

PROGRESSIONS:
PEER-LED TEAM LEARNING

Module 11: The Central Nervous System and Reflexes

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I. Introduction

Though we require the central nervous system in order to do nearly everything that we do, we usually take it for granted. Indeed, much of what we know today about the functions of the CNS comes from studies of injuries. Today's workshop will include some of these injuries as illustrations, and will also explore several physiologically important aspects of the CNS.

Prepare for your workshop by reading in your textbook (Chapter 13: 481-484, 503-508; Chapter 14: 515-516, 519-556) and completing the Pre-Workshop Activities below, *really!* Show your work in these pages.

II. Pre-Workshop Activities

Activity A. Define the following terms.

1. afferent
2. ascending
3. blood-brain barrier
4. brachial
5. cervical
6. descending
7. efferent
8. gray matter
9. lumbar
10. meninges
11. neuroglia
12. reflex
13. sacral
14. thoracic
15. white matter

III. Workshop Activities

Activity A. Reflexes.

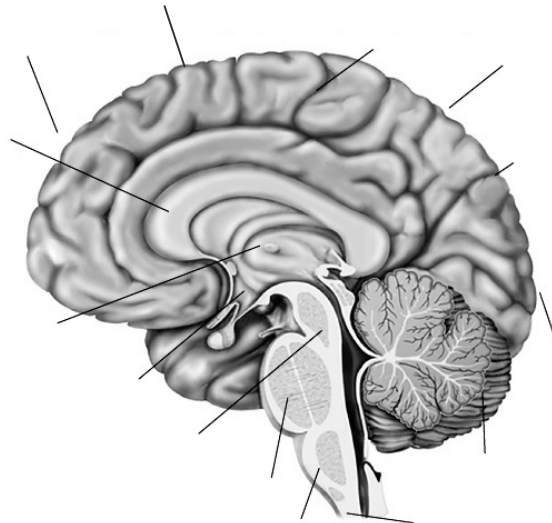
Reflexes are involuntary, stereotyped, quick, and occur in response to a stimulus. Often we think of the term “involuntary” as meaning that we are unconscious or unaware. However, in considering the withdrawal reflex in the figure to the right, I think that most of us would be aware that we had just stuck our finger into a candle flame. So “involuntary” doesn’t mean “unaware,” rather it means that it is not consciously *controlled*. You don’t have to think about pulling your finger out...you just do it. The reflex occurs independent of the brain, but the information about the reflex is sent to the brain as a “report.” Some reflexes do take place in the brain (visual and auditory), but—again—they are not consciously controlled.

With a partner, determine if the following are examples of reflexes or not. Explain your choice.

- A child quickly jerks her arm away from another child in response to “cooties” (imaginary germs).
- You are walking barefoot through the grass when you suddenly feel the sting of a bee on your right foot. You quickly shift your weight onto your left foot while lifting your right.
- You see your bus at the stop and you take off running.
- Your heartbeat increases rapidly when you open your grades that have just come in the mail.
- You are deep in meditation – your breathing has slowed down and so has your heart rate.
- A contestant on “Jeopardy” knows the answer and quickly hits the button to answer a question.
- Your friend puts a thumbtack on your chair as a joke. You sit on it and immediately leap up.
- You are walking through a busy parking lot and are looking straight ahead. Suddenly you jump as you catch movement out of the corner of your eye.
- You hold your breath to swim across a pool. When you reach the other side, you begin breathing again.
- You are absorbed in the book that you are reading when all of a sudden a loud noise makes you look up to see what happened.

Activity C. Label the diagram of the brain using the terms in the box below.

thalamus parietal lobe midbrain pons corpus callosum cerebellum medulla oblongata hypothalamus spinal cord frontal lobe occipital lobe parieto-occipital sulcus central sulcus gyrus



Activity C. Work in pairs. Use the outline of brain function below (and your book, and your notes) to try to figure out which part of the brain has been affected in the cases that follow.

A) The Hindbrain

1) *Medulla oblongata*

- respiration
- heart rate
- blood pressure
- vomiting

2) *Cerebellum*

- coordination of voluntary movement
- control of muscle tone
- balance and equilibrium
- language

3) *Pons*

- mostly a crossroads for lots of cranial nerves
- sleeping and waking

B) Diencephalon

1) *thalamus*

- distributes all sensory input to primary sensory areas of cortex

2) *hypothalamus and pituitary gland*

- endocrine activity
- metabolism
- temperature regulation
- sleep
- emotion

C) Forebrain (Telencephalon)

1) *Cerebrum*

a) Frontal lobe

- How we know what we are doing within our environment (consciousness)
- How we initiate activity in response to our environment

- Emotional response
- Expressive language
- Word associations, assigning meaning to words
- Memory for habits and motor activities
- Broca's area (speech)

b) Parietal lobe

- Visual attention (following a moving object)
- Touch perception
- Manipulation of objects
- Integration of different senses that allows for understanding a single concept
- Wernicke's area

c) Temporal lobe

- Memory acquisition
- Categorization of objects
- Olfactory area
- Hearing ability

d) Occipital lobe

- Vision primary visual area (contralateral)

2) *Limbic system:*

a) Hippocampus

- attention
- learning and memory

b) Amygdala

- motivation
- attaches emotion to experience, including memories

Case #1.

