

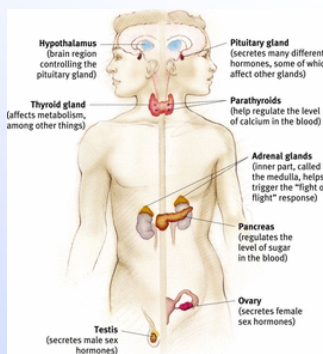
## Biological Basis of Behavior Lecture 10

## II. BIOLOGICAL BASIS OF BEHAVIOR A. Nervous & Endocrine Systems

- Over this week and next, we will discuss how behavior is related to the operation of the body
- There are a number of systems in the body, each of which may have impact on behavior
  - Digestive system
  - Reproductive system
  - Cardiovascular system
  - Skeletal system
  - Muscular system
- However, our attention will focus on two other systems: The nervous system and the endocrine system.

## I. BIOLOGICAL BASIS OF BEHAVIOR A. Nervous & Endocrine Systems

- The **endocrine system** is a group of glands that secrete hormones.
- Glands are widely dispersed over the body and have different functions by secreting different hormones.



## I. BIOLOGICAL BASIS OF BEHAVIOR A. Nervous & Endocrine Systems

- Hormones are released into the blood stream and travel around the body until finding specially sensitive cells in a target organ.
- For example, to **conserve the amount of water in the body**, the **pituitary gland** in the brain secretes a hormone that tells the kidneys to decrease the amount of water excreted in urine.
- In a moment of danger, for example, the autonomic nervous system orders the adrenal glands on top of the kidneys to release *adrenaline* and *noradrenaline*.

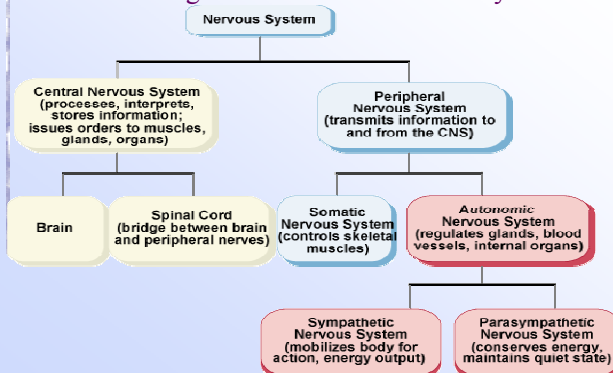
I. BIOLOGICAL BASIS OF BEHAVIOR  
A. Nervous & Endocrine Systems

Anterior Pituitary	Master gland which triggers hormone secretion in other endocrine glands. Also releases <b>Growth Hormone (GH)</b>
Posterior Pituitary	Releases <b>vasopressin</b> , which prevents water loss through kidney.
Pineal	<b>Melatonin</b> : Promotes sleeps and regulates biological clocks.
Thyroid	Thyroxine (T4) and Triiodothyronine (T3): Affects metabolic rate
Pancreas	<b>Insulin</b> and <b>Glucagon</b> : Affects utilization of glucose
Adrenal	<b>Cortisol</b> : Increases sugar output. <b>Adrenalin</b> : Arouses various internal organs (heart, lungs)
Ovaries (females)	<b>Estrogen</b> : Produces female sex characteristics. <b>Progesterone</b> : Prepares uterus for embryo implantation.
Testes (male)	<b>Testosterone</b> : Produces male sex characteristics relevant to sexual arousal and related to aggression.

I. BIOLOGICAL BASIS OF BEHAVIOR  
A. Nervous & Endocrine Systems

- **The nervous system** is a coordinating mechanism in all multi-cellular animals, except sponges, that regulates internal body functions and responses to external stimuli.
  - The coordinating activity is achieved by a group of specialized cells which are distributed throughout the body and communicate *chemically*
  - Both the nervous and endocrine systems each communicates chemically but the nervous system communicates **locally**, whereas the Endocrine System communicates **long-distance**.

