Animal Integrative Systems

A. Introduction to Organismal Integration

Nervous Systems – are the organ systems (with nervous tissues predominating) that integrate internal body functions.

Major organizational concepts are –

- sensory input, integration, motor output
- central nervous system (CNS) vs. peripheral nervous systems (PNS)
- neurons and their – axons, dendrites, synapses, support cells

Consider the diversity of nervous systems in animals – FIG. 48.13

B. Example of a simple integrative system – knee-jerk response.

Consider the components and functions of the knee-jerk -- FIG. 48.4

C. Nervous signaling — the nervous impulse

Nervous impulses are electrical signals that travel along neurons and pass from one neuron to another.

The fundamental basis is the change in membrane potential (charge) driven by differences in ions on either side of biological (cell) membranes.

Consider FIG. 48.5
All cells have membrane potentials (charge differences), what is critical is that some cells – neurons and muscle cells — can change this potential.

Major concepts in how the initial conditions and changes occur are ---

resting potential –

hyperpolarization event –

depolarization event –

threshold potential –

action potential –

refractory period --

Action potentials are local events, but propagate (i.e., travel) along the length of the neuron’s axon.

Consider FIG. 48.8 as an example

Communication between neurons happens at the synapse and is both electrical and chemical.

Consider pre-synaptic and post-synaptic cells (and their membranes) using FIG. 48.10

Electrical synapses – rather rare, but allows direct “flow” of ions.

Chemical synapses –

importance of the synaptic cleft

synaptic vesicles and their neurotransmitters

role of calcium in response to action potential

critical nature of post-synaptic receptors
D. Neurotransmitter effects

**Summation** of excitatory synapse events leads to generation of action potentials.

Major classes (and examples of neurotransmitters) are:

- **acetylcholine**  --  excites vertebrate skeletal muscle, exc/inhib others
- **biogenic amines**  --  excitatory or inhibitory – epinephrine, dopamine
- **amino acids**  --  excitatory or inhibitory – GABA, glutamate
- **neuropeptides**  --  either – endorphins and other small molecules

E. Organization of the Peripheral Nervous System

Review **vertebrate PNS systems** and their functions (FIG. 48.14-16).

F. Organization of the Vertebrate Brain

Review **organization** and **functions** of the **vertebrate brain** (FIG. 48.17).

Consider major integrative functions -- arousal and sleep, language and speech, emotions, memory and learning.
Animal Sensory Systems

A. Introduction to Sensory systems

**Sensory Systems** – are the structures and organs that detect (perceive) stimuli in the external and/or internal environments.

exteroreceptors vs. interoreceptors

Sensory Reception ⇒ Nervous system (CNS) – involves 4 steps

- sensory reception
- sensory transduction
- transmission (to CNS)
- integration

There are 5 major classes of receptors that are common in animals –

- mechanoreceptors
- pain receptors
- thermoreceptors
- chemoreceptors
- electromagnetic (photo) receptors
B. Photoreception — the eyes have it!

**Photoreception Systems** — are very common in animals, being found in most bilateral groups.

Review the form and function of a simple **eye cup** in Planaria.

*FIG. 49.4*

Review the form and function of **compound eyes** in insects.

*FIG. 49.5*

**Vertebrate eyes** are **single lens** eyes. Review their **basic structure** and the process of **focusing**.

*FIG. 49.6 to 49.7*

**Signal transduction** occurs via light-absorbing **pigment interactions** in rods and cones with retinal neurons

- rhodopsin
- rod and cone structure
- retinal and its effect
- integration and neural pathways

C. Mechanoreception (ears) and Chemoreception (nose)

**Read on your own** — but fundamentally, they each involve signal reception, transduction, transmission, and integration.
Animal Locomotor Systems

A. Introduction to Locomotor systems

Locomotor Systems – are the structures and organs that cause animals to move about. Skeletal muscles do this by acting upon skeletons.

Hydrostatic Skeletons – are fluid skeletal systems that muscles act upon in the absence of hard external or internal skeletons

FIG. 49.23

Consider exo and endoskeltons and antagonism – FIG. 49.25

B. Basis of skeletal muscle contraction – sliding filaments

Sliding-filament model – represents the cell and molecular foundation for muscle contraction.

Consider FIGs. 49.26 and 49.28