Nervous System Concept Questions

1. Identify the part of the nervous system that is involved in each of the following:
   a) throwing a ball (Somatic.)
   b) releasing bicarbonate from the pancreas (Enteric.)
   c) falling asleep (Parasympathetic.)
   d) increasing your breathing rate slightly (Autonomic.)
   e) running away from a vampire (Sympathetic.)

2. Imagine you cut yourself and some nerves are severed. Predict the effect this would have on the transmission of impulses. (The impulse would be disrupted.)

3. Imagine an accident victim suffers a spinal cord injury at the neck, resulting in paralysis. Describe the effect this would have on the affected parts of the body. (All parts of the body below the injury would be affected. The result would be that no nerve impulses going to or from there would be able to pass the point of injury.)

4. Describe the advantage of a reflex response to an organism. (A reflex allows a faster response to danger because possible reactions do not have to be considered and evaluated. Reflexes also allow repetitive tasks to be completed without the involvement of the brain.)

5. You accidentally touch a hot iron. Your hand quickly moves away from the iron.
   a) Identify what type of response this is. (This is an example of a reflex.)
   b) Describe when you would feel pain relative to the moment you pull your hand away. Explain the difference. (No. The response to the stimulus occurs before your awareness of it. The motor neuron is activated before the sensation of pain reaches the brain.)
   c) Describe what happens in the central nervous system to allow you to react so quickly. (A sensory receptor detects a stimulus and passes the signal to a sensory neuron which, in turn, passes it to a motor neuron. The motor neuron activates an effector, causing the response. The signal is also passed to the brain, but the response has already occurred before the brain evaluates the situation.)

6. Pain receptors are far more abundant in the skin than are cold receptors. Propose a reason why this is adaptive. (Pain is more dangerous than cold, so it is adaptive to be better able to detect it.)

7. Suppose that your skin was not sensitive to pressure or pain. Predict what might happen to the muscles and internal organs beneath the skin. (Structures beneath the skin could be damaged severely if pressure, burns, cuts, or other injuries to the skin were not felt.)

8. Some neurons are wrapped in a coating called the myelin sheath.
   a) Describe the advantages of myelinated nerve axons. (In myelinated axons, impulses jump from one node to the next making transmission faster. The myelin also prevents ions from leaking out of the neuron, weakening the impulse.)
   b) Explain how the functions of myelin account for the symptoms of MS. (MS is characterized by a progressive degeneration of the myelin sheath. Patients show wide range of neurological problems resulting from this increasing loss of communication between parts of the nervous system.)

9. Explain why the resting neuron is polarized. ($Na^{+/}K^{+}$pump moves 3 Na^{+} out but only 2 K^{+} in so

there is a buildup of positive ions outside the cell.)

10. Describe the distribution of ions across the cell membrane as it changes from a resting potential to an action potential and then into refractory period. (When sodium gates open , Na^+ enters the cell, increasing the potential to the action potential. The Na^+ gates close and the K^+ gates, allowing K+ to leave the cell, decreasing the potential to resting.)

11. Explain how the membrane potential of the resting cell is restored after a nerve impulse has passed. (Once K^+ gates are open, K^+ leaves the cell, decreasing the potential to resting. When the K^+ close the flow of K^+ stops so the potential stops decreasing. The Na^+/K^+ pumps then restore the ions to the proper sides.)

12. Tetrodotoxin is a toxin present in the spines of the puffer fish. It has the capability of blocking the function of voltage-regulated sodium channels. Predict the effect tetrodotoxin would have on the contractions of muscles. (The toxin stops the sodium channels from opening so nerve impulses would be blocked. Without getting signals from neurons, muscles would be paralyzed.)

13. Draw a fully labelled graph showing the potential of the neural membrane as it fires. (see graph in Notebook)

14. a) Describe what is meant by the all-or-none response. (When action potential is reached the neuron fires. If action potential is not reached the neuron does not fire. The response is not graduated.)
    b) Explain how you can distinguish different intensities of stimuli even though all action potentials are equivalent. (Different neurons have different thresholds. By knowing if a signal came from a high or a low threshold neuron, the brain can evaluate the intensity of the stimulus. Spatial and temporal summation also help to determine the intensity and the area of over which a stimulus is being applied.)

15. Use the idea of threshold levels to explain why some individuals can tolerate more pain than others. (Genetic differences mean some people may have neurons of higher thresholds so can tolerate more pain. Also, people learn to tolerate pain and may have skin of different thicknesses.)

16. Describe how the nerve impulse crosses the space between two nerve cells. (When a signal reaches a the end of a neuron neurotransmitter is released into the synapse. The neurotransmitter binds to Na^+ gates on the post-synaptic neuron, opening them.)

17. Describe the feature of a synapse that ensures a nerve impulse can move from neuron A to neuron B but not *vice versa*. (The receptors for neurotransmitter are only on the post-synaptic membrane.)

18. Describe the functions of acetylcholine and cholinesterase in the transmission of nerve impulses. (The neurotransmitter acetylcholine crosses the synapse to a muscle cells and causes contraction of the muscle. The enzyme cholinesterase is present in the synapse to degrade the neurotransmitter so that the signal is stopped.)

19. Explain the concept of summation. (Each time a neuron fires, more neurotransmitter is released into the synapse. If a stimulus is below the threshold of the post-synaptic neuron, the neurotransmitter concentration increases during each action potential and can reach the threshold.)

20. Explain how some drugs act as stimulants while others act as depressants. (A stimulant could

open Na^+ channels to increase the potential toward threshold. Alternatively, it could inhibit the enzyme responsible for degrading an excitatory neurotransmitter. A depressant could open K^+ channels to decrease the potential further away from threshold or activate an enzyme that degrades an excitatory neurotransmitter.)

21. Describe endorphins and explain how they work. (Endorphins are natural analgesics and also produce feelings of satisfaction. Their analgesic activity comes from their ability to block pain messages being sent to the brain.)