1. Gland (腺)

1^o Endocrine (内分泌)

release products into blood stream

2^o Exocrine (外分泌)

transport products from the glands via a duct (导管)
(e.g. salivary gland, pancreas)

2. Endocrine system

1^o utilizes glands that secrete hormones

2^o chemical signaling

3^o slow, prolong response

3. Hormones (激素)

1^o Hormones are produced by most plants and animals.

2^o Animal hormones

① are made and secreted mainly by endocrine glands (内分泌腺体)

② are usually carried by the circulatory system

③ communicate regulatory messages to specific sites in the body.

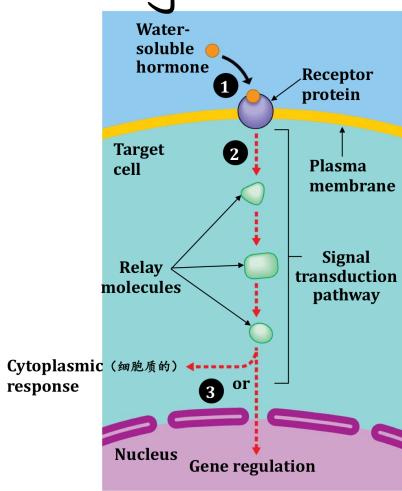
④ can affect many cells in many organs, but only effect target cells (靶细胞)

3^o Two general mechanisms

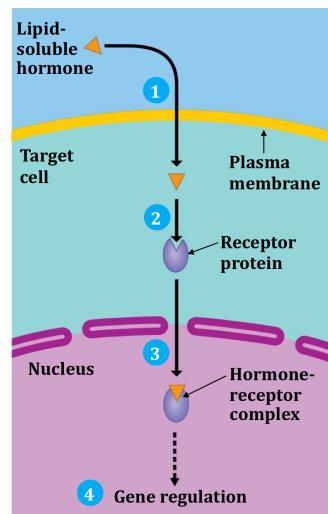
① water-soluble hormones trigger responses without entering their target cells

② *lipid-soluble hormones trigger responses after entering the target cells.*

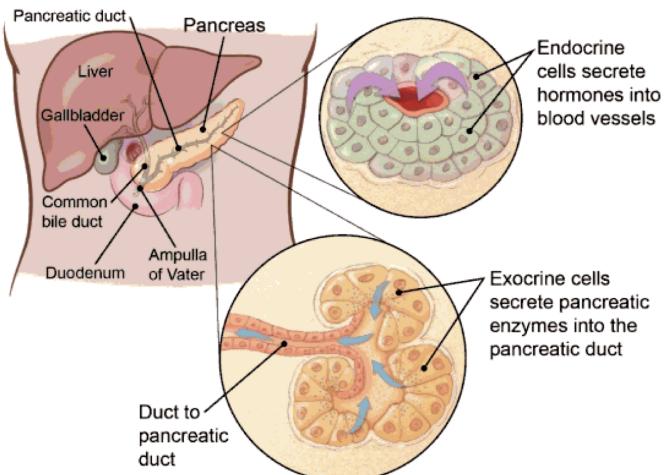
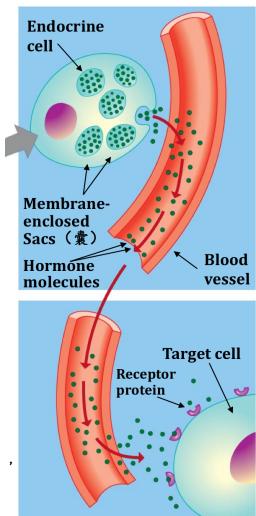
A Water-soluble Hormone that Binds to a Plasma Membrane Receptor



