Chapter 5: The peripheral nervous system

Learning activity suggested answers

Learning Activity 5.1 (p. 222)

1
   a Briefly describe the two main functions of the somatic nervous system.
      Description should refer to:
      • sensory function: transmission of sensory information from sensory receptors in the body (skin, muscles, bones and joints) to the CNS
      • motor function: control of skeletal muscle activity to enable voluntarily movements.
   b Give an example of each of these functions, but use examples not referred to in the text.
      Examples include:
      • sensory function: when you hold an ice cube sensory receptors in the skin detect the temperature change and transmit this information to the CNS
      • motor function: any voluntary movement, i.e. intentional/deliberate and not reflexive.

2 Distinguish between the roles of sensory and motor neurons.
   • Sensory neurons also called afferent neurons – specialised nerve cells that receive and carry sensory information
   • Motor neurons also called efferent neurons - specialised nerve cells that carry messages to skeletal muscles causing them to contract or relax.

3 What are interneurons and where are they found?
   • Interneurons also called connecting neurons make the connection between sensory neurons and motor neurons.
   • Only found in the CNS

4 Whenever you reach to pick up a glass, both the sensory and motor functions of the somatic nervous system are involved. Explain both the sensory and motor roles in grasping the glass.
   • sensory function, e.g. detection of presence of the glass through touch (pressure) sensations and transmission of sensory information to CNS for meaningful interpretation (such as combining with other information to determine spatial location, weight etc.)
   • motor role, e.g. initiating movements to grasp and pick up the glass, such as holding the glass appropriately, control of skeletal muscles attached to finger bones to enable pen grasping and lifting
Learning Activity 5.2 (p. 222)

Prepare a poster with a diagram and brief notes to show the ways that information is transmitted by the somatic nervous system, both to and from the central nervous system. An example of a sensory and a motor activity should be used to describe the action of the somatic nervous system. Use arrows (for direction) and labels (for identification) to illustrate the flow of sensory and motor information. Ensure that the correct names are used for the various structures identified in the diagram.

Student responses will vary, dependent on the example they apply to the model, but the format could be reflective of the figure below.

1. Barefoot on a lawn, you step on a prickle.
   SNS sensory neurons detect the pain and transmit this information (afferent transmission) via nerves to the spinal cord (CNS).

2. The spinal cord transmits this information to the brain to be processed.

3. The brain receives this sensory information and transmits motor signals back via nerve pathways through the CNS to the SNS, relating instructions to step.

4. SNS motor neurons (efferent transmission) activate the bones and muscles required to take a step.

5. Neurotransmitters are released onto foot and leg muscles causing them to expand or contract, instructing movement. Taking a step, you land on another prickle.

Why you should wear thongs in your backyard

Prickles and the PNS
Learning Activity 5.3 (p. 224)

1  a  Explain why the autonomic nervous system is described as autonomous.
   Explanation should refer to the fact that organs, glands and processes under ANS control
   are usually self-regulating/functioning independently of the brain/not normally under
   voluntary or conscious control.
   b  Is ‘autonomous’ an accurate term for describing this nervous system? Explain with
   reference to an example.
   Explanation should demonstrate understanding that the ANS is not completely self-
   regulating, e.g. biofeedback training to enable control of certain autonomic responses such
   as heart rate, respiration, perspiration etc.

2  Explain the relationship of the autonomic nervous system to the central nervous system with
   reference to a physiological response.
   Explanation should demonstrate understanding that the ANS regulates activity of visceral
   muscles, organs and glands but also provides feedback to the brain about their activities, which
   can in turn influence (increase or decrease) their activity, e.g. fight-flight response
   demonstrates role of ANS (initiating involuntary fight or flight responses) and the brain
   (interpreting the event in a way which maintains or changes autonomic responses).

3  What is the key difference between skeletal muscles and visceral muscles?
   Difference may refer to:
   •  skeletal muscles involved in or enabling voluntary movements of body parts and visceral
   muscles involved in or enabling activity of internal organs and glands
   •  skeletal muscle activity requiring initiation by motor neuron messages from the brain and
   visceral muscle activity not requiring motor neuron information/under ANS control/having
   built-in mechanisms for generating activity.

4  Which is more important in maintaining our survival: the autonomic nervous system or the
   central nervous system? Explain with reference to an example.
   Responses should demonstrate understanding of the respective roles of the ANS and CNS in
   survival, taking account of the meaning of survival per se, i.e. maintaining an organism in a living
   state.

Learning Activity 5.4 (p. 225)

Which division of the peripheral nervous system is more likely to be involved in each of the following
responses: the somatic nervous system (S), the autonomic nervous system (A) or both (B)?

