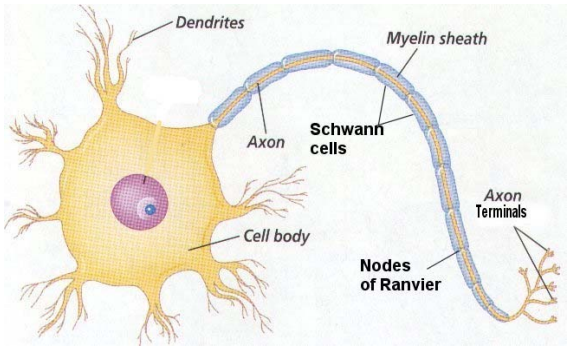
Biology 12
Human Biology *Textbook: BC Biology 12*

Study Guide – Answer Key

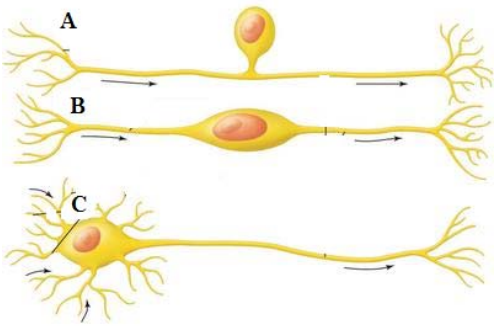
Nervous System

1. Draw a neuron, label 3 parts and give the function of those parts.

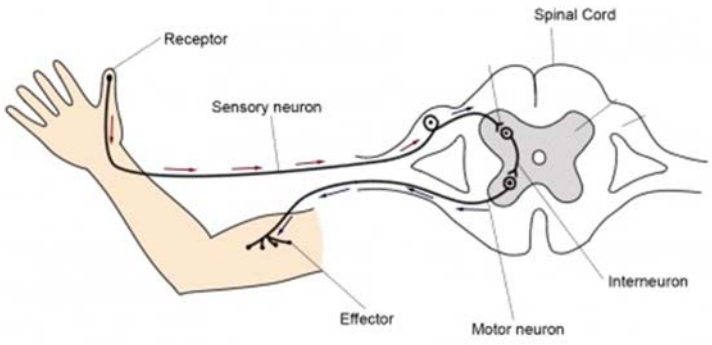


Dendrite: carry signals to the cell body
Cell body: contains all the regular cell organelles (the factory of the neuron – e.g. produces necessary proteins)
Axon: carry signals away from cell body
Axon terminals: allows neuron to synapse with other neurons
Myelin sheath: insulates and speeds impulse conduction
Schwann cells: produce the myelin sheath
Nodes of Ranvier: gaps in myelin sheath allow for saltatory conduction of impulses (jumps from node to node)

2. Give the function of an axon, dendrite and cell body of a neuron.
   See above
3. What is the difference in nerve transmission in a myelinated and a nonmyelinated nerve fibre?
   Myelinated are faster (impulse "jump" from node to node)
4. Name the three main types of neurons and identify each on a diagram.
   Sensory (A)
   Interneuron (B)
   Motor (C)

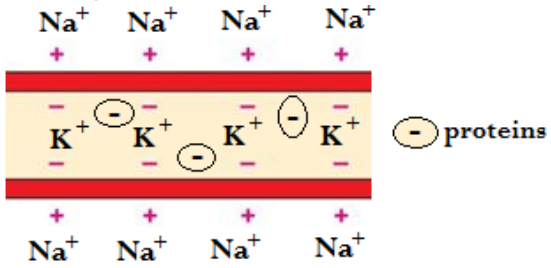


5. Give two differences between a sensory neuron and a motor neuron.
   Sensory: carry signals TO the CNS; connected to a receptor
   Motor: carry signals AWAY from the CNS; connected to an effector
6. Draw a reflex arc and label the receptor, sensory neuron, spinal cord, interneuron, motor neuron, and effector.

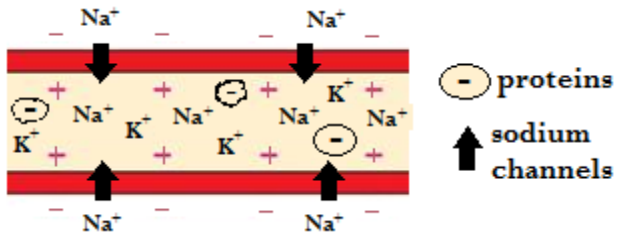


7. Explain how a reflex arc works and its evolutionary significance.
   The reflex arc allows us to quickly react to stimuli without involving the brain and allows organisms to minimize damage and thus increase chances for survival. A receptor receives the incoming stimuli which begins an action potential down the sensory neuron, the signal is passed onto the interneuron and finally the motor neuron which connects to an effector to cause a reaction.