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Categorization of the Nervous System



I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Categorization of the Nervous System

- The nervous system can be categorized separate divisions
  - **Central Nervous System:** The brain and spinal cord
  - **Peripheral Nervous System:** Conveys (a) sensory information (e.g., pain, pressure) to the Central Nervous System and (b) messages from the Central Nervous System to muscles and glands.

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Categorization of the Nervous System

- **Peripheral Nervous System:**
  - **The Somatic Nervous System:** Receives sensory information from the sensory organs and controls movements of the skeletal muscles for voluntary and involuntary behavior.
  - **The Autonomic Nervous System:** The regulation of the smooth muscles, cardiac muscle and glands. The function of the Autonomic Nervous System is the regulation of “vegetative processes” in the body. The ANS regulates life-supporting processes as digestion, heart rate, and respiration without requiring conscious control (which is a really, really good thing).

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Categorization of the Nervous System

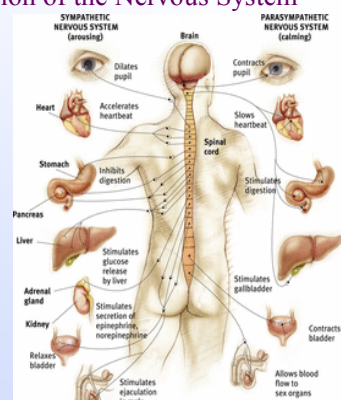
- **Peripheral Nervous System:**
  - **The Autonomic Nervous System**
    - **Sympathetic Division of ANS:** Involved in activity associated with the expenditure of energy from reserves stored in the body.
      - When the organism is excited or stressed, the Sympathetic Nervous System increases blood flow to skeletal muscles, increases heart rate, and causes piloerection (erection of fur in animals or goose bumps).
    - Think about telling a lie about which you are nervous.
      - Nervous liars increase in heart rate, respiration, pupil size.
    - Lie Detectors (Polygraphs) work on the same principle.
      - They actually measure GSR (galvanic skin response which assesses skin conductivity).

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Categorization of the Nervous System

- **Peripheral Nervous System:**
  - **The Autonomic Nervous System**
    - **Parasympathetic Division of ANS:** Involved in activity associated with increases in the body’s supply of stored energy.
      - These activities include salivation, gastric and intestinal motility, secretion of digestive juices, increased blood flow to the gastrointestinal system, and inhibits heart rate.
    - Think of what happens when you eat too much on Thanksgiving.
      - All you want to do is nothing while your body transforms the food to stored energy (fat).

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Categorization of the Nervous System

The autonomic nervous system is a dual system: The sympathetic nervous system expends energy while the parasympathetic nervous system conserves energy. In everyday situations, the two systems work together to keep us in a steady internal state.



I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Cells of the Nervous System

- The nervous system operates by the communication between trillions of cells and the integration of communicated information.
- There are two general classes of cells in the nervous system: Neurons (nerve cells) and glial (nerve glue) support cells.
  - Neurons and glial cells are like other cells in the body but have specialized functions
  - We will consider neurons first and then discuss glial cells.

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Cells of the Nervous System

- i. Regeneration and growth
  - Neurons are unique in that after a certain point in development, virtually all neurons do not reproduce (multiply) or regenerate (grow).
  - Unlike, skin cells, generally neurons do not grow back when lost.
    - In mammals, just after birth, much of the process of neuron cell reproduction just stops. The number of neurons at birth in some brain regions may be higher than later in life because some neurons die.
  - Thus, in contrast to other cells, at a point after birth, MOST neurons will never divide again and no new neurons are formed.

