

The Nervous System

**This Page Last Updated On
Saturday, March 21, 2009**

Reading – Types of neurons

The neuron is the **functional unit** of the nervous system. It is the cell that **carries** information, in the form of an electrical **impulse** (action potential) from one place to another. Neurons can be subdivided either based on function or on structure. Functionally neurons are: (1) motor neurons, (2) sensory neurons or (3) association neurons.

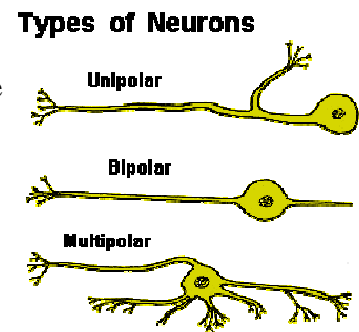
Motor neurons begin in the central nervous system (CNS) and **terminate** on structures outside the CNS, like skeletal muscles, cardiac muscle or glands. They carry information out to these structures and **initiate** a response such as contraction or **secretion**.

Sensory neurons begin outside the CNS associated with **receptors** like pain receptors, thermal receptors, or pressure receptors and terminate within the CNS. They carry information about the environment to the CNS.

Association neurons begin and end in the CNS. These neurons allow one part of the CNS to communicate with another part. These neurons **process** sensory information and produce a motor **response**. These are the neurons that make up most of the brain and within the brain they can be organized in highly specific pathways to **manage** brain activity.

The structural classification of neurons also produces 3 subdivisions: (1) multipolar, (2) bipolar or (3) unipolar. There is some **overlap** of the two classification systems.

Generally speaking, motor neurons are multipolar, sensory neurons are usually bipolar or unipolar. Association neurons are **usually** multipolar. The word polar refers to the number of **process** that **stem** from the cell body of the neuron. As you can see from the diagram, unipolar cells have a single process, bipolar cells have two processes and multipolar cells have multiple processes.



Check Point – Vocabulary

Instructions: Match the words in column A with their contextual definitions in column B.

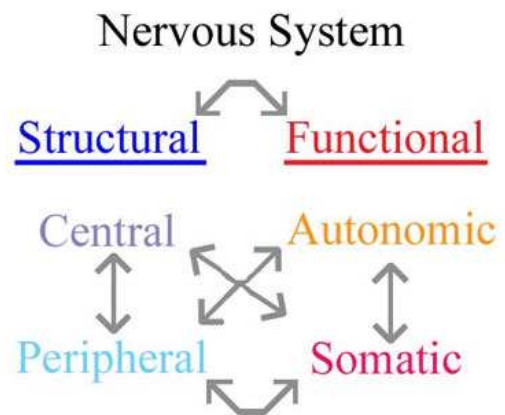
A	B
1. carries	A. the most basic part of something / fundamental
2. functional unit	B. to move something from one place to another / to transport
3. Generally speaking	C. a wave of excitation which travels along a nerve
4. impulse	D. end point / to come to a end destination
5. initiate	E. to start / to begin
6. manage	F. the process of releasing a substance from a cell
7. overlap	G. structures that pick up information about the environment
8. process (1)	H. to handle something in a systematic way
9. process (2)	I. a reaction to something
10. receptors	J. to control / to direct how something is done
11. response	K. the sharing of some common features between two things
12. secretion	L. something that is largely correct but can have exceptions
13. stem	M. is commonly true
14. terminate	N. to originate from
15. usually	O. a cell projection

Check Point – Comprehension

Instructions: Work with a partner – one person will describe the functional classification of neurons to the other. Then the other partner will describe the structural classification of neurons.

Reading – Organization of the nervous system

Like neurons, the nervous system can be described **based on** structure or function. It is important to remember that these are **artificial** subdivisions that we use to better understand and describe the nervous system. The structural system divides the nervous system into the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS **consists** of the brain and spinal cord while the PNS consists of the 12 **paired** cranial nerves and their branches and 31 paired spinal nerves and their branches. The functional system is based on how the nervous system controls the body. It divides the nervous system into the autonomic nervous system (ANS) which manages body functions which are normally considered to be **beyond** conscious control (involuntary control) such as blood pressure, heart rate and digestion. The ANS **regulates** smooth muscle, cardiac muscle and glands. Additionally the ANS is thought to be motor only – that is, there are no sensory neurons in the ANS, only motor neurons. The ANS is can be **further** subdivided into the sympathetic division (SNS) and the parasympathetic division (PNS) – remember the abbreviation PNS can be used to refer to two different parts of the nervous system. The somatic nervous system (SNS) manages all those activities that are **under conscious control** (voluntary control), and a few that aren't like reflexes. The SNS receives sensory input and control skeletal muscle. The arrows in the diagram show the **extensive** overlapping of the two descriptive systems.



Check Point – Vocabulary

Instructions: Match the words in column A with their contextual meaning in column B.

A	B
1. artificial	A. is the foundation for something / the reason for doing something
2. based on	B. not real / unreal / for intellectual use only
3. beyond conscious control	C. is made up of
4. consists	D. not part of something
5. extensive	E. to control / to influence
6. further	F. additionally
7. paired	G. having the ability to control something
8. regulates	H. to a great extent / a lot
9. under conscious control	I. having a left and a right part

Check Point – Comprehension

Instructions: Work with a partner – one person will describe the functional classification of the nervous system to the other. Then the other partner will describe the structural classification of the nervous system.

Focus On – The neurological examination

The complexity of the brain is truly beyond description. When there is a problem the ability to understand the problem depends on having some idea about where the problem originates. Visualization techniques like the MRI and CT can **detect** traumatic lesions, but often cannot visualize non-traumatic problems. Years of relentless research has provided a detailed understanding of what parts of the brain are involved with specific activities – this means that with a **thorough** neurological examination problems can often be **pinpointed** with amazing accuracy. And once the problem is understood and the diagnosis made, then an **appropriated** treatment plan can be **implemented**.



A typical neurologic exam has six major components. They are (1) mental status, (2) cranial nerve exam, (3) motor exam, (4) reflexes, (5) coordination and gait exam, and (6) sensory exam. Each component must consist of several elements that **range** from easy to difficult. Without **gradations** of difficulty it would be impossible to **differentiate** patient **responses**. Also, it is clear that not every component can be **assessed** on every patient. For example, an unconscious patient can be tested, but only for certain reflexes. Additionally the clinician will use their judgment to **determine** which tests to **emphasize** and which tests are less important. Keep in mind that the components of the neurologic exam contribute to an anatomical understanding of the location of the problem. Different elements of the exam target different regions of the brain.

Check Point – Vocabulary

Instructions: Match the word in column A with its contextual meaning in column B.

A	B
1. appropriated 2. assessed 3. detect 4. determine 5. differentiate 6. emphasize 7. gradations 8. implemented 9. pinpointed 10. range 11. responses 12. thorough	A. to find or discover B. very complete C. to know the precise location of something D. suitable E. to begin something or to start something F. to vary G. small steps or degrees H. to tell one thing from another I. answers J. to be evaluated or measured K. make a decision L. to make something more important

Instructions: Work with a partner and try to conduct some parts of a neurological exam. The short description of each test should allow you to carry out the exam. Take turns trying to conduct the different tests. Each student's exam should last about 20 minutes. Your partner in the exam should be passive and wait for and then follow your exact instructions regarding sitting, standing, lying down, eyes open, eyes closed, walking, standing etc. Giving instruction is the main objective of this activity. Consider carefully what you want the patient to do and then give clear instructions. Adjust your instructions if the patient doesn't do what you had intended.

