

Chapter 14: Integration of Nervous System Functions

I. Sensation

A. General Organization

1. General senses have receptors _____
 - a. The somatic senses provide information about _____ & _____
 1. Somatic senses include:
 - a. _____
 - b. _____
 - c. _____
 - d. _____
 - e. _____
 - b. The visceral senses provide information about _____
 1. Visceral senses consist primarily of _____ & _____
 2. Special senses are localized to _____
 - a. The special senses are:
 1. _____
 2. _____
 3. _____
 4. _____
 5. _____
 3. Describe the three steps necessary for a person to experience a sensation:
 - a. _____
 - b. _____
 - c. _____

B. Sensory Receptors

1. Types of Sensory Receptors
 - a. For each of the following receptors; specify what stimulates the receptor and what type of sensation they are responsible for:
 1. Mechanoreceptors _____

2. Chemoreceptors _____

3. Thermoreceptors _____

4. Photoreceptors _____

5. Nociceptors _____

b. Where would you find the following three types of sensory nerve endings?

1. Exteroreceptors _____

2. Visceroreceptors _____

3. Proprioceptors _____

c. What type of information does each type of sensory nerve ending provide?

1. Exteroreceptors _____

2. Visceroreceptors _____

3. Proprioceptors _____

d. Free Nerve Endings

1. Describe free nerve endings: _____

2. Free nerve endings are distributed _____

3. Most _____ are free nerve endings.

e. Merkel's Disks (Tactile Disks)

1. Describe the structure of a Merkel's disk: _____

2. Where are they distributed? _____

3. They are involved in what sensations? _____ & _____

f. Hair Follicle Receptors

1. What stimulates the hair follicle receptor? _____

2. If the nerve endings are so sensitive why is the sensation not very localized? _____

- g. Pacinian Corpuscles (Lamellated Corpuscles)
1. Pacinian corpuscles have layers that resemble _____
 2. Where are they located? _____
 3. They are responsible for sensations of _____ & _____
 4. Pacinian corpuscles in joints provide information about _____
- h. Meissner's Corpuscles (Tactile Corpuscles)
1. Where are they distributed? _____
 2. Meissner's corpuscles are involved in _____
 3. What is two-point discrimination? _____

- i. Ruffini's End Organs
1. Where are they located? _____
 2. They are important in responding to _____
- j. Muscle Spindles
1. Consist of _____
 2. They are located in _____
 3. They provide information about _____
 4. How do they play a role in muscle tone? _____

- k. Golgi Tendon Organs
1. Proprioceptive nerve endings associated with the _____
near the junction _____
 2. They are activated by _____
2. Responses of Sensory Receptors
- a. When a stimulus interacts with a sensory receptor it produces a local potential called _____
 - b. Primary receptors have _____ that conduct _____
 - c. Secondary receptors have no _____
 1. Secondary receptors respond to a stimulus by release of _____
that bind to receptors on a _____

d. Accommodation (adaptation) is _____

1. Describe what happens in accommodation: _____

e. Tonic receptors accommodate _____

1. This allows a person to determine _____

f. Phasic receptors accommodate _____

1. This allows a person to know _____

C. Sensory Nerve Tracts

1. Names usually indicate their _____ & _____

2. Spinothalamic System

a. Lateral Spinothalamic Tract

1. Carries information for _____ & _____

b. Anterior Spinothalamic Tract

1. Carries information for _____, _____
_____, & _____ sensations

c. The sensory tract consists of three neurons:

1. Primary Neuron

a. Cell bodies are located in _____

b. Relay sensory information from _____ to
_____ where they synapse with _____

2. Secondary Neuron

a. Axons _____ through the anterior portion of
_____ and enter _____
where they ascend to the _____

3. Tertiary Neuron

a. Project from the _____ to the _____

d. Which spinothalamic tract has numerous collateral branches? _____

1. What effect will this have if the spinal cord is damaged? _____

3. Dorsal-Column/Medial-Lemniscal System

- a. Carries sensations of _____, _____, _____, & _____
 - b. Primary Neuron
 1. Cell bodies are the _____ in the dorsal root ganglia.
 2. Axons enter the _____ & _____ the entire length of the spinal cord without _____
 3. They synapse with secondary neurons in the _____
 4. Axons originating below midthoracic level are in _____
 - a. Synapse with secondary neurons in the _____
 5. Axons originating above midthorax are in _____
 - a. Synapse with secondary neurons in the _____
 - c. Secondary Neuron
 1. Cross to the _____ of the medulla and ascend through the _____ to terminate in _____
 - d. Tertiary Neuron
 1. Project from _____ to _____
- ### 4. Trigeminothalamic Tract
- a. These are nerve fibers from which cranial nerve? _____
 - b. What kind of information is being carried? _____

 - c. Where is the information coming from? _____
- ### 5. Spinocerebellar System and Other Tracts
- a. What type of information do the spinocerebellar tracts carry? _____
 - b. Posterior Spinocerebellar Tract
 1. Originates in the _____ & _____
 2. Contains _____ fibers that enter the cerebellum through the _____
 - c. Anterior Spinocerebellar Tract
 1. Originates in the _____ & _____
 2. Contains _____ & _____ fibers that enter the cerebellum