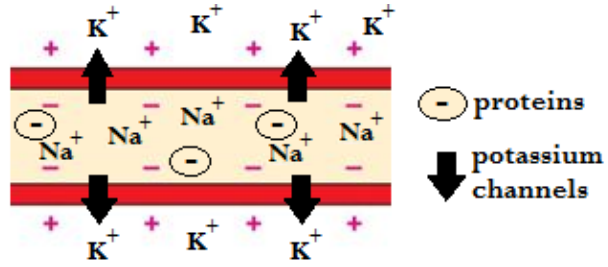
8. Describe how the brain is informed that a reflex action has occurred.
   While the reflex action itself does not require input from the brain, the information is transferred from one interneuron to the next up the spinal cord. The conscious brain is alerted to the situation that required a reflexive action.
9. What causes the transmission of a nerve impulse to begin?
   As an impulse occurs as an all-or-none phenomenon, an action potential only occurs once enough sodium ions have entered the neuron and cause it to reach **threshold** (-55mV)
10. Using specific terminology, describe how a nerve impulse is conducted along a neuron in a minimum of four steps beginning with a neuron at rest.
    - Stimulus is sufficient to reach **threshold**
    - Sodium channels open (**depolarization**)
    - Action potential reaches peak (+35mV)
    - Potassium channels open (**repolarization**)
    - Undershoot (**hyperpolarization**) ensures one way transmission
    - **Sodium-potassium pumps** reset the ion distribution during the **refractory period**
11. Use a diagram to show the polarity and ion distribution on either side of the axonal membrane at rest.



12. Use a diagram to show the polarity and ion distribution on either side of the axonal membrane during depolarization.

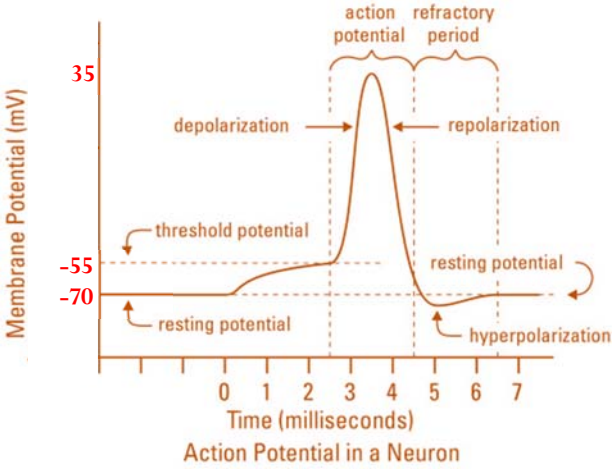


13. Use a diagram to show the polarity and ion distribution on either side of the axonal membrane during repolarization.



14. By what process does the sodium potassium pump maintain Na^+ on the outside of the axon and K^+ on the inside of the axon during the resting potential?
    Active transport using integral carrier protein
    (requires energy to maintain high [ ] of sodium outside and potassium inside)
15. Describe the direction of the transmission of a nerve impulse and explain why transmission is one way only.
    A nerve impulse (action potential) travels down an axon to the axon terminal. Each section of the axon becomes **hyperpolarized** and it takes time for the sodium-potassium pumps to "reset" the ion distribution to allow the next impulse. By this point, the impulse has travelled further down the axon.

16. Diagram and label the oscilloscope pattern that appears during nerve transmission. Use the terms: depolarization, hyperpolarization, repolarization, resting potential, threshold, -70mV, -55mV, 35 mV.



Action Potential in a Neuron

17. Explain the all-or-none phenomenon as it applies to action potential.
An axon must reach a threshold level to begin an action potential. If it does reach threshold, then an action potential is fully initiated. If it does not reach threshold, then no action potential will occur.

18. Using specific terminology, explain synaptic transmission between two neurons in a minimum of four steps.
- Action potential reaches the axon terminal
- Calcium channels open (activates contractile proteins)
- Vesicles with neurotransmitters fuse with presynaptic membrane
- Neurotransmitters diffuse across synaptic cleft
- Neurotransmitters bind to receptors on postsynaptic membrane
    - Excitatory neurotransmitters cause depolarization (sodium gates on postsynaptic membrane open)
        - Action potential continues in postsynaptic neuron
    - Inhibitory neurotransmitters cause hyperpolarization (potassium gates on postsynaptic membrane open)
        - No action potential happens on postsynaptic neuron

19. Why does the acetylcholine that diffuses into the synapse not stimulate the adjacent neuron over and over?
Neurotransmitters will either be reabsorbed by the presynaptic neuron to be used again, or they will be broken down by enzymes (e.g. acetylcholinesterase).

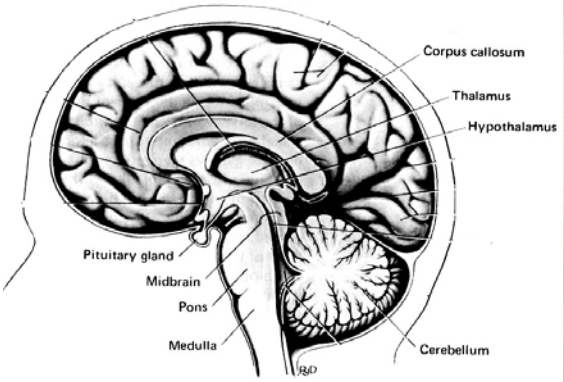
20. Compare function and effectors of the somatic and the autonomic nervous systems. Use a specific examples of body functions to support your response.