1. Mental Status

- a) Level of alertness, attention and cooperation
 - i) Spell a short word forward and then backward (WORLD / DLROW)
 - ii) Repeat 6 numbers, then repeat them backward (384769 / 967483)
 - iii) Names the months forward, then name them backwards
- b) Orientation A&O x3
 - i) Ask for patient's name
 - ii) Ask the patient where they are
 - iii) Ask for the date, day, month and year
 - iv) ** note the detail of the patient's responses
- c) Memory
 - i) Present the patient with 3 things to remember (blue ball, red rose, lamp)
 - ii) Ask the patient some historical questions:
 - (1) Who is the president
 - (2) When did world war II start
 - (3) Who were the last four presidents
 - iii) Ask the patient to recall the 3 objects presented earlier.
- d) Language
 - i) Does the patient speak spontaneously or do they only answer questions.
 - ii) Make a logical statement and see if the patient can comprehend the logic.
 - iii) Naming objects – ask the patient to name some simple objects (pen, watch) and then name some more difficult objects (keyboard, mouse).
 - iv) Repetition – say a sentence to the patient, ask the patient to say it back to you. (The grey fox jumped over the broken fence.)
 - v) Reading – ask the patient to read increasingly difficult selections of text and then test comprehension of the text.
 - vi) Writing (agraphia) – ask the patient to write a short sentence describing something in the room.
- e) Calculations, right-left confusion and finger agnosia
 - i) Ask the patient to do some simple calculations ($3+4=7$, $3*2=6$)
 - ii) Ask the patient to point using either their left or right hand to left or right body parts. (Use your right finger and touch your left ear.)
 - iii) Finger agnosia – ask the patient to identify their thumb, index finger or ring finger.
- f) Apraxia
 - i) This is a conceptualization task. Ask the patient to pretend to do something. (Pretend you are playing the piano. Pretend you are tying your tie.)
- g) Neglect and constructions
 - i) Ask the patient to draw a clock face showing a certain time.
 - ii) Draw a line on a piece of paper and ask the patient to draw a bisecting line.
 - iii) Draw a complex object and then ask the patient to copy the object.
- h) Sequencing tasks and frontal release signs
 - i) Demonstrate 3 sequenced events
 - (1) Make a fist
 - (2) Spread fingers apart
 - (3) Make a fist with thumb up

- (4) Ask the patient to repeat the sequence as fast a possible.
 - ii) Draw a sequence
 - (1) Start drawing a simple pattern on a piece of paper – draw to or three repetitions
 - (2) Ask the patient to copy the pattern but to repeat it for a longer period (maybe 10 repetitions)
 - iii) Firmly stroke the palm of the patient’s hands – see if there is a grasp reflex.
 - i) Logic and abstraction
 - i) Ask the patient to complete the following A9, B8, C7, D?
 - ii) Ask the patient to find common features between objects.
 - (1) How are a boat and a plane alike?
 - iii) Ask the patient a logic question.
 - (1) If Bill is taller than John and Fred is taller than Bill – who is the tallest?
 - j) Delusion and hallucinations
 - i) Ask patients questions to assess:
 - (1) Is anyone following you?
 - (2) Is anyone trying to hurt you?
 - (3) Do you see things no one else can see?
 - (4) Do you have any special powers that most people do not?
 - k) Mood
 - i) Ask about
 - (1) Energy level
 - (2) Initiative
 - (3) Sad thoughts
 - (4) Crying spells
 - (5) Suicidal thoughts
2. Cranial Nerves
- a) CN I – olfaction
 - b) CN II
 - i) Ophthalmoscopic exam
 - ii) Vision
 - iii) Pupillary responses
 - c) CN III, IV, VI – Extraocular movements
 - d) CN V – Facial sensation, muscles of mastication
 - e) CN VII – Muscles of facial expression and taste
 - f) CN VIII – Hearing and vestibular sense
 - g) CN IX, X – Palate elevation, gag reflex
 - h) CN V, VII, IX, X, XII – Muscles of articulation
 - i) CN XI – Sternocleidomastoid and trapezius muscle strength
 - j) CN XII – Tongue muscles
3. Motor Exam
- a) Observation and inspection
 - i) Look for twitches or tremors in muscles
 - b) Palpation
 - i) Test muscle for tenderness
 - c) Muscle tone
 - i) Upper extremity
 - (1) Ask the patient to relax their arm muscles.
 - (2) Passively move the arms to verify that the muscles are relaxed.
 - ii) Lower extremity
 - (1) Patient needs to lie on the exam table. Ask them to relax their leg muscles.
 - (2) Passively move the legs to verify that the muscles are relaxed.
 - d) Functional testing
 - i) Drift
 - (1) Ask the patient to hold their arms straight out in front of them.

- (2) Have the patient close their eyes and look for arm drift.
- (3) Have the patient turn their head left and right. Look for drift.
- ii) Rapid hand movements
 - (1) Ask the patient to touch their thumb and forefinger together repeatedly as fast as possible.
 - (2) Ask the patient to pronate and supinate the hand as fast as possible.
 - (3) Ask the patient to flex and extend their wrist as fast as possible. This can be done to an object such as the patient's thigh.
 - (4) Repeat for other hand.
- iii) Rapid foot tapping
 - (1) With the patient seated, ask them to keep their heel on the floor and tap their tap their toes as fast as possible. (Flex and extend the ankle.)
 - (2) Repeat for other foot.
- e) Strength of specific muscle groups
 - i) Upper extremity
 - (1) Ask the patient to hold their arms straight out in front of them.
 - (2) Ask the patient to resist the pressure you apply.
 - (3) Apply pressure in various directions to assess strength.
 - ii) Hand tests
 - (1) Ask the patient to oppose a variety of movements for wrist, hand and fingers.
 - iii) Lower extremity
 - (1) Have the patient lie on the exam table.
 - (2) Ask the patient to resist various movements of their legs.
 - iv) Foot tests
 - (1) Ask the patient to oppose a variety of movements for the ankle and foot and toes.
- 4. Reflexes
 - a) Deep tendon reflexes (requires a reflex hammer). Each reflex should be done on the left and right before testing the next reflex. It is important to be able to compare the left and right response immediately.
 - i) Biceps
 - ii) Brachioradialis
 - iii) Triceps
 - iv) Patellar
 - v) Achilles (calcaneal) tendon
 - b) Plantar response
 - i) Have the patient lie on the exam table or sit in a chair. Use the opposite end of a reflex hammer and press the point into the foot near the heel and draw it along the sole of the foot in a slight medial arch.
 - ii) The great toes should flex, not extend.
 - c) Finger flexors
 - i) With patients hand held palm down, tap the palm from below with a reflex hammer and look for finger flexion.
- 5. Coordination and Gait
 - a) Appendicular coordination
 - i) Rapid alternating movements
 - (1) Ask the patient to repeat an alternating movement as quickly as possible.
 - ii) Precise movements
 - (1) Ask the patient to touch their index finger to some part of their thumb as precisely and quickly as possible.
 - iii) Finger – Nose – Finger
 - (1) Ask the patient to touch their index finger to their nose.
 - (2) Hold up your finger – ask the patient to now touch your finger tip.
 - (3) Ask the patient to repeat this motion quickly.
 - (4) Increase difficulty by moving your finger as the patients carries out the task.