A Lipid-soluble Hormone That Binds to an Intracellular Receptor



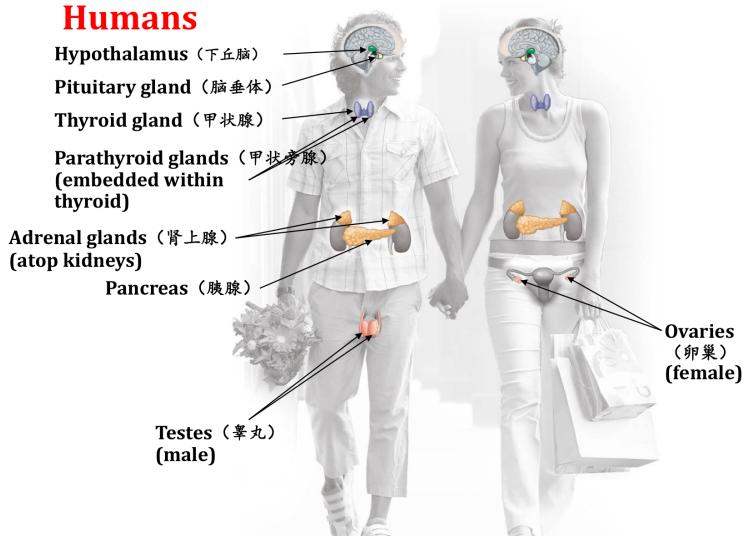
Steroid hormones usually bind to receptors in the cytoplasm or nucleus



§2 The Human Endocrine System

1. The major endocrine glands in humans

The Major Endocrine Glands (内分泌腺) in Humans



2. The Hypothalamus (下丘脑)

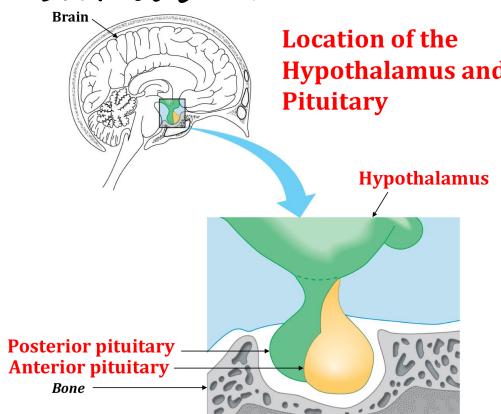
The Hypothalamus

- 1^o is part of the brain
- 2^o links between nervous system and endocrine system
- 3^o is the main control center of the endocrine system
- 4^o receive information from nerves about
 - ① the internal condition of the body
 - ② the external environment

3. The pituitary gland (腺垂体)

The pituitary gland

- 1^o is a pea-sized structure that hangs below the hypothalamus
- 2^o responds to signals from the hypothalamus
- 3^o secretes hormones that influence numerous body function

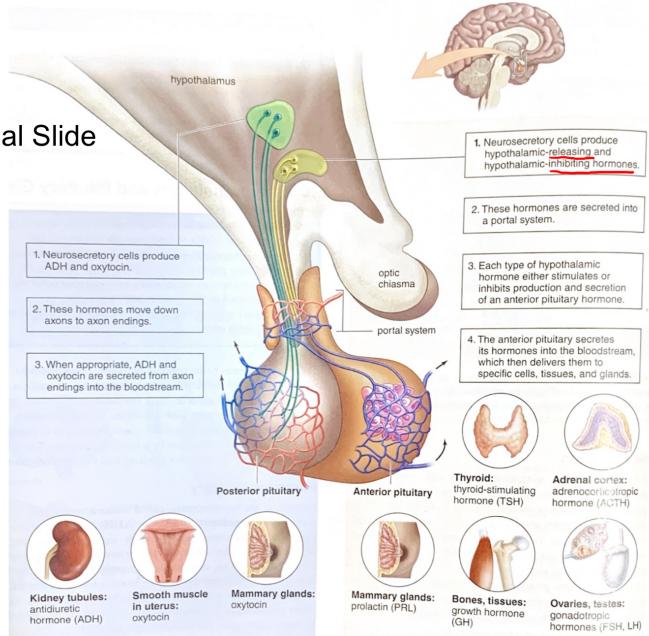


Additional Slide

The Hypothalamus and Pituitary Gland

- The pituitary gland consists of two parts:
 1. The posterior pituitary
 - is an extension of the hypothalamus,
 - stores hormones, and secretes hormones made in the hypothalamus, such as **antidiuretic hormone (ADH)** (抗利尿激素).
 2. The anterior pituitary
 - synthesizes its own hormones, such as **(Follicle stimulating hormone) FSH** and **(luteinizing hormone) LH**, and
 - secretes hormones directly into the blood.