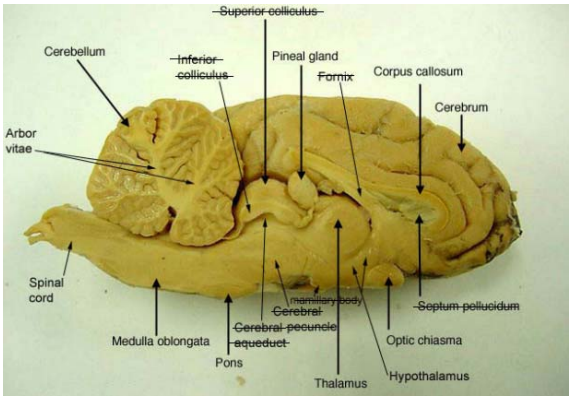
SOMATIC	AUTONOMIC
Functions under voluntary (conscious) control	Functions under involuntary (subconscious) control
Effector: skeletal muscle	Effectors: smooth and cardiac muscle, glands, organs
Example: moving your arm to wave hello	Example: the beating of your heart, breathing rate, secretions of hormones, digestion of food

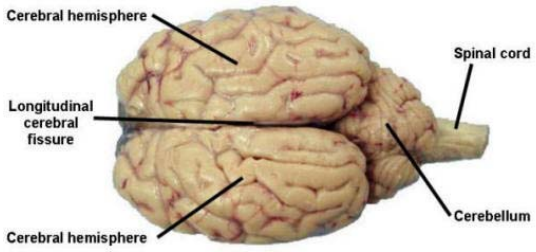
21. List the two divisions of the autonomic nervous system.
    - Briefly outline the role of each division.
    - Describe how the divisions work together.
    - Name the neurotransmitter for each division.

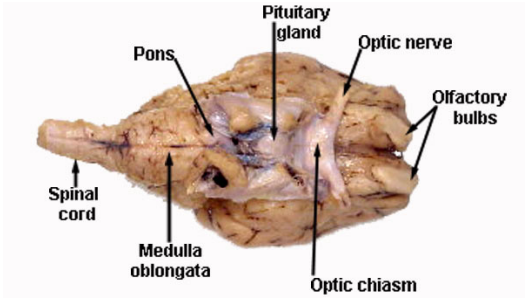
SYMPATHETIC	PARASYMPATHETIC
Brings about responses we associate with emergencies. "Fight, Flight, or Freeze" Examples: increased heart and breathing rate	Brings about responses we associate with homeostasis. "Rest & Digest" Examples: allowing digestive organs to function
These two divisions work together by performing opposite functions. The sympathetic division allows us to respond to a negative situation and helps us to survive. Once the stressful stimuli is removed from the situation however, we need the body to calm down and proceed with basic functions to provide the body with nutrients and such.	
Neurotransmitter: Norepinephrine (NE)	Neurotransmitter: Acetylcholine (ACh)

22. Name the parts of the brain (diagram or on a dissected sample)

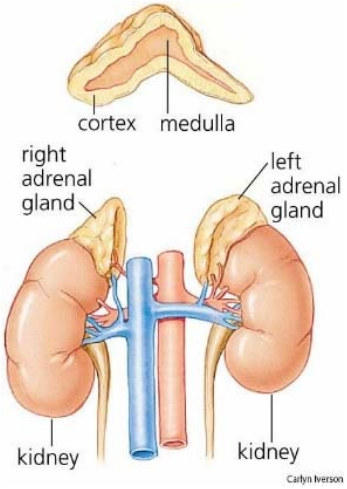








23. Where in the body is adrenaline produced? Be specific to the location and the part of the gland.
    Adrenaline is produced by the adrenal gland located on the top of the kidneys; specifically the adrenal medulla (middle)
24. Draw a basic diagram to indicate the location of the source gland for adrenalin.



- Give several examples of the effect of adrenalin on organs and tissues.
  Stimulates organs and muscles. Increases heart and blood pressure, expands air passages, dilates pupils, etc.
- Explain the overall effect of adrenalin on the nervous system.
  Allows the body to respond to stressful situations, prepares it for "fight or flight" responses. Also known as epinephrine.

25. Name the part of the brain referred to as the "neuroendocrine control center" and briefly describe how it works.
    The **hypothalamus** serves as the link between the nervous and endocrine systems. It is able to control the pituitary gland and through that, the other glands of the body. This allows the hypothalamus to control homeostasis.
26. Explain the working relationship between the hypothalamus and the pituitary glands.
    The hypothalamus releases hypothalamic-releasing hormone (HRH) which stimulates the anterior pituitary gland to produce its hormones. Once the anterior pituitary has released its hormones, the hypothalamus is able to monitor the levels in the blood stream, and by negative feedback, maintain them at a homeostatic level.
    Here's how I think of it… The hypothalamus can be related to the manager, the pituitary gland is the assistant manager and the rest of the glands are the employees.