- iv) Heel of foot – shin
 - (1) Have the patient lie down on the exam table.
 - (2) Ask them to use their right heel and move it along their left shin from knee to foot and back again several times.
 - (3) Repeat with other foot.
- v) Overshoot
 - (1) With patient standing with arms at their sides, ask them to bring both arms up as quickly as possible until they are parallel with the floor.
 - (2) With patient standing with arms raised about their head, ask them to bring both arms down as quickly as possible until they are parallel with the floor.
 - (3) Look for overshoot
- b) Romberg test
 - i) Ask the patient to stand with feet together.
 - ii) Ask the patient to close their eyes and keep them closed until you tell them to open them.
 - iii) Observe stability.
- c) Gait
 - i) Normal walk
 - (1) Ask the patient to walk toward you then turn and walk away from you. Repeat several times.
 - (2) Observe stability, direction
 - ii) Heel-to-toe walk
 - (1) Ask the patient to walk towards you placing the heel of one foot at the toe of the other and repeating for several steps.
 - (2) Ask the patient to do the same thing walking backwards.
 - (3) Observe
 - iii) Forced gait
 - (1) Walk on outsides of feet
 - (a) Ask the patient to walk on the outsides of their feet.
 - (b) Observe
 - (2) Walk on toes
 - (a) Ask the patient to walk on their toes.
 - (b) Observe
 - (3) Walk on heels
 - (a) Ask the patient to walk on the heels of their feet.
 - (b) Observe
 - (4) Hop on right foot
 - (a) Ask the patient to hop on their right foot.
 - (b) Observe
 - (5) Hop on left foot
 - (a) Ask the patient to hop on their left foot.
 - (b) Observe
- 6. Sensory Exam
 - a) Primary sensation, asymmetry, sensory level
 - i) Pin prick
 - (1) Use a pin
 - (2) Gently touch the pin to similar locations on the left and right hands and ask the patient if the sensation feels the same.
 - (3) Repeat for several different locations on the hands.
 - (4) Ask the patient to close their eyes and tell you if they feel a sharp sensation for a dull sensation.
 - (5) Test several areas using the sharp side of the pin and the dull side and see if the patient can correctly differentiate.
 - ii) Temperature
 - (1) Use two metal probes – one has been cooled in ice the other is at room temperature.

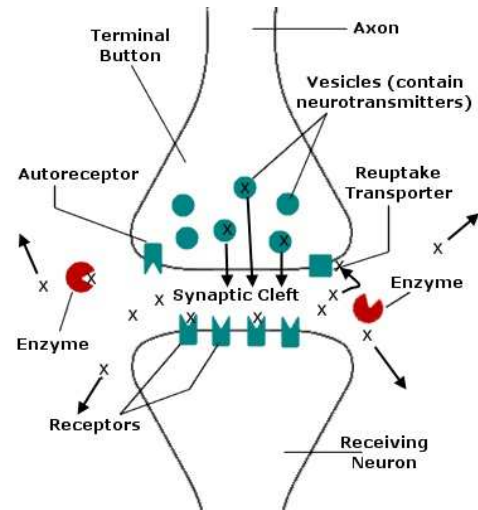
- (2) Touch the patient's hands with the probes and test for symmetry.
- (3) Ask the patient to close their eyes and differentiate between the cool probe and the warm one.
Test several locations on both sides of the body.
- iii) Vibration
 - (1) Use a tuning fork to complete the test.
 - (2) Test the fleshy parts of fingers and toes – not bones.
 - (3) Test to see if the patient can detect the vibrating stem of the tuning fork when it is placed against the toes or fingers.
 - (4) Test when tuning fork is vibrating and when it is not. Check that the patient can distinguish between the two sensations.
- iv) Joint position test
 - (1) Take the patient's hand and ask the patient to close their eyes.
 - (2) Gently grasp a finger on the medial and lateral sides and gently move it up or down.
 - (3) Ask the patient to confirm the direction of movement.
- v) Two-Point discrimination test
 - (1) Use a paper clip that has been bent so the two ends are near each other (U shaped).
 - (2) Ask the patient to close their eyes.
 - (3) Gently press either one point or two points onto the patient's fingers and palm.
 - (4) Check to see if the patient's can distinguish between one point and two points.
 - (5) Move the points closer together until the patient cannot distinguish between one and two points. Measure this distance. It will vary in different parts of the body.
- b) Cortical sensation, extinction
 - i) Graphesthesia
 - (1) Have the patient present their hand palm side up.
 - (2) Ask the patient to close their eyes.
 - (3) Use a blunt object to trace different numbers on the palm of their hand.
 - (4) Ask the patient to identify the numbers.
 - (5) Repeat with finger tips.
 - ii) Sterognosis
 - (1) Have the patient present their hand palm side up.
 - (2) Ask the patient to close their eyes.
 - (3) Place different, but common, objects in the patient's hand (one at a time) and ask the patient to identify each object.
 - iii) Tactile extinction
 - (1) Have the patient sit on the exam table or in a chair.
 - (2) Ask the patient to close their eyes.
 - (3) Using your fingers, touch different part of the patient and ask them to identify the area touched.
 - (4) Use single touches (left hand or right hand / left shoulder right shoulder).
 - (5) Use symmetrical touches (left hand and right hand / left cheek and right cheek).
 - (6) Use asymmetrical touches (left hand and right cheek / right hand and left shoulder / right cheek and right hand).

Focus On – The Synapse and Controlling Neurotransmitters

The brain uses a variety of neurotransmitters (NT) to communicate information between neurons. Many diseases have been linked to, mainly, **deficiencies** in the release of neurotransmitter substances. For example, depression is thought to be associated with too little serotonin and Parkinson's disease is thought to be linked with too little dopamine.

You may recall the brief discussion of the neuromuscular synapse from the unit on the muscular system. Neural synapses have many similarities. The neuron which brings the impulse to the synapse is called the presynaptic neuron, while the neuron that carries the impulse away from the synapse is called the postsynaptic neuron. At the end of the axon of the presynaptic neuron there are enlargements called terminal buttons or synaptic end bulbs. These structures contain vesicles filled with neurotransmitter substance. When an impulse arrives on the presynaptic neuron, the vesicles release NT (shown as an (x)) into the synaptic cleft (the space between neurons). Once in the cleft, the NT diffuses across and binds to receptors on the postsynaptic neuron membrane. This binding can be excitatory (leading to an impulse on the postsynaptic neuron or inhibitory (reducing the probability of an impulse on the postsynaptic neuron). Regardless of whether the NT is excitatory or inhibitory it must be removed from the synapse so that the action is **discrete**. The synapse can be "cleaned" by (1) the reuptake of NTs by reuptake transporters, (2) degradation of NTs by enzymes, or (3) diffusion of the NT away from the synaptic cleft. Failure to remove NTs from the synapse would be **disruptive** to normal neuronal function. Different NTs are removed in different ways. Serotonin for example is largely removed from the synapse by reuptake transporters that transport the serotonin back into vesicles of the presynaptic neuron.

Drugs that act on the brain generally act by altering synaptic transmission. Drugs can do this in a number of ways. They can **target** the release of NT from the presynaptic neuron (either increasing or decreasing it), they can target the reuptake transporters (generally inhibiting them and allowing the NT to accumulate in the synaptic cleft), they can bind to receptors and mimic the NT, they can bind to the receptor and block the binding of the NT (while having no direct effect themselves) and can inhibit the enzymes that destroy NTs in the synapse and lastly they can affect synthesis, storage and release of the NT from the terminal buttons.