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Cells of the Nervous System

- We used to believe that absolutely no neurons regenerated or reproduced, but it turns out that there are some exceptions to this rule.
  - Precursor Cells (stem cells) can reproduce.
  - Neurons in the spinal cord may regenerate if treated chemically.
  - Neurons in particular parts of the brain (hippocampus) may reproduce.
- However, we know from stroke victims, most neurons will not reproduce or regenerate when damaged. **Why?**

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Cells of the Nervous System

- Neurons do not reproduce or regenerate because the connections between cells is the basis for learning.
  - When you learn about psychology, what you learn is encoded at the cellular level in the form new connections between neurons (not new neurons).
  - If new neurons spontaneously grew overnight, then the connections you made between neurons when learning psychology may be lost.
  - So to preserve the pattern of connections between neurons over time, neurons are specialized not to reproduce or regenerate.

I. BIOLOGICAL BASIS OF BEHAVIOR  
 B. Cells of the Nervous System

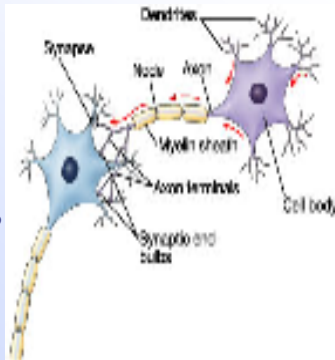
ii. Neuron structure

**Dendrite:** Branches that receive signals and transmit to cell body

**Cell Body:** Controls cell metabolism and determines firing.

**Axon:** Carries impulses away from cell body to the terminal endings.

**Myelin Sheath:** Fatty insulation surrounding the axon and creating nodes between them



I. BIOLOGICAL BASIS OF BEHAVIOR  
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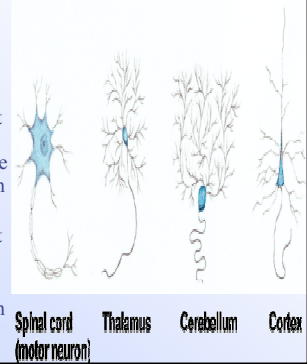
iii. Neuron types

Neurons vary in size and shape, depending on their location and function.

**Motor Neurons** -- Axons connect with muscles fibers or gland cells. They have an extensive dendrite tree, and a long axon

**Sensory Neurons** -- Convey signals from the environment to the nervous system.

**Inter-neurons** -- Communicate between neurons and come in a variety of shapes and sizes. Often short axons or axons.



I. BIOLOGICAL BASIS OF BEHAVIOR  
 B. Cells of the Nervous System

▪ Glial Cells

- There are  $10^{11}$  neurons (100,000,000,000) but the nervous system contains many more glial cells.
- Glial cells do not conduct or transmit information.
  - They provide structural support for neurons and have other functions as well.
    - They take up substances in the brain that are present in excess and are unneeded
    - Glial cells (unlike neurons) multiply to clean up and replace dead neurons
  - Two other functions: They establish the blood-brain barrier and the form myelin which coats axons.

I. BIOLOGICAL BASIS OF BEHAVIOR  
 B. Cells of the Nervous System

▪ i. Blood-Brain Barrier.

- Glial cells form a barrier between the blood stream and the brain, preventing the penetration into the brain of substances in the blood.
- The blood-brain barrier is porous, allowing some substances, like hormones, to penetrate

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Cells of the Nervous System

▪ **ii. Myelin**

- Myelin is a sheath of fatty material that wraps around (like layers of an onion) and insulates the axon.
- Myelin functions to speed of conduction of the electrical current necessary for neural communication.
- Speed matters in the effective processing of information
  - Anyone go from an old computer to a new one with a more powerful chip? What changes occurred?

I. BIOLOGICAL BASIS OF BEHAVIOR  
B. Cells of the Nervous System

- Babies born with unmyelinated axons which, in part, explains their slow and uncoordinated actions
  - Myelination may take place over years and continues from childhood into adulthood.
  - Connection between sites where myelination occurs and behavior during development.
    - Birth to 3.4 - 4.5 years: Myelination occurs in the brain region where speech is processed and understood: Associated with more language development
    - Later cycle occurs in the region of the brain where cognitive functioning is central: Associated with quicker more complex reasoning.