A 16-year old male presents (this is the term used to describe a patient when they are first seen) with inability to pay attention to an object for more than a couple of seconds (can't follow a moving finger) and shows a lack of awareness of the left side of his body and objects which are located to his left. He also has difficulties with eye-hand coordination

Case #2.

A 34-year old male is admitted after running at the swimming pool and falling on the concrete edge. He presents with tunnel vision, and an inability to identify colors.

Case #3.

A 45-year old male is brought to the emergency room after an opium overdose. He is immediately placed on life-support since he is no longer breathing on his own.

Case #4.

A 35-year old female is brought to the emergency room after being hit by a vehicle at a busy intersection. She presents with vertigo, significant tremors, slurred speech, difficulty walking and a loss of ability to coordinate fine movements (like signing her signature).

Case #5.

A 78-year old male diagnosed with Alzheimer's presents with inability to plan a sequence of complex movements needed to complete multi-stepped tasks, such as making coffee (errors of sequencing), loss of flexibility in thinking and ability to express language, and loss of ability to focus on a single task. He also shows extreme variations in mood (look for two areas here).

Activity D. The Cranial Nerves

There are twelve pairs of cranial nerves and 31 pairs of spinal nerves. Both the spinal and cranial nerves, however, perform the same function; they transmit sensory information into and motor information out of the central nervous system. Diagnose the following problems with the cranial nerves. Use the table below and your book and notes to figure out which cranial nerve has been affected in the cases that follow.

(I) Olfactory

Sensory. From receptors in the olfactory epithelium in the roof of the nasal cavity.

(II) Optic

Sensory. Carries signal from the cells of the retina.

(III) Oculomotor

Motor. Innervates sphincter of pupil and muscles of the eyeball that govern lateral eye movement and eyelid movement.

(IV) Trochlear

Motor. Innervates the superior oblique muscle of the eye (up and down eye movements).

(V) Trigeminal

Sensory and Motor. Serves muscles of mastication and sensory fibers from the face.

(VI) Abducens

Motor. Innervates lateral rectus muscle of the eye.

(VII) Facial

Sensory and Motor. Innervates facial muscles, including buccinator and taste buds on anterior two-thirds of tongue. Innervates skin of external ear.

(VIII) Auditory

Sensory. Innervates hair cells in the inner ear (cochlea and vestibular apparatus).

(IX) Glossopharyngeal

Sensory and Motor. Serves the mouth and tongue area.

(X) Vagus

Sensory and Motor. Innervates heart, lungs, and other internal organs.

(XI) Spinal Accessory

Motor. Innervates muscles of the neck.

(XII) Hypoglossal

Motor. Innervates muscles of the tongue.

Case #1

Two months after a car accident, a 17-year old male presents with weakness in the neck and an inability to shrug. You rule out whiplash because of the length of time that has elapsed.

Case #2

An organic chemistry professor presents with a reduced sense of taste when eating and anosmia (loss of sense of smell).

Case #3

A 67-year old female presents with facial numbness and difficulty chewing. She reports that she often feels pain at the mandibular joint.

Case #4

An anxious mother brings in her 3-year old child who presents with a wandering left eye (it always points to the outside). The mother is afraid that her child is blind, but after testing you confirm that vision is normal.

Case #5

A 43-year old female presents with racing heartbeat and severe constipation.

Case #6

A 32-year old male presents with partial facial paralysis and a loss of taste on the anterior part of his tongue.

Case #7

A man brings in his father, an 84-year old male, who presents with difficulty swallowing. The son reports that the father often chokes on his food because he forgets to swallow.

Case #8

A 54-year old female presents with complaints that she repeatedly bites her tongue during everyday activities. You ask her to stick her tongue out and notice that it points decidedly toward the left.

Case #9

A 16-year old female presents with tinnitus (ringing of the ears) and difficulty hearing. She also complains of losing her balance. She has a history of listening to extremely loud music at concerts and on headphones.

*Progressions: Peer-Led Team Learning
The Workshop Project Newsletter
Spring 2006, Volume 7, Issue 3*

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Progressions (ISSN 1539-1752—print; ISSN 1539-7483—online) is
published four times a year by the PLTL Workshop Project.

This newsletter is supported by a grant from the National Science
Foundation's Division of Undergraduate Education. The views expressed
herein do not necessarily represent those of the National Science
Foundation.