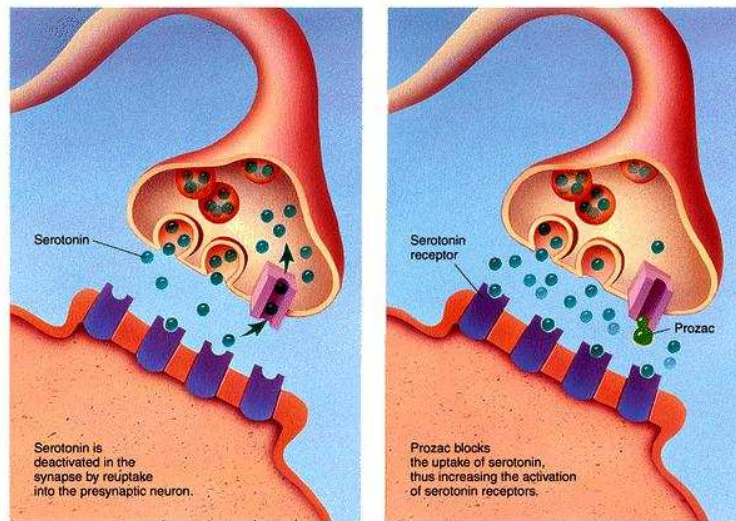


SSRI -- Selective serotonin reuptake inhibitors

Selective serotonin reuptake inhibitors or SSRIs are good examples to **illustrate** the how neuropharmacology can assist patients. The idea that depression is a chemical imbalance in the brain goes back to the 1950s. And since that time, there has been a series of drugs, each more effective than its predecessor, have been developed to treat the problem. The diagnosis is usually "major depressive disorder MDD" or "depressive episode" depending on the standard used in a particular country. In either case, a severely depressed mood that **persists** for two or more weeks is the **hallmark**. Studies have shown that patients with MDD often have low serotonin levels and over the years drugs that increase serotonin levels have proven effective in treating the condition.

SSRIs are the latest drugs to address this problem. Earlier drugs such as the tricyclic antidepressants **inhibited** the reuptake of both serotonin and norepinephrine. The newer SSRIs influence the reuptake of only serotonin. But in the case of people with MDD the serotonin synapses don't release enough serotonin. The result is that the cells that are meant to respond to serotonin don't respond strongly enough – and depression is the result. So drugs like Prozac slightly inhibit the reuptake of serotonin in the synapse. As a result, serotonin **lingers** in the synapse a bit longer and activates the postsynaptic neurons a little more strongly. The additional activation **relieves** many of the symptoms of depression.

► Blockade of Serotonin Reuptake by Fluoxetine



The advantage of the drug is that it targets serotonin synapses only. Therefore it has almost no effect on synapses that use other NTs like dopamine, norepinephrine, or GABA. The disadvantage is that there are synapses in the brain that use serotonin, but which have nothing to do with controlling **mood**. The affect of SSRIs at these locations are called side-effects. As drugs improve, the side-effects are continually reduced.

Check Point – Vocabulary

Instructions: Use the words in the box to complete the sentences.

discrete / deficiencies / disruptive / hallmark / illustrates / inhibits / linger / mood / persist / relieve / targeted

1. Information can be sent as a stream or bundled in _____ packages.
2. Some things _____ in the memory long after the object is gone. People can remember faces after only a brief presentation.
3. Proper medication can _____ most of the early symptoms of Parkinson's disease. However, it is a progressive disease and eventually symptoms will appear that can't be managed with drugs.
4. Without medication Parkinson's disease is extremely _____ to a person's daily activity.
5. Synthetic dopamine _____ the head and hand tremors that are the _____ of Parkinson's disease.
6. His condition produced terrible _____ swings. He was happy one moment and sad the next.
7. _____ in folic acid during the first trimester of pregnancy can lead to neural tube disorders in the fetus and increases the risk of spina bifida in the new born.
8. The fact the people with serious mental disorders can live functional lives in society _____ how far pharmacology has come in helping people with mental problems.
9. Some problems _____ even after pharmacological interventions. In some cases their problems can be _____ with psychiatric treatment and the combination can prove effective.

Vocabulary for Depression

Instructions: Review the words in the box. Discuss their meaning with a partner or in class. Then try to complete the sentences using the words. Finding the best word requires careful interpretation of the sentences. Many words may seem to fit, but they don't fit with the overall context of the sentence.

Also note the use of the word “**seem**.” Seem is use when you want to say something is “true” or is the “situation” without being overly assertive. It can also be used to indicate that the person isn't sure of the “truth” of the situation or information themselves and they are reporting the information as an observation or opinion rather than as a fact.

**Tense / Tired / Feel sad / Can't sleep / Anxious / Compulsive eating / Withdrawn / No appetite
Cry easily / Empty / Miserable / Apathetic / Worthless / Alone / Hopeless / Angry / A failure
Hope I die / Unbearable / Hate my life / Dead inside**

1. Even though there are people around me all the time I always **seem** to feel completely _____.
2. Everything **seems** to go wrong, I have no friends, and I'm getting fatter by the day, I'm really starting to _____.
3. It **seems** like I get _____ at the drop of a hat.
4. I can't get to sleep at night, it **seems** like I just lie there feeling _____.
5. My neck muscles are tight and _____ all the time, I can barely turn my head.
6. My family is very loving, but I can't return the affection, I feel _____.
7. I've become very _____. I never want to go out with my friends any more.
8. I go through phase of either _____ or having _____. My weight fluctuates week to week.
9. Everyone around me is happy, but I always **seem** to _____.
10. Nothing **seems** to interest me; I feel _____ about almost everything.
11. I can't say there is anything that I'm unhappy about, but I **seem** to _____ over the most trivial little things.
12. I just _____, I lie awake all night sometimes.
13. The future look terrible, I don't see any light at the end of the tunnel, life **seems** _____ to me.
14. Anything I touch turns into a disaster; I'm a complete _____ at everything.
15. Sometimes life **seems** _____ and I find myself _____.
16. My soul is _____, I never thought I could feel so _____.
17. I sleep terrible; as a result I feel _____ all the time.
18. All my friends have good jobs, and **seem** so happy, it all just makes me feel more _____ than I already do.

Check Point – Asking Questions

Instructions: Work with a partner. Interview your partner and ask questions in which your partner can respond with either one of the words in the box or a variation of the words in the box. *Try not to use the words in the boxes in your actual questions.* Sometimes you may want to ask several questions to communicate the idea. The switch roles and use the words for Interview B. ****Remember to keep your questions open – try not to suggest an answer as part of the question.**

Example: Tense

Q1: (Closed Question: this type of question can influence the patient's response. Note underlined words.)
Do your muscles feel tight? Do you have a hard time getting your shoulders to relax? Are your shoulder muscles tense?

Q2: (Open question: it lets the patient pick their own words in the response.) How do your muscles feel?
For instance, your neck and shoulder muscles, how do they feel?

P: Extremely **tense** – they're always tight, I feel like I can never get them to completely relax.

Words for Interview A

Tense **Feel tired all the time** **Feel sad** **Can't sleep** **Feel anxious** **Compulsive eating**
Feel withdrawn **No appetite** **Cry easily** **Feel empty inside** **Feel miserable**

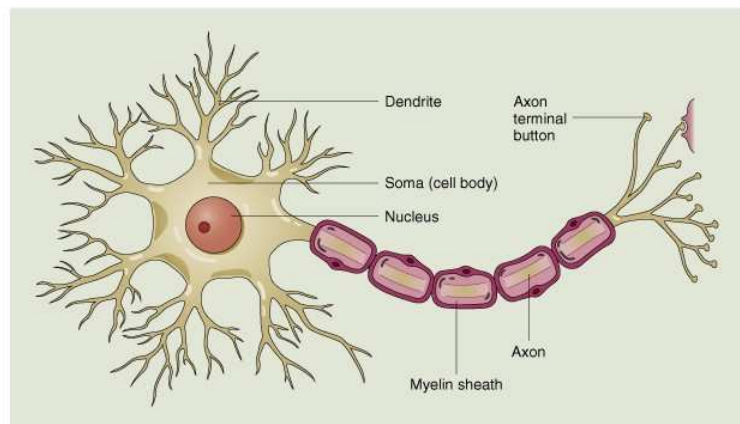
Words for Interview B

Feel apathetic **Feel worthless** **Feel alone** **Feel hopeless about things** **Get angry easily**
Feel like a failure **Hope I die** **Feel like life is unbearable** **Hate my life** **Feel dead inside**