- through the _____
- a. Crossed fibers cross again in the _____
 - d. As a result information in both tracts that originates on the right side of the body ends up in the _____ cerebellar hemisphere
 - e. Where does the cerebellum get proprioceptive information about the arms? _____
 - f. Information carried in the spinoolivary tracts contributes to _____

 - g. The spinotectal tracts terminate in the _____
 1. Involved in reflexes that _____
 - h. The spinoreticular tracts are involved in arousing _____ through _____ stimulation
6. Descending Pathways Modifying Sensations
- a. Send collateral branches to the _____
 - b. These axons release _____ which decrease the _____
 - c. This may reduce the _____ of sensations.
- D. Sensory Areas of the Cerebral Cortex
1. Where is the primary somatic sensory cortex? _____
 2. What type of information is received here? _____
 3. The right cerebral cortex receives information from _____
 4. Why is more of the sensory cortex associated with the face than the legs?

 5. Specify where each of the following primary sensory areas is located:
 - a. Taste area _____
 - b. Olfactory cortex _____
 - c. Primary auditory cortex _____
 - d. Visual cortex _____
 6. What is projection? _____
 7. What are association areas? _____
 8. Visual association areas are responsible for _____

II. Control of Skeletal Muscles

A. General

1. The motor system of the brain and spinal cord is responsible for:
 - a. Maintaining the _____ & _____
 - b. Moving the _____, _____, _____, & _____
 - c. Communicating through _____ & _____
2. What causes body movement without conscious thought? _____
3. Complex voluntary movements can occur _____ after learning
4. Describe upper motor neurons: _____
 - a. Their cell bodies are located in the _____
5. Describe lower motor neurons: _____
 - a. Their cell bodies are located in the _____
6. Describe the three mechanisms involved in voluntary movements:
 - a. _____

 - b. _____

 - c. _____

B. Motor Areas of the Cerebral Cortex

1. Where is the primary motor cortex located? _____
 - a. This area controls many _____
2. The leg is bigger than the hand, so why is more primary motor cortex associated with the hand? _____

3. Functionally the premotor area _____
4. Functionally the prefrontal area _____

C. Motor Nerve Tracts

1. Descending nerve tracts are named for _____ & _____
 - a. Direct Pathways
 1. Also called _____

2. Direct pathways are involved in:
 - a. Maintenance _____
 - b. Controlling _____
- b. Indirect Pathways
 1. Also called _____
 2. Indirect pathways are involved in less _____ of motor functions, especially those _____
2. Direct Pathways
 - a. Upper motor neurons synapse directly with _____
 - b. Why are they also called the "pyramidal system"? _____

 - c. Direct pathways include:
 1. Corticospinal tract involved in movements _____
 2. Corticobulbar tract involved in movements _____
 - d. Structurally the corticospinal tract:
 1. Upper motor neuron cell bodies are located in _____ & _____ of the frontal lobes & _____ of the parietal lobes
 2. Axons descend through _____ & _____ to _____ of the medulla oblongata
 3. At the inferior end of the medulla 75-85% of the fibers _____ to _____ through the _____
 - a. The crossed fibers descend in the _____
 - b. They innervate all _____ of the body
 4. The remaining _____ fibers descend in the _____ and decussate in the spinal cord
 - a. These fibers supply the _____
 5. These fibers synapse with interneurons in _____
 6. The interneurons synapse with the lower motor neuron of the _____ that innervate _____
 - e. Damage to the corticospinal tracts results in:
 1. Reduced _____

2. _____ &
 3. Weakness but not in _____
- f. The corticobulbar tracts innervate the _____
- g. Structurally the corticobulbar tract:
1. Axons descend to the level of the _____
 2. They terminate in the _____ near the _____ nuclei
 3. Interneurons from the _____ synapse with lower motor neurons in the _____
 4. Lower motor neurons originating here control:
 - a. _____ & _____ movements
 - b. _____
 - c. _____ &
 - d. _____, _____, & _____ movements
3. Indirect Pathways
- a. Structurally indirect pathways:
 1. Originate in upper motor neurons of the _____ & _____
 2. These neurons synapse in some _____
 3. The neurons from the nuclei then synapse with lower _____
 - b. Why are these pathways called "extrapyramidal"? _____
 - c. Rubrospinal Tract
 1. Upper motor neurons begin in the _____ decussate _____ and descend in _____
 2. Damage to the rubrospinal tract impairs _____ & _____ movements but doesn't greatly effect _____
 - d. Vestibulospinal Tract
 1. Originate in the _____
 2. Descend in the _____
 3. Synapse with lower motor neurons in the _____
 4. These fibers preferentially influence neurons innervating:
 - a. _____ in the trunk &

b. _____ limbs

5. Functionally these fibers are involved primarily in the

e. Reticulospinal Tract

1. Neuron cell bodies are in the _____

2. Axons descend in the _____

3. Synapse with lower motor neurons in the _____

4. Functionally the reticulospinal is involved in _____

D. Modifying and Refining Motor Activities

1. Basal Nuclei

a. Basal nuclei are important in _____, _____, &
_____ movements & _____

b. Basal nuclei are interconnected with _____, _____ &

c. Form several feedback loops:

1. Some are _____

2. Others are _____

d. Stimulatory circuits _____ especially _____

e. Inhibitory circuits facilitate _____ circuits by inhibiting

f. What do inhibitory circuits do when the body is at rest? _____

g. Disorders of the basal nuclei result in:

1. _____ &

2. _____

2. Cerebellum

a. Three functional parts to the cerebellum:

1. Vestibulocerebellum

a. Structurally this is the _____ lobe of cerebellum

b. It receives input from _____

c. It is connected to the _____ of the brainstem

d. Functionally the vestibulocerebellum:

1. Maintains _____ in _____
 2. Helps control _____ especially during _____
 3. Helps coordinate _____
2. Spinocerebellum
 - a. Structurally this is the _____ & medial portion of the _____
 - b. Functionally it helps accomplish _____ of _____ movements by means of its _____
 3. Cerebrocerebellum
 - a. Structurally is the _____ of the lateral hemispheres
 - b. It communicates with portions of the _____ cortex to help in _____ & _____ rapid, complex motor actions
 - c. Functionally allows a person to learn _____ & _____
 - d. Also involved in cognitive functions such as:
 1. _____
 2. _____ intervals
 3. Some _____ & _____
 4. Solving _____

III. Brainstem Functions

- A. What is the reticular activating system? _____
 1. Functionally it is involved in _____
- B. Brainstem Reflexes
 1. Gag Reflex
 - a. What cranial nerve is involved? _____
 - b. Reflex is initiated by mechanical stimulation of back _____, _____, and the _____
 2. Cough Reflex
 - a. What cranial nerve is involved? _____
 - b. Reflex is initiated by tactile stimulation of _____

3. List a few examples of the vital functions controlled by brainstem reflexes:

4. What roles does the brainstem play in vision? _____

5. What roles does the brainstem play in mastication? _____

IV. Other Brain Functions

A. Speech

1. For most people the speech area is in _____

2. Wernicke's Area

a. Where is it located? _____

b. Functionally Wernicke's area is necessary for _____

3. Broca's Area

a. Where is it located? _____

b. Functionally Broca's area initiates _____

B. Right and Left Cerebral Cortex

1. Which cerebral hemisphere controls muscular activity in and receives sensory information from the right half of the body? _____

2. What are commissures? _____

3. What is the largest cerebral commissure? _____

4. The left hemisphere is more involved in _____ & _____

5. The right hemisphere is more involved in activities like:

a. _____

b. _____

c. _____

C. Brain Waves and Sleep

1. An electroencephalogram (EEG) is _____
2. The electrodes are actually detecting _____
3. Why are EEG's irregular most of the time? _____
4. When would the following brain waves be observed on an EEG?
 - a. Alpha waves _____
 - b. Beta waves _____
 - c. Theta waves _____
 - d. Delta waves _____

D. Memory

1. Sensory Memory
 - a. How long does it last? _____
 - b. When does this type of memory occur? _____

2. Short-term Memory
 - a. Where does information in short-term memory come from? _____

 - b. How long does it last? _____
 - c. How much is normally stored in short-term memory? _____
 - d. Old short-term memory is eliminated when _____
3. Long-term Memory
 - a. Explicit (declarative) memory involves _____
 1. The actual memory is retrieved by the _____
 2. What structure is involved with associated emotions? _____
 - a. This brain structure is also involved in the development of _____
 3. Describe the organization of explicit memory storage: _____

 4. How much is lost through time? _____
 - b. Implicit (procedural) memory involves _____
 1. Where is it stored? _____
 2. How much is lost through time? _____

c. Long-term memory involves neuron changes called:

1. The amount of glutamate and glutamate receptors _____
2. Calmodulin is activated by _____
3. Calmodulin stimulates synthesis of _____
that are involved in _____ of the cell
4. Creation of a new cytoskeleton makes the memory _____

d. What is a memory engram? _____

E. Limbic System

1. The limbic system influences:

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

2. The system is associated with basic _____

3. One major source of sensory input is _____

4. What is a pheromone? _____

5. Where is the "satisfaction center"? _____

V. Effects of Aging on the Nervous System

A. Which nerve endings in the skin remain unchanged with age?

1. _____

2. _____

B. Which nerve endings in the skin decrease in number as we age?

1. _____

2. _____

3. The remaining nerve endings become less functional because _____

4. Therefore, elderly people are:

- a. Less conscious _____

- b. Decreased sense _____
- c. Difficult _____
- C. What accounts for reduced control and coordination of movement?

- D. Why does an elderly person lose muscle mass? _____

- E. Why do reflexes slow down with increased age? _____

- F. Brain Effects
 - 1. Size and weight of the brain _____
 - a. This is the result of _____
 - 2. Neuron changes include:
 - a. Plasma membranes _____
 - b. Endoplasmic reticulum _____
 - c. Neurofibrillar tangles _____
 - d. Amyloid plaques _____