<table>
<thead>
<tr>
<th>Response</th>
<th>Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>pressing a key to answer a mobile phone</td>
<td>B</td>
</tr>
<tr>
<td>eating dinner</td>
<td>B</td>
</tr>
<tr>
<td>sweating before having to give an important speech</td>
<td>A</td>
</tr>
</tbody>
</table>
Learning Activity 5.5 (p. 228)

1. In what main way do the sympathetic nervous system and the parasympathetic nervous system differ?
   Difference should refer to activation or arousal of body/increasing activity of most visceral muscles, organs and glands in times of vigorous activity, stress or threat (sympathetic nervous system) and calming of body/decreasing activity/restoring to normal state of functioning/homeostatic state (parasympathetic nervous system).

2. a. What is the role of the sympathetic nervous system in enhancing survival?
   Explanation should refer to it providing an immediate response, in a split second, to any kind of emergency, specifically situations that are stressful, threatening and entail vigorous activity.

   b. Give examples of three bodily functions that increase their activity as a result of the action of the sympathetic nervous system.
   Examples from Table 5.1 (p. 278) may include:
   - heart rate
   - respiration rate
   - adrenal gland activity.

   c. Give three examples of bodily functions that decrease their activity as a result of the action of the sympathetic nervous system.
   Examples from Table 5.1 (p. 278) may include:
   - saliva production
   - stomach contractions
   - gall bladder activity.

<table>
<thead>
<tr>
<th>Activity</th>
<th>S or A or B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clenching your fists while watching a scary movie</td>
<td>S or A or B</td>
</tr>
<tr>
<td>Crouching on the blocks awaiting the starting siren before swimming in a 50-metre freestyle final</td>
<td>S or A or B</td>
</tr>
<tr>
<td>Washing the dog</td>
<td>S</td>
</tr>
<tr>
<td>Blinking</td>
<td>A</td>
</tr>
<tr>
<td>Talking on the phone</td>
<td>S</td>
</tr>
<tr>
<td>Laughing at a joke</td>
<td>S</td>
</tr>
<tr>
<td>Flinching when you hear a loud noise</td>
<td>A or B</td>
</tr>
</tbody>
</table>
3

a  Describe the main roles of the parasympathetic nervous system.

Functions include:
- keeping bodily systems functioning efficiently
- in times of minimal stress and in the absence of threats, helping to maintain the internal body environment in a steady, balanced state of normal functioning
- restoring the body to a state of calm, once the need for the activity of the sympathetic nervous system has passed.

b  Give three examples of three bodily functions that are affected as a result of the action of the parasympathetic nervous system. Briefly explain the purpose of these changes resulting from the action of the parasympathetic nervous system.

Functions include:
- stomach and intestine stimulation—to digest food
- elimination of wastes—to aid in bodily health
- production of tears and automatic pupil constriction in conditions of bright light in the eye—affords protection of the visual system.

4  Give two reasons to explain why it takes longer for the parasympathetic nervous system to ‘slow down’ bodily functions than it does for the sympathetic nervous system to ‘speed up’ bodily functions?

Explanation should refer to
- the activation of sympathetic nervous system in a stress or threat situation, which stimulates adrenal gland hormone secretions immediately firing up a Sympathetic NS response
- the prior activation of the sympathetic nervous system delays onset of Parasympathetic NS effects as the lingering presence of the hormones released into the bloodstream still affects physiology (even though the brain has given the body the ‘all clear’ after the threat or danger has past)

**Learning Activity 5.6 (p. 228)**

1  Which division of the autonomic nervous system is likely to be dominant if you are in each of the following situations?

<table>
<thead>
<tr>
<th>Situation</th>
<th>Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>a lying on the beach reading a book</td>
<td>parasympathetic</td>
</tr>
<tr>
<td>b waiting for the delivery of your VCE results</td>
<td>sympathetic</td>
</tr>
<tr>
<td>c preparing for a blind date</td>
<td>sympathetic</td>
</tr>
<tr>
<td>d hearing an unexpected loud knock on the front door at 2 am while watching TV alone</td>
<td>sympathetic</td>
</tr>
</tbody>
</table>
2. Which division of the autonomic nervous system is likely to be dominant when each of the following physiological responses is observed?

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>increased rate of digestion</td>
<td>parasympathetic</td>
</tr>
<tr>
<td>b</td>
<td>decreased salivation</td>
<td>sympathetic</td>
</tr>
<tr>
<td>c</td>
<td>increased pulse rate</td>
<td>sympathetic</td>
</tr>
<tr>
<td>d</td>
<td>decreased pupil size</td>
<td>parasympathetic</td>
</tr>
<tr>
<td>e</td>
<td>increased perspiration</td>
<td>sympathetic</td>
</tr>
</tbody>
</table>

Learning Activity 5.7 (p. 229)

Photocopy and complete the diagram below to summarise the activities of the sympathetic and parasympathetic nervous systems. Write your answers on the lines connecting the various organs and glands, as shown for the pupil.

Refer to Table 5.1 (p. 227) for solutions.