Check Point – Prepositions

The Neuron – Fill in each blank with “in” / “on” / “of” / “to” / “from”

Recall that nerve tissue is one ___ the four primary tissue types ___ the body. As described earlier, neurons can be categorized ___ one of three ways based ___ the arrangement ___ their processes. In this figure, a typical multipolar neuron is shown. The basic function ___ all neurons is ___ transmit electrical impulse ___ one location to another. Their long slender cells processes facilitate this transmission. The three categories ___ neurons share some fundamental elements. The axon is a slender cell projection that carries impulse toward the synapse (shown ___ the upper right of figure) and away ___ the cell body. ___ this figure, the axon is wrapped by cells that form a myelin sheath. The axon ___ this cell has been wrapped ___ five locations. The myelin increases the velocity of impulse transmission. Axons end ___ structures called axon terminals or terminal buttons. These buttons store and release the NT that crosses the synapse and initiates an impulse ___ the next neuron. Dendrites are slender cell projections (in this case there are many dendrites) ___ carry impulses away ___ the synapse and toward the cell body. While not shown ___ this figure, dendrites can also have a myelin sheath (unipolar neurons).



___ the upper right of figure) and away ___ the cell body. ___ this figure, the axon is wrapped by cells that form a myelin sheath. The axon ___ this cell has been wrapped ___ five locations. The myelin increases the velocity of impulse transmission. Axons end ___ structures called axon terminals or terminal buttons. These buttons store and release the NT that crosses the synapse and initiates an impulse ___ the next neuron. Dendrites are slender cell projections (in this case there are many dendrites) ___ carry impulses away ___ the synapse and toward the cell body. While not shown ___ this figure, dendrites can also have a myelin sheath (unipolar neurons).

Talking with the Patient

Instructions: work with a partner. One person can read the part of the doctor and the other person can read the part of the patient.

1. D: Good morning Mr. Smith.
2. P: Good morning Dr. Peters.
3. D: How have you been feeling?
4. P: I think I'm doing better – I feel a little better.
5. D: Great, I'm glad to hear that.
6. D: Please have a seat so we can talk more.
7. P: Okay.
8. D: You've been on Prozac for 8 weeks now – is that right?
9. P: Yes.
- 10.D: Have you been taking it every day?
- 11.P: Yes.
- 12.D: Have you missed any doses?
- 13.P: No, I've been very careful to take it everyday.
- 14.D: Good.
- 15.D: As I told you last time, it takes about 8 weeks for these types of drugs to start to have an effect on your mood. That's why I told you not to expect overnight improvement.
- 16.P: I remember.
- 17.D: Since I saw you last how many days have you felt down or sad.
- 18.P: I have felt that way at least part of everyday.
- 19.D: Even on weekends?
- 20.P: Especially on weekends?
- 21.D: Do you think there has been any improvement from before you started the medication?
- 22.P: Yes – I don't think I feel as down or as sad as before.
- 23.D: How is your energy level – how often do you feel tired?
- 24.P: I still feel tired everyday.
- 25.D: Have you missed any work because you couldn't get out of bed in the morning?
- 26.P: Yes, in the past 2 months it has happened 3 times.
- 27.D: What did you do on those days?
- 28.P: I stayed in bed most of the day.
- 29.D: How is your concentration level – is it easy for you to concentrate at work?
- 30.P: Sometimes it is easy – most of the time it is difficult.
- 31.D: Are you having any problems falling asleep at night?
- 32.P: Most nights – yes.
- 33.D: How many hours of sleep do you think you get each night?
- 34.P: I guess about 6.
- 35.D: Do you nap when you get home from work.
- 36.P: Well I often go to bed, but I'm not sure I sleep – maybe an hour.
- 37.D: A one hour nap can really mess up your sleep patterns – I really think you need to avoid that in the future.
- 38.P: Okay.
- 39.D: What do you normally do in the evenings?
- 40.P: Watch TV.
- 41.D: How about your appetite?
- 42.P: It's fine – overly fine. I find eating to be very comforting. I think I have put on 10 pounds since I saw you last.
- 43.D: I see.
- 44.D: Do you cook meals?
- 45.P: No – mainly snack foods and sandwiches.
- 46.D: That's not particularly good – maybe you can work on that a bit. Some kind of easy cooking in the evening might be a good way for you to occupy your time after you get home.
- 47.D: Do you go out with friends – you know, for dinner or to a movie.
- 48.P: No, not really. Seems like I don't have much to say, so I avoid my friends most of the time.
- 49.D: You told me that you used to enjoy tuning your computer, always trying to get a little more performance out of it. Do you still enjoy doing that?
- 50.P: No – I barely touch it, except to check email.
- 51.D: How are things going at work?
- 52.P: It's awful – I hate going to work, if I didn't need the money I would quit today.
- 53.D: What seems to be the problem?
- 54.P: I don't know – seems like whatever I do somehow gets screwed up.
- 55.D: Well it sounds like you're still having a hard time even with the medicine.
- 56.P: I guess it does, doesn't it?

- 57.D: I started you on the smallest dose, and it isn't unusual to need to increase the dose. And that's what I'm going to do.
- 58.P: Okay.
- 59.D: Right now you're taking 20 mg each morning. I want you to start taking 20 mg twice a day; one tablet in the morning and one in the evening.
- 60.P: Okay.
- 61.D: As before, the effect will not be immediate. Since you have been on Prozac for 8 weeks already, I think we should know in about 4 weeks how the increased dose is working.
- 62.P: What if it doesn't help?
- 63.D: Should that be the case, we can increase to 3 times a day or even four times a day. In some cases, when one drug doesn't work, a different one works great. We are a long way from exhausting our treatment options.
- 64.P: Good.
- 65.D: I also want you to start keeping a diary.
- 66.P: A diary?
- 67.D: At the end of each day I want you to write a few words describing your mood that day. I also want you to make note of anything that you found particularly troubling – these can be encounters at work or just feelings that you're having. Also include how you're sleeping.
- 68.P: Everyday?
- 69.D: Yes – I don't want you to write a novel, just a few sentences – it shouldn't take you more than 4 or 5 minutes.
- 70.P: Okay – I guess I can handle that.
- 71.D: I also want you to try to get some exercise – there are some excellent studies that suggest that increasing physical activity can improve mood. Even if it's just a 20 minute walk each day – I think it might be useful to try.
- 72.P: 20 minutes? Right now it sounds like a lot, but I suppose I have the time.
- 73.D: I really think it could be helpful.
- 74.P: Okay.
- 75.D: Not to change the subject, but what about your alcohol consumption? How much are you drinking these days?
- 76.P: Maybe a bottle of wine a day.
- 77.D: When do you have your first drink of the day?
- 78.P: I usually take a swig from a bottle of whiskey before I head out the door for work. But I don't usually have anything else to drink before I get home in the evening.
- 79.D: So you're drinking a bottle of wine between when you get home and when you go to bed?
- 80.P: Yes.
- 81.D: You know what I'm going to say next – don't you?
- 82.P: I have to stop?
- 83.D: Yes! I think you are drinking to manage the depression, but at that rate you could become physically addicted to alcohol. Also, the alcohol is probably disrupting your sleep. That may be part of why you feel so tired in the morning.
- 84.P: Okay.
- 85.D: Well we've put a lot on you this visit. I don't think I want to wait a full 4 weeks before seeing you again. I think we should schedule another appointment in about 10 days. That will give me a chance to review your diary and we can see how the walking is going. How's that with you?
- 86.P: That's fine.
- 87.D: Okay – so on your way out, stop by the receptionist and she'll make an appointment for you. Tell her to make it for 20 minutes.
- 88.P: Okay. Will do.
- 89.D: Great – see you in 10 days. Like I told you before, don't hesitate to call me if your mood turns really dark and you need someone to talk to.
- 90.P: Thanks doc, I appreciate that. See you soon.
- 91.D: Bye.