Additional Slide

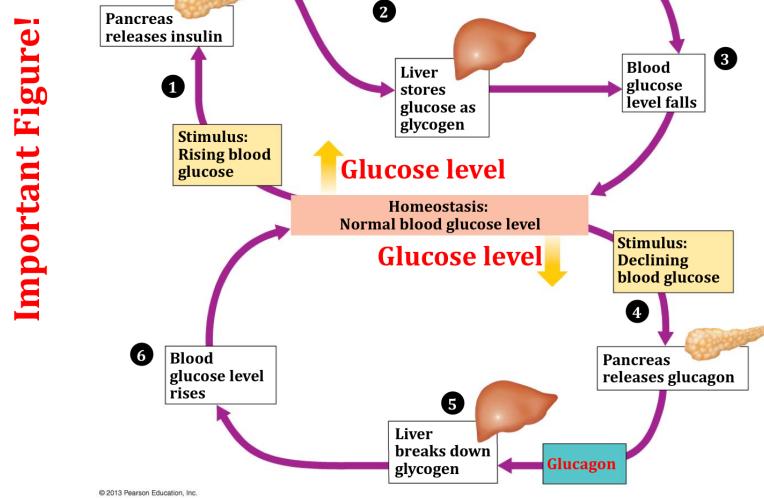


4. The pancreas (胰腺)

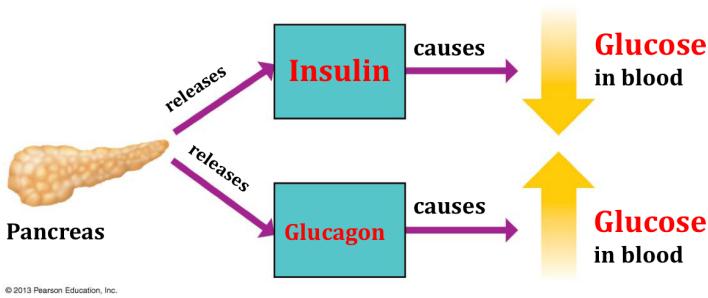
The pancreas produces two antagonistic (拮抗) hormones that help manage body's energy supplies:

1^o β cells \rightarrow insulin (胰島素) \rightarrow { liver \rightarrow store glucose } glycogen
 muscle \rightarrow store glucose
 adipose \rightarrow use glucose to form fat (脂肪细胞)

2^o α cells \rightarrow glucagon (胰高血糖素) \rightarrow { liver \rightarrow break down glycogen to glucose
 adipose tissue \rightarrow break down fat }



Important Figure!



3° Diabetes mellitus (糖尿病)

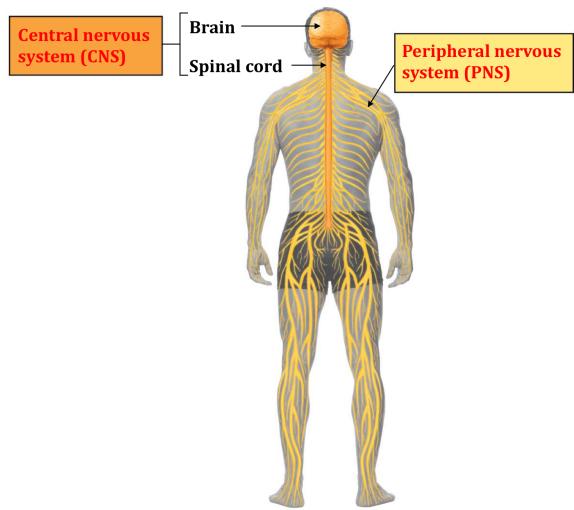
- Diabetes affects about 8% of all Americans.
- More than 90% of those affected have type 2 diabetes, which is associated with being
 - Overweight, and
 - underactive.
- People with diabetes use glucose meters to measure the amount of glucose in the blood.
- **Diabetes mellitus** (糖尿病) is a serious hormonal disease in which body cells are unable to absorb glucose from the blood because either
 - there is not enough insulin produced (type 1, or insulin-dependent diabetes) or
 - the target cells do not respond normally to insulin (type 2, or non-insulin-dependent diabetes).