Check Point – Comprehension

Instructions: Work with a partner or in a small group and discuss and answer these questions.

1. What medication is the patient taking for their mood disorder?
2. What dose and how many times a day does he take the medication?
3. Does the patient report an improvement in his mood since his last appointment?
4. How long has it been since the patient's last appointment?
5. Why did the doctor want this much time to pass between appointments?
6. Describe the patient's alcohol consumption.
7. How did the doctor change the patient's medication?
8. Name three things the doctor wants the patient to do prior to the next appointment.
9. How long before the next appointment?
10. Why do you think the doctor wants to see the patient so soon?

Instructions: Review the interview and find line numbers that correspond to the interview elements listed below. In some cases different aspects of the same interview element may be addressed in different parts of the interview – one such case has been done as an example.

Interview element	Line numbers
Patient greeting.	
Request for information on patient's current mood and feelings	
Confirmation of the patient's medication	
Checking for patient compliance regarding medication	
Request for information on patient's sleep patterns	
Request for information on patient's eating patterns	
Request for information on patient's current energy level	
Request for information on patient's current social activities	
Request for information on patient's current work day activities	
Explanation to patient regarding drug effectiveness	
Request for information on patient's current alcohol consumption	
Explanation of a change in medication	
Explanation of possible future treatment options	
Request for the patient to carry out some tasks	
Request for patient to change a behavior	37, 46, 65, 71, 81 & 83
Arrangements for next appointment	
Conclusion of patient visit.	

Talking with the Patient – Practice / Work with a partner

Instructions: Work with a partner – take turns reconstructing the interview. Make the following additions to your interviews. The person playing the patient should try to provide realistic answers.

Doctor A:

- ⇒ Get more information about the patient's sleep patterns
- ⇒ Get more information about the patient's eating habits
- ⇒ Get the patient to describe a typical work day from the time he wakes up until he goes to bed at night
- ⇒ Get more information about the problems that patient's is having at work

Doctor B:

- ⇒ Get more information about the patient's drinking habits
- ⇒ Get the patient to describe a typical weekend day from the time he wakes up until he goes to bed at night
- ⇒ Get information about in repetitive disturbing thoughts the patient might have
- ⇒ Without asking directly try to discover if the patient is having suicidal thoughts

Talking with the Patient – Practice / Work with a partner

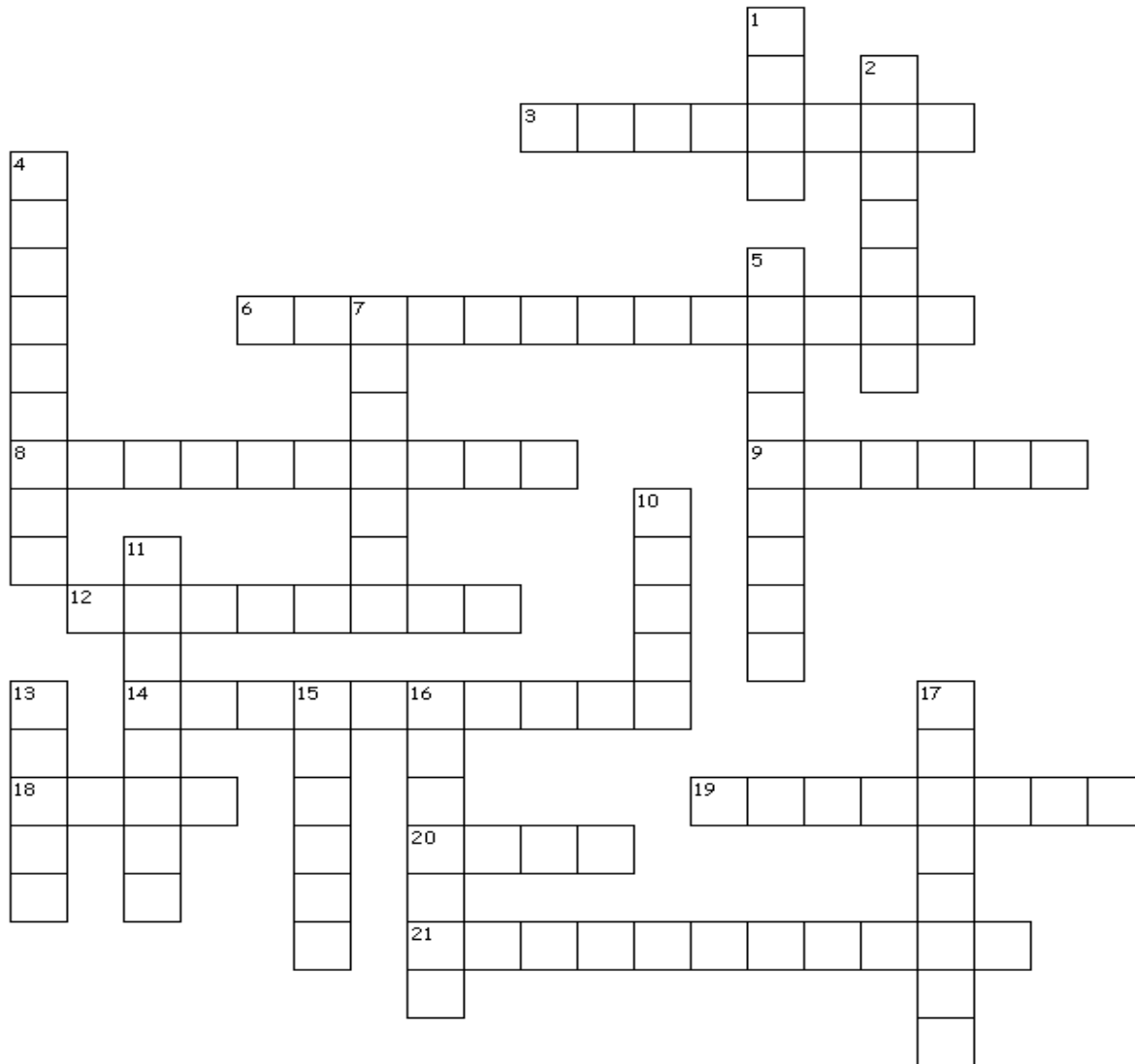
Instructions for doctor: Assume that 10 days have passed – conduct a follow up interview.

- ⇒ Be sure to assess all elements the patient was supposed to change.
- ⇒ Also inquire to see if the patient's mood has improved. You can use some of the same elements from the original interview to assess the patient's mood and behaviors.
- ⇒ Reinforce positive changes and encourage the patient to continue to work on areas where further improvement is needed.
- ⇒ Conclude the visit by arranging another appointment in 2 weeks.

Instructions for patient: As you play your role communicate the following to the doctor.

- ⇒ You wrote in your diary 7 out of 10 days.
- ⇒ You still nap when you get home from work 2 or 3 times a week.
- ⇒ You have had trouble to stop drinking alcohol. You are still drinking either wine or whiskey in the evenings.
- ⇒ You only went walking once in the past 10 days.
- ⇒ You have only cooked for yourself 5 times since the last appointment – you still mainly eat sandwiches and snack food.
- ⇒ You're overall mood is about the same, but the situation at work seems a little better.

Crossword Puzzle



Across	Down
3. Most sensory neurons are _?_ neurons.	1. A word used to describe if a person is happy or sad.
6. The ability to recognize writing on the skin.	2. A collection of neuron cell bodies outside the central nervous system.
8. Most motor neurons are _?_ neurons.	4. Part of the nervous system that regulates cardiac muscle, glands and smooth muscle.
9. Number of pairs of cranial nerves.	5. Neurotransmitter associated with depression.
12. A process in which a neurotransmitter is reabsorbed by the presynaptic neuron that released it.	7. The inability to recognize something.
14. A condition in which the patient reports being consistently sad for two or more weeks.	10. The central nervous system consists of the _?_ and spinal cord.
18. The way a person walks or runs.	11. Carries impulses towards the neuron cell body.
19. The inability to write.	13. Cranial nerve X is called the _?_ nerve.
20. Carries impulses away from the cell body.	15. An unconscious, programmed muscle contraction to a stimulus.
21. The ability to recognize an object by its shape.	16. Area where one neuron communicates with another neuron.
	17. Neurotransmitter associated with Parkinson's disease.

Clinical Corner

Alzheimer's disease (AD): The most common form of dementia. It appears in old age and results in progressive loss of mental ability. The first areas affected are the neurons of the hippocampus, which is responsible for short-term memory. Later areas in the cerebral cortex responsible for language and reasoning are affected.

Amnesia: Complete or partial loss of certain memories along with related memories. {a = not / mnesia = remembered}

Aphasia: Loss of a previously held ability to speak and understand spoken and/or written language. {a = without / phasia = speech}

Ataxia: Loss of the ability to control muscle movements of the extremities. {a = without, not / taxia = ordered}

Axon: Part of the neuron that carries electrical impulse toward the synapse and away from the cell body of the neuron.

Babinski sign (reflex): The extension of the great toe in response to stroking the sole of the foot. This is a normal reflex in infants, but suggests a lesion of the pyramidal tract with it is seen in children and adults.

Bell's palsy: Unilateral paralysis of the facial nerve in response to MS or infections. The condition can be permanent or transient.

Blood brain barrier: The glial cells of the brain wrap themselves around the blood vessels that supply brain. This wrapping allows these cells to carefully regulate what substances can enter brain tissue. Oxygen, nutrients and things like alcohol can enter freely, but many medications are excluded. This makes treating infections of the CNS particularly difficult. Antibiotics that can freely enter other tissues are restricted from entering the brain. Only a few antibiotics are available that can freely enter brain tissue and treat bacterial infections of the brain.

Brain stem: Part of the brain between the spinal cord and the thalamus. It consists of (superior to inferior) the midbrain, the pons and the medulla oblongata. It is the oldest part of the brain and is responsible for regulating a variety of functions below the level of consciousness.

Cerebral palsy: Characterized by difficulty in controlling voluntary muscle movements, this condition is thought to be caused by a prenatal brain defect or brain injury that occurs at birth.

Cerebrovascular accident (CVA or stroke): Similar to a heart attack in the brain. It occurs when a blood vessel becomes occluded with a thrombus. The cells distal to the blockage die from lack of oxygen and nutrients.

Delirium: A transient condition associated with exaggerated emotions and disturbances in consciousness. Often linked to high fevers or intoxication.

Dementia: Impairment or loss of intellectual capacity due to neuronal damage. Often dementia is accompanied by significant personality changes. {demen = madness}

Dendrite: Part of the neuron that carries electrical impulses toward the neuron cell body and away

from the synapse.

Dyslexia: A collection of reading disorders in which the person is unable to recognize special relationships of letters in written words. Often termed a learning disability. {dys = bad, difficult, abnormal / lex = word}

Epidural block: Injection of anesthetic into the epidural space of the spinal cord to produce anesthesia below the point of injection. Often used during delivery to lessen the discomfort of child birth. {epi = above}

Ganglia: A collection of neuron cell bodies located outside the CNS (not in the brain or spinal cord). An example is the dorsal root ganglia associated with the spinal nerves. {gangli = knot}

Glial cells: Cells of the central nervous system that do not conduct electrical impulses. These cells serve other functions including: providing myelin coatings for neurons and defense against infection. It is worth noting that all brain cancers are cancers of glial cells. Only glial cells have the ability to reproduce and as such only glial cells can become cancerous. {Glia = glue}

Gray matter: The gray matter of the brain and spinal cord represents cell bodies, dendrites and supporting glial cells. The dendrites are without myelin. The presence of myelin on axons is what imparts the whitish color to white matter.

Hydrocephalus: Also called water on the brain, this is a condition in which there is an imbalance between the production of cerebrospinal fluid (CSF) and its absorption, or when there is a blockage to the normal flow pathways of the CSF. The accumulation of fluid in the ventricular spaces of the brain lead to compression of the brain tissue and reduction of blood flow. {hydro = water / ceph = head}

Lumbar puncture: A procedure in which CSF is removed from the space around the spinal cord. In reality the puncture takes place below the caudal tip of the cord so that there is little danger of damaging the cord in the process. The CSF can then be examined for bacteria or viruses.

Meninges: The brain and spinal cord are covered with three layers of tissue that stabilize and protect it. The inner most layer, which is attached intimately to the surface of the brain and spinal cord is called the pia mater. The middle layer is called the arachnoid layer. The outer most layer is called the dura mater and is firmly attached to the bones of the skull and vertebral column. The region between the pia mater and the arachnoid layer is called the subarchnoid space. CSF circulates through this space as well as into spaces deeper inside the brain. {meninx = membrane}

Meningitis: Inflammation of the meninges.

Multiple sclerosis: A chronic, sometimes episodic, degenerative disease of the CNS. The disease affects the myelin sheath that surrounds neurons. {sclera = hardening / osis = condition}

Myelin sheath: A lipid sheath that surrounds certain parts of certain neurons in the CNS and PNS. The source of the myelin is a bit different in the two parts of the nervous system, but it serves basically the same function. In each case it serves to increase the velocity of impulse transmission

along nerve fibers. If the sheath is damaged, impulse conduction in the associated neuron is usually blocked. The sheath itself is part of a living cell, which wraps itself around nerve fibers thus creating a sheath. In the CNS, the sheath is produced by one of the glial cells.

Myelography: An X-ray of the spinal cord taken after the injection of a radiopaque substance into the subarchnoid space.

Nerve: A collection of, general motor and sensory neurons that have been bundled together by connective tissue. Nerves exit the spinal cord and travel to some destination in the body. Examples include the sciatic nerve that runs down the back of the leg providing motor input to the hamstrings and calf muscles or the ulnar or radial nerves that supply the medial and lateral sides of the arms.

Nuclei: A collection of neuron cell bodies inside the CNS (compare to ganglia). Keep in mind that sometimes traditional use overrides the rules. The basal ganglia should really be called the basal nuclei.

Paraplegia: Paralysis of the lower limbs due to a lower spinal cord injury or disease.

Parkinson's disease: A progressive disease of the CNS. The disease destroys the cells in a part of the brain stem. These cells release dopamine, one of the major neurotransmitters in the brain. Normally dopamine functions to keep the motor pathways quiet, it is an inhibitory NT in this case. The motor pathways are only activated with the brain needs to activate muscles. But without dopamine, the motor pathways become increasingly active, producing excessive muscle tone and tremors. The disease can be treated with variations of dopamine that can be absorbed from the digestive tract and pass the blood brain barrier.

Quadriplegia: Paralysis of both the lower limbs and upper limbs due to an upper spinal cord injury or disease. {quad = four / plegia = paralysis}

Reflex: A neural pathway that produces a fix response to a fix stimulus. The patellar or knee jerk reflex is an example.

Soma: Another name for the cell body of a neuron. {some = body}

Spinal tap: Another commonly used name for a lumbar puncture.

Tract: The equivalent of a nerve, but inside the CNS. It consists of a collection of motor or sensory neurons going from one part of the brain to another or from the brain down the spinal cord (motor) or up the spinal cord to the brain (sensory).