§3 Nervous System

1. Two main divisions of animal nervous system

1° The central nervous system (CNS) (中枢神经系统)
is made up of the brain and spinal cord (脊髓) (in vertebrates)

2° The peripheral nervous system (PNS) (外周神经系统)
is made up of mostly nerves that carry signals into and out of the CNS



2. Organization of the nervous system

The three interconnected functions of the nervous system are carried out by three types of neurons.

1^o Sensory neurons (感觉神经元)

- ① function in *sensory input*
- ② send signals from sensory receptors to the CNS

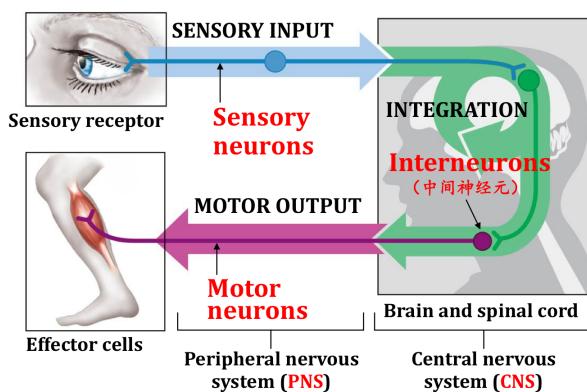
2^o Interneurons (中间神经元)

- ① integrate sensory signals
- ② formulate appropriate responses.

3^o Motor neurons (运动神经元)

- ① function in *motor output*
- ② send signals from integration centers to effector cells

An Important Figure!



§4 Neurons and Nerve Fibers

1. Neurons (神经元)

- 1° the **functional units** of the nervous system
- 2° vary widely in shape
- 3° carry **electrical signals** from one part of the body to another

2. Nerve

A **nerve** is a communication line made from bundles of **neuron fibers** tightly wrapped in connective tissue.

3. Structure of neurons

1° **Cell body**

houses the nucleus and other organelles.

2° **Dendrites (树突)**

receive incoming messages from other cells and convey the information towards the cell body.

3° **Axons (轴突)**

transmit signals towards another neuron or towards an effector cell.

An axon ends in a cluster of branches, each with a bulb-like **synaptic terminal (突触末梢)**

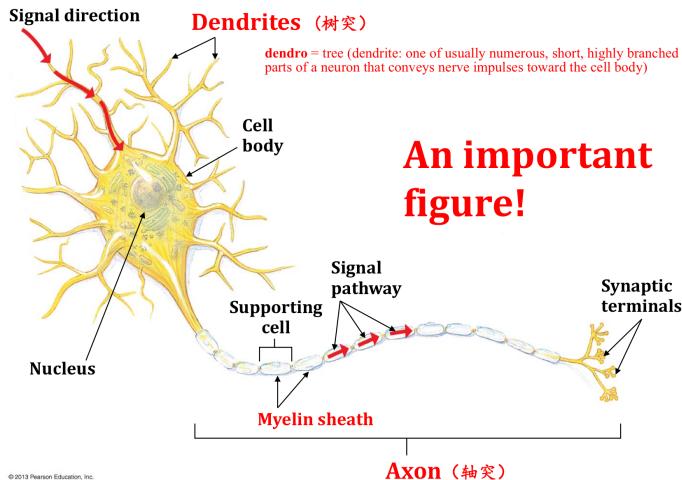
4° **Supporting cells**

outnumber neurons by as many as 50 to 1 and **protect**, **insulate** (绝缘), and **reinforce** (加强) the neurons.

5° The **myelin sheath (髓鞘)**

forms an insulating material around an Axon and help speed

electrical transmission along an Axon.

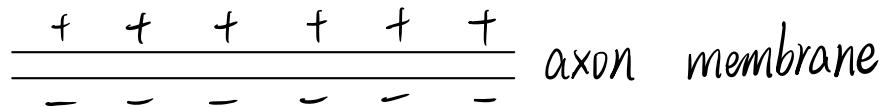


4. Sending a signal through a neuron

1^o Step 1

Resting potential: -70 mV (静息电位)

outside: $\text{Na}^+ \text{Na}^+ \text{Na}^+ \text{Na}^+ \text{K}^+ \text{K}^+$



inside: $\text{Na}^+ \text{Na}^+ \text{K}^+ \text{K}^+ \text{K}^+$

2^o Step 2

Stimulus opens Na^+ channels



Na^+ in



reach threshold (阈值) (-55 mV)

3^o Step 3

Open more Na^+ channels



more Na^+ in

trigger an **action potential** (动作电位) ($+40\text{mV}$)

4^o Step 4

open K^+ channels



K^+ out



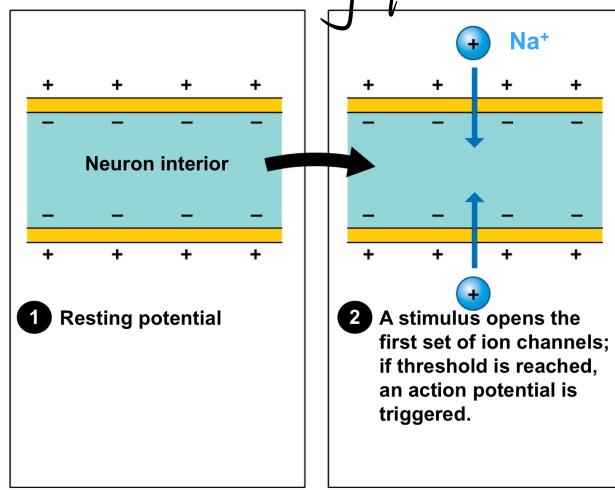
-74mV

5^o Step 5

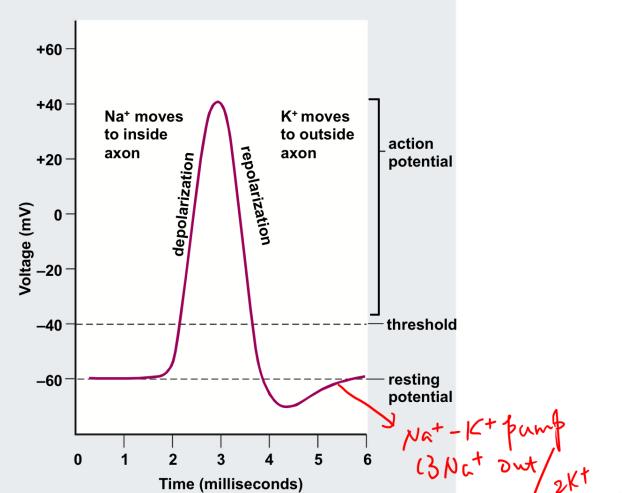
$\text{Na}^+ - \text{K}^+$ pump



restore resting potential

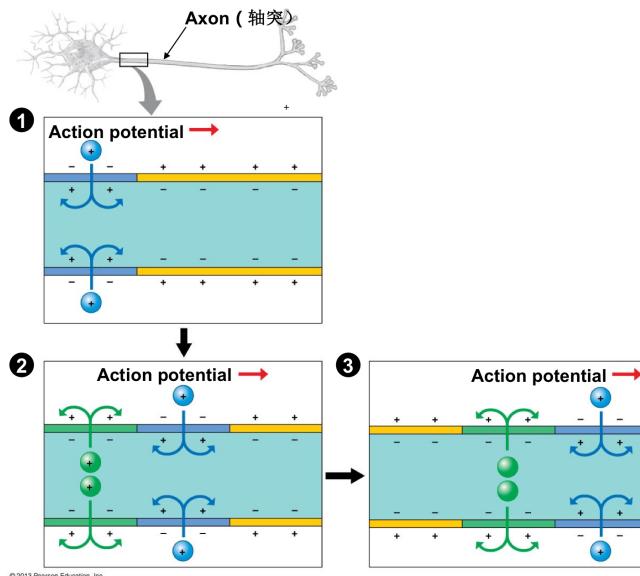


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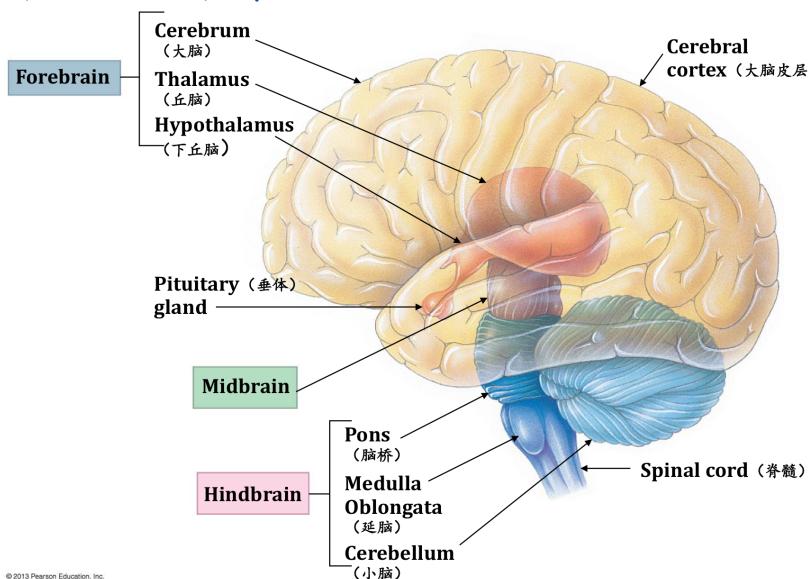


An action potential can be visualized if voltage changes are graphed over time.

- An action potential is a localized electrical event.
- To function as a long-distance signal, this local event must be passed along the neuron.
- Action potential propagation is like a “**domino effect**” along a neuron.