Tremor: Involuntary shaking of a part of the body. A common symptom of Parkinson's disease is a hand tremor.

White matter: Areas of myelinated axons or dendrites within the CNS. The white color is due to the presence of myelin sheaths around the fiber projections. White matter is usually associated with tracts within the brain.

Check Point – Technical Vocabulary

Complete the sentences using the words from the clinical corner.

1. The delivery was extremely painful – the small size of the mother and the large size of the fetus was tearing tissue. The doctor decided to administer an _____.
2. He had been riding his bicycle for hours – the constant pressure on the median _____ in the palm of his hand had made his fingers numb.
3. The brain infection was severe – the doctor decided to do a _____ and examine the CSF in an attempt to identify the bacteria causing the problem.
4. Chris Reeves (Superman) broke his neck when he was thrown from his horse. The injury was quite high and as a result he was a _____ until his death many years later.
5. The hallmark of _____ disease is the uncontrollable _____ seen in the hands of the patients.
6. Oligodendrocytes are a type of _____ cell that makes the myelin sheaths for neurons in the CNS.
7. The doctor used a special hammer to test the deep tendon _____ of the patient.
8. People with _____ often have a very hard time reading because their brain scrambles the order of the letters in the words they see.
9. _____ disease is the most common form of old age dementia.
10. When the blood flow to the brain is interrupted it is called a _____.
11. In the movie *The Bourne Identity*, Jason Bourne had _____.
12. _____ is a condition in which one of the two facial nerves is affected. As a result, when the person tries to smile, only one side of their mouth turns up. The other side of their face remains expressionless.
13. _____ is a condition that can result when there is damage to the brain during delivery. It is often characterized by difficulty controlling voluntary motor movements, while intellectual abilities are largely unaffected.
14. The injury to her spine could be easily seen on the _____.
15. The accumulation of fluid in the brain of the _____ infant had caused his head to enlarge to abnormal proportions.

Focus On – Cigarette Smoking (from Wikipedia)

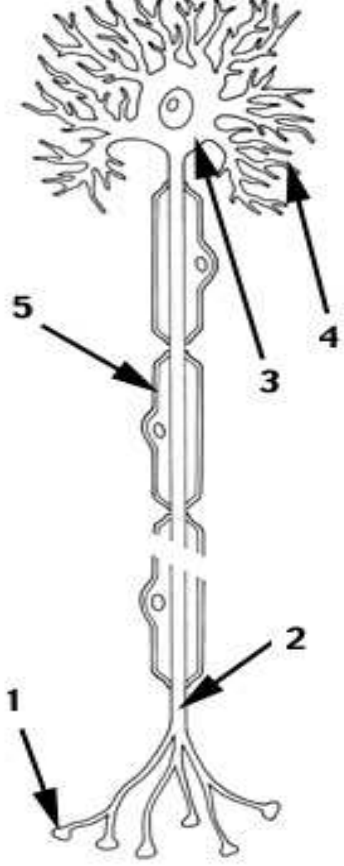
Instructions: Complete the sentences below with the word pairs in the box.

role + powerful / variety + best know / targeted + removed / toxic + widely
interacts + boost / blocks + associated / released + levels / smoking + interfere

1. Cigarette smoke contains a _____ of active ingredients. The _____ of which is nicotine.
2. Nicotine is a highly _____ substance and doses of 60 mg can be lethal. Nicotine is such an effective toxin that it was _____ used as an insecticide.
3. Nicotine _____ with acetylcholine receptors in the autonomic nervous system. The interaction **leads to** the release of epinephrine from the adrenal gland. It is the epinephrine that gives the smoker a _____ in energy.
4. Epinephrine is the hormone _____ during the **fight-or-flight response** to danger. It increases blood pressure and increases blood sugar _____.
5. The addictive part of cigarette _____ may not be due to nicotine. There is evidence that there are other compounds in tobacco that cause addiction. These other compounds _____ with the normal activity in dopamine synapses.
6. Dopamine synapses are well known for their _____ in Parkinson's disease, but they are also important in brain reward pathways. The reward pathways can produce a _____ feeling of calm, happiness and pleasure.
7. The reward pathways are the same ones _____ by cocaine and heroin. Normally the amount of dopamine in the synapses of these pathways is small and the dopamine is quickly _____ by an enzyme called monoamine oxidase (MO) which is present in the synapse.
8. Apparently, some substance present in tobacco _____ the function of this enzyme and as a result the amount of dopamine in the synapse increases. The increased levels of dopamine produce the feelings of euphoria, calmness and pleasure _____ with smoking.

Self-Test

Instructions: Fill in the blanks. Pick from the list of words to the right.

Axon / Axon terminals (axon buttons, end bulbs) / Cell body (soma) Dendrite / Myelin sheath (cells that produce)	
1. _____ 2. _____ 3. _____ 4. _____ 5. _____	 <p>The diagram shows a neuron with a cell body at the top. The cell body has several branching structures extending from it. A long, thin structure extends downwards from the cell body, covered by a segmented sheath. At the bottom of this structure, there are several branching structures. Arrows point to specific parts: 1 points to the branching structures at the bottom; 2 points to the sheath on the lower part of the long structure; 3 points to the cell body; 4 points to the branching structures at the top; 5 points to the sheath on the upper part of the long structure.</p>

Self-Test

Instructions: Take the self-test and see how well you remember the information presented in this unit.

1. Nerve tissue is one of the four primary tissue types in the body.
 - a. True
 - b. False
2. Which of the following is not a structural category of neurons?
 - a. Unipolar
 - b. Multipolar
 - c. Motor
 - d. Bipolar
3. The structural classification of the nervous system consist of the brain and ___?___.
 - a. Peripheral nervous system
 - b. Autonomic nervous system
 - c. Spinal cord
 - d. Brain stem
4. The inner most meninx is the:
 - a. Arachnoid layer
 - b. Pia mater
 - c. Dura mater
5. A major transmitter substance associated with depression is:
 - a. Dopamine
 - b. Serotonin
 - c. Acetylcholine
 - d. Norepinephrine
6. The part of the neuron that carries impulse toward the synapse is the:
 - a. Dendrite
 - b. Axon
 - c. Myelin sheath
7. The ___?___ connects the spinal cord to the cerebrum.
 - a. Brain stem
 - b. Myelin sheath
 - c. Spinal nerves
8. There are ___?___ pairs of spinal nerves.
 - a. 31
 - b. 8
 - c. 23
 - d. 12
9. Parkinson's disease results from the destruction of the ___?___ producing neuron in the brain.
 - a. Serotonin
 - b. Dopamine
 - c. GABA
 - d. Norepinephrine
10. As a general rule, most motor neurons are ___?___.
 - a. Bipolar
 - b. Multipolar
 - c. Unipolar
 - d. Sensory

Suggested Mini-Lectures

The mini-lectures listed below can be used as topics for instructors to add additional information to this unit or the topics can be assigned to students for classroom presentations.

- ⇒ Further discussion of the neuron and its parts
 - Axon
 - Dendrites
 - Cell body
- ⇒ Further differentiate between sensory (unipolar) and motor (multipolar) nerves.
- ⇒ Further discussion of the synapse
- ⇒ Further discussion of the brain ventricular system and the flow of CSF.
- ⇒ Further discussion of mood disorders and their treatments
- ⇒ Further discussion of symptoms, causes and treatments of:
 - Parkinson's disease
 - Alzheimer's disease
 - Multiple sclerosis
 - Cerebral palsy
- ⇒ Further description of the meninges
- ⇒ Brief review of brain anatomy
- ⇒ Further description of a nerve emphasizing the difference between a neuron and a nerve.
- ⇒ Assign one or two student groups to explain how to do a neurological test on a particular cranial nerve.