- Action potentials are “all-or-none” events and the same regardless of the strength of the stimulus that triggers them.



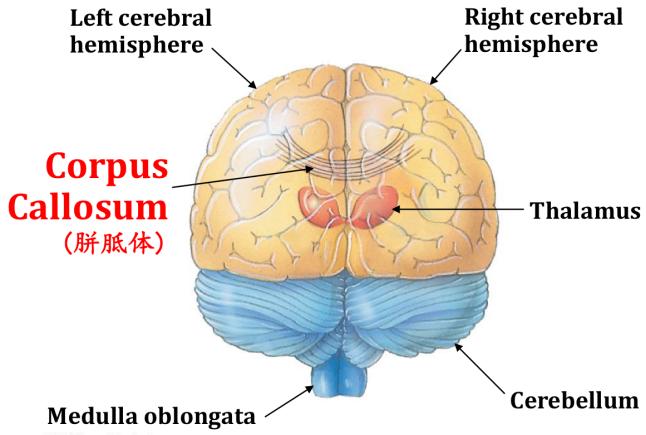
§5 The Human Brain



- The **brainstem** (脑干)
 - consists of the **hindbrain** (medulla oblongata and pons) and the **midbrain** and
 - serves as a sensory filter, selecting which information to pass on.
- The **cerebellum** (小脑), another part of the hindbrain, is a planning center for body movements.

- The forebrain contains the most sophisticated integrating centers in the brain.
 - The **thalamus** relays information to the cerebral cortex. (丘脑)
 - The **hypothalamus** has many regulatory functions. (下丘脑)
- The **cerebrum** (大脑)
 - is the largest and most complex part of the brain and
 - consists of the right and left cerebral hemispheres.

- (胼胝体)
- The **corpus callosum** connects the cerebral hemispheres, enabling them to process information together.



- The **cerebral cortex** (大脑皮层)
 - is a highly folded layer of tissue that forms the surface of the cerebrum,
 - accounts for over **80%** of the total brain mass,
 - contains about **10 billion neurons**, and
 - helps produce our most distinctive human traits.

